Proceedings

of the 21st World Congress of Soil Science

VOLUME II

RIO18

21st World Congress of Soil Science

SOCIEDADE BRASILEIRA DE CIÊNCIA DO SOLO
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P R O C E E D I N G S

of the 21st WORLD CONGRESS OF SOIL SCIENCE

Rio de Janeiro, August 12-17, 2018 BRAZIL

S O I L S C I E N C E

Beyond Food and Fuel

RIO18
21st World Congress of Soil Science
Rio de Janeiro August | 12 - 17

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VOLUME II

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GENERAL PROGRAM

PRESENTATION

Dear participants

On behalf of the International Union of Soil Science (IUSS), the Brazilian Soil Science Society (SBCS) and the Latin American Soil Science Society (SLCS), it is our pleasure to present the two volumes of the 21st World Congress of Soil Science Proceedings. This volume covers the abstracts presented in poster sessions. We want to acknowledge the authors of the papers, peer reviewers, committee members, and the production staff whose volunteer work put shape to the 21st WCSS Proceedings.

During the meeting, eight (8) conferences from highly renowned scientists and authorities were held, with subjects related to the event theme - Soil Science: beyond food and fuel. There were also 73 conferences in 16 Interdivisional Symposia, and 5 Technical & Innovation Symposia.

The themes of these lectures were defined over the last three years, with the participation of the scientific divisions of IUSS and SBCS, and were structured during InterCongress 2016 and in others meetings of the Organizing Committee and Scientific Committee. The 21st WCSS also had oral presentations of 648 papers submitted in 75 divisional symposia and 15 IUSS working group symposia, plus 3 poster sessions with 1,608 submissions in total.

The Proceedings of the 21st WCSS with the abstracts of the 2,256 papers, presented orally or as poster are also available to download from the 21st WCSS homepage. The conference / lecture summaries that were provided by the speakers are included as well.

Again, thank you all for the participation and support.

Prof. **Leandro Souza da Silva**
Editor, Scientific Committee Chair

PREFACE

Fellow Soil Scientists,

I congratulate you all for celebrating the 21st WCSS being held in Rio, Brazil from 12-17th August 2018. The theme "Beyond Food and Fuel" is highly pertinent. Multifarious demands of humanity provisioned by soil include: (i) moderating the environment, (ii) strengthening biogeochemical and biogeophysical cycles, (iii) sourcing of raw materials, (iv) creating an archive of human and planetary history, and (v) generating cultural and aesthetical values. Above all, the world peace and security depend on healthy soil capable of provisioning numerous ecosystem services. Indeed, a healthy soil is an essential prerequisites to attaining peace at: (i) local, regional and global scale on the one hand, and (ii) at personal, family, community, national and international level on the other. The goal is to lead a life in perfect harmony with mother nature – the soil.

Personal or individual transformation to create a healthy soil is the pathway to peace, by being at peace with ourselves. Soil degradation and desertification, anthropogenic climate change and the related extreme events, pedological/agronomic droughts and the attendant extreme events, low agronomic yields and perpetual hunger, and marginal living and desperateness are also serious threats to global peace and stability, and require policy interventions at local, regional and global scale. If soils are not restored, crops will fail even if rains do not; hunger will perpetuate even with emphasis on biotechnology and genetically modified crops; civil strife and political instability will plague the developing world even with sermons on human rights and democratic ideals; and humanity will suffer even with great scientific strides.

Political stability and global peace are threatened because of soil degradation, food insecurity, and desperateness. Therefore, restoring degraded soils and desertified lands are essential to global peace and security. Soil is the gift of nature for achieving eternal peace and prosperity.

I wish you all a personally pleasant and professionally rewarding experience at the 21st WCSS in Rio.

Prof. **Rattan Lal**
President, International Union of Soil Sciences

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C1.1.1 - Using soil morphology and micromorphology indicators of soil health

(9328 - 3146) Effect of wetting and drying cycles in genesis of cohesive soil horizons from north-east Brazil

Juliana Matos Vieira[1]; Ricardo Espíndola Romero[1]; Miguel Cooper[2]; Jaedson Cláudio Anunciato Mota[1]

Universidade Federal do Ceará[1]; Escola Superior de Agricultura Luiz de Queiroz[2]

The Coastal Tablelands have cohesive soils, which interfere directly in the growth of plants, due to high soil resistance to penetration and the reduction of the availability of water and air in the soil. Faced with a heterogeneity of the Coastal Soils, research has not yet been able to attribute the dominant factor about the genesis of horizons with a cohesive character. Thus, the aim of this study was to evaluate the influence of wetting and drying cycles on the cohesion of soils with a cohesive character in North-east Brazil. In the present study, samples of cohesive soils (deformed samples) of four soil profiles of the Coastal Tablelands, located in the states of Bahia, Pernambuco and Ceará. To evaluate the influence of the wetting and drying cycles on the soil densification, three different treatments were applied, corresponding to different amounts of wetting and drying cycles (6, 9, 12 cycles). After these cycles, the samples were submitted to micromorphological analysis and image analysis of the pores of the soils. Soil resistance to penetration was also determined in the three treatments. The increase of the wetting and drying cycles promoted a greater soil densification, this reveals that the soil has returned to cohesion, presenting a low porosity and high soil resistance to penetration. The increase in the wetting and drying cycles led to a reorganization of the soil particles, where they were observed argilluviation in some of the studied soils, suggesting that the accumulation of iluvial clay may be one of the causes related to the genesis of soils with cohesive character.

Keywords: Hardsetting soils, Micromorphology, Pedogenesis.
Financial support: CAPES

(7170 - 2771) hydraulic-energy indices and functions associated with micromorphological analysis to evaluate soil structure under integrate crop-livestock system

Aline M. Huf dos Reis[1]; Robson A. Armindo[1]; Luiz F. Pires[2]; Miguel Cooper[3]

Universidade Federal do Paraná[1]; Universidade Estadual de Ponta Grossa[2]; Universidade de São Paulo/ESALQ[3]

Characterizing the soil structure in macro and micro scale is very difficult. Soil structure is resulted of the arrangement of its particles and aggregates, forming its porous system. The porous medium influences plant germination, root accommodation, gas exchange, and mainly retention and redistribution of water and solutes. In this work, some soil physics quality (SPQ) indices and hydraulic functions and micromorphological analysis were carried out to evaluate the structure of a Haplohumox under integrate crop-livestock system (ICLS). Two soil depths were analyzed (0.0-0.10 m and 0.10-0.20 m) in four systems: conventional tillage (CT), minimum tillage (MT), no-tillage (NT), and chiseled no-tillage (CNT), taking into account the annual ryegrass cropped during the winter for different uses: cover crop (C), grazing (G), and silage (S). The SPQ indices and hydraulic-energy functions were applied from information obtained with soil water retention curves (SWRCs). The soil absolute aeration energy (A_a) index was used because it is related with the gravitational potential energy to perform soil water drainage from saturation (θ_s) to field capacity (θ_{fc}). Other six SPQ indices based on pore volume distribution (PVD) function were applied. Micromorphological analyses were also carried out from blocks impregnated with resin. The collected soil samples were impregnated with a polyester resin mixed with fluorescent pigments. The images (2D) were processed and analyzed using the Noesis-Visilog 5.4 software. The areal porosity (AP) was determined according to their shape and size, using three major shape groups: rounded (R), elongated (E), and complex (C); and accordingly to their function based on equivalent diameter: storage pores (<50 µm), transmission pores (50-500 µm) and fissures (>500 µm). Based on these techniques association, soil structure damages caused by management systems was identified. In the upper assessed layer (0.0-0.10 m), MT with S presented the highest A_a (19.6 hPa m^3m^{-3}), which was bigger than other samples. AP showed contribution in transmission pores (58%) exhibiting that the greatest contribution was given by pores of R shape, suggesting less connection among them. CT with C had the highest A_a (23.1 hPa m^3m^{-3}) in the lower layer (0.10-0.20 m) showing the largest pore diameter of 7.8 µm with higher retention pores abundance. A_a results indicated large work-energy to drain water needing probably long time to reach θ_{fc}.

Keywords: Soil physics; porous system; management systems
Financial support:

(9936 - 2731) Micromorphological comparison of impacted and non-impacted soils un the Sonora river basin: case of Buenavista del cobre mine

Maria Yazmin Rivera-Uria[1]; Jaime Díaz-Ortega[2]; Sergey Sedov[2]; Francisco Romero[2]; Elizabeth Solleiro-Rebolledo[2]

Posgrado en Ciencias de la Tierra, UNAM[1]; Instituto de Geología, UNAM[2]

The Buenavista del Cobre is the most important mine in Mexico, where mainly cupper is exploited. This mine is located north of Mexico in the state of Sonora. In autum of 2014 the mine had an accident where 40000 m^3 of acid leached (containing high concentrations of Fe, Al, As, Cu, Mn, Cd, Cr, Pb, Zn) was poured into the Tinajas stream and Bacanuchi river. We presented a profile (with impact of the spill and compare with other profile without impact evidence. All the samples were characterized geochemical and chemically in laboratory. Additionally, undisturbed samples were taken in field for the morphometric and micromorphological analysis, it was used an Olympus BX 51 microscope, software Image Pro Plus 7.0 and high resolution scanner Epson Perfection 700. The site belongs to Bacanuchi river, in this place we identified two profiles BR1-A (impacted) and BR1-B (non impacted), the distance between them are 1.5 m. The main characteristic in BR1-B was low pH basic and low electrical conductivity, the colour was light brown, the observations micromorphologicals were commons the carbonates infillings the pores, another minerals presents were plagioclase, quartz. The profile BR1-A had high concentrations in Fe, Al, As, Cu Pb and Zn, pH acid, high electrical conductivity and the color was reddish yellow, in the micromorphology the carbonates was not founded but was very strongly the precipitation of Fe rounded the minerals as plagioclase and quartz. So a morphometric study was done identifying organic matter, pore space, precipitation with Fe and minerals. The results showed that the concentrations of Fe in BR1-A increases and decreases pore space comparing with BR1-B. These changes are associated with precipitations of the spill, besides the carbonates dissolved assumed that changed the pH and gypsum and copiapite were identified. With the micromorphological and geochemical studies determined the changes between impacted and non-impacted soils. They soil impacted were modified the porosity, it was identified new minerals, the color change and high concentrations of potentially toxic elements. Results that will help identify recent and historical contamination of the area

Keywords: morphometric, acid leached, potentially toxic elements

Financial support: Fideicomiso del Río Sonora

(1851 - 3194) Micromorphological study of thionic technosols formed of mine tailings: case of ecological restoration of Peña Colorada, Colima Mexico.

Jaime Diaz-Ortega[1]; Francisco Romero[2]; Sergey Sedov[2]; Gerardo Martínez-Jardines[3]

Posgrado en Ciencias de la Tierra, UNAM[1]; Instituto de Geología, UNAM[2]; Instituto de Geología. UNAM[3]

The mining site of Peña Colorada is located NE of the state of Colima, Mexico. It is an ortho-magmatic field where magnetite predominates (> 85%). This site is located in the Mamey Formation in the sub-province of the Sierra Madre del Sur. At the Peña Colorada mine only iron is extracted, the tailings produced by these extractions are deposited in the Arrayanal dam. The region has a sub-humid and semi-warm climate with rain in summer and an average annual rainfall of 1600 mm, the average temperature of 26.3 ° C. The objective of this work is to recognize the development of thionic horizons and micromorphological changes in soils formed from the mine tailings with a development time of 10 years after reforestation. Three profiles were described that are located in a toposequence on a slope of the dam of tailings. These soils have A-Bti-C horizons with a depth greater than 70 cm. It was noted abundant superficial fine roots; the structure was in subangualres blocks. On the other hand, the horizon A had a dark brown color, the Bti horizon was yellowish brown and the C horizon was gray. The horizons identified as thionic (Bti) have an acidic pH of 4, are located at an average depth of 60 cm with thicknesses of 30 cm, in the micromorphology it was observed in small fragments of rocks and sand-sized particles which present coatings of Fe and gypsum minerals. In the A horizons, a development of granular structure with abundant plant tissues and evidence of coprolithic product of biological activity was observed. During the time that the dam materials have been exposed (10 years) it has allowed the formation of soils classified as Hypertonic Technosols, incorporating the landscape and allowing the restoration of vegetation that has developed organic horizons and a granular structure.
Keywords: ecological restoration, mine, technosol
Financial support: Instituto de Geología

(9467 - 1293) Micromorphology of soils erosion processes in applied urban expansion area of the coastline north of Maceió-AL

Samuel Vitor Oliveira dos Santos[1]; Antonio Soares da Silva[1]; Gabriel Spinola Garcia Tavora[1]; Vanessa Ingrid Carvalho Saraiva[1]; Roberto Marques Corrêa Junior[1]; Julia Valença Santiago[1]

Universidade do Estado do Rio de Janeiro[1]

The erosion processes tend to happen naturally in the earth's surface, but are enhanced with the interference of man in the landscape. Urban expansion stimulates degradation of green areas in the city, with the removal of the vegetation cover, the soils are exposed and become vulnerable to impacts caused by torrential rains. As a result, accelerating the breakdown of soil and the consequent sediment transport. The present work aims to understand the erosion processes that occur in three urban areas on the coast north of Maceió-AL, characterizing the soils of this region and identifying the main constraints of erosion. For the study of erosion soil samplings were made in neighborhoods of Jacarecica (Area 1), São Jorge (Area 2) and Guaxuma (Area 3). Physical and chemical analyses were carried out in the laboratory, who followed the methodology developed by Embrapa (1997), and the micromorphology of soils based on the study of Castro (2008). This analysis had as objective to characterize and describe the soils of the region so that this way it was possible to identify if they have features that accelerate erosion. The samples collected in the three studied areas indicate that these soils are vulnerable to erosion, mainly by, a high content of sandy texture, which does not favor a good stability. The micromorphology enabled show organizations of constituents of the matrix fund. From there, it was observed that in the area 1 is there any impediment to the movement of the water, while in Area 2 the favoritism of the vertical circulation. It is also worth mentioning that the area 2 presented more modifications and there's an erosive process faster, these soils presented: high content of sand and little clay, by micromorphology you can view the participation of skeletal grains of smaller diameter in the B horizon, there is a predominance of grains with bigger diameter on the horizon to this characterization allows to deduce that the circulation of water is easier in the superficial horizon, because were not observed structures that come cause impediments to the vertical circulation of water. Besides the withdrawal of much of the vegetation to the construction of a road, further exacerbating the problem. It is now strengthening the preservation of green areas still exist and studies that take into account the characteristics of soils for that to happen a better appropriation and use of these areas.
Keywords: Urban Erosion; Soils; Micromorphology of soils
Financial support: Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) - Bolsa de Estudo

(2117 - 1198) Micromorphology of the superficial horizons of the Yellow Red Acrisol subject to cattle grazing

Antonio Soares da Silva[1]; Roman Seliger[2]; Gabriel Campos Pereira da Costa[1]; Dietmar Sattler[2]; Jürgen Heinrich[2]

University of State of Rio de Janeiro[1]; University of Leipzig[2]

Soil degradation is one of the main environmental problems in Brazil. The effect of cattle trampling on soils can result in the induction of laminar erosion processes, leading to the total removal of A horizon. This research was developed in an extensive dairy farm, where severe erosive signs are observed with stretches of bare soils. The study area was divided into four sectors: terrace 1, terrace 2, terrace 3 and terrace 4, from the foothill to the top of the slope. Undisturbed samples were collected at depths of 0 cm and 25 cm, in areas with bare soil (cattle trails) and grass cover. The samples were impregnated with epoxy type resin and after hardening, cut and polished to a thickness of 30µm for description under a petrographic type microscope. In terrace 4, there is a higher biological activity due to being in a top position and less affected by the cattle trampling. In the thin sections this sector, there was almost no alteration in the porosity organization when compared to the areas with and without grass cover. In terrace 3, there are differences in the organization of soil constituents between samples collected in the cattle trails and in the areas with grass cover. In the trail sample, the soil presents compact appearance and low porosity. The color of the superficial sample is yellow-red, like the color of the B horizon. In the sample under grass cover, the color is brown, due to a higher content of organic matter. In terrace 2, the soils presented higher levels of degradation in the study area. As well as in the terrace 3, there is a predominance of reddish colors in the surface and planar pores, which may originate from the expansion and contraction of clays. At terrace 1 accumulates the debris removed uphill and the samples collected under vegetation show connected and abundant pores and root traces. The thin sections of the bare soil samples show more pores than the upslope bare soil samples and small aggregates moderately developed. The main differences between bare soil and grass-covered samples are related to color which is similar to the color of the B horizon in the areas without vegetation. Furthermore, the quantity and type of the pores varies between samples, where samples under vegetation show channels and chambers and bare soil samples have planes. These characteristics indicate that the A horizon was removed at the bare soil cattle trails and the remaining textural B horizon now forms the (new) surface.
Keywords: micromorphology; soil erosion; land use
Financial support: Intecral Project (033L162F), German Federal

Ministry of Education and Research (BMBF)

(3068 - 2998) Soil micromorphometric analysis as indicator of the subsurface erosive process genesis

Renata Cristina Bovi[1]; Nayana Alves Pereira[1]; Matheus Ortega Gomes[2]; Miguel Cooper[3]

Luiz de Queiroz School of Agriculture, University of São Paulo[1]; Federal University of São Carlos[2]; googLuiz de Queiroz School of Agriculture, University of São Paulo[3]

Erosive process on the soil surface has been well studied and comprehended by several researchers, however, little is known about subsurface erosive processes (piping). Subsurface erosive processes have a greater occurrence than is generally assumed, being found in all climates, natural and agricultural lands and in unconsolidated sediments and rocks. Piping is a type of subsurface erosion caused by water flowing in subsurface and the origin of this process is difficult to determine. Many factors have been considered as causing this process and their interaction is complex and difficult to be studied separately. The study area is located in Piracicaba, State of São Paulo, Brazil, which has several erosive features, ranging from laminar erosion to gullies and pipings. Six pits were opened and described in the study area, in which the soil was classified as Hapludults (Argissolo Amarelo distrófico típico). To detect differences in soil porosity that could favor the stagnation of water at the top of the Bt horizon and consequently trigger the activation of the subsurface erosive process, micromorphometric analyzes of the soil horizons were performed to understand the type and sizes of the pores that constitute such horizons. Undisturbed samples, representative of the soil horizons, were collected on the E and Bt horizon and subsequently impregnated with polyester resin, styrene monomer, a catalyst and a fluorescent pigment. After hardened, the blocks were polished and from these blocks were acquired images using a 10X magnification camera. The pore areas were classified as large, medium and small, while pore sizes were classified as rounded, elongated and complex. The results showed that there is a porosity gradient between these soil horizons: there is a decrease in the total pore area of the horizon E to Bt and this decrease is reflected in the large pore complex pores. This contrast is also reflected in the soil texture (sandy to medium texture) and structure (simple grains to sub-angular blocks, medium to large and moderate). We concluded that this change in the gradient was responsible for the reduction of the hydraulic conductivity between the horizons E and Bt, causing the accumulation of water at the top of the Bt horizon, which is stagnant in a seasonal manner, facilitating lateral flow instead of vertical. This flow, when reaching erosive velocity, due to the relief, can give origin to the subsurface erosive process.

Keywords: piping; micromorphometry; soil erosion

Financial support: Luiz de Queiroz School of Agriculture (University of São Paulo) and CNPq.

C1.1.2 - Structural indicators of soil quality using X-ray computed tomography

(7268 - 2516) Assessing the consequences of improved plant water use efficiency on soil structure using X-Ray computed tomography

Tinashe Mawodza[1]; Manoj Menon[1]; Stuart Casson[1]

Sheffield University[1]

Agricultural production across the world currently accounts for more than 70% of global freshwater withdrawals. The increased agricultural intensification required to feed an ever-expanding global population is set to put serious strain on the worlds' already limited freshwater resources. Development of plants with improved drought tolerance and water use efficiency to maximise on the erratic global freshwater supply has largely been suggested as a possible strategy to bring about significantly increased crop production per unit of water available. The effectiveness of the utility of such plants however may come at a cost to soil health, which would ultimately lead to reduced sustainability of crop production. We used high resolution 3-dimensional X-Ray micro-tomography as well as other classical soil structural assessment methods to assess the potential effects of the cultivation of plants with genetically altered water use efficiency (and or drought resistant) on various soil structural properties. We analysed the changes in soil structural properties as brought about by water use efficient mutants of the model plant, Thale Cress (*Arabidopsis Thalyana)* as well as wheat *(Triticum aestivum*). 3D maps of plant root proliferation into the soil and their subsequent effect on the soil was examined allowing for a close-up quantitative assessment of the intricate interactions occurring within the rhizosphere. We did not find any significant differences in the effect of plants with genetically induced water use efficiency as compared to wild type plants. Our results demonstrate that genetic modification of plants may possibly be used to improve water productivity without compromising on important soil structural properties.

Keywords: Soil Structure, Water Use efficiency, Rhizosphere

Financial support: Grantham Centre for Sustainable Futures at the University of Sheffield (United Kingdom)

(5245 - 2689) Assessing the impact of soil-seed contact on water relations for efficient seed germination using X-ray Computed Tomography

Sebastian Blunk[1]; Martine I de Heer[2]; Craig J Sturrock[3]; Sacha J Mooney[3]

Division of Agriculture and Environmental Science, School of Biosciences – University of Nottingham, Sutton Bonington, Loughborough. LE12 6HW, UK (sebastian.blunk@nottingham.ac.uk)[1]; Syngenta Crop Protection, Bracknell, RG42 6EY, UK[2]; Division of Agriculture and Environmental Science, School of Biosciences – University of Nottingham, Sutton Bonington, Loughborough. LE12 6HW, UK[3]

With an increasing global population and demand for agricultural food production, there is a need to improve crop yield and efficiency. Seedbed preparation is a crucial first step prior to sowing, especially for field crops planted using precision drilling techniques. The seed is placed into the seedbed layer and the topsoil rolled slightly to improve the contact area to the surrounding soil matrix. The common theory of seed germination is based on water absorption from the surrounding soil matrix (imbibition) to initiate the germination process. In this study, we develop a method to non-destructively quantify seed-soil contact using X-ray Computed Tomography and apply it to compare a variety of common seed enhancement technologies that influence the seed morphology (e.g. seed pelleting, seed coating and seed priming) under laboratory conditions (sieved sandy loam soil <2 mm). Results show that naked star-shaped sugar beet seeds had a lower contact to the soil matrix compared to the spherical pelleted seeds. The compatibility of the method for field structured soil was verified by sampling field cores within 24 hours after sowing by a tractor-mounted seed drill. Furthermore, we introduce the concept of the *iceberg effect* describing the relationship between the contact area of soil aggregates with the seed and the larger soil mass of the aggregates surrounding the seed. A larger iceberg effect could therefore be an indicator of a greater accessibility to water sources in the immediate vicinity to the seed. With this study, we introduce a method of quantifying the interaction potential of precision-sown seed with its surrounding soil matrix and gave an indicator for its water accessibility. This study contributes towards the selection of appropriate seedbed management techniques as well as seed enhancement technologies to improve water uptake and ultimately crop yield.

Keywords: soil-seed interface, germination, seed enhancement, X-ray

Computed Tomography
Financial support: DIvision of Agricultural and Environmental Sciences, British Soil Science Society, Syngenta

(7444 - 2719) Mitigation of soil compaction by the use of cover crops in compacted Oxisol

Altamir Mateus Bertollo[1]; Renato Levien[1]; Moacir Tuzzin de Moraes[2]; Henrique Debiasi[3]; Lucas Zulpo[1]
Federal University of Rio Grande do Sul[1]; University of São Paulo[2]; Embrapa Soybean[3]

The Soybean (Glycine max) is the most produced crop in Brazil, which stands out as the second largest grain exporter in the world. The cultivation of this cereal is, mostly, in a no-tillage system in the straw, where there is only soil mobilization in the sowing line. The non-mobilization of the soil associated with low crop rotation bring to soil compaction caused by the accumulation of agricultural machine traffic. Land use and management systems are tools for prevention and, where it occurs, remediation of soil compaction. For this, the presence of cover crops in the rotation system is important. The objective of the present work was to quantify the use of plants of economic interest in autumn-winter period in the mitigation of soil compaction. For this, a study with a split plot desing was developed at the Embrapa Soybean experimental farm, in Londrina, Paraná state, Brazil, in a Oxisol with levels compaction. The treatments cover plants: black oat (Avena strigosa), brachiaria (Urochloa ruziziensis), corn (Zea mais) and wheat (Triticum aestivum) were allocated to the plots and subplots treatments land use: chiseling, no-tillage, no-tillage with four additional agricultural tractor traffic, and no-tillage with eight additional harvesters traffic. After two years of treatment, soil samples were collected in the layers of 0.00-0.10, 0.10-0.20, 0.20-0.30- 0.30-0.40 and 9.40-0.50 m, being determined the physical parameters of the soil, morphological parameters of the soybean root system and soil tomographic analysis. No effects of the use of cover crops on conventional soil physical properties (porosity, soil bulk density and mechanical resistence to penetration) were diagnosed. Through computed tomography it was possible to diagnose soil pore space alterations for brachiaria and corn treatments up to depth of 0.20 m. The compaction levels changed the physical properties of the soil to a depth of 0.30 m. Harvested traffic increased soil bulk density, mechanical resistence to penetration and microporosity. The chiseling of the soil presents residual effects in the subsurface layer of the soil, with decrease in bulk density and mechanical resistance to penetration and increase in macroporosity and total porosity. Soybeans grown in a continuous no-tillage area show higher grain yield. Chiseling of the soil and the machine traffic decreased production.
Keywords: Mechanical traffic; no-tillage; computed tomography.
Financial support: Fundação de Estudos Agrários Luiz de Queiroz

(3938 - 1499) Quantifying Soil Structure Dynamics in Agroforestry Riparian Buffers using X-ray Computed Tomography

Anastassia Lagounova[1]; Richard Heck[1]; Naresh V. Thevathasan[1]
University of Guelph[1]

As a component of a project entitled “Riparian buffer plantings: An agroforestry land-use for greenhouse gas mitigation including multiple benefits to Canadian agriculture”, the goal of the study is to characterize the temporal variability of soil structure in common riparian agroforestry ecosystems. This study takes place within the Grand River Watershed of Ontario. Intact soil cores are taken over a period of a year (post-winter, end-of-spring, end-of-summer and pre-winter) from various riparian systems, considering soil texture (loam vs. sand soils), forest age (mature vs. restored forests) and forest type (deciduous vs. coniferous forests). High-resolution 3D imagery of the soil cores are obtained by X-ray Computed Tomography (CT). Computerized analysis of the digital imagery is used to derive both morphometric (size, shape etc) and spatial distribution (3D semivariance indices) parameters of soil phases (resolvable voids, solids and matrix). Specific attention is also given to the spatial radiodensity of the soil matrix. Results to be presented will emphasize reference soils within a natural stand of deciduous forest, typical of the region under study.
Keywords: agroforestry riparian buffers, x-ray computed tomography, voids, matrix, soil structure dynamics, 3D semivariance
Financial support: Agricultural Greenhouse Gas Program of Agriculture and Agri-food Canada

(3434 - 3096) Quantifying the Effect of Crop Rotation on Topsoil Structure Dynamics using X-ray Computed Tomography

Richard J Heck[1]; Mila Maric[1]; Lars J Munkholm[2]; Bill Deen[1]
University of Guelph[1]; Aarhus University[2]

Within temperate agriculture systems, soil structure maybe subject to both management-related (tillage, root growth) and natural (faunal activity, wetting/drying, freezing/thawing) processes. Understanding the nature and magnitude of annual changes in topsoil structure is ultimately important for establishing sustainable management practices. This study was undertaken on long-term (>30 years) management plots, maintained at the University of Guelph’s Elora Research Station, in Ontario, Canada. Five rotations, all on zero-tillage, were included: corn-corn-soybean-soybean, corn-corn-soybean-wheat, corn-corn-soybean-wheat (under-seeded to red clover), corn-corn-alfalfa-alfalfa and continuous alfalfa (as reference). Intact cores of topsoil were collected early-September (pre-harvest), early-December (pre-winter) and late-April (post-winter), from first-year and second-year corn crops in each of the rotations. High-resolution (40 micron voxel size) 3D radiodensity imagery was obtained by x-ray computed tomography. The greyscale imagery was segmented into resolvable voids and solids, as well as matrix phases. Morphometric analysis of the intra-aggregate voids considered their size, shape and orientation. Image masking permitted quantification of the spatial variabilty of matrix radiodensity, using orthogonal semivariance analysis. Indices of anisotropy and short-range variability were derived from the semivariograms. Attention will be given to comparing the relative influence of growing season and winter processes on structural parameters and their variability.
Keywords: topsoil structure, crop rotations, zero till, x-ray computed tomography, 3D semivariance
Financial support: Ontario Ministry of Agriculture, Food and Rural Affairs; Grain Farmers of Ontario; Natural Sciences and Engineering Research Council of Canada

(2028 - 1071) Renting the same room: Do roots repeatedly reoccupy the same spaces?

Ivanah Oliver[1]; Dr Richard Flavel[1]; Dr Brian Wilson[2]; Dr Oliver Knox[1]
University of New England[1]; University of New England; Office of Environment and Heritage NSW[2]
With X-ray computed tomography (xCT), we are now better equipped to understand the impact soil structure has on the spatial distribution of root systems. The distribution of root systems throughout a soil profile is influenced by many physio-chemical properties of the soil, including the pore space characteristics and presence of root channels from previous plant growth. Currently there is limited understanding about how many and how often roots will occupy the same pore spaces season after season. This in turn has implications for the spatial distribution of resource depletion (e.g. phosphorus) and accumulation of plant products (e.g. root exudates) and physical legacy. This research investigated how much of the root system of an actively growing plant utilised the existing pore spaces from a previous root system. The experiment involved growing Rhodes grass (*Chloris gayana*) in pots, with two differing soil structures, for a period of 8

weeks. X-ray computed tomography was then used to image a small section of the pot to determine the spatial distribution of the roots and pore spaces. After 12 weeks of decomposition, the pots were rescanned before a second season of plant growth and a final scan. The final images of the pore spaces and root systems at each phase were then overlayed and compared to determine the proportion of roots that reoccupied previous root channels. The results of this research will be presented and discussed. Improved understanding of the amount of reutilised pore spaces by successive crops will have broader implications for nutrient and water acquisition, help explain microbial and exudate hotspots and soil physical properties.

Keywords: Root distribution, X-ray computed tomography, Soil pore spaces, Rhodes grass
Financial support:

(6729 - 3218) Surface caracterization of an entisol using microtomography

Cassia Bezerra Machado[1]; Antonio Celso Dantas Antonino[1]; Richard Heck[2]; Larissa Fernandes Costa[1]; José Romualdo de Sousa Lima[3]
UFPE[1]; U of G[2]; UFRPE[3]

The soil structure can be defined as the arrangement of soil particles and their pore space, it is important for the maintenance of porosity, aeration, plant growth and microorganisms. The study of soil microstructure is advancing with the use of computerized microtomography (µTC). This work aims to study the microstructure in an Entisol's surface using the µTC. The samples were collected at the Várzea do Barro Farm, in São João-PE. The images were obtained using the Nikon XT H 225 ST, resulting in high-resolution images with 50 micron voxels size. A morphometric analyse were done using Image-J. The images were segmented in three phases: voids, rocks fragment and matrix, where were applied thresholding values using a Pure Voxel Extration (PVE) for each phase. Then the pores were classified in inter-agregate and intra-agregate using the Image J's plug-in Particle Analyzer. The soil's samples had 41,57% of medium porosity, with 41,51% for inter-agregate voids and 0,11% for the intra-agregate voids. The Entisols it's a highly sandy soil, so it's expected for the higher percentage of the inter-agregates. There was a high percentage (73%) for the complex pores, indicating pores with high connectivity.

Keywords: Porosity, Microstructure, Soil
Financial support: CNPQ

(4186 - 857) Using X-ray Computed Tomography to assess how plant roots can remediate compacted soils via reorganisation of the rhizosphere

Jasmine Burr-Hersey[1]; Sacha Mooney[1]; Glyn Bengough[2]; Karl Ritz[1]
University of Nottingham[1]; The James Hutton Institute[2]

Soil compaction is a form of degradation that affects agricultural land on a global scale. Primarily caused by the passage of heavy farm machinery, the effects on soils can be persistent and difficult to alleviate effectively. Currently, deep-tillage practices are used as a short-term solution to lessen soil compaction in agricultural contexts, however this intensifies the risk of permanent subsoil compaction. Plant species that are able to grow in heavily compacted soil may increase the number and size of pores helping to positively alter a degraded soils structure. Hence plants may offer a simple field-scale means to improve a compacted soil via localised structural remediation in the rhizosphere. We analysed the root growth patterns of three non-cultivated plant species often found occurring naturally on compacted soils, suggesting they have an intrinsic ability to grow effectively under such circumstances. Ribwort plantain (*Plantago lanceolata*), dandelion (*Taraxacum officinale*) and spear thistle (*Cirsium vulgare)* plants were grown for 28 days in a sandy-loam soil compacted to 1.8 g cm^{-3} with a penetration resistance of 2.55 MPa. X-ray Computed Tomography was used to observe root architecture *in situ* and visualise changes in rhizosphere porosity with distance from the root surface at a resolution of 35 µm, at 14 and 28 days after sowing. Porosity of the soil was analysed within four incremental zones up to 420 µm from the root surface. In all species the porosity of the rhizosphere was greatest closest to the root and decreased with distance from the root surface. There were significant differences in rhizosphere porosity between the three species, with the spear thistle plants exhibiting the greatest pore space creation across all rhizosphere zones. This study indicates that roots can have a localised effect in increasing the formation of pore space in the rhizosphere, counteracting any initial compression due to root penetration. The resulting structural alteration of the soil indicates the potential for a natural way to create and improve soil structure in heavily degraded soils.

Keywords: Compaction, remediation, rhizosphere, porosity, X-Ray Computed Tomography
Financial support: NERC, BBSRC, STARS

(4550 - 1867) Visualization of soil microstructure under conventional tillage and fallow using micro-focus x-ray computed tomography.

Isaiah IC Wakindiki[1]; Mashapa E Malobane[2]; Adornis D Nciizah[3]; Fhatuwani N Mudau[4]
University of Venda/University of South Africa[1]; University of South Africa/Agricultural Research Council[2]; Agricultural Research Council[3]; University of South Africa[4]

Tillage affects a soil's structure. In general, soil structure regenerates under fallow but degrades under conventional tillage. However, the effect of fallow and tillage on soil microstructure and morphology is not conclusive. Aggregates ~ 10 mm diameter of an Haplic Cambisol were collected from the top 0.1m in adjacent fields at the University of Fort Hare experimental farm (latitude 32°46'S and longitude 26°50'E). One field was under a five-year-old fallow management (FM) and the other under conventional tillage (CT). Soil aggregates were fixed on a rotary stage that rotated from 0° to 360° and sample absorption radiographs taken at the same step interval. 1000 slices were reconstructed for each sample. CT Pro 3D software® was used to reconstruct the 1000 slices into 3D images. Analysis of 3D soil aggregates was done using VGstudio MAX 3.0®. To avoid the edge effects, a region of interest of 52 ± 0.1 mm^3 volume was selected at the middle of the 3D soil aggregates. The pores were classified into seven classes: <50, 50-100, 100-200, 200-300, 300-400, 400-500 and > 500 µm. Sphericity (S) was used to classify pores into three pore shape classes: regular pores ($S \geq 0.5$), irregular pores ($0.2 < S < 0.5$) and elongated pores ($S \leq 0.2$). The soil pore distribution, pore shape, pore proportion and visualizations were similar in both treatments. Therefore, both FM and CT had a similar effect to the soil's microstructure and morphology at the time of sampling. The fractions of elongated pores, which are crucial for soil water and gas transport were ≤ 0.1% in both treatments. The low fraction of elongated pores suggest that there is high chance of soil degradation especially by erosion under both treatments. It was concluded that a five-year difference in soil use and management may not affect its microstructure and morphology but other soil properties such as the organic matter.

Keywords: Haplic Cambisol; soil microstructure and morphology; x-ray mCT; soil aggregates, soil pores
Financial support: National Research Foundation (NRF) [grant number 98690]; Nuclear Energy Corporation of South Africa (NECSA) provided the x-ray µCT scanning facility.

(9855 - 1040) X-ray computed microtomography against retention curve for assessing porosity in Latossolos (Ferralsols) with contrasting vegetation cover

Marcelo Wermelinger Aguiar Lemes[1]; Gustavo Mattos Vasques[2];

Alessandra Silveira Machado[3]; Hugo Machado Rodrigues[4]; Ricardo Tadeu Lopes[3]; Reiner Olíbano Rosas[5]
UNESA / UFF[1]; EMBRAPA SOLOS[2]; COPPE / UFRJ[3]; UFRRJ[4]; UFF[5]

Soil porosity is conventionally measured by the retention curve method and is affected by a number of factors, but mainly by the relative distribution of particles with different sizes, shapes and arrangement. X-ray computed microtomography (microCT) appears as a novel non-destructive and rapid method to characterize the particle arrangement and calculate soil porosity. This work aims to compare the retention curve and microCT methods to assess the total, macro and microporosity of the soil. The work was developed in Silva Jardim, RJ, southeastern Brazil, using Latossolo (Ferralsol) soil samples taken at about 10-cm depth. For both methods, four samples were taken from grass-covered soil, and four samples from bare soil, using either 50-mm-high x 32-mm-wide acrylic cylinders (microCT) or 50-mm-high x 26.5-mm-wide steel cylinders (retention curve). For the determination of the porosity values using the retention curve method, the Richards pressure chamber was used applying the following tensions: 0.01, 0.033, 0.06, 0.1, 0.33, 1.5, 15 bar. For the microCT assays the samples were digitized in a high energy system - Skyscan / Bruker, model 1173. Using the retention curve method, the following average porosity values were obtained in covered and bare soil, respectively: 52% and 45% total porosity, 12% and 5% macroporosity, and 40% microporosity for both cases. Using microCT, porosity values were: 27% and 22% total porosity, 11% and 10% macroporosity, and 16% and 12% microporosity in covered and bare soil, respectively. The study confirmed that grass-covered Ferralsols have higher porosity due to the presence of roots. More importantly, the total porosity measured by the retention curve was considerably higher than that measured by microCT. This may be due to the fact that Ferralsols store most of the water in micropores, whose detection using microCT is limited by the minimum detection limit of the method of 30 µm. Thus, some adaptation of the method is required for monitoring Ferralsols, which are the main agricultural soils of the Brazilian Cerrado (savanna).

Keywords: Porosity Soil, Microtomography Technique and Structure of Soil
Financial support: CAPES, EMBRAPA SOLOS, COPPE UFRJ, UNESA, UFF

(3223 - 3216) X-Ray Computed Tomography applied to analyze soil structure under different infiltration techniques

Larissa F Costa[1]; Antonio C D Antonino[2]; Richard J Heck[3]; Artur P Coutinho[1]; Eduardo S Souza[4]; Rodolfo M S Souza[5]; José Romualdo S Lima[4]
Universidade Federal de Pernambuco[1]; Universidade Federal de Penambuco[2]; University of Guelph[3]; Universidade Federal Rural de Pernambuco[4]; Universidade Ferderal de Pernamburco[5]

Tension Infiltrometer and Simple Ring Infiltrometer are useful in situ techniques which are commonly used to determine soil hydrodynamic properties. Comparing the effects of these techniques on the soil structure in a pore scale is fundamental to identify the ideal in situ method for infiltration and water storage study. This study is being conducted in areas of Caatinga vegetation in the Agreste and Sertão of Pernambuco, Brazil. Infiltration tests were carried out with the two techniques mentioned on the soil surface layer, where undisturbed soil samples were collected of the area in direct contact with the tests. For the pore scale analysis, high-resolution tomographic images (50 micron voxel size) have been obtained with scanner Nikon XT H 225 ST. The grayscale images are segmented in three phases: voids, rocks fragment and matrix. A morphometric analysis of intra-aggregate voids was done in order to quantify their size and shape. Moreover, spatial variability of matrix radiodensity are been studied to obtain more details about voids smaller than the resolution adopted. This study compare soil structural differences caused by these two infiltration techniques.

Keywords: infiltration techniques, soil structure, x-ray computed tomography, pores morphometry, spatial variability
Financial support: INCT "Observatório Nacional da Dinâmica da Água e de Carbono no Bioma Caatinga (ONDACBC)" financed by FACEPE (APQ-0498-3.07/17), CAPES (Nº 88887.136369/2017-00) and CNPq (Nº 465764/2014-2). Moreover, scholarship of the first author financed by CAPES.

(3095 - 271) X-ray microtomography analysis of lime application effects on soil porous system

Talita R. Ferreira[1]; Luiz F. Pires[1]; Dorthe Wildenschild[2]; Richard J. Heck[3]; Antonio C. D. Antonino[4]
State University of Ponta Grossa[1]; Oregon State University[2]; University of Guelph[3]; Federal University of Pernambuco[4]

Soil liming has demonstrated to be efficient to make acidic soils suitable to agriculture but little research has been done to evaluate its effect on soil structure in the microscale. X-ray microtomography (µCT) is a useful technique to obtain valuable information about the micromorphological characteristics of soil and, thus, can provide important insight into how liming affects such a porous system. In this study, µCT was used to evaluate changes on micromorphological physical properties (porosity, number of pores, pore length, elongation, shape, connectivity and tortuosity) of a soil cultivated under no-tillage (NTS) caused by the application of lime on the surface. A degraded pasture area representing soil conditions before the NTS implementation was also analyzed. Samples from two soil layers (0-10 cm, A, and 10-20 cm, B) were analyzed with a voxel size of 60 µm. Image visualization, processing and analysis were performed in the Avizo Fire 9.0 software. Liming improved the soil chemical attributes only at layer A where it also produced positive effects on the soil porous system within a period of thirty months. We highlight the increase in soil porosity (P) and number of pores (NP) into which the main soil pore was separated, as evidence of such positive effects. For layer A, those pores were found to be longer, more elongated, and more connected for the limed site. However, changes in the pattern of the separated pores, with the formation of cylindrical pores in the horizontal orientation for the limed site, were observed at both soil layers, which can be attributed to stimulation of the soil fauna activity due to liming.

Keywords: soil porous system; microtomography; soil structure; soil quality.
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C1.1.3 - How to use micromorphology to understand palaeosols and polygenetic soils?

(5583 - 349) Fate of Co-containing phyllomanganate: Implications for Co sequestration

Zhongkuan Wu[1]; Xionghan Feng[1]; Hui Yin[1]; Wenfeng Tan[1]; Guohong Qiu[1]; Caroline L. Peacock[2]; Bruno Lanson[3]; Zhongjun Chen[4]; Lirong Zheng[4]; Fan Liu[1]
Key Laboratory of Arable Land Conservation (Middle and Lower Reaches of Yangtse River) Ministry of Agriculture, College of Resources and Environment, Huazhong Agricultural University, Wuhan, China[1]; University of Leeds, School of Earth and Environment, Leeds LS2 9JT, UK[2]; Univ. Grenoble Alpes, ISTerre, 38041 Grenoble, France.[3]; Beijing Synchrotron Radiation Facility, Institute of High

Energy Physics, Chinese Academy of Sciences, Beijing 100039, China[4]

The mobility and fate of bioessential metals, such as Co and Ni, are strongly controlled by their association with phyllomanganate (PMn) minerals. These minerals however, can transform to tectomanganate (TMn) minerals under certain environmental conditions yet. The fates of these transition metals during the transformation remain largely unknown. Here, the transformation from layered precursors containing various Co contents to tunnel structure minerals was investigated via using XRD, BET surface area analysis, HRTEM, EXAFS, FTIR and nitric acid treatment. We conclude that heterogeneous ions, without Jahn-Teller distortion, associated in the layered precursor, low Mn^{3+} content and inappropriate species in the interlayer of layered precursors, together with common environmental conditions will hinder this transformation or maintain the stability of PMn in nature, resulting a higher abundance over TMn. Particularly, under reflux reaction, precursors with no or low Co contents convert to minerals with incoherent tunnel dimensions (i.e. 3×*n*) along *a** direction as natural todorokite samples. While high Co contents lead to incomplete conversion, forming mixtures of todorokite analogues and 9.6 Å layered structure stabilized by islands of Mg (hydr)oxide in the interlayer, confirmed by nitric acid treatment, an innovative approach to differentiate 10 Å PMns and todorokite. The proportion of the todorokites decreases and that of layered structure increases as Co content increase. It is suggested that needle-like morphology or showing broad peak (around 7 Å) and slope (after 4.8 Å) in XRD pattern can be regarded as indicative features for the ideal todorokite structure with uniform 3×3 tunnel size. While trillings growth features reflect *a*-disorder todorokite with various tunnel sizes along *a** direction more likely. Here, we provide an insight to the fate of Co, demonstrating that adsorbed Co in layered precursor could incorporate into reflux product structurally, and the migration of structural Co to corner sites in TMn minerals contribute the increase of the ratio of coordination numbers of corner-sharing (CS) linkages to that of edge-sharing (ES) linkages for Co. Furthermore, Co could occur at sites with only ES linkages and sites containing both E/CS linkages in TMn minerals. Structural incorporation means a more stable Co uptake with respect to adsorption, and the transformation from PMn to TMn provides a sink for the more tight sequestration of Co.

Keywords: phyllomanganate; tectomanganate; Cobalt; todorokite
Financial support: National Key Research and Development Program of China (No.2016YFD0800403) and the Natural Science Foundations of China (No. 41271253 and U1432104).

(9378 - 1376) Features of Fe-Mn nodules in southern Indiana Loess with a fragipan horizon

Zhong-Xiu Sun[1]; Ying-Ying Jiang[1]; Qiu-Bing Wang[1]; Phillip Ray Owens[2]
Shenyang Agricultural University[1]; Dale Bumpers Small Farms Research Center, Booneville[2]

In this research, nodules were collected according to loess genetic horizons from Southeast Purdue Agricultural Center (SEPAC) and wet sieved into 4 groups, including 2-1 mm, 1-0.5 mm, 0.5-0.25 mm, and 0.25-0.1 mm. Physical, chemical, micro- and macro-morphological features of nodules and their soil matrix were determined as a function of soil depth. The Ap horizon was determined to contain the highest proportion of nodules. These were derived from the subsurface horizon due to high erosion in the past. The small sized nodules concentrated in the Ap horizon were predominantly related to high SOM. In addition to the Ap, the Btx1 and Btx2 also contained a large fraction of nodules. Additional observations and chemical composition analysis using scanning electron microscope (SEM) with energy dispersive X-ray spectroscopy (EDS) were conducted on 2-1 mm and 1-0.5 mm nodules. Different micro-morphological features, including a complex Fe-Mn-oxide matrix with mineral grains consisting of predominantly quartz and feldspar, were observed. Nodules were consistently grouped into rough and smooth types. Brown nodules have a low Mn/Fe value (< 1), whereas black nodules have a high Mn/Fe value (> 1). Micro-morphology of Mn-rich, Fe-rich, and Mn-Fe-rich regions were observed inside nodules from different horizons. Fe and Mn diffused and precipitated within the matrix with an extensive micro-pore system. Examination of soil thin sections from perched water zones showed brown spherical Fe-Mn nodules with sharp boundaries and more densely differentiated fabric.

Keywords: Loess; pedogenesis; Mn/Fe ratio; redox processes
Financial support: National Natural Science Foundation of China, Project Number 40971124 and 41371223

(6764 - 954) Micromorphological description for final diagnosis of a non-lithified paleosol – a case in Brazil

Camila Fernandes Miranda[1]; Yuri Lopes Zinn[1]
Universidade Federal de Lavras[1]

Many paleosol studies identify and describe buried sequa or lithified soils constrained by geochronologically-dated rocks. If no buried A horizon, lithification or datable rocks occur, paleosols can only be identified by other morphological contrast with the overlying, current soil. However, such contrast can be highly variable and not always evident, and thus paleosol diagnosis is subject to a debate, in which Soil Micromorphology is a critical tool. Here, we describe a paleosol underneath a deep (2 to >5 m), reddish, very clayey gibbsitic Acrudox of fine granular structure developed from limestone, on a 3% slope in Ijaci, Minas Gerais, Brazil. A large excavation for a parking lot exposed this paleosol lacking a dark-colored buried A, with massive structure perforated by many faunal channels infilled by small granular peds, and marked by contrasting colors including red, yellow and white, not due to current redoximorphism. Under the microscope, the paleosol showed massive microstructure tending to fragment in weakly separated angular blocks, as noted by tapering planar voids. The c/f distribution was open-spaced porphiric. The b-fabrics was poro- and granostriated, but also circular striated, which aside with star-shaped vughs suggest that part of the massive structure was due to compaction and welding of fine granular peds. Coarse material was angular to sub-rounded quartz, often fractured but without fine material within the shards, consistent with the unusual macroscopic description of brittle, colourless gravel quartz. Pedofeatures included Fe depletion along preferential-flow paleochannels and planar voids, varying from yellowing to whitening of the reddish matrix. In addition, Fe and gibbsite nodules were also described, as well as clay coatings on pores. In contrast, the overlying Acrudox has fine to mid-sized granular microstructure, undifferentiated to speckled b-fabrics, and as pedofeatures, gibbsite/Fe nodules and excrements. We conclude that the clay illuviation coatings along pores confirms the paleosol diagnosis, since it is not compatible with the current Oxisol-forming processes. Also, XRD peaks for illite, absent in the Oxisol, further supports this conclusion. Probable evolution sequence is: 1-burial by current Oxisol material; 2-formation of faunal channels in buried paleosol; 3-hydration and deferrification along paleosol voids, 4) infilling of paleochannels and deposition of clay coats with material from the Oxisol above.

Keywords: Soil genesis, Soil mineralogy, tropical soils
Financial support: Fundação de Amparo à Pesquisa do Estado de Minas Gerais – FAPEMIG

(9841 - 2969) Pedogenesis of Bt horizons in the Marília Formation (Bauru Basin Cretaceous), Brazil.

Diego Sullivan de Jesus Alves[1]; Francisco Sergio Bernardes Ladeira[1]; Alessandro Batezelli[1]
Universidade Estadual de Campinas[1]

Several studies have identified Bt horizons in the Marília Formation (Bauru Group - Bauru Basin), especially based on field morphology, possibly only in micromorphological analysis. This study aimed to

understand the paleopedogenetic processes involved in the formation of Bt horizons in the Marília Formation, trying to identify if these Bt horizons identified in the field really were genetic Bt horizons. The study areas are located in the states of São Paulo (Monte Alto municipality), Goiás (Itajá municipality) and Minas Gerais (Campina Verde municipality). This formation consists of sandstones, conglomerate sandstones, conglomerates, mudstone, siltstones and as calcretes and silcretes. It was deposited from an association of alluvial fan systems with torrential regimes, fluvial and ephemeral or as an eolian sand sheet, being dated Maastrichtian, in the Upper Cretaceous. Three paleosols profiles were selected, subdivided in the different study areas. Medium sand texture is predominant, c/f distributions (random and grouped; not referred and cutaneous; porphyritic, chitonic, quito-gefuric mixed, enaulic), birefringent fabric (crystallitic, granostriated and undifferentiated), ferriargilans (crescent, capping, pendent, link capping and typic; microlaminated; occasional to very abundant; strong and continuous), calcans (capping and pendent; abundant; strong and continuous), pedotubules (granotubules and isotubules) and nodules (iron oxides and carbonates; typic and crossed concentric; impregnated strongly). All paleosols profiles were identified in the Marília Formation but have markedly different micromorphological characteristics. In Monte Alto, the illuviation processes were dominant, considering the free/crescent laminates ferriargilans identified, which represent expressive conditions of landscape stability and greater availability of water in the environment, which allowed the movement and deposition of the oriented clay. In Itajá, clay minerals aggregates (enaulic regions) indicate well-developed paleosols, even if they present fractures due to compaction. On the other hand, in Campina Verde, the oxidic features absence along the predominance of calcareous and carbonate nodules suggests that the high carbonate accumulation obliterated the clay films and/or caused the clays flocculation and consequently illuviation decrease.

Keywords: Pedogenesis; Bt horizon; Marília Formation.
Financial support: To CAPES for doctorate scholarhip. To CNPq for productivity scholarship (308629/2015-9). To FAPESP for funding the project 2015/17632-5 process.

(1108 - 607) The unique fabric of pedo- and lithopedogenic gravels in Brazilian savanna soils: archives of soil polygenesis on tropical sedimentary terrains

Yuri L. Zinn[1]
UFLA[1]

Although polygenesis is the rule rather than the exception in soil genesis, evidences of former soil formation cycles are difficult to detect even using micromorphology, because most soil components (sand, silt and clay) fractions are small, unconsolidated and continuously mixed by bio- and pedoturbation. However, soil gravels and coarser particles (>2 mm), usually not considered soil materials and discarded, are in many tropical soils composed of ironstones or petroplinthites, which are pedogenic and thus can preserve features of past soil genesis cycles. Peds or clods indurated by other cementation processes may also occur, all here referred to as pedogenic gravels (as proposed by Zinn & Bigham, Soil Res. 54, 440, 2016). In addition, gravels of resistant parent materials, such as quartzite and shales, can become impregnated by soil Fe/Al oxides, and are named lithopedogenic gravels. In this work, we present a micromorphological description of gravels in a Haplustox formed from mixed Proterozoic sediments near Unaí, Brazil, not treated in the previous paper and perhaps never before observed, which can confound those who would casually find then in soil thin sections. Besides magnetic and non-magnetic ironstones, in which only quartz grains are not opaque, the most common pedogenic gravels found were peds indurated with massive Fe-Mn oxide impregnation. The most common lithopedogenic gravels were shale fragments, in which soil Fe-Mn oxides were later impregnated forming 6 different, outstanding patterns: reticulate, banded, undulated, massive (opaque and diluted), banded and globular. Near pure Al-oxide depositions were also found. In addition, chert and corroded-grain quartzite nodules, with separate Fe, Mn and Al oxide impregnations, associated with pores, occurred. The current soil shows Fe- and Mn-oxide nodules, although it is not hydromorphic. It may be interpreted that impregnation with Fe and Mn oxides occurred at different short-time scales with redoximorphism, but the Al impregnations are prima facies evidence of a different, aerobic long-term formation cycle. Such impregnation has enhanced preservation of the mica-rich shales in the warm, humid climate. Alternatively, the contrasting gravels suggest reworking and spreading of different parent materials, which would add another critical component to the space-time continuous nature of soil polygenesis. In any case, the potential of such gravels as indicators of polygenesis and paleosols is clear.

Keywords: Oxisols, Fe oxides, soil polygenesis
Financial support: Fapemig (CAG-APQ 778-15), CNPq (302038/2016-7)

C1.2 - Soil geography

C1.2.1 - The geography of soils in a changing world

(3699 - 548) Analysis of a pedological transformation system of the Diamantina Plateau, MG.

Roberta Borges Parreira[1]; Cristiane Valéria de Oliveira[1]
Universidade Federal de Minas Gerais[1]

Studies regarding the interaction between soils and relief and/or, particularly, pedological processes involved in soil transformation and evolution of the landscape in the Southern Espinhaço domain (SdEM) are still scarce. In the Diamantina Plateau specifically, research is still rare and relatively recent. This paper seeks to evaluate a soil transformation system located at the Roda stream heads, on a high summit surface in the Diamantina Plateau based on morphological, physical and chemical parameters. For this purpose some laboratory analyzes were conducted, Granulometry, Dispersed Clay in Water (ADA), Determination of Organic Carbon (CO) content and Determination of iron (Fe) content extracted by Dithionite Citrate Sodium Bicarbonate (CBD) and Oxalate Acid Ammonium (OAA). According to the results, a significant loss of CO content was detected, especially when comparing the slope's hydromorphic environment to the areas presenting better drainage. The Fe contents were also low for the soils in environments that present or have already presented deficient drainage, suggesting that a loss of Fe occurred by leaching, due to the reducing environment. The change of soil colors was also considered according to its position in the slope, from a more yellowish color (lower slope) to a reddish one (medium and higher slope). As for the pedological structure of the materials found in the poorly drained portions there is no noticeable structure. However as the drainage conditions improve, the structural units become discernible. Thus, the morphological data showed an alteration in the pedological organization - as the slope of the terrain increases and the drainage in the slope improves. Thereby, it was possible to identify the following sequence of soils in the slope: Histosol (base), Gleysols (medium slope), Gleysolic Cambisol and Cambisol (medium and high slope). In this way, the following conclusions were reached 1) there is a cause and effect relationship between topography and soil distribution; 2) the organization of the horizons along the slope are resulting of the operation of an Histosol - Cambisol transformation system.

Keywords: Sistema de transformação, solos hidromórficos, Planalto de Diamantina.
Financial support: CAPES

(7491 - 2630) Behavior of a pedological Oxisols-Ultisols system in the municipality of Terra Roxa Paraná, Brazil

Rafael Martins Sanches[1]; José Edézio da Cunha[2]; Vanda Moreira

Martins[2]
PPGG/UNESP/IGCE/DEPLAN/Rio Claro[1];
PPGG/UNIOESTE/CCHEL/MCRondon[2]

The study of the structure and the functioning of landscapes implies the comprehension of processes (both natural and antropic) which involve a certain segment of space. In this sense, there is a need for studies that provide insights into soil distribution in landscapes and its relations with relief forms. The investigations aimed to identify the causes and consequences of the potential and emergent fragilities in environments with soils of medium-sandy texture, derived from the alteration of sandstones from the Caiuá Formation (Kc). The researches about this thematic indicated the need for detailed studies in the areas with greater tendency for origin and evolution of water erosion, particularly in the sectors of valley floors with convergent concave declivity ruptures which foster the loss of fine fractions (silt and clay). The Structural Analysis of the Pedological Cover methodology, systematized by Boulet et al. (1982a), oriented phases of the research, whose central goal was the vertical and lateral morphopedological representation along a topographic section on the left hillside of Tamanduá stream. The spatial cut consists of a rural sector in the municipality of Terra Roxa, on the western region of Paraná state, Brazil. For this purpose, we carried out topographic survey, pedological reconnaissance, opening of trenches for macromorphological description of soil horizons and collection of deformed and undeformed samples for physical and chemical analyses. These proceedings allowed to confirm a pedological system with the presence of oxisols on the top and on the high and lower hillside. The occurrence of these soil classes happens because of a flat relief that is slightly corrugated, has a low degree of dissection, declivity up to 8%, and hillsides of convex-concave-convergent forms. As to pedological covers resulting from sedimentary rocks of the Caiuá Formation, the soils presented a medium-sandy texture, with a high rate of sand and a low rate of clay, being of friable nature, and consequently, susceptible to hydric erosion on the downstream. In this sector of the hillside, there is a predomination of soils of E horizon, which is extremely sandy (up to 86%), and impediment subsurface horizon (Btg and Bt). This pedomorphological organization indicates the existence of two transformation fronts: one in the medium-hillside (Bw/Bt) and another in the low-hillside (AB/E and E/Bt) where the erosive instability of the system is most evident.
Keywords: Soil-relief relation. Pedological transformation systems. Erosion in soils.
Financial support:

(4092 - 2371) Development of some Mongolian soil types of Forest Steppe and Gobi Desert zones and their ecological evaluation

Undrakh-Od Baatar[1]; Karl Stahr[1]
University of Hohenheim[1]

Soil genesis is the study of the development of soils. Soil is a natural body, developing from rock at the Earth's surface through pedogenic processes (weathering and mineral formation, decomposition and humification, structure formation and various substance translocations) under a specific climate, specific litter-delivering vegetation, and population of soil organisms. Understanding the processes enables interpretation of the natural history of a soil and provides a starting point to evaluate how future changes will affect the soil resource. Combining landscape history with knowledge of principles of soil profile development allows for more precise and effective land use planning. The importance of this paper is to evaluate the Mongolian different type of soils ecologically in detail way and classify them according to the WRB Soil Classification. The soil profiles have been described in Mongolian Forest Steppe and Gobi Desert zones between 2012 and 2017. Soil chemical and physical parameters have been analyzed for each layer of the soil profiles. As Mongolian Soil Ecological Evaluation methodology has not been well developed yet, this work tried to introduce the International Methodology to the country. The calculations for soil ecological evaluation have been done using the method from Hohenheim University. The WRB soil taxonomy is presented based on chemical, physical, and morphological soil properties.
Keywords: Soil; WRB classification; Soil ecological evaluation
Financial support: Institute of RIAH, MONGOLIAN ACADEMY OF SCIENCE

(9070 - 1367) Distribution and Formation Environment of Fe-Mn Nodules in the soils derived from Quaternary Loess-like materials in the North of China

Qiu-Bing Wang[1]; Zhuo-Dong Jiang[1]; Zhong-Xiu Sun[1]
Shenyang Agricultural University[1]

The distribution of Fe-Mn nodules plays an important role in interpretation of the formation mechanism of Fe-Mn nodules and soil classification. Soils existing Fe-Mn nodules at stable upland with deeper groundwater are found in Northeast China, which causes many problems in soil classification. The objectives of the study were to figure out distribution and explore the environment and mechanism of soil nodule formation in Northern China. The principles for selecting soil profiles were: (1) soils were situated at stable uplands with deeper groundwater table, indicated that soils are not affected by groundwater and without obvious evidence of erosion and deposition in the processes of soil formation; (2) soils developed from the Quaternary loess-like materials, ensure that soils were developed from the same parent materials as far as possible. A total of 345 soil profiles, including soil series prospecting results in 2010's and the legacy data of the Second National Soil Survey during 1980's, in 10 provinces in temperate zone of northern China were selected. The mean annual precipitation and temperature of each sampling site was recorded based on China Meteorological Science Data Sharing Service. The relationship between existence of nodules in soils and climate of soil-forming was analyzed. The result shows that nodules appear in seventy-four in 345 soil profiles, which is account for 21.5% of soil profiles in total. The soil profiles existing Fe-Mn nodules are mainly distributed 120.82 ~ 133.37° E 41.19 ~ 49.01° N, where humid temperate area with MAP 370.6-917.7 mm, and MAT 0.9 - 14.9°C. The common characteristics of soils is located in a climate of relative high precipitation with a long time deeply-frozen soil in winter, and an obvious period of alternation of freezing and thawing in spring. Soil water in lower part of soil profile moves up and concentrates in upper part of the soil in the early freezing reason, and thaws during the period of alternation of freezing and thawing in spring. The thawing soil water cannot moves down to the substrate soil because of the existence of freezing layer in it. This result in reducing environment close to freezing layer for a period of time before soil thaws throughout, which lays a solid foundation for the formation of Fe-Mn nodules. We conclude that the formation of Fe-Mn nodules in the soils at stable upland is closely related to the alternation of freezing and thawing in spring.
Keywords: Fe-Mn nodules; alternation of freezing and thawing; loess-like materials; temperate zone; spatial distribution
Financial support: National Natural Science Foundation of China, Project Number 40971124 and 41371223

(8757 - 2823) Evolution of the São Pedro Cuesta Escarpment Foothills in São Paulo, Southeastern Tropical Brazil: Preliminary Results

Grace Bungenstab Alves[1]; Fernando Nadal Junqueira Villela[2]; Marcos Roberto Pinheiro[2]; José Pereira de Queiroz Neto[2]; André Mateus Barreiros[2]; Marcelo Reis Nakashima[2]; Sidneide Manfredini[2]; Beatriz Ferras Scigliano[2]; Cristiane Regina Michelon[3]
Federal University of Bahia[1]; University of São Paulo[2]; Federal

Institute of Santa Catarina[3]

The genesis of foothill landforms is attributed to the Neogene age with correlative deposits and in situ alterations. This paper presents the preliminary results of an analysis of the geomorphopedological genesis of the foothills at the São Pedro Cuesta, located between the Peripheral Depression and the Western Plateau in the State of São Paulo, southeastern tropical Brazil. Geomorphopedological genesis is approached through a multiscalar analysis, from the regional to the soil scale. A regional survey of forms, structures, and neotectonic features is followed by a structural analysis of the pedological cover. Macro- and micro-morphological, physical, chemical, and mineralogical properties of toposequence materials were analyzed in addition to dating by optically stimulated luminescence. The foothills are elongated hills in a sandstone area covered by shallow Quaternary materials. The soil toposequence is located at the gentle interfluve slopes of the foothills. The results show a pedological system with a sandy clay loam texture with less than 20% clay and minor variation in depth, except for the hillslope in the inferior sector where the texture changes suddenly. The pedological system is reddish at the top, with more clay, and becomes progressively yellowish, and coarser with more sand in the inferior sector. A weak acid pH, prevailing negative charges, low basic cation concentration, and Ki and Kr indexes greater than 0.75 suggest high degrees of weathering and leaching in these materials, with a predominance of kaolinite in the clay fraction. Although the materials show a high pedologic development, their ages are relatively young, between 22.5 ± 2.6 ka (at the top) and 27.45 ± 4.35 ka (in the inferior sector). Rock fragments (basalt, sandstone, silex, and ferruginous crust) are found at depth in the inferior sector. Magnetite and maghemite soil minerals are present in the upper sector. The preliminary results suggest the presence of allochthonous materials on the glacis surface, which would have been derived from Late Quaternary morphogenesis linked to the escarpment retreat. The current sculpture of the interfluve is a result of pronounced mechanical morphogenesis in the Upper Pleistocene, and more intense weathering and pedogenesis in subsequent wetter periods in the Holocene.

Keywords: Geomorphopedological genesis; Soil toposequence; Soil analysis; Late Quaternary morphogenesis.
Financial support: FAPESP 2016/08722-3

(5447 - 1703) Five decades in research on Vertisols: A bibliometric analysis

Lima Glêvia[1]; Corrêa Marcelo[2]; Ferreira Tiago[1]
Esalq/USP[1]; UFRPE[2]

The Vertisols present a wide world-wide occurrence, high productive potential, besides particular and dynamic features, which requires different management. Through the bibliometric analysis of publications, the objective was to analyze the dynamics and evolution of research on Vertisols between 1966 and 2015. The data were taken from the database (Scopus), using the words "vertisols" or "vertisol" in the search. "Vertosol" in the field of article title, abstract and keywords. The evaluated items of the documents were category, type of document, affiliation, language, country of publication, as well as frequency distribution of the words in the title, keywords and author keywords. The countries that published the most on Vertisols (1966-2015) were India, Australia, the United States, France and Ethiopia, which have extensive areas occupied by this soil except France. Thus, at the global level, they contributed the most scientifically to the progress of researches on Vertisols, as well as presenting the main publishing institutions on this subject, and Spain, Belgium and Mexico. The first publications indexed in the database come from the 60s, and reached the peak of production in 2014. This behavior expresses the scientometric model that followed a second-order polynomial growth pattern. A fifth of the publications came from 11 authors, although these were not responsible for the most cited articles. Articles are the main type of document and English is the predominant language of publications. Vertisols, Vertisol and Soil were the most used words. The country, elements and most frequent cultures were India; nitrogen, phosphorus, potassium, carbon, zinc; and sorghum, wheat, soybeans, rice, cotton, chickpeas. The studies focused mainly on effects, differences, productivity, growth and uses, aiming at the optimization of natural resources, their better use, as well as increased productivity. Subjects related to pedogenesis and microbiology were poorly explored.

Keywords: Vertisols, Vertisol, Vertosol, Bibliometric analysis, Scopus
Financial support: CAPES (Coordination for the Improvement of Higher Level Education)

(8778 - 2858) Influence of relief on mineralogical development in soil in the semi-arid region of Pernambuco, Brazil

Juliet Emília Santos de Sousa[1]; Alexandre Ferreira do Nascimento[2]; Marcelo Metri Corrêa[3]; Valdomiro Severino de Souza Júnior[1]
1Departamento de Agronomia, Universidade Federal Rural de Pernambuco, Rua Dom Manuel de Medeiros, s/n, Dois Irmãos - CEP 52171-900, Recife, PE, Brazil[1]; 2Empresa Brasileira de Pesquisa Agropecuária – Embrapa Agrossilvipastoril, Rodovia dos Pioneiros MT-222, Km 2,5, Zona Rural Caixa Postal: 343, CEP: 78550-970, Sinop, MT, Brazil[2]; 3Universidade Federal Rural de Pernambuco, Unidade Acadêmica de Garanhuns, Av Bom Pastor, s/n, Boa Vista - 55292270, Garanhuns, PE, Brazil[3]

Semi-arid environments occupy a large part of the terrestrial territory, are characterized by quite characteristic climatic conditions, with low rainfall and high temperatures. The soils existing in this landscape are categorically characterized as little weathered, and predominantly rich in bissialitic minerals, showing the climate as a preponderant formation factor, forgetting the importance of the others. From these theories, this study was carried out with the purpose of proving the fundamental influence of the relief and drainage condition on the formation of minerals in the semi-arid environment and consequent evolution of soils. Physical, chemical, mineralogical and petrographic analyzes were carried out, being proved the predominance of processes of monossialitization and bissialitization in the region. The studied soils are formed from materials of very similar composition, being of great importance for the mineralogical development of the same. All the chemical, physical and mineralogical characteristics are reflections of the materials of origin of the studied profiles. It is clear after all studies that the formation of minerals is directly linked to the position of the soil in the landscape, being the soils with greater drainage propitious to the formation of minerals 1: 1 (kaolinite), and the soils with less drainage conducive to the formation of minerals 2: 1 (smectite).

Keywords: kaolinite, smectite, hydrolysis, landscape, drainage.
Financial support:

(4954 - 2543) Legacy soil maps from Brazil: organizing and providing layers in an interactive WebGIS

Ricardo de Oliveira Dart[1]; Mario Luiz Diamante Aglio[1]; Hilton Luis Ferraz da Silveira[2]; Elaine Cristina Cardoso Fidalgo[1]; Margareth Gonçalves Simões[1]; José Silva de Souza[1]; Elaine Rodriguez de Souza[1]; Débora Pignatari Drucker[3]; Davi de Oliveira Custódio[4]; Claudia Regina de Laia Machado[1]; Maria Regina Capdeville Lafroet[1]
Embrapa Solos[1]; Embrapa Solos / INPE[2]; Embrapa Informática[3]; Embrapa Territorial[4]

Digital soil maps at appropriate scales are essential information for land use planning. Nevertheless, Brazilian soil information is scattered in several institutions and stored in several formats. In adition to that, this information have faced an interruption of its systematic soil

survey program, providing difficult access to decision makers. In order to organize and safeguard the spatial data produced at the Brazilian Agricultural Research Corporation (Embrapa), a spatial data infrastructure was developed (IDE-Embrapa) where thematic collections related to soil have been gathered and published in a web environment. The objective of this work is to present the initiative of organizing the spatial data of Embrapa related to soil information through the development of the IDE-Embrapa. In order to achieve this goal, the spatial data that were stored in a previous geoinformation infrastructure developed by Embrapa Soils were shifted to the IDE-Embrapa infrastructure. The implementation of the IDE-Embrapa was performed using open source software, based on the Open Geospatial Consortium standards. The IDE-Embrapa infrastructure uses GeoNode platform, which integrates a geospatial database (PostGis) with a map server (GeoServer) and a metadata catalog (PyCSW), and is controlled by a Content Management System in the Web environment. Currently, 100 information layers and 60 documents were catalogued in the IDE-Embrapa Soils (geoinfo.cnps.embrapa.br). These data and metadata are already available for download. Maps represented by various territorial boundaries and scales were registered. The main maps of Embrapa Soils are already catalogued and are available to the user with their own color pattern (styling) for each type of thematic map, allowed by incorporation of a file with the styled layer descriptor (SLD) format to each map. Soil maps, for example, are presented with the colors established according to the Brazilian Soil Classification System, which facilitates users to visualize the spatial distribution of soils in a given region. Currently, the IDE-Embrapa infrastructure is making available the Brazilian soil information available to any external user. This work is under construction and we hope soon to have all maps prepared by Embrapa Soils catalogued and available, in order to safeguard data and metadata, for ready use of these by society.

Keywords: Geoinformation, Geoservices, Geodata
Financial support: Embrapa

(8245 - 598) Pedo-ecotone as a specific soil-geographic unit

Hryhorii Moroz[1]
Peasant farm enterprise "Balkany"[1]

At the present stage of the development of geographic science, there has emerged a need to improve the conception of geographical ecotones as transitional bands between various natural systems. Within such territories, one type of landscape (soil) is changed by another, for example, the steppe – by the dry steppe (chernozems – by kastanozems). In the northwest of the Black Sea region, a distinct transitional stripe is the transition stripe from the middle to the dry Steppe, which at the same time is a peculiar transition from calcic chernozems to the gypsic kastanozems. At the present stage, the soils of this ecotone are affined to the gypsic kastanozems in the brownish color of the humus accumulative horizon, with clear signs of lessivage, very low sodic resistance, low buffer capacity and chemical signs of soil sodicity. A well-defined humus accumulative horizon, humus indexes, a broad ratio of carbon content in humic acids to the one in fulvic acids and indicators of the optical properties of humic acids characterize the soils of this ecotone as calcic chernozems. A characteristic feature of ecotones (and hence of pedo-ecotones) is the pronounced spatial streamlining of their internal structure. Accordingly, in the pattern of the soil cover of the researched area, three groups of soils, which form the local catenas, can be distinguished: the background soils of the plakors and narrow watersheds (sodic and residual-sodic calcic chernozems); the soils of the lower parts of the slopes and the soils of the reclined thalwegs of the hollows – are characterized by chernozem parameters; slightly xeromorphic and slightly eroded soils of the upper parts of the slopes – closer to gypsic kastanozems. It also confirms the transitional (ecotonal) status of the researched area. Thus, the transition stripe from the gypsic kastanozems to the calcic chernozems in the northwest of the Black Sea region should be defined as a medium-dry steppe pedo-ecotone – a peculiar soil-geographic unit. Actually, the pedo-ecotone should be defined as a dynamic spatio-temporal soil-geographic system, which is formed in the contact zone of certain types (subtypes) of soils and is characterized by relatively high gradients of properties and parameters, internal inhomogeneity and functional interconnection of the structural elements, among which both the objects of adjacent pedo-ecotone-forming bodies and specific for the given pedo-ecotone formations are found.

Keywords: Pedo-ecotone; chernozems; kastanozems; steppe.
Financial support:

(5260 - 2739) Relation of pedoenvironments with forms of nitrogen and phosphorus in semiarid soils.

Victor Junior Lima Felix[1]; Evaldo dos Santos Felix[1]; Bruno de Oliveira Dias[1]; Sebastiana Maely Saraiva das Chagas Sousa[1]; Vânia da Silva Fraga[1]; José Coelho de Araújo Filho[1]
Universidade Federal da Paraíba[1]

There are few studies related to the influence of the climatic gradient, mainly rainfall, on N and P dynamics in soils of the semiarid region of Brazil, being this information primordial for the planning of the soil management, since these nutrients are considered limiting for the production of biomass of the region. Eight sample areas were selected considering two climatic gradients (hot and semihumid, and hot and semiarid), which contained the three main orders of representative soils of the Brazilian semiarid region Planossolos, Luvissolos e Neossolos Regolíticos (Typic Albaqualf, Aridic Haplustalf and Typic Ustortent)). In these places trenches were opened, horizons were identified and samples were collected for analysis in all present horizons. The values of the fraction of P (P-Al, P-Fe and P-Ca) and mineral N (NH_4^+ and NO_3^-) were evaluated. The highest levels of P fractions were found in the Luvissolos (Aridic Haplustalf) region of the hot and semiarid climate, with predominance of P-Al and P-Fe fractions, which may be related to the reduced Ca^{2+} contents in this soil and the soil pH, since P-Al and P-Fe are more frequent in more developed soils and acids, while the P-Ca predominates in alkaline soils. As for mineral N fractions (NH_4^+ and NO_3^-), the levels were considered low in all soils and horizons, only the Luvissolos (Aridic Haplustalf) of the hot and semiarid climate had higher levels of nitrate. It was possible to conclude that with increasing rainfall there was an increase in P and N fractions in all Planossolo (Typic Albaqualf) and Luvissolos (Aridic Haplustalf) profiles, however, the source material influenced more than rainfall.

Keywords: pedogenesis, fractionation of P, NH_4^+ and NO_3^-
Financial support: Coordination for the Improvement of Higher Education Personnel (CAPES); National Council for Scientific and Technological Development (CNPq)

(3397 - 747) Soil fertility mapping: its transference to farmers by using GIS online tools

Bryan Alemán Montes[1]; Carlos Henríquez Henríquez[1]; Kenneth Largaespada Zelaya[1]
Universidad de Costa Rica[1]

The GIS helps to study the spatial variability of different characteristics on landscape and becomes an important tool for the adequate management under precision agriculture concept. The goal of this study was to use available *Online* tools in order to display the spatial variability of some soil chemical properties on field. In the project participated 235 farmers of CoopeTarrazú R.L. and CoopeLlanobonito R.L. cooperatives located at "Zona los Santos", Costa Rica and dedicated to coffee production. Cooperative Foment Institute (INFOCOOP) and University of Costa Rica (UCR) sponsored this study

in collaboration with the involved cooperatives. The farms were georeferenced reaching a total of 693 hectares; from this area, 142 soil samples for chemical analysis were taken and analyzed. Spatial autocorrelation analysis was carried out and interpolated maps were generated using Ordinary Kriging parameters with selected soil chemical characteristics data. The Effectivity Estimation Parameter was over 95% with the most of the features except with K (74%). Some critical characteristics as soil acidity were detected in some areas using the methodology. The interpolated data of each soil chemical feature was linked to georeferenced farm areas and uploaded at open source *Online* platform *QGIS-Cloud*. This allow viewing and consulting soil maps and linked data using mobile apparatus or computers with internet access. The work flow allow by this way to share and transfer the updated information related to coffee production to farmers stimulating the use of records and data base generated.

Keywords: soil mapping GIS online soil fertility
Financial support: Cooperative Foment Institute (INFOCOOP) and University of Costa Rica (UCR-project VI-733-B5-508)

(3203 - 1477) Spatial variability of soils and its relation to plant biodiversity in fluvioglacial and lacustrine landscapes of South Karelia on a large scale

Igor Ilichev[1]
Lomonosov Moscow State University, Departments of Soil Science, Leninskie Gory 1-12, Moscow, 119991, Russia[1]

The research was conducted to identify soil heterogeneity of the fluvioglacial and lacustrine landscapes of South Karelia. Field studies were conducted in the Karelian Republic in the vicinity of the village Essoila. Two complementary methods were used: analysis of soil diversity and assessment of spatial variability of soils. Studies were carried out on two different landscapes: dissected fluvioglacial ridge with well drained moraine and fluvioglacial sands as parent materials (Site 1) and waterlogged plain on lacustrine-glacial clays (Site 2). At both sites one hundred soil pits were made and described. All soils were named according to the new classification of Russian soils and WRB. Typical soils for the Site 1 are Entic Podzols (Arenic) – 39 % and Albic Podzols (Arenic) – 27 %; for the Site 2 the dominant soils are Dystric Histic Stagnosols (Clayic) – 50 % and Umbric Stagnosols (Clayic) – 22 %. Soil diversity was characterized using the Shannon–Wiener index: for the Site 1 it equaled 2,36, for the Site 2 – 2,21. Variability of thickness of soil horizons was also calculated. It showed that despite close values of the Shannon – Wiener index, there were significant differences in the spatial organization of the two landscapes. Another aspect of the research was the consideration of the impact of soil variability on plant biodiversity. The degree of difference between plant communities were assessed by the Jaccard and other similarity indices. The research showed that soil variability has a significant impact on vegetation cover.

Keywords: pedodiversity, Podzols, Stagnosols, soil horizons thickness
Financial support: The research was supported by the grant of Russian Science Foundation № 17-17-01293.

(6019 - 2587) Volcanic island in the central part of Kurily Range: pedodiversity and Andosol properties

Sergey Khokhlov[1]
V.V. Dokuchaev Soil Science Institute, Pyzhyovskiy lane 7 building 2, Moscow, 119017, Russian Federation (khohlov2000@mail.ru)[1]

The Matua Island, 52.6 sq.km, a recent volcano with the highest point 1446 m a.s.l. and its neighbor – small and flat Toporkovyi Island 1.1 sq.km, 70 m a.s.l. are located in the center of Kuril Islands Arc. The volcano – Pik Sarycheva, is an active stratovolcano of explosive and effusive eruption activity, having produced during the Holocene stratified, mostly gravelly mafic pyroclasts, 5 to 7 m thick. Their top layer, about 500 years old and 140 to 65 cm deep, serves as parent rock for Andosols. Climate is cool: mean temperature of the warmest month is 10.8°C, that of the coldest one is – 5.3°C, MAT is 2.2°C, and MAP is 1223 mm. Meadows, small-shrub tundra and dwarf alder communities alternate with bogs. Volcanic soils are formed on stratified gravelly-stony tephra more than 60 cm thick, underlain by thin layers of volcanic slags, sands and transit ashes, some of them interstratified with buried soils; their deposition started 1.6 mln years ago. The most widespread soils were qualified in WRB-2015, for Umbric Vitric Andosols (Fulvic, Endoaluandic). In most soil profiles (total of 90 pits), main diagnostic properties of Andosols are identified, and the differentiation of the soil cover is due to topsoils, which properties well correlate with vegetation. In Russian classification system, there are special diagnostic horizons or diagnostic properties for them that only partly correlate with the WRB horizons. Thus, under tundra communities, a mucky – raw-humus horizon is formed, or the dry-peat one (10-17 cm thick) if soils are somehow disturbed. Meadows are related to a soddy horizon with features of the raw-humus one (10-35 cm), ferns – to peat or mucky-peat topsoil not deeper than 15 cm. It is worth noting that the whole pyroclastic thickness is pierced by fine roots. Shallow ash-stratified peat soils associated with raw-humus gley soils are confined to the sites of ground water discharge. The Toporkovyi Island is inhabited by birds – Fratercula cirrhata, responsible for the development of unusual ornithic soils occupying 35% of its area. They have a horizon with few traces of birds' artefacts, overlying the hard rock, or loose pyroclastic deposits. Thus, the soil survey performed on the Island of Matua confirmed the occurrence of young Vitric Andosols there, associated with several variants of Leptosols, having any combinations of qualifiers, Principal: Folic/Histic/Umbric, and Supplementary: Andic, Gelic, Gleyic, Ochric, Ornithic, Protic, Tephric.

Keywords: volcanic soils, ornithic material, soil cover of Matua Island
Financial support: Acknowledgments. The author thanks Russian Geographic Society for financial support, project №2, 2017: «Organization of terrain research on Matua Island (Kuril Islands)», and Prof. Maria Gerasimova for consultations.

C1.2.2 - Remote sensing applied to soil Science

(8670 - 2766) A combined gis-analysis of major forest-forming conifers, soils and climate distributions in central Siberia

Elena I. Parfenova[1]; Nadezhda M. Tchebakova[1]; Olga V. Trefilova[1]; Eugene G. Shvetsov[1]
Forest Institute of FRC KSC SB RAS[1]

Our goal was to determine relationships between major forest-forming tree species and ecological factors (climates and soils) in central Siberia and to apply these relationships to modeling and predicting their distributions based on climatic and soil GIS layers. In our regional SibForClim model, the input climatic layers were: 1. growing degree days, base >5oC; 2. negative degree days, base <0oC, and 3. annual moisture index, representing respectively summer warmth, winter cold and dryness stress conditions. Permafrost was explicitly taken into account. The output layers were: a major forest-forming tree species and its productivity (site index). This model was updated with soil types that were derived from the Soil Map of Russia (1988). Superimposing forest tree species distributions from the Map of Russia's forests (1990) and soil types using the GIS-techniques we concluded that probabilities of each tree species occurrence were associated with particular soil types. Thus, the tree species distributions are to be mapped using surface climate, soil and permafrost layers. The next step to extend the SibForClim model is to include the soil climate being a function of surface climate, soil morphology and local microrelief.

Keywords: a bioclimatic model, major tree species, soil types, central Siberia, remote sensing, Landsat
Financial support: Russian Foundation for Basic Research # 16-05-00496

(9368 - 286) A novel technique for detection of shallow soils using remote temporal images in central Brazil

Wanderson de Sousa Mendes[1]; José Alexandre Melo Demattê[1]; Raúl Roberto Poppiel[2]; José Lucas Safanelli[1]; Caio Troula Fongaro[1]; Clécia Cristina Barbosa Guimarães[1]; Renato Zocco Belato[1]

Luiz de Queiroz College of Agriculture, University of São Paulo[1]; FAV, University of Brasilia[2]

Solum depth is controlled by soil forming processes and thus, play an important role in soil mapping, land use planning and agriculture. It is usually determined by field work (Dutch auger) and/or relief inferences, which implies on large budget to execute and requires a lot of time for evaluating the soil depth. Faster techniques are vital to evaluate the soil depth. However, solum depth are one of the most difficult tasks to be performed using sensing systems. The objective of this investigation was to create a technique to achieve area of soils with depth limitation using remote sensing temporal images. The study area is located in Central Brazil. It was collected 330 soil samples in 0-20 cm soil depth and granulometric analysis performed. The information was used to assess soil modelling with Geospatial Soil Sensing System (GEOS3)(Demattê et al., 2018). The technique allows to undercover soils using time series of images. Based on this image, we link the soil analysis with the pixel and predict sand and clay maps for the entire area. We constructed two datasets using images from the same months and different years, (a) in the wet season and (b) in the dry season. Handling the datasets, we used an algorithm in R to overlap all images and extract only the maximum Normalised Difference Vegetation Index (NDVI) of each pixel along the time series of each respective season. By the subtraction of the NDVI of the dry and wet seasons, we obtained an image which represents areas where had maximum differences in the pronounced natural vegetation. The areas with maximum differences indicated shallow or rocky soil at in-situ evaluation of the soil depth. Deep soils had higher pronounced vegetation. This was also correlated with the topsoil texture, which is an ancillary indicator of pronounced or non-pronounced vegetative areas. We suppose that shallow soils have the pronounced maximum vegetation in the wet season and minimum in the dry season because of water stress (Osakabe et al., 2014). Meanwhile, deep soils presented pronounced vegetation in both seasons. Therefore, this technique can assist soil management, classification, definition of soil zones and dataset, precision agriculture and land use planning.

Keywords: soil depth detection, soil classification, spectroscopy, temporal satellite images

Financial support: São Paulo Research Foundation (FAPESP) grant numbers: 2016/26124-6 and 2014/22262-0.

(6565 - 2194) Analysis of hazard factors to risk desertification in the Amaime river basin, department of Valle del Cauca (Colombia - South America)

Diana Lucia Correa-Moreno[1]; Jeiner Yovany Buitrago Escobar[2]; Yolanda Rubiano Sanabria[2]; Andres Javier Peña Quiñones[3]

Colombian Corporation for Agricultural Research (CORPOICA)[1]; National University of Colombia. Campus Bogotá. South America.[2]; Washington State University. Prosser. United States of America.[3]

The purpose of this study was to estimate the hazards of desertification in the Amaime river basin in the department of Valle del Cauca (Colombia - South America), through indicators such as climatic, geomorphometric and soil cover. The analysis was carried out with basic primary and secondary information of risk analysis in regions prone to desertification (RARD), through a multifactorial approach, with standardized indicators according to criteria established in this area of research for tropical zones, and the estimation of indices of climatic hazard (NHclI), geomorphometric hazard (NHgI) and anthropogenic hazard (AnHI). Series of daily precipitation data between 1970 and 2010 were analyzed for the generation of a climatic index. The geomorphometric variables were obtained from the digital elevation model (DEM - STRM) with a resolution of 30 m. The anthropic index was obtained from RapidEye satellite images for classification of cover and land use according to the corine land cover - IDEAM methodology, and reclassification with criteria for quality attributes of the vegetation and intensive soil use. The indices were processed and spatialized for the elaboration of cartography at a scale of 1: 50.000, by applying a model in GIS that allowed grouping the RARDs that presented a similar level of hazard. The natural hazard index (NHI) allowed locate the area in the category of areas with medium hazard; while the anthropic hazard index (AHI) catalogs the basin with a high hazard. The basin in general presents a high hazard to desertification (1.45), and the areas with the highest probability of hazard are located in the flat area and in the central sector of the mountainous area, covering 63,878 ha (61.2%); Considering the factors analyzed in the RARD in the basin, it was established that the hazard to desertification is determined mainly by the climatic indicators: number of dry months and climatic aggressiveness; geomorphometric indicators: slope and topographic humidity index; and by anthropic hazard indicators: quality of vegetation and intensive land use. They express constant pressure in different parts of the basin due to the water deficit in a large part of the year, with a high probability of droughts and greater intensity of rainfall, which generate runoff, erosion and sedimentation processes in a natural way and which are exacerbated by the intensive use of soil under different vegetation cover in expansion in the basin.

Keywords: Spatial analysis, land cover, climatic variability, geomorphometry.

Financial support: National University of Colombia and Corpoica

(2504 - 2683) Analysis of the incidence of fires in different classes of soils and biomes in the state of Minas Gerais-Brazil

Eliana Elizabet dos Santos[1]; Elpídio Inácio F. Filho[1]; Liovando Marciano da Costa[1]; Márcio Rocha Francelino[1]

University Federal of Viçosa[1]

The study of the spatialisation of fires in the territory is an important way of knowing and understanding its potentiating factors in order to create measures that minimize its effects on the environment. In this sense, geoprocessing becomes an essential tool when it is intended to study large and difficult access areas that need a more comprehensive analysis. This study had as objective to evaluate the incidence of burnings in different types of soils in the state of Minas Gerais considering their different biomes. From the soil map of the state of Minas Gerais, soil classes were identified according to their second categorical level proposed by the Brazilian Soil Classification System (SiBCS). Hotspots were used for the period from 2001 to 2013 provided by the National Institute of Space Research (INPE). The hotspots were superimposed on the soil map and through ArcGis 10.1 program tools. It was possible to account for the number of hotspots sources in each type of soil and thus to analyze the density of points of fire between the different classes. This relationship was also made considering each biome (Atlantic Forest, Cerrado and Caatinga) in order to identify or not influence their characteristics on the spatialization and concentration of fires in the different soil types. When performing the spatialization of hotspots sources, it was observed that 57% of the outbreaks are concentrated in the Cerrado, 41% in the Caatinga and 2% in the Atlantic Forest. When related to soil type, Entisols Fluvents present a higher concentration of heat sources per area in the Caatinga biome, presenting 0.14 hotspots/km^2. In the Cerrado, there is a higher density on the group of Entisols Fluvents and Plinthosols Argilúvicos (0.60 hotspots/km^2) followed by the group of Gleysols Melanicos (0.52 hotspots/km^2). Finally, in the Atlantic Forest prevails over the group of Ultisols (0.33 hotspots/km^2). Physical characteristics such as depth and water storage capacity of each soil,

as well as the use intended for them, especially those related to agriculture can be important factors in this distribution, leading to a higher or lower incidence of fires in the environment, as well as bio characteristics of each biome.
Keywords: Hotspots Burned areas Brazilian biomes Remote Sensing
Financial support: Fundação de Amparo à Pesquisa do Estado de Minas Gerais (FAPEMIG); Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES)

(8929 - 1536) Assimilating satellite images and soil spectroscopy to model soil loss to evaluate crop residues removal for bioenergy

Bruna Cristina Gallo[1]; José Alexandre Melo Demattê[2]; Paulo Sergio Graziano Magalhães[3]; Marcus Vinicius Sato[2]; Caio Troula Fongaro[2]; João Luis Nunes Carvalho[4]
University of Campinas and Brazilian Bioethanol Science and Technology Laboratory[1]; University of São Paulo[2]; University of Campinas[3]; Brazilian Bioethanol Science and Technology Laboratory[4]

Mapping soil attributes provides support to agricultural planning and land-use monitoring such as agricultural residues removal. The crop residues has potential of renewable energy and soil and water conservation. However, there are no well-established criteria of agricultural residues removal, and the minimum coverage required to maintain soil integrity. This work aims to model soil loss by assimilating soil spectroscopy data from satellite imagery and establish the straw removal availability for bioenergy proposes. Here, we use Geographic Information System (GIS) to integrate the factors of the Revised Universal Soil Loss Equation (RUSLE) to model soil loss in a site of 515 ha cultivated with sugarcane in Piracicaba, state of São Paulo, Brazil. We estimate rainfall erosivity (R) using a time series data of 20 years, slope length and steepness (L and S) using a digital elevation model. Soil cover management (C) and control practices (P) using the land dynamic cover. Soil erodibility (K) using bare soil technique of multi temporal Landsat TM images based on soil spectroscopy to evaluate models of clay, sand and silt content. We define soil loss tolerance (T) as the potential limiting factor for straw removal, which indicates the maximum rate of soil erosion that can occur and still permit crop productivity to be sustained economically. Landsat images were efficient and suitable for modeling soil surface texture. Clay content prediction present good performance with R^2 of 0.75 and low error. Other attributes prove significant results, such as the positive correlation between sand content and reflectance. We found that the variance of soil loss across the site range from 0.3 to 133 Mg ha^{-1} $year^{-1}$. Here, we considered that T is 12 Mg ha^{-1} $year^{-1}$ as indicated by the literature, thus the potential straw removal that remained above the tolerance limit express 46% of the site. We also considered the average of 14 Mg ha^{-1} of straw availability in the site and an optimal quantity of 7 Mg ha^{-1} of straw that should remain in the field in order to maintain the agronomic and environmental benefits. Hence, the sustainable straw removal available represents 1778 Mg (25% of the straw production), which may provide 1251 MWh of bioelectricity production (15% of straw moisture, and 0.828 MWh per Mg of straw in dry basis). This study provides information based on soil erosion caused by runoff to guide the sustainable decision-making of straw removal for bioenergy production.
Keywords: Soil Integrity; Time-series satellite Images; Soil Reflectance Spectra; Renewable Energy
Financial support: CAPES, FAPESP (processes 2014-22262-0 and 2015 -01587-0)

**(7138 - 3220) A comprehensive multiobjective sampling layout opti-
mization method**

Ziyue Chen[1]
Beijing Normal University[1]

Spatial sampling is one of the most important methods for soil survey and the sampling layout optimization draws a lot of concerns. In soil mapping, multiple variables and purposes are involved and multiple objectives should be optimized simultaneously. Due to the difference on measures, and quantities of objective functions, the implementations of methods that transform multiple objectives into single objectives are limited. In this paper we presented a comprehensive multi-objective sampling layout optimization method, named multi-paths SSA (MP-SSA), by extending the classic SSA method. The MP-SSA method optimizes multi-objective functions of different measures and quantities synchronously, and emphasizes important objective functions over less important ones. The performance of MP-SSA was examined in sampling optimization for concentration mapping and grades mapping of heavy metals in soils which have different requirements on sampling layout. The results suggest that MP-SSA can optimize multi-objective functions of soil mapping synchronously, and samples drawn by MP-SSA can improve the precision of concentration mapping and grade mapping. As a result, the MP-SSA is a promising tool of sampling layout optimization for multi-objective soil mapping.
Keywords: Spatial sampling, multiple objective sampling, soil mapping
Financial support:

(7850 - 2537) Building a spectral library for estimating soil texture in the Santa Catarina State, Brazil

Elisângela Benedet da SILVA[1]; Elvio GIASSON[2]; Alexandre ten CATEN[3]; André Carnieletto DOTTO[4]; José Alexandre M. DEMATTÊ[4]; Milton da VEIGA4[5]
EPAGRI[1]; UFRGS[2]; UFSC[3]; ESALQ[4]; UNOESC[5]

Soil properties characterization is required to inform and lead decision-makers into action. To achieve this goal, it is necessary to develop effective methods to soil measure and monitoring. Several soil databases have been used to build large spectral library for improving and facilitating the use of VIS-NIR-SWIR spectroscopy approach in a collaborative way. In this study, the performance of four multivariate statistical techniques (e.g., Partial least-squares - PLS, Support vector machine - SVM, Random forest - RF, Gaussian process regression - GPR) were compared to evaluated their ability to predict sand, silt and clay content (%) using a regional soil spectral library. A total of 1534 observations were collected throughout the State of Santa Catarina (SC). These observations were used as dataset for the calibration (n = 1151) and validation (n = 383) procedures. Soil spectra was obtained using the FieldSpec 3 (ASD) sensor in the VIS-NIR-SWIR range. The spectra were subjected to seven preprocessing techniques including raw spectra (RAW), first derivative (FD-SG), second derivative (SD-SG), continuum removed reflectance (CR), detrending (DT), normalization by range (NBR) and multiplicative scatter correction (MSC). The ranges of sand (1.0 to 99.0%), silt (0.0 to 83.0%) and clay (0.0 to 77.0 %) content are wide and their coefficients of variation are large, indicating great variability of samples as a result of different soil-forming factors. Our results showed that the best predictive validation models were obtained with FD-SG preprocessing and RF technique for sand content (R^2 = 0.68; RMSE = 11.56%; RPIQ = 2.42) and silt content (R^2 = 0.43; RMSE = 8.51%; RPIQ = 1.52) and with NBR and SVM for clay content (R^2 = 0.78; RMSE = 8.70%; RPIQ = 3.17). The Scott Knott test showed that there was no statistical difference between the RMSE values of PLS, SVM, RF and GPR for each soil property. However, when comparing preprocessing techniques used in this study, RMSE values for sand, silt and clay revealed statistical difference between the SD-SG and the others six preprocessing. The predictive ability of VIS-NIR-SWIR reflectance spectroscopy achieved

for soil texture using a regional soil spectral library was in line with those reported in international literature. On the other hand, SC soil spectral library needs to be improved adding more soil properties as well as partners to contribute in local and regional scale to obtain more soil representativeness.
Keywords: Sand, silt and clay content; reflectance spectroscopy; chemometrics techniques.
Financial support:

(9223 - 2095) Comparative analysis of five digital elevation models: SRTM, ASTER, ALOS-PALSAR, UAV and Laser Scanner

Athos Alves Vieira[1]; Elaine Caliman Sposito[1]; Rafael Gomes Siqueira[1]; Elpídio Inácio Fernandes Filho[1]; Márcio Rocha Francelino[1]
UFV[1]

Digital elevation models (DEMs) and their derivatives has applications in many different studies, especially in models of representation of the Earth's surface, digital mapping of soils and studies from river basins. The potentiality of the different models of DEMs and its application are related to their spatial resolution, which determines the proper scale and area. The choice of a particular DEM depends on the purpose of the work, once its parameters may vary according to the origin of the data. In this study, five DEMs, from different sources (SRTM 90, SRTM 30, Aster, Alos Palsar, unmanned aerial vehicle - UAV and Terrestrial Laser scanner), were generated, compared and confronted with a total of 18 control points obtained by Global Navigation Satellite System – GNSS (L1, L2), in the hydrographic basin of the Equideocultura, in Viçosa – MG (Brazil). It aimed to assist the selection of the most suitable DEM to derive morphometric attributes. DEM acquisitions were performed through freely available data (SRTM, Aster and Alos-Palsar) and field data (UAV and Laser scanner). The mean square error (MSE) was calculated to estimate the accuracy of the images. The values obtained were: 1.10 for SRTM 90; 0.80 for SRTM 30; 0.93 for Aster; 0.27 for Alos Palsar; 0.09 for UAV and 0.01 produced for Laser Scanner. Therefore, DEM generated by the Laser Scanner and the UAV are recommended to detailed scales. However, they require more financial resources and fieldwork, so that the Alos Palsar DEM also representes a suitable option. DEM SRTM 30m resolution and DEM SRTM 90m resolution are suitable in studies that use smaller scales.
Keywords: River basins; precision; mean square error
Financial support: Coordination for the Improvement of Higher Education Personnel (CAPES)

(8419 - 2754) Delineating soil nutrient management zones based on fuzzy clustering optimized by sPCA in a Colombian Oxisol.

Ruby S. Hernández S.[1]; Jaime H. Bernal R.[2]; Edgar J. Salcedo A.[2]; Orlando Arguello T.[2]; Nubia Stella Rodriguez[2]; Lina M. Moreno[2]; Miguel Arango A.[2]; Edwin F. Grisales[1]
National University of Colombia[1]; CORPOICA[2]

Crop management in the high plains of Colombia is based on generalized estimates of soil nutrients concentration, leaving aside the inherent soil variability, leading to low production efficiency and high risk of environment pollution. Delineation of soil nutrient management zones provides basis for variable fertilization technique and is the important link of variable fertilization management actualized in precision agriculture. After the spatial variability characteristics and structure of thirteen soil chemical parameters were analyzed, they were taken as the variables to delineate soil nutrient management zones. The fuzzy clustering algorithm optimized by spatial Principal Component Analysis (sPCA) was used to delineate management zones, and four indices were introduced to ascertain the reasonable number of management zones. According to the calculation, the reasonable number for the study area was 4. As single factor variance analysis was used to analyze soil nutrient data of the practical samples in each management zone, all soil nutrients show great differences among management zones on the confidence level of 87%. Zone 1 had the higher soil fertility and zone 4 had the lower. The delineation result indicated that fuzzy clustering optimized by sPCA had a good performance on delineating management zones and variable fertilization management was feasible in the study area.
Keywords: Precision Agriculture; Oxisol; Fuzzy k-means cluster; Management zone; soil nutrient spatial variability.
Financial support: Ministry of Agriculture and Rural Development (Colombia)

(3610 - 2760) Determination of potential soil management zones from soil electrical conductivity, DEM and yield data in an Oxisol of Colombia

Jaime H. Bernal R.[1]; Miguel Arango A.[1]; Nubia S. Rodriguez[1]; Lina M. Moreno[1]; Orlando Arguello T.[1]; Edgar J. Salcedo A.[1]; Jaime Gomez N.[2]; Yolanda Rubiano S.[3]; Luis J. Martinez[3]; Edwin F. Grisales C.[3]
CORPOICA[1]; CIAT[2]; National University of Colombia[3]

Field-scale characterization of soil spatial variability using remote sensing technology has a great potential for achieving the successful implementation of management zones in precision agriculture. The objectives of this study were to: (i) examine the spatial relationships between apparent soil electrical conductivity (ECa) and soil chemical and physical properties to determine if ECa could be useful to characterize soil properties related to crop productivity in a Colombian´s Oxisol; (ii) evaluate the effects of Digital Elevation Model on ECa mapping as a basis for characterization of soil spatial variability and as a data layer in cluster analysis as a means of delineating sampling zones; (iii) evaluate clustering approaches using different variable sets for management zone delineation to characterize spatial variability in soil nutrient levels and crop yields. Data were obtained in a 37 ha field in the high plains, Colombia, with a sampling grid of 225 points. Spatial measurements of ECa via electromagnetic induction (EMI) were compared with soil chemical and physical parameters using spatial correlation analysis. MULTISPATI-PCA was used to carry out for multivariate spatial analyses of soil attributes and yield data. The fuzzy clustering algorithm optimize by sPAC using sensor-based field attributes including horizontal ECa, DEM data, soil chemical and physical properties, yield data, and their combinations was performed to delineate management zones. Few strong direct correlations were found between ECa and the soil chemical properties studied, but some soil physical properties. The relationships of sensor-based field attributes as clustering variables to group soil test parameters and crop yields improve when the DEM data was included. The clustering data combinations effectively captured the within-zone variability of soil test parameters and crop yield. The results indicate that zones created by cluster analysis could provide a way to group and manage spatial variability of soil nutrients within fields.
Keywords: Precision agriculture; Fuzzy k-means cluster; management zones, spatial variability, DEM
Financial support: Ministry of Agriculture and Rural Development (Colombia)

(5871 - 2275) Determination of the P index for the watershed area of the Marrecas stream using geoprocessing

Joelma Divina Murliki[1]; Élvio Giasson[2]; Elemar Antonino Cassol[2]
PPG Ciência Do Solo UFRGS[1]; Departamento de Solos UFRGS[2]

In the quest to reduce the environmental liability caused by excess nutrients applied, there are no initial studies and development of methodologies to reduce the input of nutrients and simulations as they are transmitted to the system. Among the many nutrients that are applied, P (Phosphorus) stands out, mainly for being one of the responsible for the process of eutrophication. The objective of this work was to use the original P-Index (Phosphorus Index) to identify

areas of P contamination in the Marrecas Stram Watershed, in Caxias do Sul, Brazil. The methodology developed by Lemunyon and Gilbert (1993) was adopted and the parameters used in the original version are P soil content, soil erosion ($t.ha^{-1}.year^{-1}$), erosion by irrigation, ($P_2O_5.ha^{-1}.year^{-1}$), the application methods of mineral P and organic P (kg $P_2O_5.ha^{-1}.year.^{-1}$). The P-Index was obtained considering the transport factors and sources of P distributed in categories and weights based on the impact of this in the transportation of the P in the area. The equation of these parameters was performed using geoprocessing software, where maps of phosphorus content, soil use, soil type, runoff and soil loss were overlaid to generate the results. According to the application of the P-Index, it was verified for the watershed of the Marrecas stream that most of the watershed was classified as having a low risk of P contribution due to the type of land use predominant in the watershed, with extensive livestock farming in the natural pasture. The areas with the greatest potential risk were those in which soils are used more intensively with annual crops and without the adoption of conservation practices or degraded areas. Thus, the application of the P-Index presents a good potential to be used as a tool for the management of water resources, contributing to the identification of areas of risk of diffuse pollution and, thus, making possible the most efficient planning of the actions to be carried out for improvement of the quality of water resources.

Keywords: P-Index, eutrophication, geoprocessing

Financial support: CAPES - Coordenação de Aperfeiçoamento de Pessoal de Nível Superior e CNPq - Conselho Nacional de Desenvolvimento Científico e Tecnológico

(1437 - 2211) Digital elevation based soil mapping method for hilly areas built up of unconsolidated sediment

Károly Kovács[1]; Endre Dobos[1]; Péter Vadnai[1]; Diána R. Bertóti[1]

University of Miskolc[1]

The relative influence of each soil forming factor varies through the geographical landscape. Geomorphology of hilly regions built up of unconsolidated sediments is defined by the physical properties of the deposits. Relief is shaped accordingly the stability and stratigraphic position of the sediments. Thus within the landscape the primary soil forming factor is the parent material, and the geographic distribution of the parent material can be modelled based on the relief. The study site is of the northern piedmont of Bükk mountains (NE Hungary). The geological landscape is set up of Eocene - Miocene piedmont, tidal, alluvial and estuarine sediments, some volcanic tuff from the same age and quaternary colluvium, alluvium and aeolic deposits. The diverse parent materials form soils of different texture from gravel to heavy clay and its amalgamations of different portions. Soils chemical properties vary from extremely calcareous to strongly leached acid pH. The two geological formation characterising an area that covers 300 square kilometres, which can be mapped in high resolution with the elaborated method. The high resolution soil mapping was implemented for growing site assessment purposes to guide local authorities' land use management. The rural area is adjacent to heavy industry, mapping had the purpose of revealing soil contamination too. The 500 hectares' study site was explored by 25 soil pits and another 30 auger samples. Soil samples were analysed for texture, BS, CEC, OM, carbonates, complete available nutrient analysis and 14 toxic elements. All profiles were classified, WRB RSGs and diagnostics defined. Based on field experiences and laboratory data we delineated areas were parent material is certainly homogenous. We used these polygons as training polygons for classification of a layerstack consists of geomorphologic metric raster images derived from DEM. The obtained polygons delineate uniform soil forming environment, they are not soil type units, RSGs are divided by the most important diagnostics. The resulted stratification of the area gives those homogenous soil landscape units in which soil properties vary the least, thus predictions can be made in changes of toxic element, OM or nutrient content, water regime or pH.

Keywords: *DSM, DEM, geomorphological metrics, soil landscape defined soil diagnostic-groups, relief, unconsolidated sediment, soil forming factor,*

Financial support: INNOVÍZ (GINOP 2.3.2-15-2016-00031)

(2481 - 2214) Discriminatory performance of data obtained by unmanned aerial vehicle in soil-plant systems

Filipe Castro Felix[1]; Fabio Arnaldo Pomar Avalos[2]; Wellington de Lima[3]; Wesley Soares de França[4]; Marx Leandro Naves Silva[5]; Ronaldo Luiz Mincato[6]

Federal University of Alfenas, UNIFAL / ICN, Alfenas, 37130000, Brazil (filipecfelix@gmail.com)[1]; Federal University of Lavras, UFLA / DCS, 3720, Lavras, 37200000, Brazil (fa.ingeo@gmail.com)[2]; Federal University of Lavras, UFLA / DCS, 3720, Lavras, 37200000, Brazil (tomdelima@yahoo.com.br)[3]; Federal University of Lavras, UFLA / DCS, 3720, Lavras, 37200000, Brazil (wesley.franca@engagricola.ufla.br)[4]; Federal University of Lavras, UFLA / DCS, 3720, Lavras, 37200000, Brazil (marx@dcs.ufla.br)[5]; Federal University of Alfenas, UNIFAL / ICN, Alfenas, 37130000, Brazil (ronaldomincato@gmail.com)[6]

The soil-plant system represents the interaction of countless physical, chemical and biological soil attributes, which are responsible for the dynamic and complex plants process in the ecosystem. The understanding of these processes enables the rational management of certain soil conditions, can improve plants productivity. Like this, the objective of this study was to check the discriminatory performance of data obtained by an unmanned aerial vehicle (UAV) in relation to these systems. For this, 250 soil samples from the superficial layer (0 to 20 cm) were collected during the 2017's winter, in the municipality of Lavras, Minas Gerais. The collections occurred in five distinct vegetation cover areas that were considered as soil-plant systems. From the samples were analyzed attributes such as texture, organic matter, and soil temperature and soil moisture of the five systems: coffee, eucalyptus, pinus, native forest and cerrado, which were characterized according to indirect ordination by principal component analysis. In the same period, UAV flights were conducted to capture images, in the visible spectrum, of each vegetation cover. Subsequently, several vegetation indexes based in this spectrum were calculated, as well as the generation of a digital surface model. The images in the visible and the digital surface model were segmented to get new variables, based on these segments, like shape index, homogeneity and entropy. The discriminative capacity of the soil-plant systems as retrieved by UAV data was evaluated by linear discriminant analysis. Principal component analysis indicated a high association between vegetation types and soil attributes, which allowed us to consider vegetation type as an indicator of soil condition. The first two discriminant functions distinguished 91.35% of the data among vegetation covers (71.85 and 24.5%), which emphasizes the capability of UAV digital photogrammetry to obtaining and monitoring environmental data. It should be noted that the research is in progress, and our main objective is the seasonal monitoring of the five soil-plant systems, assessing the vegetation indexes and soil variability throughout the years 2017 and 2018.

Keywords: photogrammetry, vegetation index, ecosystem

Financial support: CNPq, FAPEMIG, CAPES

(4714 - 882) Evaluation of agricultural land potentiality for mechanized agriculture in the state of Acre

Glailson Barreto Silva[1]; Alves, Washington Santos.[1]

IBGE[1]

The potentiality of the classes of soils is expressed in the form of

schematic map and percentages represented in the form of cartogram, histograms and pizza graphics, representing the percentage of each class of potential in relation to the area of the State. The studies are based on a map of soils of the RADAMBRASIL Project. Classes were defined as follows: Good, Constrained, Inappropriate. The methodology uses information contained in the map of soils. Potentially similar individuals from the perspective of their potentialities and constraints, expressed by its natural and edaphic characteristics, were divided into three groups according to your suitability for mechanized agriculture: Inappropriate, Regular and Good. Inappropriate: group of soils with severe restrictions to the development of mechanized agriculture, represented by *Gleissolos Tiomórficos*, *Organossolos*, *Neossolos Litólicos*; soils with salic and natric properties; soils with stony, rocky and eroded phases; land types (mangrove soils, rock outcroppings). Regular: group of soils with moderate restrictions for mechanized agriculture, including the *Planossolos* (except the natric ones); *Gleissolos* (except the *Tiomórficos*); *Plintossolos*; *Vertissolos*; *Espodossolos*; *Cambissolos Flúvicos*; *Neossolos* (except *Litólicos*); hydromorphic soils (suborder and large groups); soils with intermediate characteristics or not (subgroups) as the *plínticos*, *planossólicos*, *gleissólicos*, *neofluvissólicos*, *solódicos*, *lépticos* and *salinos*, *líticos*; sandy soil with textural class; soils with gravel and much gravel fractions. Good: group of soils with slight constraints for mechanized agriculture, including classes of soils with texture different of sandy (in whole soil); soils without impediment from a physical point of view (not rocky, not stony, without gravels); deep soils; not hydromorphic soils; other soils that do not comply with the previous groupings. These three groups were crossed with the *topography* resulting in the three land capability classes for mechanized farming, namely: Good: land with soils with minor restrictions, in plan and soft wavy relief; Restricted: land with soils with moderate restrictions, in wavy relief; Inappropriate: land with soils with severe restrictions, at any kind of relief.

Keywords: Keywords: Map and legend of soils, soil and agricultural capability
Financial support: IBGE

(4071 - 1411) Generation of exposed soil composites based on Landsat imagery (1984-2014) for large regions

Uta Heiden[1]; Simone Zepp[2]; Derek Rogge[3]; Marianne Jilge[1]; Julian Zeidler[1]

DLR Oberpfaffenhofen[1]; LMU München[2]; Spectral imaging[3]

Large scale monitoring of soils in high spatial and temporal resolution is crucial to analyse soil development and to detect soil degradation. Nevertheless, monitoring large areas with a high temporal frequency is still a challenge. A promising approach is to use multitemporal Earth Observation data to increase the area of exposed soils that can be observed and to account for the temporary vegetation cover (e.g. agricultural areas). The Soil Composite Mapping Processor (SCMaP) is an operational infrastructure that been developed which makes use of Earth Observation time series imagery to generate reflectance per-pixel composite images suitable for the analyses of the spatial distribution and changes of exposed soils. The objective of this presentation is 1) to test the suitability of the SCMaP methodology across several geographical regions and 2) to present the resulting SCMaP products with an emphasis on large scale exposed soil development. First, the SCMaP was developed primarily for regions that are dominated by agriculture. The different climatic conditions, land use characteristics and agricultural practices of regions across Europe can have an influence on the vegetation index thresholds used within SCMaP to differentiate between exposed soils and other land cover types (e.g. vegetation, urban, water). The influence of climatic conditions in Europe is analysed in the North-South direction representing predominantly a climatic shift and in the East-West direction, where the climatic shift is not as dominant. The results emphasise the transferability of the SCMaP to other regions, and the needs for continental product generation. Second, the different regional products (spectral composites and additional statistical information) are compared by analysing the coverage and development of the exposed soils within the time period 1984-2014 using 5 year composites. It gives a first estimate about the development of intensively used agricultural areas across Europe. Additional statistical information related to soil use and intensity show areas, where soils are especially prone to soil erosion due the duration of exposure in the time period. In future work, the statistical results will be validated against statistical surveys of the specific regions. The composites will undergo an in-depth data quality check to prepare the reflectance composites for more detailed soil parameter analyses. A first validation concept for both product suites will be outlined.

Keywords: soil mapping, Landsat images, composites, large scale, soil development, agricultural areas
Financial support: Spaceborne Imaging Spectroscopy Ground Segment Development

(4506 - 2928) Geo-environments of the southern part of Sempre-Vivas National Park, Espinhaço, Minas Gerais, Brazil

Raphael Wakin de Araujo[1]; Carlos Ernesto Gonçalves Reynaud Schaefer[1]; juliana Costa Baptista Barreto[2]

Universidade Federal de Viçosa[1]; Universidade Federal de Juiz de Fora[2]

The Nacional Park of Sempre-Vivas (PARNA-SV) is located in the Espinhaço Range in the northern of Minas Gerais State, Brazil. The Park was created in December of 2002 as part of the Brazilian policy for conservation and protection of biodiversity, its landscape is essentially built on top of quartzite rocks from the Galho do Miguel Formation (Espinhaço Supergroup). In order to support the resources administration of this protected area, this study has identified, mapped and described the geo-environments, found in the southern sector of the most representative and diverse area of the PARNA-SV. For the mapping process, Rapideye images were used to stratify the geo-environments, considering the characteristics of the soils, the geomorphology and the vegetation type associated with each unit encontered in the field. Fifteen soil profiles, of the most representative soils of southern sector, were collected, described and classified in accordance to the Brazilian Soil Classification System. During the field visits, the identification *in locus* of the mean botanical families, genus and species of each unit were conducted. Fourteen geo-environments were identified and described. The mapping allowed to separate 20 different geo-environments units and its associations. The ecotonal landscape of PARNA-SV shows the coexistence of forests, grasslands and savannas in highland conditions, revealing an important characteristic of this sector of the Espinhaço Range, where the great richness and diversity of plants and environments are controlled by the geomorphology and the influence of the soil aspects. For each geo-environment mapped according to its particularities, an interpretative discussion was elaborated, in order to support the management plan for protection and conservation of PARNA-SV.

Keywords: Espinhaço Range, conservation, ecotonal
Financial support: Universidade Federal de Viçosa, Departamento de Solos e Nutrição de Plantas, FAPEMIG and ICMBio

(8591 - 2528) How to address the lack of soil mapping in the semiarid Chaco, a case in Santiago del Estero, Argentina

Cristina Angueira[1]; Gustavo Cruzate[2]; Eduardo Zamora[3]; Guillermo Olmedo[4]; José Sayago[5]; Manuel Sanchez de la Orden[6]; Isabel Castillejo González[6]

INTA EEA Santiago del Estero, Santiago del Estero, Argentina[1]; INTA-CIRN, Buenos Aires, Argentina[2]; INTA EEA Manfredi, Córdoba,

Argentina[3]; INTA EEA Mendoza, Argentina[4]; Universidad Nacional de Tucumán, INGEMA, Tucumán, Argentina[5]; Universidad de Córdoba, Dept. Ingeniería Gráfica y Geomática, Córdoba, España.[6]

The semiarid Chaco is an ecosystem shared by Bolivia, Paraguay, Bolivia, Brazil and Argentina where land use change from woodland and grassland to commercial agriculture and the social conflicts have been intensive since the beginning of the 21st century. These changes and the lack of reliable soil information at suitable scales a re threatening the sustainable development of the region. In order to reduce the knowledge gap, a geopedologic survey was carried out with the application of a system approach, intense use of geomatic techniques and GIS for the management of generated information. The approach was considered an appropriate due the large area, geomorphology and soil diversity, high demand of soil mapping, limited funding and lack trained staff. The study area of 4,800 km2 (27°30' - 28°35 ' S and 63°45'-64°35' W) is in Santiago del Estero province, Argentina. Data were obtained from maps and reports, remote sensing as SRTM 90 and 30m, satellite images Landsat, CBERS and SAC-C, field observations and laboratory determinations. ArcGis 9.3, Imagine 9.3.1 and SAGA softwares were used. The survey was divided into eleven steps: compilation of background information; digital processing of remote sensing data; general survey of the area; geospatial analysis; elaboration of preliminary cartography; soil profiles description, physical-chemical laboratory data, interpretation and soil classification; control of boundaries of physiographic units; a hierarchical legend of geoforms to define soil landscape relationships; geo-referenced database of soil properties; final geopedological cartography. Map units and geopedologic legend were determined based on the integration of geoforms and soils, knowledge of landscape and soil forming factors, 176 georeferenced soil profiles, and laboratory determinations. Three main landscape units were recognized and the soils associated: (1) a fluvio-eolian Chaco plain including a megafan with Haplustolls and Torripsamments, (2) the Rio Dulce valley with Torripsamments, and (3) the alluvial migratory plain of Río Salado with Torripsamments, Ustifluvents, and Natraqualfs. The used approach helped speed up the soil information collection at appropriate scale for land use planning, and other disciplines as geostatistics, precision agriculture.

Keywords: Geopedology, Soil mapping, Remote sensing, GIS
Financial support: This study was funded by the National Institute for Agricultural Technology (INTA), Argentina.

(7216 - 203) Integrating multitemporal satellite image and laboratory surface spectral data for mapping soil classes using multiple endmember spectral mixture analysis

Raúl Roberto Poppiel[1]; José Alexandre Melo Demattê[2]; Marilusa Pinto Coelho Lacerda[1]; Manuel Pereira de Oliveira Jr[1]; Caio Troula Fongaro[2]; Rodnei Rizzo[3]

FAV/University of Brasilia[1]; ESALQ/University of São Paulo[2]; CENA/University of São Paulo[3]

The Earth is under severe pressure. Long-term projections show that to ensure food security by 2050 (> 9 billion people) current production must increase by 110%. Thus, there is an urgent need to know well and assess the best soils for agriculture. Less than a third of the world has been mapped on a scale of 1:1 M or greater. In Brazil, most states have soil maps at scales of about 1:0.5 M or less. In front of these overview, data obtained by satellite and laboratory spectral sensing can help in the soil mapping and management, although many of the areas are with vegetation, straw or clouds, hindering the use of satellite images. The objective of this work was to digitally map soil classes by means of a multitemporal satellite image (MSI) of bare soil and laboratory surface spectra (SS) from 350 to 2500 nm. In a 143 km^2 study area in the Central Plateau of Brazil (Federal District), 25 soil points in three toposequences were described collecting samples for chemical and physical analyses. The soils were classified up to the 4th categorical level of the Brazilian Soil Classification System (SiBCS). SS from A horizon were registered in aboratory and used for grouping soils with similar attributes by cluster analysis. The average SS (patterns) within each one of ten clusters was calculated and were convoluted for the Landsat bands. These patterns, representative of soils of the studied area, were used to spatialize the soils in unknown locations using the MSI at the 2nd level (suborder). 19 Landsat images were selected from 1984 to 2016; the atmospheric effects were eliminated and data was transformed into surface reflectance to generate the MSI. To obtain the digital soil map (DSM), the MSI was unmixed using convoluted SS and multiple endmember spectral mixture analysis (MESMA). Posteriorly, 80 field validation points (field truths) were used to build the error matrix. The clustered soils were similar, mainly in terms of color, textural class and organic matter content. The SS unmixed 98% and 100% of the MSI (80% of bare soil) with higher than 0.691 and less than 0.025 of average endmember fraction and root mean squared error (RMSE), respectively. This good performance was achieved because the MSI presented only bare soil for modeling. The DSM presented Kappa coefficient of 78%. This work demonstrates the high potential of remote sensing techniques for soil mapping. This strategy is important for mapping large and diverse areas, such as Brazil and Africa.

Keywords: Multitemporal satellite image; soil surface reflectance; MESMA.
Financial support: FAPDF, FAPESP.

(1249 - 2172) Land use and occupation of the urban sub-basins of Ilhéus, State of Bahia, Brazil

Samuel de Amaral Macedo[1]; Pedro Enrico Salamim Fonseca Spanghero[2]

Universidade Estadual de Santa Cruz[1]; Universidade Estadual de Campinas[2]

Researches related to the dynamics of land use and occupation are relevant because they help the elaboration of public policies of territorial planning, because it allows to understand the varied forms of occupation of the territories and how this influence in the natural environment. The objective of this work was to characterize land use and occupation of the urban sub-basins of Ilhéus city, state of Bahia, Brazil. Geoprocessing and Remote Sensing techniques were used in ArcGis 10.2.2 software, which enabled the digital processing of the Landsat 8 image and acquisition of the expected results. Sub-basins 1 has a population of approximately 2,221 inhabitants distributed in 1,021,045 m² (94%) of urbanized area, 10,196 m² (0.9%) of vegetation cover and 52,109 m² (4.1%) of the beach. Sub-basins 2 presents the highest area ratio for vegetation cover, with a total of 134.753 m² (92%) of its area, the other 12,037 m² (8%) are occupied by anthropized areas. Sub-basins 3 is located in the industrial district of Ilhéus city, has 432,578 m² (35%) of anthropized area, 62,106 m² (6%) of urbanized area and 713,140 m² (59%) of vegetation cover. Sub-basins 4 has 2,012 inhabitants for the area of 0.34 km, in which 58% is urbanized area and 42% of vegetation cover. Sub-basins 5 presents 166,056 m² (10%) of urbanized area, 1,484,269 m² (89%) of vegetal cover and 1% (3 083 m²) of maguezal. Sub-basins 6 has 281,696 m² (82%) of urbanized area and 61,014 m² (18%) of vegetal cover. Sub-basins 7 presents 386,927 m² (81%) of urbanized area and 87,240 m² (19%) of vegetal cover. Sub-basins 1, 4, 6 and 7 have larger urban areas and there were greater conflicts of use and occupation, mainly in permanent protection area (riparian forest and top of hill). Sub-basins 2, 3 and 5 have greater vegetation coverage and less environmental conflicts. Geoprocessing and remote sensing techniques are indispensable in studies of this nature. It is hoped that the present study will assist in more detailed surveys of land use and occupation of Ilhéus city urban watersheds.

Keywords: Remote Sensing; Geoprocessing; land use

Financial support: Foundation for Research Support of the State of Bahia

(7591 - 1594) Local-scale soil organic carbon prediction in Southern Brazil

Diego José Gris[1]; Ricardo Simão Diniz Dalmolin[1]; Jean Michel Moura-Bueno[1]; Nicolas Augusto Rosin[1]; João Pedro Moro Flores[1]; Taciara Zborowski Horst[1]

UFSM[1]

Soil is one of the most important carbon (C) reservoirs in the environment. Depending on how it is managed, it can act as a sink or source of C to the atmosphere. In face of the current scenario of climate change, C sequestration in the soil may be one of the ways to reduce the increasing amount of CO2 in the atmosphere. Mapping soil organic carbon (SOC) is fundamental for the development of spatial information that can be used to understand how it is distributed throughout the landscape, enabling more studies that can establish the correct management in order to use soil as a sink for C. Therefore, the objective of this study was to map SOC using a prediction model based on environmental variables. SOC data consisted on 261 samples from 0-5 cm in an area of 940 ha in the Planalto region of Rio Grande do Sul, Brazil. Eleven environmental variables were used as SOC predictors, including a land use map, soil adjusted vegetation index (SAVI) derived from a 30-m Landsat 8 image, and nine terrain attributes derived from a 30-m Topodata digital elevation model: elevation, slope, LS factor, horizontal curvature, vertical curvature, terrain ruggedness index, topographic wetness index, direct insolation and diffuse insolation. SOC content was predicted for the whole area using a Boosted Regression Trees (BRT) model in R environment, adjusting model parameters for the best performance. Model accuracy was evaluated using 10-fold cross validation. SOC content in the area varied from 1.74 to 5.64 %, with the highest values in low and poorly-drained parts of the landscape and lowest values in more elevated areas where annual crops are grown. The BRT model was able to predict SOC content with moderate accuracy (R2 = 0.68, RMSE = 0.63 %, RPIQ = 1.64) and was used to produce a 30-m resolution map of SOC over the area for the 0-5 cm layer. Diffuse insolation, land use and slope were the most important variables used by the model to predict SOC content. The SOC map produced in this study might be useful for future studies that demand SOC information in this area. The procedure used to develop this study can be applied to other similar areas to produce prediction models for SOC, considering the satisfactory results achieved.

Keywords: Digital soil mapping; boosted regression trees; environmental variables.

Financial support: Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq)

(3016 - 355) Mapping of native mate herbs in the northern plateuau of santa catarina state using gis and remote sensing techniques.

Ludmila Nascimento Machado[1]; Arcângelo Loss[1]; Denilson Dortzbach[2]; Ivan Luiz Zilli Bacic[2]

Universidade Federal de Santa Catarina - UFSC[1]; Empresa de Pesquisa Agropecuária e Extensão Rural de Santa Catarina - Epagri[2]

The Northern Plateau of Santa Catarina State (PNC) is one of the main producing regions of mate herb in Brazil. It is also one of the few regions of the country with significant native production, that is, yerba mate produced in the forest. According to the Brazilian Institute of Geography and Statistics (IBGE), while in 2010 just about 34.83% of the Brazilian yerba mate was produced in native forests, in PNC the production derived from native herbs was responsible for 89.76% of the total production. The yerba mate produced in native forest, is currently more valued than those of planted herbs, because it has a softer flavor. Usually it presents an overprice of up to 30%, thus, the product of the region has been disputed by mate industries from the south of the country and even from abroad. Important tools have been used to map the areas where mate is produced, with emphasis on GIS and remote sensing techniques. These mappings are of extreme importance for environmental planning and control, since improper use can have negative consequences on the environment and even reduce productivity. Thus, the objective of this work was to identify, classify and quantify land use and cover in PNC, with emphasis on native mate, in a total area of 1202486.2126 hectares. For this purpose, the China-Brazil satellite images Cbers-4 were used, whose spatial resolution is 5m (panchromatic).For this mapping, the images were processed in the ArcGis 10.0 software and the identification of these areas was performed by automatic interpretation in the Erdas software, with subsequent visual analysis of the images using RGB colored compositions with different bands. The results showed that 44% of the PNC area is covered by natural forest, 18% with forestry (pinnus and eucalyptus), 21% occupied with agriculture, 14% with field / pasture, 1% water body, 1% floodplain and 1 % urbanized area. Thus, it was evident that native mate can be an important stimulus for the conservation of the Mixed Ombrophilous Forest that predominates in the PNC due to its occurrence in the sub-forest and its significant economic value, which gives value to "standing" forest, contributing to the conservation of forests through traditional management of these native mate herbs. It is worth to notice that in addition to monetary value, native mate herb have a high cultural significance for local populations.

Keywords: Keywords: Ilex Paraguariensis, mixed ombrophilous forest, geographic information system, land use and cover.

Financial support: Financial Support: Epagri/MAPA n°263642/2011

(5441 - 2606) Multi-temporal relationship between soil moisture in the root zone in *Coffea arabica* (L.) and the plant vigor obtained by images of UAV

Diego Armando Amaro da Silva[1]; Geraldo César de Oliveira[1]; Marx Leandro Naves Silva[1]; Wellington de Lima[1]; Fabio Arnaldo Pomar Avalos[1]

Universidade Federal de Lavras[1]

Brazil is the largest producer and exporter of coffee beans in the world, with the south and center-west of Minas Gerais accounting for 31% of total production. However, the lack of water at crucial moments, together with the acidic soils of the Brazilian Cerrado has been shown to be the major limiting factor of the coffee crop. In this context, this work will aim to verify the relationship between soil profile moisture (up to 80 cm) and vegetative vigor (accessed by UAV images), measured by different vegetation indices of the visible spectrum (RGB), to identify the effective depth of water absorption by the plants, thus to evaluate the plant vigor response time for moisture at different soil depths. The experiment is located in the municipality of Nazareno, MG, Brazil (7º14'2 "S, 44º33'14" W), with an average altitude of between 960 and 1,060 m, and climate Cwa (tropical of altitude), with average rainfall of 1,200 to 1,500 mm year^{-1} and average temperature between 18 and 19 ºC. The dominant vegetation of the site is a transition between Semideciduous Seasonal Forests and Cerrado biome. The experiment site has 1,920 m^2 (24 x 80 m), and belongs to the commercial area of the farm Frade. The soil was classified as a Cambissolo Háplico latossólico of clay-loamy texture for horizons A and B, with wavy topography and maximum slope of 12%. For the monitoring of soil moisture, TDR EC - 5 ECH2O sensors were installed, the readings of which will be stored in the data logger Em5b, both of the company DECAGON DEVICES ®, providing soil moisture values stored every 60 minutes. The sensors were fixed at depths of 35-40 cm, 55-60 cm, 75-80 cm, corresponding to furrow aperture depths, or three sensors around each point. The points are represented by the central plant of the line crop of each treatment,

that will be arranged forming a gride, with distances assimarated between the points. The DJI Phantom 2 Vision + quadricopter UAV will be used to collect a set of aerial images at three flight altitudes (30, 60 and 90 m) on the coffee crop, coupled with a Phantom Vision FC200 camera (resolution 4384 x 2466 cells, and 5 mm focal length) with the aid of the GPS and its waypoint navigation system, and subsequently vegetation indices using the RGB bands using ArcGIS 10.2 ®. It is expected that with this work it will be possible to define the most important root depths for water and nutrient absorption by the coffee tree, giving greater support to the regional coffee grower.

Keywords: Precision agriculture, Unmanned aerial vehicle, aerial images, water, site-specific management.

Financial support: CAPES - Coordenação de Aperfeiçoamento de Pessoal de Nível Superior

(9468 - 987) Open soil surface dynamics as a factor for efficient soil mapping based on remote sensing data

Prudnikova E.Yu.[1]; Savin I.Yu.[1]

Soil Science Institute[1]

Open surface of arable soils significantly changes during the warm season of the year. These changes occur mainly due to the influence of meteorological conditions and agricultural practices. Three-year field observations and one-year model experiment confirmed that during the vegetation season soil surface follows the same stages of transformation. From one agricultural practice to another the surface smoothing takes place, soil clods are destroyed by the agricultural machines and/or rain, in-between surface drying results in the formation of the crust separated by cracks. This process is accompanied by the accumulation of water-stable components (water-stable humus aggregates, washed sand grains or the combination of both) on the crust surface. If heavy rain interferes, the transformation cycle starts again. During this cycle spectral reflectance of the surface changes as the relative contribution of properties affecting it alters. Thus, it was founded that the spectral reflectance of the crust determined mainly by the amount and mineralogical composition of silt fraction differs from the reflectance of untransformed surface which highly depends on organic matter content. Significant differences were observed between spectral reflectance of water-stable components and mixed soil samples. Besides, the effect of sand grains on the general spectral reflectance of the open soil surface is lower than the contribution of water-stable humus aggregates. So, the spectral curve becomes more informative for the estimation of soil properties as the masking effect of organic matter decreases and the contribution of clay and silt fractions, and mineralogical composition of soil to its spectral reflectance increases. Determined in the research parts of the spectrum where the surface dynamics influence is more pronounced can be used for the development of soil surface dynamics model. The application of this model in the digital mapping of soil properties with satellite data can increase the accuracy and ensure the reliability of obtained maps. For these purposes, spectral libraries have to be created for open soil surface instead of libraries of soil samples spectrum acquired in laboratories. Additionally, as the impact of surface transformation on the relationship between spectral reflectance and soil properties varies, the possibilities of the application of the dynamics model and the accuracy of modelling results will also depend on the estimated soil characteristics.

Keywords: *spectral reflectance, soil surface, remote sensing, digital soil mapping*

Financial support: RFBR grant N 18-016-00052

(2409 - 1936) Predicting soil organic carbon content in farmland using Fourier transform decomposed variables

Lin Yang[1]; Min Song[2]

Nanjing University[1]; [2]

Mapping the spatial distribution of soil organic carbon has been of great interest. Most of the current soil organic carbon mapping employs natural environmental covariates. However, human activities have become an important impacting factor for soil organic carbon, especially for agricultural soils. Crop rotation impacts the amount and spatial variation of soil organic carbon, but has not been considered for mapping soil organic carbon in farmlands. In this study, we generated environmental variables indicating crop rotation using Fourier transform on HJ-1A/1B NDVI time series data, and explored the effectiveness of crop rotation type and the Fourier decomposed variables in predicting topsoil organic carbon content in farmland of a study area in Anhui province, China. Four main crop rotations were obtained through field investigation in 2010, and 68 samples were collected. One-way analysis of variance (ANOVA) for topsoil organic carbon content in the four crop rotation groups was performed. Importance of 36 environmental variables including parent lithology, climate, terrain, NDVI, crop rotation type, seven Fourier decomposed components were calculated by Random Forest. Different combinations of environmental variables were developed according to the variable importance for predicting topsoil organic carbon content using Random Forest. A cross validation was conducted to evaluate the prediction accuracies. The results showed that crop rotation types had significant impacts on topsoil organic carbon content. Crop rotation type, the 2nd harmonic amplitude and the 3rd harmonic phase are among the most important environmental variables for topsoil SOC in our study, and are more important than single NDVI time series image. Adding crop rotation information into the natural environmental variables improved the SOC prediction accuracy. Using the three variables indicating crop rotation obtained a similar accuracy with using only those important natural environmental variables, which shows the strong prediction power of crop rotation information. This study demonstrates the usefulness of human activities in digital soil mapping and thus indicates the necessity for human activity factors in digital soil mapping studies.

Keywords: Digital soil mapping; Soil organic carbon content; Human activity factor; Crop rotation; Fourier transform

Financial support:

(1257 - 1066) Quantifying forfeited wheat yield due to soil sodicity in high, moderate and low rainfall conditions in the northern grains region of Australia

Yunru Lai[1]; Matthew Pringle[2]; Peter Kopittke[1]; Neal Menzies[1]; Thomas Orton[3]; Yash Dang[1]

The University of Queensland[1]; Queensland Department of Environment and Science[2]; The University of Queensland & Queensland Department of Environment and Science[3]

Soil sodicity is a major constraint to wheat production in Australia. Obtaining an estimate of the impact of sodicity on wheat has historically been difficult due to the interactions of climate, management and disease. In this study, we have estimated the forfeited wheat yield due to sodicity in the northern grain-growing region of Australia (referred to herein as “NGR”). We considered three different approaches for estimation: (i) “calculate-then-model”; (ii) “model-then-calculate”; and, (iii) “no-interpolation”. In (i) we used an empirical yield-prediction model (linking Landsat satellite imagery to limited yield-monitored data) to estimate wheat yield over 17 years (2000-2016) at available soil-sample locations. The predicted yield was then used as the response variable, to model yield as a function of soil properties, climate, and farm-management practices. We estimated the potential yield at each data location assuming improved sodicity conditions and different rainfall scenarios. The forfeited yield at soil-sample locations was derived and subsequently interpolated across the study region. In approach (ii) we used the same yield-prediction model to first estimate wheat yield for NGR. We regarded consistently low yielding regions as limited by soil constraints. The

sodicity-related soil attributes were interpolated to the same raster grid as yield. Foregone yield was then estimated by comparing the yield and soil properties of the constrained areas to those of the unconstrained areas. Approach (iii) served as a quality-assurance by pairing actual yield-monitored data with soil data at sample locations, to investigate the direct impact of sodicity on wheat yield. This approach, however, is limited by the number of locations, where both yield-monitored data and soil samples were available. We compared the three approaches to determine if they were in reasonable agreement, and if the methods gave fair assessments of uncertainty. The simplicity of (i) means that it might be favoured when a large number of soil samples with multiple sodicity-related attributes are available. However, when the sample locations containing all the relevant attributes are limited, yet the total number of soil samples is large, then (ii) may be a useful alternative. This is particularly helpful when financial constraints do not allow collection of new soil samples, but data from past soil-sampling campaigns are available.
Keywords: sodicity, yield gap, NDVI, precision agriculture
Financial support: the Grains Research & Development Corporation; the Australian Government Research Training Program

(7149 - 2865) Reflectance spectroscopy applied to identification of pedological attributes: Chernosols of the Bahian semi-arid in question

Deorgia Tayane Mendes de Souza[1]; Gustavo de M. M. Baptista[1]; Washington de Jesus Sant'Anna da Franca Rocha2[2]
UnB[1]; UEFS[2]

The study of soils associated with analytical techniques enhances the rational management and the forms of adequate appropriation for this feature. Being an object of study of high complexity, since it involves several natural systems in its formation, this approach constitutes a technological challenge. Within the instrumental alternatives, reflectance spectroscopy applied to soil science has been reaching prominence among the researchers for producing accurate analyzes at low cost and with high potential of identification of pedological attributes. Soils, depending on their composition, have varied spectral responses and each target has a distinct spectral signature. The chernosols present peculiar attributes that determine their classification: the horizon A Chernozemic and / or incipient B with predominance of organic matter and a carbonic or calcium C horizon, are characteristics that can be identified by reflectance spectroscopy. The present work aims to analyze the spectral responses of Chernosols with different source materials and to evaluate the capacity of separation by pedological attributes using multivariate analysis. Three profiles were described in the field located in the municipalities of Juazeiro, Curaçá and Angico, state of Bahia / Brazil, where the semi - arid climate predominates. The spectral curves of the profiles in the C horizon in the SWIR range showed spectral similarity, due to the predominance of calcite in the samples. The horizons A and Bi of the Juazeiro profile exhibit a concentration of the organic matter, and the absorption of minerals 2: 1 can be identified in the VNIR range and in the SWIR range. However, the profiles of Curaçá and Angico emphasize a greater depth of feature in the VNIR range due to the concentration of iron oxides. It was applied a principal component analysis - ACP, using 15 reflectance bands of 125nm in width, covering the range of 400 to 2400nm. The results of the ACPs were satisfactory since occurred a clustering of the horizons C of all profiles, a separation between the horizons A due to the presence of organic matter and a grouping between the horizons A and Bi between the profiles, being able to affirm that the ACPs separated the spectra by mineralogy and by profiles.
Keywords: Remote sensing, semiarid, Chernosol
Financial support: Capes, UnB, UEFS

(3570 - 637) Soil Conditioners in Land Use and Land Cover in the Lagoa Formosa county, Minas Gerais, Brazil

Ligia Faria Tavares de Souza[1]; Liovando Marciano da Costa[1]; Elpídio Inácio Fernandes Filho[1]
Universidade Federal de Viçosa[1]

Lagoa Formosa county has three soil classes directly correlated to the pattern of land use and land cover. This study aims to show this influence crossing information from soil map obtained from IBGE and land use and land cover map generated with Random Forest algorithm in the R software. Pasture is the most expressive land use in the region, responsible for 53.7% of the total area. Agriculture occupies 33.13%, 8.05% is composed of riparian forests and 3.40% shows exposed soil. The remainder corresponds to lakes and urban area. From the soil classes, we have Red Latosols corresponding to 48.48% of the county area, followed by Haplic Cambisols with 27.30%, and Litholic Neosols occupy 24. Red-Yellow Latosols correspond to the remaining 0.22% but it is irrelevant to explain land use patterns in the area. Pasture and agriculture are in almost 90% of the total area of Red Latosols, where 21.51% is cultivated. Pasture prevails because of relief conditions. From the total of exposed soil in the county, only 0.76% are in Latosol area. These deep soils developed over Tertiary and Quaternary deposits in plain terrain, which explains its depth, water storage capacity and vegetation development. In Cambisols area, 60% correspond to pasture. Again, the relief associated with this soil explains the predominance of this land use. The exposed soil area is bigger on those soils, corresponding to 1.07%, and it is a consequence of the most common land use. Exposed soil in Neosols occupies 1.57% of the area of the county. Vegetation on this soil is underdeveloped due to its small depth. This is related to the mudstone deposited horizontally, making water infiltration difficult and, therefore, slows pedogenesis. We can conclude that Latosols are primarily used for agriculture, and Cambisols and Neosols are used for pasture. Erosion prevails in Neosols as a result of the steep relief and small depth of those soils. Latosols developed in plain areas less disturbed by geological events, such as the magmatism in the Cretaceous. The Cambisols are on the edge of the relief and its structure is friable and less resistant to erosion. Neosols also show less resistance to erosion due to the lack of development of those soils.
Keywords: R software; geology; erosion
Financial support:

(1570 - 1609) Soil use in the hydrografic basin of Ribeirão Jataizinho, PR and implications for erosion processes.

Rosana Kostecki de Lima[1]; Pedro Rodolfo Siqueira Vendrame[2]; Fernanda Leite Ribeiro[2]; William Renan Piva dos Santos[3]; Rafael Calore Nardini[2]
Universdade Estadual de Londrina[1]; Universidade Estadual de Londrina[2]; Universidade Federal do Paraná-Setor Palotina[3]

The hydrografic basin of Ribeirão Jataizinho is located in the north of Paraná State of, southern Brazil. Its area is approximately 11,138.14 hectares (or 111.38 km²), comprised between the geographical coordinates 23º 14 '00' 'at 23º 20' 00 '' latitude S, and 51º 01 '27 "' at 50º 50 ' 00 "W longitude. The basin is inserted in an area of intense agricultural activity. There are numerous problems related to environmental degradation, including the intensive and inadequate use of the soil by agriculture, removal of native forest for livestock activities in inappropriate areas, that cause the acceleration of erosion processes and consequently the silting of rivers . The objective of this work was to identify and measure current land use, as well as to form a database to serve as a diagnostic tool for the hydrografic basin of Ribeirão Jataizinho. The Geographic Information System- IDRISI Selva, to distinguish land use through the unsupervised Isoclust classification from satellite images provided by INPE with the support of Google Earth for the visual interpretation of vegetation cover areas. Also used were images of the LANDSAT 5 satellite, 2011 pass and IBGE

topographic charts. The classes identified were native forest (16.5 km²), temporary crop (64.64 km^2), pasture (18.06 km^2) urban mesh (2.14 km^2), reforestation (0.4 km^2) fruticulture (2,0km^2), lakes, dams and related (0.12 km^2). It was observed that 64% of the total area of the basin is used for temporary crops, often associated with the intensive and degrading use of the soil. Regarding the soil classes, it was possible to identify the presence of Neossolo Regolítico eutrófico, Nitossolo Vermelho eutroférrico, Latossolo Vermelho eutroférrico, e Gleissolo Háplico (Bhering & Santos, 2008). The presence of less developed soil classes (Neosols) and hydromorphs (Gleissolos) suggest caution in the use of these soils for temporary crops. In this way, it is concluded that the studied basin deserves attention in relation to the use of the soils and the information to the producers is of paramount importance to mitigate the degradation of those soils and other environmental damages.

Keywords: Land use, hydrografic basin, conservation.
Financial support: CNPq, Edital Universal 2014.

(3358 - 254) Spatial relationship between soybean crop and soil properties in a Colombian oxisol

Sergio Tovar-Hernandez[1]; Loren J. Sanchez-Cuesta[1]; Mauricio Castro-Franco[2]
Grupo de Investigación en Agricultura de Precisión, Ingeniería Agronómica, Universidad de los Llanos[1]; Consejo Nacional de Investigaciones Científicas y Técnicas CONICET[2]

Determine the variability of the soil within agriculture fields facilitates the implementation of site-specific management of agricultural inputs. In this report two hypotheses were tested: (*i)* the spatial variability of soil properties within agriculture fields in a Colombian Oxisols determines the spatial yield pattern in soybean crop and (*ii)* digital soil mapping (DSM) techniques allow the delimitation of potentials zones for precision agriculture. The study was carried out in three agricultural fields located in Puerto Gaitan, Meta (Lat: 4°19'; Lon: -71°58') from January to August 2016. The soil is a typical Oxisol with high acid levels and low organic matter contents. The terrain is flat with maximum slope of 3-4%. DSM techniques were applied through soil spectral indices based on a satellite image Sentinel 2A. The used indices were: (i) Clay-Mineral Rate (CMR), (ii) Iron-Mineral Rate (IMR) and (iii) Iron-Oxides Rate (IOR) to delimitate zones. A sampling scheme of 40 subsampled at 0-30 and 30-50 cm depth were implemented using conditioned Latin hypercube (cLH) within each field. Texture, CEC, pH, OC, N, P, K, Mg, Ca, Al and Na were determined. Also, Interception of radiation (IR), Leaf Area Index (LAI), Dry Matter x m^{-2} (DM), Number of nodules x m^{-2} (NN), Weight of nodules x m^{-2} (WN), Numbers of grains x m^{-2} (NG) Weight of grains Weight x m^{-2} (WG) were measured during V6, R2, R6 and R8 phenology stages. A classification of importance of soil properties was established using Random Forest. Finally, the zone delimitation was validating by soil type for soil properties and soybean yield components using a mixed lineal model. The results suggest that the soil spectral indices capture a high variability in each field. Adjacent fields do not present similar spatial patterns. cLH was effective to capture the spatial variability and distribution of all spectral indices. Crop properties such as WN and NN were highly influenced by N and OC. Chemical soil properties such as Al, CEC and pH had more importance for NG, WG and DM. IMR was more effective to determine spatial patterns of soil properties. IMR present proportionally inverse spatial relations with IOR. Two results could stand out: (*i)* there is a considerable vertical and horizontal variability of chemical and physical soil properties between fields and depth and (*ii*) our results support the implementation of zones to apply a variable management of lime amendments and soybean crop fertilization.

Keywords: Management zones, oxisols, soil mapping, spatial variability, spectral indices
Financial support: Universidad de los Llanos Project C01-F01-016-2016. "Spatial relationship between soybean crop and soil properties in a Colombian oxisol"

(6002 - 2882) Spatio-temporal Land Use Dynamics and Soil Organic Carbon in Swiss Agroecosystems

Felix Stumpf[1]; Armin Keller[1]; Karsten Schmidt[2]; Andreas Mayr[3]; Andreas Gubler[1]; Michael Schaepman[4]
Agroscope - Swiss Soil Monitoring Network[1]; University of Tuebingen, Germany[2]; University of Innsbruck, Austria[3]; University of Zuerich, Switzerland[4]

Land use change strongly affects soil organic carbon (SOC), which is a critical driving force for soil quality and soil services. However, the influence of detailed land use dynamics on SOC remains an active research field. We investigated the impact of long-term grass-/cropland conversion dynamics on SOC for the Swiss agroecosystem (8`500 km^2). In Switzerland multi-temporal SOC observations are sparse, while the spatio-temporal resolution of available land use data is inadequate to capture small structured and dynamic land use. Thus, we stratified one-time SOC observations of two periods ($n_{1995-1999}$ = 1096; $n_{2011-2015}$ = 502) into typical land use classes of grass-/cropland conversion regimes to analyze states and trends of SOC. First, based on spectral imagery and auxiliary variables, we established a Random Forest classifier to detect annual grass-/cropland distributions in a spatial resolution of 30 x 30 m for 2000 to 2015. Second, we used the annual land use maps to derive classes of typical land use dynamics based on a pattern description of conversion regimes. Third, we comparatively assessed the SOC covariate importance (IMP) and SOC sample representation of land use dynamics using terrain and climate covariates. Subsequently, we statistically analyzed SOC across land use dynamics and two periods. The land use classifier shows an Overall Accuracy of 86%, while the annual land use maps deviate by 6%-11% from census data. 46% of the farmland underlies frequent grass-/cropland conversions. The SOC covariate importance of land use dynamics is increased by at least 2.4 times compared to the SOC covariates. The SOC observations consistently represent land use dynamics across SOC covariates. In both periods, SOC increased as the grassland share within the land use regimes increased. The mean SOC for permanent grasslands is 35 g kg^{-1} and 17 g kg^{-1} for permanent croplands. Areas of land use conversions where grassland is dominant show increased SOC (29-30 g kg^{-1}) compared to areas where cropland was dominant (23-25 g kg^{-1}). The mean differences of SOC between the periods and classes are statistically not significant except for permanent cropland, for which the SOC is decreased by 5.2 g kg^{-1}.

Keywords: Soil Organic Carbon, Land Use Dynamics, Grassland, Cropland
Financial support: National Research Program 68; Project number: 406840-161896

(9777 - 296) Spectral attributes selection based on data mining for bare soil detection in remote sensing images

Marilusa Pinto Coelho Lacerda[1]; Raul Roberto Poppiel[1]; José Alexandre Melo Demattê[2]
University of Brasilia[1]; University of São Paulo[2]

The soils, as the main source of energy that supports earth life, are considered a non-renewable and increasingly scarce resource. Rapid population development and growth and mismanagement overburden soil capacity resulting in their degradation. To conserve of soils, they needs to be known and mapped, at an appropriate scale, to guide public policies, management and planning. Therefore, it is

necessary to develop technologies that provide quality information fast at low cost. The objective of this work was to define a methodology of data mining (DM) using decision tree in WEKA program for bare soil (BS) detection in remote sensing images, aiming at aiding the digital soil mapping (DSM). An image acquired on August 22, 2016, by OLI on Landsat 8 satellite, orbit 221 point 71, over the Cerrado (brazilian savanna) region, was transformed to surface reflectance. In addition to the seven OLI bands, images were highlighted by calculation of spectral indexes (NDVI, EVI and MIDII), differences between bands (3-2 and 4-3), Principal Component Analysis (PCA) and spectral mixing models (MESMA) in ENVI program. From a representative area of the image, samples of defined classes were collected and imported into WEKA for DM. The J48 was the most promising WEKA algorithm tested, since it yielded a decision tree with high Kappa (99%) and structure compatible with ENVI. These rules (threshold values) were extracted and applied (extrapolated) in the complete scene, using the ENVI decision tree classifier. From this classified image, were masked out all objects distinct to soil for obtaining the BS satellite image. For the set conditions, were selected by J48 algorithm to separate BS from other objects the next spectral attributes: OLI bands 1, 3, 5, 6 and 7, PCA1, difference between bands (3-2), NDVI, EVI and MIDII. This resulted in a decision tree trained by 14 specific rules for BS detection in ENVI. The final image yielded 30.8% of BS areas, whose spectra and soil line were in agreement with the standards of bibliographies. In this way, the use of DM improved time spent by eliminating subjectivity in the decision rules implementation, commonly generated by the analyst's knowledge. The proposed method showed good separation between BS and other objects in the image, improving its quality in terms of the representativeness of BS, when compared to other techniques. Thus, DM can be used as a powerful tool in DSM.

Keywords: data mining; decision three; bare soil satellite image.
Financial support: FAPDF

(1452 - 617) Strategies on Pedological Mapping: from traditional to digital

Fellipe Alcantara de Oliveira Mello[1]; José Alexandre Mello Demattê[1]; Caio Troula Fongaro[1]; José Lucas Safanelli[1]; Wanderson Souza Mendes[1]

Escola Superior de Agricultura Luiz de Queiroz - USP/ESALQ[1]

Soil maps have been more required as the need for agriculture improvement and environmental conservation increases. Assuming that a high detailed soil map is a difficult and expensive product to construct, technology took on the role of providing information to identify soil characteristics. In the last decade, the main goal of pedology was to use these technology advances to make the best soil map. Soil science has been developing strategies to achieve a better way to identify soil attributes since there is not many high detailed soil maps in the world. This work aims to create and present some strategies, since traditional until digital, to reach a high detail soil map. The study area is located in the state of São Paulo, Brazil (2500 ha) and six parent materials. Through geoprocessing, we obtained the drainage patterns, geological map, elevation model, bare soil satellite image and a geomorphometric map. We performed several soil maps with different techniques for comparison as follows (S=strategies). Using a legacy map constructed by traditional technique, the S1 (1:10.000) and S2 (1:50.000) were used as base validation. A detailed drainage network using stereo pair orthophotos with digital 3D visualization served as basis to an empirical/tacit mapping method on photopedology (S3). S4 map was based on bare soil satellite image. S5 was constructed from geomorphometric information. S6 used relief models to identify soils and S7 overlapped all of them and reached a unique soil map. We evaluated the number of polygons related with soil mapping units to identify witch one indicated the best delineation and umber of soil units. The S1 and S2 maps were used as base for validation. S3 reached the higher number of polygons. S4 indicated less number, but created polygons on places not indicated in S3. S5 created an extremely high number of polygons, but not related with soil map units. S6 presented a relatively important number of polygons and similar to S3. S7 reached the best map. Indeed, photopedology indicated polygons where could not see differences on colors due to vegetation. At this moment, bare soil image gave its assistance as also indicated the quantified soil texture. Relief gave more strength while complemented variation on relief not detected by photopedology. Thus, the best technique is to integrate all information related with every information from field, since relief until color, shapes and features.

Keywords: aerial photograph, soil sensing, remote sensing, soil survey, landscape
Financial support: Fundação de Amparo a Pesquisa do Estado de São Paulo – FAPESP

(8045 - 858) Surface soil moisture: point measurements, tower and satellite – voyage through the scales

Mateusz Lukowski[1]; Radoslaw Szlazak[1]; Lukasz Gluba[1]; Edyta Rojek[1]; Jan Slominski[2]; Jerzy Usowicz[3]; Boguslaw Usowicz[1]

Institute of Agrophysics, Polish Academy of Sciences, Lublin, Poland[1]; Space Research Centre, Polish Academy of Sciences, Warsaw, Poland[2]; Torun Centre of Astronomy of the Nicolaus Copernicus University, Poland[3]

The water contained in the soil is one of the most important components of the environment. Without it, any growth or development of plants would be impossible. Water in soil affects the dynamics of the energy and mass transfer for a very wide range of spatial and temporal scales. The measure that quantifies water content is called soil moisture. In this study, the examined test-site was Bubnow wetland in Poland (Europe), chosen due to its nearly undisturbed hydrological conditions and importance of wetlands in climate change issues. Soil moisture data from three sources, covering almost 2 years, were investigated. Starting from point-scale, the soil moisture has been measured using hand-held TDR devices and then extrapolated via geostatistical methods. To catch the broader context, the ELBARA (European Space Agency L-band Radiometer), mounted on a 6.5-meters-high tower was used. ELBARA measures brightness temperatures at 1.4 GHz, the frequency that is sensitive to the presence of water and may be transformed into the soil moisture using L-MEB model. In order to proceed with an increase in scale size and find which land-cover type on Bubnow may be treated as representative for the entire area, the brightness temperatures measured by ELBARA were compared with Soil Moisture and Ocean Salinity (SMOS) satellite. Despite the difference between single ELBARA footprint area (25 m^2) and SMOS DGG pixel (approx. 200 km^2) is huge, the comparison of the time-series shown some important relations. Firstly, it turned out, that only a few footprints decreased in brightness temperatures after rain, what is characteristic for strong precipitation interception effects. Analyses revealed that the lowest ELBARA-SMOS agreement is for the cultivated field, which may be caused by modification of this area through plant cultivation, mowing and ploughing. Wetland, which according to the literature is often problematic land-cover, also in the Bubnow case shows only a partial agreement. On the meadow, the best ELBARA-SMOS match is observed, what may be interpreted as a consequence of meadow-agricultural land cover domination in the examined SMOS pixel. The general conclusion is that the soil moisture moderately influence measured brightness temperatures, which are also governed by many other factors. Nevertheless, even locally it was possible to specify a representative land-cover for the whole region corresponding to the SMOS map pixel.

Keywords: *soil moisture, remote sensing, SMOS, ELBARA, Bubnow*
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BIOSTRATEG R&D programme: Water in soil - satellite monitoring and improving the retention using biochar No. BIOSTRATEG3/345940/7/NCBR/2017

(2745 - 2784) Temporal and spatial expression of water deficit evaluated through SPI and SPEI indices in mediterranean central Chile

Elizabeth Ramírez[1]; Mauricio Galleguillos[2]; Oscar Seguel[1]

Universidad de Chile, Facultad de Ciencias Agronómicas[1]; Universidad de Chile, Facultad de Ciencias Agronómicas. Centro de Estudios del Clima y la Resiliencia CR2[2]

Considering the effect of climatic change on potential crop production, in this study we evaluated the water deficit in four Communes of Central Chile (1700 km2 in O'Higgins Region, ≈500 mm precipitation and 7-8 dry months in summer), using two dryness indices: SPI and SPEI, based on the temporal distribution of precipitation and precipitation+potential evapotranspiration, respectively. The indices were calculated (each 3 and 12 months) from CHIRPS and MODIS satellital products, and validated with meteorological stations databases, using the period of 1985-2015 and 2000-2015 for SPI and SPEI, respectively. Then we calculated for both indices the magnitude of drought events and the sensibility; finally the results were separated according to soil cover and soil properties. Both indices are useful to understand the climatic variability of the study site, with the maximum dryness in 1999-2000 season (SPI ≈ 4.0). The validation was carried out through the Pearson correlation coefficient (r), shown better results when 12 months analysis are performed compared to 3 months analysis, and the higher spatial sensibility was found with SPEI index. High variability and no differences between annual and perennial crops were found, but forest plantations shown a high stability in time, while bare soil shown the lowest indices of dryness. SPI index was sensible to soil properties, with the highest dryness magnitude in shallows soils and lowest dryness magnitude as the clay content increased; SPEI was no sensible to soil properties. In the future, we will continue monitoring the dryness indices in a higher surface, looking for a better spatial sensibility for soil cover depending on new soil attributes.

Keywords: Water deficit, SPEI, SPI

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(4854 - 713) The use of the spiking methodology for the improvement of global prediction models for total aluminium, iron and silica contenent in soils from Paraná State

Aline de Carvallho Gasparotto[1]; Marcos Rafael Nanni[1]; Everson Cezar[1]; Franciele Romagnoli[1]

Universidade Estadual de Maringá[1]

The conventional chemical analysis to obtain total Fe_2O_3, Al_2O_3 and SiO_2 levels of soils modifies the system and the balance between the phases of the soil, not considering its complexity, besides being expensive, time consuming and dangerous to the handler, by the use of acids for the extraction of chemical elements. The use of remote sensing, such as spectroradiometry to generate predictions of these total soil contents, don´t modify the soil system, takes into account the complexity, and is a safe, fast and inexpensive technique. Predictions of chemical attributes by spectroradiometry provide better predictions on a local scale than on a global scale, due to the homogeneity of data and soils. Thus, in this work, the use of vis/NIR/SWIR spectrodiometry in the prediction of total contents of Fe_2O_3, Al_2O_3 and SiO_2 of the soils at a local scale (Lobato-PR municipality) and at a global scale (Paraná-BR state), the use of local samples inserted in the global set to improve global predictions was also studied. Spiking numbers (10, 20, 40 local samples), spiking site (along, center, periphery of PCA and cluster) and set weight (0, 5, 10 and 20 copies). In addition to the overall set size with 100% of the samples (n = 650), 50% of the samples (n = 325) and 25% of the samples (n = 162), as alternative methods to improve the global predictions and to generate predictions similar to those of local scale. Thus enabling its use on a global scale without losing the quality of the model, enabling an improvement in soil surveys in developing countries, which are still insufficient. The ASD FieldSpec 3 was used for acquisition of soil reflectance, the Unscrambler software was used to perform calibrations and spiking recalibrations for the total Fe_2O_3, Al_2O_3 and SiO_2 by PLSR and the Sisvar Software with the Scott-Knott test, to study the differentiation of the qualities of the models found. In the prediction of the total SiO_2 and Al_2O_3 contents, the spiking methodology for all global sets (100%, 50% and 25%) improved prediction of the models, but weren´t better or similar to the local set models, the size of the overall initial set had little influence on the results found. In order to predict the total Fe_2O_3 levels, the use of the spiking methodology for all global sets improved the prediction models providing results similar to the models of the local set, the best spiking strategy found was with the use of 40 samples selected at the center of the PCA (10 copies).

Keywords: spiking, calibration, reflectance

Financial support: CNPq – CAPES

(3292 - 2287) Unmanned Aerial System (UAS) as a tool to quantify conventional and conservation tillage crop treatment effects.

Murilo Maeda[1]; Akash Ashapure[2]; Jinha Jung[2]; Andrea Maeda[1]; Junho Yeom[2]; Anjin Chang[2]; Juan Landivar[1]

Texas A&M Agrilife Research, 10345 Hwy 44, Corpus Christi ,TX, 78406, USA[1]; Texas A&M University-Corpus Christi, 6300 Ocean Dr., Corpus Christi, TX, 78412, USA[2]

Recent advances in Unmanned Aerial System (UAS) and sensor technology are now making it possible to accurately assess overall crop growth and health status with fine spatial and high temporal resolutions previously unobtainable from traditional remote sensing platforms, at a relatively low cost. When properly equipped with remote sensors, UAS enable fast and accurate data collection throughout the growing season. The combination of these technologies (UAS + sensors) with state-of-the-art image processing algorithms, visualization techniques, and geospatial data analysis offers an innovative opportunity for the development of high-throughput phenotyping system and precision agriculture applications. Here we present a novel approach to use multi-temporal UAS data for the comparison of conventional and conservation tillage treatment effects on cotton production. The parameters considered for the comparison were: canopy height, canopy cover, canopy volume, and Normalized Difference Vegetation Index (NDVI). Measurements were extracted grid-wise from high resolution UAS data captured during the growing season. A one-tailed test hypothesis was used to compare tillage treatments. Experimental results indicate that there is a significant treatment effect on the plants' responses, for all dates compared. Overall, UAS-based measurements demonstrated that conservation tillage significantly improved plant growth, development, and yield in this study.

Keywords: Keywords: soil conservation, tillage, unmanned aerial system (UAS), drones, cotton.

Financial support: Financial Support: Texas A&M AgriLife Research

(2352 - 429) Use of Lidar derived Digital Elevation Maps and Principal Component Regression to Scale up Topographic Models of Soil Properties

Greg McCarty[1]; Xia Li[2]

USDA ARS Hydrology & Remote Sensing Laboratory[1]; Unviversity of

Maryland, Geography Department[2]

Landscape processes are critical components of soil formation and are important determinants of the distribution of soil properties on the earth surface. Thus, strong topographic relationships to observed distributions are expected. The recent availability of large-scale, high-resolution topographic information through application of a rapidly evolving Lidar technology holds promise that useful large-scale maps of soil properties can be routinely derived from topographic models. We explored the use of Principal Components (PCs) for characterizing the topography of land surfaces and the use of Principal Component Regression (PCR) to scale-up soil property prediction models at watershed or regional scales. Evidence shows that PCR models are more robust than ordinary multi-parameter regressions models for scaling up topographic prediction models at larger settings. This evidence supports the hypothesis that PCR models are better tuned to a larger setting because the underlying PCs that are used can be directly derived from analysis of the topography of the larger setting. Additionally, use of PCs removes the often-strong collinearity between individual topographic parameters and the associated dimensionality reduction diminishes the risk of overfitting the prediction model. This work advocates for a new approach for sampling and modeling of soil properties at various scales.

Keywords: LiDAR; Principal component regression; Topographic modeling; Soil erosion; Soil carbon

Financial support: USDA NRCS Conservation Effects Assessment Project

(9285 - 1236) Using multi-temporal polarimetric Sentinel-1 data to monitor soil moisture over winter crops

Miguel Eduardo Zabala Rodrgiuez[1]; Marisa Domenech[2]; Maria Jimena Berriollo[2]; Mauricio Castro-Franco[3]

UNILLANOS[1]; INTA[2]; CONICET[3]

The implementation of site-specific crop management demand techniques that allow an accurate spatio-temporal monitoring of topsoil moisture at field scale. The aim of this study was to develop and test an approach to improve the estimation of surface soil moisture over winter crops based on multi-temporal polarimetric Sentinel-1 data. Two agricultural fields located in the Argentine Pampas (Long 60º 14,264´W; Lat 38º 19,178´S) were used for this study. Wheat and oat were sown in field 1 and 2, respectively. ECa and elevation were previously determined using VERIS 3100 soil sensor and DGPS. Based on this information, two standard digital soil mapping (DSM) techniques were applied. First, a coupled spatial Principal Components and Fuzzy K-means (sPCA-FK) was used to delimitate three homogeneous zones per field. Second, 11-sampling points were determined per field using conditioned Latin Hypercube (cLHS). Ten Sentinel-1 images were acquired during the period August-December 2017 through crop growing season. All images were in dual-polarization modes (VH and VV) and were calibrated. Also, VH/VV rate was calculated. The coefficient of variation (CV) and the mean of radar backscatter within each field were calculated for all polarization modes along time serie. Volumetric soil moisture (VSM) content at 0-5, 5-10 and 10-15 cm depth was measured for each sampling point, simultaneously with Sentinel-1 image acquisition. All measurements were coupled with zone delimitation within field. A lineal model per zone between polarization modes and VSM was adjusted and validated. The results suggest that the zone delimitation was efficient to define the differences in the CV and mean radar backscatter for both fields. Also, cLHS was efficient to establsih representative sampling points. Lineal regression model results suggest that previous zone delimitation and the use of cHLS could improve the prediction of VSM. In this work, we demonstrated that the approach proposed was effective to improve the estimation of VSM based on multi-temporal polarimetric Sentinel-1 data.

Keywords: soil volumetric content; field scale; Argentina, wheat

Financial support: PNSUELO-1134023

C1.3 - Soil Genesis

C1.3.1 - Soil-forming processes and their transformation under human impact

(2115 - 1010) Attributes of Planossolos in different physiographic regions of Rio Grande do Sul State, Brazil.

Paulo César do Nascimento[1]; Luis Fernando da Silva[1]; Ana Paula Barbosa Lima[2]

Universidade Federal do Rio Grande do Sul[1]; Universidade federal do Rio Grnade do Sul[2]

Planossolos constitute a soil class established in the Brazilian System of Soil Classification. The main diagnostic attributes are the occurrence of the diagnostic subsurface horizon “B plânico”, with characteristics such as influence of aquic moisture conditions and abrupt transition (especially abrupt textural change) in relation to surface horizons. In the other hand, they show great variability in relation to morphological, physical, chemical and mineralogical attributes. In Rio Grande do Sul State (RS), southern of Brazil, these soils comprise about 12% of the territory, with widespread occurrence in different regions, and economic and environmental importance. The aim of this study is to characterize and evaluate the influence of the environment of occurrence in Planossolos of four different physiographic regions of RS. Regions chosen were the alluvial plain of “Jacuí” river -JAC (east), alluvial plain of the “Vacacaí” river - VAC (center), the North Coastal region - NOC (northeast) and “Serra do Sudeste”- SSU (southeast) for the prospection, description and sampling of soil profiles. It were chosen three profiles in each region, apart one profile from other 500 to 5000 m. After morphological description and collection of samples of the main pedogenic horizons, samples were submitted through analysis of pH in water, elements contents and active and potential acidity, allowing determining cationic exchange capacity (CEC) and bases saturation (V). It were also determined granulometry (clay dispersed in water and total clay, with calculation of degree of flocculation); and levels of iron (Fe), aluminum (Al) and silicon (Si) in oxidic forms, extracted by means of sulfuric attack. For this study, we considered, in each profile, results obtained in “B plânico” subsurface horizons, specifically in subhorizon of greater thickness, to avoid the influence of soils use and management. The results indicate variations between the environments, such as higher levels of clay, iron and cation exchange capacity in JAC profiles; higher bases saturation in VAC profiles; while NOC profiles showed lower contents of clay and occurrence of the B horizon in greater depth. Results analysis by means of multivariate analysis will be performed in next steps of the work, allowing determining in more detail the differences between Planossolos of different regions occurrence.

Keywords: Planossolos, chemical soil attributes, soil – environment relationship

Financial support: National Council for Scientific and Technological Development (Conselho Nacional de Desenvolvimento Científico e Tecnológico – CNPq). Science and Technology Minister, Brazil’s Government.

(1160 - 1448) Change of soil pH in a long-term experiment of Detritus Input and Removal Treatment

Katalin Juhos[1]; István Fekete[1]; Zsolt Kotroczó[1]

Department of Soil Science and Water Management, Szent Istvan University[1]

Climate change affects both the productions of detritus and soil moisture and temperature as well. These parameters alter the physical, chemical and biological properties of soils. We examined how to change the soil pH in the Detritus Input and Removal

Treatment sites a decadal time scale. The experimental site is located North Hungary at 320-340 m altitude (N 47°55' E 20°26'). According to the FAO World Reference Base, the soils are Luvisols. The site has Quercetum petraeae-cerris community. The permanent plots were established in November 2000. Six treatments were established: Double Litter, Double Wood, Control, No Litter, No Roots, No Inputs. Each treatment plots is 7m×7m (49m2), and each plot is in three replicates. During the long-term experiment, the pH was monitored seasonally at 0-15 cm depth of soils. In several years, soil samples of the depth of 0-5, 5-15 and 15-30 cm were analyzed as well. The pH was measured in a 1:2,5 soil/H2O mixture. The variance analysis (Tukey's range test) show that the soil pH of no litter (mean pH 5.30), no roots (mean pH 5.36) and no inputs (mean pH 5.36) treatments are significantly ($p<0.05$) lower than that of the control (mean pH 5.67). There is no significant difference in soil pH between double wood (mean pH 5.70) and control plots. Significantly the highest pH was measured for double litter treatment (mean pH 5.99). The pH at 0-5 cm soil layer in the double litter, double wood treatments and control are significantly higher than in deeper soil layers. This difference cannot be measured in the litter removal plots. Soil pH decreased in the litter removal plots presumably because litter removals reduced Ca2+ and Mg2+ inputs. The decreased soil cation content and decreased soil organic matter content decreased soil buffering capacity in the top layer, making soils less able to neutralize acidic substances from decomposition. Increased detrital inputs in the double litter and double wood treatments increased soil organic matter, Ca2+ and Mg2+ input, which resulted in a higher soil buffering capacity and soil pH. The seasonal change in the pH follows the rate of litter decomposition.

Keywords: litter decomposition, buffering capacity, acidity, cation turnover

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(4222 - 589) Clay and iron profiles of E, G, soft plinthic B, and prismacutanic B horizons described during the land type survey of South Africa

A. Stolk[1]; C.W. van Huyssteen[1]

University of the Free State[1]

Humans classify their environment, including soils. With soil classification the challenge is, however, to consistently differentiate between soils. This study was therefore initiated to ascertain to what extent pedologists succeeded in differentiating between E, G, soft plinthic B, and prismacutanic B horizons during the land type survey of South Africa. A total of 1181 soil profiles, comprising 299 Sterkspruit, 331 Estcourt, 49 Katspuit, 257 Kroonstad, 103 Westleigh, and 142 Longlands soils were extracted from the land type data base and used in the analysis. Based on the analysis, we propose the following criteria be used to quantitatively differentiate between the studied horizons: E horizons have <1.0% Fe and <16% clay; with practically no change in either Fe or clay content from the overlying horizon. Soft plinthic B horizons have ≥1.0% Fe and <25% clay; the clay increase from the overlying horizon is >1.5 times. G horizons have ≥1.0% Fe and >25% clay; the clay increase from the overlying horizon is >1.0. Prismacutanic B horizons have ≥1.0% Fe and >25% clay; the clay increase from the overlying horizon is >2.5.

Keywords: eluviation, diagnostics, quantification

Financial support:

(4025 - 397) Consequences of land use change for soils in peri-urban environments.

Kalinina Olga[1]; Dolgikh Andrey[2]; Goryachkin Sergey[2]; Novák, Tibor József[3]; Giani Luise[1]

CvO University Oldenburg, Germany[1]; Institute of Geography, Russian Academy of Sciences, Russia[2]; University of Debrecen, Hungary[3]

Urban areas are likely to increase worldwide due to a number of factors such as economic growth, population increase, rising living standards, availability of cheap agricultural land, inner city problems, increased wealth per household, and enhanced personal mobility. Since the mid-1950s, the total surface area of European cities has expanded on average by 78 % while the population has grown by just 33 %. An analysis at the 1-km^2 grid level shows that the most pronounced sprawl in peri-urban areas is in wide circles around city centers, along large transport corridors and along many coastlines. About 80 % of newly developed urban land consists of settlement areas. The majority of newly developed urban land was previously used for agriculture. The relative contribution of agricultural land to uptake by peri-urban land is about 73 % in Europe (46.2 % arable land and 26.7 % pastures), 84 % in Germany (63 % arable land and 21 % pastures), and 91 % in Hungary (69 % arable land and 22 % pastures). Furthermore, Europe's agricultural land continues to decrease at an average rate of 0.1 Mio ha per year. The same trend can be observed in developing countries at a rate of about 0.5 Mio ha per year. Most affected by urban sprawl during the 20th century was Russia, where about 64 Mio ha of former agricultural land around the cities was converted into urban land. Thus, urban expansion on arable land is a typical pattern of land use change in human history worldwide, with an increasing impact at present. Conversion of agricultural land to peri-urban land is an important challenge that has received little attention thus far. Trends in carbon balance and potential of soil carbon sequestration, soil properties and soil functions after such land use change needs to be assessed. It is expected that newly initiated pedological processes and inputs of new materials due to human activities, that occur in peri-urban areas simultaneously, will result in changing soil morphology, carbon sink functions, and biological activities. Additionally, the formation of new human-natural bodies, from which classification problems will likely arise, require resolution. First investigations are in progress in Hungary (Debrecen area), Germany (Oldenburg area), and Russia (Belgorod area) and will be presented at the congress.

Keywords: land use change, agricultural land to peri-urban land, pedogenesis, soil carbon functions

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(5573 - 1017) Diversity of pedogenetic processes in Southern Crimea

Agadzhanova N.[1]; Krasilnikov P.[2]

Lomonosov Moscow State University, Leninskie gory, 1, Moscow, 119991, Russia (nel.agadzhanova@yandex.ru)[1]; Lomonosov Moscow State University, Leninskie gory, 1, Moscow, 119991, Russia (pavel.krasilnikov@gmail.com)[2]

Complexity and diversity of soilscape is usually assessed either as taxonomic diversity or diversity of functions. In the first case it means a diversity of separate soil classes in systems but it is limited by the frames of classifications under used. In the second case the assessment of diversity is based on specific soils properties, but the set of these properties might differ for different areas. Soil diversity evaluation based on the diversity of pedogenetic processes may be a possible to the approaches listen above. The concept of pedogenetic processes (PP) coined by A. Rode in Russia and R. Simonson in the USA considers movement and transformation of matter in soil profile as a complex of phenomena occurring simultaneously or sequentially. The processes cannot be observed directly but they could be supposed on the basis of available morphological properties or hypothesis base on soil-forming factors. Diversity of PP was studied in two sites in Southern Crimea, a mountainous area with Mediterranean climate. The soils of the first in Nikitsky Botanical Garden were formed on

shales and limestone under introduced arboreal vegetation. Young underdeveloped soils prevailed on this site due to perturbation and terracing. The soils of the second site, reserve Cape Martyan, were formed on limestone under natural xerophytic vegetation. There are both deep well-developed terra rossa and shallow, stony soils. In Nikitsky Garden the following set of processes was identified: humus formation, litter accumulation, weak clay illuviation, formation of aggregate structure, leaching of carbonates and bases, physical and chemical weathering, lateral soil erosion. Because of young age of soils the properties are weakly developed. In contrast, the Cape Martyan's soils are formed in stable conditions for a long time and were not affected by anthropogenic impact. The processes observed in the above mentioned soils are: humus formation, litter accumulation, chemical weathering, rubification, carbonate leaching, karst process. Our pilot research showed that the same processes at different stages of their development produce different morphological products. Relict processes should be also carefully separated from current processes, which affect soil-related ecosystem services.

Keywords: Pedogenetic processes; human impact; Southern Crimea
Financial support: The research was supported by the grant of Russian Science Foundation № 17-17-01293.

(2514 - 2050) Effects of land use change on soil acidification and organic matter storage in tropical forests

Kazumichi Fujii[1]; Warsudi[2]; Sukartiningsih[2]; Taakeshi Toma[1]
Forestry and Forest Products Reseach Institute[1]; Mulawarman University[2]

Soils are exposed to drastic land use change in tropical forests. We compared rates of soil acidification and organic matter decomposition between primary forest, *Macaranga* natural secondary forest, *Acacia* plantation, *Imperata* grassland, and oil palm plantation in Bukit Soeharto Experimental Forest in East Kalimantan, Indonesia to extract the optimal scenario to minimize forest degradation. Experimental items include (1) litter bag tests using root and leaf litters and cellulose filter papers, (2) 30 year monitoring of soil carbon stocks under different land use change series (forest- grassland, forest-grassland-forest), and (3) analyses of proton budgets associated with plant uptake and solute leaching in plant-soil systems. The litter bag tests showed that land use changes to grassland and acacia or oil palm plantations can increase microbial activity to decompose cellulose in the Ultisol soil studied. Leaf and root decomposability depends strongly on plant traits, with faster turnover of oil palm and grass litters. Land use change from forest to grassland exhibited the greater soil C storage for initial 10 years due to considerable root litter inputs, while net increase in soil C storage during 30 year land use changes is greater for forest-grassland-forest scenario due to low decomposability of forest litters. Soil acidification rates caused by nitrification were greater in Acacia and oil palm plantations than in *Imperata* grassland and natural forests. These data suggests that *Imperata* grassland can contribute to build-up of soil organic matters in short-term fallow (< 10 years), while changes to natural secondary forests can maximize soil C storage and mitigate soil acidification in longer fallow period. Acacia and oil palm plantations have the greater risk to increase soil acidification, but proton budgets can provide minimum N application or lime requirement in acacia and oil palm plantations to ameliorate soil acidity.

Keywords: Soil acidification, soil organic matter, Soil solution, Chronosequence, Dissolved organic matter
Financial support:

(1138 - 587) Impact of pedogenetic factors on the content of organic matter in Vojvodina soils (Serbia)

Jovica Vasin[1]; Milorad Živanov[1]; Jordana Ninkov[1]; Stanko Milić[1]; Vladimir Ćirić[2]; Ljiljana Nešić[2]; Milivoj Belić[2]
Institute of Field and Vegetable Crops, Laboratory for Soil and Agroecology[1]; University of Novi Sad, Faculty of Agriculture[2]

The region of Vojvodina (coordinates of the geographical center - 45º24'05" N, 20º04'53" E) administratively belongs to the Republic of Serbia (northern part), while its geomorphological position is in the southern part of Central-European Pannonian Plain. Besides other pedogenetic factors (parent material – mostly loess, relief – mostly flat, climate – semiarid, with mean annual temperature of 11°C and the period i.e. duration of pedogenesis), the formation of soils in this region was affected mostly by biota and human activity. Natural environment affected the formation of soils through natural herbaceous vegetation represented by steppe grassland (*Festuca sulcata*, *Agropyron sp.*, *Andropogon ishaemum*, *Stipa pennata* etc.), which leaves a large amount of well-distributed alkaline organic matter in soils, causing the development of soil types well-supplied with organic matter (with the natural humus content above 5%) at 75% of Vojvodina surface. The main soil-forming process was humus accumulation. The obtained soil types are chernozem (FAO soil type Chernozem) and humogley - hydromorphic black soil (FAO soil types Vertisol and Gleysol). The effect of man as a pedogenetic factor was visible in the last 100 years. Deep tillage was performed during the period of intensive agriculture, along with soil aeration and intense mineralization of soil organic matter. Mineral fertilizers were preferred over organic fertilizers, which disturbed the natural cycling of soil organic matter, resulting in significant decrease of its content. Many systemic soil analyses have been carried out since 1950s in order to determine the dynamics of soil organic matter content in the region of Vojvodina. During 1950s and 1960s, analyses were conducted for the purpose of constructing a pedological map at the 1/50.000 scale. The network of soil samples covering the territory 4x4 km in size (over 1300 samples) was established in early 1990s, while sampling and analyses were repeated in early 2010s. Research results revealed the decrease in organic matter content by about 0.38% until 1990s, and henceforth by an additional 0.5%, depending on different soil types. The significance of organic matter content to soil fertility created the need for increased future application of organic fertilizers, as well as more rational soil tillage, higher amounts of applied green manure, etc.

Keywords: pedogenetic factors, soil types, organic matter
Financial support: Part of this study was conducted as part of the Project No. TR 31072 which is supported by the Ministry of Education, Science and Technological Development of the Republic of Serbia.

(6132 - 1567) Long-term effects of litter input change on carbon content in the soil of a Central European deciduous forest

Istvan Fekete[1]; Katalin Juhos[2]; Marianna Makádi[3]; Ibolya Demeter[3]; Imre Berki[4]; Zsolt Kotroczó[2]
Department of Soil Science and Water Management, Szent Istvan University, 29-43 Villányi St., Budapest, 1118, Hungary; Institute of Environmental Sciences, University of Nyíregyháza, Nyíregyháza, Sóstói út 31/B Hungary[1]; Department of Soil Science and Water Management, Szent Istvan University, 29-43 Villányi St., Budapest, 1118, Hungary[2]; Research Institute of Nyíregyháza, University of Debrecen, Westsik Vilmos utca 4-6, 4400 Nyíregyháza, Hungary[3]; Institute of Environment and Earth Sciences, University of Sopron, Ady u. 5, 9400 Sopron, Hungary[4]

Changes in temperature and precipitation patterns that are predicted under scenarios of global climate change will have profound effects on species diversity and forest productivity resulting in alteration of the quality and quantity of detritus inputs to soils. These changes can influence decomposition, thereby altering soil organic matter (SOM) content and dynamics. Our research at the Síkfőkút Forest (founded in 1972) and Síkfőkút Project DIRT (Detritus Input and Removal Treatments) (founded in 2000) effort to explore how changes in the quality and quantity of detritus inputs affect biological activity but

especially SOM content. We studied carbon dynamics of a Northeast Hungarian deciduous forest that has been subject to significant increases in temperature and decreases in precipitation and over the last 4 decades. The decline in sessile oak stand, which was 71% due to primarily aridification increased the organic material to the soil, thus the organic carbon content of soils also significantly (with 28%) increased in the upper 25cm. In the DIRT project, we studied how changed the carbon content of the Double Litter (adding (by doubling) of leaf litter (DL)), No Litter (NL) and Double Wood (adding of wood debris including branches, twigs, bark (DW)) in comparison with the control treatment in the upper 25 cm soil layer over 12 years. DL was 10.9%, DW 6.1% higher, while NL was 32.1% lower than control. According to variance analysis, there is a significant difference between the groups. The results show that decrease in litter production had a greater effect on soil carbon content than on its addition. Litter production and climate change have been able to influence the carbon storage capacity of the soil over a shorter period over a few years.

Keywords: detritus input, soil organic matter, litter production
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(3455 - 2330) Magnetite and maghemite: genesis, geochemistry and magnetism in Fe-rich Rhodic Oxisols in the Minas Gerais State, Brazil

Luiz Aníbal da Silva Filho[1]; João Carlos Ker[1]; Maurício Paulo Ferreira Fontes[1]; José Domingos Fabris[2]; Luciano de Moura Guimarães[1]; Luis Carlos Duarte Cavalcante[3]

Universidade Federal de Viçosa[1]; Universidade Federal de Minas Gerais[2]; Universidade Federal do Piauí[3]

Magnetite and maghemite may influence significantly the chemical, mineralogical and magnetic properties of several soils; however, they are commonly found in Fe-rich Rhodic Oxisols, which occupy around 5% of the Brazilian territory. These soils are worthy of attention because they present expressive magnetization and a high potentiality to the agricultural use. Therefore, we evaluated the occurrence and distribution of magnetite and maghemite in fine-grained fractions (sand, silt and clay fractions), which make up the air-dried fine earth, in order to determine their contribution as reserve of trace elements (Co, Cu, Ni V, Zn, Mn and Cr) and for magnetization of the soil mass. Five samples of Bw horizons at 0.8 and 1.0 m depth were collected from Rhodic Oxisols originating from basalt (2 samples), tuffite (2 samples) and itabirite (1 sample) in Minas Gerais State. The contents of Fe and Al extracted from the clay fraction with 1.8 mol L^{-1} H_2SO_4, acid ammonium oxalate and Na-citrate-bicarbonate-dithionite were determined. Mass specific magnetic susceptibility and total trace element contents in the sand, silt, clay and sand magnetic concentrated by hand magnet, were also determined. Magnetite and maghemite were identified by X-ray diffractometry, as well as by Mössbauer and Raman spectroscopy. The morphology of the grains composing the sand magnetic fraction was observed by light microscopy. So it was possible to say that magnetite is inherited from the parent material and its oxidation leads to maghemite formation. An evidence of the magnetite-maghemite-hematite transformation was observed on the surface of magnetite grains in sand magnetic fraction. In addition, Raman spectra indicated a strong signal associated with magnetite compared to the signal related to maghemite for the sand fraction, whereas the other hand, the Mössbauer spectroscopy detected only maghemite. It suggests an advanced degree of oxidation of the magnetite grains; furthermore the presence of other minerals in the sand fraction would have decreased the efficiency of magnetite and maghemite distinction by Mössbauer spectroscopy. For the clay fraction, the null values of magnetic susceptibility after H_2SO_4 1.8 mol L^{-1} extraction and Mössbauer analysis indicated maghemite as the only magnetic mineral. In general, the higher trace and magnetic susceptibility found for in the sand and silt fractions are attributed to the magnetite predominance in relation to maghemite in the soils.

Keywords: magnetite, maghemite, Oxisols.
Financial support: Foundation for Research Support of the State of Minas Gerais - FAPEMIG. JDF is PVNS/CAPES scholarship, at the Federal University of the Jequitinhonha and Mucuri Valleys, in Diamantina,

(6781 - 1239) Map of the soil surface color of Rio Grande do Sul obtained by diffuse reflectance

Priscila Vogelei Ramos[1]; Alberto Vasconcellos Inda[1]; Keyrauan Taha[1]

Universidade Federal do Rio Grande do Sul[1]

Diffuse reflectance spectroscopy (DRS) represents a technique widely used in the scientific environment, and, in recent years, has been more explored and popular in soil science. The DRS presents advantages to determine an expressive variety of soil proprieties in comparison to traditional techniques. The reflectance spectra are obtained quickly, inexpensively, accurately, non-destructively way and do not produce residues. According to the mathematic treatment done in the visible spectra wavelength possible to obtain information regarding the type and abundance of iron oxides. In addition to the effect on soil physical and chemical properties, iron oxides influence soil coloration. The strong pigmentation effect of iron oxides is the reason why most soils are brown, red and yellow. This work aimed to determinate the soil surface real color of the state of Rio Grande do Sul (RS), Brazil, using the soil reflectance technique on visible wavelength. For this, we measured the spectra of 579 soil samples from the layer of 0-0.20 m representing all RS territory. A VIS-NIR spectrophotometer was used that covered the wavelength range of 350- 2500 nm. To calculate and obtain the soil real color the visible wavelength has been selected (350–770 nm). By means of the selected range it has been possible to obtain the tristimulus values x, y and z, which have been converted into other color parameters such as hue, value, chroma and RGB (red, green, blue). According to Munsell parameters, hue values vary between 3.41-9.76 YR, value vary between 4.99-6.11, and chroma between 1.31-4.69. For the values validation obtained by conversion, values of hue, value and chroma were compared with the same parameters manually obtained in others research, which have been verified that the reflectance obtained parameters were more accurate. RGB values of the analyzed soils were assigned the mapping units of the RS soil map, generating a map with the actual color of the soil surface. Future studies may relate the color parameters obtained in this research with physical (e.g. soil drainage) and chemical attributes (e.g. soil adsorption) of RS soils. The elaboration of this map proves the potential that reflectance has, with appropriate treatment, to obtain the real color of the soil.

Keywords: Iron oxides, difuse reflectance, RGB parameteres
Financial support: Coordenação de Aperfeiçoamento de Pessoal de Nível Superior

(9413 - 1506) Prospecting of soils in topossequences in Southwestern Mato Grosso – Brazil

Ana Paula Barbosa Lima[1]; Paulo César do Nascimento[1]

Universidade Federal do Rio Grande do Sul[1]

The surveying and classification of soils has undeniable importance in the agricultural context. Knowing the processes and factors involved in the soils formation is an important step in defining their suitability for usage. Pedological studies in topossequences allow observe the differences between the formation processes and the soils that occur in different positions of the landscape. Because it is a set of soils in

different levels in the relief (higher or lower altitude, higher or lower slope), the influence of the formation factors such as climate, parent materials and relief occurs at different levels, forming different soils in the same sequence topography. The objective in this work is to characterize, classify and evaluate the influence of soil formation factors and processes in two topossequences: Chapada dos Parecis, formed from sandstone and located in counties Campo Novo dos Parecis and Tangará da Serra, and Serra Tapirapuã, formed from basalt, located between counties Tangará da Serra and Nova Olímpia, MT, Brazil. Observations were made in thirteen points, from the top of the Chapada dos Parecis to the foothills of Serra Tapirapuã. It was observed that in flatter regions there are deeper, well drained and weathered soils such as Oxisols and Ultisols. In the more inclined positions of the topossequences, the tendency is to form less weathered soils, like Entisols, and outcrops of the parent material. In some areas, despite of sloping relief, the formation processes advanced, with the formation of relatively deep profiles. There is evidence of podzolization in Serra dos Parecis, with the formation of soils with characteristics of Spodosols; also lessivage in the Serra Tapirapuã, with the formation of Molisols and/or Alfisols, classes that are not mentioned in the soil charts of the region. The discrepancy between the distribution of soils present in small-scale surveys and the field observations is normal, due to the small scale of available pedological maps, reinforcing the need for detailed survey for classification and mapping with larger scale. The sequence of the works, with complete morphological descriptions, sample collection and laboratory analysis will allow the characterization and classification of these soils, as well as to estimate the formation processes involved and establish standards in the soil-landscape relationship.

Keywords: Soil classification, formation processes, relief, classes
Financial support: UFRGS

(8001 - 323) Researches on the Evolution of Red Yellow Soil on the Earth

Zhongjie Ye[1]

Zhejiang A&F University, China[1]

I am a retired 90 years old professor from Zhejiang A&F University in China. I have been dedicated my entire career in the research and education of soil science, especially in the area of the genesis and evaluation of red yellow soil. In 1986, a few years after China opened up its door to the outside world, I was fortunately selected, through a rigorous competitive screening process, as a member of a delegation participating in the 13th World Congress of Soil Science (WCSS) in Hamburg, Germany. At the 13th WCSS more than 30 years ago, I presented a paper "The Contribution of Forest and Catastrophic High Temperature to the Formation of Yellow Red Earths". New research results and additional evidences were presented related to the formation of red soil and evaluation of yellow soil at subsequent 14th to 20th WCSS. In this paper, I would like to emphasis some of my view points. Oxisol, a widely used higher level category substance including latosol, were thought to be evolved from high degree of weathering in the tropical areas. Based on the research and analysis it would be more reasonable to believe that Oxisol was derived from the weathering of basalt. Oxisol can be found widely in the basalt stratum from the Quaternary period, from low and high latitude regions. The evolution of Oxisol has no closed relationship with the hot and humid climate in the tropic areas.

Keywords: Red Yellow Soil, Oxisol, Latosol
Financial support:

(8501 - 1307) Saline sodic cryoturbated soils at Barguzin Depression and processes of their formation

Vasiliy Ubugunov[1]; Nikolay Khitrov[2]; Vera Ubugunova[1]; Anna Zhambalova[1]

Institute of General and Experimental Biology, Ulan-Ude, Sakhyanovoy str. 6, Russia[1]; V.V. Dokuchaev Soil Science Institute, Moscow, Pyzhevskii per. 7, build 2, 119017, Russia[2]

Soil cover pattern included alluvial, swampy, saline, alkaline, cryoturbated soils occur within peculiar landscape at the northern-eastern part of Barguzin Depression that is a part of Baikal Rift at the north of Asia (Buryatia). The landscape is characterized by unusual combination of endogenous and exogenous soil-forming factors been chanced at small distance, namely, existence of surface and subsurface thermal spring relieving in swampy-alluvial plain with insular permafrost sediments near the surface at the bottom of intermountain Barguzin Depression with rainless extra continental climate. Thermal springs are the main source of soluble salts and a cause of formation of local thermic "windows" in the landscape with insular permafrost. Upper soil horizons have symptoms of cryoturbation and long-term reducing conditions. Lateral flow of soluble salts above permafrost layer promotes hydrogenic accumulation of gypsum, carbonates and salts in the solum. Eluvial-illuvial clay differentiation is a result of weakly expressed solonetzic process.

Keywords: Cryosols, Sodic Gleyic Cambisols, thermal spring, permafrost, solonetzic process, reducing conditions, gypsum accumulation, soluble salts
Financial support: Russian Foundation for Basic Research, project no. 18-04-00454

(1263 - 322) Soil covers variability as an indicator of intraplate base level change: an example from the San Francisco Craton, Minas Gerais, Brazil.

Renata Jordan Henriques[1]; Roberto Célio Valadão[1]

Federal University of Minas Gerais - Geosciences Institute - Belo Horizonte - Brazil[1]

The investigation of intraplate crustal movements demands a series of indicators and techniques to evince how this movements condition the earth's surface and its processes. In this context, the main objective of this work is to present the hypothesis that soil coverings may be able to reveal indicators of crust mobility. The study area is a drainage basin of 50km² localized in San Francisco Craton. The Sujo stream is the main tributary that drains this basin and flows to Mata River, an important tributary of Velhas River in Minas Gerais. This drainage basin comprises a regional geological transition between the Neoproterozoic sedimentary basin of the Bambui Group and the Belo Horizonte Complex, which is an Archaean granite-gneiss basal complex. This kind of geological transition is consider as an area of most sensibility intraplate crustal perturbations, which in this case is motivated especially by the continental drift E-W of the South-American plate. As a research methodology this work involved principally fieldwork observation of spatial distribution of soil covers and its characteristics. By this way, these coverages were categorized according to their structural organization and textural aspects. To represent each type of soil cover was also developed a regional topographic section to insert their respective position on the surface. As a result, the soil covers reveals significant allochthonous contribution, which their materials vary according to the topographic position. These coverings correspond mainly to heterogeneous materials composed by clay minerals and coarse fragments of sub-rounded quartz. In upstream of the drainage basin investigated were found a lot of thin allochthonous coverings (about 0,3m in thickness) upon saproliths from the sedimentary rocks and the basal complex. Downstream these covers have thicknesses ranging from 0.3m to more than 6m and also indicate, in some places, that they have been incorporated into a river dynamics, which was responsible for reorganized the quartz gravels and clays. The investigation of these coverings allows suggesting that there are two main moments; the first involves a more lowering of the base level that mobilized the

thicker fragments, and another later moment responsible for deposition of fine clays and crystallizations of iron oxides in some places. Notably, this variation in the basal level may also be conditioned to karsts process because of the carbonates from the Bambui Group.

Keywords: Pedogeomorphology; Morphotectonic; Cratonic plataform; Tropical climate; Karst

Financial support: National Council for Scientific and Technological Development (CNPq, Brazil), Project Number 130655/2016-3.

(2684 - 2513) Soil distribution associated with special coffee farming in Mantiqueira mountains, Carmo de Minas, MG

Aurélio Alves Amaral Chaves[1]; Marilusa Pinto Coelho Lacerda[2]; Helena Maria Ramos Alves[3]; Flávio Meira Borém[4]; Margarete Marin Lordelo Volpato[5]

Universidade de Brasília, Faculdade de Agronomia e Medicina Veterinária – UnB/FAV, P.O. Box: 4508, Instituto Central de Ciências, Asa Norte, Brasília, DF, 70910-960, Brazil (aaa.chaves@hotmail.com)[1]; Universidade de Brasília, Faculdade de Agronomia e Medicina Veterinária – UnB/FAV, P.O. Box: 4508, Instituto Central de Ciências, Asa Norte, Brasília, DF, 70910-960, Brazil.[2]; Empresa Brasileira de Pesquisa Agropecuária - Embrapa Café, Parque Estação Biológica, Brasília, DF, 70770-901, Brazil[3]; Universidade Federal de Lavras – UFLA, P.O. Box 3037, Av. Doutor Sylvio Menicucci 1001, Kennedy, Lavras, MG, 37200-000, Brazil[4]; Empresa de Pesquisa Agropecuária de Minas Gerais – EPAMIG, P.O. Box 176, Av. Doutor Sylvio Menicucci 1001, Kennedy, Lavras, MG, 37200-000, Brazil[5]

In order to develop a sustainable and economically feasible agricultural production capable of maintaining its soils, it is necessary to know the features of different types of soils and their distribution over the landscape. This research categorizes the soils of high quality coffee crops and their distribution at the municipality of Carmo de Minas, as a sample of the region of Serra da Mantiqueira (Mantiqueira Mountains), state of Minas Gerais, to provide data for a Geographic Indication (IG) seal in the Designation of Origin (DO) modality. Field activities led to selecting the curvature and pedological profiles of significant soil classes, in order to produce a complete morphological description and characterization, and to collecting lab samples as an input for the Brazilian Soil Classification System (SiBCS). This research also assessed the morphometric parameters of the terrain, e.g. declivity, hypsometry and curvature, in relation to its soil classes, and found that in altitudes higher than 1,000m, curvature classes linked to a specific declivity class control the variability of soil classes in the region. Hapludox from previous epochs in geomorphological flatlands were preserved in convex slopes with a declivity of up to 45%; Oxic Hapludult occur in transitional convex-concave terrains within a declivity range of 45-75%; and Hapludept occur in concave landforms with a declivity higher than 75%. The linkage between these soils and quality coffee crops is related to the long evolution and depth of these soils in rugged terrains and to their preserved oxic features, which facilitate the existence of coffee crops. The frequent occurrence of thick umbric horizons also contributes physically and chemically to coffee crops in this region.

Keywords: Soil-landscape relations, Pedomorphogeology, Soil genesis, Curvature, Serra da Mantiqueira.

Financial support: Embrapa; CNPq.

(4141 - 2913) Soil-landscape relationship in slightly dissected plateau in Central Brazil

Renato Henrique Ferrari[1]; Vinicius Vasconcelos[2]; Mateus de Alencar Ramos Fernandes[2]; Diego Silva Siqueira[3]; José Marques Junior[3]; Eder de Souza Martins[4]; Gabriela Bielefeld Nardoto[2]

University of Brasília, Asa Norte, Brasília, 70910-900, Brazil (1renatoferrari@gmail.com)[1]; University of Brasília, Asa Norte, Brasília, 70910-900, Brazil[2]; São Paulo State University, Rod. Paulo Donato Castellane s/n, Jaboticabal, 14884-900, Brazil[3]; Embrapa Cerrados, BR-040 Km 18, Planaltina, 73310-970, Brazil[4]

In tropical soils, the proportion of goethite-hematite and kaolinite-gibbsite indicates the landscape dynamic helping to understand the relationship between soil and landscape evolution. The objective of this work was to characterize the soil-landscape relationship, based on mineralogical characteristics in different landscape positions in a slightly dissected plateau at Jardim River Basin, Central Brazil. This region is well known by extensive agricultural occupation for at least four decades. Topossequences were selected along the landscape: two were performed on soft undulated ramps and two on partially dissected channels along an interfluve. Soils were sampled at 10 to 20 cm depth intervals up to 80 cm. They were air-dried and sieved with a 2 mm mash. Soil color was verified with the Munsell book to estimate the proportion of Hematite and Goethite. The presence of iron oxides was evaluated by magnetic susceptibility (SM) and the proportions of kaolinite and gibbsite were determined with a Thermogravimetric Analyzer (ATG). The lowest kaolinite and gibbsite ratios were found in the headslope of the basin. There was a decrease in SM values from the headslope to the bottom with hue color ranging from 5YR to 7.5YR. At the ramps the soils are more reddish, 2.5YR, and more kaolinitic. The results showed that in a slightly dissected plateau in a neotropical savanna region the dissection of the landscape changed the mineralogical dynamics where higher levels of gibbsite did not mean greater stability and the soil enriched with kaolinite in the ramps represent an old pedogeneses deposits rich in iron oxides.

Keywords: Magnetic Susceptibility, Thermogravimetric Analysis, landforms, iron forms, kaolinite-gibbsite ratio.

Financial support: FUB – University of Brasília; Capes – Ministry of Education.

(6450 - 356) Urban soils in the Metropolitan Region of São Paulo (Brazil) and their role in the provision of ecosystem services

Wagner Sousa Gomes[1]; Icaro de Sena Almeida[2]; Sheila Aparecida Correia Furquim[1]

Universidade Federal de São Paulo - UNIFESP[1]; Universidade de São Paulo - USP[2]

The Metropolitan Region of São Paulo (MRSP), the biggest of Latin America, comprises 39 counties and approximately 20 million people. This region experienced a significant process of soil alteration due to intense and mostly unplanned urban expansion, accelerated during the XX century. Although the environmental role of the MRSP soils has been highly neglected, they are probably able to provide ecosystems services, as other urban soils in the world, even if affected by higher anthropic influence. In this work, field descriptions and laboratory analyses (pH, exchangeable cations and particle-size) were performed in five soil profiles (a, b, c, d, e) of two vacant lots (L1 and L2) located in developed urban sites of the MRSP, in order to determine their capacity to provide ecosystems services. The profiles are divided in two main sets: upper horizons developed in embankment materials and lower horizons that represent the original soils. The upper horizons are mainly brownish and reddish at L1 (10R to 10YR) and reddish at L2 (10R to 5YR). The surface horizons of L1a, L1b, L1c and L2d profiles present low values (1 to 2), indicating presence of organic matter (OM). All the upper horizons of both profiles have a high heterogeneity due to the abundant presence of volumes with different colors, many of them composed by construction residues. These horizons are majority acid (pH<5.0), clayey, highly compacted and massive, although some of the horizons of L1 (a, b, c) and L2 (d) present granular or blocky structure. The lower horizons at L1 are saprolite materials, mainly reddish (5R or 10R), clayey and massive,

developed by Pre-Cambrian granite weathering. At L2, the *in situ* horizons are black (10YR 2/1) or grayish (7.5YR 5/1), very clayey and massive, developed over Quaternary fluvial sediments. Despite the clear disturbance provoked by anthropogenic activities, such as high compaction, heterogeneity and mix with human artefacts, most of the studied soils have OM accumulation and incipient structure. These characteristics reveals the action of pedological processes, which enable the studied soils to better exert ecosystem services such as mitigation of floods, carbon storage, local climate regulation and soil biological activity. Thus, the definition of the future use of sites in the MRSP should consider their soil functions in order to develop more sustainable cities.

Keywords: São Paulo; anthropogenic soils; regulating services; supporting services

Financial support: Coordination for the Improvement of Higher Level Education (CAPES) and National Council for Scientific and Technological Development (CNPq)

(7199 - 2356) Using luminescence dating to understand Ferralsol genesis near Piracicaba, SP, Brazil

Tobias Sprafke[1]; Felix Lauer[2]; Andre O. Sawakutchi[3]; Marcia R. Calegari[4]; Leonor Rodrigues[5]; Tais Almeida Santos[6]; Beatriz M. Rodrigues[6]; Heinz Veit[1]; Pablo Vidal-Torrado[6]

Institute of Geography, University of Bern, Hallerstrasse 12, 3012 Bern, Switzerland[1]; Institute of Geography, Friedrich-Schiller-University Jena, Löbdergraben 32, 07743 Jena, Gemany[2]; Institute of Geosciences, University of São Paulo, Rua do Lago 562, São Paulo, SP, Brazil[3]; Geography Department, University of West Paraná State - Campus Marechal Cândido Rondon. R. Pernambuco 1777, 85960-000 Marechal Cândido Rondon, PR, Brazil[4]; Centre d'Écologie Fonctionnelle et Évolutive, CNRS UMR 5175, 1919 Route de Mende, 34293 Montpellier 5, France[5]; Soil Science Department, University of São Paulo. Av Pádua Dias 11, 13418-900 Piracicaba, SP, Brazil[6]

Thick and deeply weathered tropical soils are the basis for the most diverse ecosystems worldwide and an important pillar of global food production. Under today's increasing pressure on soils, the understanding of soil formation and its rate are essential. There is remaining debate if in-situ processes can sufficiently explain the genesis and distribution of thick tropical soils, or if additionally, allochtonous components transported by e.g. water or wind have to be taken into account. Luminescence dating is a promising tool of Quaternary research and increasingly recognized in soil science. Mainly regarded as tool to date sedimentation, it can also be used to evaluate rates of soil turnover by bioturbation. In this presentation, we present first luminescence ages from > 4 m thick Ferralsols near Piracicaba, SP, southeastern Brazil. Preliminary data point to a Late Pleistocene to Holocene age of the dated material. We discuss the significance of these ages to understand the formation of these soils and the implications for the paleoenvironmental development and present land-use.

Keywords: pedogenesis, Quaternary, bioturbation, lithological discontinuity, paleoenvironment

Financial support:

(2776 - 2378) Vegetation produces but pedotubation decides where carbon is allocated in soils: Assessing O and A horizon thicknesses across the forest-prairie biome transition in Minnesota, USA

Adrian A. Wackett[1]; Kyungsoo Yoo[1]; Nicolas A. Jelinski[1]

University of Minnesota - Twin Cities[1]

The paradigm surrounding humus forms and thicknesses across forest-prairie biome transitions suggests that these morphological distinctions arise from intrinsic vegetation characteristics. The cumulative effects of growth, senescence, and decay of deeply rooted grasses is thought to cultivate a roughly 1:10 ratio of organic matter cycling through above (1) vs. belowground (10) reservoirs in grasslands, resulting in thick A horizons wherein minerals and organic matter are intimately mixed. Alternatively, in forests, plant and litter biomass is concentrated above-ground and the above:below-ground reservoir ratio approaches 1:1. This partially explains the thicker O horizons found on forest floors. In such systems, organic and mineral layers are often stratified and un-associated with one another, in the absence of agricultural land use or the introduction of bioturbating agents such as earthworms. Here, we use the U.S. state of Minnesota as a natural laboratory to test the hypothesis that the modes and magnitude of pedoturbation is critical to explaining the observed trends in litter (O horizon) vs. topsoil (A horizon) thicknesses within and across soil landscapes. Capitalizing on the ternary intersection of grassland, deciduous and coniferous forest ecosystems within Minnesota, we use the U.S. Soil Survey Geographic Database (SSURGO) to extract O- and A-horizon thicknesses at the component level. From these mapping exercises, we estimate A:O horizon ratios that far exceed the anticipated 1:10 ratios for grasslands and fall far below the anticipated 1:1 relationship in forests. Under intensive agriculture, these ratios converge and are independent of vegetation type, reflecting the role of tillage as an efficient soil mixing process. These results may suggest that pedoturbation (or a lack thereof) may play a significant role in establishing and maintaining the form and thickness of humus across soil-mantled landscapes. These thickness relationships and ratios are also compared with biogeographical maps of pre-settlement vegetation and pedoturbation derived from multiple datasets, which permit additional qualitative assessment of the interplay between humus form/thickness, soil mixing agents (both natural and anthropogenic), and vegetation type. Our findings reveal that the mechanism and magnitude of bioturbation should be considered as a significant regulatory factor in setting the type and thickness of humus forms across grassland and forested ecosystems.

Keywords: Pedoturbation, Humus form, Soil formation, Soil mixing, GIS mapping

Financial support: University of Minnesota, Department of Soil, Water and Climate, Saint Paul, Minnesota 55108

(1682 - 1837) Weathering sequence of clay-size minerals based on weathering index and silicic acid activity

Tetsuhiro Watanabe[1]; Han Lyu[1]; Shinya Funakawa[1]

Kyoto University[1]

Changes in clay-size minerals during soil formation (i.e., weathering sequence) have been reported in case investigations and summarized in various schemes. In case investigations, however, effects of soil forming factors on the composition of clay-size minerals are difficult to compare with those in other regions. It is also difficult to relate actual soil forming factors to the composition shown in summarized schemes. This is likely because of the complexity of combinations of soil forming factors. In this study, we propose that soil weathering index and H_4SiO_4 activity (Si activity) can be used to relate soil forming factors and clay-size mineral composition, and demonstrate the effects of soil forming factors on changes in mineral composition. Soils formed under different parent material, climate, and time conditions were collected from B horizons in Japan, Thailand, Indonesia, Cameroon, and Tanzania. The samples were from volcanic soils to strongly weathered soils. Mineralogy of the clay fraction was determined by X-ray diffraction, differential thermal analysis, and selective dissolution methods using sodium pyrophosphate and acid ammonium oxalate solutions. Total contents of Ca, Mg, K, Na, and Fe and dithionite citrate extractable Fe content were determined to calculate the weathering indices (i.e., total reserve in bases and crystalline Fe oxide ratio to total Fe). Si activity was determined in soil water extract. For transformation of 2:1 type minerals, mica was commonly found in soils derived from felsic and sedimentary parent

materials; it weathered to vermiculite under the lower pH conditions of the udic soil moisture regime and less weathered under higher pH conditions of the ustic moisture regime. For neoformation of minerals, in weakly weathered soils, higher Si/Al ratio nanocrystalline minerals were found in soils with high Si activity, whereas lower Si/Al ratio nanocrystalline minerals were found in soils with low Si activity. In moderately weathered soils, smectite was detected in soils with high Si activity and gibbsite with low Si activity; gibbsite was found in soils with low Si activity in strongly weathered soils. Kaolinite was widely found in weakly to strongly weathered soils. The pH and Si activity, which were affected by precipitation, and weathering indices, which were affected by parent material, time, topography, and temperature, were found to be good indices for describing the weathering sequence of clay-size minerals.

Keywords: clay minerals, transformation, neoformation
Financial support: JSPS KAKENHI Grants no. 17H06171 and 24228007

C1.3.2 - Soil pedogenesis and diversity in extreme environments

(4588 - 3009) Characteristics and genesis of profiles developed from Amphibolite complex rocks in Southwestern Nigeria.

Sikiru Adekoya MUDA[1]; Temitope Abayomi OKUSAMI[1]; Oladipo OMOTOSO[2]

Obafemi Awolowo University, Ile-Ife, Osun State, Nigeria[1]; Suncor Energy Inc.P.O. Box 2844, 150 - 6 Avenue S.W. Calgary, Alberta Canada T2P 3E3[2]

Limited data have been published on the nature of deeply weathered soils in humid tropical soils of Southwestern Nigeria. The study evaluated the characteristics and formation of weathered soil profiles in rain forest region of Southwestern Nigeria. The soils developed from mafic rocks (Amphibolite and Talc). Results revealed that the soils have generally similar morphological characteristics, particularly in terms of colour (2.5 YR-10 R), and structure (granular to subangular blocky), although the Mokuro profile has higher clay content than the other profiles. The soils have similar chemical properties (e.g. acidic, low exchangeable bases) except that the Ajindo profile has higher CEC values and higher exchangeable Ca content, resulting in a higher base saturation in the upper horizons. The soils also have high dithionite-extractable Fe contents and very low oxalate/dithionite ratios. They are dominated by kaolinite, goethite, hematite, and quartz in the clay fraction. Apparently as a result of their more weatherable mafic parent rock and more stable geomorphic surface, the Mokuro, Wonu 1 and Wonu 2 profiles show more advanced weathering and soil development than the Ajindo profile. The Mokuro profile has higher Ti and Cr contents inherited from its mafic parent material. The study revealed that on the deeply weathered humid tropical soils of Southwestern Nigeria, the characteristics and genesis of the soils are greatly affected by the geochemical characteristic of the parent rock material.

Keywords: Humid tropical soils; southwestern Nigeria; genesis; amphibolite; mafic rock; weathering; deeply weathered soils.
Financial support: TETFund

(9145 - 1001) Characterization and classification of soils under native forest in the Western Amazon, Brazil

Andrei Dobner[1]; Luís Antônio Coutrim dos Santos[1]; Fabrício de Araújo Pedron[1]; Catiusca Peretto[1]; Jessica Rafaela da Costa[1]; Uilson Franciscon[2]; Mariana Coutrim dos Santos[2]

Federal University of Santa Maria[1]; Federal University of Amazonas[2]

The Amazon region covers a vast area of land, some areas are cleared for agricultural or livestock use, but the quality of the soil in relation to the sustainability of these practices is inefficient, so it is very important to know the soil attributes of this region. The objective was to characterize and classify two Amazon soils of the native forest. The soils are located in the municipality of Apuí, southern region of the state of Amazonas. The morphological characterization was carried out, and the samples were collected by horizons for the physical and chemical characterization. Were realized physical analyzes of soil bulk density (BD), granulometry and water dispersed clay (WDC) and chemical analyzes of pH, Ca, Mg and Al exchangeable, available P and K, total organic carbon (TOC) and oxides extracted by means of sulfuric attack (SiO_2, Fe_2O_3, Al_2O_3), low crystalline iron (Feo) and Pedogenic Fe (Fed). The soils presented a horizonal sequence described as A, AB, Bw1, Bw2, Bw3 and BC, darker coloring in the surface horizons (10 YR 3/3) due to the higher organic matter contents. Both soils have a very clayey texture and a silt/clay ratio of less than 0.7, possibly indicating a higher degree of weathering. The surface horizons of both soils had WDC ranging from 211 to 314 g kg^{-1}, while for subsurface B horizons the values were 0 g kg^{-1}, which resulted in a flocculation degree of 100%. The BD presented ranging from 1.1 to 1.3 g cm^{-3}, with the lowest values for horizons A, justified by the higher TOC levels and biological activity. The pH varied from 4.5 to 4.9. The exchangeable bases (Ca, Mg, K, and Na) were very low, resulting in base saturation of less than 14%, while the higher Al contents resulted in Al saturation of 46 to 96%, common aspects for soils of the region. The highest TOC in horizons A, are due to the higher contribution and incorporation of organic matter in the surface caused by the Amazonian forest. The Ki index ranging from 1.6 to 1.8, and the Kr index always higher than 0.75, shows the moderate weathering stage and indicates the dominance of the kaolinite mineral in the soil. The Feo/Fed ratio presented values ranging from 0.02 to 0.08, showing the predominance of crystalline iron oxides. Soils were classified in the world reference base as Haplic Ferralsol (Alumic Clayic). Both studied soils present acidic reactions and low levels of exchangeable bases and configure the chemically poor nature of the Amazonian soils.

Keywords: South Amazon, Amazonian soils, ferralsol
Financial support: Foundation for Research Support of the State of Amazonas.

(6779 - 309) Clay minerals formation in a Solod soil in the Brazilian Pantanal wetland

Thiago Tavares Vidoca[1]; Sheila Aparecida Correia Furquim[2]; Gabriel Ramatis Pugliese Andrade[3]

Universidade de São Paulo, São Paulo, SP, Brazil (thiagovidoca@usp.br)[1]; Universidade Federal de São Paulo, Diadema, SP, Brazil (sacfurquim@gmail.com)[2]; Universidade Estadual do Norte Fluminense Darcy Ribeiro, Campos dos Goytacazes, RJ, Brazil (gabrielramatis1@gmail.com)[3]

The Nhecolândia subregion, located in the Brazilian Pantanal wetland, is distinguished by the existence of thousands of freshwater lakes, brackish lakes and alkaline-saline lakes. Recent researches showed that the brackish lakes have been formed by the progressive decrease in water salinity of alkaline-saline lakes, due to atypical freshwater flows from the floods that reach the wetland during the summer. These geochemical changes are responsible for the transformation of Saline-Sodic soils, typically formed by solonization around the alkaline -saline lakes, into Degraded Sodic Soils (Solodized-Solonetzes and Solods) around the brackish lakes, which are submitted to solodization process. In the present work, the identification and crystal chemistry of clay minerals in the fine clay fraction of a Solod soil were investigated by XRD, XRD modelling by Newmod II and STEM techniques, in order to understand the mineral genesis related to the replacement of solonization by solodization in the Nhecolândia soils. Previous works showed that the Saline-Sodic soils are mainly composed by iron-enriched mixed layered phases, majority kaolinite-illite (K-I, 53%) and illite-smectite (I-S, 34%). Both these phases are strongly dominated by illite layers, with proportions of 91% and 81%

of illites in the K-I and I-S crystals, respectively. In the Solods, our data revealed mainly kaolinite-illite (K-I, 20%), illite-smectite (I-S, 38%) and kaolinite-smectite (K-S, 19%) minerals. These phases are still iron-enriched, but the illite layers are no longer dominant in the crystals. The K-I is formed by 95% of kaolinite whereas the I-S and K-S phases have 53% and 54% of smectite layers, respectively. Thus, the more acidic conditions promoted by solodization have been responsible for the transformation of illite into smectite and kaolinite layers in the crystals, which is evidenced by the lower presence of illite in the assemblages and the high content of iron in the kaolinite and smectite layers in the Solod. Hence, iron-enriched mixed-layered illites, initially formed in soils associated with the alkaline-saline lakes, appear to remain only transiently in brackish lake soils, since the environmental conditions responsible for their formation and maintenance are incompatible with the geochemical conditions created by solodization.
Keywords: kaolinite-illite; illite-smectite; kaolinite-smectite; brackish lakes; solodization.
Financial support: Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES)

(6474 - 3056) Edaphic characterization of a quartzitic highland Tepui of monte Roraima, Brazil/ Venezuela border

Augusto César Rodrigues Santos[1]; Carlos Ernesto Gonçalves Reynaud Schaefer[2]; Prímula Viana Campos[2]; José Frutuoso do Vale Júnior[3]; Matheus Gonçalves Paulichi[3]; João Vitor Garcia de Lima[3]; Raphael Henrique da Silva Siqueira[4]
Universidade Federal de Roraima, Department of Soil and Agricultural Engineering. Campus Cauamé, BR 174 - KM 12, Boa Vista, Roraima, CEP 69300-000, Brazil (augustocrs4@gmail.com)[1]; Universidade Federal de Viçosa, Department of Soil. Campus Universitário, Avenida Peter Henry Rolfs - s/n, Viçosa, Minas Gerais, CEP 36570-900, Brazil[2]; Universidade Federal de Roraima, Department of Soil and Agricultural Engineering. Campus Cauamé, BR 174 - KM 12, Boa Vista, Roraima, CEP 69300-000, Brazil[3]; Instituto Federal de Educação, Ciência e Tecnologia do Amazonas, Av. Sete de Setembro - 1975, Manaus, Amazonas, CEP 69020-120, Brazil[4]

Monte Roraima is a morphological table-shaped feature (tepui), which is a characteristic of the Guianas Plateau, with an altitude of approximately 2,734m. They are characterized by heterogeneity of habitats under the control of diverse edaphoclimatic factors. This work aimed to evaluate the chemical characteristics of the soils of three geoenvironments in an area of a Rupestrian Grassland (Campo Rupestre) complex developed on Quartzitic rocks located at Monte Roraima, Brazil-Venezuela Border. Three geoenvironments were studied: Bonnetia roraimae Rupestrian Shrubby Grassland (CRB); Rupestrian Grassland on Organosols (CRO); and Open Rupestrian Grassland on Sandy Neosols (CRN). Soil samples were collected at twenty distinct points for each geoenvironment in the 0-0.1 m layer for the following chemical analyses: potential of hydrogen (pH), potassium (K^+), sodium (Na^+), calcium (Ca^{2+}), magnesium (Mg^{2+}), exchangeable aluminum (Al^{3+}), and potential acidity (H + Al). From these analyses, the following soil sorption complex characteristics were calculated: base sum (SB), potential cation exchange capacity (T), effective cation exchange capacity (t), and base saturation (V%). In addition, the soil organic matter content (OM) was determined. A variance analysis (ANOVA) was performed to evaluate the differences between soil chemical variables among the three geoenvironments, followed by the Tukey test at 5% probability. Differences were observed in all characteristics, except for pH in water. The geoenvironment CRO was superior to the other geoenvironments in the characteristics K, Na, Al^{3+}, H + Al, T, and OM. However, for the variables Ca, Mg, Al, SB, t and V%, the CRO environment did not differ from the CRB environment. For all chemical characteristics the CRN environment presented the lowest values, except for Na, Al and MO, where it did not differ from CRB. The soil classes found in the geoenvironments are determinants of the chemical composition found. The CRO geoenvironment presents greater chemical wealth than the other geoenvironments.
Keywords: GEOENVIRONMENTS; TEPUI; SOIL PEDOGENESIS
Financial support: CNPq; CAPES; UNIVERSIDADE FEDERAL DE VIÇOSA; UNIVERSIDADE FEDERAL DE RORAIMA.

(6829 - 2988) Genealogic Hypothesis of Semi-Arid Brazilian Ultisols and Inceptisols

Aderson Stanrley Peixoto Santos[1]; José João Lelis Leal de Souza[2]; Bartolomeu Israel de Souza[3]; Eduardo Rodrigues Viana de Lima[3]
Universidade Federal da Paraíba, João Pessoa/PB, 5045, Brasil (stanrleys@gmail.com)[1]; Universidade Federal do Rio Grande do Norte, Natal/RN, Brasil.[2]; Universidade Federal da Paraíba, João Pessoa/PB, 5045, Brasil[3]

Previous studies described Caatinga biome in Brazil as dominated by Entisols and Luvisols. However, us hypothesis is that wetter sites in Caatinga could conduce the formation of more developed soils. In this context, the work aims to highlight the taxonomic hypothesis of pedo-genealogy of the Inceptisols and Ultisols in the Brazilian semiarid. For this, nine profiles were described and collected in sites with different local and regional topographical conformations (between 400 and 1010 m above sea level). Physic-chemical soil properties were determined according to established tropical soils methods. The data were compared with the regional dynamic, climatic, geological and geomorphological conditions, with support from SRTM and GOES 13 and METEOSAT 12 satellites. As a result, the indication of genetic tendency in the formation of the Inceptisols in areas to the leeward of the regional relief, along the syncline portions of the residual masses of the outcrops, whose concavity or relief invoice allow the sedimentary stability and relative pedogenic changes that configure them. The existence of these soils occurs along the heights of 400 to 800 m of altitude, where the influence of a topographic amplitude does not occur in a representative way, in the retention of the humidity of adiabatic difference of relief, as in the environments where the Ultisols. On the other hand, Ultisols are observed in above 800 m (Θ = 20%). Contiguous regional valleys favored a zone of influence and convective systems and moisture retention of moisture, which reduced the daily thermal gradient. Therefore, we conclude that both the Ultisols and the Inceptisols present preponderant distinctions, caused by topographical (and locational) and climatic conditions, which together influence their distributions.
Keywords: Pedogenesis; Borborema province; Xeric shrubland; Caatinga biome.
Financial support:

(5883 - 1483) Highly Weathered Soil Development in the Southeastern U.S.A.

J.N. Shaw[1]; B.F. Hajek[1]; T. Knappenberger[1]; E.A. Brantley[1]; B.V. Ortiz[1]
Auburn University[1]

Highly-weathered soils of the southeastern U.S. occur in upland, well-drained environments of the Piedmont and Coastal Plain. By Soil Taxonomy, these soils are commonly Ultisols with kandic horizons or subactive CEC activity classes. Kandic horizons possess low activity clay dominated by kaolinite, hydroxy-interlayered vermiculite and sesquioxides, and share certain characteristics with argillic (relatively finer textured subsoils) and oxic (low activity clay) diagnostic horizons. These highly weathered properties are mostly due to a warm, humid climate, landscape stability due to a predominant backwearing development, and recycled sedimentary parent materials. Improved quantification of clay minerals, thermodynamic modeling, and fluvial chronosequences illustrate that clay mineralogy

systematically varies with soil development in this region. Chronosequence studies (35 pedons) in Alabama (U.S.A.) (climatic, aggradation terraces from Holocene to late Pliocene age) have illustrated the presence of vermiculite and smectite and the relative absence of hydroxy-interlayered vermiculite within the solum of Holocene terraces, but the presence of hydroxy-interlayered vermiculite with systematic depth trends on significantly older (>50,000 ybp) terraces. Pedogenic indicators including depth of solum, clay content, dithionite extractable iron, and CEC/clay ratios indicate highly weathered soils and mineralogical suites develop on the scale of 10^4 to 10^5 years in this environment.

Keywords: Ultisols, Kandic horizons, Chronosequences
Financial support:

(6161 - 1615) Modelling of water balance dynamics of a Technosol on an abandoned mine site in northern Québec (Canada)

Yves-Dady Botula[1]; Touria Ben Khouya[1]; Bruno Bussière[2]; Marie Guittonny[1]; Abdelkabir Maqsoud[1]
UQAT-Polytechnique Research Institute on Mine and Environment (RIME)[1]; UQAT-Polytechnique Research Institute on Mine and Environment (RIME) / NSERC-UQAT Industrial Chair on Mine Site Reclamation[2]

Acid mine drainage (AMD) is responsible of soil and groundwater pollution in most mining countries such as Canada, and represents a major environmental concern for the mining industry. It originates from oxidation of sulfide minerals in the mine wastes with sharp decrease of pH and increase of heavy metals concentration in drainage water. Until 2008, the Manitou mine site was considered as one of the most polluted abandoned mine sites in northern Québec (Canada) with acid-generating mine wastes covering an area of approximately 190 ha. Recently, a part of this site (identified as Tailings Storage Facility TSF 2) was reclaimed with a cover made of Goldex non-acid generating mine wastes of 1.2 to 1.8 m thick combined with an elevated water table. Half of the cover was revegetated with herbaceous plants. The main objective of the reclamation approach is to maintain a high level of water saturation in the reactive Manitou tailings and the cover made with non-reactive Goldex tailings material. This water saturation allows to limit oxidation of sulfide minerals and inhibit the production of AMD. The Manitou acid-generating tailings and the Goldex non-generating cover material above with or without vegetation can be referred as a Technosol since its properties and pedogenesis are dominated by its technical origin. Pedological properties and hydrogeological dynamics of the engineered soil cover and its colonization by plants (e.g. grasses, legumes and willows) are critical to maintain tailings at high degree of water saturation and allow successful reclamation of the abandoned Manitou mine site in the long term. The objective of our research is to model the water balance dynamics in the experimental plots of the TSF 2 and to compare it with monitoring and field observation of water balance parameters. From 2015 to 2017, volumetric water content, matric suction, soil temperature and groundwater level were monitored on 8 instrumented stations of the Manitou site. Complementary laboratory analyses were performed to determine hydrogeological properties of the cover material used to reclaim the site. Additionally, a monitoring of natural vegetation species that successfully established on the site was conducted. A one-dimensional water balance modeling was performed with Vadose/W (GEO-SLOPE International, Ltd., 2016). The aim was to evaluate the ability of this numerical model to adequately simulate the water balance while including the effect of the vegetation.

Keywords: Technosol, soil cover, water balance, mine reclamation, revegetation, abandoned mine site
Financial support: Fonds de recherche du Québec – Nature et technologies (FRQNT)

(7325 - 3063) Pedogenesis in a semi-arid wetland

Evaniely Sayonara Dos Santos Costa Gualberto de Sá[1]; Valdomiro Severino de Souza Júnior[1]; Artur Henrique Nascimento da Silva[1]; Juliet Emília Santos de Sousa[1]; José Coelho de Araújo Filho[2]
UFRPE[1]; EMBRAPA[2]

The Convention on Wetlands of International Importance - RAMSAR is an intergovernmental treaty that establishes frameworks for national actions and for cooperation among countries with the aim of promoting the conservation and the wise use of wetlands in the world. These wetlands include environments with natural or artificial, permanent or periodic water. These wetlands are also found in arid and semi-arid environments, such as temporary ponds, which are generally small and shallow, intermittently flooded, and pass through a period of annual drying with no surface water. They are of great importance to the environment because they are responsible for a high biodiversity and productivity. There are many studies about these lands in the fields of biogeochemistry, ecology and botany. However, no significant studies were found regarding the pedogenesis of these soils. Thus, the purpose of this work is to identify the pedogenetic processes and to classify chemically, physically and morphologically the soils. The study was carried out in four soil profiles (P1, P2, P3, P4) distributed in a dry lagoon in Parnamirim City, Pernambuco, Brazil, taking into account the position of the points in the landscape and the absence of anthropic interference. The profiles were morphologically described and the horizons evaluated for physical, chemical and mineralogical properties. The profiles P1 and P2 were classified as Vertisols, with a gray color typical of gleation processes, as well as vertization: presence of slits, slickensides and argiloturbation. P3 was classified as Gleysol with gley horizon; and P4 classified as Planosol with presence of B textural. Soils also have kaolinite, smectite and strong feldspar minerals.

Keywords: temporary ponds, wetlands, semiarid, pedogenesis.
Financial support:

(8226 - 689) Pedogenic forms of iron and manganese and its implication on soil genesis over a lithosequence in Nigeria.

Babalola, Temitope S.[1]; Fasina, Abayomi S.[2]; Shittu, Olubunmi Samuel[3]; Ogunleye, Kayode S.[2]; Kadiri, Wasiu O. J.[1]; Ilori, Augustus O. A.[3]
Kabba College of Agriculture, Division of Agricultural Colleges, Ahmadu Bello University, Nigeria.[1]; Department of Soil Science and Land Resources Management, Faculty of Agriculture, Federal University Oye, Oye-Ekiti, Nigeria.[2]; Department of Soil Resources and Environmental Management, Faculty of Agricultural Sciences, Ekiti State University, Ado-Ekiti, Nigeria.[3]

Citrate-bicarbonate-dithionite extractable iron and manganese oxides (Fe_d and Mn_d), Oxalate extractable iron and manganese oxides (Fe_{ox} and Mn_{ox}) and Sodium pyrophosphate extractable iron and manganese oxides (Fe_p and Mn_p) were studied on soils from two agro ecological zones in Nigeria. The active iron and manganese oxide ratios ($Fe_{ox/d}$ and $Mn_{ox/d}$) and Clay/dithionite iron ratio (clay/Fe_d) were evaluated in the soils derived from schist and older granite to establish influence of parent material on soil development and identify major pedogenic processes in the study area. Significant differences were observed in means of most of the properties studied between the parent materials with exception of means of Fe_d and $Mn_{ox/d}$ that were not significant. There were higher values of Fe_d, Fe_{ox}, Fe_p, Mn_d, Mn_{ox} and Mn_p (2.276, 0.511, 0.350, 0.085, 0.017 and 0.016%) respectively in soils formed on schist. Significant differences were observed in the means of Fe_d between horizons with subsurface

horizons having higher mean values than the surface. There was correlation between the forms of iron and manganese with gravel, clay, pH and exchangeable cations. This study revealed that parent materials influence pedogenesis in the soils studied and the extent of pedogenesis varied on the lithosequence. Furthermore, co-translocation of Fe with clay by elluviation and illuviation, plinthization and co-migration of clay with Mn_d were the major pedogenic processes in the soils.

Keywords: Iron, manganese, older granite, parent material, pedogenesis and schist.
Financial support:

(3785 - 338) Physical properties of salt-affected soils surrounding saline and brackish lakes in the Pantanal wetland, Brazil.

Flávia de Oliveira Damaceno[1]; Sheila Aparecida Correia Furquim[1]; Juliana Gardenalli de Freitas[1]
UNIFESP[1]

The Nhecolândia subregion, located in the central-southern portion of the Pantanal wetland, presents hundreds of saline lakes that are not commonly reached by the seasonal floods. However, recent studies showed that some of these saline lakes have been transformed into brackish lakes due to the input of freshwater from the inundations, provoked by the erosion of the saline lake surroundings. Consequently, the Saline-Sodic soils formed around the saline lakes have been converted into Sodic (Solonetzes) and Degraded Sodic soils (Solodized-Solonetzes and Solods). In this study, the hydraulic conductivity (K) and bulk density (BD) of one Saline-Sodic, two Solonetzes, one Solodized-Solonetz and two Solod profiles, the former associated to a saline lake and the last three associated to brackish lakes, were determined in order to understand the consequences of the salt-affected soils transformation in these physical properties. K and BD were determined, respectively, by the falling head permeameter test and the clod method. K has the lowest value in the Saline Sodic soil ($4.5x10^{-4}$ cm s^{-1}), increases in the Solonetzes ($1.2x10^{-3}$ to 2,8 x 10^{-3} cm s^{-1}) and tend to decrease again in the Solodized Solonetz ($8.0x10^{-4}$ cm s^{-1}) and Solods ($9.3x10^{-4}$ to$1.3x10^{-3}$ cm s^{-1}). Also, the Saline Sodic soil present the lowest SD (2.8 g cm^3), whereas no clear pattern was verified from the Solonetzes (2.9 to 3.6 g cm^3) to the Solodized Solonetz (3.5 g cm^3) and Solods (2.9 to 3.4 g cm^3). These results do not corroborate the assumption that the progressive decrease of soil sodicity correspond to an increase of K and decrease of BD values, especially due to a higher colloid flocculation and the consequent structure and pore development. Our results are likely related to the formation of nodules (Mn, Fe, silt and clay-enriched) around the brackish lakes, which tend to generate higher bulk densities and prevent significant K increasing in the evolution of the salt-affected soils. The lower K in the Solonetzes is probably associated with a higher presence of silt and clay-enriched nodules and a less abundant presence of Mn/Fe nodules, which probably allows the production of a more connected porosity. Because the formation of the Mn and Fe nodules is common in salt-affected soils, the interpretation that the decrease of sodicity improves soil physical conditions is not always valid.

Keywords: Solonetz, Solodized-Solonetz; Solod; bulk density; hydraulic conductivity.
Financial support:

(9017 - 1666) Salt distribution and organization in Soils from Arid and Hyperarid environments, northern Chile

Davi Feital Gjorup[1]; Carlos Ernesto G. R. Schaefer[1]; Marcio Rocha Francelino[1]
Universidade Federal de Viçosa[1]

Many soils in desertic zones shows soluble minerals accumulation. Low information is available about distribution and organization of these minerals in arid-hyperarid soils. We present the distribution and organization of soluble minerals in 10 soils from arid and hyperarid zones of Atacama Desert, Northern Chile. Samples were characterized chemically and physically. Soluble minerals were extracted in soil solution (1:1 soil:water), and anions were determined by ionic chromatography (NO3, SO4, Cl) and titration (CO3 and HCO3). Micromorphological descriptions of selected horizons were performed. Soluble minerals accumulation is the main pedological process in the study area. At hyperarid zones, salt redistribution is closed to soil profile, and losses are negligible; accumulation is high and very soluble minerals is an important component. At arid zones, accumulation and losses coexist, and vary due to landscape position. Well drained arid soils are subject to leaching losses. Poorly drained soils receipt soluble minerals from other zones, and accumulation is intense. Landscape transport of soluble minerals in arid landscape vary due to mineral solubility and landscape position. Pedogenic carbonate accumulation is widely distributed, but incipient. Present-day climate is not favourable to pedogenic carbonate reorganization. Extensive carbonate pedofeatures were attributed to past hydrologic conditions. Gypsification is general in study area, and all stages of the process were detected. The process vary due to precipitation and landscape position. In extreme hyperarid zones pedogenic sulphate reorganization were not detected. Some soils were subject to a almost complete gypsification, with volumetric gain, to the extent that the original soil constituents become of secondary quantitative importance. Salt accumulation is associated with proximity to salt sources, or very low precipitation. Some organization forms indicate climatic variation with aridity intensification. Lowland soils shows higher saline content in any climatic system, due to high solubility and landscape mobility of saline minerals. Micromorphological study of soils subjected to a intense soluble minerals accumulation requires conceptual and methodological development. In this study, possible mineral alterations were detected in thin sections, due to hydratation or solubilisation of instable minerals.

Keywords: Pedogenesis, Saline Soils, Atacama.
Financial support: CAPES CNPq

(8183 - 2832) Soil relations and landscape in ferruginous geosystems: The example of the Tableland of Canga, in Minas Gerais, Brazil.

Anna Paula Vilemberg Botelho[1]; Cristiane Valéria de Oliveira[1]; Henrique Amorim Machado[1]
Universidade Federal de Minas Gerais[1]

Ferruginous soils and ferruginous outcrops are among the most threatened ecological systems in Brazil due to their restricted distribution, associated with the country's main iron ore deposits, harboring an endemic biodiversity, providing a high relevance geoenvironmental heritage such as water recharge areas. Therefore,the objective of this work was to understand the soil and landscape relationships of ferruginous environments with the landscape of the Tableland of Canga, inserted in the Fonseca Basin, located in the extreme east of the Quadrangle Iron. It should be emphatize the influence of two distinct geomorphological units: a dominant topographic positioning (Montain of Caraça), formed by itabirites and supported by quartzites and a relief of aplaine (tabuliform), formed by sedimentary depositions, originating from the Fonseca Basin formation, presenting fluvial dissection in the less resistant areas, superimposed by a ferruginous bed. As a méthod of analysis of the soils present in the Tableland of Canga, particle size and particle density analyzes were used, in which it was possible to infer the existence of the domain of the lithostructural control of the geological material of itabirite source, with high density and high degree of magnetization, resulting in shallower soils in the upper portion of the Tableland of Canga and deeper soil in the areas of depression near the drainage head, on the left margin of the

Piracicaba River, where it is inferred that this lower altimetric level portion suffered preteritally the influence of alluvial fan formation, generating soils of greater thickness and with ferruginous characteristics.
Keywords: ferruginous soils, soil Genesis, Quadrangle Iron
Financial support:

(4030 - 502) Typical and extreme Vertisols in space and time

Irina Kovda[1]
1- Institute of Geography RAS; 2 - V.V. Dokuchaev Soil Science Institute[1]

Typical Vertisols (WRB, 2015) are churning, heavy clay soils formed on parent material with a high proportion of swelling clays. They have deep wide cracks when dry, and occur in depressions and level to undulating areas, mainly in tropical, subtropical, semi-arid to subhumid and humid climates with an alternation of wet and dry seasons. Typical vegetation is savannah, grassland and/or woodland. They may have a gilgai microrelief. Vertisols are recognized by vertic horizon with wedge-shaped aggregates and slickensides starting ≤ 100 cm from the soil surface. The aim of our research is to evaluate the extreme environments for Vertisol formation i.e. the full range of possible climate (MAAT and MAP), vegetation, geomorphology, parent material and time, where they occur. We also aimed to estimate the change of leading soil forming factor and its impact on shrink-swell process and formation of vertic features in the extreme cases, and to find the special attributes, characteristic for each extreme case. Most Vertisols occur in semi-arid tropics with MAP 500–1000 mm/yr. Meanwhile they are known in extremely dry (50 mm) or wet (3000 mm) climates. The MAAT in Vertisols areas is generally in between of 15-26 ^{o}C. But they occur in areas with MAAT 30 ^{o}C, and have been recently found in Siberia with MAAT –4.2 ^{o}C. Typically Vertisols are montmorillonitic. At the same time kaolinite (in Australia, Hawaii, Cambodia, Salvador, Sudan), illite (Australia, Bulgary) and polymineral (Trinidad) Vertisols also occur. Gilgai indicating strongest shrinking, swelling and shearing vary in lateral size from 3-4 up to 20 m, have amplitude from 5-30 up to 100 cm, and a range of forms. The most common gilgai are rounded. Tank, melon-hole, wavy, lattice, dendritic gilgai also occur. Extremal gilgai in Australia having an amplitude > 240 m and wavelength ~120 m was named giant. The age of Vertisols is known from < 100 yrs to ~2.5 billion yrs. Extreme Vertisols (i.e. formed in atypical environment or having atypical attributes) may be the result of various combinations of texture, mineralogy, geomorphology, and hydrothermic conditions. On the other hand, extreme Vertisols can be associated with the history of soils and landscapes development being in fact relic soils (exhumed or non-buried paleosol), or initial Vertisols started to shrink/swell due to climatic changes (drying, wetting, warming) or at a next appropriate stage of the climatic cycle.
Keywords: soil geography, pedogenesis, morphology, evolution, landscapes, climate change
Financial support: This study was supported by the Russian Science Foundation, project no. 14-27-00133

(3925 - 615) unity of soils evolution during time

Tskhovrebov V.S.[1]; Faizova V.I.[1]; Novikov A.A.[1]
Stavropol State Agrarian University[1]

The process of soil formation is uniform for all corners of the land and there are no soil-forming processes. There are specific features in the direction of soil formation, due to the composition and quality of the parent rocks, climate, and relief. The essence of soil formation is in the biological weathering, accumulation and transformation of weathering products of mineral and organic matter. In evolutionary development, soils sequentially undergo stages from birth on the rock to their natural death (neo-breed). The first stage is the beginning of soil formation. There is a settlement of vegetation on the initial soil-forming rock. The second stage is accelerated soil formation. The formation of the upper genetic horizons begins and the main soil features and differentiation of the profile appear. The third stage is slowed down soil formation. All genetic horizons of soils continue to form and the profile capacity and fertility level increase. The fourth stage is mature soil. The formation of the soil profile and all genetic horizons is completed. It is used to call this stage climacteric when the stage of equilibrium functioning comes and all the processes take place within the framework of relatively stable biochemical cycles. But is it possible to achieve equilibrium and constancy in open biological systems with constant inflow and outflow of matter and energy? The weathering of the mineral base, the alienation of the elements of nutrition continues and the depletion of soils is inevitable. The fifth stage is the aging of the soil. Further weathering of minerals leads to a significant difference in their qualitative composition between the soil and the soil-forming rock. The amount of organic matter and elements of nutrition is reduced. Soil fertility decreases. The sixth stage is the death of soils. The mineralogical composition of soils and soil-forming rocks is radically different from each other. The bulk is made up of poor in chemical composition of newly formed minerals. Soil can no longer satisfy the needs of plants in the elements of mineral nutrition. Depending on climatic conditions, the first four stages can last from ten to one hundred thousand years, the fifth stage from one to two million years. The given scheme of evolution can be successfully applied only in the wet zone. Naturally, in conditions of dry or moderately damp climate of steppes, the duration of the stages is longer and it is impossible to expect the death of soils.
Keywords: Key words: evolution, stages of soil formation, weathering, aging, death of soils.
Financial support:

(5933 - 1924) Weathering of metamorphic rocks and formation of planosols in semi-arid environment, Brazil

Valdomiro Severino de Souza Junior[1]; Laércio Vieira de Melo Wanderley Neves[1]; Jean Cheyson Barros dos Santos[1]; José Coelho de Araújo Filho[2]; Marcelo Metri Correa[1]; Luís Felipe Inácio da Silva[1]
Universidade Federal Rural de Pernambuco[1]; Embrapa Solos[2]

In the Brazilian semi-arid region, the evolution of the surface tends to the flattening with monotonous landscapes of smooth undulating relief where large expanses of Planosols occur. The action of the time, with perpetuation of the aridity conditions, results in the formation of shallow soils, physical and chemical denudation with loss of the superficial layers, water regime with evapotranspiration that exceeds the precipitation, making these areas naturally susceptible to degradation. However, recent studies of soil genesis in the region have shown that the lithology of felsic rocks is the main factor that leads to the Planosols pedogenesis imposing on the soil the main physical, chemical and mineralogical attributes. The objective of this work was study the evolution of the weathering front in gneiss saprolites (felsic rocks) in two profiles of Planosols under different levels of severity of degradation (point 1 incipient degradation and point 2 degradaded area under desertified area in Pernambuco. In order to deepen the knowledge of the role of the source material in the intrinsic characteristics of the soils. The primary assembly and pedological features were determined using optical microscopy techniques in thin sections of the R / Cr horizon. The variability in the contents of the series albite up to anorthite was determined by the Michael-Levy diagram, as well as the domains of primary mineralogy and accessory minerals. The secondary assembly was identified by X-ray diffractometry, coupled with complementary techniques such as SEM / EDS scanning electron microscopy, thermogravimetric and differential (DTA /GT), vibrational analyzes using InfraRed (IR). The results showed that felsic rocks present great variability in types and proportions of alkali and plagioclase feldspar, including perthites, with alteration routes and quite different secondary products. Point 1 has

higher concentrations of quartz, K-feldspar, biotite and presence of pertites. The secondary mineralogy is dominated by alumina smectites. Alteration route with K-feldspar / biotite > Ilite> beidelite. It presented pedalities with b-factories and biological cavities. In point 2 the quartz domain and higher concentrations of placiocases in relation to alkalis-feldspar, domain of smectites with octahedral sites of negative charge in the secondary, possible route Plagioclase / sericite / biotite > kaolinite / montmorilonoite. It presented weak pedality.

Keywords: Desertification; Mineral alteration; feldspar; plagioclase; perthitas; beidelitas; montmorillonite

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C1.3.3 - Anthrosols - the human constructed soils

(7005 - 1629) Amazonian Dark Earth: proposal of modification of the pretic horizon criteria

Fernanda Reis Cordeiro[1]; Ademir Fontana[2]; Andressa Rosas de Menezes[1]; Wenceslau Geraldes Teixeira[2]; Lúcia Helena Cunha dos Anjos[1]

Federal Rural University of Rio de Janeiro[1]; Embrapa Solos[2]

The Amazonian Dark Earths (ADE) were formed by influence of pre-Columbian anthropic activities and have being reported mainly in the Amazon Basin. According to the World Reference Base for Soil Resources (WRB), among the diagnostic horizons for the Anthrosol class, the pretic horizon is a mineral surface horizon characterized by its dark colour, the presence of artefacts and high contents of organic carbon, phosphorus, calcium, magnesium and micronutrients, usually contrasting with natural soils in the surrounding area. It typically contains visible remnants of charcoal. It has as diagnostic criteria: dark color; organic carbon (C org) ≥ 10 g kg^{-1}, P (Melich I) ≥ 30 mg kg^{-1} and Ca^{2+} + Mg^{2+} ≥ 2.0 $cmol_c$ kg^{-1}. The objective of this work was to classify profiles identified in Brazil as ADE using the WRB system. The profiles were compiled through a bibliographical research of soil surveys, thesis and dissertations, and other publications. Thirty profiles with anthropic horizons were identified with data sufficient to classify the soils using WRB. These ADE are distributed in the Brazilian states of Amazonas (24 profiles), Roraima (1 profile), Rondônia (1 profile), and Pará (4 profiles). From the horizons identified as anthropic (Au), only 30% were classified as pretic horizon. Therefore, considering the low correspondence of the taxonomic classification in the WRB with the identification of the ADE by Brazilian standards, new quantitative criteria are proposed for the pretic horizon: (i) thickness ≥ 20 cm; (ii) color (wet) with value ≤ 4 and chroma ≤ 3; (iii) Ca^{2+} + Mg^{2+} weighted: Σ [(Ca^{2+} + Mg^{2+} x thickness of the Au sub-horizons) / total thickness of the Anthropic A horizon] ≥ 2.0 $cmol_c$ kg^{-1}; (v) P (Melich I) weighted: Σ [(P x thickness of the sub-horizons Au) / total thickness of the anthropic horizon A] ≥ 30 mg kg^{-1}; and (v) C org weighted: Σ [(C org x thickness of the sub-horizons Au) / total thickness of the anthropic horizon A] ≥ 6.0 g kg^{-1}. It is also proposed to reduce the thickness of the pretic horizon required to be included in the Anthrosols class from 50 to 30 cm. Using these criteria 50% of the profiles that had a pretic horizon were classified as Anthrosols. The current WRB criteria for classification of pretic horizon and Anthrosols exclude 70% of the profiles identified in the literature from Brazil as ADE. Therefore, a revision of the criteria is recommended, since this horizon was created to encompass the so called Amazonian Dark Earths.

Keywords: Diagnostic surface horizon; 'Terra Preta de Indio'; Anthrosols.

Financial support: CNPq; Embrapa Solos; UFRRJ.

(7561 - 2497) Amazonian dark earths located in the fertile floodplains in the central Amazon - Brazil

Wenceslau Geraldes Teixeira[1]; Rodrigo Santana Macedo[2]; Eduardo Góes Neves[3]

Embrapa Solos, Rua Jardim Botânico, 1024, 22460-000, Rio de Janeiro, Brazil; wenceslau.teixeira@embrapa.br[1]; Instituto Nacional do Semiárido - INSA, Campina Grande, Brazil; rodrigo.macedo@insa.gov.br[2]; Museum of Archaeology and Ethnology, University of São Paulo,vedgneves@usp.br[3]

Amazonian Dark Earths (ADEs) are highly fertile soils horizons created by pre-Columbian Amerindian societies of the Amazon basin. However, there is still not agreement on whether these Anthrosols were produced intentionally to improve the unfertile Amazonian upland soils or whether resulted from the accumulation of waste from sedentary settlements. This study brings a pedogeochemical characterization of ADE found in the naturally fertile alluvial floodplains of the Amazon river in the Central Brazilian Amazon. The analyzes quantify total, exchangeable and available contents of elements and organic carbon in soil profiles. The ADEs showed higher contents of available, and total P, Ca, Zn and Cu. High contents of total Cr, Ni, Co and V indicate contribution of mafic minerals in the soil genesis, while higher contents of P, Zn, Ba and Sr in the ADEs indicate anthropic enrichment. The occurrence of ADE in floodplains brings strong evidence of non-intentional anthropic fertilization of the alluvial soils, which, in natural conditions have contents of P, Ca, Zn, Cu above of the critical levels to cultivate the most common plants. The presence of archaeological sites in the floodplains shows also that pre-Columbian populations lived on the floodplains as well as on the bluffs overlooking the Amazon river.

Keywords: Terra Preta de Índio, Gleisols, Anthrosols, pretic, Amazonian archaeology

Financial support: Embrapa Amazônia Ocidental, Universidade Federal do Amazonas – Programa Agronomia Tropical

(6704 - 2734) Anthropic soils in central Brazil archaeological sites

Jordana Batista Barbosa[1]; Marisa Coutinho Afonso[1]; Julio Cezar Rubin de Rubin[2]

Museu de Arqueologia e Etnologia da Universidade de São Paulo[1]; Pontifícia Universidade Católica de Goiás[2]

Everything that surrounds us involves physical and chemical transformations, so that the understanding of these phenomena is essential for human development in every aspect. Making use of geochemistry, archaeometry and micromorphology techniques is fundamental to study the soils in archaeological context and its indicators of human occupation. Amid the biomes in Central Brazil, the *Cerrado* stands out for its biodiversity and tropical climate with two well defined seasons, humid in the summer and dry in winter and with a higher thermal amplitude than in the equatorial climate and lower rainfall. In this sense, the environment is an extremely important variable when it comes to chemical phenomena. An example is phosphorus which is considered a nutrient of low mobility in tropical soils, a behavior attributed to its fixation by the clay minerals. This element has a relevant presence in archaeological sites located in tropical environments that also present high levels of iron and aluminum oxides - with which P has a great affinity. Considering this, we use the archaeological sites Cangas I and Lago Rico (Goiás, Central Brazil) to study and understand the behavior of the chemical composition of anthropogenic soils in tropical environments and their pedological features (features inherited from the parental rock or formed by processes of deposition of transported material). Carbon, organic matter and some minerals stand out in the analyzes including phosphorus, calcium, zinc, potassium, barium and strontium. Among

all the analyses carried out at the sites, the values of Carbon and organic matter have similar mean values, but the phosphorus contents ranged from 55.0 to 288 (ppm) and Carbon from 5.8 to 14.5 (ppm) in the areas with higher concentration of ceramic traces. Hence, geoarchaeological techniques associated with ethnohistorical and ethnographic information allow inferences on the existence or non-correlation between cultural vestiges and forms of occupation, regardless of whether they are dark Earth (terra preta), and may present information on the patterns of human occupation of the area.
Keywords: Geochemistry; micromorphology of soils; geoarchaeology; archaeological sites, Central Brazil.
Financial support: FAPESP/Fundação de Amparo à Pesquisa do Estado de São Paulo/ Brasil, Processo: 2016/22192-7 (JBB) e CNPq/ Conselho Nacional de Desenvolvimento Científico e Tecnológico, Processos:310373/2016-6 (MCA) e 303798/2016-5 (JCRR).

(9299 - 901) Anthrosols constructed by the indigenous people of southern Brazil

Fabrício de Araújo Pedron[1]; Luis Antonio Coutrim dos Santos[1]; Catiusca Peretto[1]; Alice Prates Bisso Dambroz[2]
Universidade Federal de Santa Maria[1]; Unversidade de Cruz Alta[2]

The indigenous peoples of the Neolithic period who lived in the southern region of Rio Grande do Sul (RS), Brazil, were known as Charruas and Minuanos. They had nomadic habits, living in seasonal camps on the banks of ponds or rivers. In order to escape the constant flooding of these lowlands, they constructed their camps on landfills called "cerritos". Cerritos are human made mounds of earth and residues of anthropic activity with a few centimeters to several meters in height. These archaeological sites were dated from 500BC to 1750AC. The cerritos are important archaeological sites with a huge research demand. The objective of this research was to investigate the characteristics of the soils constructed in an archaeological site located on the Butui-Mirim river in the municipality of São Borja, RS, Brazil. Four cerritos were evaluated, samples of adjacent natural soils were also collected under annual cropping and native grass field for comparison. The soils in the cerritos were classified as Anthrosols, while the adjacent soils were classified as Leptosols and Gleysols. The evaluated cerritos presented depth ranging from 60 to 120 cm. The Leptosols presented a maximum depth of 10 cm over the parent rock (basalt). The Gleysols had a depth greater than 80 cm. Morphological evidence of anthropic alteration was observed in the profile of the soils in the cerritos, such as the erratic presence of coarse fragments, resulting from the transport of stony soils from the surrounding areas and the presence of chipped silicified sandstone. The average clay content of the Gleysols was 50% while in the Antrhosols it was 21%, very close to the value of the Leptosols (24%) suggesting that the cerritos were constructed by the accumulation of adjacent areas. The Anthrosols presented an average of sum of bases (14 cmolc kg^{-1}) higher than the adjacent Leptosols (7 cmolc kg^{-1}). The P values, which ranged from 37 to 486 mg kg^{-1} in the Anthrosols, from 8 to 19 mg kg^{-1} in Leptosols and from 2 to 5 mg kg^{-1} in the Gleysols, evidencing the increase of P in the soils constructed by the native indians. These archaeological sites have suffered frequent degradation by their leveling in areas of irrigated rice cultivation. Its preservation and study is fundamental for the understanding of important pedological processes for society.
Keywords: Arqueological soils, Charrua, Minuano
Financial support: Soil Museum of Rio Grande do Sul – Brazil

(8870 - 1416) Chemical properties and Δ13 C of Amazonian Dark Earths under different land uses from Southern Amazon

Rafael de Souza Cavassani[1]; Lúcia Helena Cunha dos Anjos[1]; Marcos Gervasio Pereira[1]; Robson Altiellys Tosta Marcondes[1]
Universidade Federal Rural do Rio de Janeiro[1]

The Amazon Dark Earths (ADE), also known as "*Terra Preta de Índio*", are identified by the anthropic horizons, and result of ancient Pre-Colombian civilizations. Five sites of ADE where chosen in Rondônia, Southern Amazon. Profiles with (P1 to P6) and without (P7) anthropic horizons, and variation of land coverage (forest, pasture, and no-till system with soybean and maize) were selected. Soils were characterized according to Santos et al (2013) and EMBRAPA (1997). The total organic carbon (TOC) and isotopic variation of $^{13}C/^{12}C$ (δ13C) were analyzed. Charcoal samples were submitted to radiocarbon dating by Accelerator Mass Spectrometry technique. Contents of Ca^{2+} and Mg^{2+} were high (23.0 and 4.4 $cmol_c$ kg^{-1}) compared to the non-ADE soil (2.8 and 1.3 $cmol_c$ kg^{-1}). This is associated with presence of animal bones, and some authors relate it to increase of CEC due to high contents of stable organic matter. Contents of phosphorus were also very high, up to 451.9 mg kg^{-1}. The high P is associated to dietician habits of the Pre-Colombian civilizations. Sodium and potassium were low in all soils. The high precipitation rates of Amazon region leads to lixiviation of monovalent cations. The CEC of ADE were up to 27.7 $cmol_c$ kg^{-1}, while the non-ADE had values lower than 8.0 $cmol_c$ kg^{-1}. The low CEC is typical of weathered soils with low organic matter. The results of δ13C in the ADE under pasture had δ13C varying from -20.8 to -25.8 ‰. Despite the usage with grasses (*Brachiaria sp)* of cycle C4 for over 20 years, the results reveal dominance of C from plants with metabolic cycle C3, inherited from previous forest cover. It is not clear if these results are related to a higher capacity of ADE in maintaining the δ13C levels because of the biochar content, or simply due to time of usage with C4 plants. Values of δ13C were similar among P5 (ADE-under forest), P6 (ADE) and P7 (non-ADE), these last two under no-till system. The similarity is explained by implementation time of the system, only 7 years, as well as presence of soybean (C3 plant) in this succession. The horizons used for 14C carbon dating, P2 Au4, P4 AB and P5 Au4 had values δ13C of -24.4, -23.4 and -23.8 ‰, respectively, indicating the origin of the C from C3 plants. The main aspect in ADE soils is the high amounts of stabilized organic matter and pyrogenic carbon, up to 44.43 g kg^{-1}. Understanding formation of ADE can lead to development of agricultural sustainable models in tropical low fertility soils.
Keywords: Terra Preta de Índio; Amazon soils; natural abundance of ^{13}C
Financial support: CNPq, CAPES e UFRRJ- PPGA-CS

(3526 - 2097) ecosystem engineers and other macroinvertebrates in dark earths and non-anthropic soils in central amazonia

Wilian C. Demetrio[1]; David Stanton[2]; Ana Caroline Conrado[1]; Talita Ferreira[1]; Marie L. C. Bartz[3]; Alessandra Santos[1]; Peter Kille[2]; Luís Cunha[2]; George G. Brown[4]; TPI Network[5]
Federal University of Paraná[1]; Cardiff University[2]; Positivo University[3]; Embrapa Forestry[4]; [5]

Soil invertebrates drive many ecological functions in the environment. Due their sensitivity to anthropic disturbances, these animals can be used as a tool to evaluate environmental quality. Earthworms, ants and termites generally represent the majority of the soil macrofauna population at a given site, and are called "ecosystem engineers" for being able to alter the physical soil environment. However, little is known about soil animals in Terras Pretas de Índio (TPIs), also called Amazonian Dark Earths, soils formed after centuries of occupation the pre-Columbian civilizations, and the consequences of ancient and recent land use management on their populations. We evaluated soil macrofauna communities in TPIs and non-anthropic soils (ADJ) under

old and young forests and agricultural systems in three States of Central Amazonia (Brazil) using the Tropical Soil Biology and Fertility (TBSF) standard handsorting methodology. The Principal Component Analysis (PCA) separated TPIs from ADJ soil in the first axis considering the soil fertility, and the environments evaluated in the second one considering the level of human disturbance. The results showed that ecosystem engineers were the most representative macrofauna group in all systems studied and soils evaluated. Termites presented preference by ADJ soils, while earthworms were more abundant in TPIs. Other invertebrates, such as ants, beetles and myriapods showed no preference for TPIs or ADJ soils, however, land use systems strongly affected their populations, with lower densities observed with increasing environmental disturbance.

Keywords: Earthworms. *Terra Preta de Índio*. Soil macrofauna. Land use systems.

Financial support: CAPES, CNPq

(5901 - 1828) Features and processes behind charcoal-kiln artefacts on volcanic lands

Mwampamba T.H.[1]; Olivares-Martínez L.D.[2]

Ecosystems and sustainability Research Institute, UNAM Campus Morelia, 8701 Antigua Carretera a Pátzcuaro Col. Ex Hacienda de Sán José de la Huerta, Morelia, Michoacán, Z.C. 58190 México[1]; [2]

Rural people living in forests uses wood for charcoal production, they cut some trees, then they pile them up in mounds used as in situ kilns which they pyrolysis after; at the end they take the useful charcoal from the kiln and leave a thin debris layer. This activity can produce not only charcoal garbage, but strong physical disturbances. We surveyed the features of 8 charcoal-kiln influenced soils in forest of the Trans-Mexican Volcanic Belt and we evaluated their physical and morphological effects on volcanic soils. We used preliminary classifications according to all the applicable WRB criteria for only field descriptions and inferred characteristics without lab analysis. Eighteen horizons with charcoal remnants with different abandonedages where identified, The normal length of a charcoal-kiln horizon was around 20 cm. It is very often that the place destined once to be a charcoal-kiln is used again as a charcoal-kiln. Very recent abandoned charcoal-kilns showed the superficial crust and a layer full of pieces of charcoal. In charcoal-kilns with more than 5 years of abandonment showed some fine earth between the charcoal pieces and some hydrophobicity in their underneath layer. In old rests there were just a couple of little pieces of charcoal, but a high soil penetrability. It resulted evident the more time of abandonment the less charcoal percentage in a layer. Moreover, the soils where classified as Technosols for the accumulated charcoal content of all the layers, the oldest charcoal soils returned back to Andosols –the dominant soil and the original soil on these cases– anyway they preserved enough remanent artifacts and Prototechnic was an applicable qualifier. The hydrophobic effects seem to be related with the heat reached during the pyrolysis of the kiln. It is possible than the hydrophobic materials were formed during the pyrolysis and during the decomposition and washing of the remanent charcoal by the rain. The rodent activity generated parts on specific layers with less amount of artefacts, which reduces the layer percentage of charcoal and promotes an illusion of older soils. Tilling generates a very similar effect. At the end, charcoal-kilns affect the hydrophobicity, the bulk density and the length of the original soil, in most cases Andosols. The more years an abandoned layer has the less charcoal percentage is observed.

Keywords: Anthropic soils, hydrophobicity, Technosol

Financial support:

(8807 - 934) Geochemical balance of Archaeological Dark Earth and adjacent soils in Western Amazonia, Brazil

Luís Antônio Coutrim dos Santos[1]; Fabrício de Araújo Pedron[1]; Bruno Campos Mantovanelli[1]; Mariana Coutrim dos sSntos[2]; Catiusca Peretto[1]; Uilson Franciscon[2]

Federal University of Santa Maria[1]; Federal University of Amazonas[2]

In the middle of the landscape of infertile soils of the Brazilian Amazon, there are patches of soils of high natural fertility, known as Archaeological Dark Earth (ADEs). The objective of this work was to study the geochemical balance in ADEs and adjacent soils in the Western Amazon. The areas of Archaeological Dark Earths (ADEs), Mulatto Earth (MEs) and Non-Antropical Soils (SNAs) are located in the Southern Amazonas mesoregion, more precisely in the municipality of Apuí. Two sites were selected in each environment to open trenchs, totaling six profiles. The semiquantification of total elements (Al, Si, Fe, K, Na, Mg, Ca, Mn, Zr, Zn, Ti and P) was performed in an X-ray fluorescence spectrometer. The elements were expressed in the form of oxides: Na_2O, MgO, Al_2O_3, SiO_2, P_2O_5, K_2O, CaO, TiO_2, MnO, Fe_2O_3, ZnO, ZrO_2. It was estimated the degree of weathering by chemical change index (CIA) and geochemical balance by means of the mass transport function in open system (Ʈ) by the relations between the most mobile elements (K, Ca, P, Fe, Si and Al) and less mobile (titanium). The dominance of SiO_2 and Al_2O_3 was observed for all studied soils. The similarity of the values of the less mobile elements in the soil (TiO_2 and ZrO_2) between the soil horizons and between the soils indicates the same source material for the soils. The highest CIA values were observed for the NASs, with values higher than 98%, evidencing a weathering stage above the other soils. The function Ʈ presented losses for the elements Al, K and Si in all the soils, showing the mobility and the loss of these elements during the weathering. The positive values of the function Ʈ (Fe), shows the enrichment of Fe, mainly in the B horizons, which is justified by the concentration of iron sesquioxides in these horizons. For the ADEs and the anthropogenic horizons of MEs, the values of Ʈ (Ca) show the gain of this element in the soil, mainly in the superficial horizons. The function Ʈ (P) was positive only for the Aup horizons of the ADEs. The highest positive values of Ʈ (Ca) and (P) are directly related to the higher incorporation of calcium and phosphorus rich residues during the antrophication process of the anthropic soils. In spite of the formation of the same source material, the enrichment of P and Ca in the ADEs and MEs shows the contrast between the anthropic soils and the NASs, thus showing that the anthropophic processes were responsible for the Ca and P enrichment of the anthropic soils.

Keywords: Amazonian Soils, Anthropization, Anthropogenic Soils, X-ray fluorescence.

Financial support: Foundation for Research Support of the State of Amazonas

(4584 - 1297) Magnetic signature of anthropogenic and non-anthropogenic soils from Western Amazonia, Brazil

Alice Prates Bisso Dambroz[1]; Luís Antônio Coutrim dos Santos[2]; Fabrício de Araújo Pedron[2]; Laércio Santos Silva[3]; Camila Viero Maia[2]

University of Cruz Alta[1]; Federal University of Santa Maria[2]; São Paulo State University, School of Agricultural and Veterinary Studies[3]

Amazon's anthropogenic soils are characterized by the presence of ceramic fragments, high natural fertility and high levels of organic matter, in contrast to adjacent soils. The determination of the presence of ferrimagnetic minerals in Archaeological Dark Earths (ADEs), through the magnetic susceptibility (MS) technique, allows the understanding of these soils attributes and formation processes. The aim of this study was to determine the magnetic susceptibility and the percentage of dependent frequency magnetic susceptibility (χdf) of Archaeological Dark Earths, Mulatto Earths (MEs) and non-anthropogenic soils. The soils are located in the municipality of Apuí, Southern region of the state of Amazonas. Six profiles were analyzed, two with ADEs, two with MEs and two non-anthropogenic soils. The MS of air-dried fine earth (ADFE) and of clay fraction samples were determined. To calculate the χdf, the values of low and high frequency

MS were used. In the ADFE samples, the highest low frequency MS (MSlf) value was observed in ADEs, while the lowest MSlf values were observed in non-anthropogenic soils and ME 02. In the ADEs and ME 01, the highest MSlf values are observed in the surface horizons, decreasing in depth (9,20 – 0,52 10^{-6} m^3 kg^{-1}), these results are probably due to the anthropogenic actions, such as the use of fire, which favor the formation of magnetic minerals, as maghemite, in the anthropogenic A horizons, by the process of burning organic matter. The MSlf of the clay fraction showed the same tendency from the values found in the ADFE, with the higher values being observed in ADEs. The relatively close values of the MSlf in the ADFE and clay fraction, indicate that the MS is mainly resulting from the maghemite. The χdf in the ADFE samples from ADEs surface horizons showed values from 7,53 to 9,69%, thus indicating a mixture of multi-domain and single-domain (SD) minerals, or probably, a predominance of superparamagnetic minerals (SP). The close to 10% χdf values observed in ADEs and ME 01 indicate the predominance of particles smaller than 0,03µm, with a SP behavior, common in the clay fraction (maghemite), to the detriment of SD and multiple (magnetite), common in sand and silt's coarse fractions. The higher MS in ADEs and ME 01 is due to the use of fire by pre-Columbian populations, consequently promoting maghemite formation in these soils.

Keywords: Anthropogenic horizons; soil magnetism; Amazonian soils; magnetic susceptibility.

Financial support: Foundation for Research Support of the State of Amazonas

(6879 - 1563) Magnetic susceptibility and its relation to human modification of soils in archaeological sites in brazilian central plateau.

Daniel V. Sousa[1]; Wenceslau G. Teixeira[2]; Maria J. Rodet[3]; André Prous[3]; João C. Ker[4]; Carlos E. R.G. Schaefer[4]

Universidade Federal do Vale do São Francisco[1]; Centro Nacional de Pesquisa em Solos[2]; Universidade Federal de Minas Gerais[3]; Universidade Federal de Viçosa[4]

The study of magnetic properties in archaeological soils has been very useful in detecting activities related to the use of fire. The warming produces a reorganization of the molecules and a neoformation of magnetic minerals. The present study aims to evaluate the variation of magnetic susceptibility in soils archaeological sites in San Francisco's depression. Ten archaeological sites and three control sites were studied. Volumetric magnetic susceptibility (VMS) were determined in 10 cm^3 aliquots of TFSA using a Bartington MS2 system and an MS2B sensor, Carbon-14 dating was also done. The control sites results show values of VMS in order of 40 to 62 x 10^{-3} m^3 kg^{-1}. Samples related to human burning features the VMS ranged from 2518 to 145 x 10^{-3} m^3 kg^{-1}. The site called Lapa Pintada seems to have the more intense anthropic fire activities, followed by Lapa do Boquete. Dating showed that an intense occupation was between 1000 and 8000 yrs BP but with indications of an occupation older than 12000 years BP. The Anthrosol of Santana do Riacho had a value of VMS 1293 X 10^{-3} m^3 kg^{-1} in the burials layer. Dating show an age between 8230+-150 to 9460±110 years BP, we have also found an indication of throwing ashes and coals inside the graves, as well as make campfires above them. The oldest level dated was 11960±250 yrs BP, and shows high MS values, although lower than the previous ones, 877 X 1010^{-3} m^3 kg^{-1}. The Bibocas II archaeological site, in its oldest level, 10470±80 BP, show intense fire activities. The VMS data suggest that the Lapa Grande, Lapa do Malhador, Cave da Passagem and Lapa do Sol, had incipient human activities. The Lapa Grande had its highest value in recent level. The Lapa of the Malhador, had high VMS value (2199 x 10^{-3} m^3 kg^{-1}) in its oldest level. The cave da Passagem, had its highest value in a representative level of bonfire. The Lapa do Sol, is an open-air site, had high VSM at the same level where many lithic artifacts were found. Our results indicated that VSM is a very useful parameter as diagnostic characteristic for anthropic soils horizons, or horizons were activities using fire were conducted.These activities that heat the soil and change the magnetic characteristics and may also change the mineralogical assemblage are related to fire to food and pigment preparation, thermal flaking, ceramic burning, lighting, or ritual bonfires.

Keywords: Termoremanence, Anthrosols, Magnetite, Maghemite, Anthropic

Financial support: Fundação de Amparo à Pesquisa do Estado de Minas Gerais (FAPEMIG), Project Number APQ-00681-14

(3849 - 3129) Micromorphology study of the soil of the archaeological site Sol de Campinas do Acre

Kelly Brandão[1]; Ximena Suarez Villagran[1]

Museu de Arqueologia e Etnologia da Universidade de São Paulo[1]

The southwest region of the Brazilian Amazon has gained visibility in the last decades due to the mapping of many earthworks build, currently counted in 450 sites and this number only increases. Two types of distinct structures are observed, geoglyphs are formed by ditches or embankments and appear in great quantity, whereas mound constructions normally are in elliptic shape, are scarce and are associated spatially with the geoglyphs. One of the main issues nowadays is the indigenous interference in the Amazonian landscape and these earth structures are inserted in this debate due to the movement of the necessary pedological material during their constructions. Recent research in the region conceives earth engineering as a dynamic and enduring cultural practice that has transformed the landscape and established regional communication networks. This research has a geoarchaeological approach and studies archaeosedimentary material from the archaeological site Sol de Campinas do Acre. The site consists of 15 mounts with an average height of 3 meters, which are arranged elliptically around a central square covering approximately 15.000 m². The dating radiocarbon on mound 11 revealed a succession of occupancy events between the 11th and 17th centuries, placing the period of its construction later than the geoglyphs of the region. Preliminary results of the micromorphological study of Mound 11 in SCA indicated an intentionality in the choice of building material. The lower layers of Mound 11 were designed using the A horizon of the surrounding soil, adding allochthonous material such as iron oxide and / or manganese nodules, possibly to provide more strength to the structure. Micromorphology has the potential to reveal hidden aspects in the formation of earthworks and to offer complementary data for the interpretation of the use and function of the site. To complement the micromorphological data particle size and X-ray Fluorescence analyzes are being performed.

Keywords: micromorphology of soils; geoarchaeology; earthen mounds; Amazon

Financial support: CAPES - Coordenação de Aperfeiçoamento de Pessoal de Nível Superior

(3357 - 2483) Spatial variability of soil erodibility in areas of indian dark earth under different uses in the south of the Amazon

Milton César Costa Campos[1]; Elilson Gomes de Brito Filho[1]; José Maurício da Cunha[1]; Wildson Benedito Mendes Brito[1]; Lucivânia Izidoro da Silva[1]; Eduardo Antonio Neves dos Santos[1]; Luana Celestino Calista[1]; Francisca Xavier Quintino Neta[1]; Fernando Gomes de Souza[1]

Federal University of Amazonas[1]

The erodibility represents the susceptibility of the soil when exposed to erosive agents, disintegration and transport of particles, and can

occur naturally or even accelerated by anthropic action due to inadequate management. The indirectly estimated erodibility is defined by the variables K, Ki, Kr and Tc, being respectively global erodibility, interrill and rill erosion and critical shear stress. In the case of Indian Dark Earth (IDE) few studies have been concerned about understanding the influence of management on the chemical and physical attributes. Therefore, the aim of this work was to investigate the spatial variability of soil erodibility in area of Indian Dark Earth under cultivation of pea beans and native forest in the region of Manicoré, AM. The sampling was done in the two IDE areas, containing meshes of 88 m x 64 m with regular spacing of 8 m between the points, making a total of 88 sampling points per mesh. These points were geo-referenced using GPS equipment in order to have the Digital Elevation Model (MDE) constructed. The samples were then collected at a depth of 0.00-0.20 m. The following procedures were performed: textural analysis, organic matter, sand fractionation and stability of the aggregates. After this step, indirect models of soil loss prediction were used to estimate the erodibility factors (K, Ki, Kr, and Tc), followed by descriptive and geostatistical analyzes for modeling spatial variability. The mean and median values in both areas were similar with tendency to a symmetrical distribution of the data, which can be confirmed with asymmetry values close to zero. However, the mean values of the factor K in the pea bean area were higher than those of the forest area, indicating that the management influenced to a greater loss of soil, considering that the uncovered soil was more susceptible to erosion. All the variables studied presented normality, except the silt in the forest area, although the normality of the data is not a requirement in geostatistics. Regarding geostatistics, the models that fit the most were exponential and spherical, showing a strong and moderate degree of spatial dependence (DSD) for all the attributes studied. The range varied between 11 and 20 m in the forest area and 13 to 29 m in the area of pea beans. Therefore, the lower vegetation covered of the pea bean cultivated area provided a higher K factor. The area of pea bean reported a higher DSD, showing a lower variability.

Keywords: Geostatistics; erodibility; amazonian Soils
Financial support: FAPEAM, CNPq

(2950 - 293) Spatial variability of soil respiration in Archaeological Dark Earth areas in Amazonas state, Brazil

José Maurício da Cunha[1]; Milton César Costa Campos[1]; Marcelo Dayron Rodrigues Soares[1]; Douglas Marcelo pinheiro da Silva[1]; Alan Ferreira Leite de Lima[1]; Bruno Campos Mantovanelli[2]; Uilson Franciscon[1]

Universidade Federal do Amazonas[1]; Universidade Federal de Santa Maria[2]

In natural ecosystems, soil respirationis one of the important components of carbon emission into the atmosphere – CO_2 efflux. Soil CO_2 efflux has both temporal (due to temperature and moisture changes) and spatial variability, which can be explained by different types of soil, soil use and management, as well as the influence of vegetation on CO_2 efflux. In this context, quantifying and understanding the spatial variability of soil CO_2 efflux may help elucidate the dynamics of abiotic and biotic effects on the main components of soil CO_2 efflux. Thus, in these environments few studies assess the spatial variability of soil CO_2 efflux, soil temperature and soil moisture content, which requires a more detailed understanding of the spatial variability patterns of these attributes in native forest and agricultural areas, thereby contributing to a better understanding of CO_2 efflux dynamics in atypical soils. As such, we aim to evaluate the spatial variability of soil CO_2 efflux, soil temperature and soil moisture content in archaeological dark earth environments in guandu bean and pasture areas, compared to the natural forest environment. To that end, regular meshes were marked out in areas of forest (6 x 6 m spacing), guandu bean (4 x 5 m spacing) and pasture (8 x 8 m spacing) measuring 2,500 m^2, 1,700 m^2 and 4,800 m^2, respectively, with 88 sample points georeferenced in each area. Soil CO_2 efflux and soil temperature were measured at the intersection points of the meshes, and soil samples were collected at a depth of 0.00-0.10 m to determine soil moisture in the laboratory. Soil CO_2 efflux and soil temperature measurements were taken using LI-6400 systems, and soil moisture using soil samples collected at 0.00-0.10 m. Spatial variability was observed for soil CO_2 efflux, soil temperature and soil moisture, with a high degree of spatial dependence. Higher spatial correlation ranges were recorded for soil CO_2 efflux and soil temperature in the pasture area, as well as soil moisture in the forest area. The spatial distribution maps indicate a trend towards concentration among the properties assessed, showing positive correlations between soil CO_2 efflux and soil moisture and negative correlations between soil CO_2 efflux with soil temperature, in the forest area.

Keywords: spatial variability; soil temperature; soil moisture.
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(7577 - 2850) Terras Pretas Arqueológicas: comparing sites on the Solimões River and its tributaries

José Furtado de Miranda[1]; Carlos Ernesto Gonçalves R. Schaefer[1]; João Santiago Reis[1]; Hedinaldo Narciso Lima[2]; Ronaldo de Almeida[3]; Angélica de Cássia Ladeira[1]

Universidade Federal de Viçosa[1]; Universidade Federal do Amazonas[2]; Universidade Federal de Rondônia[3]

Research on Terra Preta Arqueológica, or Terra Preta de Índio (TPAs), is mostly concentrated along the Amazon River, with few studies being conducted at sites far from the main river, where are supposed to be chemically poor and less developed. Based on the finding that size, depth and chemical richness differ between TPAs, it was hypothesized that TPAs on the banks of the Solimões/Amazonas River provided a greater opportunity for sedentarization compared to the tributaries. This study compare sites of TPAs on the Solimões River and on their tributaries. The study area is located along almost the entire Solimões/Amazonas River. A database was constructed from the collection of papers that studied TPAs, in articles, theses and dissertations, totaling 125 soil profiles. The analyzed variables were: pH; available calcium (Ca^{2+}), magnesium, potassium, and phosphorus; exchangeable acidity; potential acidity (H^++Al); base sum (SB); base saturation (V); saturation by aluminum; total organic carbon (CO); cation exchange capacity (CTC); sand, silt and clay. The dataset was organized on anthropic A horizon and B horizon in banks of Solimões/Amazonas River and in tributary rivers. Principal Component Analysis (PCA) and Discriminant Analysis (DA) were performed in software R. A and B horizons of adjacent non-anthropic soils (ANS) were also included for DA. The averages of the characteristics of the A horizons of the Solimões TPAs are higher for most variables. This also occur in the B horizons. PCA has selected two main components, accounting for 80% of the variables. pH, Ca^{2+}, SB, CTC, H^++Al and V were selected as the most important to explain the variability of TPAs. DA generated two functions for the A horizons, with a hit of 73.91%. Similar results in B horizons show 83% of accuracy. For the A horizons of the ANS the classification was 100% correct, indicating that there is perfect differentiation of these compared to the TPAs. In the 139 observations in A horizons (tributaries), 96 remained in this group, 11 were relocated in the ANS and 32 in the Solimões TPAs. About the 150 observations of the A horizon of the Solimões, the function maintained the classification in 115 cases, only 2 were for the ANS,

and 33 for the TPAs of the tributaries. Similar results was observed in B horizons. Therefore, the TPAs of the tributary rivers show more similarities with characteristics of the ANS, evidencing less chemical enrichment, in contrast to the Solimões TPAs.
Keywords: Anthropic soils; Terra Preta de Índio; Solimões River; Amazon River
Financial support: Fundação de Amparo a Pesquisa do Estado do Amazonas (FAPEAM)

C1.4 - Soil classification

C1.4.1 - Soil systems and soil classification - their links and feedbacks

(1751 - 2816) Characterization and classification of soils with lamellae in the semiarid region of Pernambuco, Brazil

Francis Henrique Tenório Firmino[1]; Marcelo Metri Corrêa[2]; Alexandre Ferreira do Nascimento[3]; Valdomiro Severino de Souza-Junior[4]; Brivaldo Gomes de Almemida[4]; José Romualdo de Sousa Lima[2]
Universidade Federal de Viçosa/UFV; Viçosa, MG; francis-henrique@hotmail.com[1]; Universidade Federal Rural de Pernambuco/Unidade Acadêmica de Garanhuns-UFRPE/UAG; Garanhuns, PE[2]; Empresa Brasileira de Pesquisa Agropecuária (Embrapa Agrossilvipastoril), Sinop, MT[3]; Universidade Federal Rural de Pernambuco - UFRPE; Recife, PE[4]

The Brazilian Soil Classification System (SiBCS) is 20 years old, currently in its third edition. And to each of them the improvement is sought with alterations, corrections of the definitions and concepts, even with the restructuring of classes in all the categorical levels. In relation to the presence of lamellae in soils, the SiBCS makes a single mention, which defines that the occurrence, when demarcated by texture's summation and specificities, constitute a B textural (Bt) horizon . However, studies have shown the importance of these features when these specifications are not met. What makes emerge the need for studies that evaluate how the presence of lamellae with different patterns (thickness, depth and total sum) are contemplated by the taxonomic classification systems. For that, three sites were selected within a toposequence with an auger. In each site a trench (P1, P2 and P3) was opened for morphological description and sample collection for chemical, granulometric, physical-hydro, mineralogical and micromorphological analyzes. Each profile was classified according to Soil Taxonomy, World Reference Base (WRB) and SiBCS criteria. Morphologically the most significant differences between the profiles were in the horizons with presence of lamellae. The textural class is similar between the profiles, with quantity greater than 4% of primary minerals of easy weathering in the sand fraction. When the sum of the lamellae was greater than 0.15 m (P3), the horizon did not fit as Bt, because the lamella particle size did not present a sandy or finer sandy texture. Micromorphology indicates that the lamellae are of an e-iluvial constitution due to the clay movement (argilluviation). Despite the dystrophy in the horizons with lamellae, the lamellae are eutrophic in addition to favoring the increase in water retention capacity. For the SiBCS the profiles are classified as Neossolo Regolítico Distrófico espessarênico. By Soil Taxonomy, P1 and P2 are classified as Lamellic Ustipsamments and P3 as Lamellic Haplustalfs, while in WRB P1 and P2 are classified as Dystric Regossol (Arenic, Lamellic) and P3 as Totilamellic Acrisols (Arenic, Cutanic, Differentic, Hyperdystric, Proffondic). The non-imposition of the lamellae in the SiBCS does not emphasize the presence of extraordinary characteristics at the fourth categorical level. Thus, the need to include the lamelic character at the level of a subgroup is emphasized, for the importance of these features.
Keywords: SiBCS; Soil Taxonomy; WRB; Clay bands; B textural
Financial support: CNPq; CAPES; FAPEMIG

(4135 - 974) Characterization of the soil classes of the southeast region of the Mato Grosso State - Brazil, by the digital model of elevation in different reliefs and slopes

Kelly Cristina da Silva Freitas[1]; Jeferson Vieira José[1]; Edna Maria Bonfim-Silva[1]; Tonny José Araujo da Silva[1]; Helon Hebáno de Freitas Souza[1]; Ronaldo Aparecido de Oliveira[1]; Niclene Ponce Rodrigues de Oliveira[1]
UFMT[1]

Soil surveys are important tools for land use planning. However, there is a lack of mapping due to the limitations of soil data acquisition due to the great demand for time and cost. Thus, the objective was to characterize the soil classes of the southeast region of Mato Grosso in function of the relief and corresponding slopes based on the digital terrain model (DTM). The DTM SRTM (Shuttle Radar Topographic Mission) was obtained through the GIS for the characterization of the soil classes of the region, resulting in the elaboration of maps with the occurrence of the classes of soils and respective classes of slopes and altitudes. The study area covers an area of 16,438,600 ha. It was predominant in the region, the Entisols Quartzipsamments with 34.58% of the total area, located in regions of flat or smooth corrugated relief, being suitable for reforestation because they have sandy texture and reduced available water quantity. The highest elevations were found in flat and smooth undulating regions classified as Oxisols (13.9% of the total area), with an average altitude of 846 meters, these soils are characterized by being well drained and deep. In the distribution of slope, the highest average was observed in the class of Ultisols, with an average slope of 11.7% and the lowest average was observed in the Alfisols Albaqualfs (2.4%). lowlands, floodplains and depressions, this region was that of the Mato Grosso marshland and corresponding to about 1,184,109 ha totaling 7.20% of the total area.
Keywords: soil survey, Oxisol, land use
Financial support:

(2109 - 1786) Classification of the soils of the area of influence of Santa María Asunción Codex and their pictorial representation

Ma. del Carmen Gutierrez Castorena[1]; Edgar Vladimir Gutierrez Castorena[2]
Programa de edafologia, Colegio de Postgraduados[1]; Facultad de Agronomía, Universidad Autónoma de Nuevo León[2]
Classification of the soils of the area of influence of Santa María Asunción Codex and their pictorial representation Ma. del Carmen Gutiérrez Castorena[1], Carlos Alberto Ortiz Solorio[1], Beatriz Stephanie Fernández Galán[1], Edgar Vladimir Gutiérrez Castorena[2] and Tania González Vargas[1] 1 Programa de Edafología, Colegio de Postgraduados. Km 36.5 Carretera México-Texcoco. 56230 Texcoco, Estado de México, México. castor@colpos.mx. 2 Facultad de Agronomía. Universidad Autónoma de Nuevo León. Escobedo, N. L., México.

Although the Santa Maria Asunción Codex (SMAC) has been extensively studied, the soil survey on which it was based to interpret the glyphs of different kinds of land was performed outside the area of influence of the codex. Reinterpreting the glyphs of different land classes through a study of soils, geomorphology and parent materials are the objective of this research. Five neighborhoods that appear in the SMAC were studied, and the frequency of the glyphs in each one of them was quantified. Subsequently, plot-by-plot field visits were carried out and samples of soil and tuffs (tepetates) were collected for laboratory analysis and taxonomic classification. The results indicate that the soils of area of influence of the SMAC are classified mainly of Terric Anthrosols (*Escalic*, *Technic*), Leptosols/Regosols (*tephric, technic*) formed from rhyolite, andesite and tuffs, and Fluvisols (*technic*). The frequency of glyphs in each neighborhood and type of soil indicated that Tepetatlalli (tepetates) can represent terraces (land

and stones), Xalallis granular peds (< 3 mm) and non-sandy soils; Tezoquilt represent the land with subangular blocky/granular peds with hard and soft consistency (< 2 cm); Tlalcoztli is a dusty yellow land of low agricultural quality; and Atoctlis and Tezoquitl/ Xalalli correspond to active and passive alluvial soils, respectively. In addition, with soil classification, local knowledge and geomorphology were possible to determine the localization of the different plots represented in the SMAC The conclusions are that the Nahua classified their lands based on aggregate size, soil consistency, and origin (natural and artificial), and not on texture or color; and the soils correspond to Anthrosols with abundant gment of ceramic (*technic*). Finally, the tepetates (*tepetatlallis*) do not correspond to indurated volcanic soils but to terraces. *Keywords: Ethnoedaphology, soil classification*, *land classes, aggregation*

Keywords: *Ethnoedaphology, soil classification*, *land classes, aggregation*

Financial support: Colegio de Postgraduados

(6475 - 1537) Genesis and classification of Gleissolos Belonging of the Meia Ponte River on the Granulitic Complex Anápolis-Itauçú, Goiás State, Brazil.

Djavan Pinheiro Santos[1]; Tiago Camilo Duarte[1]; José Arnaldo de Castro Netto[1]; Rafael Almeida Ferreira[1]; Lucas Pergentino Brandão[1]; Gustavo Cassiano da Silva[1]; Thiago Pereira de Souza[1]; Angélica Pires Batista Martins[1]; Otávio Silveira Gravina[1]; Glenio Guimarães Santos[1]
Universidade Federal de Goiás[1]

The Granulitic Complex Anápolis-Itauçú has predominance of igneous rocks of basic-ultrabasic affiliation. The aim of this study was to know the genesis and classification of two soil profiles adjacent to the Meia Ponte River on the Granulitic Complex Anápolis-Itauçú in the State of Goiás, Brazil. The geographic coordinates of profile 1 are: 16° 36' 03.3" S, 49° 17' 37.5" W, 711 m altitude and profile 2: 16° 35' 43.8" S, 49° 17' 24.9" W, 703 m altitude. The climate of the region is classified as type Aw, according to the Köppen classification, with a mean annual temperature of 22.5 ºC and precipitation of 1,571.4 mm. Two soil profiles were selected belonging to the watershed of Meia Ponte River in the municipality of Goiânia, State of Goiás, Brazil, between the months June and July 2016, which present poor drainage conditions, characterizing them in morphological, physical and chemical properties of the soil. The soils formed in this watershed are due to the factors and processes of soil formation and the performance of alluvial and colluvial materials due to the position of the relief. For reasons of the organic carbon content and the thickness, the surface horizons of the two soil profiles were identified as A moderate horizon. Profile 1, located in area saturated in the rainy season, influenced by the water table and aluvinares materials from Meia Ponte River allows accumulation of water for a long time, favoring the development of pedogenetic process of gleation, indicated by the colors with low chroma. The set of attributes observed this profile allowed to classify as Gleissolo Háplico at the suborder level, associated with high clay activity, with base saturation greater than 50% in large groups and have a vertic character in one or more horizons up until 100 cm of the surface of the soil, allowing to classify as Gleissolo Háplico Ta Eutrófico vertissólico. The profile 2 had a high contribution of coluvial materials, due to the position in the relief, presented with similar characteristics to the P1 profile in first and second categorical levels, with low clay activity and base saturation less than 50%. In this way, it was noticed as intermediate soils for Neossolo and presence of fluvic character, being determinant to characterize as Gleissolo Háplico Tb Distrófico neofluvissólico. It is concluded that the relief and alluvium-colluvial materials were the most active factors in the genesis and classification of these soils studied.

Keywords: Toposequence; soil genesis; aluvio-coluvionar influence.
Financial support: Federal University of Goiás

(5129 - 610) Great groups of soils of the Northeast of Brazil not yet cataloged in the Brazilian System of Soil Classification

José Coelho de Araújo Filho[1]; Flávio Adriano Marques[1]; Karolina Esther da Silva[2]
Embrapa Soils[1]; Universidade Federal Rural de Pernambuco[2]

The improvement of the Brazilian System of Soil Classification (SiBCS) depends on its effective use in soil surveys, soil classification and correlation meetings, and researches in soil science. The objective of this work is to present taxonomic information on soil great groups not yet cataloged in the SiBCS. The study area comprises the coastal parts (Coastal Tablelands, Coastal Lowlands and surrounding areas) of seven states, amounting to an extension of 224,000 km², of the Northeast region of Brazil. In order to accomplish the objective, it was reviewed morphological, analytical and taxonomic information of 650 soil profiles, comprising 300 soil profiles available from pedological studies published in the 70's and 80's of the past century, and 350 profiles of the reconnaissance soil survey (1:100,000 scale) under execution in Ceará State of Brazil. All these profiles were analyzed according to the methodology of Embrapa Soils, the National Soil Research Center of the Brazilian Agricultural Research Corporation (Embrapa). The analyses of the 650 soil profiles and of the current structure of the SiBCS showed the necessity of addition of five new great groups of soil to the system. They are: *Latossolos Vermelho-Amarelos Eutrocoesos* (Eutrudox), *Argissolos Vermelho-Amarelos Distrocoesos* (Kandiudults), *Luvissolos Crômicos Sódicos* (Natustalfs), *Vertissolos Ebânicos Sálicos* (Salusterts) and *Neossolos Flúvicos Ta Distróficos* (Ustifluvents).

Keywords: Taxonomy of soils; tropical soils; Coastal Tablelands; Northeast of Brazil.
Financial support: Project GeoTab number 05.14.05.002.00.00 (Embrapa).

(7389 - 1841) Identification and classification of the soils of Garhwal Himalayas in India using remote sensing and GIS techniques.

S.K. Mahapatra[1]; Ritu Nagdev[2]; R.P. Yadav[2]; S.K. Singh[3]
ICAR-National Bureau of Soil Survey and Land Use Planning, Regional Centre, IARI Campus, New Delhi 110012, India (sankarkmahapatra@yahoo.co.in)[1]; ICAR-National Bureau of Soil Survey and Land Use Planning, Regional Centre, IARI Campus, New Delhi 110012, India[2]; ICAR-National Bureau of Soil Survey and Land Use Planning, Amravati Road, Nagpur, 440033, Maharashtra, India[3]

A study was undertaken to identify and classify the soils of Tehri Garhwal district of Uttarakahnd state in India using remote sensing and GIS techniques. The area falls in warm humid Garhwal region of Lesser Himalayas. It lies between $32^0 00'$ to $31^0 10'$ N latitides and $77^0 55'$ to $79^0 05'$ E longitudes covering 3,33,000 ha area. About 70% area of the district is under forest and only 11% of the district is under agriculture which is main occupation of the inhabitants of this area. The elevation ranges from 350 to 6578 m above msl. Ont he basis of image data (IRS 1D LISS IV) interpretation, major physiographies viz., summits/ridge tops, side/reposed slopes, valleys and piedmonts were identified with varying degree of slopes. On the basis of field study and laboratory characterisation 17 soil series have been identified and mapped into 43 soil units as soil series association. The soils of summits/ridge tops occur on moderately steep to steep slopes and are mainly very shallow to moderately shallow, excessively drained, gravelly loam, sandy loam to laom in texture and suffer from severe to very severe erosion and stoniness. They are classified as loamy skeletal/coarse loamy Lithi/Typic Udorthents and patches of Typic Dystrudepts. Soils of side/reposed slopes occur on moderately steep to very steep slopes and are mostly very shallow to moderately deep, excessively drained, gravelly sandy loam, gravelly loam and gravelly clay loam in texture and prone to very severe erosion. They are

classified as loamy skeletal Lithic/Typic udorthents and coarse loamy Typic Dystrudepts. Soils of valleys occur on gentle to moderate slopes and are moderately shallow to deep, sandy loam to loam in texture and prone to moderate to severe erosion and stoniness. They are classified as loamy skeletal Typic Udorthents and coarse loamy Typic Dystrudsepts. Soil of piedmonts occur on gentle slopes and are moderately deep to very deep, well drained, sandy loam to loam in texture and prone to moderate erosion. They are classified as loamy skeletal Typic Udorthents, coarse loamy Typic Dystrudepts and fine loamy Dystric Eutrudepts. Thematic maps viz., soil erosion, drainage, texture, reaction, soil depth, slope and organic carbon have been generated in GIS mode.

Keywords: Lesser Himalayas; Tehri Garwal; physiography; soil classification

Financial support: ICAR-NBSS&LUP. Amravati Road, Nagpur-440033, Maharashtra, India.

(2097 - 1187) Optimal simultaneous classification of salt-affected soils into USDA ST, WRB and Hungarian Soil Classification soil types

Tibor Tóth[1]; Gábor Szatmári[1]

1Institute for Soil Science and Agricultural Chemistry, Centre for Agricultural Research, Hungarian Academy of Sciences, H–1022 Budapest Herman Ottó út 15., Hungary[1]

Long before the future Universal Soil Classification will be widely accepted, more and more pieces of land will be classified into more than one classification system because of legal etc issues. The European Community is an exemplary region, where often national and WRB classifications are used parallel. Soil classification, as a rule, is carried out with the proper designated field and laboratory methods of the respective classification systems. When more than one taxonomic systems are used for many soil profiles, there are several options. a) Each soil profile might be classified by the proper methods in each soil classification system. This is the lengthiest and most costly procedure. b) Another option is to limit the field/laboratory analysis by using cross-correlative functions between the designated methods in order to facilitate faster and less costly analysis. The dataset on which the functions are based is ideally the same as that being classified. The only requirement of the cross-correlative functions is to provide precise decision on reaching the threshold values. c) Classifying algorithms can be used to convert one soil classification system into another. We shall compare these options for classifying 200 salt-affected soils by USDA ST, WRB and Hungarian Soil Classification systems. Our presentation shows the conceptual framework for selecting the best option in terms of cost, time and precision for the simultaneous classification of salt-affected soils in three classification systems.

Keywords: cross-correlative function, classifying algorithm, optimal classification

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(9127 - 909) Physical, chemical, mineralogical and spectroscopic constitution of the soils of a microbasin representative of the extreme stream basin, Federal District

Otávio Junio de Oliveira Souza[1]; Marilusa Pinto Coelho Lacerda[1]; Caio Isaias Cardoso[1]; Letícia dos Santos Ferreira[1]; Manoel Pereira de Oliveira Junior[1]

Universidade de Brasília[1]

Soil surveys are becoming increasingly necessary and detailed so that the best agricultural yields can be obtained from them without causing so many environmental changes in the present ecosystem. The objective of this work was to determine the physical, chemical, mineralogical and spectroscopic composition of the soils class of occurrence in the Barbatimão stream microbasin, considered representative of the Extrema river basin, to generate data for surveys and pedological mapping of greater detail of the field. With primary level curve data, quoted points and hydrography a terrain model was generated in ArcGis 10.3. obtaining a map of hypsometry and slope. With this one was selected a topossequence in the region of the barbatimão stream. The position of the soil profiles to be studied was orientated according to the change of slope, and four representative profiles were selected. In the soil profiles the physical, chemical, mineralogical and spectroscopic characterization of the soil diagnostic horizons. The physical, chemical, mineralogical and spectroscopic analyzes allowed to individualize the following classes of soils. The first profile was classified with typical Red Latossol Distrophic in flat relief in typical cerrado vegetation. It presented a clayey and very porous texture with good drainage. The second profile was classified as a dystrophic petroplinthic red-yellow Latosol with a clayey texture, with a thick and dense A horizon. This profile was found in change of slope between smooth wavy to wavy. The third profile was established when the slope was uniform in smooth corrugation being classified with typical dystrophic Red Latosol. Featuring clayey texture, very porous and good drainage. The fourth profile studied was classified as Plintossolo Háplico was found wavy relief already near the drainage. It presented clay texture, with horizon A compact. Physical, chemical, mineralogical and spectroscopic analyzes were essential in the characterization and classification of soils studied in the Barbatimão stream microbasin, representative of the stream Extrema basin, DF. The data generated can support information for more detailed pedological mappings in relation to those in the region.

Keywords: drainage, mineralogy, slope

Financial support: CAPES, CNPq

(4603 - 3105) Preliminary characterization study of a Cenozoic-Mesozoic transition layer to improve parameter information for numerical groundwater flux model

Jaqueline Vígolo Coutinho[1]; Edson Wendland[1]

Universidade de São Paulo[1]

Water flux in saturated zone depends on several factors related to hydrological data, land use and soil characteristics such as soil particle size distribution and porosity. These soil features, as well as chemical characteristics, vary with the soil depth which may aid to characterize geologic layers with different ages. On a transition geologic zone, hydrogeological parameters (e.g. hydraulic conductivity) may suffer an abrupt change which highly modifies groundwater flow nets. Usually, numerical models have been used to simulate groundwater fluxes, however there is a lack of substantial soil information to feed the models. This study aims to identify a transition layer from Cenozoic to Mesozoic sediments to improve a conceptual hydrogeological model applied to an outcrop zone of the Guarani Aquifer System, in Brotas, São Paulo, Brazil. Preliminary physical and chemical soil characterization through field observation, soil particle size distribution by the gamma-ray attenuation method, and determination of iron (III) in sulfuric acid analysis were realized on six disturbed soil samples. The samples were collect from 6 depths: i) 0-1, ii) 1-2, iii) 2-3.45, iv) 3.45-4, v) 4-5 and vi) 5-5.45 m. Predominantly sandy soil (mean of 90.57%) was identified at the first meters (i, ii and iii samples). A line of pebbles was identified at depth of 3 m which is common at the bottom of Cenozoic layer. In sequence, there was a thin sheet of mostly sandy soil (96.2%) (iv sample) following by v and vi soil samples with higher iron (III) content (increase of 91.25%) and more clay fraction (21.8%). The latter layers correspond to Mesozoic sediments. Also, it was detected that the water level was above the Cenozoic sediments. Therefore, it was possible to identify soil morphology changes in depth which characterized a transition layer from Cenozoic to Mesozoic sediments, located below groundwater level, which may contribute to improve a conceptual hydrogeological model.

Keywords: soil morphology;hydrogeology;groundwater flux;Guarani Aquifer System
Financial support: Water availability and quality threats in a Guarani Aquifer System outcrop zone - FAPESP. Project Number: 2015/03806-1

(5322 - 1580) Progress in making fundamental changes to Soil Taxonomy

David Lindbo[1]; Mark Stolt[2]; Joey Shaw[3]; John Galbraith[4]; Marty Rabenhorst[5]; Curtis Monger[1]
USDA-NRCS[1]; URI[2]; Auburn University[3]; VPI[4]; UMd[5]

Soil Taxonomy is the dominant soil classification system in the United States and is recognized by the IUSS as one of the two international classification systems. As the system has developed and grown, it has become increasingly complex, resulting in a document that is difficult for non-trained soil scientists to apply. Thus, few other disciplines use the system to communicate soils information. In 2015 the Soil Science Society of America established the Fundamental Changes to Soil Taxonomy Task Force to address the growing number of issues with using and teaching Soil Taxonomy. The objective of the task force is to facilitate an open and transparent process to develop a suite of fundamental changes to Soil Taxonomy leading to a more user-friendly product that can and will be used by more than just trained soil scientists. The task force has identified and discussed many fundamental changes. Proposals to redefine organic soil materials and reducing the complexity of the oxic and kandic diagnostic horizons have been vetted to the larger soil science community (over 70 soil scientists world-wide have agreed to comment on proposed changes). In addition, there has been significant progress towards developing proposals for a new wet soil order, removing the complexity from the mollic epipedon criteria, and including all climate related components of the classification system at the family level. This poster will highlight these proposals, reasons supporting the changes, and the associated discussion.
Keywords: Taxomony, Classification, Kandic, Aquic
Financial support:

(9219 - 2331) Soil potential in agricultural areas of Cerrado in southern Tocantins

Gilberto Coutinho Machado Filho[1]; Weslany Silva Rocha[1]; Marcelo Almeida Mota[1]; Fabiano Rocha da Silva[1]; Osvaldo Jose Ferreira Junior[1]; Tania Rodrigues Peixoto Sakai[1]; Samara Ferreira de Azevedo[1]; Edson Santos Castro[1]; Manoel Mota dos Santos[1]
Universidade Federal do Tocantins[1]

The misuse of land leads to a shortage of resources, enabling destruction, increasing poverty, and do not preventing the permanence of man in countryside, and other social damages. In view of this reality, the study aimed the realization of a soil survey in area of livestock exploration, located in the state of Tocantins. At first, the area was separated according to the soil patches. Trenches were opened to study the physical and morphological characteristics of soil profile. After exposing each soil profile, the horizons were identified, delimiting them using a millimeter grid and determining the thicknesses of each horizon and depth of the soil profile. Also, occurred verification of presence of impediments to roots, structure, drainage, color, consistency, slope and other attributes that helped in the classifications. After which the classification according to the Brazilian Soil Classification System (*Sistema Brasileiro de Classificação de Solos* - SiBCS) and their possible uses, according to agricultural aptitude. The studied area showed four classes of soils, which were classified as *PLINTOSSOLO ARGILÚVICO Distrófico petroplíntico, LATOSSOLO VERMELHO-AMARELO Distrófico típico* and *GLEISSOLO MELÂNICO Ta Eutrófico* with agricultural suitability in subgroups 1(a)bC; 4P; 1aBC and 3(bc), in order. The studied area showed that it could be used for other types of agricultural crops besides livestock.
Keywords: soil classification; capacity; fertility
Financial support:

(3260 - 1981) Soil Series Survey and Research of Zhejiang Province Based on Chinese Soil Taxonomy

Wanzhu MA[1]; Mingkui ZHANG[2]; Xiaonan LV[1]; Zhouqiao REN[1]
Insitute of Digital Agriculture, Zhejiang Academy of Agricultural Sciences.[1]; Zhejiang University[2]

Soil classification is a summary of human understanding of soil. It is not only an important way to further understand the soil, but also the basis for suitable comprehensive utilization of the soils. Therefore, it has always been a great concern of relevant researchers. Currently, there were three major factions in the international soil classification system, namely the soil diagnostic classification of the Unite State (Soil Taxonomy), the soil genetic classification of the Soviet Union and the soil morphogenetic classification of the Western Europe. The quantitative and standardized classification of Soil Taxonomy is now the mainstream of international soil classification. Chinese Soil Taxonomy is based on diagnostic horizons and characteristicses, and guided by the principle of genesis. The project of 'Soil Series Survey and Research of China' is the study of primary soil classification led by Nanjing Institute of Soil Research, CAS, and participated by several soil research institutes and colleges, that was supported by the Chinese National Science and Technology Basic Reaearch Project(2008FY110600). The soil series survey and research project of Zhejiang Province, China was started in 2009 and lasted for 5 years. There were 145 soil profiles investigated, 205 soil profiles observed, 588 soil layers sampled and more than 3500 survey photos shot. Through comprehensive analysis and classification of field observations and laboratory test data and the history of Zhejiang province soil classification data retrieval, the 145 sections respectively belong to 8 soil orders as Anthrosols, Halosols, Gleyosols, Isohumosols, Ferrosols, Argosols, Cambosols and Primosols, 13 suborders, 28 soil groups and 52 subgroups. With the establishment of soil families and soil series classification principles and standards, all these profiles were divided into 106 families, and 144 series were established. For each soil series, details of distributional environment, characteristic amplitude, representative pedon and utilization performance were described. Soil series survey scope covers most of the soils that with large distribute area, high importance of agricultural use and regional characteristics in Zhejiang province, China.
Keywords: Chinese Soil Taxonomy, taxonomy, Zhejiang province, soil classification
Financial support: Chinese National Science and Technology Basic Research Project(2008FY110600)

(1575 - 2727) Soil subgroups of the Northeast of Brazil not yet cataloged in the Brazilian System of Soil Classification

Karolina Esther da Silva[1]; Antônio Diomescio da Silva Filho[1]; Estevão Lucas Ramos da Silva[2]; Melissa Correia Lacerda[2]; Arthur Felipe Ferreira de Lima[2]; Joaquim Pedro de Santana Xavier[2]; José Coelho de Araújo Filho[3]; Daniel Chaves Webber[3]; Flávio Adriano Marques[3]
Universidade Federal Rural de Pernambuco[1]; Universidade Federal de Pernambuco[2]; Embrapa Solos UEP Recife[3]

The Brazilian System of Soil Classification (SiBCS) is under continuous improvement since its first edition published in 1999. Advancements in the System have been accomplished with its use in soil surveys, classification and correlation meetings and researches in Soil Science. The objective of this work is to suggest the addition of new subgroups into the SiBCS as a result of studies in the Northeast Region of Brazil. The Coastal Tablelands and surrounding areas of the

Northeast Region of Brazil comprises the study area. The proposal of the new subgroups are based on the morphological, analitical and taxonomic review of 750 soil profiles, comprising 400 soil profiles available from pedological studies published in the 70s and 80s of the past century, and 350 soil profiles of the reconaissance soil survey (1:100,000 scale) under execution in the State of Ceará. The physical and chemical analyses of all soil profiles were made according to the methodology developed and used by Embrapa Soils. The detailed analysis of the 750 soil profiles and the current SiBCS structure showed the necessity of addition of 45 new subgroups to the system. These new subgroups will be distributed as follows: 13 in the order of the *Argissolos* (Ultisols); 3 in the order of the *Cambissolos* (Inceptisolos); 2 in the order of the *Chernossolos* (Molisols); 3 in the order of the *Espodosolos* (Spodosols); 2 in the order of the *Gleissolos* (Aqualfs); 7 in the order of the *Latossolos* (Oxisols); 3 in the order of the *Luvissolos* (Alfisols); 3 in the order of the *Neossolos* (Entisols); 1 in the order of the *Organossolos* (Histosols); 2 in the order of the Planossolos (Alfisols); 4 in the order of the *Plintossolos* (Plinthudults); and 2 in the order of the *Vertissolos* (Vertisols).

Keywords: Taxonomy of soils; Coastal Tablelands; Brazilian soils.
Financial support: Project GeoTab number 05.14.05.002.00.00 (Embrapa).

(8673 - 2925) *Soils and soil organic carbon stocks in the Restinga de Cabedelo National Forest, in Cabedelo and João Pessoa Municipalities, Paraíba State, Brazil*

Aline Pacobahyba de Oliveira[1]; Maurício Rizzato Coelho[1]; Alexandre Fonseca D' Andrea[2]; Orione Álvares da Silva[3]; Gustavo de Mattos Vasques[1]
Embrapa[1]; IFPB - Campus João Pessoa[2]; ICMBio[3]

National Forests are conservation units of the nature that objective the sustainable multiple use of forest resources and the scientific research. This work aims to provide soil information for part of the Restinga de Cabedelo National Forest (Flona Cabedelo), specifically on taxonomic soil classes and soil organic carbon stocks (CS). The Flona Cabedelo is located in the municipalities of Cabedelo and João Pessoa (PB) and encompasses an area of 114.34 ha. Conventional methods were used to soil survey of the all area under coastal sandy plain vegetation (*restinga* vegetation) and a small area of mangrove. The carbon stock (CS) was to assess only under *restinga* vegetation at 0-20 cm and 0-100 cm depths using kriging. The results showed a close soil-sediment-vegetation relationship in the area: *Neossolos Quartzarênicos* are the unique soil classes under *restinga* vegetation. They occupy about 58 ha (91 % of the area) and are related to the sandy sediments of holocene marine terraces. The rest of the area is strongly influenced by riverine and marine tides, which can cause sulfidic, saline, sodic, gleyzic and lithologic discontinuity features in soils. The presence and intensity of one or more of these features in the soil are related to the current and past hydrological dynamics, which shaped the local relief, causing subtle differences in elevation at short distances, often defining the soil class, drainage regime and vegetation. At the lower elevations under permanently flooded salt marsh, the *Gleissolos Tiomórficos* predominate. As the landscape rises subtly, the soils are progressively less poorly drained, predominantly non-sulfidic, but still salic or solodic, and saline, and still present lithological discontinuities within 100 cm depth. In these areas, halophilic grass vegetation with a low density of individuals occur on *Gleissolos Sálicos* and *Neossolos Flúvicos*. The CS up to 100 cm depth in the *restinga* vegetation area ranged from 4.89 to 43.79 Mg ha^{-1} (mean of 23.20 Mg ha^{-1}), with approximately 50 % of this stock concentrated in the upper 20 cm. There was no clear relationship between soil classes and EC. Higher CS values for both depths were observed in the eastern part of the study area, possibly due to the stronger edge effect relative to the other parts of the remnant *restinga* vegetation.

Keywords: Soil-landscape relationship; coastal sandy plain; mangrove soils, *restinga* vegetation
Financial support: Project MEC/SETEC/CNPq, nº 94/2013

(2229 - 2675) Soils of the Brazilian *Quadrilátero Ferrífero*, Minas Gerais state, under different native vegetation and parent materials

Maurício R Coelho[1]; Gustavo M Vasques[1]; Diego Tassinari[1]; Zélio Resende de Souza[2]; Aline P de Oliveira[1]; Fátima M S Moreira[2]
Embrapa Solos[1]; Universidade Federal de Lavras[2]

The *Quadrilátero Ferrífero (QF)*, in the Brazilian state of Minas Gerais, is a region of great environmental diversity with strong potential for mining. Consequently, mining-related studies have been carried out, whereas soil-related studies are less common. This study aims to characterize the soils and evaluate their relation to the relief, geology and native vegetation in three representative sites of the *QF* region in Minas Gerais state: Córrego do Meio mine, municipality of Sabará; Miguelão mine, municipality of Nova Lima; and Córrego do Feijão mine, municipality of Brumadinho. The 28 soil profiles are allocated in five toposequences, encompassing all local physiographic variations. In most toposequences, *Cambissolos Háplicos Distróficos latossólicos* (Cambisols) were the dominant soils in Sabará, occurring on metasedimentary rocks, hilly relief with concave curvature, and under semi-deciduous forest and savanna vegetation. They are soils with low fertility, usually aluminic, stony at the surface when occurring under savanna, with high silt content, often superior to clay, and have medium (savanna) or clay (forest) texture. *Latossolos Vermelhos Distróficos cambissólicos* or *húmicos* (Ferralsols) are also present in Sabará on the same parent materials, both under semi-deciduous forest and savanna, and always located at the footslopes on hilly relief. In Brumadinho, *Latossolos Vermelhos* or *Vermelho-Amarelos* (Ferralsols) occur under semi-deciduous forest on granite parent material on gently undulated relief with concave curvature. These are the most evolved non-ferric soils observed in this study, and are located at the upper third of the only toposequence visited in Brumadinho. Below this portion of the slope, *Cambissolos Háplicos* or *Húmicos* (Cambisols) vary in classification and attributes as a function of the local relief ranging from gently undulated with convex curvature to undulated with concave curvature. In Nova Lima, *Plintossolos Pétricos* (Petroplinthic Plinthosols) are the only soils present in the *canga* fields in the visited toposequence, and are originated from the weathering of the ferruginous rocky outcrop. They have more than 70 % in volume of petroplinthite beginning at different depths in their profiles, and their physical and chemical attributes vary much across the landscape. Soil and relief vary at short distances in Nova Lima originating different physiographic, vegetation types and microhabitats for the local fauna and flora.

Keywords: Ferruginous rocks; Canga fields; Plinthosols.
Financial support: Project CRA – RDP – 00136-10 (FAPEMIG/ FAPESP/ FAPESPA/ VALE S.A.

(7884 - 452) Soils of the hydrographic bowl of the Uberaba river

Joao Chrisostomo Pedroso Neto[1]
EPAMIG[1]

The catchment area of the Uberaba river includes tropical soils, highly weathered and with great agricultural potential, which makes the Uberaba municipality the largest state producer of corn and soybean. However, much information about the limitations and potentials of these soils remains beyond the reach of farmers. Thus, the work was conducted in the years of 2009 and 2010, with the objectives of geological characterization of the area; detailed survey of soils of the basin and classification of these soils, using the Brazilian Soil Classification System. Fieldwork consisted of the identification and characterization of the areas, as well as the collection of materials for analysis. According to the results obtained, it can be concluded that:

near the river banks, basaltic rocks with gray to black coloration were found, giving rise to clayey soils, low acidity and medium to high natural fertility; The upper edges of the basin consist of volcanic sandstones, with medium granulation and small pebbles, besides debris from the erosion of pre-existing volcanic rocks. They originate soils with frank to sandy texture, with medium acidity and medium to low natural fertility; It was observed predominance of soils of the order LATOSSOLO, in the RED and RED-YELLOW suborders and dystrophic, eutroferric and dystroferric classes. To a lesser extent, soils of the orders CAMBISSOLO, GLEISSOLOS, NEOSSOLOS and ARGISSOLOS were observed.

Keywords: Geological characterization, soil classification, soil survey
Financial support: Fundação de Amparo a Pesquisa de Minas Gerais – FAPEMIG

C1.5 - Pedometrics

C1.5.1 - Global soil carbon modeling

(5738 - 577) Carbon stock of a Red-Yellow Latosol under different plant coverages

Victor Barros Damacena[1]; Giovana Fornaciari Moreira[1]; Thalia Inês Aleixo Barbosa[1]; Jeferson da Silva Muniz[1]

Instituto Federal de Mato Grosso - Campus Profº Olegário Baldo[1]

Understanding ecological dynamics in ecosystems, especially soil and carbon, is extremely important for their maintenance and restoration, as well as to promote management strategies. In this context, this work aimed to quantify and evaluate the carbon stock of a dystrophic red-yellow latosol under different vegetation cover. The study was conducted at the Federal Institute of Mato Grosso - Prof. Olegário Baldo Campus (Cáceres-MT, Brazil), whose geographical coordinates are latitude 16º07'43.9 ", longitude 57º41'09.5" and elevation of 117 m. The climate is of tropical savannas with wet summer and dry winter (Awi), according to the classification of Köppen, with average annual temperature varying between 23 ° C and 25 ° C. Four treatments were evaluated: T1- remaining forest savanna; T2- native forested savanna; T3- continuous pasture of Brachiaria brizantha and T4- silvipastoril integrated system. Soil sampling was done by collecting four samples in each treatment, at depths of 0-10, 10-20, 20-40 and 40-60 cm, totaling 64 samples (undeformed). The total soil carbon content was defined by the oxidation of organic matter with $K_2Cr_2O_7$ in sulfuric medium. The carbon stock in each layer of soil was determined by the expression: C content (g kg^{-1}) × ds × e, where ds = soil density (kg dm^{-3}) and e = soil layer thickness cm). The experimental design was a randomized complete block design, in a 4x4x4 factorial scheme, with 4 treatments, 4 depths and 4 replications. The data were presented to the analysis of variance and their means were compared by the Tukey test at 5% of probability, using the R software. The divergence of the sampling depths shows that the highest values are found in the first layer 0-10 cm. When the treatments at the different sampling depths were analyzed, there is a reduction in carbon stock with depth addition. The highest values were obtained for depth 0-10 cm in the soil under the native forested savanna.

Keywords: Soil, Management, Carbon
Financial support:

(9445 - 2393) Estimation of carbon stock and nitrogen in the semiarid region

Isnara Regina Assunção Medeiros[1]; Adilson Alves Costa[1]; Bruno de Oliveira Dias[1]; Luiz Fernando Carvalho Leite[2]; Henrique Antunes de Souza[2]

Federal University of Paraíba[1]; Embrapa Meio Norte[2]

The management and use of the soil in semi-arid areas, over time have caused significant decreases of carbon (C) and nitrogen (N) in these soils, due to the fact that it is a region where normally enough conditions are found favorable to the different decomposition processes of MOS, with man being the main agent responsible for these phenomena. The use of mathematical models can be a useful tool to improve understanding and to assist in more compatible practices of land use and management of the characteristics of this ecosystem. The Century model has been used in several ecosystems, but the model has not been adapted yet to simulate ecosystems of dry tropical forests, such as the caatinga in northeastern Brazil. With this, the objective of the present work was to validate the Century model for simulations of C and N stocks in caatinga areas under different cropping systems. The data used for the calibration of the model were obtained in field plots with preserved vegetation, in the municipality of São João do Piauí, located in the semiarid region of Piauí, Brazil, under the dominance of the Caatinga biome. For the validation, we used data from the municipality of Santa Teresinha-PB, with a distance between them of 740 km and similar soil-climatic conditions, but different soil types. Thus, it was possible to analyze the behavior of the C and N stocks of the soil. In the native vegetation areas, simulated values of C and N stocks (23.76 and 5.27 Mg ha^{-1}) were similar to the values observed in the field (25.72 and 5.77 Mg ha^{-1}) , where the differences between simulated and found values are well below the maximum allowed which is 20%. Therefore, the Century model can be used to simulate the C and N cycling in the soil system, in addition to being able to present future scenarios for improvements in caatinga areas of the Brazilian semiarid region.

Keywords: Modeling; white forest; simulation; stocks of C and N
Financial support: National Council for Scientific and Technological Development (CNPq)

(9032 - 704) Multivariate analysis of CO_2 emissions in surface horizons under different types of soil cover.

Cássia Barreto Brandão[1]

Universidade do Estado do Rio de Janeiro-UERJ[1]

The analysis of CO_2 emissions from soil in recent years has become an object of study, especially in tropical forests, in an attempt to understand the participation of these ecosystems in the global carbon cycle. Thus, this study proposes to estimate the CO_2 efflux in surface horizons in different areas under the domain of the Atlantic forest in the city of Santo Antonio de Padua-RJ. For this, the closed chamber with infrared sensor technique was used for three days of summer (13/01-15/01) and winter (28/07-30/07) of 2015 in four different types of areas (A1- area reforested ; A2- deforested areas ,A3- area in recovery, A4- control area) in simultaneous analysis in the morning (08:00) and afternoon (15:00) periods. Associated with the analyses of CO_2 were collected meteorological and pedological information from selected areas, in order to establish correlations statistics through Multivariate analysis of main components. A seasonal variation of CO_2 efflux was observed in the results obtained, with the highest effluxes in the summer and the lowest in the winter, as well as the highest values at 3 p.m. and the lowest values at 8 a.m. The results of the main components analysis showed an opposite behavior between the deforested area and the control area, and as the chemical parameters were more adequate, the lower the CO_2 emissions and vice versa. In the ACP, the first three components together explained 85.4% of the total variance of the data set, and of the fifteen variables selected, only five were more important, especially the role of phosphorus, base saturation, organic matter, CTC and clay, the latter in positive association with the emissions and the others in inverse relation. The reforested and recovering areas were more influenced by the atmospheric and physical parameters of the soil, and the deforested area was more induced by air and soil temperature and by the clay content. Thus, this study highlights the importance of preserving

native forests as well as the recovery of degraded areas, since deforested areas contributed more to emissions than to carbon sequestration, and the most preserved ones, such as the control area of this study contributed more to the sequestration than to the CO_2 emissions to the atmosphere.

Keywords: Emissions; CO_2, soil; multivariate; surface horizons.

Financial support: CAPES

(4985 - 2080) Multivariate approach of soil carbon flow in sugarcane areas in Brazil

Paulo Alexandre Silva[1]; Bruno Horschut de Lima[2]; Alan Rodrigo Panosso[2]; Newton La Scala Junior[1]; Nelson José Peruzzi[1]; Fabio Roberto Chavarette([2]

Paulista State University/UNESP, s/n Path of Access Prof. Paulo Donato Castellane, Jaboticabal-SP, Zip: 14884-900[1]; Paulista State University /UNESP, 56 South Brazil Av., Single Island – SP, Zip: 15385-000, Brazil[2]

In the year of 2015 the CO_2 concentrations in the atmosphere reached record levels of 400 parts per million (ppm) that contributed to the formation of the El Niño phenomenon, causing the devastation of several areas in the world in 2015 and 2016. Therefore, the process of CO_2 emission soil (FCO_2) it comes from the interactions of the physical, chemical and biological attributes of the soil. The amount of organic carbon, nitrogen content, C/N ratio, temperature and moisture influence the stability of carbon in agricultural areas, expressed by the soil carbon decay constant (k). Aim: The objective of this work was to determine the multivariate structure of the spatial variability of the carbon stability and its relationship with the soil attributes in the areas of sugarcane. Material and Methods – The data were collected in sugarcane cultivation areas in the green management system, located in the cities of Guariba and Pradópolis (São Paulo, Brazil) (2008, 2010 and 2012) and city of Aparecida do Taboado (Mato Grosso do Sul, Brazil) in the year of 2014. Soil samples were collected at depth of 0 to 0.10 m to determine soil attributes: Moisture (Us), air-filled pore space (PLA), macroporosity (Macro), available Phosphorus content (P) and cation exchange capacity. (CTC). The carbon stock was calculated at a depth of 0.10 m and the decay constant (k) was calculated based on the ratio between the C-CO_2 emissions and the soil carbon stock. Results and Discussion - Principal component analysis (ACP) indicated that the first two major components (CPs), CP1 and CP2 explained 55% and 68% of the total variability in the dataset, respectively. In 2008 the values of the factor k ranged from 1.4 to 3.9 × 10^{-3} times^{-1}, with carbon stock (EstC) ranging from 7.2 to 8.7 Mg ha^{-1}. In the year of 2010 the values of factor k ranged from 0.65 to 1.65 × 10^{-3} time^{-1}, with carbon stock (EstC) varying from 10 to 16 Mg ha^{-1}. Already in the observed values of the factor k were between 1 and 2.40 × 10^{-3} time^{-1}, with carbon stock (EstC) ranging from 6.2 to 10.2 Mg ha^{-1}. For 2014, in Aparecida do Taboado (MS) the values of factor k were between 2 and 3,15 × 10^{-3} times^{-1}, with carbon stock (EstC) varying from 5.8 to 7.05 Mg ha^{-1}. In the same area, there were changes in the spatial patterns of the factor k, there are regions with potential for accumulation or carbon emission in areas of sugarcane, defining thus, specific management regions within the same area.

Keywords: spatial variability, major components, soil respiration, greenhouse effect, multivariate analysis.

Financial support: CNPq and FAPESP.

(1965 - 558) Prediction and mapping of soil carbon using Vis-NIR spectroscopy and magnetic susceptibility

Angélica Santos Rabelo de Souza Bahia[1]; José Marques Júnior[1]; Newton La Scala Júnior[1]; Carlos Eduardo Pellegrino Cerri[2]

State University of São Paulo (FCAV/UNESP)[1]; São Paulo University (ESALQ/USP)[2]

The development of prediction models to represent the spatial variability of soil carbon is essential for strategic planning from agricultural emissions. For this it's necessary the use of fast, accurate and low cost tools for soil carbon prediction, allowing the detailed mapping of large areas, since with conventional methods this task becomes difficult due to the large number of samples required. Thus, this study aimed to evaluate the capacity for predicting soil carbon and their spatial variability using visible and infrared (Vis-NIR) spectroscopy and magnetic susceptibility (MS). Soil samples (0-25 cm depth) were collected at 446 sites in the sandstone-basaltic transition, in the geomorphological unit of the Western Paulista Plateau, São Paulo, Brazil. The Vis–NIR spectra of each soil sample were measured in laboratory using a Lambda 950 UV/Vis/NIR PerkinElmer spectrophotometer. The MS of the soil samples was measured on the Bartington MS2 sensor, coupled to the Bartington MS2B magnetic sensitivity sensor. To develop models based on soil spectra and laboratory data, the partial least squares regression (PLSR) was used. Already, the MS-based models were calibrated by linear regression between magnetic and laboratory data. Good prediction accuracy parameters were obtained with Vis-NIR (R^2 = 0.88, RRMSE = 0.25), VIS (R^2 = 0.82, RRMSE = 0.33) and MS (R^2 = 0.79, RRMSE = 0.15). However, the more accurate results between the observed and predicted values (R^2 = 0.83, RRMSE = 1.18) were found for soil carbon estimated by MS. These results revealing that these tools are good predictors of key attributes of studied soils, even with wide chemical and mineralogical variation. Soil carbon maps predicted by Vis-NIR spectroscopy and MS shows similarity to the interpolated maps with the field observations. These are promising results once that Vis-NIR spectroscopy and MS are fast, cheap and non-destructive tools, allowing the prediction of a large number of samples. Therefore, both tools are very attractive for the strategic planning of land use and occupation, environmental monitoring and detailed mapping of large areas.

Keywords: Total carbon, Partial least squares regression, Digital soil mapping, Chemometric modelling, Pedometrics.

Financial support: São Paulo Research Foundation (FAPESP) and Brazilian National Council for Scientifc and Technological Development (CNPq)

(7213 - 2282) Prediction models development for organic carbon and total nitrogen in Mexican forest soils through VIS-NIR spectroscopy

Esquivel-Valenzuela Berenice[1]; Cueto-Wong José Antonio[2]; Cruz-Gaistardo Carlos O.[3]; Guerrero-Peña Armando[4]; Jarquín-Sánchez Aaron[5]; Burgos-Cordova David A.[6]

Universidad Autónoma Chapingo[1]; Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias[2]; Instituto Nacional de Geografía y Estadística[3]; Colegio de Postgraduados[4]; Colegio de la Frontera Sur[5]; Insituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias[6]

The knowledge of the soil physical and chemical characteristics, allows us to make better decisions about its management and conservation. Commonly, soil properties are determined by laborious and costly methods that generate chemical residues that can cause environmental pollution. NIR spectroscopy is a non-destructive, low cost, and minimum sample management that has the potential to predict various soil properties with the reading of a single spectrum. The objective of this research was to create a prediction model for the organic carbon and total nitrogen content in soil samples from different regions of Mexico using VIS-NIR spectroscopy. A total of 599

samples of forest soils were analyzed. Total carbon (TC) and total nitrogen (TN) were obtained by the dry combustion method in a Flash 2000 Total Elemental Analyzer (Thermo Scientific). Inorganic carbon (IC) was calculated from the total carbonates content determined by the Bernard calciminer method. Organic carbon (OC) content was then calculated by substracting IC from TC. The development of the NIR model was carried out in a NIR Feed and Forage 6500 (FOSS) equipment. The spectral data was obtained with the software ISIscan v3.1 in a wavelength range of 400 to 2500 nm. The calibration equation was obtained by MPLS regression (Modified partial least squares) with the software winISI v4.20. The validation of the model was carried out with 46 samples independent of those used for the calibration. The accuracy of the model was evaluated based on the coefficient of determination (R^2) and the relationship between the standard error of prediction and the standard deviation (RPD). The values of R^2 in the calibration were 0.93 for OC and 0.88 for TN, respectively. In the case of the RPD, the values were 2.69 for OC and 2.05 for TN. According with several references, the models were classified with a good prediction capacity. In the case of validation, the values of R^2 were greater than 0.9 and RPD values greater than 2. Our results support that the use of NIR spectroscopy to determine soil TN and OC fast and accurate, reducing the time and cost necessary to process the sample, and with minimum waste generation.

Keywords: Organic carbon, total nitrogen, forest soils, spectral analysis, reflectance, chemometrics.
Financial support: PROYECTO CONAFOR-INIFAP

(7363 - 1444) Scaling impacts on soil organic carbon stocks and its environmental controllers

Kabindra Adhikari[1]; Umakant Mishra[2]; Phillip R. Owens[3]; Skye Wills[4]; Zamir Libohova[4]
University of Arkansas, Department of Crop, Soil, and Environmental Sciences/USDA-ARS, Dale Bumpers Small Farms Research Center[1]; Argonne National Laboratory, Environmental Sciences Division[2]; USDA-ARS, Dale Bumpers Small Farms Research Center[3]; USDA-NRCS, National Soil Survey Center[4]

Achieving an accurate representation of the spatial heterogeneity of existing soil organic carbon (SOC) stocks in Earth system models (ESMs) is a prerequisite for reducing the existing uncertainty in predicting future carbon–climate feedbacks. Scaling properties of SOC stocks and its environmental controllers can help in appropriate representation of SOC spatial heterogeneity in ESMs. We quantified scaling impacts on SOC stocks and its environmental controllers at a regional scale in continental US. We selected Temperate Prairies Ecological Region (522,333 km^2 area) for this study, and compiled 428 pedon data of topsoil (0-30 cm) SOC stocks (Mg ha^{-1}) from Rapid Carbon Assessment (RaCA) project of the USDA-NRCS. Environmental variables of SOC predictors included terrain parameters derived from a digital elevation model (DEM), precipitation, temperature, incoming solar radiation, potential evapotranspiration, land use/land cover, satellite vegetation indices, soil types, soil temperature and moisture regime, parent material, geological age and bedrock types, and the geographical coordinates of the pedons. Terrain attributes were derived from a 10 m national DEM, and were subsequently aggregated to 30m, 90m, 200m, 500m, 1km, 2km, 5km, and 10km, grid size/scale. All the remaining variables were resampled to the similar spatial scale. Significant environmental controllers were identified at each scale using best subset regressions and SOC stocks at each scale were predicted using geographically weighted regression (GWR) model. The scaling impacts on environmental controllers were identified by plotting the median GWR coefficients (βs) of significant environmental controllers with scale. The predicted variance of SOC stocks at each scale was plotted with scale to determine the scaling property of SOC stocks. We expect that the strength of environmental controllers on SOC stocks changes with scale, and beyond certain scale, there is no significant influence. This study will determine the scaling properties of SOC stocks and its environmental controllers which inform the land surface models.

Keywords: soil organic carbon, pedometrics, environmental variables, scale dependency
Financial support: University of Arkansas, Department of Crop, Soil, and Environmental Sciences/USDA-ARS, Dale Bumpers Small Farms Research Center

(2871 - 2200) Spatial variability of Carbon dioxide emission and Carbon stock in silvopastoral system

Deise Cristina Santos Nogueira[1]; Fernando Pavanin Martins[2]; Christtiane Fernandes Oliveira[3]; Jaqueline Bonfim de Carvalho[3]; Newton La Scala Júnior[4]; Rafael Montanari[2]; Alan Rodrigo Panosso[2]
FCAV/Unesp -College of Agricultural and Veterinarian Sciences, São Paulo[1]; FEIS/UNESP – College of Engineering of Ilha Solteira, São Paulo State University[2]; FEIS/UNESP – College of Engineering of Ilha Solteira, São Paulo State University, 56 Av. Brasil, Ilha Solteira,SP, 15385-000, Brazil.[3]; FCAV/UNESP – College of Agricultural and Veterinarian Sciences, São Paulo State University[4]

The identification of agricultural areas with the same characteristics is essential for studies related to soil carbon dioxide emissions (FCO_2) and soil carbon stock. To identify areas with the same characteristics the study of spatial variability of soil attributes has been adopted. This study aimed to describe the spatial variability of soil carbon dioxide emission and soil carbon stock in a silvopastoral system (consortium of *Myracrodruon urundeuva* and signalgrass with more than 30 years of implantation) in the Cerrado region located in the state of Mato Grosso do Sul. The spatial variability of FCO_2, carbon stock, temperature, moisture and chemical attributes was evaluated in a DYSTROPHIC HAPLUSTOX typical clayed. To study the relationship between FCO_2 and soil carbon stock the chemical and physical attributes were determined in the layer of 0-0,10 m. The spatial dependence of the variables was taken by experimental variogram analyses, the maps of the study area were made by sequential Gaussian simulation (sGs) and ordinary Kriging, the accuracy and goodness of reproduction of the probability density of the interpolation methods were evaluated by the G statistic. The FCO_2 average in the rain period was 4,62 µmol m^{-2} s^{-1} meanwhile in the dry period it was 2,96 µmol m^{-2} s^{-1}. The exponential semi-variograms model was fitted to FCO_2, for carbon stock and moisture the Spherical model was fitted. The range for FCO_2 was 74,50 m in the rainy period and 86,90 m for dry period, for carbon stock the range was 24,89 m. The FCO_2 showed a strong degree of spatial dependence justifying the use of geostatistic thecniques on this study. There wasn't correlation between the FCO_2, temperature and moisture maps. The higher values showed in the G statistics in the accuracy graphics for sequential Gaussian simulation indicate a good proximity of the simulates values and real values, like that this method is more reliable and accurate in the creation of maps.

Keywords: Keywords: soil respiration, geostatistic, sequential Gaussian simulation, semi-variogram.
Financial support:

(2941 - 2298) Spatial variability of soil carbon pools in the andean grassland (páramo ecosytem)

Pablo Armando Alvarez Figueroa[1]; Gabriela Moreno[1]
National University of Loja[1]

The paramo has great potential of carbon storage, due to the low rates of mineralization and high recycling of nutrients, as a consequence of its low temperatures. The present research was carried out with the purpose of quantifying the total carbon (soil, necromass and soil) contents of the PNP paramo ecosystem and its spatial distribution, for which 80 temporary plots of 1m2 were installed, where the content was quantified of carbon in biomass and necromass by the destructive method. To determine the carbon content in the soil, two samples of soil were taken, one disturbed to determine the carbon content in the soil by the modified method of Walkley and Black (1947) and the second sample in a Kopecky cylinder to determine the bulk density and hydrophysical soil constants. To determine its spatial distribution, the IDW interpolation method was used in the ArcGis 10.4 software. The average carbon content was 163.11 t ha^{-1}, where the soil contributed 90% of total carbon with positive correlation (r = 0.99), whereas that the vegetation did not significantly influence in its content. Spatially the highest total carbon contents were found in the lake systems named "Lagunas del Compadre", and the lowest contained in the north and south ends of the paramo ecosystem. The external variables that influenced its carbon content were: altitude (rs = 0.45), temperature (rs = -0.47), soil humidity at field capacity (rs = 0.64) and saturation (rs = 0.79).

Keywords: soil carbon sequestration, páramo, climate change, andean grassland, soil carbon pools

Financial support: Forest, Biodiversity and Ecosystem Services Poject , National University of Loja

(2914 - 2346) Spatial variability of soil CO_2 emission by Sequential Gaussian Simulation in the Cerrado of Mato Grosso do Sul, Brazil

Ludhanna Marinho Veras[1]; Vivian Aparecida Brancaglioni[2]; Maira Caroline Terçariol[1]; Carla Regina Pinotti[3]; Rafael Montanari[3]; Newton La Scala Junior[1]; Alan Rodrigo Panosso[3]

FCAV/UNESP – College of Agricultural and Veterinarian Sciences[1]; ESALq USP - Luiz de Queiroz College of Agriculture, University of São Paulo[2]; FEIS/UNESP – College of Engineering of Ilha Solteira, Sao Paulo State University[3]

The soil CO_2 emission (FCO2) shows high spatial variability which is strongly influenced by soil attributes. The characterization of this spatial variability is important because it is a main component of the terrestrial carbon cycle. The objective of this study was to identify and characterize the heterogeneity of CO_2, physical and chemical attributes of the soil in an area under cultivation of sugarcane and soybean in the east state of Mato Grosso do Sul, Brazil. Two experinments were conducted for this study, the first one with the soybean (*Glycine max* - L. Merril) in the experimental area of the College of Engineering of Ilha Solteira, city of Selviria in the state of Mato Grosso do Sul. The second study was conducted in the commercial planting area of sugarcane (*Saccharum* spp.) in the city of Aparecida do Taboado in the state of Mato Grosso do Sul. The soil of the areas were classified as dystrophic haplustox typical clayed, being the natural vegetation of the Cerrado. For the sampling to the initial characterization of physical and chemical attributes of the soils were conducted in the 0-0,20 m and 0,2-0,40 m depth. The CO_2 emission and soil temperature were verified by LI-COR (LI-8100), also the soil moisture was determined by TDR (Time Domain Reflectometry). The spatial dependence of the variables were made through the geostatistical analysis from the adjustment of theoretical mathematical models to the experimental variograms and the construction of maps of spatial patterns by the ordinary kriging technique (OK) and Sequential Gaussian Simulation (SGS), accuracy and goodness of reproduction of the probability density of the interpolation methods were evaluated by the G statistic. Higher emissions were found in the soybean area for temperature (27,38 ^{O}C) and soil moisture (17.6%), this result may be linked due to the values being higher when compared to the same variables in the sugarcane area, soil temperature (21,79 ^{O}C), and soil moisture (9,46%). The spatial variability structure of soil CO^2 emissions varied between the study days for the two areas evaluated. The sequential Gaussian simulation showed better performance in the soybean area with variation between 0,80 and 0,91, being superior and more homogeneous values of G statistic, when compared to the area of sugarcane with values between 0,51 and 0,88.

Keywords: *Saccharum* spp., Geostatistics, soil respiration.

Financial support: CNPq, UNESP Reitoria and Sao Paulo Research Foundation (FAPESP).

(3093 - 2621) Spatial variability of soil organic carbon from different management systems in the Cerrado - Sete Lagoas, MG

Matheus Paula Fialho de Carvalho[1]; Raphael Hosken[1]; André Thomazini[1]; Cláudio Manoel Teixeira Vitor[1]; José Carlos Moraes Rufini[1]

Universidade Federal de São João del-Rei[1]

Soil organic matter is highly sensitive to changes through management or land use, being widely used as an indicator of sustainability. The conversion from natural to agricultural systems has largely contributed to the degradation of Brazilian Cerrado. In this case, the impact of land management can be assessed by applying an efficient soil quality indicator coupled with digital mapping techniques. Thus, the objective of the study was to determine spatial variability of soil organic carbon from different management systems in the Cerrado region. The study was carried out in the experimental area of the Federal University of São João Del-Rei, Sete Lagoas, MG. In November 2017, a regular 60-point grid, with a minimum and maximum separation distance of 5 and 100 m was installed. In each grid-point, one single soil sample was taken at 0-10 cm depth. The entire area comprises plots with: Cerrado trees, pasture and fruits. Total soil organic carbon was determined according to Walkley–Black method. The spatial variability was assessed by producing an experimental semivariograma in order to verify the occurrence of spatial dependence. Maps of spatial distribution were generated using ordinary kriging interpolation method. Spatial variability pattern was best established using isotropic model (exponential model), with a range of 12 m, with low spatial dependence index (>75%). Results suggest that higher soil organic carbon contents were observed in the pasture area 60 g kg^{-1}. On the other hand, the most intensive land (fruits) used has been contributing to decreasing soil organic matter. By using the geostatistical technique, the spatial distribution of soil organic carbon can be easily observable, indicating where soil quality is rapidly decreasing. In this case, besides contributing with erosive processes, the depletion of the soil organic matter also contributes to the CO_2 emissions, directly linked with climate issues. In this study, pasture system provides a more efficient incorporation/preservation of organic matter in the soil. The lack of vegetation residues on the soil surface in the fruit cultivation accelerated mineralization, impairing the maintenance of soil quality.

Keywords: Soil Organic matter; kriging; land use; Geostatistical techniques

Financial support:

(2456 - 2398) Spatial variability of soil organic carbon in anthropized areas of the Cerrado in Sete Lagoas, MG

Paulo Antonio Coura[1]; André Hirsch[1]; André Thomazini[1]; Samuel Petraccone Caixeta[1]

Universidade Federal de São João del Rei - Campi Sete Lagoas[1]

Surface soils (0–30 cm depth) store almost half of soil organic carbon

and up to three times of the above-ground carbon stored on vegetation. This soil layer is strongly vulnerable to carbon losses, mainly due to oxidation processes and erosion, as a consequence of climatic changes and land management practices. However, carbon distribution on landscapes is highly heterogeneous. With this, through the application of spatial statistical analysis (geostatistical techniques), factors leading to current carbon dynamic can be properly determined and assessed, helping the correct use and management of ecosystems, especially in tropical zones. The objective of the present study was to map and to determine spatial variability of soil organic carbon of the UFSJ boundary (*campi* Sete Lagoas, MG, Brazil). In August 2017, a regular 29-point grid, with a minimum and maximum separation distance of 100 and 1000 m (one point per hectare) was generated in the *QGIS 2.14 Essen* software. In each grid-point, one single soil sample was taken at 0-5 cm depth. Total soil organic carbon was determined according to Walkley–Black method. The spatial variability was assessed by producing an experimental semivariograma in order to verify the occurrence of spatial dependence. Maps of spatial distribution were generated using ordinary kriging interpolation method. Spatial variability pattern was best established using isotropic model (spherical model), with a range of 120 m, with low spatial dependence index (>75%). Greater organic carbon contents were observed in areas with Cerrado fragments, ranging from 50 to 70 g kg^{-1}. In this area, the A horizon is preserved, storing more carbon than experimental areas of the University, as well as where vegetation was removed due to the human activities. We observed organic carbon contents varying from 20 to 40 g kg^{-1} at anthropized areas, suggesting a degradation of the A horizon. Results evidence that human activity has been contributing to the degradation of soil organic matter in Cerrado areas. Thus, it's important to point out the importance of soil organic carbon preservation at this Brazilian biome, in order to improve soil quality and reduce greenhouse gas emissions.

Keywords: mapping organic matter Ordinary kriging
Financial support:

(8125 - 392) Spectral range (FRX-VIS-NIR-SWIR-MIR) interaction on the organic matter prediction

Diego Fernando Urbina Salazar[1]; José A. M. Demattê*[2]; Luiz E. Vicente[3]; Clecia C. Guimaraes[1]; Arnaldo Barros de Souza[1]; Leonardo Inforsato[4]; Hudson Wallace Pereira de Carvalho[4]
Department of Soil Science, College of Agriculture Luiz de Queiroz, University of São Paulo[1]; Department of Soil Science, College of Agriculture Luiz de Queiroz, University of São Paulo*[2]; Satellite Monitoring Unit, Brazilian Corporation of Agricultural Research-EMBRAPA[3]; Center of Nuclear Energy in Agriculture, University of São Paulo[4]

Organic matter (OM) is an important indicator of soil quality and, therefore, must be quantified quickly and efficiently. Besides traditional methods, and countless studies with sensors have been advanced, but few integratively. This work aimed to develop models for OM content prediction using the FRX-VIS-NIR-SWIR-MIR regions separately and together. A total of 22 soil samples were collected in the state of São Paulo, Brazil (80-100 cm). Each sample was oven dried at 45 ° C for 48 hours, milled and sieved to a diameter of 0.150 mm and had a series of 8 treatments, considering the addition of humified organic material (MOH) in different amounts (0, 5, 10, 15, 20, 30, 40, 50 g). Afterwards, the treated samples were read in the sensors FIELDSPEC-PRO (VISNIRSWIR), ALPHA FTIR (MIR), and portable FRX for the extraction of the spectral responses. For the creation of the best model by Partial least squares regression (PLSR), 70% of the samples were used for calibration and 30% for validation and different preprocessing techniques were used: transformation of the reflectance data for absorbance, smoothing, first derivative Savitzky-Golay (SGD), standard normal variation (SNV) and multiplicative signal correction (MSC). The spectral data were tested separately and together using the absorbance transformation as a fixed preprocessing to which other was added. The calibration results for all models presented R^2 greater than 0.8 for the best preprocessing, which varies according to the spectral region analyzed. The best validation occurred for the preprocessed model with only absorbance and smoothing using the VIS-NIR-SIWIR-MIR spectral regions and presented values of R^2, RMSE and RPIQ equal to 0.8, 6.8 and 4.55, respectively. When using all the regions (RX-VIS-NIR-SWIR-MIR) simultaneously, validation values similar to those cited above (R^2 = 0.8, RMSE = 6.96 and RPIQ = 4.45)were obtained, indicating that the X-ray region does not influence the improvement of the prediction of OM. Models created only with a the spectral x-ray region presented the worst validation values. OM considerably influences on the spectral response from visible to medium infrared regions and, in this manner, they can be used for more accurate prediction of its values.

Keywords: Soil sensing, quantification, spectroscopy, environment, spectral library.
Financial support: FAPESP 2014-22262-0

(4103 - 2573) Total soil organic carbon in integrated systems in the Brazilian Amazon

Rodrigo da Silva Ribeiro[1]; Marilia Locatelli[1]; Pedro Gomes da Cruz[1]; Alaerto Luiz Marcolan[1]; Henrique Nery Cipriani[1]; Alexandre Martins Abdão dos Passos[2]
EMBRAPA RONDÔNIA[1]; EMBRAPA MILHO E SORGO[2]

Amazon The Integrated Crop-Livestock (ICL) or Crop - Livestock-Forestry (ICLF) systems are alternatives for soil quality recovery in degraded areas of the Amazon, and also help the development of agriculture without incorporating new forest areas into the production. The objective of this work was to evaluate total soil organic carbon content (TSOC) in ICL and ICLF systems in Amazonia. The experiment was conducted at Embrapa Rondônia, in Porto Velho - RO at 8º 47 '42''south latitude and 63º 50' 45 '' west longitude, since 2008/2009 agricultural period. The soil of the experimental area is a plinthic dystrophic Red-Yellow Oxisol of clay texture. The ICLFS has two eucalyptus clones (VM01 and GG100) in various spatial arrangements between plants and tiers. Tiers are composed of four planting lines, spaced at 3.5 m. The soil was managed with succession of soybean (*Glycine max* cv. BRS Valiosa), maize (*Zea mays* cv. LG6038), intercropped with Xaraes grass (*Urochloa brizantha* cv Xaraés). Soil sampling took place in 2014 in May (dry period) and November (rainy season). The sampling points were determined in a regular grid of 30 x 30 m, in the depths of 0 to 10 and of 10 to 20 cm. The organic matter data for TSOC calculation were obtained according to the method proposed by Walkley & Black. The ICL and ICLF systems were compared using the t-test (ICL n = 56 and ICLF n = 64). TSOC was higher in the ICL system when compared to the ICLF system ($p \leq 0.05$). The ICL system in the rainy season presented TSOC values of 21.71 and 30.16 g kg^{-1} and the ICLF values of 16.41 and 16.84 g kg-1, at depths of 0 to 10 and 10 a 20 cm, respectively. There were differences in the ICL and ICLF systems ($p \leq 0.05$), in both depths evaluated. The ICL system presented a TSOC increase of 8.7 and 64.2% at depths of 0-10 and 10-20 cm. For the ICLF system, there was a reduction of TSOC of 1.5 and 2.6% in the depths of 0-10 and 10-20 cm. The ICL system promoted increase of TSOC in the topsoil from 0 to 20 cm.

Keywords: integrated systems, Rondônia, Eucalyptus, corn, Brachiaria
Financial support: EMBRAPA and FAPERO

(8771 - 2280) Unraveling the fate of organic carbon in plinthic horizons upon flooding

Benini, Natalia Silva[1]; De-Campos, Alfredo Borges[1]
Institute of Geosciences, University of Campinas (UNICAMP)[1]

Flood irrigation projects for agricultural purpose have been implemented in Plinthosols in Central Brazil. Little is known about the geochemical transformations that can occur in these soils during flooding, especially those related to the fate of organic carbon compounds which can potentially solubilize and migrate in the soil profile. Plinthosols' diagnostic Fe and Al-rich plinthic horizons may control the mobilization of organic carbon but this hypothesis has not been tested. The objective of this study was to determine the changes in concentration of dissolved organic carbon (DOC) related to plinthic horizons when these horizons undergo prolonged flooding. Samples of plinthic horizons were collected at 60cm depth (Bf1) and 100cm depth (Bf2) from an area under flood irrigation for 18yr located in the district of Luis Alves do Araguaia, state of Goias, Brazil. The soil organic matter content was 2 g/dm^3 for both horizons. After sieving (<2mm), soil samples were incubated in triplicate under anoxic and reducing conditions in the laboratory for 1,7,15,30,60,120 days, then filtered (0.22µm) and analyzed for DOC by TOC analyzer. Between 1 and 15 days the mean value of DOC concentrations (mg/L) was 23.6 for Bf1 and 14.5 for Bf2 whereas between 30 and 120 days was 5.6 for Bf1 and 5.0 for Bf2. Results showed flooding favored the solubilization of organic carbon between 1 and 15 days for both horizons, but after this period DOC did not remain in solution and was possibly resorbed by the solid phase. This indicates the period of greatest mobility of organic carbon in plinthic horizons is at the beginning of flooding. Results also showed DOC solubilization was higher for Bf1 in comparison to Bf2. This indicates that in Plinthosols subjected to prolonged flood irrigation organic carbon is more easily solubilized in plinthic horizons close to the surface, regardless of the organic matter content. In conclusion, organic carbon from plinthic horizons only migrates in the soil profile or is exported to adjacent water bodies at the beginning of flooding. The mobilization of organic compounds in plinthic horizons depends on soil depth. Soil mineralogy might contribute to enhance or decrease organic carbon mobilization however this was not investigated in this study.

Keywords: DOC; Flooded soil; Wetlands
Financial support: FAPESP - Project 16/01270-0

(6923 - 914) Using of regression tree for soil organic carbon prediction in the caatinga biome

Valéria Ramos Lourenço[1]; Carlos Alberto Kenji Taniguchi[2]; Carlos Alexandre Gomes Costa[3]; Raul Shiso Toma[3]; Pedro Henrique Lima Alencar[3]

Universidade Federal de Viçosa[1]; Embrapa Agroindústria Tropical[2]; Universidade Federal do Ceará[3]

The selection of variables related to soil organic carbon content and its distribution on the ecosystem is essential for the parameterization of prediction models. In the Caatinga biome is indispensable the selection of parameter able to represent its dynamics in different space-temporal compounds observed in the local vegetation. Accordingly, this work aimed to evaluate the viability of the use of climatic and topographic parameters on carbon prediction through regression trees in a Caatinga biome watershed. The experiment was carried in the Bengue Representative Basin (BRB), which has an area of approximately 1,000 km², located in the Brazilian northeastern region, in the state of Ceará. In order to proceed analysis of organic carbon (g.kg-1), forty deformed soil samples on the depth of 0 – 0.2 m were collected in the BRB. Climatic and topographic parameters were obtained using digital elevation models (SRTM data), geoprocessing tools and climatic database FUNCEME (Company of Meteorology and Water Resources of Ceará). The methods of classification were developed in R language and the package "rpart" was used for the prediction using regression tree. For the performance analysis of the prediction model, the following indicators were used: Mean absolute error (MAE = 0.43 g.kg-1), the root mean squared error of prediction (RMSE = 3.02 g.kg-1) and the coefficient of determination (R^2 = 0.65). Those values indicate a small difference between observed and modelled data, nonetheless with a certain sensibility to outliers that may be attributed to collect issues. The value of R^2 argues that the model has a fair skill on predicting soil organic carbon content. Thus, we may conclude that models of prediction using regression tree receiving inputs of climatic and topographic data showed to be promising on the prediction soil carbon content in the Caatinga Biome.

Keywords: parametrization slope precipitation.
Financial support: Fapemig

C1.5.2 - Crucial techniques for the critical zone: Soil morphometrics, monitoring & modeling

(4020 - 2414) Contribution of different environmental covariates in digital soil mapping

Ebrahim Majmoudabadi[1]; Gholam Hosain Haghnia[1]; Alireza Karimi[1]; Adel Sepehr[2]

Department of Soil Science, Ferdowsi University of Mashhad[1]; Department of Desert Arid Zones Management, Natural Resources and Environment[2]

Soil covariates are the available and cost-effective data over large areas which can be applied as inputs of digital soil mapping procedures. Environmental factors have been recognized as governing the soil formation (e.g. parent material, relief, vegetation, and climate) and the spatial soil information that can be retrieved from remote sensing images or small scale soil maps of the region of interest. Therefore, a great variety of environmental covariates are now used as input for estimating soil properties. The purpose of this paper was to find the contribution of different auxiliary data to the prediction of different soil properties. The study area with an area of 1225 ha was located in Bajgiran rangelands, Khorasan Razavi province, Iran. In order to investigate vegetation cover and soil, 137 sampling sites were investigated in which 3-5 plots were selected with a distance of 10 meters apart along a transect. In each plot, plant species names and numbers as well as vegetation cover percentage (VCP) were recorded. Next, one soil sample was taken from each transect (Totally 137 soil sample). Train attributes were derived from digital elevation model; different bands and spectral indices were obtained from the Landsat7 ETM+ images, and vegetation features were calculated in the plots. These obtained parameters were used as covariate in estimating calcium carbonate equivalent (CCE), clay, bulk density (BD), total nitrogen (TN), soil organic carbon (SOC), sand, silt and soil moisture capacity (SMC) using artificial neural network. The significance of input variables on different outputs was investigated based on performance of ANN models in estimating output variable. The results indicated that vegetation features and indices were more effective than remotely sensed data and terrain attributes in the prediction of SOC, TN, silt, SMC CCE, BD, and sand. However, Terrain attributes data were the most important auxiliary data for the prediction of clay contents. It is also found that vegetation spectral indices, including NDVI, SAVI, MSAVI, SARVI, RDVI, and DVI, showed greater effectiveness in the estimation of soil properties relative to the separate bands and even soil spectral indices. It is concluded that vegetation features data especially vegetation percentage cover (a component of o in scorpan model) can be used as an effective covariate to enhance the accuracy of soil properties prediction models.

Keywords: Environmental variables, Soil properties, Terrain attributes, Vegetation indices
Financial support: Ferdowsi University of Mashhad

(3232 - 1866) Evaluation of spectral analysis models for determination of soil attibutes

Patrícia Morais da Matta Campbell[1]; Márcio Rocha Francelino[2]; Elpídio Inácio Fernandes Filho[2]; José Alexandre Melo Demattê[3]; Clécia Cristina Barbosa Guimarães[3]; Carlos E R G. Schaefer[4]

Universidade Federal Rural do Rio de Janeiro, Rodovia BR 465, Km 07, s/n - Zona Rural, Seropédica - RJ, 23890-000 , Brasil[1]; Universidade Federal de Viçosa, Avenida Peter Henry Rolfs, s/n - Campus Universitário, Viçosa - MG, 36570-900, Brasil[2]; Escola Superior de Agricultura "Luiz de Queiroz", Avenida Pádua Dias, 11 - Agronomia, Piracicaba - SP, 13418-900, Brasil[3]; 2Universidade Federal de Viçosa, Avenida Peter Henry Rolfs, s/n - Campus Universitário, Viçosa - MG, 36570-900, Brasil[4]

The quantification of soil attributes is essential for a better knowledge on environmental aspects and improved soil management. However, traditional laboratory methods are time consuming and expensive, besides harmful in many aspects. Hence, the development of new techniques, such as spectroscopy, is needed to have a feasible and economic way of rapidly estimating a wide range of soil properties. The objective of this work was to predict organic carbon (CO), clay and extractable P contents from the MIR, Vis-NIR and Vis-NIR-MIR spectra using different methods of pre-processing (Continuum removal-CR; Absorbance-ABS (SNP) and the Multiplicative Scatter Correction (MSC), combined with five predictive models (Partial Least Squares Regression-PLSR, Artificial Neural Network-ANN, Random Forest-RF, Guassian Process Regression-GPR and Support Vector Machine-SVM). The work was carried out in Iconha/ES (Brazil), in the Ribeirão Inhaúma catchment. We used 184 samples, collected in 92 points at two depths (0-10 and 10-30 cm). Physical, chemical and spectral analyzes were performed according to the method used in the routine soil laboratory. Of the samples, 70% were randomly selected for training and 30% for validation (external set of samples) of the models, cross-validation was used. By combining the pre-processing methods and the multivariate regression algorithms, we obtained 30 tests. For the performance analysis, the coefficient of determination R^2, RMSE, prediction error standardization indexes, RPD (Ratio of performance/prediction to deviation) and RPIQ (Ratio of performance/prediction to interquatile) were calculated. For clay and OC the best R^2 was found in the MIR spectrum, 0.69 and 0.65, respectively; whereas for P (0.57) using Vis-NIR. This study found satisfactory models (RPIQ superior to 2.0) to predict clay, OC and P. The MSC, CR and SNV preprocessing were the most efficient for prediction of clay, OC and P, respectively, while the PLSR (OC and P) and SVM (clay) methods stood out as the best predictions and are therefore recommended for modeling these attributes in similar areas. The models found can be tested to discriminate soils according to a critical test value for clay, OC and P, as for example, separating sandy and clayey soils. It is believed that the addition of more samples in the training and validation set can improve the models with RPIQ and RPD between 1.4 and 2.0, improving their accuravy and attaining excellent prediction performance.

Keywords: Vis-NIR-MIR spectraVis-NIR-MIR spectra; Reflectance, chemometrics.

Financial support:

(6151 - 654) Evaluation of the spatial distribution of selected soil attributes in the El Oro Province, Ecuador.

Rayner Sversut Barbieri[1]; Eduarda Lossavaro de Almeida[1]; Douglas Henrique Bandeira[2]; Salomón Alejandro Barrezueta-Unda[3]; Julio Enrique Chabla-Carrillo[3]; Rafael Montanari[1]; Antonio Paz González[2] Universidade Estadual Paulista "Júlio de Mesquita Filho", Faculdade de Engenharia de Ilha Solteira.[1]; Centro de Investigaciones Científicas Avanzadas (CICA), grupo AQUASOL-Facultad de Ciencias, Universidad de La Coruña, Campus A Zapateira s/n 15008 A Coruña, Spain.[2]; Facultad de Ciencias Agropecuarias, Universidad Técnica de Machala. Km 51/2 Via Machala-Pasaje, Ecuador.[3]

The mathematical modeling of the semivariogram, and the kriging technique, which allows interpolation of values at any unsampled position within a study field, without trend and with minimum variance through geostatistical analysis are tools increasingly used for agricultural and environmental research. This study was motivated by the need of soil studies in the province of El Oro, Ecuador, and the objectives were to obtain information through the analysis of spatial variability and to assess the structure of the spatial dependence of selected soil attributes, for assisting in the planning of agricultural activities. We used data from soils sampled at six municipalities in the province, namely: Huaquillas, Machala, Chilla, Atahualpa, Portovelo and Las Lajas. Samples were collected every two kilometers following a regular grid and georeferenced using a GPS. The grid consisted of 368 points and sampling depth was 0-20 cm. The studied attributes were: pH, exchangeable sodium, potassium, calcium, and magnesium, sum of bases and available concentrations of of zinc, copper, iron and manganese. Adjustment of semivariogam models and interpolation by ordinary kriging were performed by the R Core Team program. Most semivariograms were best fitted by spherical models; the greater range was for magnesium (41.500 m) and the lowest for copper (7.740 m).Extractable zinc concentrations showed the best fit to a theorethical semivariogram with the highest coefficient of determination (r2 = 0,959). Mappings were carried out by means of kriging. Kriging allowed to verify that only for of the studied attributes, namely pH, iron and sodium concentrations and base sum showed higher estimation reliability in the non-sampled area, while the rest of the attributes presented very high variation. The maps of soil pH, magnesium and calcium concentrations and sum of bases have been demonstrated to show high similarities and were important to determine specific areas of soil management in each municipality.This was mainly true when considering acidity. In this sense, the pH is accredited in this research as an influencer of other soil attributes studied and their specific areas of management.Despite the absence of sampling points between the 6 municipalities studied and the high variability of the attributes induced by soil use our results indicated that geostatistical analysis can be used as a /source of planning in the future management of soils in the region of El Oro, Ecuador.

Keywords: Geostatistics; ordinary kriging; soil fertility, macronutrients, micronutrients.

Financial support: Universidad de La Coruña.

(5803 - 2093) Geostatistical mapping of soil organic carbon using isotropic and anisotropic models considering soil mapping units represented at different scales

Dioni Glei Bonini BITENCOURT[1]; Luana Nunes CENTENO[2]; Luís Carlos TIMM[3]; Ednaldo Carvalho GUIMARÃES[4]; Luiz Fernando Spinelli PINTO[5]; Eloy Antonio PAULETTO[6]
Federal University of Pampa, Campus Universitário, S/N, 97501-970, Uruguaiana, RS, Brazil (dioniglei@gmail.com)[1]; Post-Graduate Program in Water Resources (PPG Recursos Hídricos), Federal University of Pelotas, Campus Porto, 96010-610, Pelotas, RS, Brazil (luananunescenteno@gmail.com)[2]; Federal University of Pelotas, Campus Universitário, S/N, 96160-000, Capão do Leão, RS, Brazil (lctimm@ufpel.edu.br)[3]; Federal University of Uberlândia, Uberlândia, MG, Brazil (ecg@ufu.br)[4]; Federal University of Pelotas, Campus Universitário, S/N, 96160-000, Capão do Leão, RS, Brazil (lfspin@uol.com.br)[5]; Federal University of Pelotas, Campus Universitário, S/N, 96160-000, Capão do Leão, RS, Brazil (pauletto_sul@yahoo.com.br)[6]

The factors of soil formation, due to the complexity of interactions of their processes in nature, are responsible for the different patterns of spatial distribution of soil properties, varying in intensity in different directions and spatial scales. The study aimed to: i. quantify the spatial variability of organic carbon of the surface layer of a Gleysol mapping unit in reconnaissance scale in the Coastal Plain of Rio Grande do Sul

(RS) state, Brazil, through Geostatistics with the use of isotropic and anisotropic models, and ii. compare the results taking into account the existence at least one mapping unit in semi-detailed scale within the reconnaissance scale mapping unit. The study was carried out in a 403 ha area, located within the "Formiga" mapping unit according to the Reconnaissance Survey in the RS state. An experimental grid of 403 points, spaced 100 m from each other, was established in the area. At each experimental point, soil no-preserved samples were collected to determine the organic carbon (C) in the 0-0.20 m layer. The data set was submitted to an exploratory analysis through a descriptive statistical and the Kolmogorov-Smirnov test to check its normality. The proportional effect and spatial continuity, by applying the Monte Carlo simulation envelopes, were also evaluated. Directional semivariograms were built to identify the anisotropy type. Anistropic and isotropic models were built for the organic carbon data set in the reconnaissance and semi-detailed mapping units. Ordinary kriging was used to build contour maps of C at each scale. C data showed moderate variability, tended a normal distribution and no proportional effect was observed at both scales. Spatial continuity was verified for the distribution of C considering both soil map units. Results show that the organic carbon spatial variability structure was best modeled by an anisotropic model and by an isotropic one in the reconnaissance and semi-detailed scales, respectively. The use of an isotropy or an anisotropy semivariogram to model the organic carbon spatial variability structure depends on the study scale.

Keywords: Lowland soil, soil spatial variability, semivariogram.
Financial support: National Center National Council of Scientific and Technological Development (CNPq), Coordination of Improvement of Higher Level – or Education- Personnel (CAPES), Federal University of Pampa (Uruguaiana), Federal University of Pelotas and Post-Graduation

(9305 - 1632) Pedoclimatic monitoring in high andean intertropical mountains (Bolivia and Peru)

Eduardo Osório Senra[1]; Carlos Ernesto Schaefer[1]; André Thomazini[2]; Marcio Rocha Francelino[1]
Universidade Federal de Viçosa[1]; Universidade Federal de São João Del Rei[2]

Pedoclimatic regimes in high mountain environments at snow line are differently affected by latitudinal efects. The objective of this work was to compare two pedoclimatic sites in different latitudes, in the central portion of high Andean mountain. The physiographic conditions are similar, same altitude (4800m), slope and face of exposure. Monitoring was conducted in the Cordillera Blanca (P1, 9^0 South), Peru, and another profile in the Cordillera Real (P2, 16^0 South), Bolivia. Time data for soil temperature (5, 10, 30, 50, 80 cm), humidity (10, 30, 50, 80 cm) and air temperature (100 cm above the soil surface) were continuously collected over 4 years at P1 and 9 months at P2. The two soils were classified as Entisols, with a cryic temperature regime up to 80 cm deep and without evidence of current permafrost, despite the evidence of cryoturbian and periglacial features. The thermal and water behavior of the soils were affected by the local climate, situation and morphology. Soils with contribution of coarse material (> 2mm) show higher thermal conductivity, while organic matter and higher percentage of clay have a buffer effect on temperature variation. The Peruvian site (P1) has higher average and maximum temperatures, with a strong isothermal, consistent with its lower latitude. In Bolivia (P2) the mean and minimum temperature values are smaller, with a more pronounced thermal seasonality over the time series. In P2 there is a more evident water drought between the months of May and September, but P1 has greater daily variations. P2, at the bottom of the slope, has a greater depth of solum, higher clay content and higher organic matter input while P1, at the top, with sparse vegetation, is shallow and has a higher contribution of coarse material (> 2mm). Therefore local terrain differences, such as hillside situation and vegetation cover, affect soil and climate regimes and consequently weathering. In both sites the analysis of the periglacial thermal pattern is very different from that observed in regions of high latitudes.

Keywords: Tropical Andes, Permafrost, Active layer, Thermal regime, Water regime
Financial support: Grupo TCNPq

(5531 - 2903) Proximal sensors on soil profiles evaluation with morphometrics purposes at field conditions

Arnaldo B. Souza[1]; José A. M. Demattê[1]; Fellipe Alcântara[1]; Vinicio Lima[1]
ESALQ/USP[1]

Field measurements are a big challenge on soil science. The sensors are greatly affected by humidity and other natural uncontrolled conditions. We studied soil profiles using three sensors with different working spectra range to find out potentials and limitations on morphometrics purposes. Seven soil profiles from Southeast of São Paulo Brazil (Lixisols and Ferralsols, WRB/FAO) were measured up to 1.7 m deep every 10 cm by VIS-NIR-SWIR Diffuse Reflectance (DR) (350-2500 nm), and Elemental Distribution by XRF (X-Ray Fluorescence – 0-40 keV) and Gamma Spectrometry (GS) (0-3,000 keV). VIS-NIR-SWIR DR gives a multi soil properties perspective due to be affected by Humidity, Organic Matter, Clay content and its quality (i.e., 2:1 or 1:1). This properties assessment allows inferring about biotic and abiotic process on soil profiles, which are essential on soil evolution and behavior. XRF technic is based on a primary method that gives information about chemical composition and relative abundance of the elements on soil profiles. This method can be helpful on element's dynamics studies allowing to identify imported material or translocation processes at field conditions. It's necessary to consider matrix effect in using this technic due to constructive and destructive energy interactions. Soil's natural gamma radiation is mainly due to Uranium (U), Thorium (Th) and Potassium (K) decay series. The distribution dynamics of these elements differs one to another and allows differentiating soil bodies and the originating materials. Along with this, nutrient's stocks can be modeled and used on Soil Quality Indexes development. Ultimately, proximal sensors use enables the study of soil at natural conditions. This approach allows to reconstruct soil's evolution history and associate it with natural phenomena, like climate changes. Soil's vertical organization can be accessed by sensors. It gives support on soil vertical evolution identification and elements dynamics in real time. It's possible to identify elements concentration through profiles and to make inferences about soil genesis at field conditions.

Keywords: Soil sensing, soil mapping, environment, big data
Financial support: CAPES; FAPESP 2014-22262-0

(8982 - 1555) Quantifying the soil hydromorphism in riparian zone by magnetic induction

R.J.Heck[1]; K.Prapagar[1]; N.V.Thevathasan[1]
University of Guelph[1]

This research study is part of the multidisciplinary project, "Riparian buffer plantings: An Agroforestry land-use for greenhouse gas mitigation including multiple benefits to Canadian agricultural systems" funded by Agriculture and Agri- food Canada. The goal on this research to explore the potential to use electromagnetic induction techniques to help delineate hydromorphic conditions within riparian zones .Riparian forest buffers play a significant role in improving soil and water quality. The presence and distribution of gleying and mottling is typically used, at the field level, to determine natural soil drainage classes, which is one of the principal considerations for soil mapping in the province of Ontario. Soil redox behavior, key to the question of the sequestration of organic

compounds and generation of greenhouse gases, is also fundamental in the development of hydromorphic features, including iron oxides (zones of depletion/accumulation, oxidation state). The measurement of magnetic susceptibility can be useful to help understand the state of iron oxide behaviour in the soil. Detailed analysis of magnetic susceptibility by electromagnetic induction survey combined with laboratory-based measurements will provide the reference basis for soil hydromorphism, which in turn help to delineate soil drainage classes. The findings will also help to evaluate greenhouse gas emission reduction potentials in agroforestry ecosystems. In this context, this research is designed with the following specific objective; to characterize the magnetic susceptibility of soil along hydromorphic gradients in relation to the nature of secondary iron oxide. The following methodology is applied to test the objective; Soil samples are collected by hand auger, from 4 depths (0-25, 25-50, 50-75 and 75-100 cm) along the upstream and downstream transacts, to represent 5 soil drainage classes; detailed laboratory analysis is conducted to characterization soil material for i) magnetic susceptibility (MS), using a Bartington MS-2B system; ii) iron oxide characterization by acid ammonium oxalate and by citrate bicarbonate-dithionite (CBD) extraction; and iii) effect of heating on magnetic susceptibility by progressive heating soil samples in a furnace. Key words: Bartington MS-2B system, iron oxide, magnetic susceptibility, upstream-downstream Financial support: Agriculture and Agri- food Canada (AAFC)

Keywords: Bartington MS-2B system, iron oxide, magnetic susceptibility, upstream-downstream
Financial support: Agriculture and Agri-Food Canada (AAFC)

(3013 - 2479) Similarity analysis among soil and topographic attributes along a watershed spatial transect, Southern Brazil

Jeferson Prass Pimentel[1]; Luana Nunes Centeno[2]; Luís Carlos Timm[3]; Alexssandra Soares de Campos[4]; Samuel Beskow[5]; Tamara Leitzke Caldeira[6]; Dioni Glei Bonini Bitencourt[7]
Federal University of Pelotas, University Campus, S/N, Capão do Leão-RS, 96160-000, Brazil (jefersonprass@gmail.com)[1]; Post-Graduate Program in Water Resources (PPG Recursos Hídricos), Federal University of Pelotas, Campus Porto, 96010-610, Pelotas, RS, Brazil (luananunescenteno@gmail.com)[2]; Federal University of Pelotas, University Campus, S/N, Capão do Leão-RS, 96160-000, Brazil (lctimm@ufpel.edu.br)[3]; Federal University of Pelotas, University Campus, S/N, Capão do Leão-RS, 96160-000, Brazil (alexssandra1_sc@yahoo.com.br)[4]; Federal University of Pelotas, Campus Porto, 96010-610, Pelotas, RS, Brazil (samuel.beskow@ufpel.edu.br)[5]; Federal University of Pelotas, Campus Cotada, 96010-020, Pelotas, RS, Brazil (tamaraleitzkecaldeira@gmail.com)[6]; Federal University of Pampa, Campus Universitário, S/N, 97501-970, Uruguaiana, RS, Brazil (dioniglei@gmail.com)[7]

Soil hydro-physical and topographic attributes are key factors to understand and model hydrological process at the watershed scale. The objective of this study was to evaluate the relationship between soil physical and hydraulic attributes and topographic attributes along a 25 km spatial transect using cluster cluster analysis. The spatial transect was set up in the Pelotas river watershed (PRW), Pelotas, Rio Grande do Sul State, Brazil. Upstream of the outlet named as “Ponte” Cordeiro de Farias, 100 points spaced 250 m from each other were demarcated along a 25 km transect. At each experimental point, samples of preserved and non-preserved soil were collected in the 0.0-0.20 m layer to determine the following attributes: soil bulk density, soil total porosity, macroporosity and microporosity, sand, silt and clay percentages, organic carbon content, saturated soil hydraulic conductivity, soil water content at field capacity (-10 kPa-matric potential) and soil water content at permanent wilting point (-1,500 kPa-matric potential). Some topographical attributes, such as elevation, slope, profile curve, aspect, curvature, plan curvature, upslope contributing area and contour area, were derived from the Hydrologically Consistent Digital Elevation Model (HCDEM). The HCDEM was elaborated based on the cartographic database of Rio Grande do Sul (scale 1: 50,000). To measure the similarity between the soil and topographic attributes, the Euclidian distance and the Ward methods were used to form the clusters. All the statistical procedures were performed in the software R, version 3.4.2. Five clusters were formed according to the attributes as follows: 1 – elevation, saturated soil hydraulic conductivity, soil total porosity, macroporosity and sand percentage; 2 –slope, profile curve, aspect, soil bulk density; 3 – curvature e plan curve; 4 – upslope contributing area, specific upslope contributing area and width of contour; and 5 – organic carbon content, clay and silt percentages, soil water contents at field capacity and at permanent wilting point, and microporosity. It was concluded that some clusters were theoretically and consistently formed among soil hydro-physical and topographic attributes, while some of them had not meaning from the practical point of view.

Keywords: Cluster analyses, Pelotas river watershed, Correlated water soil dynamics.
Financial support: National Council of Scientific and Technological Development (CNPq), Coordination of Improvement of Higher Level – or Education- Personnel (CAPES), Federal University of Pelotas and Post-Graduation Program in Water Resources (PPG Recursos Hídricos).

(6306 - 2054) Soil cation exchange capacity and sum of bases prediction from pXRF and laboratory analysis in Brazil

Michele Duarte de Menezes[1]; Sérgio Henrique Godinho Silva[1]; Wilson Missina Faria[1]; Gabriela Costa Lima da Silva[1]; Marcelo Mancini[1]; Thaís Santos Branco Dijair[1]; Laís Rodarte Barros[1]; Luis Roberto Guimarães Guilherme[1]; Nilton Curi[1]
Universidade Federal de Lavras[1]

Cation exchange capacity (CEC) and sum of bases (SB) are important fertility parameters, which are routinely measured to guide fertilizer application rate. Their prediction by means of a cheaper, faster, less polluting, non-destructive sensor, as portable X-ray fluorescence (pXRF), would be strategic to decrease costs of agricultural practices. Since pXRF provides several elemental data, there is a great potential of such information to predict CEC and SB from machine-learning techniques, as Artificial Neural Networks (ANN) and Support Vector Machine (SVM). The methods are promising, since no assumption concerning data distribution are necessary, and they have outperformed other predictive algorithms in different environmental studies. This work aimed to test the potential of pXRF for soil CEC and SB prediction by evaluating 594 soil samples widespread in several Brazilian regions (totaling seven Brazilian states). ANN and SVM were applied to the CEC and SB determined by tradition laboratory techniques, establishing relationship between them and pXRF (Bruker model S1 Titan LE; samples were air-dried and passed through a 2-mm sieve) results, with or without additional traditional laboratory determined soil properties (organic matter, clay, silt and sandy content). In addition, different dataset input models were also tested: samples from A or B horizon. The models accuracy was assessed by an independent dataset, composed by 30% of total soil samples. Thus, mean square of error (MAE), root mean square of error (RMSE) and R^2adjusted calculated from adjustment of predicted and estimated values were calculated. ANN presented highest accuracy of prediction. The methods performed differently when A or B horizon were used as input information. The use of lab-determined soil properties did not promoted an increase in accuracy for all of models. The best CEC model performance was found for ANN, pXRF+lab determined from B horizon input dataset (MAE = 1.70 $cmol_c\ kg^{-1}$; RMSE=2.24 $cmol_c\ kg^{-1}$;

R^2adjusted= 0.70). Considering that the use of only pXRF would be faster and cheaper option, the ANN model from A horizon (MAE = 2.98 $cmol_c$ kg^{-1}; RMSE=4.15; $cmol_c$ kg^{-1}; R^2adjusted= 0.62) could be considered as an alternative for CEC prediction. The best model performance for SB was obtained from ANN, pXRF from A horizon (MAE = 1.26 $cmol_c$ kg^{-1}; RMSE=1.77; $cmol_c$ kg^{-1}; R^2adjusted= 0.86). Considering the accuracy indexes, the prediction of CEC and SB by means of pXRF is feasible.

Keywords: Machine-learning algorithms; artificial neural networks; support vector machine; soil fertility
Financial support: CNPq, FAPEMIG, CAPES

(4516 - 2131) Spatial dependence structure of the soil saturated hydraulic conductivity along a Brazilian watershed transect

Luana Nunes CENTENO[1]; Luís Carlos TIMM[2]; Willian Silva BARROS[3]; Arlan Da Silva FERREIRA[4]; Luciana Montebello de OLIVEIRA[5]; Dongli SHE[6]; Dioni Glei Bonini BITENCOURT[7]
Post-Graduate Program in Water Resources (PPG Recursos Hídricos), Federal University of Pelotas, Campus Porto, 96010-610, Pelotas (luananunescenteno@gmail.com)[1]; Federal University of Pelotas, University Campus, S/N, Capão do Leão-RS, 96160-000, Brazil (lctimm@ufpel.edu.br)[2]; Federal University of Pelotas, University Campus, S/N, Capão do Leão-RS, 96160-000, Brazil (wsbarros@hotmail.com)[3]; Federal University of Pelotas, University Campus, S/N, Capão do Leão-RS, 96160-000, Brazil (arlansil@yahoo.com.br)[4]; Federal University of Pelotas, University Campus, S/N, Capão do Leão-RS, 96160-000, Brazil (lumontebello@hotmail.com)[5]; Key Laboratory of Efficient Irrigation-Drainage and Agricultural Soil-Water Environment in Southern China, Ministry of Education, College of Water Conservancy and Hydropower Engineering, Hohai University, Nanjing 210098, China[6]; Federal University of Pampa, Campus Universitário, S/N, 97501-970, Uruguaiana, RS, Brazil (dioniglei@gmail.com)[7]

Soil saturated hydraulic conductivity (K_S) is a hydro-physical key property to understand and to simulate hydrological processes in a watershed. It is well known that K_S is highly variable on space and time. Autocorrelation function has been used in the quantification of the spatial variability structure of hydro-physical soil properties, indicating the range of spatial dependence amongst observations of a variable. However, the Power Spectrum Density (PSD) can also be used to define the range of spatial correlation of a soil property, since it is obtained by the Fourier transform of the autocorrelation function of a process, that is, it describes the distribution of the variance of a process in the frequency domain. The objective of the present study was to quantify the range of spatial dependence of the soil saturated hydraulic conductivity measured along a spatial transect of 25 km via PSD. The spatial transect was set up at the Pelotas River Watershed, Pelotas, Rio Grande do Sul state, Brazil. Upstream of the Ponte Cordeiro de Farias control section, 100 points, 250 m far from each other, were demarcated along the spatial transect. At each experimental point, preserved soil samples were collected, in the 0.0-0.20 m soil layer, to determine the soil saturated hydraulic conductivity through the method of constant head permeameter. From a log-log graph between PSD ("y" axis) and frequency ("x" axis) values, a linear regression model was adjusted and the β value was obtained, which indicates the range of spatial dependence of K_S values. All statistical procedures were performed in the MATLAB® R2017b software. The obtained β value was -0.01861, indicating a low range of spatial dependence amongst K_S adjacent observations, since the closer to zero the β value is, the lower is the range of spatial dependence of the variable. Therefore, we can conclude that PSD is a useful tool to quantify the range of spatial dependence of a property based on frequency-domain tools.

Keywords: Spatial variability, power spectral density, hydro-physical soil property.
Financial support: National Council of Scientific and Technological Development (CNPq), Coordination of Improvement of Higher Level – or Education- Personnel (CAPES), Federal University of Pelotas and Post-Graduation Program in Water Resources (PPG Recursos Hídricos).

(5468 - 1163) Using soil spatial data for crop yield estimation and optimisation: A machine learning approach

Mr Stirling Roberton[1]; A/Prof John Bennett[1]; A/Prof Yan Li[1]; Dr Craig Lobsey[1]
University of Southern Queensland[1]

Advancements in Precision Agriculture (PA) over the past decade has led to the development and adoption of Variable Rate Agriculture (VRA), which aims to optimize production by making site-specific recommendations based on soil variability. Such recommendations are currently being made on limited soil information that is not available at the required resolution, and often does not capture the extent of the variability. Whilst there is limited data in the x-y plane, the greatest limitation to date is the severe lack of soil depth information (z plane) and knowledge on its interaction with crop performance. Even if such data was available, traditional statistical approaches may not provide the level of insight required, purely due to the highly complex patterns that may exist. We therefore propose a machine learning (ML) approach that incorporates spatial soil data in an effort for site-specific yield estimation and optimisation. The ML model will be learnt from data collected at a 100ha trial site that has been grid sampled (60m grids) at 4 depth increments to 80cm and analysed for an array of soil parameters. Using this dataset along with historical yield and weather information, the model will be trained to predict site-specific yield in an attempt to later perform yield optimisation. This body of work aims to 1) Model the complex relationship between soil-depth information and yield in order to optimize production, and 2) Showcase the potential for machine learning to be used as a powerful tool in modelling the complexities within the soil system.

Keywords: Soil variability, precision agriculture, machine learning
Financial support: Grains Research and Development Corporation

C1.5.3 - Reconciling pedometrics and pedology

(5995 - 565) A detailed soil weathering evaluation of profiles from parent material to soil by proximal sensing (gama ray, X ray, hyperspectral vis-nir-swir-mir)

Clécia Cristina Barbosa Guimarães[1]; José Alexandre Melo Demattê[1]; Antônio Carlos de Azevedo[1]; Marcos Rafael Nanni[2]; Rafael Cipriano Silva[1]
Department of Soil Science, College of Agriculture Luiz de Queiroz, University of São Paulo[1]; Agronomy Department, Agricultural Science Center, State University of Maringá[2]

The study of weathering has primary importance since the chemical breakdown of thermodynamically unstable minerals on the surface of the earth by weathering agents is a fundamental part of the global element cycling. This process is responsible soil formation on which all terrestrial life depends, playing a central role in soil fertility control by providing many nutrients that enable plant growth. At the present time, the analysis of weathering is performed through mathematical indexes related to the presence or absence of certain minerals and observation of the behavior of the chemical elements along the soil profile. There is, therefore, a necessity for faster and more effective techniques. The objectives of the present work were to characterize

and evaluate the potential of several proximal sensor instruments in the identification of weathering processes in vertical sections of soils. Two soil profiles with contrasting source materials were used to evaluate spectroscopy as a tool capable of identifying changes in profile during weathering. Soil samples were collected and sent for chemical, physical, mineralogical and spectroscopic analyzes. For the latter, three sensors were used, each one contemplating a region of the electromagnetic spectrum (x-ray, visible and infrared). In the field, the gamma ray sensor and the multispectral AISA fênix camera were used to read the entire soil profile. The physical, chemical and mineralogical data were used to understand the behavior of the spectra and were made the elementary, mineralogical and other attributes descriptions present in the collected soil samples. The oxides were spatialized in the images of the Fenix AISA sensor for the visual observation of the behavior of the elements and minerals along the profiles. It was possible to identify, from the spectral behavior, the difference in texture of the horizons, the presence of structural and soil water, the influence of the organic matter and the main minerals that are results of the intensity of weathering. The data of the GAMA and FRX sensors presented high values of correlation with the oxides used in the quantification of the intensity of weathering, indicating the viability of the sensors for the calculation of the indices. The application of multivariate models to the AISA images allowed the quantification of these oxides pixel by pixel along the profile and to observe the differentiation of the horizons.

Keywords: weathering, soil spectroscopy, proximal sensing, profiles, geology

Financial support: CNPQ; FAPESP

(5443 - 2237) Characterization of the magnetic susceptibility and its correlation with the chemical attributes in the Cerrado region

Maysa Danielly de Souza Ferreira[1]; Sammy Sidney Rocha Matias[1]; Maria Iolanda Leal Lustosa[1]; Cinthya Herley Kochhann Ribeiro[1]; Ronny Sobreira Barbosa[2]; Rafael Felippe Ratke[2]; Júlio César Azevedo Nóbrega[3]; Tarcisa Fé da Silva[1]; Inária Vogado Borges[1]

Universidade Estadual do Piauí[1]; Universidade Federal do Piauí[2]; Universidade Federal do Recôncavo da Bahia[3]

The correlation between variables indicates when one attribute is being influenced by another, or when, the management may be affecting that parameter. The present work aimed to characterize the magnetic susceptibility and its correlation with the chemical attributes in the Cerrado. The work was conducted in the municipality of Barreiras do Piauí, whose geographic coordinates are 10º03 'south latitude and 45º68' longitude west, with an average elevation of 400 m, with a slope variation of 1 and 10%. The climate of the region is type AW ', characterized by being semi-humid and with an average temperature of 27°C. The average annual precipitation is around 1200 mm, with concentrated rainfall from November to April. The soil was classified as ENTISOLS. The area under study was delimited and georeferenced, being selected an area of 1 (one) hectare with dimensions of 100 x 100 m. In this area a regular mesh of 10 x 10 m was assembled, totaling 121 sample points, being collected soil samples in the depth of 0.0-0.20 m. Soil characterization was performed by means of a soil profile. The parameters evaluated in the work were chemical attributes, pH in H_2O, phosphorus, potassium, calcium, magnesium and soil magnetic susceptibility (MS), being analyzed by means of an analytical balance. The data were evaluated through geostatistics and Pearson's linear correlation in the soil attributes studied. The correlations between the analyzed variables were determined using the Pearson's correlation (p and ≤ 0.3), moderate (0.4> and ≤ 0.6) and strong (0.7> and 1.0), with a good correlation above or equal to 0.60 (positive correlation), or below -0.60 (negative correlation). Through the geostatistic tool it was possible to establish and identify the variation of this attribute in the soil.When analyzing the data, it was not possible to establish a significant correlation of any of the chemical attributes with the magnetic susceptibility. This result may be related to the management of the area and intense burnings occurring in the place, disorganizing the contents present in the soil through volatilization of the nutrient or change of the state of availability for the plants. The magnetic susceptibility identified the spatial variability in the area. The magnetic susceptibility did not identify correlation with the attributes pH, potassium, calcium and magnesium in the Cerrado region of Piauí.

Keywords: Soil management, preservation, indicators of soil quality

Financial support: Secretary of State for Economic and Technological Development of Piauí – SEDET.

(1789 - 2232) Chemical attributes characterization in soil of Barreiras of Piauí city, Brazil

Tarcisa Fé da Silva[1]; Sammy Sidney Rocha Matias[1]; Maria Iolanda Leal Lustosa[1]; Cinthya Herley Kochhann Ribeiro[1]; Ronny Sobreira Barbosa[2]; Rafael Felippe Ratke[2]; Júlio César Azevedo Nóbrega[3]; Maysa Danielly de Sousa Ferreira[1]; Inária Vogado Borges[1]

Universidade Estadual do Piauí[1]; Universidade Federal do Piauí[2]; Universidade Federal do Recôncavo da Bahia[3]

Soil management interferes with the evaluation of soil chemical attributes, causing errors in its interpretations. The present work had as objective to evaluate the chemical attributes in the municipality of Barreiras do Piauí. The work was conducted in the Barreiras of Piauí city, whose geographic coordinates are 10º03 'south latitude and 45º68' longitude west, with an average elevation of 400 m. The climate of the region is type AW, average temperature of 27°C. The average annual precipitation is around 1200 mm. The soil was classified as ENTISOLS. The area under study was delimited and georeferenced, being selected an area of 1 (one) hectare with dimensions of 100 x 100 m. In this area, a sample mesh of 10 x 10 m was assembled, and soil samples were collected at depths of 0.0-0.20 and 0.20-0.40 m. Soil characterization was performed by means of a soil profile. The parameters evaluated in the work were pH in H_2O, phosphorus, potassium, calcium and magnesium. Data were evaluated through descriptive statistics, initially an exploratory data study was carried out using Minitab software, calculating location (mean and median), variability (coefficient of variation) and central tendency measurements (asymmetry and kurtosis), to verify the normality of the evaluated attributes. For the analysis of the coefficient of variation, the following classification was used, low variability for values lower than 12%, average between 12 and 60%, and high values higher than 60%. The descriptive analysis of the data showed that the distribution of data follows a trend of normality for the attributes pH, potassium and magnesium, according to the asymmetry and kurtosis, not being observed the same result for calcium and phosphorus in the two depths. In this situation, the result should be confirmed by the mean and median, to identify a normal log distribution. By verifying the data, we can see that all attributes analyzed can be represented by the mean and median values, with the exception of calcium at both depths. The coefficient of variation values were classified as low for pH and high for phosphorus, potassium, calcium and magnesium at both depths. The variation of the coefficient is a reflection of the interactions of the processes of its formation and of the management adopted in the place. Descriptive analysis confirmed the normality of the data. Variations of the chemical attributes were identified by the coefficient of variation.

Keywords: Soil management, preservation, nutrient content.

Financial support: Secretary of State for Economic and Technological Development of Piauí – SEDET.

(9144 - 1250) Distribution of the soils in the watershed of the São Francisco Verdadeiro river, watershed of the Paraná III - state Paraná – Brazil

Bruno Aparecido da Silva[1]; Marcia Regina Calegari[1]
West State University of Paraná[1]

Digital Soil Mapping (DSM) are important tools that help in the pedological mapping, because they allow to predict the distribution of soils from the soil-landscape model. In the West of the state of Paraná, the MDS have allowed understanding the distribution of soil covers about landforms flat to wavy. However, the absence of soil mapping in detail scale (1:50,000) has become a methodological barrier to environmental research. Therefore, the objective of this work was to systematize information regarding distribution of soils through the DSM in the watershed of the São Francisco Verdadeiro river. Thematic maps of Slope and Curvature were elaborated from SRTM (Shuttle Radar Topography Mission) and Topodata Project, respectively, both in the Geographic Information System (GIS) Qgis 2.18.0. The Sediment Transport Capacity (CTS) map was elaborated in SAGA 2.2.6. Finally, we proceeded with the map algebra in Arcgis 10.4 to generate the MDS and identify the mapping units in the field. Finally, map algebra was realized in Arcgis 10.4 to generate the DSM and identify the field mapping units. Ferrasols, Nitisols, Regosol + Leptosol + Cambisol and Gleysols were the identified units. The Ferrasols are in the top sectors with slope 0-3%, rectilinear and convex forms, and in stable areas (low CTS). The Nitisols dominate the high-medium and low slope with gradient between 6 and 20% and concave and convex shapes. This unit occupies segments with low to medium CTS, stable sectors of the slope. The association Regosol + Leptosol + Cambisol is distributed in sectors with gradient between 20 and > 45%; in segments with rectilinear, convex and concave forms and unstable sectors of the slope (high CTS). Gleysols are found in the flat valley bottom. The MDS, complemented with the field works, allowed the identification of 4 mapping units. The distribution of soils is related to the morphological characteristics of the slope, reflecting in sectors of progressive and/or regressive pedogenesis. The results corroborated the influence of landform on the distribution of soil.

Keywords: Digital Soil Mapping; soil-landscape; landform.
Financial support: CAPES/Fundação Araucária

(4641 - 2186) Environmental covariates selection by mathematical algorithm for digital soils mapping of mountainous relief area

Martin Meier[1]; Márcio Rocha Francelino[1]; Elpídio Inácio Fernandes Filho[1]; Adriano Luis Schünnemann[2]
UFV[1]; Unipampa[2]

Digital Soil Mapping (MDS) seeks to create a soil spatial distribution system by numerical models, from the spatial distribution of environmental variables used in MDS to establish which properties are grouped in homogeneous patterns that characterize the soil units. It's believed that the variation of the morphometric characteristics has a cause and effect connection with the formation and distribution of soils. The objective of this work was to infer about the selection of covariates for the prediction of soil classes using hierarchical classifications in mathematical algorithms for the production of detailed maps of a mountainous area of the Zona da Mata region of Minas Gerais state. Data describing variables related to soil formation factors obtained from: Orbital images; Euclidean distance between the drainage network; Digital elevation model (MDE) with resolution of 12.5 meters of Alos-Palsar; Conventional map of soils of the state of Minas Gerais in scale 1: 650,000 in vector format; Map of lithology in scale 1: 100,000: in the vector format of the area of Juiz de For a municipality; WorldClim average precipitation and temperature database; Images of LANDSAT-8. The RSaga library was used in the R program to generate 40 morphometric covariates from the MDE. With a function of the "Hmisc" R package, from the values of nonlinear correlation and similarity, the redundant variables of the model were removed, as well as those that best described the dispersion of the soil classes. Classification accuracy values were measured by the Kappa index. A total of 10 covariables were selected in order of importance with best performance in the MDS: 4 Morphometric (Elevation of Slope, Standardized Elevation, TWI and MRVBF), Landsat-8 Bands 7 and 11; Euclidian distance of the drainage network; and two climatic covariables: precipitation of the coldest quarter (BIO19) and annual temperature variation (BIO07). The results of the variables being related to the predominance of the relief factor in the soil formation of the region, agrees that the contribution of the morphometric covariates derived from the MDE is more important that other covariates and variables, in the description, through mathematical perspective, of the relief importance as a soils formation factor.

Keywords: Pedometrics, soil classification, soil mapping, machine learning
Financial support: UFV, LabGEO, CNPQ, FAPEMIG

(7575 - 967) Estimation of sediment moisture with terrestrial laser scanner data

Felipe Carvalho Santana[1]; Guilherme de Castro Oliveira[1]; Márcio Rocha Francelino[1]; Elpídio Inácio Fernandes Filho[1]
Universidade Federal de Viçosa[1]

In the spectral range of the infrared, water and soil have a lot different spectral behavior. While water absorbs practically all incident energy, dry soil reflects more than a third of it, so the gradual increase in soil water content can be inferred by remote sensing. Based on this fact, the present study sought to verify the correlation between the moisture of sediment and the reflectance measured with the use of the Riegl VZ-1000 Terrestrial Laser Scanner. The scanning was carried out in the floor surface of a dam that had only the watercourse, comprising a good part of the dry area, located on the campus of the Federal University of Viçosa, in the state of Minas Gerais, Brazil. A scanning frequency of 300 KHz was used. Three transects were delimited perpendicular to the dam spillway, being traced from the dry sediment to where it was saturated with water. In each of them, immediately after the scanning, five superficial samples (0.05 m) of the sediment were collected for moisture verification, spaced approximately 1.50 m apart. The collection of the reflectance intensity data (dB) of the sediment was done in the RiscanPRO software, in which five samples (points) were extracted from the place where the surface samples were taken. The sediment samples were dried in a forced air oven at 65 ºC for 48 hours and then weighed in an analytical balance. The moisture content of the sediment samples varied from 0.05 to 2.15 g g^{-1}, while the reflectance intensity ranged from -2.46 to -9.06 dB. The correlation between the sediment moisture and the reflectance intensity (dB) of the laser was 0.90. The linear regression y = -2.4337x - 3.3401 was adjusted with the coefficient of linear determination (R^2) of 0.81. The reflectance data in dB were converted to reflectance coefficient, and new correlation and regression were adjusted, with the values correlation coefficient and the R^2 remaining the same. The reflectance data obtained by laser scanner have the potential of use in estimating the moisture of sediments, provided that they are calibrated to the type of sediment or soil to be studied, reducing time and costs with the sampling and analysis.

Keywords: Reflectance intensity; reflectance coefficient; near infrared; remote sensing.
Financial support: CAPES; CNPq; FAPEMIG

(3640 - 2986) Mapping of iron oxides using indirect techniques in soils of the Western Paulista Plateau, Brazil.

JOSÉ MARQUES JÚNIOR[1]; LAÉRCIO SANTOS SILVA[1]
UNESP Jaboticabal[1]

The characterization of the spatial behavior of soil attributes in large areas becomes unfeasible using traditional methodologies. An alternative is the use of indirect methods such as diffuse reflectance

spectroscopy (DRS) and magnetic susceptibility variation (χFD). They are methods that can aid in soil survey and classification, especially in tropical environments, where color and spontaneous magnetism are reliable pedoindicators of the presence of iron oxides and their covariate attributes. Among of many advantages of these methods is the low cost of analysis and rapid results, which can be carried out in the field. Therefore, the purpose is to present the application of DRS and χFD in the mapping of hematite (Hm) and goethite (Gt) in soils of the Western Plateau. For this, 300 soil samples were selected in the depth 0.0 - 0.20 m, spaced 10 km apart. Soils are representative of the Serra Geral (basalt) and Vale do Rio do Peixe (sandstone) geological formations, corresponding to 13 million hectares (~ 50% of the State of São Paulo). The iron oxides Hm and Gt were characterized by X-ray diffraction (XRD), diffuse reflectance spectroscopy (DRS) and the variation of magnetic susceptibility (χFD). The real content estimated and the values of the χFD were submitted to geostatistical analysis, being the points that ware not sampled, estimated by ordinary kriging. It was observed the predominance of Hm on the edges of the Western Paulista Plateau in the lithological domain of basalt, while in the center, where the substrate is essentially sandstone, the goethite was predominant. By both techniques, the semivariogram parameters indicated that the Gt /(Gt+Hm) relation fitted to the spherical model, presenting moderate spatial dependence [$(C_0/(C_0+C_1)\times100]$ =35 and 50%). The range values (a) of the χFD maps (117 km)> ERD (101 km)> XRD (94 km) show the XRD with greater spatial variability for Hm and Gt, since it provides microstructural information dependent on the pedoenvironmental conditions. The well-distant and defined isolines of the ERD map defined the sandstone-basalt lithologic control, while the χFD presented a hybrid behavior between the XRD and the DRS, since the pedoenvironmental and lithological differences affect the χFD. It is concluded that the ERD and χFD are promising in the mapping of soil attributes also in large areas, delimiting bodies of soils with potential to assist in the elaboration of mapping and soil survey units on a regional scale.

Keywords: Hematite; goethite; geostatistics; magnetic susceptibility; X-ray diffraction, diffuse reflectance spectroscopy.
Financial support: Foundation of the São Paulo State (FAPESP), Coordination for the Improvement of Higher Education Personnel (CAPES) and National Council for Scientific and Technological Development (CNPq).

(1798 - 2907) Multifractal and joint multifractal analysis of soil water content measured at successive depths and during three periods along a transect

Antonio Paz-González[1]; Glécio M. Siqueira[2]; Enio F. F. Silva[3]
University of A Coruña (UDC)[1]; Federal University of Maranhao (UFMA)[2]; Federal Rural University of Pernambuco (UFRPE)[3]

Soils are highly variable and heterogeneous over several spatial scales. The spatial variability of soils might be characterized through concepts of scale invariance, fractals and multifractals. Spatiotemporal behavior of soil water content has important applications in soil physics and hydrodynamics. The objective of this study was to analyse and to compare the scaling patterns and structural heterogeneity of soil water contents measured at successive depths along a longitudinal transect, and during three different periods, using the multifractal formalism. The data set analyzed was obtained at an experimental farm in Pernambuco state, Brazil. The studied transect was 185 m long, and along this transect 128 point measurements of soil water content were carried out at the 0-20 and 20-40 cm depth during three different periods using time domain reflectometry (TDR). The spatial distributions of soil water content at all the depths and periods studied exhibited various degrees of scaling heterogeneity or multifractality, which were characterized though three functions: generalized dimension, mass exponent function and singularity spectra functions. In general increasing depth resulted in the reduction of the degree of multifractality. Moreover, joint multifractal analysis showed that the relationships of soil water content measured at successive depths were scale dependent across the spatial domain studied, and that their respective scaling indices had a high degree of association during the three periods studied. The multifractal nature of the spatial distributions of soil water content indicated that multiple scaling indices are needed for assessing soil water variability information over various scales. The strong similarity between the scaling properties at the surface and subsurface layer allowed inference about the soil water dynamics at successive soil depths using the scaling properties of the soil water content measured at the uppermost layer. Also, the multifractal approach provided considerable detailed information on the hidden structure of the spatial data sets of water content studied. It was shown that soil water content variability was driven by natural causes, mainly topography, but also by other soil forming factors such as parent material. Moreover, at the soil surface layers, scale heterogeneity in the spatial distribution of soil water content was enhanced by the interaction of various natural or anthropogenic sources of variability.

Keywords: Soil water content, Spatial variability, Multifractals
Financial support:

(3906 - 3074) Spatial correlation between terrain attributes and soil depth in small-extent rugged terrain

Taciara Zborowski Horst[1]; Alessandro Samuel-Rosa[1]; Ricardo Simão Diniz Dalmolin[1]; Jean Michel Moura-Bueno[1]
Universidade Federal de Santa Maria[1]

Soil deepening generally occurs in response to water flows over the landscape and through the soil profile. Terrain attributes can provide an accurate picture of water distribution across the landscape. If the underlying geology is homogeneous, then a strong correlation between terrain attributes and soil depth can be expected to exist. The objective of this study was to investigate the presence and strength of this correlation in a small-extent rugged terrain (109 ha) in southern Brazil, used for timber production over the last 30 years, as a means to make spatial soil depth predictions. Soil depth (up to 10 dm) was recorded at 102 point locations (0.9 points per ha) purposively selected using conditioned Latin Hypercube Sampling as to reproduce the correlation and marginal distribution of the 10-m spatial resolution covariates elevation, slope, topographic wetness index, valley depth, and channel network base level. Ten neighbourhood sizes, ranging from 10 to 100 m, were considered for mean-sampling covariates at the observation locations. The largest neighbourhood size (100 m) was selected for yielding the strongest correlation between covariates and soil depth. A linear mixed effects model with the exponential covariance function was fitted to the data (assuming Gaussian-distributed errors) using restricted maximum likelihood. Spatial predictions were made using the empirical best linear unbiased predictor. Prediction performance was evaluated using the amount of variance explained (AVE), root mean square error (RMSE), and mean error (ME) computed using leave-one-out cross-validation. The latter showed that predictions are unbiased (ME = -0.04 dm), but have low accuracy (AVE = 14%, RMSE = 3.28 dm), mostly due to the weak correlation of soil depth with terrain attributes. The strongest correlation was with slope (r = -0.16), the reason why smaller depths were predicted in steeper slopes. The estimated nugget variance was high, about 50% of the total variance (11 dm^2). When the nugget (measurement error) variance was fixed at 0.25 dm^2, the estimated range dropped from 97 to 47 m, which is shorter than the mean sampling distance (61 m). This result suggests that the spatial autocorrelation of soil depth in the area is structured over distances of a few tens of meters, indicating the occurrence of a strong local control of soil development, e.g. litology. For this reason, predictions can likely be improved by using more intensive sampling.

Keywords: Digital soil mapping; Soil thickness; Terrain attributes; Analysis scale; REML–E-BLUP.

Financial support: Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES).

(5396 - 2365) Spatial prediction of weathering-related soil properties obtained from portable X-ray fluorescence

Fabio Arnaldo Pomar Avalos[1]; Bárbara Pereira Christofaro Silva[1]; Michele Duarte de Menezes[1]; Marx Leandro Naves Silva[1]; Nilton Curi[1]

Universidade Federal de Lavras[1]

Portable X-ray Fluorescence (pXRF) stands as an efficient equipment for the characterization of soil geochemical features. Spatial distribution of such features is an important resource for soil characterization, as investigation of pedogenesis processes. This work aimed to model the spatial distribution of weathering-related soil geochemical variables. For this, aluminum oxide (Al_2O_3), iron (Fe) and silicon dioxide (SiO_2) parts-per-million (ppm) contents from 72 B-horizon samples in the Posses watershed, southeast Brazil, were retrieved by means of pXRF (Bruker model S1 Titan LE). For the analysis, soil samples were previously air-dried and passed through a 2-mm sieve. Then, a regression-kriging approach was applied for the geochemical variables, where a random forest regression model (RF), with 24 digital terrain attributes as covariates and Al_2O_3, Fe and SiO_2, as dependent variables. Accuracy assessment was based on RF out-of-bag error. Kriging interpolation for RF residual values was intended, however, residuals from each RF model showed pure nugget effect of variograms, putting away the necessity of this procedure and emphasizing the association between terrain landscape and soil geochemical properties. The most important terrain attributes for spatial prediction were channel network base level for Fe, with accuracy indexes of RMSE = 8281.4 and R^2 = 0.89. The stream power index was the most important for Al_2O_3, with RMSE = 10984.4 and R^2= 0.87. Multiresolution index of valley bottom flatness and topographic wetness index were the most important variables for SiO_2, with RMSE = 21703.98 and R^2 = 0.88. These results indicate that the association between terrain landscape and weathering-related soil properties could be mapped out by means of regression trees only.
Keywords: Random Forest, regression-kriging, terrain attributes
Financial support: CAPES, CNPq, FAPEMIG

(4626 - 3088) Spatial variability and multivariate analysis in the determination of the sample density of the Western Paulista Plateau, Brazil

Laércio Santos Silva[1]; José Marques Júnior[1]; Romário Pimenta Gomes[1]; Diego Silva Siqueira[1]; Jeferson dos Santos da Silva[1]; Thiago de Andrade Águas[1]

Unesp Jaboticabal[1]

In large areas, the prediction and knowledge of the spatial variability of the attributes can delimit homogeneous areas and assist the planning of agricultural practices. However, one of the difficulties and know the minimum of sampled points representative of the lithological, pedological and geomorphological diversity. Thus, mathematical tools such as multivariate analysis and geostatistics have been one of the alternatives, so we evaluated the potential of combining these techniques in the selection of pedoindicator attributes of environments and determination of sample density. In the Western Paulista Plateau with 13 000000 hectares, 200 soil samples were selected in depth 0.0 - 0.20 m, distanced at 10 km from each other, from arenitic and basaltic rocks. A granulometric analysis was carried out and the oxides of iron hematite and goethite were characterized by x-ray diffraction and magnetic susceptibility (SM). The analytical results were submitted to multivariate and geostatistical statistics. The semivariograms (simple and scaled) and the map of mineralogical and textural attributes were performed from the scores of the variables retained in CP1. Sample density was calculated from the ranges. The analysis of factors indicated hematite, SMbf, sand and clay attributes with high discriminatory power of the soils, contributing with 89.25% of explanation of the total variance of the data (73.01% and 16.24%). This behavior allowed the main component analysis (PCA) to better evaluate soil attributes correlated with lithological characteristics. The semivariogram performed from the variables retained in CP1 presented a spatial dependence structure, described by the spherical model. The degree of spatial dependence [(C0 / (C0 + C1))> 25%] for the semivariogram of CP1 and the graded one was classified as moderate spatial dependence. The proximity of the range values of CP1 (a = 88.70 km) and the scaled semivariogram (a = 70 km) reveals the similar sensitivity of the techniques in capturing the heterogeneity of the attributes. It is concluded that hematite, SMbf, clay and sand present high discriminatory power of soils of different geological types, requiring a minimum number of 17 (CP1) or 27 (scaled semivariograms) samples to represent the diversity of attributes evaluated in the Western Paulista Plateau.
Keywords: Hematite, goethite, magnetic susceptibility, scaled semivariogram, pedometrics
Financial support: Research Support Foundation of the São Paulo State (FAPESP) for the financial backing (Proc. FAPESP n° 402796/2016-0) and the Coordination for the Improvement of Higher Education Personnel (CAPES).

(9504 - 2248) Spatial variability of attributes with different sample densities in the savanna

Inária Vogado Borges[1]; Sammy Sidney Rocha Matias[1]; Maria Iolanda Leal Lustosa[1]; Cinthya Herley Kochhann Ribeiro[1]; Ronny Sobreira Barbosa[2]; Rafael Felippe Ratke[2]; Júlio César Azevedo Nóbrega[3]; Tarcisa Fé da Silva[1]; Maysa Danielly de Sousa Ferreira[1]

Universidade Estadual do Piauí[1]; Universidade Federal do Piauí[2]; Universidade Federal do Recôncavo da Bahia[3]

The behavior of soil attributes can be verified in several ways. The present work had as objective to verify the spatial variability of the attributes with different sample densities in the Cerrado of Piauí. The work was conducted in the municipality of Barreiras do Piauí, whose geographic coordinates are 10º03 'south latitude and 45º68' longitude west, with an average elevation of 400 m. The average annual precipitation is around 1200 mm. The soil was classified as ENTISOLS. The area under study was delimited and georeferenced, being selected an area of 1 (one) hectare with dimensions of 100 x 100 m. In this area, two sample densities were set apart between the central points in 10 x 10 and 20 x 20 m, and soil samples were collected at a depth of 0.0-0.20 m. Soil characterization was performed by means of a soil profile. The parameters evaluated in the work were pH in H_2O, phosphorus and potassium. Data were evaluated through semivariograms, and the models were adjusted in spherical, exponential and gaussian. By means of these models, we predicted each attribute in areas not sampled by kriging, represented in contour maps. The choice of the theoretical models was performed observing the sum of the square of the residues, the coefficient of determination and, later, the correlation coefficient obtained by the cross-validation technique. The classification of the degree of spatial dependence was made based on the ratio between the nugget effect and the level, being considered strong, superior of 75%, moderate between 25% and 75%, and weakness when smaller of than 25%. The adjusted models in the two sample densities were the same for phosphorus and potassium, gaussian and spherical respectively. For pH, in both cases (densities) the adjusted models were, gaussian and exponential, spacing of 10 x 10m and 20 x 20 m, respectively. In relation to the degree of spatial dependence, all presented moderate dependence.

The range varied from 34 to 48 m, with the highest range obtained for pH at the sample density of 10 x 10 m. The coefficients of spatial determination (R2) for pH and potassium obtained values above 0.71 at both depths. This result was also evidenced by cross validation. The geostatistical technique identified the spatial variability of the pH, phosphorus and potassium attributes through the kriging maps. The 20 x 20m spacing can be used for soil sampling and identification of the variability of chemical attributes pH, phosphorus and potassium.
Keywords: Soil management soil sampling, spatial variability.
Financial support: Secretary of State for Economic and Technological Development of Piauí – SEDET.

(9658 - 1480) Usage of pedometrics for data evaluation and harmonization in soil profiles from Cerrado region, Mato Grosso do Sul

Pedro Armentano Mudado Xavier[1]; Lúcia Helena Cunha dos Anjos[1]; Helena Saraiva Koenow Pinheiro[1]; César da Silva Chagas[2]; Waldir de Carvalho Junior[2]
UFRRJ[1]; EMBRAPA Solos[2]

Usage of pedometric tools to analyze information on soil properties relevant to classification and interpretation of potential is increasing. Harmonization of key soil properties, such as granulometry, organic carbon, pH, cation exchange capacity, allows comparison between soils, facilitates transfer of information among scientists and users, and contributes to modeling of soil horizons spatial distribution. The global consortium for soil mapping suggests harmonization of data in depths at predefined intervals, to compile the global database and to generate maps for different properties. The objective of this study is to point out similarities between soils from a collection of 19 profiles, sampled in the state of Mato Grosso do Sul, latitude 20º26'34 "South and longitude 54 ° 38'47" West. The total surface is of 8,096,051 km². The climate is tropical with dry season, average annual rainfall of 1534 mm and temperature of 25 °C. It belongs to domains of the phytogeographic region of savanna with deciduous trees, Cerrado Biome. It has a dominantly flat topography, and geology is of Serra Geral Formation that has a sequence of basalt from Jurassic to Cretaceous periods in Mesozoic Era. These effusive rocks covered sandstones of the Botucatu Formation. The elevation ranges from 490 to 701 meters, with 532 meters average. The most important cause of soil variability in the study area is parent material, composed of basic eruptive rocks (basalt), sandstones and colluvial sediments derived from them. The most representative soil classes, according to Brazilian Soil Classification System, are *Latossolos, Neossolos* and *Planossolos,* but also occur *Gleissolos, Cambissolos* and *Organossolo*s. The motivation for the research is that with the data harmonization a more detailed analysis of the soil classes and their spatial distribution will be possible. The quantitative pedology algorithms, known as the AQP package (Beaudette et al., 2013), were applied in the R software. The application of the slice-wise algorithm of the AQP package allowed to define values for soil properties in each one centimeter layer of the soil profiles. After that, the data in different layer thicknesses were grouped, allowing analysis of the similarity between the profiles, using a dissimilarity matrix for each depth slice. The results are presented in the form of graphics and tables that simplify the comparisons and interpretation of dominant classes and soil properties in the area.
Keywords: Quantitative pedology; algorithms for quantitative pedology- AQP; harmonization of soil data.
Financial support: Embrapa Soils, CAPES - PPGA-CS/UFRRJ, CNPq, FAPERJ

(5151 - 3045) Use of magnetic susceptibility for the Identification of Pedogenetic Environments in Archaeological Black Earth in southern Amazonas, Brazil

Ivanildo Amorim de Oliveira[1]; José Marques Júnior[2]; Milton César Costa Campos[3]; Ludmila de Freitas[1]; Renato Eleotério de Aquino[2]; Diego Silva Siqueira[2]; Laércio Santos Silva[2]; Ana Beatriz Coelho França[2]
IFPA Campus Breves[1]; Unesp Campus Jaboticabal[2]; UFAM Campus Humaitá[3]

In the Brazilian Amazon region, it is common the existence of archaeological sites in which there are significant changes in the physical, morphological and chemical aspects of the soils, promoted by the human action known as Archaeological Black Earth (ABE). Although many studies have been conducted in order to understand the magnitude of these modifications and their reflexes in soil genesis, many questions need to be clarified, especially those related to the mineralogy of these soils. The objective of this study was to use the magnetic susceptibility (MS) to identify different pedogenetics environments in ABE in the southern region of the Amazonas. Thirteen profiles of ABE and one (1) a forest profile (non-anthropogenic) were analyzed, being collected samples by horizon in each profile. Mineralogical analysis was performed, and certain minerals of the clay fraction hematite (Hm_012), goethite (Gt_110) and maghemita (Mh_220 and Mh_400) being characterized by x-ray Diffraction (XRD) at blades made with powdered material. Were determined the iron contents extracted with dithionite–citrate–bicarbonate of sodium (FeDBC (in %)), iron contents extracted with ammonium oxalate (FeOAA (in %)) and total iron (in %). The MS was evaluated in soils (earth thin air-dried), in the ashes of plants and in ceramic fragments found in ABE areas, being determined to SM in low frequency (MSlf) and the percentage of frequency-dependent magnetic susceptibility (χ_{fd}). The ceramic fragments have greater magnetic susceptibility compared to soils with archeological black earth (earth thin air-dried), and can be one of the reasons of the highest values of magnetic susceptibility in relation to non-anthropogenic soil. On the other hand, it is possible to observe through the diffractograms the characterization of clay fraction oxides Hm and Gt, including discreet expression of Mh in ABE. The ashes of the plants showed low values of magnetic susceptibility, indicating the phytogenetic influence in the values of MS of ABE can occur as a result of the cumulative process of burning of the plants over the years. The χ_{fd} has greater variation in subsurface in the archeological black earth, due to the mixture and accumulation of minerals formed in normal conditions (hypothesis pedogenetic and/or lithogenetic), in addition to the influence of fire (pedogenic hypothesis) and ashes of the plants (hypothesis phytogenetic).
Keywords: Amazonian soils, minerais ferrimagnéticos, mineralogia
Financial support: FAPEAM, Unesp, IFPA

(8513 - 957) Using the Toposhape algorithm as a tool to automatic generation of terrain variables applied to digital soil mapping in a watershed

Mara de Andrade Marinho[1]; Estevão Conceição Gomes Junior[2]
State University of Campinas[1]; State University of Londrina[2]

Terrain inclination and surface shape are the elements of the relief that largely control the dynamics of the surface water. Additionally, the slope orientation affects the amount of solar radiation that reaches the soil surface. These elements influence deeply the development of a given soil, reason for what their use is quite common as auxiliary variables in digital soil mapping (DSM). The present work aimed to generate terrain auxiliary variables for DSM in a watershed by applying a computational algorithm for automatic classification of the surface shapes. The study area encompass the Ceveiro watershed (SP, Brazil) and the employed algorithm was the Toposhape, developed by Pellegrini in 1995 (*apud* Herrington and Pellegrini, 2000). This algorithm works from a digital elevation model (DEM), runs in a geographical information system environment and

performs a continuous classification by taking into account the changes in the slope and curvature of the terrain. Eleven possible classes of surface shapes are distinguished: peak, ridge, saddle, flat, ravine, pit, convex hillside, saddle hillside, slope hillside, concave hillside and inflection hillside. To validate the automatic terrain classification and to observe the soils associated to the surface shapes, a field survey was performed in six sequences of soils distributed along the watershed. The algorithm has identified all the eleven classes of surface shapes in the Ceveiro watershed. However, saddle hillsides, convex hillsides and ridges were the most frequent. The field work, adopted as the terrain truth, has demonstrated the occurrence of a high rate of correspondence (85%) between the automated classification and the field segmentation; such results demonstrate the validity of the classification performed by the algorithm in the watershed. Other results have showed that the largest inclinations (higher slopes) were associated with convex hillsides in the majority (more than 90%) of the cases. The cross between the surface shape map and the detailed soil map has allowed associating the occurrence of *Tropoaquents* in the low flat areas and of *Entisols* in the convex hillsides. From the results we concluded that the algorithm is a promising tool to generate auxiliary variables applicable in DSM.

Keywords: Pedometrics; soil-relief relationships; terrain classification; Ceveiro watershed

Financial support: National Council for Scientific and Technological Development (CNPq), project number 132051/2015-0.

C1.6 - Paleopedology

C1.6.1 - Human-environment interactions recorded in soils and palaeosols

(1148 - 1166) Archaeopedological analyses of Bronze Age land use practices and landscape evolution in Southwest Germany

Sascha Scherer[1]; Benjamin Höpfer[2]; Eva Lehndorff[3]; Markus Fuchs[4]; Thomas Scholten[1]; Thomas Knopf[2]; Peter Kühn[1]

Department of Geosciences, Chair of Soil Science and Geomorphology, Eberhard Karls University Tübingen, Germany[1]; Institute of Pre- and Protohistory and Medieval Archaeology, Eberhard Karls University Tübingen, Germany[2]; Institute of Crop Science and Resource Conservation (INRES), Soil Sciences and Soil Ecology, Bonn University, Germany[3]; Department of Geography, Justus-Liebig-University Giessen, Germany[4]

What data do colluvial deposits provide to portray land use practices in Bronze Age (~2200-800 BCE)? Can small-scale movements and local impact on landscape be identified for the Bronze Age agricultural society? Are differences and shifts between allegedly favorable and unfavorable regions ascertainable? To examine these questions, the authors combine archaeopedological and archaeological approaches in a project of the Collaborative Research Center 1070 ResourceCultures. Distinctions in Bronze Age assessment and utilization of particular landscape are investigated by the sudy of three physio-geographically differing regions in Southwestern Germany: the Baar and Western Allgäu (unfavorable) and the Hegau (favorable). In this respect, evolution and distribution of colluvial deposits in the landscape generally indicate patterns of human activity at various spatial and temporal scales. We study on- and offsite colluvial deposits located in the surrounding of Bronze Age settlements. A high resolution sampling strategy (5 cm depth increments within diagnostic horizons) and variety of (paleo-)pedological methods are applied. Besides the typological classification of archaeological finds, chronostratigraphic analysis is conducted using AMS ^{14}C and luminescence dating techniques to identify phases of soil erosion. Phases of pedogenesis are differentiated by pedochemical (calcium carbonate, pedogenic oxides, pH, SOC) and soil micromorphological indices (soil microstructure, small-scale soil formation processes). Further, we use heavy metals (Cd, Cu, Cr, Ni, Pb, Zn, Hg, As) and geobiochemical markers (black carbon, phosphorus, steroids, gallic acids) as anthropogenic tracers for land use practices such as metal processing, fertilization and livestock farming within and in the surrounding of Bronze Age settlement areas. The archaeological approach comprises a source-critical evaluation and GIS-analysis of known sites as well as own prospections or smaller sondages. Among others, a yet unpublished Middle Bronze Age settlement in the Hegau, excavated on several hectares by the Cultural Heritage authorities of Baden-Württemberg during the last decade, serves as reference site and as initial point for the archaeopedological investigations. The poster presentation comprises first pedological and archaeological mappings, their incorporation into the theoretical project framework and a reflection of research status concerning the formulated questions.

Keywords: archaeopedology, land use, Bronze Age

Financial support:

(1535 - 2044) Fire dynamics of a mid mountain range – analytical evidence versus fire modelling

Luisa Wöstehoff[1]; Arne Kappenberg[1]; Frank Sirocko[2]; Yaping Shao[3]; Wulf Amelung[1]; Eva Lehndorff[1]

Bonn University, INRES Soil Sciences & Soil Ecology, Nussallee 13, 53115 Bonn, Germany[1]; University of Mainz, Institute for Geosciences, J.-J.-Becher-Weg 21, 55128 Mainz, Germany[2]; University of Cologne, Institute for Geophysics and Meteorology, Pohligstraße 3, 50937 Cologne, Germany[3]

Fire impacts on the environment, shaping past landscapes and likely altering habitability by humans. Many studies show evidence of fire events for specific periods of time at one site. However, information about the spatial variation of fires on e.g. regional scales is yet unknown. To investigate the spatial properties of past fires, sediment cores from two maar lakes, situated at different elevation in the Eifel region, a Central European mid mountain range, were sampled. These sediments cover a continuous fire record of about 120,000 years before present (BP). They were analysed for black carbon (BC), polycyclic aromatic hydrocarbons (PAH) and lignin as geochemical markers for fire and vegetation composition and compared to modelling of paleo-temperatures, vegetation and fire aerosol dispersal using ChemWRF. We hypothesized that in the Eifel region significant variation in fire activity existed, due to the establishment of forests at lower elevation (37 to 28 ka BP). Further, we investigate whether change in annual mean temperature and vegetation cover (=fuel of fire) could have been responsible for this variation in fire activity. Within the period from 37 to 28 ka BP, we found significantly different lignin, BC and PAH inputs reaching between the two lakes. At lower elevation (450 m asl and 35 km east of the other maar lake), lignin and BC were at highest concentration, while at higher elevation (565 m asl) a decrease in concentration was observed. We interpret this as an indication for a local formation of steppe vegetation at high elevation (as supported by pollen data, Sirocko et al., 2016). However, in this steppe environment we found peaking PAH concentrations from fine material (<500 µm) which likely stemmed from long-distance transported fire aerosols. In accordance with peaking lignin and BC concentrations at the maar lake at lower elevation, this supports the hypothesis that some regions in Central Europe have been forested during this period of time, which is currently under debate. Such forests might have affected human mobility in Central Europe around 37 to 28 ka BP.

Keywords: paleofire, black carbon, fire dynamics, climate modelling, human mobility

Financial support: German Research Council, CRC806 “Our way to Europe”

(5309 - 2307) Interface between soils, morphogenetic processes, records of past human occupation and environmental changes in the

low terraces of the Jacaré-Guaçu river (Boa Esperança do Sul, State of São Paulo, Brazil)

Pedro Michelutti Cheliz[1]; Francisco Sergio Bernardes Ladeira[1]
UNICAMP[1]

This work discuss about interface between soils and human occupation, referring to the low terraces of Jacaré-Guaçu river near to the hunter-gattherer site Boa Esperança II (BES II, Santos 2011), (SP-Brazil). Were done 2 new trenchs, micromorphological descriptions, recordings of archaeological pieces (together to Araújo, Rodrigues and Santos), and colect samples for chemical, OSL, C-14, petrographic and granulometric analyzes. Has registered the presence of gley soils marked by ausence of B horizon and with sand-clayey granulometry. They cover nivels with well roundeds gravels (sandstones), of a medium particle size (20 cm) until 4 times higher than the current river pebbles of Jacaré-Guaçu, with coarse-sand matrix (that also register gleying). Archaeological materials (mostly chipped sandstones) were distributed along the profiles, with higher concentration next to the limit between the gravel units and the C horizons that cover them. Chemical analyzes indicate discontinuities in the concentration of phosphorus (P) between the mentioned limit, with deeper gravel nivels with values of phosporus (7mg/dm3) until two times higher than that (3mg/dm3) of C horizon that cover them. It has appointed that the profiles involve the presence of two sets of soils. The former being connected to pedogenesis on the gravels-matrix nível (deposits of ephemeral channels). The second linked to the alteration of the sand-clayey covers (at least partially deposits of flood plains relied on a new and higher (5-8 m) base level that in a second moment would cover the gravel). OSL and C-14 data sugest that the first soil cycle starts at least on the Pleistocene-Holocene transition, and the second could extend at least to the Medium Holocene. It has apointed that the exposure of the gravel (source of suitable raw material for making lithic tools) for the time required to form the first soil would be attractive for human occupation, and could contribute to the concentration of archaeological pieces registered on gravel´s top. The intense gleying recorded in the whole would be related to the flood plains linked to the deposits that orignes the second soil, and to humidity increases in relation to the predominant environments when depositing the basal gravel. Interfaces between local soils, morphogenesis and human registers of these low terraces merge with a set of environmental changes, including passage from semi-arid to more umids patterns and multiple base level variations.

Keywords: morfophogenetic-soils interfaces, soils-archaeological sites interfaces, Pleistocene-Holocene transition, Boa Esperança II archaeological site
Financial support: CNPQ

(4658 - 772) The coastal soil of the Atacama Desert, properties, and implications in the conservation of mummified bodies, in the validity of the postmortem chemical result and the inference regarding the health of the ancient human populations

Leonardo Figueroa[1]; Bernardo Arriaza[1]
Universidad de Tarapacá[1]

The coastal soil of the Atacama Desert, northern Chile, Aridisol class, devoid of rain and vegetation, of geological age in the Jurassic period and at least since the Quaternary, is an extremely arid desert. Considering the desert's geochemical composition, two aspects are discussed: 1) Its implication in the preservation of bioarchaeological remains and 2) the validity of the concentration result of the chemical analyte in the mummified body and the inference regarding the health of the old human populations. The sedimentary formation of these coastal soils, with absence of rainfall, warm environmental temperature, high solar radiation, moderate intensity winds in the photoperiod, high relative humidity, mild condensation of marine water vapor, constant reception of marine aerosol, absence of Edaphon , absence of runoff water, the prevalence of Na (1 to 5%), Ca (0.2 to 1%) and Cl (2 to 5%) as the most abundant ions, make these soils a medium capable of adsorbing water favoring the inactivity of bacteria in the human body and mummification. Less than 0.5% organic matter in these soils, determines that there are simple aggregates, with weathering limited by time, a thick texture, with macropores and favorable airspace for air flow and therefore the favorable preservation of bioarchaeological remains. On the other hand, the high concentration of natural As and Li in the water and soils used in life, affect the quality of life of the associated populations, producing pathologies that include cancer. The set of soil qualities and burial techniques have generated an unwritten legacy through the excellent preservation of human remains in the soil without contamination by diagenesis, ranging from the first populations called Chinchorro (ca. 7000 BC). Until the remains of the Inca Period (ca. 1400-1500 AD). Chemical studies carried out on mummies, particularly the Inca Period (Cam 9 site), reveal that these populations were significantly affected by overconsumption of Li and As. The mummified bodies show skin lesions and high concentrations of these elements in different organs. In short, this type of study allows us to visualize and reconstruct the living conditions faced by the ancient populations in the desert environment with water and soil that provide bioavailable substances naturally.

Keywords: Salinity, adsorption, mummification, diagenesis
Financial support: FONDECYT, Project Number 1170120

C1.6.2 - Soil memory: proxies for deciphering records of past environmental conditions in soils and palaeosols

(2642 - 1133) Biological memory of soils and occupation layers of archaeological sites.

Elena Chernysheva[1]; Alexandr Borisov[2]
Institute of Physicochemical and Biological Problems in Soil Science Russian Academy of Sciences, Institutskaya 2, Pushchino, Moscow region, 142290, Russia (chernysheva1988@gmail.com)[1]; Institute of Physicochemical and Biological Problems in Soil Science Russian Academy of Sciences, Institutskaya 2, Pushchino, Moscow region, 142290, Russia[2]

Applied to archaeological sites, the essence of biological memory consists in the following. Human activity is accompanied by the input of specific organic materials into the soil. These organic materials are subsequently lost due to their complete mineralization by soil microorganisms. Despite the fact that organic substances had been decomposed, the information about their income may store in changes of soil microbial communities and enzyme activity and these changes can be preserved up to now. Unique objects, allowing study dynamics of microbial communities in soils through hundreds and thousands years after cessation of anthropogenic activity, are the soils of archaeological sites. Soils and occupation layers of settlements, in this case, represent a natural experiment with well-known place, time, and nature of anthropogenic activity. Their study allows evaluating the peculiarities of transformation of soil microbial community. The aim of this work was to study the effect of residential land-use and farming practice on soil properties and evaluate the peculiarities of changes of microbiological and biochemical soil properties of archaeological sites. Objects of studies were: (i) occupation layers of settlements (AD 200-400); (ii) soils around archaeological sites (AD 200-800); and (iii) ancient stone corrals (1400-1200 BC). All sites investigated are situated in the Kislovodsk basin (North Caucasus, Russia), and were under only one step of occupation in ancient time presently out of exploitation. Farming practice with long-term manuring in AD 200-800 had led to significant changes in soil microbiological properties. Application of cattle manure had led to a change in microbial biomass and enzyme activity. It was shown that in the soils of ancient agricultural lands viable spores of thermophilic bacteria were preserved and their high level indicates the long-term

manuring in the past. At the settlements high urease activity and abundance of thermophilic microorganisms allow to reveal places of cattle keeping. The study of soils from corrals also showed a significant increasing of these microbiological parameters in buried anthropogenically transformed layers. Thus, our work shows that the information about entering into the soil organic substrate can be stored in soil biological memory for about 3000 years. However, the time of keeping the information about human activity is seem to be much longer.

Keywords: Soil memory; microbial communities; enzyme activity.
Financial support: This study was funded by the Russian Science Foundation (grant no. 17-78-10207).

(9451 - 785) Climate and environmental changes in central-eastern Brazil during the Last Glacial Maximum

Ingrid Horák-Terra[1]; Antonio Martínez Cortizas[2]; Cynthia Fernandes Pinto da Luz[3]; Alexandre Christófaro Silva[4]; Pablo Vidal-Torrado[5]
Federal University of Jequitinhonha and Mucuri Valleys (UFVJM), Av. Vereador João Narciso, 1380, Unaí (MG), 38610000, Brazil (ingrid.horak@ufvjm.edu.br)[1]; University of Santiago de Compostela (USC), Santiago de Compostela, Spain[2]; Institute of Botany - Secretary of São Paulo State for Environment, São Paulo, Brazil[3]; Federal University of Jequitinhonha and Mucuri Valleys, Diamantina, Brazil[4]; University of São Paulo, Piracicaba, Brazil[5]

It is consensus that landscape and climate have undergone several changes over time and at several spatio-temporal scales. However, there is an intense debate about the actual conditions prevailing in different phase, as for example the Last Glacial Maximum (LGM) in tropical regions. Recent studies have provided new insights and confronted with hypotheses already established (Amazonian refugia and Pleistocenic arc), these asserting aridity was prevalent. Tropical peatlands have a large potential for the reconstitution of Pleistocene climate changes, and records of a large variety of proxies (biotic and abiotic) have already been used. Here, we present data on stable isotopes, ^{14}C dating, geochemical, and pollen records of a peat core (PI, 324 cm deep, spanning the last ~60 kyr) sampled in a tropical mountain mire (Pinheiro) from central-eastern Brazil. Isotopic ($\delta^{13}C$, $\delta^{15}N$) and elemental composition were determined in continuous 2 cm peat slices using an elemental analyzer coupled to a mass spectrometer and a X-ray fluorescence analyzer, respectively; whereas pollen was counted on mounted slides after physico-chemical treatment every 10 cm. Thirteen peat samples (2 cm thick) were radiocarbon dated by AMS, and an age-depth model was obtained. Statistical analysis was applied only to elemental composition using PCA. At the onset of the LGM, by ~27.8 kyr BP, a new pattern of climate conditions was established after the MIS 3 phase (Marine Isotope Stage 3; ~60-27.8 kyr BP). This pattern remained more or less constant beyond the end LGM (~18.9 kyr BP) and until the mid-Holocene (~6.6 kyr BP). Predominant wet conditions are supported by constant low $\delta^{13}C$ values (between -23.3 and -21.4‰) and by cold and humid forest as indicated by pollen data (Drimys, Podocarpus, Myrsine and others). Erosion in the catchment increased with increasing humidity (as attested by increases in concentrations of lithogenic elements in the peat), but it was relatively lower than during MIS 3, most probably due to denser tree-shrub vegetation cover. Increasing trend of $\delta^{15}N$ values (between 2.7-4.5‰) suggest a greater accumulation of organic material. Growing oceanic-atmospheric activity inferred by the increasing of Br/C ratios (between 12.99-78.35 µmol mol^{-1}) strengthens the evidence of the LGM as a likely wetter period. Pinheiro mire certainly contains a sensitive record that suggests the LGM was wetter than previously reported, besides being cold.

Keywords: Tropical peatlands; multi-proxy approach; Pleistocene changes.
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(9331 - 1785) Environmental setting of the early irrigation in Oasisamerica: paleopedological evidences from the alluvial paleosols in la Playa/Sonoran Desert

Georgina Ibarra[1]; Elizabeth Solleiro[2]; Guadalupe Sánchez[3]; Sergey Sedov[2]; Carmen Ortega[4]
Posgrado Ciencias de la Tierra, UNAM[1]; Instituto de Geología, UNAM[2]; Instituto de Geología, ERNO, UNAM[3]; UES, México[4]

Environmental conditions and human-landscape interaction during the onset of the irrigated agriculture in Oasisamerica are not clear yet. In la Playa site (Sonora, NW Mexico) the evidences of sedentary population, land cultivation and water management developed after the end of Altithermal period since ~ 4.3 kyr BP: more than 550 archaeological features including hundreds of human cremations and a net of buried artificial channels. These findings are closely associated with several paleosol levels alternating with the sediments within a large alluvial fan. We studied micromorphological features, physical characteristics (texture, rock magnetic properties), composition of organic matter to reconstruct pedogenesis and sedimentary environment of the paleosol sequence. Additional paleoenvironmental information was extracted from pollen assemblages, extracted from paleosols. The results point to a long period of geomorphic and climatic stability in the early-middle Holocene marked by well developed red Cambisol. It was followed by an unstable interval round 4.5 kyr BP marked by severe erosion of earlier soil profiles and sedimentation of different kind: channel, floodplain, eolian. Later synsedimentary Fluvisols were formed showing signs of predominantly arid pedogenesis, interrupted by occasional flooding; indicators of human impact are also encountered. We conclude that the shift to irrigated agriculture as the main subsistence activity occurred during the period of major climatic and geomorphic fluctuation and then irrigation developed further under dry environment with limited water resources during the Late Holocene.

Keywords: Palaeosols, environmental conditions, alluvial fan, Altithermal, pedogenesis.
Financial support: Palaeosols, environmental conditions, alluvial fan, Altithermal, pedogenesis

(8576 - 1284) Geochemical signals of pedogenic processes in the profiles of surface and buried soils at the Nozha-Var archaeological site, European Russia

Elena Aseeva[1]; Alexander Makeev[1]; Alexey Rusakov[2]; Ksenia Sorokina[1]; Fatima Kurbanova[1]
M.V. Lomonosov Moscow State University, Moscow, Russia[1]; Institute of Earth Sciences, Saint-Petersburg State University, Saint-Petersburg, Russia[2]

Many soil properties that are preserved in buried soils of archaeological sites are associated with particular type of environmental conditions and thus carry paleoenvironmental signatures. Visual observation of pedofeatures, however, provides insufficient information on the soil processes and therefore the integrated analysis including application of analytical methods is needed for their better interpretation. This study presents the results of a geochemical study of two nearly 2m deep morphologically similar soils which were formed on the same surface and in close proximity to each other at the Nozha-Var archaeological site, located at the

northern boundary of the forest-steppe zone in European Russia. The study objects included a paleosol buried 2000-1400 cal yr BP (Early Iron Age) under a fortification earth wall of an ancient settlement and the off-site surface soil. Concentrations of major and trace elements were determined in the bulk soil samples (n=29) and also in the soil clay-particle fraction (n=15) by XRS method after loss on ignition determination (1000ºC). Data on the ratios of relatively immobile elements (Ti/Al, Ti/Zr, Zr/Y, Zr/Nb) were used to evaluate the geochemical uniformity of the parent materials in which the soils were formed. The similarity between the soils according to the parameters' values and also the absence of abrupt changes in their depth functions were found. This allows for relating the possible differences in the soil geochemistry to either environmental changes or duration of pedogenesis. Both morphological and analytical features confirmed that the studied soils meet diagnostic criteria for Retisols and have a similar textural contrast between the upper (Ah, E) and middle (Argic) horizons. However, the surface soil showed better expressed retic properties which were in line with higher molar SiO_2/Al_2O_3 ratio both in the bulk samples and also in the clay-sized fraction. The distribution of element concentrations in the clay-particle fraction across soil horizons indicated better development of eluvial and leaching processes in the surface soil: in its upper horizons (Ah, E, E/Bt) the clay was clearly depleted in Fe_2O_3, Al_2O_3, CaO. In the Argic horizons of both soils the clay-sized fractions showed similar geochemical patterns. Thus, geochemical characteristics of the studied soils proved that they experienced one-way evolution and the geochemical differences between them seem to be related to the duration of pedogenesis.

Keywords: paleosol, Early Iron Age, forest-steppe zone, element ratios, bulk samples, clay-sized fraction

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(6271 - 357) Late Pleistocene Paleosols of Serra da Mantiqueira, southeastern Brazil: pedological processes and genesis conditions

Sheila A. C. Furquim[1]; Silvio T. Hiruma[2]

Environmental Sciences Department, Universidade Federal de São Paulo (UNIFESP), Diadema, SP (sacfurquim@gmail.com)[1]; Instituto Geológico (IG), Secretaria do Meio Ambiente/SP, São Paulo, SP (sthiruma@gmail.com)[2]

A vertical succession of 3 paleosols located in the summits of Serra da Mantiqueira, specifically in the Cambuí/Monte Verde (MV) plateau, was studied in order to understand their pedological processes and conditions of formation. Morphological descriptions, physical and chemical analysis and radiocarbon dating were perfomed in the soils. Each paleosol is formed by a black (10YR 2/1), thick (25 to 40 cm) and mostly massive organic horizon, which overlies brown (10YR 3/2), shallower (8 to 23 cm) and massive C horizons. The organic horizons are sapric, with variable texture, organic carbon (OC) from 290 to 430 g kg^{-1} and cation exchange capacity (CEC) between 380 and 470 mmolc kg^{-1}. The underlying C horizons have sandy clay loam texture and significantly lower OC (6 to 18 g kg^{-1}) and CEC (49.9 to 88.5 mmolc kg^{-1}). The age of the three generations of organic horizons, from the shallowest (92-117 cm) to the deepest (240-270 cm), is 14180±50, 25410±110 and 28990±170 BP. Thus, these soils likely developed over colluvium deposited in discontinuous periods of more active erosional processes during the late Pleistocene. Higher stability periods between intense colluviation allowed a more significant action of the pedological processes, especially the addition and accumulation of organic material in the surface and their transformation into organic matter. The parallelism between the topography boundaries of the horizons and the current surface topography suggests a concave paleosurface. Hence, the organic matter accumulation likely occurred in a geomorphological condition subjected to local water saturation, typical of H horizon formation. Because of this past concave position, which prevents intensive leaching, and the high presence of colloids in the organic horizons, the high CEC of these horizons is probably an ancient property that is still currently preserved. The age gap between the shallowest and intermediate organic horizons is 11230 years, and between the intermediate and bottom organic horizons is 3580 years. Thus, the deposition of colluvium and the intense accumulation of organic matter occurred in these short periods, generating a total thickness of 58 cm and 90 cm in the shallowest and intermediate paleosol, respectively. These data show the high velocity of the geomorphological and pedological processes in the area.

Keywords: Quaternary paleosol; organic matter accumulation; pedological processes

Financial support: FAPESP (Process 2014/016487)

(5211 - 707) Paleoenvironmental reconstitution by stable C and N isotopes in a mountain tropical peatland, Minas Gerais State - Brazil

Camila Rodrigues Costa[1]; Alexandre Christófaro Silva[1]; Cynthia Fernandes Pinto da Luz[2]; Plínio Barbosa de Camargo[3]; Ingrid Horák-Terra[1]; Uidemar Morais Barral[1]; Aparecido de Penafort Abreu Filho[1]; Geisla Mendes Macedo[1]

Universidade Federal dos Vales do Jequitinhonha e Mucuri[1]; Núcleo de Pesquisa em Palinologia - Instituto de Botânica, São Paulo[2]; Universidade de São Paulo[3]

Peatlands are humid ecosystems formed by organosols, from the successive accumulation of decaying organic matter. Using the ^{13}C and ^{15}N stable isotopes, can know the origin of the soil organic matter recognizing the photosynthetic pattern (C3, C4 and CAM) and thus determine the type of vegetation (terrestrial or aquatic) that colonized the area and the local humidity condition. The objective of this study was to evaluate the soil isotopic composition ($d^{13}C$ and $d^{15}N$) of a tropical peatland located in the Serra do Espinhaço Meridional (Minas Gerais State, Brazil). The study area is located in the Rio Preto State Park. A testimony of 3.71 meters of depth of the Rio Preto peatland (18° 14.5 '25" S, 43° 19.7 '24" W, 1.593m.sm) was sampled. Samples were sectioned every 5 cm and were used to determine the values $d^{13}C$, $d^{15}N$ and C/N ratio. ^{14}C dating was also performed at 4 depths (20, 172, 330 and 368cm). The results indicate the occurrence of five environmental conditions from Late Pleistocene to present: I) 23,037 to 13,555 years cal. AP (371-272 cm layer); the values of $d^{13}C$ ranged from -24 to -20‰, $d^{15}N$ between 0.35 and 5‰ and the C/N ratio of 20 to 45, indicating a predominance of C3 plants and a humid condition; II) 13,555 to 11,720 years cal. AP (272-197 cm layer); the values of $d^{13}C$ ranged from -25 to -21‰, $d^{15}N$ between 2 and 4‰ and C/N of 33 to 44, indicating an even greater predominance of C3 plants and elevated humidity; III) 11,720 to 8,564 years cal. AP (197-97 cm layer); the values of $d^{13}C$ ranged from -24 to -19‰, $d^{15}N$ between 3 and 4‰ and C/N of 28 to 46, indicating a large influence of C4 plants (field vegetation) and a accentuated decline of humidity; IV) 8,564 to 6,987 cal. AP (97-50 cm layer); the values of $d^{13}C$ varied from -22 to -21‰, $d^{15}N$ of 4 to 5‰ and C/N of 34 to 42, indicating greater influence of C4 plants and even lower humidity; V) 6,987 cal. AP to the present (50-0 cm layer); the values of $d^{13}C$ varied from -23 to -20‰, $d^{15}N$ from 4 to 6‰ and C/N from 21 to 48, indicating a mixture of organic matter of terrestrial origin (C3 and C4) and aquatic, with predominance of terrestrial plants and increased humidity conditions, similar to current conditions. Stable isotope analysis allowed us to infer changes in the vegetation cover and in the moisture conditions of the Rio Preto peatland.

Keywords: Climatic changes, radiocarbon dating, palaeovegetation.

Financial support: FAPEMIG, CAPES, CNPq

(7409 - 1232) Palynofacies and carbon isotope analysis as indicators of pedogenesis and paleoenvironmental changes of upper montane soil in Espírito Santo State, Brazil.

Eduardo Carvalho da Silva Neto[1]; Marcos Gervasio Pereira[1]; Jolimar Antonio Schiavo[2]; Marcelo de Araújo Carvalho[3]; Natália de Paula Sá[3]
Federal Rural University of Rio de Janeiro[1]; State University of Mato Grosso do Sul[2]; National Museum, Federal University of Rio de Janeiro[3]

Records of changes in the landscape can be observed more clearly in soils that present high accumulation of organic matter, such as Histosols. The objective of this work was to describe the pedogenetic process in the formation of an Histosol profile in a upland environmental of the Espírito Santo State, southern Brazil, through the palynofacies analysis and carbon isotopes. The samples were processed following the standards of preparation for palynofacies and later analyzed in organopalinological slides using the microscopy in transmitted white light. The genesis of the Histosol is associated to the pedogenetic process of paludization, influenced by relief, conditioning poor drainage, and organisms, providing and transforming the added organic matter. According to the dating (^{14}C) performed at the base of the profile, its formation corresponds to Holocene deposits. It was observed the predominance of components of the particulate organic matter of the groups amorphous organic matter and phytoclasts. The results of the palinofacies analysis indicated variations in the proximal-distal tendency and a depositional environment of low energy and reducing conditions. Through the characterization of the particulate organic components and the correlation between the variations of their percentages, it was possible to identify three depositional intervals: phase I, characterized by the deposition of transported sediments, marked by the amorphous organic matter group associated to the predominance of opaque phytoclasts; phase II, with evidence of sedimentation typical of a lacustrine environment with the most significant records of amorphous organic matter and freshwater microplankton; phase III, which corresponds to the current plant cover, with greater abundance of non-opaque and sporomorphic phytoplasts. The variations in the isotopic composition (^{13}C) of the carbon indicated changes in the organic matter sources, suggesting a mixed vegetation (C_3 and C_4) at the beginning of the formation of the soil, aquatic organic matter (freshwater algae) during the pedogenic evolution of the profile and a predominantly herbaceous vegetation (C_4), reflecting the current conditions. The analysis of palinofacies was effective to complement the soil characterization results, agreeing with the paleoenvironmental interpretation of the paludization process and making possible inferences about the changes in the soil formation environment.

Keywords: Histosols; Organic matter; Atlantic Forest.
Financial support: Programa de Pós-Graduação em Agronomia – Ciência do Solo (PPGA-CS), Universidade Federal Rural do Rio de Janeiro (UFRRJ).

(8032 - 2423) Pedogenic carbonate crusts (caliches) in tropical karst landscapes as archives for paleoenvironmental reconstructions – a case study from Yucatan Peninsula, Mexico)

Daisy Valera Fernández[1]; Héctor V. Cabadas Báez[2]; Elizabeth Solleiro Rebolledo[3]
Universidad Nacional Autónoma de México (UNAM)[1]; Universidad Autónoma del Estado de México[2]; Universidad Nacional Autónoma de México (Instituto de Geología)[3]

In the Yucatan Peninsula (southeast of Mexico), several outcrops have been observed with the presence of compact limestones in the form of thick sheets. The pedogenetic origin of these carbonated crusts (caliches) allows us to infer paleoenvironmental information about climatic regimes in this región for the uplifting periods of the carbonate platform and the development of pedogenic processes. Caliches were studied in quarries located in the Cancun-Tulum corridor in littoral carbonates sequences from the northeast of the Quintana Roo state, which are derived from shallow marine and eolianites facies. Micromorphological observations indicate the presence of a edaphic environment attending to features such as microgranular relict structure, acicular carbonates (typical for soil and fungi environment) and traces of roots. The stable isotope signatures ($\delta^{13}C$ and $\delta^{18}O$) point to the formation of caliches under a higher proportion of C4 plants therefore a drier or more seasonal climate. Uranium-thorium (U/Th) dating indicate that these caliches were formed more than 100,000 years BP; during previous glacial episodes (marine isotope stage (MIS) 6 and 8) in contrast with moments of eolianites deposition during interglacial periods (insufficiently rainfall to support vegetation) and karst develoment (glacial-interglacial transicion). This pedogenic carbonates represent an ancient phases of soil formation, whose remains are no longer visible today, due to the strong eroción that takes place in this karstic región.

Keywords: caliches, micromorphology, stable isotopes, paleoenviromental reconstruction
Financial support: Earth Sciences PhD Program, Universidad Nacional Autónoma de México (National Autonomous University of Mexico)

(9166 - 509) Reconstruction of the environment on the basis of complex study of steppe buried palaeosols

Valentina Prikhodko[1]
Institute of physicochemical and biological problems in soil science RAS[1]

The reconstruction of the environment on the basis of complex study of steppe palaeosols buried under archaeological monuments of the Bronze, Early Iron and Medieval Ages of the Urals region and Southern Siberia was done. Separation of pollen plants into ecological groups: xerophytes, mesophytes, hydrophytes and ruderals allowed to restore landscapes more detail based on the composition and ratio of plant communities, which grow in more humid, dry, warmer and colder conditions. Use of different geochemical weathering coefficients helped to clarify the palaeoclimate humidity. The multidisciplinary study of four Scythian burial mounds (2565-2390 ca, 1 s) of the Turan-Uyk intermountain plain in Tuva, southern Siberia revealed that after 95 years from the beginning of their erection, there were signs of dry climate, in other chrono-intervals natural conditions were slightly wetter than modern. This is evidenced by soil properties, greater amount of pollen of mesophytic and hydrophytic plants in Scythian times than now. Such conditions favored by the Scythian tribes appearance there the first than in other territories, spread in the region and increased anthropogenic pressure on the landscape in the final phase of mounds erection. For the forest-steppe of Sic-Urals area it was shown that climate of the Srubnaya epoch (3900-3600 ca, 1σ) was wetter and cooler than now, these are indicated by the greater content of organic matter, landscapes with more content of mesophytic grasses and less xerophytes and small birch and pine forests with less area of thermophilic broad-leaved species. The landscape placement of 120 archaeological monuments of the Medieval Srostki culture of the Altai area was done and their distance from water and mineral resources was determinated based on use the space images and GIS technologies (Schayakhmetov, 2017). The "cascade" filtration of bacteria on nuclear filters with a diameter of 0.1 to 1.85 μm shown that large bacterial cells (1.4-1.85 μm) predominate in forest soils and former plowlands, small ones (0.2-0.4 μm) - in palaeosols as an adaptation to lack of nutrients and moisture; biomass of bacteria is in 2-20 times greater than that found in luminescence microscopy; the biomass of microfungi (91-99%) dominates

(Polyanskaya et al., 2016). It was established by phosphate and geochemical methods that composite food, milk porridge, cheese and water were initially in the ceramic vessels from the Srubnaya and Sarmatian epochs barrows.

Keywords: steppe palaeosols, palynological analysis, geochemical coefficients, vessel

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(3165 - 720) Soil chronosequence of the Early Iron Age in the central part of the forest-steppe zone of the East European Plain

Tatiana Puzanova[1]; Alexander Makeev[1]; Fatima Kurbanova[1]

Lomonosov Moscow State University[1]

The hillforts were widespread in the steppe, forest-steppe and forest areas in the centre of the East European Plain during the Scythian time. Soils buried under defensive ramparts keep unique information on the paleoclimatic conditions that existed at the time prior to burial. The hillforts often had several lines of defense that allows revealing short-term environmental changes. Soils buried under the defensive ramparts of different age at the three archaeological sites in Lipetsk region were investigated to reveal environmental changes during the second half of the Holocene. The study includes soils buried under two defensive ramparts of the Mukhino hillfort (2500 ± 150 and 1500 ± 150 cal BP), the earth wall of Ksizovo fortified settlement (2090 ± 70 cal BP), the earth wall of the Degtevoe hillfort (2500 ± 150 cal BP), and the surface soils formed in similar landscape positions. All hillforts were built on a narrow promontories formed by a junction of several gullies with steep slopes heading to local stream valleys. Both buried and surface soils are formed in similar loess sediments. The surface soils and the buried soils of the early Scythian time are similar: Greyzemic Luvic Phaeozems, formed under broadleaf forest vegetation. The soil buried 1500 ± 150 cal BP is presented by Luvic Chernozem indicating more arid environment and the onset of steppe ecosystem within the interval of I century BC - I century AD. The soils have chernic horizon, the secondary carbonates are presented by abundant pseudomycelium and carbonate coatings above clay cutans that were formed earlier. More humid environments during the V-VIII and XIII-XVI centuries AD resulted in the advance of broadleaf forests and the formation of Greyzemic Luvic Phaeozems with deeply leaching of carbonates. The study shows that surface Greyzemic Phaeozems of the forest-steppe areas are polygenetic and reflect dynamic changes in the border between forest and steppe landscapes.

Keywords: Paleopedology, paleoclimate, paleolandscape, Holocene

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C2.1 - Soil physics

C2.1.1 - Soil structure dynamics

(4316 - 2565) Aggregate Stability in Soil with Humic and Histic Horizons in a Toposequence under Araucaria Forest

Daniel Hanke[1]; Deborah Pinheiro Dick[2]
UNIPAMPA[1]; UFRGS[2]

Aggregate stability is one of the most important factors in soil conservation and maintenance of soil environmental functions. Aggregation affects soil capacity to store and stabilize organic C, as well as soil water storage capacity and soil structural stability against erosive agents and compaction. The objective of this study was to investigate the aggregate stability mechanisms related to chemical composition of organic matter in soil profiles with humic and histic horizons in a toposequence under Araucaria moist forest in southern Brazil. The soils sampled were classified as Humic Hapludox (highest position), Fluvaquentic Humaquepts (lowest slope position), and Typic Haplosaprists (floodplain). The C and N contents were determined in bulk soil samples. The chemical composition of soil organic matter was evaluated by infrared spectroscopy. Aggregate stability was determined by applying increasing levels of ultrasound energy. Results were analyzed by descriptive statistics and multivariate analysis. To support the multivariate studies, simple linear regressions were also applied. Carbon content increased from the top of the slope to the alluvial plain. The SOM_{HF} samples showed the same FTIR spectrum pattern; in figure 1, the FH spectra are shown as an example. The absorption bands observed in the spectra were 3420 cm^{-1} - O-H stretching in H-bonds; two bands at 2950 and 2840 cm^{-1} - C-H of aliphatic groups; 1710 cm^{-1} - C=O of carboxyls; 1630 cm^{-1} - C=C of aromatic groups; 1540 cm^{-1}, - N-H and C=N; 1245 cm^{-1} - C-O of OH deformation of the carboxyl; and 1075 cm^{-1}, - the C-O bond of primary and secondary alcohols. In SOM studies, this organic function is considered a part of the carbohydrate-like structures (C-O-alkyl). Higher ultrasonic energy values for clay dispersion were observed in the C-rich soils in the lower landscape positions, indicating that organic compounds play an important role in the structural stabilization of these profiles. Both aliphatic and carbohydrate-like structures were pertinent to aggregate stability. In the Oxisol, organo-mineral interaction between carbohydrates and the clay mineral surface was the most important mechanism affecting aggregation. In soils with a higher C content (Humaquepts and Haplosaprists), stabilization is predominantly conferred by the aliphatic groups, which is probably due to the structural protection offered by these hydrophobic organic groups.

Keywords: carbon, soil structure, ultrasound energy, organo-mineral interaction, hydrophobicity.
Financial support: CNPq and CAPES

(8269 - 2279) Aggregation and organic carbon in Oxisol under areas with and without tillage

Mariele Monique Honorato Fernandes[1]; Matheus Flavio da Silva[1]; Carolina Fernandes[1]
Faculdade de Ciências Agrárias e Veterinárias FCAV/UNESP Câmpus de Jaboticabal[1]

The intensive preparation consists in soil revolving and incorporation of the vegetal residues. This process accelerates the decomposition of the organic matter, reducing the carbon stock in the soil, besides favoring the rupture of the aggregates, damaging the soil structure. On the other hand, the no-tillage of the soil increases the carbon stock and preserves the larger aggregates. The objective of this study was to evaluate soil attributes in an area where the soil is prepared (PA) and in an area that does not receive this preparation with fallow (NTA). The experimental areas are located in Jaboticabal, state of São Paulo, Brazil. The soil of the areas is characterized as Red Oxisol clay-textured (564 g kg-1 clay, 180 g kg-1 sand, 256 g kg-1 silt). In each area 20 points were sampled in three layers: 0.00-0.05 m (L1); 0.05-0.10 m (L2) and 0.10-0.20 m (L3). Weighted mean diameter (WMD), aggregate mass (AM) and organic carbon (OC) were analyzed. Data descriptive statistics were performed. The mean and standard error of WMD (mm) in NTA were: 3.4 ± 0.08 (L1); 2.3 ± 0.07 (L2); 1.7 ± 0.04 (L3). For the PA they were: 3.1 ± 0.09 (L1); 2.8 ± 0.08 (L2); 2.3 ± 0.07 (L3). From the mean values, a higher WMD was observed in NTA in L1, however, in L2 and L3 the highest WMD values occurred in the PA. AM (g g-1 soil) greater than 4 mm was higher in NTA (0.48 ± 0.02) in L1, but lower in L2 (0.24 ± 0.01) and L3 (0.13 ± 0.008) compared to PA (0.43 ± 0.02 (L1), 0.36 ± 0.02 (L2), 0.24 ± 0.01 (L3)). AM between 4 and 2 mm was greater in NTA (0.19 ± 0.004 (L1), 0.17 ± 0.003 (L2), 0.13 ± 0.002 (L3)) than in PA (0.16 ± 0.004 L1), 0.16 ± 0.004 (L2), 0.16 ± 0.005 (L3)) in L1 and L2, but lower in the L3 layer. AM between 2 and 1 mm was equal in NTA (0.12 ± 0.006) and in PA (0.13 ± 0.008) in L1, but was higher in NTA in L2 (0.19 ± 0.004) and L3 (0, 20 ± 0.005) relative to PA (0.14 ± 0.004 (L2); 0.18 ± 0.008 (L3)). The OC content (g kg-1) was higher in NTA in all layers (21.1 ± 0.6 (L1), 15.3 ± 0.4 (L2), 13.8 ± 0.3 (L3)) when compared to PA (12.2 ± 0.32 (L1), 11.9 ± 0.36 (L2), 10.6 ± 0.36 (L3)). Soil preparation caused the aggregates rupture, decreasing WMD in L1 and increasing in L2 and L3. The no-tillage preserved the aggregates in L1. Soil preparation decreased OC soil content.

Keywords: Weighted mean diameter, aggregate mass, Oxisol
Financial support: Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES)

(5071 - 3135) Assessment of soil compression stress and organic carbon content under grazing and swine manure application

Douglas Leandro Scheid[1]
Universidade Federal de Santa Maria[1]

The raise of swine produces a great amount of slurry, in their composition had nitrogen, phosphorus and organic material. Because of that composition swine slurry can be applied on the soil, and the areas with cultivation of *Cynodon dactilon* to feed ruminants need a great quantity of nutrients so the application of swine slurry is a good option. However, the physical attributes of this areas can be influenced with the addition of carbon and cattle trampling. The aim of this work was to study the impact of swine slurry application on fields with cultivation of *Cynodon dactilon* under grazing on the soil physical attributes. The soil in the field is a Rhodic Oxisol with 490 g kg^{-1} of clay, 154 g kg^{-1} of sand and 356 g kg^{-1} of silt. The field have different times of cultivation with *Cynodon dactilon* and application of swine slurry, with grazing: three, eight and 15 years. The average application rate of swine slurry was approximated to 200 m^3 ha^{-1} $year^{-1}$. The soil sampling was done with cylinders having a average of 100 cm^3. The soil samples were collected on four layers: 0.02-0.07 m, 0.1-0.15 m, 0.15-0.20 m and 0.20-0.25 m depth. The pre compression stress was determined under static loading with steps of 12.5, 25, 50, 100, 200, 400, 800 and 1600 KPa. The total organic carbon content was determined by the wet oxidation method. The bulk density with three years was greater than with 15 years in the superficial layer. We did not find difference in the others layer for bulk density. The preconsolidation pressure (σp, KPa) was greater with three years than eight and 15 years. The σp was greater in the layer 15-20 cm with three years, and was greater in the layers 10-15 cm with eight and 15 years. The results shows that higher σp in subsuperficial layers were because the cattle trampling effect. Cattle trampling results in compaction in subsuperficial layers because the little foot area. The compaction degree did not show difference. The compression index was greater with three and eight years, that shows that the soil had more settlement when cultivated a short period with *C. dactilon* and grazing. The total organic carbon was greater in the superficial layers

(0.02-0.07 m and 0.10-0.15 m). The time of application did not change the total organic carbon content. The bulk density and σp show that with more time of *C. dactilon* cultivation can have better conditions for plant growth than shorter time.
Keywords: Pre-compression stress, Compaction, Organic carbon, Trampling
Financial support: CAPES

(8566 - 2342) Assessment on Soil Aggregate Stability Relations with Organic Carbon Pools at different Tropical Climates and Soil Use Systems in Colombian Andes.

Efrain Francisco Visconti Moreno[1]; Ibonne Geaneth Valenzuela Balcazar[1]
Universidad Francisco de Paula Santander[1]

Measurements of stable aggregates (SA) at 2.36; 1.18; 0.60 and 0.30mm, stable aggregates weighted mean diameter (WMD), organic carbon (OC) at particulate organic matter (OM) pool (POC), OC at mineral associated OM pool (MAOC), total OC (TOC) and humification rate (HR) on soils sampled at 2 altitudinal sites: Humic Dystrudepts in cold tropical climate (CC) with 3 use plots; tropical mountain rainforest (MF), pastures (PA) and crops (IC). Fluvaquentic Dystrudepts in warm tropical climate (WC) with 3 use plots; tropical rainforest (RF), oil palm pastures association (OP) and irrigated rice (RC). Soil sampled at 3 depths: 0–5, 5–10 and 10–20 cm. Also mineral particles distribution, bulk density (Bd) was measured. Results of SA >2.36mm was higher at CC soil (51.48%) than WC soil (9.23%). SA 1.18-2.36mm was also higher at CC soil (7.78%) than WC soil (0.62%). SA 0.60-1.18mm resulted indifferent. SA 0.30-0.60mm was higher at WC soil (13.95%) than CC soil (4.67%). SA <0.30mm was higher at WC soil (72.56%) than CC soil (32.15%). Analysis reveals significant effect of climate on SA; SA 0.60-1.18mm is excluded, CC soil had highest values. Significant effect of use on SA was partial (only for SA 0.30-0.60mm), being higher in IC. Higher aggregation stability is remarkable at CC and between soil uses the MF is most favorable for higher SA content. MWD at CC soil is higher in layer 1 and layer 2, of MF (2.93 and 2.91 mm respectively). The layers 1 and 2 of IC presented MWD values of 1.96 and 1.73 mm, respectively. Having the lowest values of MWD the layers 1 and 2 of PA. For layer 3, MWD is higher at IC (2.13 mm), followed by MF and PA. With regard aggregates MWD at WC soil, layer 1 of RC presents the highest value (1.08 mm). All other values of MWD are 0.50 mm and less. A depth stratification of AS content is observed, top soil has bigger size classes of SA. At CC the PA has higher TOC and the MF together with IC present lower TOC. Comparing TOC and mineral particles distribution with SA, results that higher TOC improves presence of bigger size of aggregates at sandy soils. POC is highest at CC soil. Despite no significant effect of use system or depth, layer 1 at both MF and PA had the higher values. So the dominant presence of SA > 2.36 mm in CC soil is directly related to higher POC. It is observed that MWD and SA > 2.36 mm increase linearly with a higher POC. But decrease linearly with a higher HR. For SA < 0.30 mm, a linear decrease is observed at higher POC.
Keywords: aggregate stability, soil organic carbon, particulate organic carbon, Andes
Financial support:

(3672 - 2138) Biological and mechanical decompaction of an Oxisol in the Brazilian Western Amazon.

Anderson Cristian Bergamin[1]; Fábio Lucas de Mattia1[1]; Emerson Oliveira Souza1[1]; Wesley Santana Ferreira[1]; Diogo Arthur Valiati Dantas[1]; Fábio Régis de Souza[1]; Renan Marré Biazatti[1]
Universidade Federal de Rondônia[1]

Soil compaction is a problem in the Brazilian agricultural activity due to the intense traffic of agricultural machinery and the animal trampling, being necessary the decompaction of the soil to maintain the productivity in these productive systems. This study aimed to evaluate the influence of soil compaction induced by the traffic of a tractor, submitted to mechanical and biological decompaction, on soil density and dry matter yield of soil cover crops. The experiment was installed in a clayey Oxisol at the experimental farm of the Federal University of Rondônia (UNIR), in Rolim de Moura, Rondônia state, Brazil. A randomized complete block design was applied, with a split plot arrangement and three replicates. In the split plot, three soil cover crops were introduced: Brachiaria brizantha, Crotalaria grahamiana, Crotalaria spectabilis, plus mechanical chiseling (soil with B. brizantha cover); and in the main plot five induced levels of compaction by tractor traffic (mass of 3.2 Mg) in zero, one, two, four and eight passes. Soil density was determined by the volumetric ring method at depths of 0.0-0.05 m, 0.05-0.10 m and 0.10-0.20 m. For the 0.0-0.05 m layer, with the exception of mechanical chiseling, there was an increase in soil density with the tractor traffic. Without the traffic tractor, and with a passes, there was no difference between the cover crops for the density of the soil. With two to eight passes of the tractor, there was only effect of reducing the soil density with the use of mechanical chiseling and cultivation of C. grahamiana, showing a better effect of these treatments in the recovery of compacted areas. For the subsurface layers (0.0-0.05 to 0.20 m) only mechanical chiseling reduced soil density. There was a reduction in the production of dry mass in all the cover crops with the increase of the tractor passes. The B. brizantha in all tractor passes and C. grahamiana with up to two passes of the tractor produced greater amount of dry mass. Thus, it was observed that the mechanical decompaction was more efficient to reduce the soil density and the B. brizantha had a higher dry mass production, in addition, C. grahamiana can be used as a practice for the decompaction of lightly compacted soils.
Keywords: soil cover crops; soil density; mechanical chiseling.
Financial support: National Council for Scientific and Technological Development (CNPq) and Rondônia Foundation for the Support to the Development of Scientific and Technological Actions, and the State of Rondônia Research Foundation (FAPERO)

(6904 - 1393) Clay fraction flocculation degree of Mato Grosso do Sul State soils

Rafaela Silva Santana[1]; Felipe Ceccon[1]; Thais Stradioto Melo[1]; Izabela Richena Barboza[1]; Leandro Escobar Dalarosa[1]; Gabriele Bezerra Diolindo da Silva[1]; Matheus Anghinoni[1]; Lucas Costa Soares[2]; Alessandra Mayumi Tokura Alovisi[1]
Federal University of Grande Dourados[1]; State University of Mato Grosso do Sul[2]

Mato Grosso do Sul has 35.7 million hectares of extension, and 4.5 million of these were used for growing crops on 2017/18 harvest. The change from native vegetation to agricultural exploitation significantly affects soil physics, so as the soil management adopted directly influences the physical attributes of the soil. Red-yellow ultisol, haplic albaqualf, chromic alfisol, quartzipisamment entisol, red-dystrophic oxisol, red dystroferric oxisol, dystrophic oxisol, dystroferric oxisol, red nitosol, hydromorphic albaqualf, red alfisol, rendzic chernosol, regolith entisol, ultic entisol, vertisol and gley soil were induced to two methods of clay dispersion in three replications. The variables water-dispersed clay (WDC), total clay (TC) and flocculation degree (FD) were induced to analysis of variance and when significant were compared by the Scott-Knott test (p <0.05). Soils that had a clay textural classification in the NaOH dispersion method (total clay) represent statistically the group of soils with the highest flocculation. The water-dispersed clay method overestimates the silt fraction. The clay flocculation degree varies along with the mineral composition of the soil. Clay dispersion methods can generate different textural classes of soils.
Keywords: soil physics; soil texture; dispersion methods.
Financial support:

(1510 - 249) Coffee conilon shaded by rubber tree improving the soil structure

Gustavo Soares de Souza[1]; Henrique de Sá Paye[1]; Lucas Calazans Santos[1]

INCAPER[1]

The state of Espírito Santo, southeastern Brazil, is one of the main conilon coffee (*Coffea canephora*) producing areas in the world. However, it presents in these areas one of the highest proportions of soil degradation in the state. Poorly managed conilon coffee plantations have negative soil consequences, such as compaction, erosion, loss of water and nutrients, and accelerated mineralization of organic matter. The occurrence of high temperatures and a long period of drought can accelerate soil degradation, with a negative influence on productivity and longevity of crop. The implantation of coffee plantations in intercropped or agroforestry systems is an option to minimize the soil degradation process, since it can better promote the soil structure and increase the soil carbon stock. The objective of this study was to evaluate the soil bulk density, soil porosity, plant-available soil water capacity, soil water content, soil temperature and soil carbon stock of an Argissolo Amarelo under coffee conilon shaded with rubber tree in the Sooretama, ES. The treatments under study were: T1- conilon coffee shaded with rubber tree and T2- monoculture of the conilon coffee in full sun. Deformed and undisturbed soil samples were collected with four replicates of the layers 0-0.1, 0.1-0.2 and 0.2-0.4 m. Statistical analysis was performed using the F test ($p<0.05$) and Tukey test ($p<0.05$). The conilon coffee shaded with rubber tree showed a lower soil bulk density and greater total porosity and macroporosity in relation to treatment in full sun in the soil layers. The plant-available soil water capacity and soil water content did not differ significantly between treatments. The conilon coffee shaded presented lower soil temperature in the three layers in relation to treatment in full sun. The soil carbon stock did not differ between the treatments in the three layers. The conilon coffee shaded with rubber tree improved soil structure and reduced soil temperature, contributing to soil conservation and maintaining its productive potential.

Keywords: Soil bulk density; soil porosity; agroforestry system; *Coffea canephora*

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(1705 - 1281) Compaction of the soil in sugarcane cultivation area under different soil preparations

Ciro Pozzi Garcia[1]; Juliano Carlos Calonego[1]; Carlos Alexandre Costa Crusciol[1]; Tiara Moraes Guimarães[1]; Jorge Martinelli Martello[1]; Ariane Garcia[1]

UNESP - São Paulo State University, College of Agricultural Sciences.[1]

Soil compaction in sugarcane cultivation areas is common, mainly due to the end of burning and the replacement of human labor by mechanized means. The increase of the frequency of agricultural machinery passing through the soil, especially during the harvesting process with the transshipments and harvesters, leads to the densification of the soil particles. Soil compaction is detrimental, as it causes restriction of the root system development, reduction of water absorption and retention, and reduction of soil aeration. These factors directly interfere in the vegetative development of the crop, which can lead to productive losses. The objective of this study was to evaluate soil penetration resistance (SPR) in different soil preparation systems. The experiment was installed in 2015 under Red-Yellow Latosol (sandy texture), located in Borebi, a city in the interior of the state of São Paulo, Brazil. The experimental design was a randomized complete block design, with two treatments (conventional soil preparation - CSP (control / standard), deep soil tillage – (DST) with four replications each. The CSP system is characterized by tillage with disk harrow, chiseling and disk harrow again. In the DST was used deep tillage with rod up 0.80m and rotating hoe. The planting of the crop was in double lines spacing (0.9m x 1.50m). All the machines were equipped with GPS in order to control the traffic and to allow the definition of the plant growth zone and traffic zone. The SPR evaluations were carried out by the Stolf method, and the readings were carried out shortly after planting and after harvesting (1.5 years after planting). A rule of 1.20m (transcept) was used, which was placed perpendicularly over the center of the site, in order to obtain a reading every 0.15m, thus totaling 9 points per evaluation, covering the site and the traffic line. The reading was performed up to 0.70m depth, so that 7 layers were layered (spaced 0.10m). The CSP presented values higher than the DST in the layers from 0.10m to 0.60m at the site (up to 0.45m from the ruler). The values found in the two soil preparations were not the limiting factor for the development of the root system, which according to the literature is 2.5MPa. After harvesting the cane, in the second evaluation, the bed was still preserved in the DST treatment.

Keywords: Minimal tillage; Beds; Traffic control; Sandy texture; Penetrometer.

Financial support: São Paulo Research Foundation (FAPESP - Project Number 2014/20593-9)

(2417 - 1920) Correlation between tensile strength and clay and organic matter content in a transect in the Micaela basin, RS, Brazil

Thais Palumbo Silva[1]; Cláudia Liane Rodrigues de Lima[1]; Maria Cândida Moitinho Nunes[1]; Mateus Rodrigues Fonseca[1]; Ana Paula Knapp[1]; Gabriel Luís Schroeder[1]; Luana Nunes Centeno[1]; Marlon Rodrigues[2]

Universidade Federal de Pelotas[1]; Universidade Estadual de Maringá[2]

The study of the soil physical quality indicators aims to identify the conditions that the soil is under its current use and management, in order to provide subsidies for agricultural and environmental planning. A sensitive indicator for the impact of the system of use and management is the tensile strength soil aggregates (TS), due to the soil response to the physical and mechanical processes related to the manipulation, such as the preparation, the formation of superficial crusts, the emergence of seedlings and the root penetration. TS is defined as the stress or force per unit area required to fracture soil aggregates when subjected to a pressure. This is influenced mainly by agricultural management, clay content and organic matter. The objective of this study was to evaluate the behavior of the tensile strength in different uses of the soil and to correlate spatially with the content of clay and the organic matter. The study was carried out in the Micaela basin, located in Pelotas, RS, Brazil. This basin has an area of 37.36 km^2, a transect of 11.2 km with 101 georeferenced points, which includes all predominant soil classes in the basin. Soil samples were collected in the layer of 0.00 to 0.10 meters for the evaluation of the clay content, organic matter and tensile strength. Thus, they were subjected to autocorrelation analysis, which evaluates the spatial dependence of a variable with itself, and crosscorrelation, which considers the distance in the space in which two variables are related. When the results were obtained, a spatial dependence of 1 lag for clay and organic matter, corresponding to 112 meters, and 5 lags for tensile strength were observed that is, up to 560 meters are spatially influenced, after that distance the samples are independent of each other. When performing the crosscorrelation of these variables, it was observed that between the tensile strength and the clay content they presented only a simple correlation, that is, a correlation only at point 0, considered as a relation of weak dependence, as well as between TS and matter organic, and can conclude that these variables did not present spatial relationship.

Keywords: soil physical quality, spatial dependence, autocorrelation

Financial support: CAPES

(3861 - 770) Cover crops in the Ocidental Amazon

Alam Carlos da Silva Costa[1]; Reginaldo Almeida Andrade[1]; Fábio Régis de Souza[1]; Anderson Cristian Bergamin[1]; Adriano Reis Prazeres Mascarenhas[1]; Rhayra Zanol Pereira[1]; Ivair Miguel da Costa[1]; Gabriel Ferreira Soares[1]; Luciana Sônia da Silva[1]
Foundation Federal University of Rondônia.[1]

The cultivation of cover crops has been adopted to be a new way of conservationist agriculture. Can be use grasses like brachiaria and millet or leguminous plants like sunn hemp. These plants are cultivated and after it reaches the maximum development they are cut, bedridden in surface or incorporated in the soil, increasing the organic matter, improving the chemical physics and biology characteristics of the soil. The objective of this work was evaluate the agronomic characteristics of the cover crop and his effects in the physical attributes of the soil. The experimental delineation was randomized in blocks with five (11) treatments and four (4) repetitions. The treatments consist in the evaluation of the species; *Crotalaria breviflora, Crotalaria juncea, Crotalaria ochroleuca, Cajanus cajan* cv. IAC/Fava-larga*, Cajanus cajan* cv. IAPAR 43*, Mucuna cinereum, Mucuna aterrima, Brachiaria brizantha* Hochst. Stapf, *Pennisetum glaucum, Canavalia ensiformis and S. capitata + S. macrocephala* crotalária breviflora; crotalária ochroleuca; crotalária juncea; two pigeon pea; two velvetbeans; brachiaria; millet; jack bean and estilosantes Campo Grande. The variables evaluated were: coverage rate of the soil, fresh mass, dry mass, rate of decomposition, density and porosity of the soil. The bean (*Canavalia ensiformis*) and the (*Mucuna cinereum, Mucuna aterrima.*) totally covered the soil in the evaluated period. The brachiaria, the millet and the (Cajanus cajan cv. IAC/Fava-larga) present the highest values of fresh mass, however, was (*Crotalaria juncea*) that produced more dry mass. The millet, brachiaria, the (*Cajanus cajan* cv. IAPAR 43, Cajanus cajan cv. IAC/Fava-larga) and common was the species with minors rate of decomposition in 60 days. The physical attributes of the soil were not influenced by green manure.

Keywords: Green manure. Coverage rate. Soil porosity. Rate of decomposition
Financial support:

(4561 - 1530) Determination and analysis of curve of soil water retention under different ground coverings, wetland matogrossense

Osvaldo Borges Pinto Junior[1]; Heloisa Agnes Bodnar Massad[2]; Eduardo Guimarães Couto[2]
Universidade de Cuiabá[1]; Universidade Federal de Mato Grosso[2]

In general, "pantaneiros" soils closely related to the nature of deposited sediments, which in turn are a consequence of the physical nature of the "source material" and arranged in each place in the order of event of the processes of deposition/sedimentation. The objective of this work was to determine the water retention curve, the unsaturated hydraulic conductivity of the soil and to characterize and analyze soil density and moisture in different soil coverings on a typical haplic soil. This study carried out in the Brazilian Northern Pantanal, in a region with predominant palm tree *Scheelea phalerata* (Mart. Ex Spreng), under different soil coverages (with litter, without litter and an area of control). The unsaturated hydraulic conductivity of the soil used the pressure infiltrometer. WRCS performed using the tension table, the *Richards* chamber and the automated method using the WP4-C equipment. The soil density presented similar values in the withdrawal and control treatments, 1.27 g cm^{-3} and 1.28 g cm^{-3}, respectively, and were higher than the soil density value of the litter treatment, 1, 14 g cm^{-3}. The lower soil density in litter treatment may be caused by the higher amount of organic matter deposited under the control treatment. Soil moisture had a mean value of 52% for litter treatment, and 43% and 40% for treatment without litter and control, respectively. The results of the unsaturated soil conductivity were higher in the control treatment, being 31.6 mm h^{-1}, the treatments without litter and litter the values were similar (17 mm h^{-1} and 16.18 mm h^{-1}). The greater amount of soil moisture may reflect lower unsaturated hydraulic conductivity. Regarding WRCS, even with the presence of a greater amount of organic matter in one of the treatments, there were no significant differences between treatments after having performed ANOVA. The soil water content in the field capacity and the permanent wilt point reached the maximum value of 0.38 $m^3\ m^{-3}$ and 0.21 $m^3\ m^{-3}$, respectively, in the treatment that had the and the minimum values were found in the treatment without litter respectively of 0.32 $m^3\ m^{-3}$ for FC and 0.09 $m^3\ m^{-3}$ for PWP. In this way, the objectives of this work reached, concluding that regardless of the soil cover, the variables did not present significant differences.

Keywords: Matrix Potential, Seasonal Climate, Hydromorphic Soils
Financial support: CNPq, FAPEMAT e CAPES

(8395 - 1756) Determination of optimized soil matric potential thresholds for potatoes.

Jean-Pascal Matteau[1]; Guillaume Létourneau[1]; Thiago Gumiere[2]; Lotfi Khiari[1]; Jacques Gallichand[1]; Silvio Gumiere[1]
Université Laval[1]; INRS[2]

The human use of fresh water has expanded at a rate twice that of the population increase. Nowadays, 70 percent of the 3 830 cubic km of water use is being taken by the agricultural sector. Among the major crops, the potato stands on top of the calories production per liter of water. Ironically, potato yields are particularly sensitive to soil water deficit. Therefore, to ensure optimized potato yield and a high water efficiency, an intelligent water management method needs to be developed. Irrigation management based on soil matric potential increases water efficiency. However, soil matric potential thresholds need to be clearly defined for the different growth stages. In this study, four different irrigation thresholds (wet, optimal, dry and ETP) were tested to determine the optimal matric potential range for optimizing potato yield and water efficiency. This experiment was performed in a greenhouse using a highly monitored experimental setup including two tensiometers for two potato plants, 8 soil moisture probes and meteorological sensors controlling the greenhouse climate. The wet and the optimal treatments showed a significantly higher total yield than the dry and ETP treatments. However, the commercial yield of the optimal treatment was significantly higher than the wet treatment, due to a disease. This irrigation management produced almost no runoff for every growth stage and very little nutrient leaching. Results suggests that the irrigation management and the water content have a significant impact on potato growth and on the disease occurence. Hence, irrigation management based on matric potential can optimize the potato yield. Finally, the little quantity of runoff water collected under our treatments suggests that an irrigation management based on matric potential have the ability to reduce runoff, thus helping reduce water contamination. The irrigation thresholds identified in the study will benefit the potato growers and may serve as guide-lines for a more intelligent water management reducing water and nutrient loss in potato production.

Keywords: Irrigation management, tensiometer, optimized yield, water content
Financial support: CRSNG

(9747 - 2191) Determination of the physical quality of sandy soil at different depths by computed tomography Rx in microtomograph.

Luanda Torquato Feba[1]; Jacqueline Leal Marques[2]; Luis Gustavo Torquato Feba[1]; Everton Luís Santos[1]; Maik Sérgio Lopes da Silva[1];

Aline Saraiva Viudes[1]; Carlos Sérgio Tiritan[1]; Edemar Moro[1]; Henrique Debiasi[3]

Unoeste[1]; Université de Rennes[2]; Embrapa Soja[3]

Changes in soil structure and breakage of aggregates from intensive agricultural use restrict root growth and reduce the exploitation of water and nutrients by crops. These changes are manifested by high levels of compaction, porosity and water infiltration velocity in the soil, water accumulation on the soil surface and water erosion. With the objective of evaluating the physical quality of sandy soil degraded at different depths, it was proposed in this work to apply the Computed Tomography (X-ray) method, more precisely the use of a non-medical microtomograph. The experiment was conducted at the Experimental Farm of University of West of São Paulo (Unoeste) in Presidente Bernardes - SP, at 22º17'27 "S, 51º40'51" W and 385 m altitude. The soil of the experimental area is classified as Dystrophic Red Argisol, with smooth undulating relief. Soil samples were collected in soil profiles with 5 different depths (0-5, 5-10, 10-20, 20-30, 30-40 cm) in the treatments with 0 t / ha^{-1} of limestone with and without gypsum (4 t / ha^{-1}). Initially, a basic study was made on the fundamentals of soil physics, the Computed Tomography method and soil recovery techniques. Afterwards, the tomographic images were obtained by microtomograph and NRCon software, belonging to Embrapa Instrumentacion. Based on these images, the CT-Analyzer software was used to obtain the physical attributes such as pore size and size, which are fundamental for the evaluation of soil environmental quality. The results showed qualitative and quantitative differences in the 5 depths of the treatments with and without agricultural plaster by means of the image analysis. With this, the work showed the potentiality and the application of the C.T. in the soil investigations, in particular in the physical quality indicators, since the surface samples have larger amounts of pores than the subsurface samples.

Keywords: Gypsum; Limestone; Porosity.
Financial support:

(9311 - 3150) Direct shear resistance parameters of a Bt horizon: under field and saturated moisture

Carlos Vítor Oliveira Alves[1]; Tiago de Oliveira Santos[1]; Wagner Luís de Souza Silva[2]; José Ramon Bastos Cantalice[1]

Universidade Federal Rural de Pernambuco[1]; Instituto Federal de Pernambuco[2]

Soil shear strength is one of the most important dynamic properties for the evaluation of soil interaction with the use of agricultural implements and with the management practices adopted for the soil. The present study was carried out to evaluate the shear strength of the soil from shear wraps in samples of a clayey Bt horizon subjected to different moisture contents different normal stresses and also to evaluate the changes in cohesion and internal friction angle. The study was carried out at the sugarcane experimental station of the Federal Rural University of Pernambuco (UFRPE), located in the Carpina town. Samples with preserved structure were collected to perform direct shear tests and determination of physical parameters and organic carbon content of a Tb Dystrophic A moderate Red-Yellow Argisol, medium / very clay texture. Direct shear tests were performed according to ASTM D-3080/98. The shear rate was 0.125 mm min^{-1}. The normal stresses used during the tests were: 50, 100, 150 and 200 kPa. The shear stresses were higher for the field moisture condition and lower for the saturation condition. Despite the high clay content of the soil, according to the pearson correlation matrix and the multivariate grouping technique, this fraction was not important for the soil cohesion parameter. Only with the use of the multivariate aproach of principal component analysis was possible to visualize the importance of the silt fraction in the parameter of apparent cohesion in the soil, demonstrating the importance of the multivariate aproach in the understanding of the phenomenon.

Keywords: Soil rupture. Soil cohesion. Multivariate statistics.
Financial support:

(1630 - 2599) Does land use change the spatio-temporal nature of soil moisture? A multi-spectral analysis in the Caatinga

Cynthia Wright[1]; Eduardo Souza[2]; Jason West[1]; Brad Wilcox[1]

Texas A&M University[1]; Universidade Federal Rural de Pernambuco[2]

Soil water is central to ecohydrology. In addition to driving the partitioning of rainfall into runoff and evapotranspiration, soil water drive vegetation response. Soil water has a particularly strong role in water-limited systems, such as the Caatinga, a seasonally dry forest/shrubland in Northeast Brazil. In the Caatinga, rainfall seasonality is more dramatic than temperature seasonality, and thus ecological processes can be thought of as pulse-driven, where rainfall feeds soil water in pulses. Yet, the Caatinga is plagued by an accelerated rate of deforestation and potentially degradation, which likely impacts the soil water reserve available to vegetation. Thus, the objective of this research is to understand the temporal dynamics of soil water for different vegetation covers. Soil water was measured for two cover types: a native Caatingta stand ~50 years old vs. a pasture site near Serra Talhada, PE, Brazil. Soil water for each site was measured at three different spatio-temporal scales: a) small (point) scale measurements continuous in time; b) medium (pedon) scale measurements taken weekly using a portable probe; both small and medium scale measurements used FDR-type probes; and c) large (plot/pixel)-scale measurement obtained via remote sensing (SMAP L4 9 km data available since 2015). Discrete and continuous wavelet analysis was conducted on each time series to better understand soil moisture dynamics at different spatio-temporal scales. Because rainfall seasonality drives soil water, these dynamics are important to understanding potential shifts in vegetation composition and distribution, plant phenology, and trends regarding deforestation and agricultural activities.

Keywords: soil moisture; wavelets; spatio-temporal scales; ecohydrology; dry forest
Financial support: Boren Fellowship; CAPES/TAMU

(6568 - 471) Effect of agricultural plaster, soil scarification and culture succession systems on physical attributes of a distrophic red-yellow latosol, in Porto Velho - RO

Elyenayra Nogueira Pinheiro[1]; Eduardo Antonio Neves dos Santos[1]; Roneres Deniz Barbosa[1]; Milton César Costa Campos[1]; Elilson Gomes de Brito Filho[1]; Carlos Henrique Gima Relvas[1]; Anderson Vieira Rodrigues[1]; Ludimila Souza de OLiveira[1]; Fernando Gomes de Souza[1]; Luana Celestino Calista[1]

Federal University of Amazonas[1]

Understanding and quantifying the impact of land use and management on physical quality is critical to the development of sustainable agricultural systems. Thus, the objective of this work was to evaluate the effect of gypsum, soil scarification and crop succession systems on the physical attributes of a Red-Yellow Dystrophic Latosol. The experiment was implemented in the agricultural year 2013 crop 2014 in an area in the experimental field of Embrapa Rondônia. The area was being cultivated with *Brachiaria brizantha cv. Marandú* during eighteen years (1990 to 2008) and after that was kept in fallow for four years (2009 to 2013), when the experiment was installed. The treatments consisted of the absence and addition of 2 ton ha-1 of agricultural gypsum, absence and presence of soil scarification, and three crop succession systems: SP (soybean/fallow), SMP (soybean/corn/fallow) and SMBP (soybean/corn/brachiaria/fallow). The experimental design was in randomized blocks arranged in a

2x2x3 factorial scheme with eight blocks. Four years after the implementation of the experiment, soil samples were collected in the layers of (0.00-0.05, 0.05-0.10 and 0.10-0.20 m). With the aid of volumetric rings soil samples were collected for determination of macroporosity, microporosity, total porosity, soil density, soil moisture and penetration resistance. Blocks with preserved structure were manually collected and defragmented in aggregates. With the aid of sieves, aggregates with a diameter of between 8 and 4.75 mm were separated for stability analysis of aggregates in water. The hypothesis of normality of the data was tested by the Shapiro-Wilk test, and submitted to analysis of variance (ANOVA). When the significance test was found, the means were compared by the Scott-Knott test at the 5% probability level. The agricultural gypsum caused alterations in soil porosity and stability of aggregates, with better values of MaP in the first two layers evaluated, observed in the treatments where there was application of agricultural gypsum. Crop succession systems can influence the physical characteristics of the soil. The best values of aggregate stability were observed in the SMBP and SMP succession systems, which, besides preserving the structure of the aggregates, allowed a reduction in soil resistance to penetration. Taking into account these facts, the levels of sand, silt, clay and soil density were not altered by the agricultural gypsum and scarification of the soil.

Keywords: physical attributes, soil management, crop succession.
Financial support: National Council for Scientific and Technological Development - CNPq; Foundation for Research Support in the state of Amazonas- FAPEAM

(8538 - 345) Effect of land use, location and depth on soil organic carbon stock and aggregate dynamics of degraded ultisol in Nsukka, Southeastern Nigeria.

Azuka Chukwuebuka Vincent[1]; Odoh Chidimma Peace[1]
Department Of Soil Science, University Of Nigeria, Nsukka[1]

Changes in agricultural practices and land use influence the storage and release of soil organic carbon, and soil structural dynamics. To investigate this in Nsukka, southeastern Nigeria, soil samples were collected at 0-10 cm, 10-20 cm and 20-30 cm from three locations; Ovoko (OV), Obukpa (OB) and University of Nigeria, Nsukka (UNN) and three land use types; cultivated land (CL), forest land (FL) and grass land (GL)). The result showed that Ksat was significantly ($p < 0.05$) influenced by location with mean values of 68 $cmhr^{-1}$,121.63 $cmhr^{-1}$, 8.42 $cmhr^{-1}$ in OV, OB and UNN respectively. The MWD and aggregate stability (AS) were significantly ($p < 0.05$) influenced by land use and depth. The mean values of MWD are 0.85 (CL), 1.35 (FL) and 1.45 (GL), and 1.66 at 0-10 cm, 1.08 at 10-20 cm and 0.88 mm at 20-30 cm. The mean values of AS are; 27.66% (CL), 46.39% (FL) and 49.81% (GL), and 53.96% at 0-10cm, 40.22% at 10-20cm and 29.57% at 20-30cm. Clay flocculation (CFI) and dispersion indices (CDI) differed significantly ($p < 0.05$) among the land use. Soil pH differed significantly ($p < 0.05$) across the land use and locations with mean values ranging from 3.90-6.14. Soil organic carbon (SOC) significantly ($p < 0.05$) differed across locations and depths. SOC decreases as depth increases depth with mean values of 15.6 gkg^{-1}, 10.1 gkg^{-1}, and 8.6 gkg^{-1} at 0-10 cm, 10-20 cm, and 20-30 cm respectively. SOC in the three land use were 8.8 g kg^{-1}, 15.2 gkg^{-1} and 10.4 gkg^{-1} at CL, FL, and GL respectively. The highest aggregate associated carbon was recorded in 0.5 mm across the land use and depth except in cultivated land and at 20-30 cm which recorded their highest SOC at 1mm. SOC stock, total nitrogen (TN) and CEC were significantly ($p < 0.05$) different across the locations with highest values of 23.43 t/ha, 0.07g/kg and 14.27 Cmol/kg respectively recorded in UNN. SOC stock was significantly ($p < 0.05$) influenced by depth as follows; 0-10>10-20>20-30 cm. TN was low with mean values ranging from 0.03-0.07 g/kg across the locations, land use and depths. The mean values of CEC ranged from 9.96-14.27 Cmol kg^{-1} across the locations and land use. SOC stock showed correlation with silt, coarse sand, N and CEC (r = 0.40*, -0.39*, -0.65** and 0.64** respectively. AS showed correlation with BD, Ksat, pH in water and KCl, and SOC (r = -0.42*, 0.54**, -0.44*, -0.45* and 0.49** respectively. Thus, land use and location plays significant role in sustainable management of soil resources.

Keywords: Agricultural practice, structural dynamics, sequestration, soil resources, management
Financial support:

(3841 - 1430) Effect of soil texture and structure on the K(θ) function parameters.

Fernando Henrique Setti Gimenes[1]; Cezar Augusto Medeiros Rebouças[1]; Ismael Meurer[1]; Paulo Leonel Libardi[1]
University of São Paulo, 11 Pádua Dias Ave, Piracicaba, 13418-900, Brazil[1]

The instantaneous profile method, IPM, is one of the most used to determine the unsaturated soil hydraulic conductivity, K(θ) function. Thus, the objective of this work was to compare the K(θ) function, determined by IPM under field conditions, in the pedogenetical horizons of an Oxisol (Bw) and an Ultisols (Bt), as related to texture and structure. The Bw texture was defined as sandy clay loam and its structure as weak, small to medium subangular blocks that break to moderate small to medium granular. With respect to the Bt, the texture is very clayey and the structure is moderate, large subangular blocks. The soil water retention curves, determined in the laboratory using funnels and pressure chambers with porous plate, were used to convert the matric potential values obtained by the tensiometers, installed along the soil profile, in values of volumetric water content. According to the results, the Bw horizon presented a very high value of hydraulic conductivity at the initial redistribution time, K_0, directly related to the soil texture and structure, which provided higher total porosity and, mainly, macroporosity. The dimensionless parameter γ, exponent in $K(\theta) = K_0 \exp [\gamma (\theta - \theta_0)]$, was slightly larger in the Bw horizon than in the Bt, being close to those found in the literature. The value of volumetric soil water content at the initial redistribution time, θ_0, was higher in the Bt horizon than in the Bw due to the higher clay content and microporosity in Bt, emphasizing the influence of soil texture and structure attributes on the water retention. The fitted values to the model were close to the calculated values, confirmed by values greater than 0.98 for the determination coefficients, indicating that the dependent variable can be explained by the model. It could be concluded that soil structure and texture directly affected K_0 and θ_0 values of the K(θ) function, with the Bw horizon conducting water more easily than the Bt due to its greater macroporosity, while the Bt horizon retaining more volume of water due to its texture and microporosity.

Keywords: Soil hydraulic conductivity; unsaturated soil; soil porosity.
Financial support: CNPq; FAPESP.

(3233 - 2914) Effective hydraulic conductivity and its relationship with soil attributes of cerrado Mato-Grossense

Edwaldo Dias Bocuti[1]; Ricardo santos silva Amorim[1]; Tulio gonçalves dos Santos[1]; Yuri william Santos Duarte[1]
Universidade Federal de Mato Grosso[1]

The objective of this work was to determine the values of the effective hydraulic conductivity for soils of Cerrado Mato-Grossense, as well as to indicate physical attributes of soil with predictive potential of Ke. The work was developed in six areas located in the Mato Grosso state, that they contemplate texture soils very sandy, clayey and sandy average and the uses following: pasture (Pp1 and Pp2), agricultural (Ap1, Ap2 and SV1) and Cerrado (C1). The study was performed in three steps: characterization of the attributes physicals an physicals-hydric the of soils; determination of the effective hydraulic

conductivity (K_e); evaluation of the correlation between K_e and the chacteristcs of the soils. In order to determine the soil properties, preserved, semi-preserved and deformed soils samples were collected and was utilized proposal metodology in Manual of method of soil analysis of Embrapa. For the k_i determination was utilized proposal methodology by US Department of Agriculture Agricultural Research Service - ARS / USDA. The statistical treatment of the informations consisted in the application of Kruskal-Wallis test and Pearson's correlation between variables. Due to the different soil characteristics of the areas, the test durations were different, corresponding to an average of 114, 118, 115, 98, 204 and 126 minutes per repetition for the areas, Pasture point 1 (Pp1), Pasture point 2 (Pp2), Agricultural point 1 (Ap1), Agricultural point 2 (Ap2), Cerrado 1 (C1) and São Vicente 1 (SV1), respectively. The effective hydraulic conductivity (Ke) was determined when the infiltration rate was stable, which corresponded to 81.52; 109.94; 30.63; 24.49; 48.31; and 28.37 mm h^{-1} for Pp1, Pp2, Ap1, Ap2, C1 and SV1, respectively. Through the Kruskal-Wallis test ($p \leq 0.05$) it was verified that there is significant difference between the Ke of the studied areas. This difference was observed only between Ap2 and Pp2, and the effective hydraulic conductivity was higher for the Pp2 area. The attributes total sand, organic matter and clay presented a significant correlation with the effective hydraulic conductivity of the soil, evidencing that these attributes are good predictors of the effective hydraulic conductivity of Cerrado soils.

Keywords: hydraulic conductivity; Physical-hydrics Attributes, Soil erosion

Financial support: CNPq for the financial support granted for the development of the work (Case 481990 / 2013-5)

(3220 - 2819) Erodibility Interril and its relationship with attributes of Cerrado soils Mato-Grossense

Edwaldo Dias Bocuti[1]; Ricardo Santos Silva Amorim[1]; Tulio Gonçalves dos Santos[1]; Luis Augusto0 Di loreto Di Raimo[1]; Wellington de Azambuja Magalhães[1]

Universidade Federal de Mato Grosso[1]

The objective this work was to determine in field the erodibility interrill (K_i) in soils of the Cerrado Mato-Grossense and find characteristcs physicals and physicals-hydric that better correlate and are predictors of K_i. The work was developed in six areas located in the Mato Grosso state, that they contemplate texture soils very sandy, clayey and sandy average and the uses following: pasture (Pp1 and Pp2), agricultural (Ap1, Ap2 and SV1) and Cerrado (C1). The study was performed in three steps: characterization of the attributes physicals an physicals-hydric the of soils; determination of the interrill erodibility (k_i); evaluation of the correlation between K_i and the chacteristcs of the soils. In order to determine the soil properties, preserved, semi-preserved and deformed soils samples were collected and was utilized proposal metodology in Manual of method of soil analysis of Embrapa. For the k_i determination was utilized proposal methodology by US Department of Agriculture Agricultural Research Service - ARS / USDA. The statistical treatment of the informations consisted in the application of t-student test, Kruskal-Wallis test and Pearson's correlation between variables. The mean values obtained for K_i were $1{,}56 \times 10^5$; $2{,}47 \times 10^5$; $2{,}44 \times 10^5$; $1{,}32 \times 10^6$; $8{,}56 \times 10^4$ e $5{,}93 \times 10^5$ kg s m^{-4} for subáreas Pp1, Pp2, Ap1, Ap2, C1, SVp1, respectively. The interrill erodibility was bigger in Ap2, when compared whit C1. Larger correlations between K_i and the physicals characteristics or physicals-hydric characteristics of the soils can be obtained if the soils of similar textural class are initially grouped to later be carried out the statistical treatment of the data. For group soils A (Pp1,Pp2 and C1) the attributes coarse sand,very fine sand and aggregate stability index presented greater potential of prediction of the K_i. For group soils B(Ap1,Ap2 and SV1) the attributes coarse sand, average sand,weighted mean diameter, geometric mean diameter and aggregate stability index present a higher prediction potential of k_i.

Keywords: Soil erodibility, Interrill, Physical-hydrics Attributes, Soil erosion

Financial support: CNPq for the financial support granted for the development of the work (Case 481990 / 2013-5)

(9622 - 686) Estimation of soil temperature based on climatic parameters with artificial neural network model and artificial neural network - firefly hybrid model (case study, Tabriz, Ahar)

Fatemeh Esmaeilbeyki[1]; Davoud Zarehaghi[1]; Mohammadreza Neyshabouri[1]

University of Tabriz[1]

The soil temperature (ST) varies in different depths of the soil and fluctuates throughout the day, month, and year. Surface temperature and depth of soil are not measured continuously. So, in terms of soil temperature data, we face a lack of statistics. Considering the continuous measurement of climate variables in meteorological stations, establishing a relationship between soil temperature and climatic characteristics of the area is of particular importance. In the meantime, smart models can play an effective role. In this study, measured data are related to the weather stations of Tabriz and Ahar and meteorological variables including air temperature, relative humidity, wind speed, sunshine and soil temperature at depths of 5, 10, 20, 30, 50 and 100 cm with a 3-year statistical period than 2014 to 2016 using artificial neural network model (ANN) and artificial neural network-firefly hybrid model (ANN-FFA) for estimating and comparing soil temperature in the next two days at a depth of 5 cm. Results showed that ANN-FFA with RMSE= 1.71 was more successful than ANN with RMSE= 3.26 in soil temperature estimation two days ahead. Also, in Ahar, MLP-FFA with RMSE= 5.03 was more successful than ANN with RMSE= 6.34 in soil temperature estimation of the next two days. ANN-FFA with high precision in estimating soil temperature, was introduced as the top model which can be used in modeling and soil science and the modeling error rate dramatically decreases.

Keywords: Firefly algorithm, soil temperature estimation, artificial neural network- firefly hybrid model.

Financial support: University of Tabriz

(3402 - 2297) Evaluation of a physical-empirical ptf for soil water retention

Daniel Boeno[1]; Paulo Ivonir Gubiani[1]; Rodrigo Pivoto Mulazzani[1]

Universidade Federal de Santa Maria[1]

The soil water retention curve (SWRC) is useful for understanding the water availability for plants and for modeling water flow in soil. Since the determination of SWRC is a laborious and time-consuming task, pedotransfer functions (PTFs) has been used by soil scientists to estimate the SWRC. As the most of the currently available PTFs are empirical, its use is restrict to soils where the model was calibrated. Thus, there is a demand for physical or physical-empirical PTFs that consider the mechanisms and soil physical characteristics to estimate soil water retention. The physical-empirical model proposed by Mulazzani (2016) considers that the specific soil surface available for water retention (SSa) and the bulk density (ρ_b) can satisfactorily predict soil water retention. The SSa depends on particles characteristics (shape, size distribution) and is estimated from total SS (SSt) and degree of arrangement, represented by ρ_b. The model calculates a factor 'fa', which represents the mass of water per unit of SSa, at a given water potential (ψ), and relates it to SSt for estimating the gravimetric water content (W): $W = [SSf = f(SSt, \rho_b)] \times [fa = f(\psi,$

SSt, ρ_b)]. Mulazzani (2016) parameterized the model for samples with non-preserved structure. In this study, the objective was to evaluate the model in soil samples with preserved structure. Stainless rings were used for collecting samples at depths of 5, 15, 30 and 50 centimeters in a field experiment. Water retention was measured at potentials of 0, -0.1, -0.6, -1, -3.3, -10, -50 and -150 m. The estimates obtained with the model were not satisfactory in the potentials of -0.1, -0.6, -1, -3.3, -10, -50 and -150 m. The coefficient of determination (R^2) of the regression ranged from 0.777 to 0.001 (mean of 0.12) in the comparison between experimental and estimated W by the model. The results show that the model failed to predict SWRC with adequate accuracy for the undisturbed sample set. Thus, the model needs adjustments to allow its application in undisturbed soil.

Keywords: Water content. Pedotransfer Function. Preserved structure. Specific Surface.
Financial support: CAPES

(7555 - 263) Evaluation of the application of anthropic load on a trail in the serra da canastra national park

Ian Lucas de Oliveira Rocha[1]; Rita de Cássia Ribeiro Carvalho[1]; Welligton Willian Rocha[2]; Maria José Reis[1]; Bruno Silva Pires[1]
Universidade do Estado de Minas Gerais[1]; Universidade Federal dos Vales Jequitinhonha e Mucuri[2]

It is fundamental to study issues related to anthropogenic capacity to assess the intensity of public use in Conservation Units that do not compromise the sustainability of this ecosystem. Each trail should be designed considering the physical characteristics of the place, seeking to have the least possible impact on the soil, vegetation and fauna. The objective of this work was to analyze the resistance to penetration in the soil moisture of the soil, to detect possible impacts caused by the anthropic trampling, allowing the access to the information regarding the evaluation of the anthropic load capacity of a trail in the Serra National Park of the Canastra-MG through compaction indices (penetrometry) inside and outside the bed of the track investigated. In this way, it is possible to propose management measures that ameliorate environmental impacts. The Resistance to Penetration (RP) in the field capacity moisture was compared by the Snedcor and Cochran (1989) test. The values are derived from the mathematical modeling of RP x Humidity. The resistance to penetration in the center of the trail presented the greatest value, certainly due to the fact of the intense trampling. Considering the lateral evaluations, outside the trail, a lower resistance was perceived, which can be explained by the fact that they are not submitted to anthropic loads. These values from the agronomic point of view do not constitute compaction, which can be justified by the soil presenting sandy texture. However, because it is a trail, this resistance to penetration, even if reduced, can cause long-term degradation, since it can suffer erosion, since these signs are already present in some stretches of the trail. Therefore, due to the characteristics of the texture, and even with low RP values for this trail, an alert for a good planning of the number of visitors, certifying that in the long term, the possible impacts will not compromise the corresponding space. The combination of these indicators is of fundamental importance for the monitoring of the impacts of the trails, since it generates information for the creation of proposals and management strategies for them.

Keywords: Resistance to penetration; Trekking; Soil conservation; Environmental impact; Environmental education.
Financial support: Universidade do Estado de Minas Gerais através do Programa de Apoio a Publicação Qualificada (PAPq/UEMG)

(4635 - 2620) Evaluation of the stability of soil aggregates in the forest islands of two agro-ecological zones in Burkina Faso.

B. Amelie Bougma[1]; Korodjouma Ouattara[2]; Halidou Compaore[2]; B Hassan Nacro[3]; Caleb Melenya[4]; A. Samuel Messele[5]; Vincent Logah[4]; J. Azeez Oladipupo[5]; Jon Lioyd[6]
Inera, Polytechnic University Of Bobo Dioulasso[1]; Inera[2]; Polytechnique University Of Bobo Dioulasso[3]; Knust[4]; Funaab[5]; Imperial College Of London[6]

In the more mesic savanna areas of West Africa, significant areas of dense vegetation with the species and structural characteristics of forest are often found around village areas (of areas of less than 1 to more than 10 ha). It is thought that these 'forest islands' may the direct consequence of human activity and to help understand the processes giving rise to these patches of relatively luxuriant vegetation we studied the stability of soil aggregates for forest islands in the north and southern Sudan savanna zone of Burkina Faso. Aggregate stability is one key soil physical variable influencing biogeochemical processes and soil fertility in natural ecosystems. Soil samples were taken from the 0-5, 5-10, 10-20, 20-30 cm soil horizons of forest islands, comparing them with nearby savanna and cropland and with three aggregate fractions: diameter> 500 µm, 500-250 µm and 250-53 µm, respectively *viz* "macro-aggregates", "meso-aggregates" and "micro-aggregates" subjected to stability testing under water sieving (Kemper and Rosoneau, 1986). Comparing the forest island soils with those of surrounding savanna and cropping areas, we found a highly significant difference in aggregate distributions between agro-ecological zones (p <0.001) with the largest proportion of stable aggregate observed for forest island soils. Regardless of the class of aggregates, the lowest proportions were found in cropland soils. The proportion of aggregates was also found to vary according to the soil depth being highest for the 0-5cm surface layer and decreasing with soil depth. Micro-aggregates dominated all three soil types.

Keywords: Forest island, Soil aggregates stability, ecosystem, Agro ecological Zone, Burkina-Faso
Financial support: SOFIIA/ Royal Society-DFID

(9028 - 3023) Impact of land use on physical quality and GHG emissions in the Atlantic Forest Biome

Reginaldo Barboza da Silva[1]; Marina Pedroso Carneiro[1]; Ana Paula Parker[2]; Piero Iori[3]; Francisca A. Melo Silva[1]
UNESP[1]; Embrapa Meio Ambiente[2]; UFG[3]

In Brazil, land use and occupation in environmentally vulnerable areas protected by law has been a recurring practice and difficult to combat. Permanent preservation areas (PPPs), especially those adjacent to the watercourses, are used by agricultural activities, causing land losses and soil degradation. The objective of this study was to assess the impact of soil use in the physical quality and emission of greenhouse gases (GHG) in PPPs of the Atlantic forest biome. The study was conducted in Haplic Cambisol (Inceptsol), located in marginal strips of vegetation (70 m) adjacent to the Ribeira de Iguape River, in Registro, a county in the South of São Paulo State, Brazil, There were identified and selected four kinds of land use in the experimental area: banana cultivation (BC), extensive pasture (EP) and native forest (NF). Physical and chemical soil analyses were carried out to assess bulk density, macro and microporosity and total porosity, total organic carbon (TOC), mean weight-diameter of soil (MWD), stability index (SI) and soil erodibility (SE). Soil analyzes were evaluated according to Embrapa (2011). The method used to capture GHG was the closed chamber. Subsequently, from GC Shimadzu® gas chromatograph model GC 2014, N_2O and CO_2 concentrations were determined by ECD (electron capture) detector, operating at 300°C, and CH_4 concentrations by type detector FID (flame ionization). The results from this study showed that, BC area had an average annual loss of 10 times greater than EP, even with higher soil organic matter and structural stability. The values for CO_2 and N_2O emission were higher in EP, probably due to the type of vegetation, presence of animals, soil

exposure to solar radiation and soil compaction by animal trampling. MN area had higher CH_4 emission values, probably due to the humidity, favoring anaerobic respiration and greater presence and mineralization of soil organic matter. About soil erodibility and GHG emissions, in the BC area lowest rates of gas emissions found are due to the loss of soil physical properties related to soil structure, to the transport and eluviation of particles, and losses the chemical fertilizers in these areas.

Keywords: soil degradation greenhouse gases banana cultivation
Financial support: CNPq; EMBRAPA

(4207 - 2664) Impact Of Mechanized Forest Management On Soil Penetration Resistance In Eucalyptus Cultivation

Judyson de Matos Oliveira[1]; Teógenes Senna de Oliveira[1]; Gerson Rodrigues dos Santos[1]; Raphael Bragança Alves Fernandes[1]; James Stahl[2]

Universidade Federal de Viçosa[1]; Klabin S/A[2]

The objective of this study was to evaluate the cumulative effect of machine traffic after forest harvesting and soil preparation over soil penetration resistance (PR) in an eucalyptus planting. The relief is classified as gently undulating and the predominant soil is Oxisol, medium texture. The treatments involved two systems of harvesting "with" and "without" subsoiling, being: Cut-to-Length; using Harvester + Forwarder (HF-N) machinery and Full-tree; using Feller + Skidder (FS-N) no subsolings, and both subsoling (HF-S and FS-S). In treatments, an assessment of PR "in situ" evaluation was made using a digital electronic penetrometer, up to a depth of 0.55 m. A systematized sampling scheme, with points collected at the vertices of isosceles triangles distributed in a mesh with 225 m^2 each one, was adopted, totaling 22 points per treatment. Besides, deformed sample were collected to determine the gravimetric moisture (θ) between the layers 0-0.20, 0.20-0.40 and 0.40-0.60 m, in 50% of total PR points. Statistically, the confidence intervals were calculated for the mean of θ and PR, with significance level (1-α) of 0.10, considering the number of samples and the standard deviation of sample. The θ levels were similar between treatments and presented an overall mean of 0.23 g. g-1, denoting the homogeneity of soil moisture conditions during PR sampling. Comparing harvest systems, the mean of PR were similar to each other. However, for the same harvesting system, the PR mean were significantly different in the subsoiling treatments compared to the no-subsoiling treatments. The highest values of PR were observed between the depths 0.10 - 0.40 m and 0 - 0.30 m, with maximum PR of 2.75 and 2.38 MPa, in layers of equal thickness (0.30 m), for HF - N and FS - N, respectively. The PR values in these layers were above the critical level for this soil physical indicator (PR> 2 MPa). Considering the same layers of the subsoiling treatments, there was a mean reduction in PR of 1.3 and 1.2 MPa for HF-S and FS-S, respectively. The subsoling treatments did not present PR critical values. The results showed that the depth of the critical PR can diversify between different harvest systems and that the subsoiling was efficient to reduce PR in the soil profile. The depth of the critical PR layer in forest management systems should be considered in the correction operations, as it may result in lower energy costs and reduced environmental impact.

Keywords: subsoiling, Cut-to-Length, systems of harvesting
Financial support: Klabin S/A

(1671-1542) Importance of long-term experiments in soil management of productive processes

Tiago Stumpf da Silva[1]; Leonardo Pereira Fortes[1]; Amanda Duarte de Duarte[1]; Leonardo Nascimento dos Santos[1]; Michael Mazurana[1]; Renato Levien[1]

Departamento de Solos; Universidade Federal do Rio Grande do Sul[1]

Long-term experiments have been the key to the understanding of productive processes, such as those occurring in soil-machine-plant-atmosphere relations. Under the yield aspect, great variations are be observed due to different reasons. The soil structure (and their quality, for example, to provide best conditions to plant grow, environmental filter) coordinate all process in the soil. These processes are water, nutrient and gas flow, biological activity and root growth, the plants depend directly on the quality structural. Thereby, different management practices carried out over time can be influenced the structure. This work aimed to evaluate the soil structural reorganization under different management systems and relate to growth of corn plants. The study was carried out in South Brazil, under Ultisol (25% of clay) locate in Experimental Station at Federal University of Rio Grande do Sul. Soil samples were collected in the 0-0.1, 0.1-0.2 and 0.2-0.3 m soil depth in randomized blocks subdivided into plots in which three treatments were distributed: 16-year no-tillage system (NT16); no-tillage system with three years after 13 years of reduced tillage system (NT3-RTS) and no-tillage system with three years after 13 years of conventional tillage system (NT3-CTS). The saturated hydraulic conductivity (Ksat), bulk density (Bd) and plant height in the V7 stage were evaluated. Our data show significant differences in depth of 0-0.1 m to Ksat with best result to NT16 (29.12 mm h^{-1}) followed by NT3-RTS (20.52 mm h^{-1}) and NT3-CTS (2.3 mm h^{-1}). These results was correlate with those obtained for Bd where NT16, NT3-RTS and NT3-CTS show 1.32, 1.43 and 1.53 Mg ha^{-1}, respectively. Both conditions influenced the mean heights of corn, being 62.0, 58.8 and 51.6 cm in NT16, NT3-RTS and NT3-CTS, respectively. We believe that soil management conditions and root activity are influence this behavior, because the different management systems influence of soil structural quality, altering physical properties that affect the initial growth of corn plants. The reorganization of soil structure after management is occurring slowly, requiring further studies to analyze correlation with yield.

Keywords: soil management, hydraulic conductivity, bulk density
Financial support: CAPES, CNPq

(2601 - 1750) Indicators of the physical quality of soils cultivated with rubber tree (H*avea brasiliensis)* in the brazilian cerrado biome

Roberta Ferreira Coutinho[1]; Letícia Custódio de Oliveira[1]; Wilber Pereira Machado[1]; Guilherme Camilo de Andrade[1]; Fabrício Messias Dias da Silva[1]; Wíslei Gomes Lima[1]; Gabriel Junqueira Pires[2]; Adriana Aparecida Ribon[3]; Taíza Nogueira Barros[4]; Larissa Gabriela Marinho da Silva[5]

UEG- Palmeiras de Goiás[1]; ue[2]; [3]; UF do Recôncavo da Bahia[4]; UFG[5]

The study of soil physical quality in areas cultivated with rubber tree (Hevea brasiliensis) associated to the use of organomineral fertilizers with chicken litter, aiming to establish sustainable use and management strategies in the Cerrado region, is scarce. The use of appropriate doses of fertilizers of organic origin can benefit the physical attributes of soils, reduce soil compaction and improve soil chemical and microbiological properties. The benefits of using green manure have also been reported in several recent studies that show a relation to soil physical attributes. This fertilization increases the soil porosity and the organic matter content, guaranteeing a greater stability of the aggregates, a reduction of soil compaction, since the green manure root system improves soil porosity, among other factors. Therefore, the objective of this work was to evaluate the management time in the alteration of the aggregation and physical quality in a soil under the rubber tree under different management systems in the Cerrado biome. The experiment started in 2016 and was developed at the Baru farm, in the municipality of Palmeiras de Goiás - GO. The experimental design was completely randomized blocks with three treatments (organomineral, brushcutter and pigeon pea), five replicates and two different rubber tree clones (PB312 and

RRIM600). The plots consisted of 10 plants in the spacing of 7 x 2.5 meters , where each plot has a size of 175m². The penetration resistance, aggregate stability and soil organic matter content were evaluated. The averages were compared statistically by the Tukey test at a probability level of 5%. All the treatments had a higher amount of aggregates retained in the 2 mm sieve, which is quite common in this type of soil (Latossolo) because it has a high structural stability, provided by the action of aluminum and iron oxides and also by organic matter. Experiments carried out in perennial crops evaluating soil physical quality require more evaluation time to obtain better results in the evaluated properties, such as soil penetration resistance, water aggregate stability, MOS, among others. The treatments with organomineral and pigeon pea, presented better results in relation to MOS, showing that these treatments can contribute to better results, in the physical quality of soils with this crop.
Keywords: Latossolo; rubber tree; organomineral
Financial support:

(3092 - 1029) Influence of biochar on microstructural behavior of a Brazilian subtropical soil

Amanda Romeiro Alves[1]; Dörthe Holthusen[1]; Qamar Sarfaraz[1]; José Miguel Reichert[1]; Mayara Torres Mendonça[1]; Leandro Souza da Silva[1]

Universidade Federal de Santa Maria[1]

Biochar, in general pyrolyzed biomass like plant residues, is commonly used as a soil conditioner. Recent research showed the benefits of its application on soil physical properties, both on macro and microscale. A promising method for the investigation of physical processes on the soil microscale due to mechanical stress is rheometry. The deduced rheological parameters allow for a semi-quantitative classification of structural degradation on the particle level. While composition parameters like water and nutrient retention are already quite well understood, studies on the effect of biochar on microstructural stability are rare. The objective of our study was to evaluate the effects of biochar on the microstructural stability of a Typic Hapludult. The experiment was conducted as a completely randomized 3x4 factorial design, where two types of biochar (rice and soybean biochar, 10 t ha^{-1}) and a control treatment were incubated for four periods (15, 30, 45 and 60 days). The used soil was classified as sandy (62% sand). Rheometry was done with a modular compact rheometer (Anton Paar MCR 102) with the help of amplitude sweep tests of constant frequency of 0.5 Hz, uncontrolled normal force, gap of 0.04 m, temperature of 20 °C, and amplitude ramp of 0.0001 to 100%. Soil-biochar mixtures were compacted to a density of 1.72 Mg m^{-3} and drained to a matric potential of -10 kPa. The following parameters were derived from the tests with the help of Rheoplus software: storage modulus (G'), loss modulus (G"), deformation at the limit of the linear viscoelastic range (γL), maximum shear strength (τ max), deformation, G' and G" at the yield point (γYP, G'G''$_{\gamma P}$), and integral Z. These parameters were subjected to ANOVA and Tukey test at 5% level of probability, using the R software. The soil treated with biochar showed a significantly higher elasticity by means of increased γL than untreated soil. Irrespective of incubation time, τ max was reduced due to biochar application, possibly because the fine-grained biochar reduced the interparticle friction. However, no statistical significant interaction was found between the factors biochar and incubation time on the other parameters. It seems that biochar is not only changing the composition parameters, but also affects the microstructural stability. Further investigations of field application of biochar are necessary to reveal if there are also effects on aggregation.
Keywords: Reometry, Biochar, Typic Hapludult.
Financial support: CAPES

(4039 - 1589) Influence of different types of grasses on soil pore volume in silvopastoral system

Vanessa de Sousa Lourenço[1]; Brenner Cabalheiro dos Santos[1]; Murilo Silva Machado[1]; Thaisa Cambréa Silva[1]; Nathalia Siqueira Carvalho[1]; Talles Eduardo Borges dos Santos[1]

Universidade Estadual de Goiás[1]

In systems where grasses are cultivated, these can help to improve soil drainage and water retention rates, due to the development of the roots, decompressing the soil at different depths, improving the porosity and consequently the movement of water in the soil. The objective of this work was to verify the influence of different types of grasses on the soil pore volume of a silvopastoral system at Santa Brígida farm, located in Ipameri-GO. The experiment was carried out in a randomized complete block design, distributed in six main treatments in 5 grass species, as treatments: *Brachiariaruziziensis*(Syn. *Urochloaruziziensis*), *Brachiaria* (Syn. *Urochloabrizantha*) cv. Marandú, *Brachiaria* (Syn. *Urochloabrizantha*) cv. BRS Paiaguás, *Panicum maximum* cv. BRS Tamani and *Panicum maximum* cv. Zuri and one (control-fallow) and four secondary treatments as subplots: 4 soil depths (0-0.05 m, 0.05-0.10 m, 0.10-0.15 m, 0.15-0.20m) with four replications, grown in plots of 50 m^2 (2 x 25 m) and scrubbed with the height of 60 cm leaving them with 20 cm and the residuals left in the area. Three variables were analyzed: total porosity, macroporosity and microporosity. The data were analyzed by the Tukey test at the 5% probability level. For analysis after the first grass cutting, there were no significant statistical differences between the treatments for total porosity and macroporosity, but for *Brachiariabrizantha* (BRS Paiaguás) microporosity obtained the best result, differing from the fallow, which can be explained by the higher volume of organic matter incorporated into the soil by *Brachiariabrizantha* (BRS Paiaguás). In relation to depth all treatments obtained the best results in the 0.00 - 0.05m layer with respect to macroporosity probably due to the large root volume found up to 0.05m in the first year of experiment.
Keywords: Aeration, Grassland, Eucalyptus.
Financial support: University State of Goiás.

(9899 - 3132) Integral variable of soil penetration resistance as soil physical quality indicator

Cláudio Roberto Marciano[1]; Lucas Luís Faustino[1]; David Silva Gomes[1]

UENF[1]

Inadequate agricultural land use leads to environmental degradation, including structure depreciation and compaction of soil, which can be both identified by soil penetration resistance (PR). Since PR is closely related to bulk density (BD) and water content (WC), these soil attributes should be both accessed at the same time than PR, otherwise PR cannot be adequately interpreted. Based on Letey (1985), Silva et al. (1994) proposed a systematic methodology to obtain PR as function of BD and WC during the soil water retention curve determination from soil samples with undisturbed structure. This procedure allows obtaining the "least limiting water range" (LLWR) and the r critical value related to a PR value also critical. Particularly in Brazil, a significant amount of data regarding PR was obtained, which was possibly underutilized concerning to ecological significance in affecting plants throughout the year seasons. The objective of this work was to propose a soil quality indicator variable related to PR that can be obtained by the mathematical integration of the equation that expresses PR as a function of soil water tension (WT). Undisturbed soil samples were collected from the 0-0.10 and 0.10-0.20 m depth layers of a Typic Hapludult soil under five vegetation cover (secondary forest, pasture, and *acácia*, *ingá* e *sabiá* - leguminous tree species), in Conceição de Macabú, RJ, Brazil. Tests with lab penetrometer were performed to measure PR after sample was equilibrated in Richards pressure chambers at water tensions of 10, 33, 100, 500 e 1500 kPa. Equations for relating PR exponentially to

BD and WT were adjusted and then simplified as PR = a exp^(b WT) to correspond to the mean values of soil bulk density under each vegetation cover. Afterwards, the equations were integrated from field capacity (WT = 10 kPa) to permanent wilting point (WT = 1500 kPa), named IntPR, covering the whole of available water capacity to plants. The lowest PR values occurred in the area under secondary forest (0.51, 0.66, 0.88, 1.27 e 1.59 MPa for WT growing from 10 to 1500 kPa), resulting in IntPR = 1958. The highest PR values occurred under *acácia* (2.24, 3.07, 4.08, 6.44 e 9.95 MPa for WT growing from 10 to 1500 kPa), resulting in IntPR = 11711. The other vegetal covers presented intermediate values of IntPR (4409 for *ingá*, 5272 for *pasture*, and 7015 for *sabiá*), so that we concluded that proposed variable has the potential to discriminate soils with different quality levels.

Keywords: soil compaction; soil water capacity available for plants; least limiting water range; critical soil bulk density; integration of exponential equations
Financial support: CAPES; FAPERJ

(1019 - 326) Inter-relationship between physical attributes and carbon storage in Oxisol and Humic Inceptisol under tillage

Carla Eloize Carducci[1]; Jânio dos Santos Barbosa[2]; Letícia Salvi Kohn[2]
UFGD[1]; UFSC[2]

With a view to sustainable agriculture, we seek management systems that promote the lowest soil degradation, however physical, chemical and biological improvements from carbon interaction versus soil aggregation. It is known that the smaller aggregates, the greater its resistance to external factors, and therefore the greater its contribution to the carbon storage, which is dependent on the soil class, climate and current use. Thus, the study aimed to determine the relationship between soil physical attributes with the carbon storage in a Oxisol and Humic Inceptsol submitted to agricultural and forestry use. The experiment was conducted in two soil classes of a Red Yellow Latosol (RYL) under Araucaria plantation at 4 years of age and Humic Inceptisol (HI) with a 3 year old of linseed crop in a no-tillage system. Undisturbed soil samples were collected (0.010x0.010m) in two contrasting layers identified by the cultural profile method: 0-0.05 and 0.05-0.20 m depth in three replicates. The following physical attributes were determined: soil bulk density (BD) and total porosity (TP) by volumetric ring method, particle size by pipette method and particle density (Dp) by volumetric balloon method, chemical attributes: total organic carbon (TOC) and carbon storage (CS) in aggregates with 1-4.76 mm and 4.76-9.52 mm of diameter (size classes easily altered by soil management). The BD presented similar values among the soils, although they had distinct genesis (humic horizon in HI), the conservation management system used in RYL and HI improved or maintained, the low BD (0.97 and 1 g cm^{-3} HI and RYL, respectively) and high TP (> 0.55 cm^3 cm^{-3}) due to the high CS on evaluated layers. The RYL aggregates stored a large amount of TOC in the 0-0.05 m (± 45 g kg^{-1}) layer which represents in CS around 52 mg ha^{-1} with a small reduction in the subsequent layer, which is expected, due to the decrease supply of plant and animal waste in deeper, already in HI, the mean values of CS on two aggregate sizes in the two layers were homogeneous (≈44 mg ha^{-1}), which indicates a good carbon distribution along the soil profile, with a consequent reduction of Ds values, promoting in both soils the structure relief, as well as the environmental contribution to decreasing the greenhouse effect.

Keywords: soil aggregation; carbon storage; physical quality
Financial support: UFGD; UFSC

(7542 - 902) Interrill soil erosion and aggregate stability along a climate gradient (arid to humid) on hillslopes in Chile

Bernhard, N.[1]; Seitz, S.[2]; Kinkela, J.[2]; Klein, J.[2]; Kühn, P.[2]; Rivas, S.[3]; Schmidt, K.[2]; Seguel, O.[3]; Scholten, T.[2]

Department of Geosciences, Soil Science and Geomorphology, Eberhard Karls University Tübingen, Rümelinstr. 19-23, 72070 Tübingen, Germany (nadine.bernhard@uni-tuebingen.de)[1]; Department of Geosciences, Soil Science and Geomorphology, Eberhard Karls University Tübingen, Rümelinstr. 19-23, 72070 Tübingen, Germany[2]; Facultad de Ciencias Agronómicas, Universidad de Chile, Av. Santa Rosa N°11315, 8820808 La Pintana, Santiago, Chile[3]

As soil erosion is an environmental problem in vast parts of the world and fundamental mechanisms of soil surface stabilization are still unclear, it is important to improve our understanding of basic erosion processes. In particular, comparative studies over different climate zones are scarce. A broad latitudinal climate gradient in Chile together with its typical natural vegetation allows to investigate climate specific soil properties, which may consequently imply a specific aggregate stability and resistance against erosion. Furthermore, the topographic position along hillslopes is expected to play an important role due to downslope relocation of clays and soil organic matter, both parameters influencing aggregate stability. The objectives of our study are to examine to which extend aggregate stability and soil physico-chemical properties control surface resistance against initial soil erosion and how this system is influenced by climate and topography. The study took place in four national parks on similar granitoid parent material within the Chilean Costal Cordillera from Pan de Azucar (26 °S) in the north to Nahuelbuta in the south (38 °S). The research plots were located on four different topographic slope positions at each site. We analyzed bulk samples and implemented an on-site rainfall simulation experiment with 0.4 × 0.4 m runoff plot sizes and a standardized rainfall intensity of 60 mm h^{-1} at every plot. Runoff and sediment delivery were measured in austral autumn 2017. Linear mixed effects models to evaluate the impact of soil properties, topographic position and slope were compiled. First results revealed a significantly lower sediment delivery in the humid study site compared to the arid to mediterranean study sites. This can be explained by the increasing amounts of clay, soil organic matter and the hereby related aggregate stability from arid to humid climate. The most humid site showed also higher oxide contents than the arid to mediterranean study sites, also a major factors for aggregate stability. Topographic position and slope angle play a crucial role as the amount of sediment delivery increased in each site from the shallower south upper slope to the steeper south mid slope and south lower slope positions. We assume that the climate gradient along Chile has a major influence on soil stabilization. Further results will be presented at the World Congress of Soil Science 2018.

Keywords: rainfall simulation experiment climate gradient aggregate stability
Financial support:

(2317 - 1689) Land levelling effects on the relationships of lowland hydro-physical soil attributes, southern brazilland

Alexssandra Dayanne Soares de Campos[1]; José Maria Barbat Parfitt[2]; Luana Nunes Centeno[3]; Dioni Glei Bonini Bitencourt[4]; Luís Carlos Timm[5]; Luiz Fernando Pires[6]; Klaus Reichardt[7]

FederalUniversityof Pelotas[1]; Embrapa – Brazilian Agricultural Research[2]; Post-Graduate Program in Water Resources[3]; Federal University of Pampa[4]; Federal University of Pelotas[5]; State University of Ponta Grossa[6]; State University of São Paulo[7]

Land levelling practice consists in leveling the soil surface to facilitate the management of irrigation and drainage operations forflooded rice cultivation.Due to soil movement while lower parts of a field being filled and higher parts being cut,severe soil surface disturbance occurscausing a significant decrease of the A horizon thickness with

possible exposure of subsoil layers. This study aimed to evaluate levelling effects on the relationships of lowland hydro-physical soil attributes using classical statistical tools. On a 1.0 ha field in Southern Brazil a grid of 10x10 m points was used to sample the 0-0.20 m soil layer, before and after levelling. In each sampling point, soil water retention curves (SWRC), sand and clay contents, soil bulk density (Ds), macroporosity and microporosity (Micro) values were determined. Each experimental SWRC was adjusted to the van Genuchten model in order to obtain the parameters a, n, qr and qs, considered here as an adjusted parameter. All data sets were submitted to descriptive statistics and the Kolmogorov-Smirnov test to check the data normality.In order to evaluate the levelling effects on the relationships among qs and all other soil hydro-physical attributes, two correlation coefficients were used: the Pearson correlation coefficient when the distributions of qs and the other variable followed normal distribution and the Spearman correlation coefficient, when not. Levelling altered mean, except for qs, and coefficient of variation values of all data sets. The tendency of data distributions was not altered by levelling. qs data presented significant Pearson correlation coefficients (p value <5%) with all soil attributes before levelling. All correlation coefficients were significant for qs and the other soil attributes after levelling, except for that between qs and clay content. Future studies should be carried out to evaluate effects of levelling on the soil water availability in lowland areas and for future operations of land recuperation as well.

Keywords: Keywords: Lowland; van Genuchten equation; soil attributes.

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(5006 - 803) Least limiting water range in consortium of corn and forage grasses under no-tillage

Lucas de Oliveira Neves[1]; Camila Pereira Cagna[1]; Zieglenristen Karswegaard Pereira Calábria[2]; Osvaldo Guedes Filho[1]

Universidade Federal do Paraná[1]; Universidade Federal do Mato Grosso[2]

No-tillage system is based on crop rotation, no mobilization and soil cover. The soil cover may be maintained through crop straw involved in the crop rotation system as well the consortium with forage grasses. Least limiting water range (LLWR) is an indicator of soil physical quality that represent the real water availability to plant growth. The objective was to determine the LLWR of an Oxisol in consortium of corn and forage grasses under no-tillage. The experimental design was in randomized blocks with seven treatments distributed in three replications, resulting in 21 experimental plots. The treatments were: corn+ *U. brizantha* cv Marandu, corn + *U. ruziziensis*, corn + *U. humidicola*, corn + *U. decumbens*, corn + *P. maximum* cv Tanzânia, corn + *P. maximum* cv Mombaça and corn without consortium. Undisturbed samples were taken at 0 to 0.10 and 0.10 to 0.20 m soil depth and then split in eight groups corresponding to potentials of -0.002; -0.006; -0.01; -0.033; -0.07; -0.1 and -1.5 MPa. For water retention curve determination, it was used the tension table and Richards's chambers. For soil penetration curve determination, it was used an electronic penetrometer. The upper limits of the LLWR were field capacity at -0.01 MPa and the air-filled porosity of 10%. The lower limits of the LLWR were wilting point at -1.5 MPa and the penetration resistance of 2 MPa. The higher mean value of the LLWR at 0 to 0.10 m soil depth was found to consortium of corn + *U. ruziziensis* and the lower mean value to consortium of corn + *U. humidicola*. At 0.10 to 0.20 m soil depth the consortium of corn + *U. ruziziensis* presented the higher mean value of the LLWR and corn without consortium presented the lower one. The consortium of corn and forage grasses is a good option to improve the soil water availability, specially considering the combination of corn + *U. ruziziensis*.

Keywords: soil cover; soil water content; penetration resistance

Financial support: UFPR

(1992 - 215) Load support capacity of oxisol with and without controlled traffic in a sugarcane area

Diego Alexander Aguilera Esteban[1]; Elizeu de Souza Lima[1]; Lenon Henrique Lovera[1]; Ingrid Nehmi de Oliveira[1]; Náiade de Paula Ribeiro[1]; Fábio Henrique Barbosa Sandoval[1]; Zigomar Menezes de Souza1[1]

University of Campinas[1]

Intense traffic on the soil generated from sugarcane production system lead to harmful effects on its physical attributes as a result from the compaction caused by mechanization. To minimize such effects, a management system with controlled traffic emerges, in which traffic lines concentrate soil permanent compaction in a small area to avoid tire traffic at most part of the field. Such a physical soil degradation can be monitored by analyzing soil compressibility, since its compaction occurs when its load bearing capacity is exceeded generating increased soil density and redistribution of the porous space. Our research aimed at modelling the load support capacity of an Oxisol cultivated with sugar cane after the third cane cycle, planted with single spacing and combined double spacing in management systems with and without controlled traffic. We carried out the experiment at the Santa Fé Sugar Mill, Nova Europa, state of São Paulo – Brazil, using the following treatments: T1- single spacing (1.5 m) without the autopilot use; T2 - single spacing (1.5 m) using autopilot and T3- double combined spacing (1.50 x 0.90 m) with autopilot use. Load support capacity was assessed at the inter-row center and the seedbed at the depth of maximum soil resistance at penetration located at 0.20-0.30 m. The comparison of the load support capacity models obtained showed differences between T1xT2 and T1xT3 interactions at the inter-row center. The management systems with controlled traffic regardless soil water content at the inter-row center had higher pre-consolidation pressure in relation to the management without controlled traffic. In the soil friability region, suitable to agricultural operations, a pre-consolidation pressure ranging from 214 to 270 kPa for T1, 231 to 287 kPa for T2, and 239 to 311 kPa for T3. If larger loads are imposed to the soil friable region or the soil is managed above its plasticity limit, it occurs an additional compaction. Load support capacity models indicated a higher soil compaction at the inter-row center in relation to the seedbed in response to a cumulative effect of traffic machinery concentration along the crop cycles; therefore, managing sugarcane fields with controlled traffic systems preserves the physical quality of the soil at the ratoon region.

Keywords: pre-consolidation pressure; autopilot; soil friability

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(6776 - 3000) Moving towards functional physical properties for an improved understanding of soil structure

José Miguel Reichert[1]

Federal University of Santa Maria[1]

The dynamics of soils and crops affected by soil management systems are better understood when using the concept of soil capacity and soil intensity properties or improved alternatives. Soil physical capacity property defines a general status, but not the soil's internal structure and function, while an intensity property includes dynamic aspects over time and space and thus covers the quantification of functionality and reaction or processes of systems within given environmental conditions. The terms "capacity" and "intensity" were later used for the distinction between composition properties in contrast to functional properties. The terms capacity and intensity properties should not be used as synonyms to composition and functional

properties. They should rather be reserved to the thermodynamically basic quantity-intensity-capacity concept, as widely used for example in description of potassium and phosphorus in soil. In a soil physics context, the water retention characteristic can serve as an example: the quantity Q is (volumetric) water content, the intensity I is the matric water potential, and the capacity is the change in Q with change in I. Recent research results will be presented to discuss these concepts in studies on soil tillage and management affecting composition and functioning soil structure.

Keywords: pore functioning; air and water permeability; mechanical properties.

Financial support:

(8381 - 3013) Nonlinear models for calibration of soil moisture capacitance sensors in tropical mountainous Inceptisols and Ultisols

Bárbara Pereira Christofaro Silva[1]; Diego Tassinari[1]; Marx Leandro Naves Silva[1]; Bruno Montoani Silva[1]; Nilton Curi[1]; Humberto Ribeiro da Rocha[2]; Pierre Vanhooydonck[2]

UFLA[1]; USP[2]

Capacitance sensors are now widely employed in monitoring soil water content (θ). However, for accurate measurements, calibrations specific to the monitored site are needed. This study aimed to conduct a thorough investigation on the regression models used for calibration of soil capacitance sensors and to generate specific calibrations for the soils and horizons studied. Additionally, we investigated the relation between soil attributes and the adjusted parameters of the specific calibrations, in order to develop a general calibration equation for all the studied soils and horizons. Undisturbed soil samples were collected in the A and B horizons of two Paleudults and two Dystrudepts from the Mantiqueira Range in Southeastern Brazil. After saturation, a time-domain reflectometry (TDR) sensor was used to measure the soil dielectric constant (ε). Several readings were made, ranging from saturation to oven-dry. After each reading, the samples were weighted so that θ (m^3 m^{-3}) could be calculated. Seventeen regression models (linear, linearized and nonlinear) were adjusted to the calibration data and checked for their residue distribution. The exponential models with three parameters performed the best and were the only ones that met the regression assumptions regarding residue distribution. Stepwise regression was used to obtain multiple linear equations to estimate the adjusted parameters ("a", "b" and "c") of the calibration model from soil attributes, with silt and clay content providing the best relations. Both the specific and the general calibrations performed well, with RMSE values of 0.02 and 0.03 respectively. The manufacturer calibration and the equations taken from the literature were much less accurate, reinforcing the need to develop specific calibrations for determining soil moisture with capacitance sensors. The chosen exponential model was $\theta = a + b (1 - c^{\varepsilon})$ and the parameters "a", "b" and "c" can be estimated from silt and clay contents with the equations a = -0.086 - 0.006*Silt + 0.004*Clay; b = 0.535 + 0.009*Silt - 0.003*Clay; c = 0.929 - 0.001*Silt.

Keywords: soil dielectric constant, TDR, soil water content, exponential model

Financial support: Coordination of Superior Level Staff Improvement – CAPES, the National Council of Technological and Scientific Development – CNPq , Minas Gerais State Research Foundation – FAPEMIG and São Paulo Research Foundation (FAPESP).

(3661 - 961) Oxisol and Ultisol CO_2 emission and soil pore classes after soil tillage of sugarcane area in Brazil

Carolina Fernandes[1]; Luma Castro de Souza[1]; Mara Regina Moitinho[1]; Newton La Scala Junior[1]

UNESP, São Paulo State University[1]

Agriculture is considered an important source of CO_2 emission to the atmosphere. Thus, studies on the use of agricultural practices with less soil mobilization are promising in reducing soil CO_2 emission. The objective of this work was to characterize soil CO_2 emission, soil organic carbon and soil pore distribution in an Oxisol and Ultisol under chiseling in the planting row and in total area for sugarcane cultivation. The study took place in two experimental sites located at Brazil (21º 14' S, 48º 17' W), under Oxisol (at 0.10 m depth, clay content = 550 g kg^{-1} and sand content = 392 g kg^{-1}) and Ultisol (at 0.10 m depth, clay content = 130 g kg^{-1} and sand content = 809 g kg^{-1}). A large paired-plot design was used with two treatments and ten replications. The treatments were two soil tillages to sugarcane planting: soil chiseling only in row planting (CR) and soil chiseling on total area (CT). Soil samples were collected at 0.00 - 0.10 m depth. Soil CO_2 emission, soil temperature and soil moisture were assessed over 12 days in the Oxisol and 11 days in the Ultisol at 0.00 - 0.10 m depth. In Oxisol, the lowest average value of soil CO_2 emission (2.8 µmol m^{-2} s^{-1}) was observed in CR whereas CT presented the highest value (3.4 µmol m^{-2} s^{-1}). In Ultisol, CR and CT did not affect soil CO_2 emission. In Oxisol, 72% of the soil CO_2 emission variability in CR was explained by organic carbon associated with minerals and pore class C2 ($0.05 \leq \phi < 0.1$ mm), and 53% of soil CO_2 emission variability in CT was explained by soil moisture and soil temperature. In Ultisol, 82% of the soil CO_2 emission variability in CR was explained by soil moisture, pore class C1 ($\phi \geq 0.1$ mm) and organic carbon associated with minerals, and 67% of soil CO_2 emission variability in CT was explained by soil moisture, organic carbon associated with minerals and particulate organic carbon. The results showed that in Oxisol, CR and CT affected soil structure, causing changes in both soil porosity and soil CO_2 emission. On the other hand, in the Ultisol, soil CO_2 emission was not affected by soil tillages.

Keywords: soil organic carbon, pore distribution, chiseling, soil temperature, soil moisture

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(5273 - 1729) Physical attributes of a soil submitted to biological decompaction and mechanical in Rondonia

Marcelo Henrique Gomes[1]; Emerson Oliveira Souza[1]; Fábio Lucas de Mattia[1]; Renan Marré Biazatti[1]; Anderson Cristian Bergamin[1]; Wesley Santana Ferreira[1]; Diogo Arthur Valiati Dantas[1]; Fábio Régis de Souza[1]

Fundação Universidade Federal de Rondônia[1]

The compaction of the soil caused by traffic of agricultural machinery or animal stamping promotes the limited development of explored crop in the system. The search of methods that can promote a decompacting of the soil is an important factor for a viability in the production system. The physical attributes of the soil are good parameters for analyses of the quality of the soil that will be explored. So the present work had as objective assesses the physical attributes of a soil under biological decompacting and mechanical. The experiment was installed in an Oxisol soil (Typic Haplustox) dystrophic in the experimental farm of UNIR at Rolim de Moura (RO). The experiment was in randomizing block with three repetitions, assessing macroporosity and total volume in four treatments: Brachiaria brizantha, Crotalaria grahamiana, Crotalaria spectabilis and mechanical scarification (soil cover with B. brizantha), in five induced states of compaction: 0, 1, 2, 4 and 8 passes of an agricultural tractor. Was collected samples of soil with structure preserved in the layers of 0,0-0,05 m, 0,05-0,10m and 0,10-0,20m, carried to laboratory for

obtain the macroporosity and total volume of pores. The mechanical scarification of the soil promotes higher macroporosity in all analyzed layers, showing more efficiency of this system in relation to biological decompaction. Was observed significantly reduces in macroporosity from two passes with tractor in the treatments with cover crops, already for mechanical scarification, can break the layers compacted in the passes leaving the soil in the same conditions of macroporosity. For the total volume the pores in the layer 0,0-0,05 m, was observed significantly reduces according to increase the compaction of soil, and between methods of decompacting the mechanical scarification was more efficiently, already for the deeper layers did not have effects by the decompacting soil methods, just reduced the total volume of pores with the increase of tractor passes. The mechanical scarification of soil promote better effects in the physical attributes of macroporosity and total volume of pores being an efficiently method of decompacting in degraded areas with physical limitations.
Keywords: Porosity; decompacting of soil, scarification.
Financial support: CNPq e Fapero

(3819 - 2067) Physical attributes of soil cultivated under different species of cover crops

Juan Ricardo Rocha[1]; Ivne Franco Pires[1]; Yan Vinturini Vieira Dantas[1]; João Victor Fiorot Cescon[1]; Hugo Callegari Bonini[1]; João Vitor Furlan[1]; Allan Mendes de Araújo Lima[1]; Ivoney Gontijo[1]
Universidade Federal do Espirito Santo[1]

The management systems determine the conditions of the physical properties of the soil. The soils of the north of the Espírito Santo state have cohesive subsurface horizon, so the infiltration of rainwater is naturally lower when compared to soils with good drainage. The preferred route through which rainwater travels is the infiltration into the soil pores and consequent supply of the water table. As an alternative to soil management, cover crops, whether spontaneous or cultivated, that keep the soil covered mainly in the rainy season, are important for obtaining a more sustainable production, aiming to increase soil erosion resistance, supply of plant material to the surface. The litter has a fundamental role in the energy dissipation, because in the discovered soil (common condition in the conventional systems of cultivation), the clays are removed, the finer particles of the soil obstruct the porous ones, the soil roughness is overcome and it crosses a differentiated path giving beginning to the erosive process. The objective of this research was to study the potential of different species used as cover crops in *Piper nigrum* cultivation in the soil and climate conditions of the northern region of Espírito Santo state. The study was developed on a dystrophic Yellow Latosol. The experiment was conducted in DBC, with five treatments, being four species of cover plants and one control, totalizing four blocks. *Crotalaria spectabilis, Cajanus cajan, Pennisetum glaucum* and *Brachiria* were used, which were cut in flowering. Soil samples were collected in September, 45 days after the mowing of the cover plants. In each experimental plot an undisturbed sample was collected at depths of 0.0-0.10 m and 0.10-0.20 meters using an Uhland sampler, in the crop planting line, in the line of traffic of implements. These samples were used to determine soil density, total pore volume, macropores, micropores, moisture at field capacity and at the permanent wilting point. Analysis of variance was performed by GENES software. There was no statistically significant difference for the variables studied. Probably because they were collected only in one agricultural year. It is known that organic matter takes time to stabilize in the soil, since the region presents high rates of solar radiation and soil temperature, thus, the continuity of this experiment is necessary to be able to clearly state the possible improvements in the physical structure of the soil by the cover plants.
Keywords: Cover plants, soil porosity, *Piper nigrum.*
Financial support: CAPES, FAPES

(7559 - 1327) Physical attributes of soil in the pineapple culture in miracema do tocantins - TO

Talita Maia Freire[1]; Thalline Rodrigues da Silva[1]; Michele Ribeiro Ramos[1]; Danilo Marcelo Aires dos Santos[1]; Dione Joaquim Pereira[1]; Lorena dos santos campos[1]; Sebastiana Patricia Alves Coelho[1]; Dara Chaves Paixão[1]
University of Tocantins[1]

Pineapple is a plant with specific characteristics. Its cultivation requires adequate knowledge and the application of a range of technologies indispensable to bring economic success to the activity. In Tocantins the pineapple culture presents as main characteristic the production in the Brazilian off-season, which gives it high profitability. The objective of this work was to evaluate the physical attributes of the soil in different slopes in a pineapple commercial plantation. Soil samples were collected at Providencia Farm in Miracema do Tocantins - TO, the area of 4.83 ha was divided according to the slope in 3 plots, being plot 1 (1.7 ha), plot 2 (0.62 ha) and field 3 (1.51 ha). Analyzes of total porosity, bulk density and hydraulic conductivity were performed using a methodology recommended by Embrapa (2011). Chemical and granulometry analyzes were also performed to characterize the areas. The results were analyzed in the statistical program SISVAR 5.6, and a mean test (Tukey, 5%) was applied. The average values of density found were 1.13 g/dm^3, 0.87 g/dm^3, 1.30 g/dm^3, respectively plot 1, plot 2 and plot 3. While for the total porosity attribute, there were 0.70 cm^3/cm^3, 0.76 cm^3/cm^3 and 0.59 cm^3/cm^3. The hydraulic conductivity was 61.41 mm.h^{-1}, 52.49 mm.h^{-1}and 26.62 mm.h^{-1}. From the application of the Tukey Test to 5% it was possible to conclude that there was a statistical difference between the values found for density between the plots; for the total porosity attribute the averages of plots 1 and 2 were not statistically different, but these were statistically different from the mean of plot 3; with respect to hydraulic conductivity there was no statistical difference between the plots. The values found will allow a greater effectiveness of the local productivity of the pineapple, corroborating for future studies of intercorrelation of the production of the cultivar in different slopes.
Keywords: Bulk density, total porosity, soil management
Financial support: Tocantins State Government

(4780 - 2170) Physical attributes of soil under management of cupuaçu (Theobroma grandiflorum) in the municipality of canutama, south of the amazonas

Juliana Malta de Assis[1]; Ludimila Souza Oliveira[1]; Milton César Costa Campos[1]; José Maurício da Cunha[1]; José Igor Silva Praça[1]; Luana Celestino Calista[1]; Estefani de Souza Oliveira[1]; Fernando Gomes de Souza[1]; Anderson Vieira Rodrigues[1]; Sabrina Isabela da Silva Fernandes[1]
Federal University of Amazonas[1]

The soil, when kept in its natural state, under native vegetation, presents physical attributes such as density, porosity, aggregation and permeability considered adequate. As the soil undergoes interferences in the use, changes in its physical attributes occur, such as increase in soil density, decrease in total porosity, pore diameter distribution, alteration in aggregation and organic matter content. Thus, this study aimed to evaluate the spatial variability of the physical attributes of the soil, carried out in the São Francisco Settlement Project, in the municipality of Canutama - AM. The collection was carried out in the Cupuaçu cultivation area, which was established a mesh of 90 m x 70 m with regular spacing of 10 m between the points, making a total of 80 sampling points, at depths of 0.00-0 , 05; 0.05-0.10; and 0.10-0.20

m. The undisturbed samples were collected using volumetric rings with a mean volume of 90.0 cm³. In the laboratory, samples were prepared by retreating the excess soil from its ends, and then saturated by raising a water slide in an aluminum form to about 2/3 of the sample height. After the analyzes were performed the statistics were run. By the descriptive statistics of the data, it behaved in a way where, where the mean and median values were close confirming the symmetric distribution of data by the asymmetry coefficients close to zero for both depths, the amount of micropores (MiP) was superior to that of macropores (MaP) at all depths, which formed soils with material of the upper clay in its textural composition and, consequently, indicating soils with good water retention, but with slow drainage as for the total porosity, it decreased in depth , as many the classification of the coefficient of variation (CV%) proposed by Warrick and Nielson (1980) for the soil variables, the attributes had medium and low variability ranging from 7 to 14%, from 12 to 27% and 10 to 20 %, to depths 0.00-0.05; 0.00-0.10 and 0.10-0.20 m respectively . Thus, the management did not influence in the pore reduction of the superficial part of the soil, by the porosity conditions this soil does not need a high frequency of irrigation.

Keywords: Porous spaces , Cupuaçu, Amazonian soils.
Financial support: Foundation for Research Support in Amazonas (FAPEAM), National Council for Scientific and Technological Development (CNPq)

(7725 - 3110) Physical quality and blocked pores in Humic Inceptsol under flax cultivation

Letícia Salvi Kohn[1]; Carla Eloize Carducci[2]; Leosane Cristina Bosco[1]; Jânio dos Santos Barbosa[1]; Wagner Tobias Haubert[3]
UFSC - Campus Curitibanos[1]; UFGD[2]; IFRS - Campus Sertão[3]

The dynamics of air and water in the soil has a direct influence on its physical attributes, which are of fundamental importance for the good development of the plants. Due to the growing need to favor soil structure, conservationist management practices are being used along with species that can bring benefits to the soil. Flax is a winter culture that has simple management and can be used in crop rotation to recover the soil from physical and chemical wear due to the action of its roots system, which occupies about 0.20-0.30 m in the soil profile. The aeration of the soil depends on the quantity, size and continuity of the pores, and the water content, and must have and ideal pore size for the entrance, movement and retetion of water and air. The objective of the present work was to evaluate the amount of blocked pores in a Humic Inceptsol under the cultivation of 3 genotypes of flax in Curitibanos - SC. The experiment was implanted in an area belonging to the UFSC, and the flax was sown in April 2016 and conduced in a minimum cropping system. The genotypes were: golden variety, and the brown cultivars, Aguará and Caburé. Samples with preseverd structure were collected for analysis of soil density and pore distribution, in two depths (0-0.05 and 0.05-0.20 m) in the row and interline of cultivation, in triplicate. Deformed samples were also collected to determine the particle density. The total and calculated porosity was determined from the data, the difference between them being the number of blocked pores. The analysis of variance was performed and when significative, the averages were compared by the Tukey test (5%). The average of the particle density was between 2.39-2.55 Mg m^{-3}, indicating homogeneity in the layers. The blocked pores volume did not differ statistically between the genotypes and the layers avaluated. In both study layers, in the cultivation line, the golden variety and the Caburé cultivar presented more than 1% of the total soil pores classified as blocked (1.1%); for the other genotypes, the soil had lower value of blocked pores. In the interline of cultivation, only the Aguará cultivar had more than 1% of blocked pores. The tendency of these pores is to evolve into micropores and assist in water retention and reduce the diffusion rate of gases in the soil. The results obtained from soil blocked pores on flax culture indicated good structural quality of the same.

Keywords: *Linum usitatissimum* L.; soil physics; porous space
Financial support: CNPq

(2672 - 2154) Physical attributes of soil in archaeological black land area (TPA) with cocoa cultivation in the south of Amazonas

José Igor Silva Praça[1]; Juliana Malta de Assis[1]; Ludmilla Colares Rodrigues[1]; Milton César Costa Campos[1]; Elyenayra Nogueira Pinheiro[1]; Ludimila Souza Oliveira[1]; Luana Celestino Calista[1]; Estefani de Souza Oliveira[1]; Francisca Xavier Quintino Neta[1]; Fernando Gomes de Souza[1]
Federal University of Amazonas[1]

Archaeological Black Lands (TPA) or Black Indian Lands comprise characteristically dark soils and ceramic and / or lytic fragments incorporated into their more superficial horizons, these soils usually exhibit high natural fertility, with high levels of P, Ca, Mg and stable organic matter, in addition to greater biological activity, when compared to adjacent soils. This work you've aimed to investigate the spatial behavior of soil physical properties in areas of Terra Preta Archaeological under use of pasture, cocoa and coffee in the southern Amazon region. The study is located in the municipality of apuí in the south of Amazonas, the climate classified with rainy tropical type Am. The mapping of the area of TPA was carried out with cocoa cultivation and in this was established a mesh of 88 m by 64 m with regular spacing of 8 m between the sampling points, the soils were sampled at the crossing points of the mesh, making a total of 88 sampling points. These points will be georeferenced with GPS equipment and then collected soil samples at depths 0.00-0.05, 0.05-0.10, 0.10-0.20. Physical analyzes will be performed texture, macroporosity, microporosity and total porosity. The data will be analyzed using descriptive statistical techniques.It was observed that the silt fraction corresponding to more than half the granulometric composition with a value of 572.83 g kg^{-1}, while the sand showed a value of 221.10 g kg^{-1} clay and 204.52 g kg^{-1}, the silt fraction is justified due to the high degree of weathering. As for porous spaces of the soil, the macroporosity had values ranging from 19,40 m 3 m -3 to 22.38 m 3 m -3 , while the microporosity varied from 41.98 to 49.05 m 3 m -3 and presented a reduction of the values with the increase of the depth, this occurs as a function of the density, which also increases, decreasing the macros to micropores. Thus by the texture the soil was measured with medium texture and from the porosity it can be concluded that these have a good drainage of water.

Keywords: Anthropogenic soils; Physical attributes; Amazonas.
Financial support: Foundation for Research Support in Amazonas (FAPEAM), National Council for Scientific and Technological Development (CNPq)

(2266 - 3034) Pore Size Distribution Frequency of Intensively Cultivated Oxidic Ferralsols.

Thaís Nascimento Pessoa[1]; Igor Rodrigues de Assis[2]; Teogenes Senna de Oliveira[2]
University of São Paulo, "Luiz de Queiroz" College of Agriculture, Pádua Dias Avenue, 11, 13418-900, Piracicaba, São Paulo, Brazil (thaisnpessoa@usp.br)[1]; Federal University of Viçosa, Peter Henry Rolfs Avenue, 36570-000, Viçosa, MG, Brazil[2]

Oxidic Ferralsols are characterized by physical properties that are favorable to agricultural mechanization due to their high resistance and resilience to the structural degradation process. Vegetable production cropping systems (generally irrigated) are intensively used and consist of a larger number of crops per year. The large number of operations using machines and implements, along the cropping period intensifies even more the soil use with these systems. The purpose of

this study was to evaluate changes in the frequency and the frequency distribution curves of soil pore size, after different times of soil use in areas of intensive cultivation with vegetable cropping systems. Undisturbed soil samples were collected from the layers 0-0.10; 0.10-0.30; 0.30-0.40; 0.40-0.70 and 0.70-1.00 m in areas of commercial farms and native Savanna (CE), both located in the region of Rio Paranaíba, Minas Gerais, Brazil. In these farm areas are vegetable cropping cultivated in succession with cereals and grasses, during different times of agricultural uses: 15 (HT_{15}), 20 (HT_{20}) and 30 (HT_{30}) years. It was evaluated the macroporosity (MA), mesoporosity (ME), microporosity (MI) from the curves of frequency distribution of soil pore diameter per unit of soil tension. These curves showed that, for the native area (CE), there was a higher frequency of pores with larger diameters in all layers, indicating more heterogeneity. For the areas with agricultural uses (AU), prevailed frequency of pores with smaller diameter and greater homogeneity. The comparison between CE and AU showed significant difference in MA and MI. With respect to ME, however, values were practically the same. There was a tendency of higher MA and ME in CE and in HT_{20} compared to other areas (HT_{15} and HT_{30}). For MI, there was a significant increase in all cultivated areas and in most of the layers, being significantly higher in HT_{30}. Thus, the soil use systems with intensive vegetable cropping modified the distribution of the pores in the evaluated Ferralsols. The level of alteration was not proportional to the time of agricultural use, since in the intermediate use (HT_{20}) higher values were obtained for MA and ME that are the most influenced by the impacts on the soil structure. This behaviour in the HT_{20} use can be attributed to the high resilience of the oxidic Ferralsols, which can recover from impacts on the structure in the short term.

Keywords: Water Retention Curve, Soil Compaction, Vegetable Crops.
Financial support: CAPES, CNPq

(5778 - 283) Porosity of an Ultisol cultivated with soybean in integration system for livestock farming

Melissa Alexandre Santos[1]; Carolina dos Santos Batista Bonini[1]; Guilherme Constantino Meirelles[1]; Juliana Megumi Kanashiro de Oliveira[1]; Ronaldo Cintra Lima[1]
FCAT/UNESP DRACENA[1]

Large areas used for agricultural production have been increasingly exploited resulting in degraded soils and consequently reflecting lower productivity since their physical attributes can be negatively influenced by poor soil use. The objective of this study was to evaluate the effect of intercropping between soybean and tropical forages on the changes in the physical properties of a Ultisols in a no - tillage system by means of physical attributes evaluation. The experiment was carried out at the Faculty of Agrarian and Technological Sciences - UNESP / FCAT, in the city of Dracena / SP, since 2016. The experimental design was a randomized complete block design with fourteen replications, four SPD levels, consisting of four treatments: 1 - Witness with conventional soybean planting; 2 - Direct planting of soybean with forage of *Uroclhoa Ruziziensis*; 3 - Direct planting of soybean with forage of *Uroclhoa Brizantha* cv. Paiaguás; 4 - Direct planting of soybean with forage of *Uroclhoa Brizantha* cv. Piatã. The evaluations were physical soil attributes (macroporosity, microporosity, total porosity and soil density). Soil analyzes were done on three depths of soil, 0.00-0.10; 0.10-0.20 and 0.20-0.40 m. The results were analyzed by performing analysis of variance and Tukey's test at 5% probability for the comparison of means. In the 0.00-0.10 m depth macroporosity values were higher with conventional soil preparation. The microporosity values were not influenced by the treatments. The soil density was in increasing order with conventional preparation Uroclhoa Brizantha cv. Piatã. as cover plant got the highest macroporosity and lower soil density.

Keywords: Physical attributes of soil, forage, no-tillage
Financial support: FAPESP- Process 2017/20003-5

(4551 - 417) Porous spaces of soil in area under cultivation of guarana (*Paullinia cupana*) in South of Amazonas

Anderson Vieria Rodrigues[1]; Elyenayra Nogueira Pinheiro[1]; Carlos Henrique Gima Relvas[1]; José Maurício da Cunha[1]; Elilson Gomes de Brito Filho[1]; Milton César Costa Campos[1]; José Igor Silva Praça[1]; Sabrina Isabela da Silva Fernandes[1]; Francisca Xavier Quintino Neta[1]; Ludmilla Colares Rodrigues[1]
Federal University of Amazonas[1]

The southern region of Amazonas is characterized by natural environments and cultivated areas where, in addition to natural variability, anthropogenic sources of heterogeneity are added to the soil. Knowledge of soil asset variability has been characterized as an important step for proper management, as well as its use and limitations. Thus, there is a need to know if there are results and knowledge related to the evaluation of the spatial variability in Guaraná cultivated area, under Amazonian conditions, and with this, improvements in the sustainable use of soil, good efficiency in production and less degradation make the soil. The objective of this work was to verify the soil porous spaces under guaraná management, with no São Francisco settlement project in the south of Amazonas. The study was carried out in the Canutama municipality of Amazonas, Brazil, in an area under cultivation of Guarana. A mesh of 80 points, with a size of 90x70 m and a regular spacing of 10 m between samples were established, where undisturbed samples were collected at depths of 0.00-0.05 m; 0.05-0.10 m and 0.10-0.20 m. As samples in volumetric rings were saturated by means of gradual elevation, up to two thirds of the ring height. After saturation, as samples of heavy and brought to the tension table and subjected to a pressure of -0.006 MPa, a water column 60 mm high. By the descriptive analysis of the data, it was possible to verify the normality of the data by the test of Komogorov-Smirnova 5% probability. The data tend to symmetry with average and near median, as evidenced by the coefficients of asymmetry and kurtosis close to zero, and coefficients of variation for the classification of Warrick and Nielson in medium and low variability. Observed the porosity increased in depth, with a layer of 0.00-0.05 presenting the lowest values of porosities, justified by exposure layer of soil subjected to anthropic action, and its porous spaces decreased. The amount of micropores was higher than that of macropores, so these soils tend to make up most of the clay particles, and consequently a good retention of water without soil. Thus, the soil presented good characteristics regarding its porous spaces, which contributes to its other attributes and, consequently, to the management of the crop.

Keywords: porosity, guarana, Amazon soils
Financial support: Foundation for Research Support of the State of Amazonas (FAPEAM); National Council for Scientific and Technological Development (CNPq)

(4382 - 768) Productivity of Linseed genotypes under edaphoclimatic conditions in Dourados City- MS

Kaliana Gottschalk de Freitas[1]; Carla Eloize Carducci[1]; Eloise Mello Viana de Moraes[1]; Joyce Castro Xavier[1]; João Claudio Teodoro Turtt[1]; Leonardo de Assis Lopes[1]; Rafael Costa Ferreira[1]
Universidade Federal da Grande Dourados- UFGD[1]

The suthern region of central-west shows edaphoclimatic potential for linseed cultivation, however characterization studies of linseed performance in that region are very scarce. The aimed of this work were to evaluate the relationship between linseed genotypes fenometria and the edaphoclimatic conditions from Dourados-MS. The experiment were conducted in the experimental area of FCA/UFGD in acrustox, under Cwa climate. The experimental design

was in randomized blocks with three genotypes: M1= Caburé Argentina, M2= Aguará Argentina and M3= UFSC, all are brown seeds, in triplicate. The soil was prepared with plowing and manual sowing. Cover fertilization (8 g m^{-2} NPK (8-20-20)) was performed. Soil samples disturbed were collected in the plating line at 0-0.16 and 0.16-0.30 m depth, which refer to soil stratification found through visual analysis of the soil structure. It were determined: the particle size by the pipette method and the phenometric characteristics: plant height, capsules number, seeds per plant and productivity (kg ha^{-1}). The M1 genotype had a significant interaction ($R^2 \geq 0.50$) for clay and silt with seeds and capsules. The M2 negative linear interaction for silt (R^2= 0.57) with the phenometry and M3 differed from M1 genotype only in the clay interaction with the capsules number. It should be emphasized that the Oxisol particle size with clayey texture positively influeced the production capsules and seeds. The clay electrical charge gave it good nutrient adsorption and water retention, while the silt retained water with less retention force in the soil profile, both contributing to the seeds formation. When occurrence of water stress in the initial phase of linseed development, there wew a decrease in the capsules number. In this phase there were a Indian summer seriod in our region (± 60 days), which injured the capsules formation and seeds per capsule. M1, M2 and M3 genotypes showed the following yields of 122, 135 and 186 kg ha^{-1}, respectively, values considered average for the first harvest, besides being influenced by the variations of the climatic conditions to the region and by the soil-plant interaction, that were, with the increase of the clay content the increase of seeds number occurs, due to greater availability of soil electrical charhe. The genotype M3= UFSC were more adaptable to the regions conditions o: very clayey soil and Cwa climate, with Indian summer in winter.

Keywords: Linseed; edafoclimate; productivity.
Financial support: Federal University of Grande Dourados- UFGD

(1889 - 2126) Red Latosol physical attributes under degraded pastures in Dourados-MS, Brazil

João Claudio Teodoro Turtt[1]; Kaliana Gottschalk de Freitas[1]; Maximiliano Kawahata Pagliarini[1]; Kamila de Almeida Monaco[1]; Carla Eloize Carducci[1]; Joyce Castro Xavier[1]; Leonardo de Assis Lopes[1]
Federal University of Grande Dourados[1]

Degraded pastures are the result of an evolutionary process of forage loss vigor and productivity, without natural recovery possibilities, which affects animal production and its performance culminating with soil and natural resources degradation due to inadequate management. The aim of this work was to evaluate the relationship between pastures degradation and Oxisoil physical properties changes in Dourados-MS, Brazil. The samples were collected at UFGD experimental farm inside four different areas with some forage degradation level : 1- fallow land (FL), 2- *Brachiaria* spp. Syn Urochloa without grazing (BWG), 3- *Brachiaria* spp. Syn Urochloa with ovine grazing (BOG), 4- inverted soil / restore pasture (IS/RP). Soil samples were collected in undisturbed and disturbed structure in two layers: 0-0.05 and 0.05-0.10 m depth, with three replications in a completely randomized design plot. The particle size distribution and water dispersed clay (ADA) were analyzed by the pipette method. Furthermore, it was analyzed flocculation index (FI), clay aggregate (CA), soil bulk density (BD) and pore distribution (>145, 145-73, 73 - 49, 49-29, 29-2.9, <2.9µm). There was difference among evaluated areas and depth where the best soil aggregates stability according to the FI> 50% and CA> 40% was found in the BWG. However, better distribution of drainage pores (0.20; 0.11, 0.07 cm3 cm-3 to >145, 145-73 and 73-49µm, respectively), lower BD (<1.30 g cm-3) and medium values of retention pores (<2.9 µm = 0.26 cm3 cm-3) was verified in BOG area at 0.05-0.10 m depth, favoring good supply of soil water to forage plant. On the other hand, the most degraded area was IS/RP where had had an intense soil inverting promoting high clay dispersion (AF and FI = <10%), which reflected significant micropores increase responsible to high energy to water retention (<2.9µm = 0.45cm^3 / cm^3).

Keywords: degradation, soil physics, forage
Financial support: Federal University of Grande Dourados

(1058 - 2070) Resistance to penetration in Latosol cultivated under different species of green manure

Ivne Franco Pires[1]; Juan Ricardo Rocha[1]; Hugo Callegari Bonini[1]; João Victor Fiorot Cescon[1]; Yan Vinturini Vieira Dantas[1]; João Vitor Furlan[1]; Allan Mendes de Araújo Lima[1]; Ivoney Gontijo[1]
Universidade Federal do Espírito Santo[1]

The Coastal Flat Lands, a geological formation occurring predominantly in the north of Espírito Santo state, have a cohesive subsurface horizon. These horizons affect the processes and physical phenomena of the soil as well as the monoculture systems in the region, which contribute to the destructuring with effect on the compaction along the profile and the formation of surface sealing layer, which hinders the emergence of seedlings, reducing the stand of crops. Due to its ability to improve soil quality, the use of green manure has been shown to be efficient in achieving sustainability in the agricultural system. The objective of this research was to study the potential of different species used as cover crops in *Piper nigrum* cultivation in the soil and climate conditions of the northern region of Espírito Santo state. The study was carried out in a commercial crop with drip irrigation regime on a dystrophic Yellow Latosol with a clay-loamy texture and particle density of 2.65 g cm^{-3}. The experimental design was a randomized block design with four species of cover plants (*Crotalaria spectabilis, Cajanus cajan, Pennisetum glaucum* and *Brachiaria*) and one control (without cover plants), totaling four blocks. After 45 days of the cutting of the plants that were in full flowering stage, the undisturbed soil samples were taken at two depths (0-0.10 and 0.10-0.20 meters), and the physical test penetration resistance through a bench penetrograph where the samples were maintained in the condition of field capacity aiming at the standardization of the humidity. Data were submitted to analysis of variance by the GENES software. It was found that there was no significant statistical difference between the different species of cover plants used and also between the two depths of soil sampling. These results may be related to the short duration of the experiment, not enough time for the accumulation of organic matter necessary to promote the physical improvements of the soil. The continuation of the experiment for a few more cycles would be crucial to obtain more satisfactory results.

Keywords: Keywords: Green fertilization, resistance to penetration, *Piper nigrum.*
Financial support: CAPES, FAPES

(6871 - 975) Resistance values to penetration in red argisol with different doses of limestone with and without superficial agricultural plaster.

Everton Luís Santos[1]; Luanda Torquato Feba[1]; Mais Sérgio Lopes da Silva[1]; Aline Saraiva Viudes[1]; Carlos Sérgio Tiritan[1]; Henrique Debiasi[2]
Universidade do Oeste Paulista[1]; Embrapa Soja[2]

In soils with high penetration resistance, the structure changes and, consequently, the loss of porosity, macroporosity, availability of water and nutrients and the diffusion of gases in the soil. The objective of this work was to evaluate the dynamics of resistance to penetration in different doses of superficial limestone combined with and without gypsum. The experiment was conducted at the Experimental Farm of University West of São Paulo (Unoeste) in Presidente Bernardes-SP at 22º17'27 "S, 51º40'51" W and 385 m

altitude. The soil of the experimental area is classified as Dystrophic Red Argisol, with smooth undulating relief. The area was carried out in bands with subdivided plot, in a 4x2 factorial scheme, with three replications. The plots were composed of the following limestone doses (0, 2, 4 and 8 t ha-1) and the plots with and without agricultural plaster (0 and 4 t ha-1), resistance to penetration (0 to 60 cm) and moisture analysis (from 0-10, 10-20, 20-30 and 30- 40 cm). The penetration resistance analysis was performed with a penetrometer (Falker PLG 1020), the points were defined by a transect of 1,92 m, composed of 16 points of 12 cm of distance between them. According to the results, there is a significant interaction between levels of compaction, liming and soil plaster, so this indicates that these three variables should be considered in the application of limestone and gypsum. However, it was generally concluded that the increase in penetration resistance was due to lower average soil moisture. Also the value of the resistance to penetration, when compared between the treatments, which contained limestone, obtained a higher value than the one without limestone.

Keywords: Compaction; Penetrometer; Porosity.
Financial support:

(9914 - 992) Soil aggregate stability cultivated with organic strawberry under management systems

Daiane de Fatima da Silva Haubert[1]; Osvaldo Guedes Filho[1]; Lucas de Oliveira Neves[1]; Camila Pereira Cagna[1]; Nádia da Silva Salatta[1]
Universidade Federal do Paraná[1]

Organic production is based in the use of organic sources of nutrients and no addition of chemical fertilizers. It is a sustainable agricultural practice that coupled with a conservation management as no-tillage system may be improve the soil physical quality. Aggregate stability is one of the soil physical indicators that have been used to evaluate the alteration on soil physical condition throughout of weight mean diameter and geometric mean diameter. The objective was to evaluate the soil aggregate stability cultivated with organic strawberry under no-tillage and conventional tillage system. The experimental area has been cultivated by 17-years with strawberry organic production under conventional tillage. For experiment implantation the area was split in two parts: conventional tillage and no-tillage system. No-tillage area presents a triannual crop rotation system and integral soil cover. For the planting of the strawberry seedlings were made holes of 10-centimeter soil depth. A year after the experiment installation it was collected ten soil blocks in each management system at 0.0 to 0.10 and 0.10 to 0.20 m soil depth. The aggregates size used in the aggregate stability determination was 4 to 2 mm diameter. It was used the humid method with size sieves of 2; 1; 0.5; 0.25; 0.106 mm. It was obtained the following aggregates parameters: weight mean diameter (WMD), geometric mean diameter (GMD) and aggregate stability index (ASI). The WMD, GMD and ASI were statistically higher in no-tillage system compared with conventional tillage for 0 to 0.10 m soil depth. At 0.10 to 0.20 m soil depth there were no significant differences among management systems for WMD, GMD and ASI. No-tillage system showed a better soil structural quality for the surface layer in the strawberry organic production.

Keywords: no-tillage; conservation management; soil structure
Financial support:

(4713 - 1921) Soil aggregation evaluation in systems with cover crops using ultrasonic energy

Micael Stolben Mallmann[1]; Dalvan José Reinert[1]; Felipe D. Bertol[1]; William S. Foggiato[1]; Érika Andressa Silva[1]
UFSM[1]

The use of cover crops is essential for promoting the improvement of the structural quality of the soil. For the evaluation of the structural quality, mainly the stability of the aggregates, the use of ultrasonic energy has been a useful tool, since with this technique it is possible to evaluate the energy necessary to promote the dispersion of the aggregates. We objected was to evaluate the aggregates stability in soil with several cover crops using ultrasonic energy. Six treatments were evaluated: 1. Bared soil (BS); 2. Spontaneous vegetation (EV); 3. Forage peanuts (Arachis pintoi) (FP); 4. Pensacola Grass (Paspalum notatum) (PG); 5. Black Oats (Avena strigosa) and radish (Raphanus sativus) -winter- and cowpea (Vigna unguiculata) -summer (ORB); 6. Black Oats (Avena strigosa) and vetch (Vicia sativa) -winter- and cowpea (Vigna unguiculata) -summer (OVB). The soil of the study area is a Hapludalf, with 85 g kg-1 of clay, 225 g kg-1 of silt and 690 g kg-1 of sand in A horizon. The soil was sampled 18 months after implantation. Aggregates from 4 to 8 mm collected from the 0 to 0.05 m depth layer were sonicated using seven times: 0, 21, 39, 74, 110, 150 and 200 s, equivalent to 0, 3, 6, 12, 18 , 24 and 32 J ml-1. The equipment operated with a power of 31.4 W. We determined the dispersion index (DI) and the normalized dispersion index (NDI). The treatments were compared by energy applied through the Tukey test with 5% alpha. Only at the energy levels of 24 and 32 J ml-1 treatments did not differ. At energy level 0, EV presented the lowest values of DI and NDI, differing from PG and ORB. With the application of 6 J ml-1, BS and EV presented the lowest DI values and were different from PG. NDI was higher for BS and EV, differing from PG. With increased energy to 12 J ml-1, EV, BS and OVB showed the lowest and PG the highest DI. The NID was lower in EV and BS and higher in PG. With 16 J mL-1, EV, OVB, BS and FP differed from PG. The use of BS and EV in soil management systems negatively affects the stability of aggregates, while the use of PG improves the stability of the aggregates, requiring greater energy for soil dispersion. The use of FP, ORB and OVB present intermediate results, with a tendency to improve aggregation with time.

Keywords: Soil Structure, Aggregates, Energy Levels.
Financial support: CNPQ/CAPES

(6796 - 1992) Soil aggregation in rhizosphere and in bulk soil of a Haplorthox soil in Paraná, Brazil.

Aline Martineli Batista[1]; Paulo Leonel Libardi[2]; Neyde Fabíola Balarezo Giarola[3]
University of São Paulo/Luiz de Queiroz College of Agriculture, Department of Soil Science, 11 Pádua Dias, Piracicaba, CEP 13418-900, Brazil (martineli.aline@gmail.com).[1]; University of São Paulo/Luiz de Queiroz College of Agriculture, Department of Soil Science, 11 Pádua Dias, Piracicaba, CEP 13418-900, Brazil.[2]; State University of Ponta Grossa, Department of Soil Science and Agricultural Engineering, Gal. Carlos Cavalcanti, Ponta Grossa, CEP 84030-900, Brazil.[3]

Soil aggregation is one of the main indicators of the soil structure state and its adequate maintenance is very important to avoid soil degradation. With respect to the root effect on soil, there are evidences that properties of rhizosphere differ from bulk soil leading to structural differences. The objective of this study was to investigate the rhizosphere soil aggregation. The experimental area was located in the state of Paraná, Brazil, in a Haplorthox soil. It was implanted in the winter of 2016 and the sampling was made in the summer of 2017 with other rotation crops. Then, the treatments consisted of differents winter/summer rotation crops: T1) wheat/soybean; T2) black oats + rye + vetch/buckwheat; T3) black oats + ryegrass/soybean; T4) blue lupine + black oats/maize, which were distributed in four blocks. The sampling was performed in the soil surface (0.00 - 0.05 m), considering as rhizosphere the soil adhered to the roots and, as bulk soil the soil not adhered to the roots and without plants in its proximity. The samples were prepared and the soil aggregation evaluated by the analyses: readily dispersible clay (RDC) and mechanically dispersible clay (MDC). The procedure for these analyses consists of the agitation of a small amount of soil in water inside a bottle followed by

measurement of clay in suspension with a turbidimeter. The agitation was done manually for RDC and mechanically for MDC. Data obtained were submitted to analysis of variance and, when significant to Tukey test ($P<0.05$). It was observed that MDC was more sensible than RDC to detect differences between rhizosphere and bulk soil, because RDC consisted of very small values that resulted in high variation, complicating to see the differences. Thus, the interaction between treatments and environments (rhizosphere or bulk soil) was significant only for MDC. MDC showed that for T1, T2 and T3 there was more dispersible clay in bulk soil than in rhizosphere. T4 did not present differences for both environments. This fact probably occurred because the aggregates removal from the maize rhizosphere was more difficult than the other treatments and the aggregates may had broken during this process. For both rhizosphere and bulk soil, T2 and T3 had smaller values of dispersible clay. As higher levels of dispersible clay indicates poor soil aggregation, then, these results showed that the root system affects the soil by improving its aggregation.

Keywords: Root system, soil structure, turbidimeter.
Financial support: CNPq and CAPES.

(1672 - 2452) Soil macroinvertebrate activity and pore size distribution: characterization by X ray CT and 3D image analysis.

Gilda Buscemi[1]; Laura Gargiulo[2]; Fabio Terribile[1]; Giacomo Mele[2]
University of Naples Federico II - Department of Agricultural Science[1]; National Research Council - Institute for Agriculture and Forestry in the Mediterranean[2]

Soil organisms play a role in soil structure dynamics mainly by their activities like burrowing and mixing of materials, which in turn influence water and matter fluxes. Since the beginning of the 90s non-invasive technologies such as X-ray CT have been applied to directly observe and quantify macroporosity and bioturbation induced by soil fauna. However, in comparison with earthworms, termites and ants, the direct quantification of the effects of the activities of other soil macroinvertebrates on soil pore system development remains largely unexplored. In this work we carried out a short-term microcosm experiment combined with tridimensional image analysis to identify and quantify separately the contribution of five different taxa of macroinvertebrates to the formation of the soil pore system. Biopore size distribution produced by earthworms, millipedes, centipedes, campodeiform and elateriform lavae has been calculated from X-ray CT images of repacked soil samples inoculated each with one individual and then incubated in the field where soil and invertebrates were collected. Pore system has then been analysed appling the "successive opening" algorithm. All taxa exhibited specific signs in term of shape of the pore size distribution: except for elateriform larvae and centipedes, all studied macroinvertebrates induced evident multimodality in the pore size spectrum, with negative skewness for the worms and strongly positive one for the Campodeiform larvae due, this latter, to the excavation of caves. Earthworms showed an individual burrowing ratio significantly lower than that of the other soil invertebrates, being such parameter inversely correlated with the size of the individuals for all the taxa. Overall, results confirm the need to properly consider the specific role of the different soil macroinvertebrates as ecosystem engineers, while the applied experimental approach has provided data suitable for modeling the contribution of macroinvertebrates in soil structure formation.

Keywords: soil structure, biopore size distribution, soil fauna activty
Financial support:

(6393 - 2092) Soil Physical Attributes and Productivity in Corn-Green Manure Intercropping

Wellington da Silva Toledo[1]; Marcelo Zaffalon Bobato[1]; Flávio Sergio Afferri[1]; Laíze Aparecida Ferreira Vilela[1]
Universidade Federal de São Carlos-UFSCar[1]

Nutrients loss and organic matter depletion are important factors related to reduction of the productive potential in tropical lands. Therefore, to promote the soil quality, some cultivation practices have stood out, especially to improve physical soil quality. In this sense, grain crops-green manure intercropping can be a promising strategy to conservation of agricultural soils, since it is an economically accessible practice, particularly for low-tech farmers. Thus, our research evaluated the agronomic performance of corn in single crop or corn-green manure intercropping, and its influence on soil physical attributes. This study was carried out in a *Latossolo Vermelho Distroférrico típico,* in experimental field of the Campus Lagoa do Sino, Federal University of São Carlos (CCN/UFSCar). The field trial includes 4 treatments with 5 replicates in a randomized block design: 1. Single corn; 2. Corn-*Crotalaria juncea* intercropping; 3. Corn-millet intercropping; 4. Negative control (uncultivated, with spontaneous vegetation). The evaluations included, in plants: weight and size of green maize ears, dry grains yield, 100 grain mass and biomass production of green manures; in soil: soil penetration resistance, average aggregate diameter, soil density, total porosity and moisture. Our results showed that only one year of intercropping, both green manure did not benefit the green maize productivity and 100 grain mass, because none of the species promoted greater yield than single maize. On the other hand, in the grain yield, corn-crotalaria intercropping was statistically similar to single maize in the first year of cultivation, suggesting the great potential of this practice to increase productivity in the medium and long term. In the plant biomass production, millet was better to crotalaria, producing 45% more dry mass than this legume. Most of the soil physical quality parameters were not improved in the first year, our treatments only influenced soil penetration resistance. The consortium using grasses (corn-millet) had the lowest penetration resistance indexes and similar results were also observed in the corn-crotalaria intercropping. Finally, there is a need to evaluate the benefits of green manure in soil physical parameters in long term, in order to verify efficiency of these consortium systems, collaborating for more sustainable management of agricultural soils and improvements in the agronomic performance of maize.

Keywords: Cover crops; legume; graminea.
Financial support: Conselho Nacional de Desenvolvimento Científico e Tecnológico-CNPq, Universidade Federal de São Carlos-UFSCar.

(1883 - 990) Soil physical attributes as a function of crop rotation and soil acidity amendment in a long term No till System (NTS) study.

Jayme Ferrari Neto[1]; Carlos Alexandre Costa Crusciol[2]; Alan Franzluebbers[3]; Katiuça Sueko Tanaka[2]; Letusa Momesso[2]
Dom Bosco Catholic University, Campo Grande, MS, Brazil[1]; Sao Paulo State University, Botucatu, SP, Brazil[2]; North Carolina State University, Raleigh, NC, USA[3]

The higher amount of plant residues in the soil profile in NTS, results in an increase in the soil organic matter content (SOM), which favors the formation of aggregates due to the cementing and agglutinating action that SOM exerts on the mineral particles of the soil. Soil acidity amendment may also have an indirect effect on the soil physical properties, as they favor the shoot and root development of the crops and increase the organic matter and microbial activity in the soil; factors that also help the formation of aggregates. Thus, the aim was to evaluate the bulk density, macro, micro and total soil porosity in the profile of a Rhodic Hapludox as a function of crop rotation system and superficial liming and calciumand calcium/magnesium silicate application on soil. This experiment was set up in October 2006 in Botucatu, SaoBotucatu, Sao Paulo, Brazil. A randomized block design consisted of four crop systems, varying by the type of crop during the offseason (forage crop, second crop, cover crops and fallow). The

main crop during the summer was either soybean, maize, rice, or common bean. Split-plots were two sources for soil acidity correction (dolomitic lime; calcium/magnesium silicate) and a control (no soil correction for a total of 12 treatments with four replications. Soil samples were collected in 2013 at depths of 0-5, 5-10, and 10-20 cm for evaluation bulk density, macro, micro and total soil porosity. In general, when there were two crops per agricultural year, there was a greater macroaggregation of the soil, which may also be related to the input of dry matter mass in these crop systems and the only production system that influencedthat influenced on soil microaggregates was the forage crop in the 0 to 5 cm layer of soil. Although no direct effect of the soil acidity correction on soil physical properties was observed, the benefits provided by them on the production of shoot dry matter during the seven agricultural years negated the possible deleterious effect of clay dispersion.
Keywords: Shoot dry matter, Carbon stock and soil porosity.
Financial support: FAPESP (Sao Paulo Research Foundation), Project numbers: 2006/1705-4, 2009/05066-4, 2011/10566-6, 2013/18594-4, 2013/02000-8.

(7473 - 2096) Soil physical attributes in an integrated crop-livestock systems in southern Brazil

Douglas Rodrigo Kaiser[1]; Lucas Raimundo Rauber[1]; Flávio de Lara Lemes[1]
Universidade Federal da Fronteira Sul[1]

The integrated crop-livestock systems (ICLS), when well managed, generates benefits to the soil-animal-plant system, due to the synergism between its components. However, there is a concern about soil compaction by animal trampling in intensive systems, which may compromise soil structure. In this systems the reducing porosity and increasing soil bulk density may compromise water availability and plant root growth. This study evaluated the effect of rotational grazing and soil chiseling on an ICLS, where during the winter the area is destined to produce oats for grazing with dairy cows and in the summer the soybean and corn crops are grown. The experimental design was a randomized block design with three treatments and four replications: T1: Area with grazing in winter; T2: Area with winter grazing followed by soil chiseling and T3: Area without grazing in winter. The soil was a Oxisol. During the winter, the area underwent four cycles of grazing, and before each grazing the soil moisture was evaluated. Before and after each grazing cycle, the dry mass of oats was evaluated. At the end of the grazing cycles the bulk density and distribution of soil pores were evaluated in the layers 0-5, 5-10, 10-20 and 20-30 cm. After the end of the oat pasture cycle, soybean (Glycine max) was implanted and during its cycle were evaluated the soil moisture and the root distribution and grain yield. On days when grazing occurred the soil was in a friable state. The cows trampling increased the bulk density and decreased the porosity of the soil in the superficial layer (0-5 cm). The soil chiseling reducing the bulk density and increasing the porosity of the soil up to 15 cm, but it was unnecessary because it did not influence the root distribution and soybean yield. In addition, changes in soil surface structure due to grazing did not affect the retention and availability of water for the soybean crop. Therefore, in an integrated crop-livestock systems, with high stocking of dairy cows in the winter, if a rotation grazing and carried out under conditions of friable soil, soil degradation does not occur and not affecting root growth and yield of summer crops.
Keywords: cattle trampling; soil compaction, soil structure
Financial support: FAPERGS, CNPq, UFFS

(4035 - 3140) Soil Physical Indicators in an Agroforestry System in the Cerrado-Amazonian Maranhense Forest

Diego Freire Almeida[1]; Wilson Araújo da Silva[1]; Alinne da Silva[1]; Cristiane Matos da Silva[1]; Willian Araújo Cardins[1]
UEMASUL[1]

The study is carried out in the city of São Francisco do Brejão in the state of Maranhão, farm Monalisa. The property has an area of 740 hectares in its extension and is located in the ecotone Cerrado-Amazon forest. On the site the existence of two types of management for pasture, conventional pasture and another with a silvopastoral system, a type of agroforestry system. The objective of this work is to evaluate soil physical characteristics as a function of land use change in the ecotone Cerrado-Amazonian forest of Maranhão. The collection of undisturbed samples for the evaluation of soil density and particle density was performed in two areas, in two random points, with 3 replicates, and 3 depths of 0 to 10 cm, 10 to 20 cm and 20 to 30 cm, using Kopeck's rings. For the analysis of soil density and particle density, a factorial experiment was used, evaluating the effects of grassland pasture and conventional pasture on the soil. As for the average of the treatments of the parameters were submitted to analysis of variance and compared by the test of Tukey to 5% of probability using the software ASSISTAT 7.7. The rings were weighed on a scale, obtaining the wet weight and, after that, they were conditioned in an oven with a temperature of 110 ° C for 24 hours, then they were weighed, determining the mass of dry soil for calculations of densities. The compaction index was determined on site using an impact penetrometer, at two random points in each area, at each point with three replicates. Regarding the soil density results, there were no significant differences between the evaluated depths for both evaluated areas. In the particle density there was a significant difference, where in the conventional pasture area in comparison with the wooded pasture presented higher density of particles. As a result, the compaction index values are higher for the conventional pasture area compared to the wooded pasture area. The conventional pasture area presented values of up to 20 dm^{-1} and the pasture was already up to 13 dm^{-1}. Considering the results obtained in the project, the wooded pasture the degree of compaction is smaller because of the intercropping of trees with the pastures, because it presented greater protection to the soil and that the lowest value also occurred in the density of particles, concluding that the area of conventional pasture is more compacted than the wooded pasture area.
Keywords: Soil; Physics; Agroforest.
Financial support: Universidade Estadual da Região Tocantina do Maranhão

(1498 - 2221) Soil precompression stress related to water meniscus forces

Paulo Ivonir Gubiani[1]
Universidade Federal de Santa Maria, 1000 Camobi, Santa Maria, 97105900, Brazil[1]

The soil precompression stress (σ_p) has been used as an estimator of the soil load bearing capacity, mainly indicating the maximum previous load applied on sol. The part of σ_p resulting from forces other than the external load applied on soil is little studied. The objective of this study was quantify the increase in σ_p caused by water meniscus forces. Samples of a Rhodic Hapludox (RH1: 14, 24, 62), a Rhodic Hapludox (RH2: 45, 20, 35) and a Typic Paleudults (TP: 64, 26, 10) were used (numbers in parentheses are the percentage of sand, silt and clay, respectively). The air-dried samples were milled with a porcelain pistil inside a porcelain bowl, for breaking aggregates as much as possible to remove mechanical resistance stored inside the aggregates. A set of ten samples for each soil were built just spilling the milled soil fraction into metal rings. All samples were water saturated by capillary rise during 48 h. From the ten saturated samples for each soil, two other sets with five samples each one was randomly prepared. In one of these two sets, it were applied three sequence of drying followed by saturation (D-S). Finally, all samples (set with and without D-S sequence) were transferred to a pressure plate extractor to standardize the matric suction at 33kPa. The uniaxial static compression test was performed applying successively loads (σ) of

12.5, 25, 50, 100, 200, 400, 800 and 1600 kPa, and σ_p was determined according to Casagrande procedure. The σ_p of samples without D-S was 35, 50 and 46 kPa for RH1, RH2 and TP, respectively. These values reflect mainly the mechanical resistance stored inside the aggregates. The sequence of D-S increased σ_p up to 75, 92 and 60 kP for RH1, RH2 and TP, respectively. Thus, water meniscus forces increased from 14 to 42 kPa the σ_p, indicating that a large part of σ_p can be a result of forces other than the external load applied on soil.
Keywords: compaction, compressibility, bearing capacity
Financial support:

(7477 - 1670) Soil resistance to penetration in sugarcane area as a function of different soil tillage

Tiara Moraes Guimarães[1]; Ciro Pozzi Garcia[1]; Ariani Garcia[1]; Jorge Martinelli Martello[1]; Erilene Romeiro[1]; Juliano Carlos Calonego[1]; Carlos Alexandre Costa Crusciol[1]
Universidade Estadual Paulista[1]

The increasing adoption of mechanical harvesting of sugarcane and an inadequate traffic of the machines, through the mechanized operation in the field, has significantly increased soil compaction. However, a recent technique of management of agricultural mechanization, called traffic control, represents an interesting alternative for the cultivation of sugarcane, since it separates the traffic zones from areas where there is plant growth, concentrating the passage of tires in delimited lines, substantially decreasing the soil compaction at the plant site, with consequent increase of productivity and longevity of the sugarcane. The objective of this experiment was to evaluate the soil compaction as a function of soil tillage system. The experiment was installed in April, 2015 in a clay soil at Macatuba, SP, Brazil. The experimental design was a randomized complet blocks with four replications. The treatments were constituted by two systems of soil tillage: conventional soil preparation (CSP) - standard / control and deep soil tillage (DST). The CSP system was characterized by the tillage with disk harrow, chiseling and disk harrow again. In the DST was used deep tillage with rod up to 0.80 m and rotating hoe. The plant growth zone are 1.20 m wide, with the two planting grooves 0.9 m apart, located in the center of the revolved area. After planting and immediately after the first harvest, the soil resistence to penetration was measured by means of the impact penetrometer, Stolf model. The samples were taken based on a perpendicular transept of 1.20 m, between the center of the plant growth zone and the center of the traffic zone. In this transept, 9 points distanced in 0.15 m of each other were evaluated. With this, results were obtained both in the non-traffic area and in the traffic area. A compaction was observed mainly in the traffic zones of machines for both system of soil tillage with a more significant value in the layer of 20 to 60 cm depth. The DST presented values lower than the CSP in the region of the plant growth zone (0 to 45 cm), the most evident differences being located mainly in the intermediate depths (between 20 to 50 cm of depth). Inside the plant growth zone, the contrasts between resistance to penetration values were three times higher in CSP than DST, with values above 2.5 MPa, values that are restrictive to the root development of the crop.
Keywords: soil compaction; controlled traffic farming; *Saccharum spp*.
Financial support: São Paulo Research Foundation (FAPESP – Project Number 2014/20593-9)

(6884 - 2737) Soil resistance to penetration of an Plintossolo Argilúvico under different management systems

Gustavo Cassiano da Silva[1]; Otavio Silveira Gravina[1]; Rafael Almeida Ferreira[1]; Lucas Pergentino Brandão[1]; Djavan Pinheiro Santos[1]; Thiago Pereira de Souza[1]; Angélica Pires Batista Martins[1]; Fillipe de Paula Almeida[1]; Vladia Correchel[1]; Glenio Guimarães Santos[1]
Federal University of Goiás[1]

The intensification of agricultural production systems has led to one of the main problems faced by farmers, soil compaction, since the use of increasingly large and heavy machinery can lead to changes in the structure, density, porosity, and infiltration of water content in the soil. Among the physical attributes of the soil that best portray the compaction is resistance to penetration (RP), as it has a direct relationship with soil density and plant growth. This study was carried out in the Araguaia Valley, in Luiz Alves city, state of Goiás, the soil was classified as Plintossolo Argilúvico, in the following systems: rice cultivated two years ago, without water blade (A2); rice for five years, with 27 cm of water blade (A5); rice for ten years, with 21 cm of water (A10); rice for fourteen years, with 5 cm of water blade (A14); kills with a 5 cm blade of water (M5). The resistance to soil penetration was determined using the Impact Penetrometer Model IAA / Planalsucar - Stolf, from the soil surface to the depth of 0.60 m. The initial evaluation of the data was done by means of descriptive statistics of the values obtained in the 30 points sampled, as well as the coefficient of variation and the 95% confidence interval. The intensification of the systems of cultivation A2 showed higher values of resistance to penetration at depth 0-0.20 m, in this system, there was no water slide, evidencing that the resistance to penetration can be influenced by soil moisture, that is, the lower the humidity, the greater the soil resistance to penetration. At the depth of 0.20-0.40 m, both A2 and A14 obtained higher values of resistance to penetration between the evaluated systems, which indicates that with the passage of the time of handling, even areas with water slides the resistance of the only tends to increase. At depth 0.40-0.60 indicated lower soil resistance to penetration at M5, and the other systems at these depths were not statistically different. The systems of rice cultivated two years ago without a water slide and rice fourteen years ago, with 5 cm of water blade, have higher values of resistance to penetration in the 0-0.20 and 0.20-0.40 layers of the ground.
Keywords: Compaction, Irrigated rice, Araguaia
Financial support: Capes, Project Number CNPq 457628/2014-6.

(2102 - 1412) Soil structural state in continuous cropping systems

De León Gastón[1]; Pérez Bidegain Mario[2]; Terra José[3]; Ernst Oswaldo[2]
Universidad de la República. Centro Universitario Región Este[1]; Universidad de la República. Facultad de Agronomía[2]; Instituto Nacional de Investigación Agropecuaria[3]

Soil compaction in no tillage systems is a degrading process that reduces crop productivity and soil quality. However, methodologies to analyze soil compaction at field scale are scarce. The “Profile Cultural” (PC) methodology is based on visually identifying structures with varying compaction status. In this study, we used the PC to evaluate soil structure of a Uruguayan Typic Argiudoll after 14 years of continuous cropping. Two different continuous cropping systems (treatments) were analyzed; soybean (SB) and sorghum (S). In each pit (n=2) we quantified the proportion of the surface occupied by PC structures: Δ, Φ, Γ and P. On each of those structures we measured soil strength (SS), soil bulk density (BD), soil total porosity (TP), soil structural porosity (SP), and soil textural porosity (TexP). Additionally, root frequency (RF) was evaluated on a grid on each pit. Field work was done in May-June 2015, after crop harvest. Treatment effect on the proportion of PC structures was analyzed using the X^2 test (α=0.05). Within treatments, we compared SS, BD, TP, SP, TexP values of the structures (Δ, Φ, Γ, P) using one-way ANOVA (α=0.05). Among treatments, we compared total SS, BD, TP, SP, TexP, those means were calculated as the weighted average of the values on each structure. We did not found treatment effect on the proportion of structures; 63% the Φ structures, 19% of Δ, and 18% of P. The type Φ structures are characterized by the development of porosity caused by alternation of wetting and drying cycles. The Δ are compact structures

related to traffic. The P are surface structures which have horizontal porosity. Interestingly, in this systems of continuous agriculture in clay loamy soils the presence of P structures was verified. The SS showed significant differences in the structures being the compact zones (Δ) more resistant to the shear stress. SS value in Δ zones it was 179, 1 KPa and 179. 3 KPa for SB and S, respectively. SS value in Φ zone it was 74.2 KPa and 137.1 KPa for SB and S respectively. Soil BD was not affected by treatments (1.36 $Mg.m^{-3}$ and 1.42 $Mg.m^{-3}$ for SB and S, respectively). TexP was constant within the soil profile (38.1 % and 35.5 % for SB and S, respectively). Treatments did not affect RF. Applying the PC we found evidence of compact structures, regardless of the crop used. Therefore, continuous cropping systems may compromise soil long term sustainability, and other management options, besides no tillage, must be included.

Keywords: Cultural profile, roots, compaction, shear strength
Financial support: Universidad de la República

(1225 - 1460) Soil tillage effects on some soil physical properties in a lowland soybean cropping system

Vinícius Pedron[1]; Robson Giacomeli[1]; Leonardo Chechi[1]; Reimar Carlesso[1]; Mirta Petry[1]; Bernardo Dalmolin[1]; Diego Londero[1]; Jéssica Maiara Iensen[1]; Felipe Sarmento[1]
UFSM[1]

The lowlands located in the Rio Grande do Sul State Southern region correspond to nearly 4.4 million ha, usually cropped with sole rice and presenting a compacted layer between 10-20 cm deep and textural B horizon, that when not well managed leads to poor aeration, low hydraulic conductivity and low water holding capacity. Crop rotation appears as an excellent soil management alternative to improve soil physical quality and to diversify the soil biota. However, to grow dryland crops in these soils, it is necessary to study alternatives to reduce the environment stress to plants caused by poor soil conditions. In this way, the present study aimed to study the effect of different tillage practices on some soil physical properties in a lowland cropped with soybean. The study area is located at the Federal University of Pampa, Campus Itaqui. The experiment was carried out in the 2016/17 growing season, applying a randomized block design, with three replications. The treatments were composed by: no-tillage, where no soil disturbance was applied after a soil chiseling realized in August, 2016, intending to begin a no-till system; conventional tillage performed by two times disking at 10 cm depth, plus soil leveling 15 days before sowing; no-tillage with raised seedbed (built in the winter of the first year, with a 0.15 m height in relation to the soil level, and 1.0 m wide); and conventional tillage with raised seedbed, built after the tillage, 15 days before sowing. After the soil chiseling in early August, a cover crop was implanted, and on November 8th, 2016 soybean was sown. Soil physical properties were monitored two months after soybean sown in the 0-5, 5-10 and 10-20 cm depth layers. The properties measured were: bulk density, total porosity, macroporosity, microporosity and penetration resistance, using 71.2749 cm3 soil core samples and applying -100kpa soil matric potential. The results showed that no-till with raised seedbed obtained the least total porosity and greatest macroporosity of 43.59 and 16.56%, respectively at 5-10 cm depth layer while the microporosity was greater for both conventional tillage, with and without raised seedbed. The penetration resistance was greater for conventional tillage at 0-5 and 5-10 cm depth layers, and the conventional tillage with raised seedbed treatment at 10-20 cm depth layer. No-tillage with and without seedbed raised promoted improvements in soil physical properties compared to conventional tillage treatments.

Keywords: No-tillage, Bulk density, Soil porosity
Financial support: CAPES

(6986 - 1751) Soil water storage and water available in irrigated wheat crop in the cerrado

William Fenner[1]; Tonny José Araújo da Silva[1]; Edna Maria Bonfim-Silva[1]; Thiago Franco Duarte[1]; Thiago Henrique Ferreira Matos Castañon[1]; Vinícius Melo da Silva[1]
UFMT[1]

Given the current dynamics of irrigated agriculture associated with meteorological instabilities during the cropping, the monitoring soil moisture and storing water are essential for productive stability and rationalization of water and monetary resources. Thus, the objective was to determine the water storage in irrigated wheat cultivation (*Triticum aestivum* L.), BRS 254 variety in Cerrado Oxisol. To this end, 12 access tubes were installed at a depth of 0.6 m to read the water content of soil using a capacitance probe model Diviner 2000. The access tubes were installed after sowing the wheat, in the central line of each plot and the readings were performed daily between 8:00 am and 9:00 am. For the storage, the effective depth of the root system of wheat (0.3 m) was considered. Using the soil water retention characteristic curve, were obtained the values of moisture equivalent to the field capacity and the permanent wilting point and, sequentially, the water available for the wheat crop was determined. The amount of water available for the crop is 43.08 mm for the considered depth. The average storage until maturation of the culture was 63.69 mm.

Keywords: *Triticum aestivum* L., soil moisture, soil water, water management
Financial support: CNPq; CAPES

(7102 – 2127) Space correlation of soil texture in archaeological black land area under different uses in south of amazonas

Luana Celestino Calista[1]; Milton César Costa Campos[1]; Elilson Gomes de Brito Filho[1]; Wildson Benedito Mendes Brito[1]; Thalita Silva Martins[1]; Lucas Eduardo Realto da Silva[1]; José Maurício da Cunha[1]; Marcelo Dayron Rogrigues Soares[1]; Francisca Xavier Quintino Neta[1]; Ludimila Souza Oliveira[1]
Federal University of Amazonas[1]

The Amazon region has mostly low fertility soils, but with soils called black archeological lands (TPA), usually presenting the sand fraction as dominant, besides, these soils present high natural fertility and physical potential in relation to the adjacent soils. a study of its texture is of great importance to obtain information and to relate its characteristics. The objective of this work was to evaluate the spatial variability of texture in black archeological areas under different uses in the southern region of Amazonas. The study was carried out in the city of Apuí, where a sample grid of 88x64 m was established in the study area and the soils were sampled at the crossing points of the mesh, with regular intervals of 8 m, totalizing 88 sample points. Soil samples were collected at a depth of 0.0-0.5 m. The granulometric analysis was performed by the pipette method. Data were submitted to descriptive and geostatistical statistics. When the average of the textured attributes was evaluated, it was possible to observe the domain of the silt fraction, in the areas of cocoa and coffee, which corresponds to more than half of the granulometric composition justified by the by the high degree of weathering of these soils. In the pasture area, dominance of the sand fraction was observed, this soil tending the sandy texturewhere, the greater concentration of sand between the granulometric fractions is a common characteristic of the TPA's that can be attributed to the formation of stable organic - material size equivalent to sand, it is clear lycombining the practice of the use of fire and depositing organic material by Native Americans occupying these sites. Regarding geostatistics, the models that best fit the data were exponential and spherical, according toCambardella et al. (1994) for the classification of the degree of spatial dependence

(GDE%) , it was observed that in the areas of cocoa and coffee all variables presented a strong degree of spatial dependence for sand, silt and clay, with values close to zero , the highest range values were found in the pasture area and the smaller ones in the area under coffee. By observ study or that cocoa areas, coffee and pasture respectively presented the average textures, sandy and clay and the area under pasture management, was the most differed with respect to cocoa and coffee areas with higher reach (a) and lesser degree of spatial dependence (GDE).

Keywords: Geostatistics, Amazonian soils, Texture

Financial support: Foundation for Research Support in Amazonas (FAPEAM), National Council for Scientific and Technological Development (CNPq)

(3126 - 2185) Space variability of aggregate stability only in arqueological black land area (tpa) with cocoa cultivation in south of amazonas

Estefani de Souza Oliveira[1]; Anderson Vieira Rodrigues[1]; Milton César Costa Campos[1]; José Maurício da Cunha[1]; Elilson Gomes de Brito Filho[1]; José Igor Silva Praça[1]; Ludmilla Colares Rodrigues[1]; Carlos Henrique Gima Relvas[1]; Sabrina Isabela da Silva Fernandes[1]; Elyenayra Nogueira Pinheiro[1]

Federal University of Amazonas[1]

The soils of Amazonas are considered as little fertile soils presenting high levels of aluminum and low CTC (cation exchange capacity), presenting good physical fitness for handling . On the other hand, in Amazonas there are soil patches where by the anthropic action of the pre-Columbian peoples who used them for their daily use, they modified these areas and made these soils with fertile potential higher than adjacent soils . The objective of this work was to verify the spatial variability of soil aggregate stability in archeological black earth (TPA) area with cocoa management in southern Amazonas. TPA area with cocoa cultivation is localized in Apuí in the Amazon's ul state, a sampling this mesh 80 x 56 m and regular spacing of 8 m where soil samples were collected at depths was established 0,00- 0.05; 0.05-0.1% ;0.10-0.20 and 0.20-0.30, making 352 samples with each point being georeferenced with GPS. After drying and dewatering, the stability analysis of aggregates was performed and the results were calculated the Geometric Mean Diameter (DMG) and the Weighted Mean Diameter (WMD). After obtaining the data, these were analyzed through descriptive statistics and geostatistics . By the descriptive statistics it was observed that the values of DMG varied between 2.50 and 2.67 mm and there was reduction according to the depth increase. The DMP varied from 2.50 to 3.12mm for the 0.10-0.20m layer and 0.00-0.05m respectively. The values of aggregates in the class> 2mm ranged from 72.94 to 88.84% and the values also decreased according to the depth increase. However, the values of aggregates in the class <2mm ranged from 11.15 to 27.06% and, unlike DMG and class> 2mm, increased values according to depth increase. By the normality test, all variables were significant at 5% probability. In relation to geoesthetics, the model that best fit the data was the exponential for all attributes at all depths, according to the classification of Cambardella et al. (1994) for the degree of spatial dependence (GDE%) of attributes in strong, moderate and low, the attributes varied all around zero except for the unanimous class of aggregates in the layer of 0.20-0.30m that presented value of 15.33% , in terms of the range this presented different values among the attributes, being around 11.00 and 53.10m . Thus by GDE% the attributes had strong spatial dependence and by the low reach spatial variability

Keywords: Geostatistics, Aggregate stability, TPA.

Financial support: Foundation for Research Support in Amazonas (FAPEAM), National Council for Scientific and Technological Development (CNPq)

(7646 - 2972) Spatial distribution of attributes of Red Oxisols by geostatistics in Geographic Information Systems.

Lucas Emanuel Servidoni[1]; Joaquim Ernesto Bernardes Ayer[2]; André Silva Tavares[3]; Augusto César Ferreira Guiçardi[4]; Natanael Rodolfo Ribeiro Sakuno[5]; Marx Leandro Naves Silva[6]; Ronaldo Luiz Mincato[7]
Federal University of Alfenas - UNIFAL-MG 700 St. Gabriel Monteiro Silva, Alfenas, 37130-000, Brazil (lucas_servidoni@hotmail.com)[1]; State University of Campinas, UNICAMP/IGE – Faculty of Paulínia, FACP, 250 St. São Carlos Gomes, Campinas, 13083-855, Brazil (joaquimayer@gmail.com)[2]; Federal University of Alfenas - UNIFAL-MG, 700 St. Gabriel Monteiro Silva, Alfenas, 37130-000, Brazil (andresttavares@gmail.com)[3]; Federal University of Alfenas - UNIFAL-MG, 700 St. Gabriel Monteiro Silva, Alfenas, 37130-000, Brazil (augusto_guicardi@hotmail.com)[4]; Federal University of Alfenas - UNIFAL-MG, 700 St. Gabriel Monteiro Silva, Alfenas, 37130-000, Brazil (natanael.sakuno@gmail.com)[5]; Federal University of Lavras, UFLA/DCS, 3037, Lavras, 37200-000, Brazil (marx@dcs.ufla.br).[6]; Federal University of Alfenas - UNIFAL-MG, 700 St. Gabriel Monteiro Silva, Alfenas, 37130-000, Brazil (ronaldo.mincato@unifal-mg.edu.br)[7]

Soils are indispensable to life, as they have fundamental chemical, physical and biological properties for agricultural sustainability, as well as providing environmental and ecosystem services. Thus, the physical and chemical attributes of Red Oxisols were obtained and spatialized by geostatistical, remote sensing and geoprocessing techniques. For this, 18 samples of deformed and undeformed soil were collected from 0.0 to 0.2m depth to evaluate the land use capacity for agricultural activities in the Caçús basin river in southern Minas Gerais, Brazil. The climate of the region is Tropical Mesothermic with mean precipitation of 1,500 mm/year. The region is characterized by the transition between Atlantic Forest and Savanna biomes but with only 10% of native forest remnants. The geological substrate is dating from Proterozoic with gneissic and granulitic rocks, and have relief slightly undulated to undulated where slopes between 2 to 20% prevail and Red Oxisols dominate. The distribution of the attributes of soil pH, aluminum toxicity, organic matter, cation exchange capacity effective and potential, soil texture, clay flocculation, geometric mean diameter and soil permeability to water were used to evaluate the hydrosedimentological flow. It was identified out high concentrations of organic matter associated with fragments of native forest. In general, the basin presents low base saturation, due to the low natural fertility of the tropical soils. The results point the pastures and crops with tillage are poor in organic matter and have difficulty in maintenance of capacity of cation exchange when they do not were previously fertilized. In these areas when they are close to streams and in high slopes, they should be destined to the reconstitution of the native forests, to protect the soils against water erosion. In the downstream area, the acid pH, increase of cation exchange capacities, and increment small grains, result of deposition the particles by hydric erosion and are regions susceptible the contamination. Thus, this work detected priority areas for to improve agricultural management practices and for recovery of degraded areas. Alternatives such as integrated crop, no till, pasture rotation, and sustainable forestry systems should be used to combine production and conservation of natural resources. Thus, the geostatistics and geoprocessing techniques were efficient for a sustainable evaluation of soils and management practices.

Keywords: Landscape; Soil Sustainable; Latossolo; Interpolation.

Financial support: CAPES and FAPEMIG

(5796 - 2055) Spatial variability of hydraulic properties in two contrasting soils under maize monoculture

Oscar Seguel[1]; Nicolás Riveras[2]; Carla Silva[3]; Osvaldo Salazar[3]

Universidad de Chile, Fac. de Ciencias Agronómicas. Santa Rosa 11315, casilla 1004, Santiago, Chile (oseguel@uchile.cl)[1]; Universidad de Chile, Escuela de Postgrado. Santa Rosa 11315, casilla 1004, Santiago, Chile.[2]; Universidad de Chile, Fac. de Ciencias Agronómicas. Santa Rosa 11315, casilla 1004, Santiago, Chile[3]

Soil compaction changes its porosity and structure, which affect the hydraulic conductivity (K) as a highly variable property; nevertheless, in soils under tillage, a dependence of K due to traffic is expected. In the present work, it was considered that the tillage is a homogenization factor of K. To verify this, a previous characterization of penetration resistance (PR) was carried out in two soils (corn fields) with contrasting textures (San Luis, sandy loam Entisol, and Caleuche, clay Alfisol), identifying zones of high PR (close to 2.0 MPa at 0-10 cm) and low PR (<1.0 MPa at 0-10 cm). In each case, in-track and out-track positions were identified and the bulk density (Db) and the hydraulic conductivity (K) were measured, both on surface and in depth (20 cm). The Db did not show sensibility to the spatial components, except in the low PR site of the clay soil, with significant higher values in depth. The sandy loam soil showed an increase of K in depth in the PR site (4.47 cm h^{-1} at surface and 8.89 cm h^{-1} at 20 cm depth), due to the persistence of the porosity because of the structure was not altered with the tillage; in the clay soil was identified a low stability at surface and a plough-pan distributed heterogeneously throughout the field, with low K values in all cases (<2.0 cm h^{-1}), which leads to unfavorable conditions for the crops. Based on the results it is concluded that the conventional tillage affects the soil structure, homogenizing the porous system. Thus, there is a strong spatial dependence in depth, but not in relation to the wheel-track, of properties such as penetration resistance, bulk density and hydraulic conductivity.

Keywords: hydraulic conjductivity, penetration resistance, soil structure, soil texture

Financial support: Project “Seguimiento y Control: Acuerdo de Producción Limpia (APL) Rubro Maíz Grano de la Región de O’Higgins” CPL-COOPEUMO.

(7391 - 2177) Spatial variability of stability of soil aggregates in archaeological black land area (tpa) with coffee cultivation in south of amazonas

Francisca Xavier Quintino Neta[1]; Milton César Costa Campos[1]; José Maurício da Cunha[1]; Elilson Gomes de Brito Filho[1]; Elyenayra Nogueira Pinheiro[1]; Carlos Henrique Gima Relvas[1]; Ludmilla Colares Rodrigues[1]; Sabrina Isabela da Silva Fernandes[1]; José Igor Silva Praça[1]; Luana Celestino Calista[1]

Federal University of Amazonas[1]

The Black Indian Lands are soils that exhibit dark coloration, anthropic horizon with presence of lithic and / or ceramic artifacts besides high fertility. Several studies indicate that the TPAs are of anthropic origin from pre-Columbian peoples; that is, it would be the result of old indigenous settlements. The evidences of the passage of the human being through these areas are the very elements that were part of the daily life of the indigenous peoples of the Amazon. Therefore, the objective of this work was to verify the spatial variability of the stability of aggregate stability in black archeological land area with cocoa cultivation in southern Amazonas. The study area is located in the region of Manicoré, in the South of Amazonas, where an area with Archaeological Black Terra (TPI) was established, with coffee cultivation , with a sample mesh of 80 x 56 m and regular spacing of 8 m where samples were taken at depths of 0.00-0.05; 0.05-0.10 and 0.10-0.20 m, making 264 samples with each point being georeferenced with GPS.After drying and destorroadas performed to aggregate stability analysis and the results obtained were calculated the average diameter Ge and knitting the m (DMG) and weighted mean diameter (SMD). After obtaining the data, these were analyzed through descriptive statistics and geostatistics. By the descriptive statistics the values of DMG and DMP varied between 2 and 3, and DMP presented values greater than DMG for all depths, this is probably because the DMG presents an estimate of the class of aggregates of greater occurrence, whereas the DMP increases as the percentage of large aggregates increases. The coefficient of variation (CV%) according to Warrick and Nielson (1980) classification for variability of the soil variables showed that the attributes presented low variability for WMD except for the last depth, moderate variability for DMG, low and moderate variability for class> 2mm and, high variability for class <2mm. By geostatistics, there was predominance of the exponential model, by the evaluation of the degree of spatial dependence (GDE%) all variables presented a strong degree of spatial dependence with. The range varied between 11.80 m and 28.50 m being larger than the spacing between sample points, and smaller than the maximum length limited by geostatistical analysis, thus justifying its degree of spatial dependence. Thus, due to low range values and strong GDE%, the variables presented low spatial variability.

Keywords: Geostatistics, Stability of aggregates, Amazonian soils.

Financial support: Foundation for Research Support in Amazonas (FAPEAM), National Council for Scientific and Technological Development (CNPq)

(8425 - 2649) Specific surface area for the development of pedotransfer functions and their use in the estimation of water retention and availability in soils of the State of Santa Catarina.

Diego Bortolini[1]; Jackson Adriano Albuquerque[1]; Luana da Silva[1]; Juliano Silva Teles[1]

UDESC[1]

The specific surface area of the soil (SSA) is directly related to the retention of water, nutrients and other molecules. Therefore, this property has potential to be used in pedotransfer functions to estimate retention and availability of water in soils. The objective of this work was to determine the specific surface area of soils of the State of Santa Catarina and to use it as a predictor variable of the field capacity (FC), permanent wilting point (PWP) and available water (AW) in the soil. The samples of the horizons of 37 soil profiles of the State of Santa Catarina were used. The database is composed of the following properties: total clay (0-0.002 mm), silt (0.002-0.053 mm), very fine sand (0.053-0.106 mm), fine sand (0.106-0.25 mm), average sand (0.25-0.5 mm), coarse sand (0.5-1.0 mm), very coarse sand (1.0-2.0 mm), water retention curve in the soil (points: total porosity, 1, 6, 10, 33, 100, 500 and 1,500 kPa), available water, total organic carbon content, SSA, FC, PWP and AW. The analyzed variables were submitted to normality analysis by Kolmogorov-Smirnov, indicating that they didn’t present normal by performing Spearman correlation analysis. The FC, PWP and AW were estimated by two models; Model 1: clay, silt, organic carbon and specific surface área; Model 2: five classes of sand, silt, organic carbon and specific surface área, through multiple linear regressions, artificial neural networks (ANN) and regression trees (RT). Pearson's coefficient of determination (R2) and root mean square error (RMSE) were used as statistical indicators to evaluate the predictive capacity of the models. The use of ASE to develop pedotransfer functions generated estimates with high predictive capacity, mainly for ANN and RT for the soils of the State of Santa Catarina. The use of five grades of sand has similar results in the estimation of water retention and availability compared to the use of clay contente. In general, the estimation has better statistical indicators in the surface horizons, for model 1 (clay, silt, organic carbon and specific surface area) and regression trees, for estimating the field capacity, permanent wilting point and water available.

Keywords: available water, artificial neural networks, Specific surface área.

Financial support: CNPq, UDESC and FAPESC.

(8338 - 1323) Susceptibility to erosion of soils in the Planalto Serrano Catarinense under forest cultivation.

Leonardo de Assis Lopes[1]; João Cláudio Teodoro Turtt[1]; Carla Eloize Carducci[1]; Kaliana Gottschalk de Freitas[1]; Joyce Castro Xavier[1]; Felipe Ceccon[1]; Luiz Antonio Assis Lima[1]

Universidade Federal da Grande Dourados[1]

The erodibility is a complex attribute and intrinsic to each soil which expresses the greater or lesser susceptibility of the soil to erosive process. Represents the integrated effect of processes that govern the dynamics of water and soil resistance to breakdown and transport of particles. The objective of this work was to evaluate the erodibility of two classes of soils under experimental forest plantations in the Planalto Serrano, State of Santa Catarina UFSC/Curitibanos, SC. Deformed soil samples were collected in the horizons (Hz) A and B of 14 sampling points distributed in the third strand (upper, middle and lower), referring to the Oxisols and Alfisols cultivated with pinus, eucalyptus, Araucaria, Bamboo and Liquidambar (± 4 to 6 years). Were determined the particle size distribution and water dispersible clay (ADA) by the method of the pipette, made up of clay (AF), silt/clay ratio, textural relationship (RTHzB/A), and the estimators of soil erodibility index of Boyoucous (IB) and flocculation index (IE), in triplicate. The experiment was carried out in a completely randomized design and evaluated the interactions between the attributes. All soils were classified as clayey and very clayey with average clay content LVAd, LVd, LBd and SXd (580, 425, 545, 450 g kg-1 in Hz A, respectively). The soils present in the region of the Planalto Serrano have recently genesis (RT > 1.2) even the Oxisols (RR 0.99). The Dystrophic Red-Yellow Latosol (LVAd) B horizon although young presented higher IE, AF and ADA (78%, 50% and 66%, respectively). The soil more susceptible to erosion in accordance with the IB was the Red-Yellow Latosol (LBd) on the horizon A, presenting 13% IF AND IB 0.41% and location in a bustling relief more and more resistant the dystrophic Red Latosol (LVd) in Hz A with IB of 1.35%, inserted in a relief softened with effective depth high and high content of clay, organic matter (37.24 g kg-1) and textural relationship of 1.28. The Sxe (Alfisols) presented high concentration of clay B horizon (> 550 g kg-1), located in continuous areas and flat, which reduces the incidence of erosion. Therefore, since the areas are used with forests of Pinus plants in the LVAd and LBd, araucaria, eucalyptus and liquidambar in the LVAd and bamboo in SXd low resistance to erosion of the LBd and SXd are compensated by the protection of residual plant material left on the soil with the performance of the forests and increase in organic carbon in the soil.

Keywords: Erodibility; relief; depth.

Financial support: UFGD e UFSC

(5052 - 278) Tensile strength and friability of soil aggregates cultivated with organic strawberry under no-tillage

Nádia da Silva Salatta[1]; Osvaldo Guedes Filho[1]; Camila Pereira Cagna[1]; Lucas de Oliveira Neves[1]; Daiane de Fátima da Silva Haubert[1]

Universidade Federal do Paraná[1]

Organic agriculture is an alternative to more sustainable agricultural production. No-tillage system is a soil management option to maintain its quality in organic production systems. The soil physical quality is commonly measured through the evaluation of properties related to shape and structural stability. The tensile strength of the aggregates is an indicator of the effects of management on the soil structural quality. The objective was to evaluate the tensile strength and friability of the aggregates of an Oxisol cultivated with organic strawberry under no-tillage. The study area has been cultivated with organic strawberry in the conventional tillage over 17-years. The organic production area was split in two parts for the experiment installation. An area in conventional tillage with shallow plowing of 0.15 m soil depth and another with no-tillage, which has soil cover and triannual crop rotation. The planting of strawberry seedlings was performed with a cutting tool for the hole opening. A year after the experiment installation it was collected ten soil blocks in each management system at 0.0 to 0.10 and 0.10 to 0.20 m soil depth. The aggregates size used in the tensile strength determination was 12.5 to 19 mm diameter. Tensile strength of the aggregates was measured through the penetrometer with penetration needle adapted. In each collected sample five replications were performed with 10 aggregates each. Soil friability was estimated by the variation coefficient of the tensile strength values. Tensile strength in the no-tillage system was significantly higher than in conventional tillage at 0.0 to 0.10 m soil depth. Soil friability in the conventional tillage was significantly higher than in no-tillage system at 0.0 to 0.10 m soil depth. For the 0.10 to 0.20 m soil depth there was no significant difference between the management systems for tensile strength and friability. By the analysis of the tensile strength and friability, the no-tillage system proved to be a good option for improvement and maintenance of soil physical quality in the organic production system.

Keywords: soil physical quality, conservation management, sustainable production

Financial support:

(1121 - 3098) Tensiometer with reading systems in the estimation of soil hydraulic parameters

Alcione Guimarães Freire[1]; Thiago Leite de Alencar[2]; Raimundo Nonato de Assis Júnior[3]; Jaedson Cláudio Anunciato Mota[3]; Francisco Ítalo Fernandes de Oliveira[1]

Federal Rural University of Pernambuco[1]; Federal Institute of Education, Science and Technology of Piauí[2]; Federal University of Ceará[3]

The tensiometer presents itself as an excellent instrument to monitor soil solution drainage, for measuring soil water energy in situ. However, measuring this variable requires a tensiometer reading system sensitive enough to accurately record the matric potential. Hence, an instantaneous profile-type experiment was conducted in the field, to measure the potentials within a moisture range from saturation to field capacity. After that, matric potential, soil moisture, total potential gradient, flow density and hydraulic conductivity were calculated and van Genuchten equation parameters were estimated through inverse modeling. This study aimed to test two alternative systems to the mercury manometer to quantify the soil water matric potential and observe their implications in the estimates of soil moisture, soil water flow density and hydraulic conductivity as a function of soil moisture. In addition, the study also aimed to evaluate soil hydraulic parameters, obtained by inverse modeling, based on the matric potentials from each reading system. Bourdon pressure gauge replaces the Hg manometer in the measurement of soil water matric potential within the moisture range from saturation to field capacity; alternative systems led to underestimation of flow density and hydraulic conductivity as a function of soil moisture and overestimation of hydraulic gradient and, therefore, are not recommended for the estimation of these hydraulic parameters; tensiometer reading systems converged in the estimation of hydraulic parameters by inverse modeling.

Keywords: Irrigation, Hydrological modeling, Instrumentation.

Financial support:

(2727 - 2729) The change of kaolinite's physical properties after cultivation of Bacillus sp.

Bykova Galina[1]; Shein Evgeny[1]; Milanovskiy Evgeny[1]; Verkhovtseva Nadezda[1]; Pashkevich Elena[1]; Khaydapova Dolgor[1]

Lomonosov Moscow State University[1]

The influence of microorganisms on the soil properties is hard to

underestimate. They affect the soil's solid, liquid and gas phase, cause the destruction and transformation of minerals, formation and preservation of the organic matter, changes of the pore solution. They are able to participate in the formation of soil structure via gluing of the soil particles by their metabolic products. The adsorption of microorganisms and their metabolic products on the surface of mineral particles can change their wettability. The aim of this work is the studying of the microbiological modification of the one of the main soil primary mineral - the modification of the surface of the kaolinite clay by the pure culture of bacteria (Bacillus velezensis), which can remove silicon and potassium from the minerals. Within two months microorganisms was cultivated in liquid culture medium the following composition: sucrose - 0, 75 g/l; $(NH_4)_2SO_4$ - 0.15 g/l; Na_2HPO_4 - 0,30 g/l; $MgSO_4$ - 0,075 g/l; $FeCl_3$ – traces; clay mineral - 5 g/l. In this breading ground the clay mineral was the only source of potassium. After incubation, the mineral was separated from the liquid medium and dried. Properties of the mineral were determined after 10, 20, 30, 40, 50 and 60 days of cultivation. Assessment of the rheological characteristics was performed in the mineral suspension with the modular compact MCR rheometer (Anton Paar, Austria). Microaggregate composition of the clay mineral and its particle size distribution was investigated by laser diffraction method (Microtrac Bluewave SDC, United States). To assess the wetability of the surface the sessile-drop contact angle was determined (DSA-100, Krüss, Germany). After two months of culturing the bacteria in a clay medium, where the clay minerals were the source of potassium, the surfaces properties (the contact angle), the microaggregate composition and the rheological characteristics of clay mineral were changed. Obtained data have shown an increasing of viscosity of suspension during the cultivation in comparison with the control sample and the pure mineral. There was the increasing of the content of microaggregates with diameter greater than 50 µm during the incubation. The influence of Bacillus sp. on the wettability of the mineral surface was determined.

Keywords: wettability, microaggregate composition, rheology, soil microorganisms
Financial support:

(4587 - 3094) The role of biopores to reduce the mechanical impedance to soybean root elongation

Nayara Caroline Majewski Ulbrich[1]; Moacir Tuzzin de Moraes[2]; Rafael Soriani[3]; Julio Cezar Franchini[3]; Henrique Debiasi[3]
University of Parana[1]; University of Sao Paulo[2]; Embrapa Soja[3]

The presence of biopores and cracks in structured soil layers under no-tillage may reduce the soil strength to soybean root penetration. We aim to determine the root elongation rate in structured and packed soil sample to quantify the biopores effect to soybean root growth. Soil compaction levels of a Rhodic Eutrudox were simulated at the field (structured soil) and in the laboratory (packed soils). Undisturbed soil cores were sampled from topsoil (0-10 cm) in four soil compaction levels (chiselled soil; no-tillage; and both compacted with 10 tractor passes), with nine replicates. Additionally, six compaction levels (0.8; 0.9; 1.0; 1.1; 1.2; 1.3; and 1.4 Mg m^{-3}) were produced compacting disturbed soil samples into cores (10 cm height and 5 cm diameter), with six replicates. Soil bulk density, macroporosity and penetration resistance were measured using these samples. Soybean seeds (BRS 1010-PRO) were incubated at 25^{o}C for 72h in a germination chamber. Resulting soybean seedlings were transplanted into both structured and packed soil cores, previously saturated and equilibrated at a matric potential of -6 kPa, and then maintained at 25^{o}C for 96h in the germination chamber. Length of tap root was measured with a digital pachymeter. Biopore effects on soybean root growth were analysed taking into account the relation of root elongation rate obtained in undisturbed or remoulded soil samples vs physical properties. Penetration resistance was higher in packed soil at the same bulk density or macroporosity. However, in the same water contents, penetration resistance was higher in structured samples. For similar values of bulk density, macro- and total porosity, soybean root elongation rate was larger in structured than remoulded samples, proving the key role played by soil structure and pore quality on root growth. The relationship between root elongation rate and soil penetration resistance was described by an exponential negative function regardless of soil structure. Undisturbed cores taken from chiselled or trafficked plots yielded similar soybean root elongations rates compared do remoulded cores with similar bulk densities. In contrast, soybean root elongation rate was increased 58% in undisturbed soil samples collected from no-tillage plots compared to remoulded cores with the same degree of compaction. The presence of biopores and continuous pores in no-tillage increases soybean root elongation rate due to reduction of mechanical stress to root growth.

Keywords: *Glycine max*; soil structure; soil compaction; soil penetration resistance; root growth.
Financial support: Agrisus Foundation Project Number 1236/13.

(8017 - 2656) Total carbon and nitrogen contents and soil aggregation index under onion culture systems in succession or crop rotation

Arcângelo Loss[1]; Janaine de Almeida[2]; Lucas Dupont Giumbelli[3]; Elano dos Santos Junior[4]; Aline Goedel[5]; Claudinei Kurtz[6]; Alvaro Luiz Mafra[7]
Universidade Federal de Santa Catarina. Rod. Admar Gonzaga, 1346, Itacorubi, Florianópolis, Santa Catarina, 88034-000. Brasil (arcangelo.loss@ufsc.br)[1]; Universidade Federal de Santa Catarina. Rod. Admar Gonzaga, 1346, Itacorubi, Florianópolis, Santa Catarina, 88034-000. Brasil (janaine.al@gmail.com)[2]; Universidade Federal de Santa Catarina. Rod. Admar Gonzaga, 1346, Itacorubi, Florianópolis, Santa Catarina, 88034-000. Brasil (lukdg@hotmail.com)[3]; Universidade Federal de Santa Catarina. Rod. Admar Gonzaga, 1346, Itacorubi, Florianópolis, Santa Catarina, 88034-000. Brasil (elanoagro@gmail.com)[4]; Universidade Federal de Santa Catarina. Rod. Admar Gonzaga, 1346, Itacorubi, Florianópolis, Santa Catarina, 88034-000. Brasil (aline.goedel@gmail.com)[5]; Empresa de Pesquisa Agropecuária e Extensão Rural de Santa Catarina. Estrada Geral, Lageado Aguas Negras, Ituporanga, Santa Catarina, 88400000. Brasil (kurtz@epagri.sc.gov.br)[6]; Universidade do Estado de Santa Catarina, Av. Luiz de Camões, 2090, Conta dinheiro, Lages, Santa Catarina, 88520000. Brasil (alvaro.mafra@udesc.br)[7]

The State of Santa Catarina is the largest national producer of onion, where cultivation is still carried out, through the conventional tillage system (CTS), which is characterized by excessive soil disturbance, resulting in physical, chemical and biological soil degradation. One way to alleviate this problem caused by CTS can be obtained using the no-tillage system (NTS). The objective of this work was to quantify total organic carbon (TOC) and total nitrogen (TN), soil aggregation index and mass distribution of the aggregates of a Humic Distrudept under onion culture systems in succession or crop rotation. The experiment was implemented in 2011 and the treatments used were: T1 - onion/corn succession in NTS; T2 - commercial rotation with winter cover and biennial onion in NTS; T3 - corn/winter grasses rotation and annual onion in NTS; T4 - legume succession of summer and annual onion in NTS; T5 – grasses rotation of summer/winter and annual onion in NTS; T6 - legume summer/winter grassy succession and annual onion in NTS; T7 – onion/corn succession in CTS; T8 - consortium of summer covers plants and annual onion in NTS. In August 2016, the soil was collected and the soil aggregation indexes were determined: weighted average diameter (WMD) and geometric average diameter (GAD) of the aggregates, respectively; distribution of macro, meso and microaggregates masses; as well as the TOC and

TN contents in the layers of 0-5, 5-10 and 10-20 cm. The treatments T1 and T7 presented lower TOC (0-5 cm), lower WMD and GAD (0-5 cm) and lower NT (10-20 cm) contents compared to the other onion culture systems. The treatment T8 favors the formation of stable macroaggregates, with higher values of WMD and GAD in depth (10-20 cm). The use of cover crops in winter or summer in the treatments T2, T3, T4, T5, T6 and T8 favors the formation of stable macroaggregates in comparison to treatments T1 and T7, which do not use cover crops in winter and summer.

Keywords: *Allium cepa* L., cover plants, weighted average diameter, plant diversity, no-tillage system

Financial support: CNPq Edital Universal number 403949/2016-5

(1404 - 2061) Ultrasonic energy in the stability of the aggregates of oxidic Oxisols with intensive cultivation and irrigation

Marcel Thomas Job Pereira[1]; Raphael Bragança Alves Fernandes[1]; Maurício Paulo Ferreira Fontes[1]; Teógenes Senna de Oliveira[1]

Federal University of Viçosa[1]

Soil, when subjected to conventional intensive crops, tends to lose its original structure. The objective of this study was to evaluate the stability of aggregates of Red-Yellow Oxisols submitted to long periods of intensive cultivation and irrigation, from the mesoregion of Rio Paranaíba, Minas Gerais, Brazil. Samples of 0.1 to 0.2 m were collected in areas under native vegetation and with horticulture cultivation in different times of use, characterized by the intensive use of machines and implements, inorganic fertilizers, and center-pivot irrigation. The data were analysed using a completely randomized experimental design, arranged in factorial scheme (7x7), corresponding to the times of use (1; 17; 22, 28, 32 and 43 years) + native vegetation (Cerrado) and times of sonication (0; 15; 30; 60; 120; 240; and 480 seconds) with three replicates. First, samples of 5 g of 2-4 mm aggregates were pre-wetted (sprayed) with deionized water and allowed to stand for 2 hours. Subsequently, the samples were transferred to a beaker of 250 mL, completing the beaker with 200 mL of deionized water (soil:water ratio of 1:40). They were then sonicated with ultrasonic probe (Sonics Vibracell, model Ultrasonic processor 750 Watt operating at 20 kHz), applying the calculated energy of 0,0; 3.5; 7.0; 14.0; 28.0 56.0; and 112.0 J mL^{-1}, at the amplitude of 60% and calibrated power of 46.67 W. Finally, the dispersion indices were normalized, and from the relationship between the parameters of the regression equation (b/a) the disaggregation index was calculated. The results were submitted to analysis of variance, with the comparisons between the intensive use by the Scott-Knott test and the sonication times by regression, both at 5% probability. The depletion of the significant interaction indicated that, at each applied energy level, the lowest rates of soil disaggregation were observed under native vegetation (0.13), while in those with only one year of cultivation the highest index was observed (0.33). Meanwhile, cultures of 43, 32 and 28 years presented higher disintegration rates (0.30, 0.27, and 0.28, respectively) when compared to the use times of 17 and 22 years of cultivation (0.19 and 0.24, respectively). The results observed for the first year of cultivation led to the hypothesis that, with a time of use, there is a process of selection of aggregates by the stability, but the results indicated that soil aggregation is being compromised with the time of soil use.

Keywords: Soil structure; applied energy; sonication.

Financial support: National Council of Scientific and Technological Development - CNPq; Foundation for Research Support of the State of Minas Gerais - FAPEMIG.

(9055 - 2999) Use of pedotranfer function to predict field capacity of soils of Pernambuco State, Brazil

Estevão Lucas Ramos Da Silva[1]; Arthur Felipe Ferreira De Lima[1]; Antonio Diomescio Da Silva Filho[2]; Karolina Esther Da Silva[2]; Alexandre Hugo Cezar Barros[3]; José Coelho De Araújo Filho[3]; Daniel Chaves Webber[3]; Flávio Adriano Marques[3]; Paulo Cardoso De Lima[3]; Melissa Correia Lacerda[1]

UFPE[1]; UFRPE[2]; EMBRAPA[3]

Physical, chemical and mineralogical characteristics of tropical soils influence their hydro-physical behavior, which is different from that of soils of temperate climates. The mineralogy of tropical soils, mainly that of the clay fraction, makes soil texture the dominant factor to define their water retention properties. Çlay type is directly related to the specific surface of clay particles, their arrangement and pore distribution. Pernambuco State, located in Northeast region of Brazil, is the study area. In this State, there are many soil profiles that lack information related to field capacity. The objective of this study is to develop pedotransfer function (PTF) to estimate field capacity using physical and chemical analyzes of representative soil profiles from Pernambuco State. Data from 81 profiles comprising 285 horizons were used. PTF were developed by multiple regression techniques, using a forward stepwise procedure to select the best predictor from the proportions of sand (S, g.kg-1), silt (Si, g.kg-1) and clay (C, g.kg-1). The evaluation of adequacy of the PTF was based on the correlation coefficient (r) and Willmott index (d). The obtained PTF was FC (%) = 22.7625030 - 0.02136242S + 0.020114636C. The obtained PTF with r = 0.89 and d = 0.96 indicate its suitability to estimate field capacity using only soil texture. Results also showed that silt content has little influence in water retention of tropical soils, chiefly because of its low values.

Keywords: Soil texture, PTF, tropical soils.

Financial support: EMBRAPA

C2.1.2 - The role of soil physics in water conservation and food security

(5383 - 2302) Are shallow impermeable layers beneficial for vegetation function in the semi-arid zone?

Alexandre Tadeu Brunello[1]; Carlos Alberto Nobre Quesada[2]; Tomas Ferreira Domingues[3]; Jonathan James Lloyd[4]

Faculdade de Filosofia, Ciências e Letras de Ribeirão Preto (FFCLRP), Universidade de São Paulo (USP), 3900 Bandeirantes Avenue, Ribeirão Preto, 14040-901, Brazil, brunelloflorestal@gmail.com[1]; Instituto Nacional de Pesquisas da Amazônia, 2932 André Araújo Avenue, Manaus, 69060-001, Brazil, quesada.beto@gmail.com;[2]; Faculdade de Filosofia, Ciências e Letras de Ribeirão Preto (FFCLRP), Universidade de São Paulo (USP), 3900 Bandeirantes Avenue, Ribeirão Preto, 14040-901, Brazil, tdomingu@gmail.com;[3]; Department of Life Sciences, Imperial College London, Silwood Park Campus, Buckhurst Road, Ascot, Berkshire SL5 7PY, England, UK, jonathan.lloyd@imperial.ac.uk[4]

This work develops upon the idea that - not only should root systems in precipitation limited ecosystems have shallower optimal rooting depths than vegetation types growing where water is more abundant – but also, due to reduced drainage losses, that shallow soils with an impermeable layer should actually be beneficial for vegetation function in water limited situations. Finding support for this hypothesis, we show that, - sampling over 20 sites across the Brazilian Caatinga (a semi-arid dry deciduous forest/shrubland vegetation type) - that sites with shallow impermeable layers (usually 0.5 to 1.0 m deep) typically support much higher vegetation biomass amounts than is found under the same climatic conditions but with no such impermeable layer present. This result is found to be consistent with predictions of ecosystem water use as obtained from a simple plant carbon-investment/water uptake trade-off approach and we would like to suggest, contrary to common assumption, that potentially deeper rooting zones are not always beneficial for

ecosystem function.
Keywords: holding capacity, semi-arid region; caatinga soils
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(1116 - 1599) Artificial neural networks to estimate soil moisture content under corn in integrated crop-livestock-forest system

Vinicius Marchioro[1]; Renan Francisco Rimoldi Tavanti[2]; Hugo Miranda Faria[1]; Daniel Dalvan do Nascimento[1]; Henildo de Sousa Pereira[1]; José Eduardo Corá[1]; Antônio Sergio Ferraudo[1]; Glauco de Souza Rolim[1]
Unesp Jaboticabal[1]; Unesp Ilha Solteira[2]

The soil water availability is one of the main factors that influence crop yield, and it is affected by climatological agents and soil management. Complex agricultural systems such as integrated crop-livestock-forest (ICLF), may contribute to increase the spatial variability of soil attributes and, consequently, affect soil water availability for plants. The objective of the present work was to test artificial neural networks to estimate soil moisture at different positions related to the forest component of an ICLF system. The study was developed at the Teaching, Research and Extension Farm of the UNESP campus of Jaboticabal (FCAV-UNESP). The forest components of the ICLF were composed by Urograndis I144 (*Eucalyptus grandis* (MAIDEN) W. Hill x *Eucalyptus urophylla* (MAIDEN) W. Hill) and the *Corymbia citriodora*, planted in double rows, at 20 m apart. An intercropped corn/brachiaria grass was planted between rows of the forest component, during the winter time. Soil moisture was monitored by tensiometers, installed at 0.2 m depth, every 3 meters, between the corn rows. Tension data obtained by the tensiometers were transformed into soil moisture content, using the van Genutchen model. Perceptron Multi-layered Artificial Neural Network was used to estimate soil moisture content, using average, minimum and maximum temperature, rainfall and number of days without rainfall. The neural network was composed of two hidden layers with ten neurons in each. Therefore, the neural network architecture was described as 5-10-10-1, using hyperbolic tangent activation function. The results showed that soil moisture content was accurately estimated using artificial neural networks (R = 0.98). Soil moisture content varied differently for soil water measuring positions and for the two forest component species. Dryer soil was observed closer to the forest component, independently of the specie, which resulted in lower corn yield. However, soil water content values were higher close (27.9%) or far (29.9%) from the plants of the *Corymbia citriodora,* compared to those soil water content values observed close (19.4%) or far (27.1%) from the plants of the Urograndis I144, probably due to the higher water uptake of the Urogradis specie, compared to those from the plants of the *Corymbia citriodora*.
Keywords: soil water; crop-livestock-forest integration*; Zea mays* L.*; Corymbia citriodora; Eucalyptus urograndis.*
Financial support: UNESP campus of Jaboticabal

(9210 - 1916) Characterization of soil physical attributes in degraded slope for revegetation purposes

Fábio Ribeiro Pires[1]; Ana Carolina Roos Pinheiro[1]; Henrique Capucho Justiniano dos Santos[1]; Larissa Pinto Seiberti[1]; Felipe Gabriel Cardoso Pires[1]; Paulo Roberto da Rocha Junior[2]; Amanda Duim Ferreira[1]; Adriano Alves Fernandes[1]; André Luiz Ribeiro Azevedo[1]
Universidade Federal do Espirito Santo[1]; Fazenda da Toca[2]

Extraction of clay as a substrate for roads and buildings results in degradation due to the removal of local vegetation and the exposure of the subsoil in the deposits, besides promoting changes in the physical attributes of the soil, triggering accelerated erosive processes. In this sense, the slopes wake up great concern for exhibiting great structural fragility. Revegetation is the main practice to recover vegetation cover and soil physical attributes are fundamental in determining the vegetation used and management technique adopted. Therefore, this work aimed to characterize the slope area regarding the physical attributes in order to plan the best form of revegetation. The soil characterization was performed in a field at region of São Mateus/ES, an area used for clay loan. The slope was divided into four horizons: A, AB, B and C. Deformed and undisturbed samples were collected in this horizons for the determination of particles density (PD), soil texture, soil density (SD), total porosity (TP), macro and microporosity (Ma, Mi) and geometric mean diameter (GMD). To determine the resistance to soil penetration (RSP), an impact penetrometer was used, as well as sample collection to determine the present moisture. The average clay, silt and sand content in the four horizons evaluated was 505.3 g kg^{-1}, 63.1 g kg^{-1} and 431.6 g kg^{-1}, respectively, which characterizes the soil as clay texture according to the Soil Survey Manual. The soil presented a mean SD of 2.13 g cm^{-3}, classified as high for its textural class. The PD was also high, on average equal to 2.95 g cm^{-3}, indicating the presence of iron oxides, common in these soils of tropical regions. The structural quality of the soil can be characterized as low due to the low values of GMD, that varied from 0.68 to 1 mm. Higher moisture content and resistance to penetration were observed in the B horizon, in relation to horizon A. Despite the high retention capacity of water in this soil depth, the RSP greater than 15 MPa in the firsts 0.1m of the soil could be a serious limitation to the root development of the species. High total porosity was observed in the B horizon, due to the higher number of micropores, as a result of to the higher clay content in this horizon. The attributes indicate high degree of compaction and soil degradation and management practices are necessary before the introduction of vegetation.
Keywords: Soil degradation, recuperation, soil management
Financial support: Petrobras

(6055 - 997) Climate change impact on groundwater quantity under different land management systems in Central Sand Area of Wisconsin, USA.

Birl Lowery[1]; Amber M. Radatz[1]
University of Wisconsin-Madison[1]

Groundwater quantity and quality is a vital resource worldwide, but it is especially critical for Wisconsin Central Sand Plain (WCSP) and other areas where sand plains are used in irrigated agricultural production. Thus, an understanding of the linkage between various land uses, including conservation practices, and groundwater usage with respect to climate change are important to understanding the breadth of potential solutions to water shortage. We investigated water table changes over time and the interface between groundwater resources under several management systems as they are impacted by climate change. While total precipitation has either increased or remained the same over time, the water table elevation assessed by monitoring wells in WCSP declined over many years, and those near Hancock, Wisconsin dropped about two meters over the period from 2002 to 2011. This water table decline was also reflected in lake levels as several lakes in WCSP suffered from low water levels. The objective of this research was to quantify interactions between vegetation (irrigated agricultural crops, prairie, and forest) and groundwater recharge in WCSP over extended time under changing climate conditions. Groundwater monitoring data were obtained from the US Geological Survey and specific water monitoring equipment was installed at eight sites to assess water table elevation, soil water content, and precipitation at 15-minute intervals under different vegetations. Data showed that the water table responded to

precipitation events differently based on the position in the groundwatershed and depth to the water table. Monitoring sites in the groundwatershed's discharge area responded quickly to precipitation events and the amount of rise of the water table increased linearly with precipitation. Interception of precipitation by plant canopy and decaying vegetative material on the soil surface in forest and prairie environments of the discharge area decreased groundwater rise as it responded to precipitation relative to agricultural fields. While agricultural crops used groundwater through irrigation, natural vegetation relied on water stored in the sandy soils and the shallow water table (1.5 to 3 m) for daily transpiration needs. Where groundwater was further from the surface, responses to precipitation events were buffered by the greater depth (5 to 7 m) of soil above the water table.

Keywords: Groundwater, land use, water quantity
Financial support: State of Wisconsin

(8819 - 204) Cover plants on the control of soil water content in sugar cane areas

Ingrid Nehmi De Oliveira[1]; Camila Viana Vieira Farhate[1]; Lenon Henrique Lovera[1]; Zigomar Menezes De Souza[1]; Juliana Aparecida Fracarolli[1]; Diego Alexander Aguilera Esteban[1]; Elizeu De Souza Lima[1]; Euriana Maria Guimarães[1]; Renato Lopez Noronha[1]; Camila De Souza Gabriel[1]
State University of Campinas (Unicamp), Agricultural Engineering (Feagri)[1]

The use of cover crops in sugarcane cultivation generates higher levels of water in the soil, reflecting on crop development and productivity. The objective of this study was to monitor soil water content in sugarcane areas where millet and peanut were used as cover crops. We carried out the study along two agricultural years at Santa Fe Mill, in an experimental area in Ibitinga county, São Paulo, cane plant and first ratoon. Experimental design was performed in randomized blocks with three replicates. The experiment started in December 2014 with soil collection for physical and chemical characterization of the area. The cover plants were sown in December 2014 and conducted until April 2015 and managed (desiccation) at the point of maximum flowering . Sugarcane planting occurred in April 2016, upon the use of minimum tillage system (subsoiling at 0.40 m and sulcation) and sugarcane variety CTC 4. Water content monitoring was performed between August 2015 and January 2017 using a FDR (Frequency Domain Reflectometry) probe, model Diviner 2000. The readings were performed monthly, up to 1.0 m depth. In general, applying the treatment sown with millet as cover plant lead to higher water contents in the soil on surface layers (0.00 to 0.50 m) compared to peanuts (a difference of 26%). Such behavior probably occurred due to the higher amount of straw produced by the millet (10 Mg ha^{-1}), which guarantees a lower solar incidence, low evaporation, and higher water content in the soil. In contrast, for the subsurface layers (0.50 to 1.00 m), soil water contents were very similar between the treatments, demonstrating that the straw from the cover plants were determinant at controlling soil water content only on surface layers. Such results can lead to the conclusion that millet provides higher soil water content in relation to peanuts, an effect which is more pronounced on soil surface layers.

Keywords: Water content in soil, minimum tillage, millet, peanut.
Financial support: Agrisus

(7373 - 2617) Data assimilation techniques for retrieving soil moisture in root-zone by using a combination of satellites.

Uvarov M.V.[1]; Martyniuk P.M.[1]; Gnatushenko V.V.[1]; Panchii N.I.[1]
EOS Data Analytics[1]

Soil moisture can be retrieved from in-situ observation, hydro-meteorological models and remote-sensing inverse problems. But only remote sensing observation provides acceptable spatial coverage and resolution of retrievals value. The modern Data Assimilation techniques, such as Optimal Interpolation, Kalman filtering techniques or variational assimilation (4D-Var), provides an effective way to combine hydro-meteorological simulations and remote sensing observations to obtain acceptable accuracy of soil moisture retrievals. Thus, for Data Assimilation system it is very important to develop a hydro-meteorological model for soil moisture dynamics modelling. For this purpose, the mathematical model of soil moisture transfer were built including the impact of the soil heat and taking into account the terrain topography. To describe the movement of water in soil we are using Richards' equation [1]. For efficient numerical solution of the soil moisture equation, it is convenient to describe the soil hydraulic properties using analytical relationship. The following models were used: BC (R.H. Brooks & A.T.Corey model [1]), VGM (Van Genuchten - Mualem model [1]). The corresponding one-dimensional boundary value problem was solved by finite element method. For retrieving states and parameters controlling the soil water dynamics in the root zone (~100cm) by assimilating near-surface state observation, we develop a dual Kalman filter technique using a model based on the Richards equation with Lü et al. (2011) approach, by combining the EKF to update the state variables, with an optimization algorithm for retrieving parameters of soil hydraulic functions defined according to the BC/VGM relations and BG/VGM parameters by using a particle filter algorithm. In order to provide topsoil (3–5 cm) moisture maps with a good spatial resolution ~100x100m we developed a multi-sensor approach, which combined data from different satellites. The coarse scale satellite data SMOS/SMAP, MODIS(LST&NDVI data utilized to take vegetation into account by trapezoid technique), and high-resolution Sentinel data (S1,S2,S3). To combine active/passive soil moisture product we are develop DISPATCH (DISaggregation based on Physical And Theoretical scale Change) method. 1. P. M. Martyniuk, et al. Mathematical model of nonisothermal moisture transference in the form of water and vapor in soils. //(FJMS) © 2017 Pushpa Publishing House, Allahabad, India. Vol. 102, Number 12, 2017, Pages 3211-3221.

Keywords: soil moisture; soil composition; remote sensing; data assimilation; hydro-meteorological modeling;
Financial support:

(3787 - 1263) Effect of Afforestation of Marginal Lands on Infiltration and Penetration Resistance

Thomas J. Sauer[1]; Eric C. Brevik[2]
USDA[1]; Dickinson State University[2]

Food security can be reduced when agricultural lands are converted from crop to bioenergy feedstock production. Targeting marginal lands for woody feedstock production avoids some of the competition for food production and may improve soil health and the local microclimate and provide additional ecosystem services. The objective of this study was to evaluate the effect of eastern red cedar (*Juniperus virginiana* L.) windbreaks on soil quality in the U.S. Great Plains. Eastern red cedar has great potential for bioenergy production due to its adaptability to a wide range of soil and climate conditions and the physical and chemical characteristics of its biomass. Nine sites were selected from latitudes 41-47 deg N and longitudes 94-103 deg W with MAP from 425 to 970 mm and MAT from 4.9 to 9.9 deg C. Tree age varied from 22 to 59 years. Ponded infiltration (twin ring technique) and penetration resistance at 2.5 cm increments to 30 cm (digital static cone penetrometer) were measured at 9 locations under the trees and in adjacent fields (crop, pasture, or hay) at each site. Soil samples were collected for bulk density, pH, carbon, and nutrient analyses from the same locations. Infiltration rates averaged 163 mm/h (55%) greater and penetration resistance averaged 228 kPa lower under tree cover. These results suggest that precipitation was more likely to infiltrate and be available for root uptake under the

trees. Additional hydraulic properties (saturated hydraulic conductivity and sorptivity will be determined from the twin ring infiltration measurements. Improvements in soil physical and chemical quality following tree planting for bioenergy feedstock production may allow some marginal lands to be converted back to crop or forage production at a higher level of productivity.
Keywords: plant available water, soil organic carbon, eastern red cedar, agroforestry
Financial support: This research was supported by funding from the North Central Regional Sun Grant Center at South Dakota State University through a grant provided by the US Department of Agriculture under award number 2014-38502-22598.

(7589 - 841) Effect the runoff harvesting collection area shape on the efficiency of the water conservation in the soil profile

Pedro Berliner[1]; Gennady Carmi[1]; Solomon Leake[1]
Ben-Gurion University of the Negev[1]

Water is a primary limiting factor to agricultural development in many arid and semi-arid regions. In these regions, much of the annual rainfall occurs as a result of a few intensive convective storms. Only a small fraction of the rain is absorbed by the soil, does not penetrate deeply into the soil profile and is mostly lost by direct evaporation into the atmosphere shortly after the rain event. Runoff harvesting technique may be used for food, fuel production, flood and erosion control, as well as for landscape development. Microcatchments are one of the primary techniques used for collecting, storing and conserving local surface runoff for growing trees/shrubs. In this system, runoff water is collected close-by the area in which it was generated, and trees/shrubs may utilize the water during the next dry season. The main objective of the present research was to estimate the effect the shape of the micro-catchment collection area (shallow basin and deep trench) has on the efficiency of the water conservation in the soil profile. The study was carried out using regular micro-catchments (three replicates) with a surface area of 9 m^2 (3 x 3 m) and a depth of 0.1 m and trenches (three replicates) with a surface area of 12 m^2 (12 x 1 m) and 1 m depth. One and three olive trees were planted inside the trenches and micro-catchments, respectively. Access tubes for neutron probe were installed in micro-catchments and trenches (four and seven, respectively) to depths of 3 m. Soil water content in the soil profile was monitored. Sap flow in trees was measured by PS-TDP8 Granier sap flow system every 0.5 hour and fluxes computed for the time intervals that correspond to the soil water measurements. The study included flooding trenches and regular micro-catchments with the same amount of water (1 m^3), monitoring the water balance components and estimation of evaporation losses and water use efficiency by olive trees. Evaporation from trenches and regular micro-catchments was estimated as the difference between evapotranspiration obtained by soil water content monitoring and transpiration estimated by sap flow measurements. The results clearly show that the evaporation from the regular micro-catchments was significantly larger than that of trenches during the entire duration of the experiment. The fractional loss due to evaporation for the entire experimental period was 53 and 22% for micro-catchments and trenches, respectively.
Keywords: water conservation, plant-soil-water interaction, evapotranspiration, infiltration, arid zone
Financial support:

(2501 - 324) Effects of solute type and mineralization on soil salt ions during the release water process

Quanen Guo[1]; Yiquan Wang[2]; Zongxian Che[1]; Lili Nan[3]; Shiyu Cao[1]; Jiancheng Wang[1]
Soil Fertilizer and Water-Saving Institute, Gansu Academy of Agricultural Sciences[1]; College of Resources and Environmental, Northwest A & F University[2]; Pratacultural College, Gansu Agricultural University[3]

Water resource shortage has become an important limiting factor for the agricultural production in arid areas in Northwest China. The efficient utilization of brackish water resources is of great importance significance for food safety in irrigated areas. However, the influence of irrigation with different salt ion compositions on soil salt ions during the release water process is unknown. In the study, the soil samples were collected from orchard calcareous soil in Qin'an County of Gansu Province. The content of soil organic matter is 10.52 g/kg and pH is 8.54. Soil electrical conductivity is 0.43 mS/cm. The influences of two sodium salts (NaCl, Na_2SO_4) with different mineralization degrees (0, 1, 3, 5, 10 g/L) on salt ion composition (HCO_3^-, Cl^-, SO_4^{2-}, K^+, Na^+,Ca^{2+},Mg^{2+}) in soil solution were explored with the dehydration centrifugal method under different water suction conditions (*pF* 1.0, 1.49, 2.01, 2.71, 3.49, and 4.09). The influences of NaCl and Na_2SO_4 on salt ions in soil solution were different. When soil water tension (*pF*) was more than 2.0, Cl^- and SO_4^{2-} in irrigation water inhibited the dissociation of Cl^- in soil solution and Cl^- in irrigation water inhibited the dissociation of SO_4^{2-} in soil solution. When soil water tension (*pF*) was less than 2.0, the NaCl solution with the degree of mineralization more than 3 g/L promoted the dissociation of the Ca^{2+} in soil solution and the promoting effects of dissociation increased with the increase of salinity. When soil water tension (*pF*) was more than 2.0, NaCl solution (the degree of mineralization of was 1 g/L) inhibited the dissociation of Ca^{2+} in soil solution. NaCl and Na_2SO_4 in irrigation water promoted the dissociation of Mg^{2+} in soil solution. The study could provide the basis for restraining soil salts in brackish water irrigation in arid regions.
Keywords: Mineralization degrees; release water process; salt ions
Financial support: National Natural Science Foundation of China (Nos. 41363004) and Innovation Team of Gansu Academy of Agricultural Sciences (2015GAAS03)

(7794 - 658) Establishment of critical soil water potential tresholds for water stress deficit in *Carica Papaya*

Róger Armando Fallas Corrales[1]; Bryan Alemán Montes[1]; Gabriel Garbanzo León[1]; Carlos Henríquez Henríquez[1]
University of Costa Rica[1]

Carica papaya is a tropical crop with a very high potential yield (if well fertilized and irrigated can achieve more than 200.000 kg fresh fruit ha^{-1}). In order to define the soil water potential in which *Carica papaya* begins to suffer from water stress deficit (a necessary parameter for the proper management of irrigation), it were developed pot experiments with variation in soil moisture. It was measured the soil water potential, its plant canopy temperature and the spectral signature in the most recent completely expanded leaf for each plant in different evaluations. A good Spearman´s correlation rank (rho=0,71, p-value<0,0001) was observed between the relative increase of the plant canopy temperature and soil water potential. Using the graphical data of the relative increase of leaf temperature, it was possible to define the critical soil water potential that generates water stress deficit to *Carica papaya* plants. There were high variations in the spectral signatures of plants submitted to similar soil water potential, which difficult to correlate plant measurements with the respective soil water potentials.
Keywords: water deficit, Carica papaya, soil water potential thresholds
Financial support: FITTACORI and University of Costa Rica

(7827 - 2429) Estimation of surface runoff using the stable infiltration rate determined by different methods

Felipe Dalla-zen Bertol[1]; Dalvan José Reinert[1]; Micael Stolben Mallmann[1]; Willian Saidelles Foggiato[1]
Universidade Federal de Santa Maria - RS[1]

The infiltration rate of water in the soil is one of the main factors that regulates and determines the volume of the surface runoff, responsible for the soil erosive process. For determination of infiltration rate, different methods are used, seeking better to represent an infiltration in rainfall events. Among the methods are the Double Rings and Cornell Sprinkle Infiltrometers. We objective to estimate the runoff using Steady Infiltration Rate (SIR) values determined by three different methods. The study was carried out in the experimental area of the Department of Soil in Federal University of Santa Maria, Santa Maria, Brazil, in a Hapludalf. The SIR was determined with the Double Rings and Cornell Sprinkler Infiltrometer and using a Natural Rain runoff measuring in three treatments: 1. Bare soil (BS); 2. Black oats (Avena strigosa) and vetch (Vicia sativa) – winter - and cowpea (Vigna unguiculata) - summer (OVB); 3. Pensacola Grass (Paspalum notatum) (PG). The plots with dimensions of 3 x 14.5 m, are delimited by metal sheets and in the lower part of the plot a frame collect runoff and direct the volume to a reservoir of 1 m³, where were volume readings are made at intervals of 1 min. The SIR with Natural Rain event was determined in a rain event that occurred a few days after the measuring infiltration with the other methods, and calculated by integrating the difference between a precipitation and the surface runoff for 1 min time intervals. The runoff estimation was performed for 1 min intervals, using a difference between precipitation rate and SIR, and time-integrated values. The three methods were compared by evaluation of Nash-Sutcliffe efficiency coefficient (NSE) and the standard deviation of observations (RSR). The runoff estimation using the SIR determined with Natural Rain was more efficient instead of using the SIR by double ring and Cornell methods, with NSE between 0.87 and 0.96 and RSR between 0.21 and 0.36. Using a SIR determined by Double Ring and Cornell methods, the estimate of the runoff showed NSE between -0.22 and -1.17 for double ring and -0.06 and 0.1 for the Cornell. The surface runoff is underestimated when using the SIR determined by Double Ring and Cornell methods, being better estimated, for plot scale, when use SIR determined with natural rain.

Keywords: *erosion, water conservation, cover crops*
Financial support: PIBIC-CNPq

(6249 - 2234) Evaluation of a low-cost sensor to implement a wireless soil moisture sensor networks

Pedro Vieira CRUZ[1]; Marcos Bacis CEDDIA[1]
UFRRJ[1]

The monitoring of the spatial variability of soil moisture is very important in order to improve the efficiency of water use in agriculture. However, the implementation of a monitoring system demands the combination of technology (soil moisture sensors, methods of data transmission and processing) and low-cost. In recent years, wireless soil moisture sensor networks (WSMN) have emerged. Basically, it encompasses the soil sensor, a wireless communication technology like ZigBee/XBee, Bluetooth, Wibree and WiFi and hardware platforms (like Arduino). In this work, we present an evaluation of a low-cost soil sensor to be implemented in a WSMN which will be used to characterize the spatial variability of soil moisture in an agroecological production system. The soil sensor evaluated was the model Analog Capacitive Soil Moisture Sensor-Corrosion Resistant. In order to evaluate the accuracy of soil sensor, a laboratory experiment was performed to compare the estimation of soil moisture using the sensor with the soil moisture measurement using the thermogravimetric method. The evaluation tested the sensor under different soil moisture (six levels - from hygroscopic to saturated soil moisture) soil texture (sandy, loamy and clayed soil). Considering the soil moisture level (6), soil texture (3) and the repetitions (4), the soil sensors were installed in 72 PVC soil recipients (11.3 cm of high, 3.6 cm of radius, 460 cm^3). From 72 PVC soil recipients, 48 (75%) were used to develop the prediction equation, while 24 PVC (25%) were used to validation. The index RMSE and MAE and R^2 were used to evaluate if a unique equation could be used for all soil texture or if the accuracy is significantly improved adopting specific equation for each soil texture. The results show that both the MAE and RMSE were lower (higher accuracy) in sandy soil. The accuracy reduced as the clay content increase and the use of a unique equation cause a significant loss of accuracy (MAE of 1.7, 2.3, 4.1 and 5.4; RMSE of 2.1, 2.9, 4.1 and 5.4, for sandy, loamy, clayed and all soil texture respectively). The results show that the accuracy of the soil sensor is acceptable and the soil sensor can be used in a WSMN, however, the topology of the network has to be implemented including different equations according to the soil texture of the position where the sensor is inserted along the field.

Keywords: Arduino, Soil physics, Soil Electrical Resistance, XBee, Sensor Network
Financial support: CNPq, UFRRJ

(8976 - 3230) Evaluation of the hydraulic conductivity of the soil under different uses and sun-exposed faces

Lopes, Vanessa Schiavon[1]; Fernandes, Osmar Rosa[1]; Zeferino, Leiliane Bozzi[1]; Cardoso, Irene Maria[1]; Simas, Felipe Nogueira Bello[1]
Universidade Federal de Viçosa[1]

Understanding the hydraulic conductivity of soil (Ks) in different types of soil cover and faces of exposure to the sun helps the acquisition of new knowledge on the behavior of soil hydraulic properties. The change of land cover has great influence on K s, many studies have shown that the conversion of degraded pastures into forest increases the K s, but there is little knowledge about the Ks of areas in the regeneration process to the native vegetation as well as the influence of the different faces of exposure to the sun on the soil. The objective of this study was to evaluate the relationship between the type of land use and cover, pastures and areas under regeneration, and the two faces of exposure to the sun, east and west, on Ks. The study was carried out at the headwaters of the São Bartolomeu River, responsible for part of the water supply of the city of Viçosa, MG. Fifteen soil samples were collected at depths of 0.0-0.15 m in regeneration and pasture areas on the east and west faces of exposure to the sun, with a total of 60 samplings. For the purpose of comparison, the slope and the type of soil were standardized. Undisturbed soil samples were collected to measure the Ks with the help of auger type-Uhland. The samples were saturated (from the bottom up to expel the air bubbles) with water for 24 hours. Then a tube of the same diameter and height was fixed by means of waterproof adhesive tape to act as a reservoir and Mariotte bottle were used to maintain a constant load. Finally, the volume of water in the sample cylinder was measured after the flow stabilization, with each sample showing reproducibility in five successive determinations. The results showed that Ks was significantly higher ($P < 0.05$) in the regenerated area compared to the pasture area. The area under regeneration with the soil facing the east presented higher ($P < 0.05$) Ks than the area in regeneration with facing the west exposure to the sun. The Ks decreased in the order of regeneration area with east exposure face, regeneration area with west exposure face, pasture with east facing face and pasture with face of west exposure, corresponding to the degree of vegetation degradation. The west face of exposure to the sun is affected by increased sunlight that favor the greatest number of wetting and drying cycles, greater degradation of organic matter in influencing different physical soil

properties such as hydraulic conductivity.
Keywords: soil management, soil quality, water dynamic
Financial support: Fapemig

(1000 - 745) Evapotranspiration: model versus measurements

Sascha Reth[1]; Christian Heerdt[1]
UGT GmbH[1]

Evapotranspiration is one of the most needed information in environmental research, and one of the most discussed. The calculation of the evapotranspiration using climate data measured by a (standard) climate station is stand of the art. Calculations normally used the equations of Penman-Monteith, Haude or Turc, with all the known limitations of each method. Further on eddy covariance is a common method. Often the calculated rates are not in line with the real scenarios at the place, because of the requirements postulated by the different methods – e.g. homogeneous surface structure- are not given. Real measurements of the evapotranspiration need the use of large lysimeters which are time and money consuming. The new Ready-to-go Lysimeter is a small lysimeter station for soil columns with an area of up to 0.5 m² and a length of up to 1 m. The Ready-to-go lysimeter is suitable both for disturbed soil (filled by hand) and for undisturbed soil monoliths when using the patented UGT excavation technology. The Ready-to-go Lysimeter is the ideal supplement to an existing weather/climate station for directly calculating evaporation and the recalibration of the mentioned above calculation methods for the exanimate area.
Keywords: evapotranspiration, model, lysimeter, climate
Financial support:

(5746 - 2018) Filtration of *Phytophthora* and *Pythium* Zoospores in Recycled Irrigation Water to Control Plant Disease Outbreaks in Greenhouse

Sangho Jeon[1]; Charles S. Krasnow[2]; Mary K. Hausbeck[2]; Yeon-Kyu Sonn[1]; Byung-Keun Hyun[1]; Sun-Gang Yun[1]; Wei Zhang[2]
National Institute of Agricultural Science in Korea[1]; Michigan State University[2]

Pythium and *Phytophthora*, also known as “water molds”, cause enormous economic losses on crop species worldwide, which include seedling damping-off, stunting, and stem, crown, and root rot diseases in both floriculture and vegetable crops as well as environmental damage in natural ecosystems. It is challenging to control these pathogens because plants are infected and do not show symptoms until the disease is too advanced to respond to treatment, and easily develop resistance to effective fungicides. In this regard, our study investigated the transport and retention of *Phytophthora. capsici* zoospores in saturated columns packed with iron oxide coated sand (IOCS) or uncoated sand in Na^+ or Ca^{2+} background solution at pH 7.2 or 4.4, in combination with zeta-potential and microscopic visualizations. The findings suggest that the transport of the plant pathogen *Phytophthora. capsici* zoospores in porous media was collectively controlled by surface properties of zoospores and porous media, solution chemistry, and pore straining. Greenhouse experiment was investigated to demonstrate a proof-of-concept of using fast-flow filtration system to control *Pythium* disease of poinsettias grown with ebb-and-flow and flood floor irrigation systems in greenhouses. This study showed that *Pythium aphanidermatum* could be effectively removed by the sand and AC filters during fast-flow filtration with low water pressure. The rapid sand filter had the best performance because no decrease in the poinsettia quality was observed when compared to the non-inoculated control plants. Additional greenhouse experiment was carried out to investigate the effectiveness of fast-flow filtration to control *Phytophthora* diseases in the greenhouse vegetable production. This study found that the IOCM filter could effectively protect the squash plants from *Phytophthora capsici*, but caused the nutrient deficiency in the squash. The sand filter could not prevent, but only slow the disease development in the squash. Thus, it is clear that the IOCM filter has the potential to be used in treating irrigation water in the greenhouse vegetable production. Overall my results suggested that physical removal of pathogens using fast-flow filtration can overcome many limitations of fungicide application, and may be a promising alternative for disease management in the greenhouses.
Keywords: Phytophthora, Pythium, fast-flow Filtration, Iron oxide coated media(IOCM), Activated carbon
Financial support: American Floral Endowment, MSU AgBioResearch, NAS

(2411 - 2981) Geophysical investigation of soil moisture content for agricultural purposes

Ruan Ainslie[1]; Jaco Koch[1]
North-West University[1]

Water scarcity is on the rise and is rapidly becoming an international problem. This has enormous effects on agriculture and water management systems. The causes of water scarcity is mainly due to the large continuous increase in population, urbanisation and the continued improvement of living standards. This greatly increases the pressure on water supplies, due to the increasing demand for food production and industrial activities. Draught is seen as a common and recurring phenomena globally. Such severe climatic events can have an enormous effect on crop production and livestock, which occurs in agricultural regions worldwide. This study aims at correlating geophysical techniques applicable to soil moisture estimation, as to ensure that soil moisture content is managed correctly and efficiently. Thereby saving time and decreasing expenses by minimising water and electricity usage on pivots, and maximising crop yields. Furthermore, this study is also aimed at determining the best and most efficient method (of the methods used in this study) for soil moisture investigation aimed at decreasing time and cost of data collection for soil moisture. Previous studies usually concentrates on only one or two of the methods used. This study compares three geophysical techniques and is correlated with the gravimetric water content of the soils. With the correlation of the three different techniques, it would be able to establish the most accurate, quick and easy method for continues soil moisture monitoring. In this study, the CMD Explorer, the CMD Mini-Explorer, the CPN 501DR Depthprobe and the Diviner 2000 will be used throughout the planting season, on a farm near Potchefstroom, South Africa, to measure and monitor soil moisture content. This data will be monitored over a period of six months, to ensure accurate short term data for ground water management. The preliminary assumption is that the Diviner 2000 would be the method of choice. This is mostly due to the mobility, cost and ease at which the apparatus is used, given that this apparatus correlates with the other, more known and trusted, methods of geophysical investigation with regard to soil moisture content.
Keywords: Food production; geophysical techniques; soil moisture; water management.
Financial support:

(2412 - 1644) Hydrological characteristics of four Soilless Substrates for Potting Cultivation

Daniel Fonseca de Carvalho[1]; Eleandro Silva da Cruz[1]; Clodoaldo Spadeto Ambrozim[1]; Wendel Lucas de Sousa[1]
Universidade Federal Rural do Rio de Janeiro[1]

In the last years the soilless potting cultivation has increased considerably in face of traditional technics. The materials adopted as substrate in these systems must present favorable physical characteristics to the development of the plants, highlighting those directly related to the capacity of water retention. This study was

developed at Federal Rural University of Rio de Janeiro, Rio de Janeiro State – Brazil, and intend to generate water retention curves of four soilless medium. The evaluated materials were: S1 –coconut fiber crushed with vermicompost produced from bovine manure (3:1 vol. by vol.); S2 – sewage sludge provided by the State Water and Sewerage Company of Rio de Janeiro (CEDAE); S3 - substrate S1 plus granite powder, a residue of stone cutting and polishing resulting from its preparation for ornamental use (3:1 vol. by vol.); and S4 - substrate S2 plus granite powder (3:1 vol. by vol.). The sample was obtained from the hidraulic campactation process, that consists in to put the substrates on a plastic pipe (diameter: 15 cm, height: 65 cm), and fill it loosely up to 5 cm below the upper edge. After water must be added at the surface until water left at the bottom of the pipe, and than the pipe must be placed for 2 days in a pan with a 3 cm water level. After this time, the tension at the surface layer its about 50 hPa. The substrate material of the upper 5 cm layer of the pipe was taken, mixed and used to loosely fill 250 cm^3 HYPROP steel cylinders.The samples were then homogenized and conditioned again in the steel cylinders. They were then saturated and subsequently placed in the HYPROP system (UMS) to begin the readings. The observed dry bulk densities observed were 0.12; 0.44; 0.69 and 0.58 $g.cm^{-3}$, respectively, for S1, S2, S3 and S4. The Van Guenuchten model was adjusted to the water retention data, whose soil residual water content (θr), soil saturated water content (θs), scale parameter (α) and shape parameter (n) values were respectively: 0.261, 0.970, 0.1102 and 2.657 (S1); 0.277, 0.707, 0.0781 and 1.945 (S2); 0.272, 0.806, 0.1162 and 1.489 (S3) and 0.339, 0.781, 0.0941 and 1.714 (S4). The root mean square error values of the adjustments were 0.0431 (S1), 0.0086 (S2), 0.0145 (S3) and 0.0111 (S4). The results show that the water retention capacity is altered according to the soilless medium adopted, and it is necessary to be properly characterized before being used as agricultural substrates.

Keywords: water retention granite powder coconut fiber sewage sludge

Financial support: Fundação de Amparo à Pesquisa do Estado do Rio de Janeiro – FAPERJ

(3631 - 284) Infiltration of water in a Oxisol in organic corn crop using different cover crops

Juliana Megumi Kanashiro de Oliveira[1]; Carolina dos Santos Batista Bonini[1]; Melissa Alexandre Santos[1]; Neli Cristina Belmiro dos Santos[2]; Guilherme Constantino Meirelles[1]

FCAT/UNESP DRACENA[1]; Agência Paulista de Tecnologia dos Agronegócios - Pólo Regional de Andradina[2]

The quality of the physical aspects of the soil, as a consequence of the use and management, is given by the indices of different physical properties related to the structural stability and soil form. The changes in the physical properties are many, we can mention the decrease of the rate of infiltration of the soil, which is influenced by the reduction of the macropores, leading to the reduction in the cross-sectional area for the water flow. The use of other species for the production of biomass as ground cover, prevents leaching of nutrients, allowing for more efficient use of nutrients in solo. To ensure good root development and water infiltration capacity of the soil, it is necessary that the internal physical conditions are suitable for infiltration occurs. Once the structural quality is good, the pore size distribution favors the factors mentioned above. The infiltration rate is a good parameter for the internal physical condition of the soil. The field experiment is being developed for the agricultural year 2016-17, the Technological Development of Regional Center of West Far Agribusiness, Andradina-SP. The soil is classified as Oxisol dystrophic. The experimental design was a randomized block with four replications. Seven treatments were evaluated consisting of green manures described below: *Canavalia ensiformis*, *Mucuna cinereum*, *Mucuna pruriens*, crotalária (*Crotalaria juncea*), *Dolichos lablab, Canavalia ensiformis* + *Mucuna pruriens and witness (fallow).* Evaluating the constant rate of water infiltration into the soil was carried out using the Mini Disk infiltrometer, at the time of green manure (October / 2016) and green maize (April / 2017). The statistical test used for analysis was the Scott-Knott test at 5% probability. Statistically analyzing the treatments were not influenced by different green manures used. This result agrees with that 6 soils with sandy texture have average infiltration ranging from 38.1 to 111.8 mm/h. And second the adopted handling systems have great effect on the rate of infiltration into the soil. The homogeneity of the constant rate of infiltration all close to 100 mm / hr due to the fact that all species tested belonging to the legume family that has a root system which beneficially influences the physical properties of the soil. Therefore, it was concluded that the treatments used did not influence the water infiltration rate in the soil.

Keywords: green manures, agrosystems, physical attributes of soil

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(4605 - 2616) Influence of soil layers with canal bed with different water cuttings on frost heaving of lining structure

Xiangdong Shen[1]

IMAU[1]

Freezing tests were carried out on canal bed soil, foundation soil and lining composite structures with water content of 10%, 15% and 20%, respectively. The frost heaving volume, freezing thickness and freezing time of various soils were measured. The relationship between the three factors is analyzed, and the influence of soil with different water content on the frost heaving failure of the lining structure is analyzed. The influence of the freezing and thawing of the soil with different water content on the frost heaving failure of the lining structure is obtained. With the increase of soil water content, the scope and depth of deformation and failure in the structure increase. The failure mode changes mainly from the local slump of the interface to that of the whole slump. The greater the moisture content, the more severe the freezing and destruction. Using Leica Z16APOA super-depth of field to observe the change of the interface during the freezing process, the variation of the frost heaving failure on the interface was obtained.

Keywords: freeze test, moisture content, interface, frost heaving volume

Financial support:

(8238 - 277) Measuring near-wilting soil hydraulic properties and their application in crop water availability modeling

Quirijn de Jong van Lier[1]; Everton Alves Rodrigues Pinheiro[1]

CENA/USP[1]

Water availability to crops depends on dynamic processes in the soil, however, predictions of characteristic water contents like field capacity or permanent wilting point are commonly based on a fixed pressure head value alone. Mesoscopic root water uptake models show that crop water availability and the characterizing conditions largely depend on soil hydraulic properties, especially those for the dry soil close to wilting point. On its turn, agricultural management affects the hydraulic properties, hence the evaluation of changes in crop water availability should include their determination. We verified the changes in water availability limits in some Brazilian soils with different management histories and, based on obtained values, made predictions of the available water fraction and how it is affected by soil management. We performed evaporation experiments measuring soil water content by gamma-ray attenuation readings. Undisturbed soil samples were taken from some soils from São Paulo State, Brazil. Samples were saturated by capillarity, closed at the bottom and then submitted to natural evaporation from their upper surface. Evaporation rate was determined by weighing. Measurements of attenuation of a collimated gamma ray, produced by a ^{137}Cs source

were performed at several times and depths below the sample surface, during some weeks after the onset of evaporation, until samples reached a very low (quasi air-dry) water content. Samples were finally oven dried and one last reading was performed to determine the attenuated reading of the dry sample. Water contents corresponding to attenuated readings were calculated using Beer´s law. From these measurements, hydraulic properties (retention and conductivity) were obtained as a function of pressure head using Richards equation-based inverse modeling. The obtained hydraulic properties allowed to determine field capacity by a flux density criterion at the lower soil boundary. Critical and wilting point conditions could be estimated by a matric flux potential approach. Determined values for field capacity and critical and wilting point conditions were evaluated by comparison to values obtained by the common practice using fixed pressure heads. The set of information allowed to discuss the validity of the common (fixed pressure head) method, suggest improvements for its interpretation and limitations to its use. Impact of agricultural management on crop water availability will be discussed in this context.

Keywords: root water uptake, transpiration, wilting point, field capacity

Financial support: Fapesp Processo 2016/13318-7

(3996 - 2613) Modernizing surface irrigation and land levelling in Hetao with application of the DSS SADREG

Haibin Shi[1]; Qingfeng Miao[1]; José M. Gonçalves[2]; Luis S. Pereira[3]

IMAU[1]; CEER - Biosystems Engineering, Institute of Agronomy, University of Lisbon[2]; Polytechnic Institute of Coimbra, College of Agriculture[3]

Water resources allocated to the agricultural sector in the Yellow River basin are being reduced due to severe water scarcity and an increasing demand by the non-agricultural sectors, which imply surface irrigation modernization and the adopting water-saving technologies. The Hetao irrigation district has 0,570 Mha of irrigated land; traditional basin irrigation is the most common irrigation method. Its general conditions are adequate for surface irrigation due to the high charge of sediments on irrigation water and, among other factors, due to its appropriateness to leach salts. The new technologies of surface irrigation, including the modernized furrowed and flat basin irrigation systems, require the adoption of effective precise land levelling to reach the best performance standards. In this context, the development of high quality land levelling operation is a main condition for irrigation modernization. The laser land levelling technology provides for high land leveling quality, with significant benefits on water saving, salinity control and crop productivity. The irrigation modernization also requires adopting adequate irrigation scheduling, control of inflow discharges and of related application times. The DSS methodology may contribute to improved design and management. The DSS SADREG aims to support design and selection of farm surface irrigation alternatives; it ranks those alternatives relative to irrigation performance and environmental and economic impacts using multicriteria analysis. The DSS application bases on three years field work to evaluate the traditional practices and for the parameterization of design models from field irrigation systems evaluation. This paper presents the following SADREG application results: (i) evaluation of land levelling operation based on field observations and the comparison between laser and common practices; (ii) SADREG base models parameterization, including crop irrigation scheduling, infiltration, SIRMOD hydraulic simulation and economics.

Keywords: basin irrigation, surface irrigation modeling, irrigation design, decision support systems (DSS), Yellow River basin

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(6149 - 2950) Physical attributes of a dystrophic Yellow Latosol submitted to different mulchings in 'Ateira' (*Annona squamosa* L.) plantation

João Vitor Garcia de Lima[1]; Matheus Gonçalves Paulichi[1]; Augusto César Rodrigues Santos[1]; Patrícia dos Santos Mendes[1]; Wellington Farias de Araújo[1]; Pollyana Cardoso Chagas[1]; Marcus Vinicius Cardoso Trento[2]; Carlos Abanto Rodriguez[1]; João Luiz Lopes Monteiro Neto[1]; Raphael Henrique da Silva Siqueira[3]

Federal University of Roraima (UFRR)[1]; Federal University of Lavras (UFLA)[2]; Federal University of Amazonas (UFAM)[3]

The control of soil moisture and temperature can interfere in the dynamics of physical, chemical, and biological attributes in their different uses and management. The use of mulching is a practice that has been disseminated to improve the characteristics of water retention in the soil and to leverage the development of the crops in the field. Therefore, the objective of this research was to evaluate possible physical changes caused by different mulchings in a Yellow Latosol cultivated with 'Ateira' (*Annona squamosa* L.). The experimental design was a randomized block with 5 treatments (SC-no cover (control group); CA – *in-natura* rice hulls; PB – white plastic; CAC – carbonized rice hulls; and PP-black plastic) and 2 layers (0-0.15 and 0.15-0.30 m), with 4 repetitions. The different types of mulching were applied in the line of the 'ateira' trees, after having been made a heap in the dimensions of the plot (1 meter wide x 12 meters long), respecting the growth area of the plant. Soil samples were collected with Kopech rings and analyzed according to EMBRAPA (1997). The variables analyzed were: soil density (Ds), total pore volume (VTP), macroporosity (Macro), and microporosity (Micro). Soil density and total pore volume did not vary between layers and treatments, presenting mean values of 1.64 Mg m^{-3} and 36.46%, respectively. Macro and microporosity demonstrated interaction effect between layers and treatments. For the macroporosity, in the 0-0.15 m layer, the CAC treatment presented greater macroporosity in relation to the other treatments, presenting 30.22% of macropores. The microporosity was higher in the treatments CA, PP, and SC in comparison to the other treatments in the first layer, whereas for the layer 0.15-0.30 m it did not present differences between treatments. Variation in the pore dynamics occurs with the different types of mulching in the Latosol cultivated with 'ateira'. The 0-0.15 m layer is most influenced by the mulchings.

Keywords: Soil physics; mulching; *Annona squamosa* L.

Financial support: CNPq, CAPES, UFRR, IFAM – CMZL.

(2550 - 2990) Physical soil quality indicators under cassava harvesting systems (*Manihot esculenta Crantz*)

Ronilson de Souza Santos[1]; Sandra Andréa Santos da Silva[1]; Maria Helena Morais[2]; Kléber Pereira Lanças[2]

Universidade Federal do Pará/Campus de Altamira[1]; Universidade Estadual Paulista/Campus Botucatu[2]

The cassava originally from the Brazilian Amazon, has a worldwide production of 275 million tons and feeds approximately 500 million people. In Brazil, the crop has average yield of 14 $t.ha^{-1}$. The objective this work was to evaluate some physical soil indicators, considering the management actions maked during cassava harvesting process. The experiment was conducted in commercial cassava field, and was composed of three treatments called of Manual harvesting system (S1), that was composed of manual pruning of the aerial part plant, manual roots pulling, roots separation following of roots boarding into mobile wagon unit that doesn't traffic by inter row planting; Semi-

mechanized harvesting system (S2), that was composed of mechanized pruning of the aerial part plant, soil detachment, manual roots pulling, root separation following of boarding into mobile wagon unit that got traffic by inter row planting and Mechanized harvesting system (S3), that was composed of mechanized pruning of the aerial part plant, soil detachment, mechanized picking and machanized boarding roots into mobile wagon unit that doesn't traffic by inter row planting. The experimental design used was in strip, measuring 23.4 x 100 meters, composed of 15 pair of rows per system. Randomly, among row pair, was chosen six pair of inter rows planting, and was make penetrometry action to six radom places per inter row. The measure was done using the transept that had five measuring places with 0,18 meter between them, positioned transversely to the traffic line maked by farm workers and wheel agricultural machines, during harvesting operation. Also was collected at the center of the inter row undisturbed sample, distanced perpendicularly to 0.50 m of the transept line, being for both quality indicators, the data collect happened from 0 to 0,30 meter of depth. From the data obtained, was calculated the cone index and the soil density. The averages results obtained for cone index at the transept were 0.77, 1.20, 1.44, 1.52, 1.27 MPa; 1.40, 1.83, 2.09, 2.05, 1.86 MPa and 1.28, 1.93, 2.22, 1.91, 2.06 MPa, S1, S2 and S3 systems, respectively. The superior results to S2 and S3 treatments could be associated to located traffic from the whell agricultural machines, condition observed mainly to central samples. This behavior was repeated to results of soil density that were to 1.53, 1.57 and 1.59 $Mg.m^{-3}$; S1, S3 and S2 systems, respectively.

Keywords: Penetration resistance, controlled traffic, cassava crop
Financial support: Coordination for the Improvement of Higher Level Personnel- CAPES

(5893 - 1522) Physico-empirical approach to predict soil water retention

Rodrigo Pivoto Mulazzani[1]; Paulo Ivonir Gubiani[1]
Federal University of Santa Maria[1]

Soil water content is physically linked to its pressure head (ψ), resulting in a relation known as soil water retention curve (SWRC). As SWRC obtainment is time-consuming, scientists try to access it by using pedotransfer functions (PTF). Currently, most of PTFs are empirical, therefore, restricted in application. Thus, efforts must be made to produce PTFs based on mechanistic processes or elementary relationship of physical soil characteristics. From this approach, we have proposed a model to predict SWRC based on soil specific surface (SS – textural component) and bulk density (ρ_b – structural component). The model describes gravimetric water (W) as the product of free SS (SS_f – particle specific surface that is not in contact with surrounding particles) by factor 'fa', which represents water mass by unit of surface. Free SS depends on particles characteristics (shape, size distribution), estimated by total SS (SS_t), and degree of packing, represented by ρ_b. Factor 'fa' was related to ψ by Van Genuchten's (1980) sigmoidal model, and the effects of SS and ρ_b on 'fa' were incorporated to the model parameters. Overall, the model can be described as $W = [SS_f = f(SS_t, \rho_b)] \times [fa = f(\psi, SSt, \rho_b)]$. Samples from 13 soils with different textures were used to draw up two sample sets. One set of disturbed soil samples was artificially set up in metal cylinders to obtain controlled ρ_b (artificial set); the other set was constituted of undisturbed soil samples (undisturbed set). A part of the artificial set was used for model calibration and another part of the artificial set and the whole undisturbed set was used for model validation. Results of the calibration process show that the model can describe physically consistent variations of SS (texture) and ρ_b (structure) on soil water retention. The model validation shows values of Nash–Sutcliffe efficiency index of 0.73 to 0.99 (mean 0.93) to artificial set and values of 0.27 to 0.90 (mean 0.65) to undisturbed set samples. Results evidence that the proposed model has potential to be used to estimate water retention, because it was able to predict SWRCs with good accuracy in both sample sets (0.99 and 0.90). On the other hand, a few undisturbed samples did not show good estimative (0.27). Thus, it is reasonable to conclude that either water retention at undisturbed samples is still too complex to be modeled or the proposed model needs improvements to ensure its applicability to broader soil conditions.

Keywords: pedotransfer functions, specific surface, water content.
Financial support: Coordination for the Improvement of Higher Level Personnel (Capes)

(7360 - 897) Retention and availability of water from a soil treated with biochar

Maria Maiara Cazotti[1]; Hélio Alves Pereira Filho[1]; Leiliane Bozzi Zeferino[1]; Luís Paulo Patente Tanure[2]; Liovando Marciano da Costa[1]
Universidade Federal de Viçosa[1]; Produquímica[2]

The agricultural sector is responsible for the production of food, fiber, and energy. However, it has been largely responsible for water consumption as well as the extensive areas of degraded soils, which increasingly constrains gains in agricultural production and threatens food security. In this sense, the application of biochar has been proposed as an excellent alternative for improving the chemical, physical and biological quality of agricultural systems. Although many studies have shown positive effects of the application of biochar, some aspects need to be further studied, especially those related to the soil physicohydric properties. The objective of this work was to improve the knowledge about biochar of forest residues, in the retention and availability of water when applied in an Oxisol. The biochar used in the test was produced by the slow pyrolysis process at 350 ºC, using *Eucalyptus* spp. as feedstock. The pyrolysis was performed with an average heating rate of 4 min and a residence time of 60 min. To conduct the test, the biochar was milled to obtain the particle size less than 0.5 mm. Oxisol B horizon samples, with 35% sand, 3% silt and 62% clay, were passed in a 2 mm sieve and then added three doses biochar (0, 20 and 40 g kg^{-1}). Three deformed samples of each treatment and a treatment with only biochar were used to generate the water retention curve in the soil from the tensions (6; 10; 30; 50; 100; 300; 1500 kPa). The available water content (AWC) was calculated by means of difference of humidity between the 30 and 1500 kPa tensions. The analysis of variance was performed and the means compared by the Tukey Test. It was observed that the water retention capacity of the pure biochar is large, that at 6 kPa the material retains water mass greater than its own mass (1.40 kg kg-1). The increment of the doses increased the retained moisture in the different potentials in compared to the control (dose of biochar 0 g kg^{-1}). The AWC was statistically higher in the only biochar, equal between the treatments of 20 and 40 g kg^{-1} of biochar and lower in the treatment with 0 g kg^{-1} of biochar. Characteristics such as, high specific surface area and high porosity may be responsible for increasing retention and water availability of soils treated with biochar. The results show that at the lower dose applied the biochar could be used to improve the retention and availability of water in the soil.

Keywords: Sustainability; soil water; biochar.
Financial support: FAPEMIG, project number APQ 03538-16

(4005 - 2527) Seasonal Plant Water Status in Native Shrubs and Trees, northeastern Mexico

Humberto González Rodríguez[1]; Haydee Alejandra Dueñas Tijerina[1]; Israel Cantú Silva[1]; Roque Gonzalo Ramírez Lozano[1]; Marco Vinicio Gómez Meza[1]
Universidad Autónoma de Nuevo León[1]

Since plant internal water potentials (Ψ) are a consequence of the soil-plant atmospheric continuum, measuring the actual internal plant water potential and soil water status directly in the field gives us reliable information about the water stress plants may suffer. Hence, it is important to measure water potential in order to identify the plant's capacity and strategy to cope with drought. According to the above mentioned, this study deals with the physiological adaptation of native trees and shrubs to drought stress in the semiarid ecosystems of northeastern Mexico. The present study has the objective to relate the soil water content with xylem water potential in native woody species such as *Condalia hookeri* (Rhamnaceae), *Cordia boissieri* (Boraginaceae), *Prosopis laevigata* (Fabaceae), and *Celtis pallida*. Seasonal xylem predawn (06:00 hrs) and midday (12:00 hrs) water potentials were determined at 15 day-intervals. Maximum and minimum seasonal predawn values ranged from –0.67 MPa (*C. pallida*) to –2.92 MPa (*C. hookeri*). At midday, xylem water potential varied from –1.07 MPa (*C. pallida*) to –3.10 MPa (*C. hookeri*). Predawn water potential values were highly and positively correlated with midday ones (r values varied from 0.900, *C. boissieri*, to .867 in *C. pallida*) and rainfall (r values ranged from .894, *C. hookeri*, to .697 in *C. pallida*). Correlation analysis between soil water content at different soil layers with predawn water potential values was weak. During the course of the study, native plant species faced mild to severe drought periods, being the species *P. laevigata* and *C. pallida* the ones that achieved higher predawn and midday water potential values. Thus, these species, could be considered as drought tolerant species while, *C. hookeri* and *C. boissieri* showed lower water potentials and could be in a physiological disadvantage under soil water stress. In conclusion, the study shows that the ability of species to control its water status may depends on the response capacity to absorb water and to control the loss of water during the day.

Keywords: Trees, Shrubs, water potential, drought resistance, physiological adaptation, northeastern Mexico

Financial support: This research was funded by Consejo Nacional de Ciencia y Tecnología (CONACYT, Grant 250732)

(8748 - 2648) Simulation of planting date on the yield of vegetable soybean and irrgation strategy in southern Taiwan by GLYCIM model

Chu-Chung Chen[1]; Chi-Chieh Hu[2]; Suh-Jen Lin[1]; Chi-Ling Chen[1]

Taiwan Agricultural Research Institute[1]; Kaohsiung District Agricultural Research and Extension Station[2]

The purpose of this study was to use the soybean simulation model on analyzing the climate and planting date effect of vegetable soybean in Taiwan. The variety parameter was calibrated from field experiment conducted in 2017. Two vegetable soybean variety Kaohsiung 9 and Kaohsiung 11 were planted in in three experiment sites one located in central and two located in southern Taiwan to acquire crop response data from different climate and soil properties. The vegetable soybean was grown in two planting date, spring crop and autumn crop, in southern experimental sites and one planting date, spring crop, in central experimental site. The validation results indicated that high consistence between simulated and observed results of phenostage, leaf area, leaf dry matter, stem dry matter, stem height and yield. Simulation of planting date effect in spring crop and autumn crop on yield was carried out by using historical climate data and major soil properties of vegetable soybean growing sites in southern Taiwan. The simulation results indicated that more irrigation required in early spring crop and late autumn crop to overcome the yield gap. Higher frequency requirement of irrigation in the sandy loam soil than the loam soil especially in spring crop.

Keywords: crop model, vegetable soybean, irrigation

Financial support:

(8527 - 2153) Soil and crop management strategies under drought conditions in the semiarid north of Chile

Ricardo Quintana[1]; Oscar Seguel[1]; Claudio Pastenes[1]; Charlotte Hardy[2]; Francisco Alfaro[2]; Nicolás Franck[1]

Universidad de Chile[1]; Centro de Estudios de Zonas Áridas[2]

In the north semiarid region of Chile, with an average precipitation of 100 mm year^{-1}, water scarcity is a normal constraint in crop production. In the present study, we have assessed the resistance and capacity to recover to transient drought of grapevines (*Vitis vinifera*) cv. Chardonnay, submitted to water deficit, by means of soil organic amendments and pruning severity, evaluating both: soil physical properties and plant physiology. In a 6 years old vine orchard, cultivated on a clay soil, four levels of soil amendments (E) were established: Control (EO), humic substances (EA), N-fixing bacteria (EB) and humic substances with N-fixing bacteria (EAB). Also, three levels of pruning (P) were established: no pruning (PO), 50% pruning (P5) and 80% pruning (P8). Finally, the combined effects of soil amendments and pruning were assessed, evaluating the treatments of no pruning and no amendments (POEO) and 50% pruning and humic substances (P5EA). After 60% of veraison, water irrigation was withheld. Soil amendments were effective in decreasing the bulk density of the soil, increasing water availability, mainly when humic substances were combined with microorganisms (EAB). Pruning resulted in reductions of total transpiration, with significant reductions of the stem water potential levels, but with no enhanced performance upon humic amendments. After the first rain, the different soil and pruning treatments showed a better recovery than the control, similar to the well-watered plants. At present, we continue assessing the cumulative effects of drought on grapevines, and also, olives, seeking for sustainable crop practices in arid and semi arid agricultural zones in Chile.

Keywords: *Vitis vinifera*; water availability; soil amendments; pruning.

Financial support: FIA PYT-2016-0152 Estrategias agronómicas de gestión del riego que permitan aumentar la productividad y la sustentabilidad de los sistemas frutícolas ante el proceso de aridización.

(3863 - 592) Soil moisture movement and spatial distribution on sand dune at a cold desert in the central Eurasian, China

Hongfei ZHOU[1]; Lanhai LI[1]; Hao LIU[1]; Xiang LIU[1]

Xinjiang Institute of Ecology and Geography, Chinese Academy of Sciences[1]

Water is the main driving forces for the vegetation succession in a desert ecosystem. We established a rainfall and snowmelt water infiltration and migration observation experiment site (44°22′ N, 87°55′ E) at a sand dune in the Gurbantunggut Desert. The artificial rainfall and brilliant blue FCF traced experiment were arranged. The soil water content and meteorological parameters were observed. By analyzing the monitoring data, it is recognized that the soil water movement and spatial variability at sand dune in the Gurbantunggut Desert is complex. (1) Soil moisture migration along the slope direction is existed under the rainfall and snowmelt water infiltration condition. When the accumulation of snow water equivalent is 40 mm, the soil water at the foot of sand dune derived from snowmelt lateral flow was 43.29%. When rainfall intensity is 0.52 mm/min and rainfall amount is 20.9 mm, the soil water at the foot of sand dune derived from rain infiltration lateral flow is 32.63%. (2) The soil moisture has the same variation tendency at different sites of the sand dune in different season. But the changing trend of soil moisture is different in the upper soil layers (0-100cm) and subsoil layers (100-200cm). Soil moisture is top > hill >foot in upper soil layers and foot > hill > top in the subsoil layers. (3) There are obvious seasonally and soil layering changing law for the soil moisture. The spring is the richest and fastest changes season of the soil moisture. The CV of the soil moisture in 0~40cm, 40~140cm and 140~200cm soil layers are 13.56%, 5.35% and 0.8% respectively. This is correspondence with the

surface layer, shrub root distribution layer and the deep layer. In conclusion, after the snowmelt water and rainfall infiltration, the soil lateral flow takes an important role on spatial redistribution of soil moisture. There exists a water enrichment zone at the foot of the sand dune.

Keywords: soil moisture; spatial variation; sand dune; desert; soil lateral flow

Financial support:

(6074 - 295) Soil penetration resistance and water content of a Oxisol cultivated with degraded pasture in recovery with estilosants

Beatriz Santos Bisi[1]; Carolina dos Santos Batista Bonini[2]; Reges Heinrichs[2]; Alfredo Bonini Neto[3]; Cleiton Alexandre Silveira do Nascimento[2]; Aline Magalhães[2]

São Paulo State University (UNESP/Tupã). R. Domingos da Costa Lopes 780 , Tupã, 17602-496, Brazil. beatriz_bisi@hotmail.com[1]; São Paulo State University (UNESP/Dracena). Rodovia SP 294, km 651, Dracena, 179000-000, Brazil.[2]; São Paulo State University (UNESP/Tupã). R. Domingos da Costa Lopes 780 , Tupã, 17602-496, Brazil.[3]

Agricultural systems associated with the use of inadequate soil preparation equipment result in rapid soil degradation. This condition also occurs in pastures under extensive management regime. The use of more rustic forages, such as those of the Brachiaria genus, has alleviated the problem of degradation, but over time, not even these forages have managed to develop well in these soils. The need for recovery of degraded pasture areas is evident. Thus, the objective of this work was to evaluate the mechanical resistance to penetration and the water content of a degraded Urochloa decumbens (Brachiaria decumbens) pasture in recovery since 2012, with different forms of introduction of Estilosants cv. Campo Grande (Stylosanthes capitata and S. macrocephala). The experiment was carried out in Andradina-SP, with Oxisol. The experimental design was a randomized block design with four replicates composed of seven strategies in no-tillage of the legume (estilosantes - E) in the pasture: Brachiaria grass (B); B + E with partial desiccation with 1.5 L ha^{-1} glyphosate; B + E with total desiccation with 3.0 L ha^{-1} glyphosate; B + E with no-tillage; B + E with soil scarification, B + E with rome and B + E with plowing + harrowing. Samples were collected for the determination of the water content, obtained by the classical weighing method, and mechanical resistance to soil penetration, using penetroLOG, model Falker automatic. Soil analyzes were performed in three soil depths, from 0.00-0.10; 0.10-0.20 and 0.20-0.40 m, from the years 2015 and 2016. For the soil resistance to penetration (SRP) , only one depth of 0.20-0.40 m presented a significant difference between the treatments, where the treatment harrow + plow showed lower SRP, while no-tillage with soil scarification presented the higher SRP. In the studied years, it was observed that the studied layers can be classified as low resistance to penetration, since the values found are below the average resistance class (2.0-5.0 MPa). In the evaluation of soil water content, in all the studied layers, did not present the significant difference between the treatments. It is concluded with the experiment that as a soil management strategy for sowing of the legume influenced in the mechanical resistance a penetration, in which the treatment harrow + plow showed lower SRP. It is concluded that the values obtained in the treatments studied did not limit root growth.

Keywords: Soil quality; pasture recovery; legumes.

Financial support: FAPESP- Process 2016/15370-6.

(3788 - 3071) Soil physical properties affected by different land uses in the Cauquenes catchment, central Chile.

Eduardo Vega[1]; Mauricio Galleguillos[2]; Oscar Seguel[1]; Cristobal Puelma[1]

Universidad de Chile[1]; Center of Climate Research and Resilience[2]

The soils of the coastal range of Chile show a critical state by the water regime (high precipitations during winter, with dry summer), the parent material (erodible granitic soils) and the relief condition (steeply lands), factors that lead the soil degradation enlarged by the soil use change. The original native forest has been replaced by other uses, affecting the water dynamic of the watersheds. The purpose of this work is to characterize the physical properties of soil under different land uses and its effects on basin hydrology. In the Cauquenes watershed (central south of the rainfeed coastal Chile), five land uses were selected (native forest, pine forest plantations, meadows, vineyards, shrublands) with five replicates each ones. The morphologic profile description and the soil physical properties by genetic horizons were assessed to understand its effects on soil hydrology behavior. Besides, the water dynamic was characterized in a catena of a vineyard. The undisturbed original condition (native forest) ensures the best soil physical properties, due to the highest organic matter contents, the lowest bulk density and the higher aggregate stability. The meadows and the shrublands sites showed variable results depending on the magnitude of stocking rate, and pine industrial plantations shows the most affected soil properties, as result of forest harvest with heavy machinery. The long term soil use with vineyards explains a good soil physical condition, with an expected water dynamic during season; in this sense, the physiographical condition better explains the water content in the soil profile than the local soil properties, but future studies have to be done to understand the water dynamic in a watershed scale.

Keywords: Soil use change, soil degradation, water movement, soil catena.

Financial support: Project: “Assessing spatio-temporal impacts of global change on water and biomass production processes at catchment scale: a synergistic approach based on remote sensing and coupled hydrological models to improve sustainable management of forest ecosystem

(7108 - 2432) Soil-use changes: effect on the water dynamic in soils

Tania Soledad Rey Montoya[1]; Ditmar Kurtz[1]; Cristina Sanabria[1]; Carolina Fernandez Lopez[1]; Alicia Fabrizzio de Iorio[2]; Juan Fernando Gallardo Lancho[3]

INTA Corrientes[1]; FAUBA[2]; IRNASa[3]

The objective of the study was to assess the effects of the change of land use (measuring edaphic-climatic variables) after replacement natural grasslands by conifers in these sandy soils. The evaluated sites were a) natural grasslands (T), b) forested land by *Pinus* sp. after 5 yr (F). Province of Corrientes (Argentina) has a subtropical climate, i.e., wet weather, frequent water surplus during autumn and spring. The climatic classification indicates that average precipitation corresponds to 1,100 mm yr^{-1}, with the average annual temperature ranging between 20-22 °C. Soils are classified as *Psammaquents*, with limited evolution and dominate by the sandy fraction in all horizons (except relic underlying); that produces a fluctuating phreatic layer. This study includes 5 months (November 2016-March 2017). Soil moisture and groundwater dynamic study were measure and carried out in two soil profiles (one in each site); the clay horizon was found at -80 cm soil depth in both sites. Two portable automatic meteorological stations were placed in each site, including a sensor of soil moisture, with measurements every 10 cm to the soil depth of -1.2 m, with variable adjustment to field conditions. Temperature sensors was also included, permitting monitoring this variable. Data of temperature, rainfall and soil moisture were analyzed using the INFOSTAT software. The groundwater level was found at -55 and -65 cm soil depth in T and F, respectively. The average monthly temperature was similar in both sites, varying between 27 and 31 °C, registering the maximum average value in January (2017). The order of the monthly accumulated rainfall recorded was: December (2016) > January (2017) > March >

February > November, registering a greater value in T (645 mm) that in F (572 mm); the different found should be attributed to the canopy interception (and later evaporation). Soil moisture (SM) changed differently in the two sites from -55 cm soil depth, from November and January; in F, SM increased significantly from 18,7 ±0.17 mm to 32 ±1.1 mm; but in T, the value of SM did not change (26 ±1.1). For the months of December, February, and March the quantity of soil water retained at each site also varied; however, F retains more quantity of water just below to -65 cm soil depth. The data measured allow to infer that the soil water, perched above the clay horizon, varies between -55 and -75 cm soil depth and it is regulated by the water consumption of the trees.

Keywords: *Psammaquents*; *Pinus* sp.; Soil moisture
Financial support: Scholarship INTA-Argentina and Project "Adaptación y resiliencia de la agricultura familiar del Nordeste de Argentina ante el impacto del cambio climático y su variabilidad"

(9492 - 824) Spatiotemporal Heterogeneity of Soil Water Content at Different Size of Gaps of *Pinus koraiensis*-Dominated Broadleaved Mixed Forest

wenbiao duan[1]; feng jing[1]; lixin chen[1]
School of Forestry, Northeast Forestry University[1]

Sampling plots were established by the method of grids in a forest gap and closed forest of *Pinus koraiensis*-dominated broadleaved mixed forests in Xiaoxing'anling Mountains, the volumetric soil water content (SWC) in I-III soil layers in medium and small gaps was measured by using time domain reflectometry 200 (TDR 200) during the period of July and September, 2010. The basic characteristics of SWC in each soil layer and the difference in SWC among various sampling locations in the same gap were analyzed by traditional statistics and geo-statistical methods, Kriging interpolating was performed and the spatial distribution maps of SWC were drawn by using surfer 8.0 software, the spatiotemporal heterogeneity of SWC in the gaps was analyzed. The aim of this study was to provide the theoretical basis and data support for further studies on soil physical properties, gap regeneration and sustainable management of *Pinus koraiensis*-dominated broadleaved mixed forest. The results showed that SWC in I-III soil layers in medium and small gaps fell into moderate variability. With increased soil depth, the SWC and patchy connection degree increased. The maximum SWC occurred in the area in and around gap center, and this area expanded and approached to the gap center with increased soil depth. However, the minimum SWC appeared within the expanded gaps and closed forest. For medium and small gaps, the difference in SWC in layer II among respective gap center and its edge was larger than that in layer I and layer III. Between July and September, the mean SWC exhibited single-peak variation, larger in medium gap than in small gap, the maximum appeared in August. The SWC in layer I and II in September decreased substantially than that in August, but there was slightly variation in layer III in September as compared with that in August.

Keywords: Xiaoxing'anling Mountains; *Pinus koraiensis*-dominated broadleaved mixed forest; forest gap; soil water content; spatiotemporal heterogeneity
Financial support: National Natural Foundation of Science of China(31670627; 31770656; 31270666)

(2693 - 2266) The influence of thin soil fractions in the attenuation of groundwater contamination

Francisco Afonso Cavalcanti-Junior[1]; Déborah de Oliveira[2]
University of São Paulo, Departamentnt of Geography, CP 72042, São Paulo, Brazil (cavalcantijunior@usp.br)[1]; University of São Paulo, Departamentnt of Geography, CP 72042, São Paulo, Brazil (debolive@usp.br)[2]

The physical characteristics of the soil are very important for their understanding, as well as to understand the natural and induced processes, such as the contamination frames. The main objective of this work is to bring notes on the relation of the physical properties of the soil in the attenuation of the contamination of groundwater by domestic effluents in the urban perimeter of the city of Turiaçu/Maranhão/Brazil. The area of study is located in the coastal region of the Legal Amazon, with predominance of plinthosols and characterized by average annual temperature of 27 º C and average precipitation of 2169mm. The collection of 37 samples was carried out in 8 points spread in the features top, strand and base, the collection of the samples complied with the morphological variations observed in the profiles. For the determination of the silt and clay fractions the Method of the Pipette was used and for sand the agitator with mesh sieves of 1, 00mm, was used; 0, 50mm; 0, 25mm; 0,125mm, and 0,66mm. In the tops, the profiles present a predominantly red-yellow coloration, and in the strands, there is predominance of the yellow color in the deeper horizons, in the two features the most striking characteristic is the presence concretions iron, from the surface, and Reaching more than 200 cm deep independent of the presence of gley horizon and pale colours. The first results point to an augmentation of thinner sediments (clay and silt) both downstream of the interfluves and in depth of the profiles, with a high concentration of clay at the base of the strands, characterized by paler coloring profiles and outcrop of the water table. The predominance of smaller particles exerts a strong influence on the quantity of soil porosity, in the case in question, and may make it less porous and hinder the drainage of water and other fluids. The reduced size of the fine particles increases the specific surface area (SSA) in this way, increasing the adsorption process, thus retaining atoms, molecules and hydrocarbon ions in these fractions. As assumptions, we believe that the attenuation of groundwater contamination is linked to the deviations of fluxes caused by geomorphological influence; To the concentration of fine particles, such as clay; And the high cationic exchange Capacity (CEC). However, the study still needs chemical and micromorphological analyses for better results.

Keywords: Turiaçu, Specific Surface Area, Morphological Description.
Financial support: CAPES

(2422 - 3236) The role of cover crop in improving rainwater and nutrient use efficiency for a no-tilled dryland corn and soybean rotation system

Gary Feng[1]; Wei Yang[2]; Dennis Reginelli[3]
USDA-ARS, Genetics and Sustainable Agricultural Research Unit[1]; Department of Soil and Water Sciences, China Agricultural University[2]; Mississippi State University[3]

Integrating cover crops into a crop production system should be considered a long-term investment for conserving soil, nutrient and water resources. However, the E×M impact of this practice has not been well investigated under long-term various weather conditions. We conducted 4-yr field study (2014-2017) in the Mississippi Blackland Prairie of the United States and measured soil water content, nitrate, and organic carbon as well as cover crop, corn and soybean N uptake, height, cover, leaf area index, aboveground biomass, and grain yield. Then those data were used to calibrate and validate RZWQM2 model. We applied the calibrated agroecosystem model to conduct 80-yr (1938-2017) simulation study and determine the long-term impacts of a wheat cover crop from October to April on water balance, nitrogen and water use efficiency in a rainfed and no-tilled corn and soybean cropping system. Long-term simulation demonstrated that average annual percolation under the wheat cover crop system was decreased by 9%, 11%, and 12% in wet, normal, and dry years over 8 decades as compared with the plots without cover crop. Evaporation during crop vegetative growth period under cover crop plots was 25% less than under no cover crop plots over 8 decades. Crop evapotranspiration under cover crop was increased by 6% during corn growth period and by 3% during soybean growth

period. Corn and soybean yields were increased by 5% and 4% in the cover crop-based cropping system. Compared to the plots with no cover crop, the WUE for soybean and corn were respectively improved by 12% and by 9% for the plots with cover crop, due primarily to the decrease in soil evaporation. Growing a winter wheat cover crop between harvest and planting of corn and soybean reduced the NO_3-N loss by 16% and improved soil organic carbon by 15%. This study suggests that incorporating wheat cover crop between summer crops rotation is a promising practice to reduce deep percolation, restrict soil evaporation, and improve crop water and nitrogen use efficiency in the dryland system.

Keywords: Cover crop, water balance, water use efficiency, nitrate, no-till, soybean, corn
Financial support:

(3594 - 2049) Validation of a hydrological model to simulate water transport in a volcanic ash soil of southern Chile

Tihare Hermosilla[1]; José Dörner[2]; Dorota Dec[2]; Susana Valle[2]
Magíster en Ciencias del Suelo, Escuela de Graduados, Facultad de Ciencias Agrarias, Universidad Austral de Chile, Valdivia, Chile[1]; Instituto de Ingeniería Agraria y Suelos, Facultad de Ciencias Agrarias, Universidad Austral de Chile, Valdivia, Chile[2]

Climate change caused variations in water supplies in the soil, affecting agriculture and food security. This, emphasis the importance of exact estimation of soil water content in the forestry and agricultural sector. The latter, can be done by the estimation of soil water balance with lysimeters which are high precision instruments. The information generate by them, however, refers to a certain area. The extrapolation of data is possible through modeling, with its respective validation. Andisoles soils are characterized by low bulk density, high water storage capacity, water conduction and contraction. The objective of this study is to validate a hydrological model that allows simulating the potential effects of global climate change on the availability of water in a volcanic ash soil. The water transport was modeled for Andisol (Duric Hapludand) using the HYDRUS-1D. During lysimeter installation undisturbed soils samples were collected to determine the hydraulic properties of the soils. Sensors to measure volumetric water content were installed at 10, 20, 60 cm. and the registered information will be used to validate the model comparing them with the modeled data. The simulation considers evaluating the variations in the moisture content of a Duric Hapludand soil, assuming reduction scenarios in rainfall by 15% and 20%. It is expected that the HYDRUS-1D allows modeling the water transport in a Duric Hapludand soil, and obtain a high level of adjustment with respect to the values actually measured. Thereafter, the simulate of different scenario whicho quantify the potential effects of global climate change on the availability of water in the soil for plants. Based on the expected results, information can be generated that allows a more efficient use of water resources, solving problems related to irrigation water needs, environmental considerations and determination of water surpluses and / or projections of water supply.

Keywords: Palabras claves: Hydrological model; water flow in soils; climate change; Andisol, Modelling
Financial support: Proyecto Fondequip Código EQM130202

(8326 - 360) Variability of soil hydraulic properties and its impact on predictions of an agro-hydrological model

Thalita Campos Oliveira[1]; Quirijn de Jong van Lier[1]
Center for Nuclear Energy in Agriculture/University os São Paulo[1]

Soil hydraulic properties may show a high spatial variability both vertically and horizontally. The strong non-linearity of soil hydraulic properties relationships (ϑ-h-K) disqualifies conventional statistics for the purpose of describing this variability. In an agro-hydrological modeling context, soil hydraulic properties are key input parameter and their variability may affect prediction of water balance components and, ultimately, crop yield. The aim of this study is to investigate the impact of within-field variability of soil hydraulic properties on transpiration and crop yield predictions for different scenarios using the SWAP model, and to evaluate the sensitivity of SWAP predictions to soil hydraulic parameters through a stochastic procedure. A soil hydraulic property dataset (Van Genuchten-Mualem ϑ_s, ϑ_r, α n, K_{sat} and λ) obtained by inverse modeling of field water content data measured in a small agricultural field in Piracicaba, Brazil was used. The climate scenarios comprised meteorological records from the past 30 years. Simulated cropping systems included an annual (maize) and a perennial (pasture) crop. Results about model sensitivity to the soil hydraulic properties and the consequent impact of the within-field variability on the model predictions will be presented and discussed.

Keywords: Hydraulic properties variability Agro-hydrology modeling Model sensitivity
Financial support: Fapesp

(6198 - 794) Water retention properties of stony soils.

Balin Robertson[1]; Peter Almond[1]; Sam Carrick[2]; Henry Chau[1]; Carol Smith[1]
Lincoln University, Lincoln, New Zealand[1]; Landcare Research, Lincoln, New Zealand[2]

New Zealand is currently in a period of land-use intensification including expansion of irrigated grazed-pasture systems, particularly in the Canterbury region, where two-thirds of irrigated land is on stony soils. Environmental models consistently predict stony soils as being vulnerable to nutrient leaching because of their low water storage and high hydraulic conductivity. However, leaching predictions are based on limited experimental research, and rely mostly on estimated soil water attributes because of the limitations of small-core based techniques for measuring soil water retention in stony soils. Nutrient leaching models that New Zealand uses for nutrient discharge regulation are strongly sensitive to soil attribute data, particularly water holding capacity and field capacity. In New Zealand, field capacity is taken as the water content at 10 kPa tension, which is applied to all soils, but on stony soils our preliminary research indicates that this tension may not be appropriate. This paper presents results from a project aimed at determining the appropriate water tension for field capacity, and key drivers of its variation, in stony soils. Multiple locations with soils of varying stone content were chosen for field sampling across the Canterbury region. All sites were under pastoral dairy grazing. At each site, two sampling locations were selected, one site on an area of land that has been irrigated for > 3 years, the other on an area of land that has never been irrigated. Field work was conducted in winter to early spring, to ensure the antecedent soil moisture was near field capacity. At each site, an initial infiltration experiment was conducted to thoroughly wet the soil. After two days drainage (~field capacity), a 30 x 30 cm soil pit was excavated in 10 cm increments to 60 cm depth. In each increment, water tension was measured with tensiometer probes, and samples collected for measurements of particle size distribution, rock fragment volume and size, carbon content, specific surface area and soil water content. Results from our study will show the variation in field capacity tension that can occur down a soil profile, among different stony soils, and between dryland and irrigated practices. Preliminary results indicate field capacity may occur at tensions less than 10 kPa, implying that changes in nutrient discharge predictions and management strategies for Canterbury stony soils may be necessary.

Keywords: Field capacity; stony soils; field sampling.
Financial support: This project was funded in a collaboration between Manaaki Whenua / Landcare Research and Lincoln University, New

Zealand, as part of the S-map Next Generation research programme funded by the Ministry of Business, Innovation and Employment.

C2.2 - Soil chemistry

C2.2.1 - Soil organic matter dynamics from molecules to landscapes

(4047 - 1882) Adsorption kinetics of dissolve organic matter at the water-air interface

Gilboa Arye[1]
French Associates Institute for Agriculture and Biotechnology of Drylands, The Jacob Blaustein Institutes for Desert Research, Ben-Gurion University of the Negev, Israel[1]

The surface active nature of humic substances and naturally occurring dissolved organic matter (DOM), has been confirmed by a growing number of studies. The main quantity from which the surface activity has been deduced obtained from measurements of surface-tension (ST, mN m^{-1}) at the water/air interface. All studies demonstrated the decay in the ST of water (72.5 mN m^{-1} at 25°C) with increased aqueous concentrations of dissolved organic carbon (DOC). The ST values reported for DOM should be defined as equilibrium ST, when the adsorption and orientation of the amphipathic molecule at the water/air interface have reached equilibrium state. However, for any amphipathic molecule the adsorption kinetics at the water/air interface is not reached instantaneously and may range from seconds up to several hours. The time depended ST started from the time where a new water/air interface is formed. Thereafter, amphipathic molecules need first to diffuse from the bulk solution to the interface, subsequently adsorb and simultaneously achieving the correct orientation at the interface. The consequence of this process will be expressed in a decay of the ST as a function of time until it will reach the equilibrium surface tension. The main objective of this study was to quantify the rate and extent of DOM adsorption kinetics at the water-air interface through dynamic surface tension measurement, using the pendant drop method. The applicability of a diffusion-only model to describe the results will be presented and discussed.

Keywords: Dissolved organic matter, Surface tension, Adsorption, Water-air interface.
Financial support:

(9825 - 1186) An advanced wet oxidation methods of soil organic carbon determination

sanjib kar[1]
University of calcutta[1]

An advanced wet oxidation methods of soil organic carbon determination Sanjib Kar Department of Agricultural Chemistry & Soil Science, Institute of Agricultural Science, University of Calcutta ; 35, B.C.Road; Kolkata-700019, India. E-mail: sanjib_@yahoo.co.iun Abstract: Several methods exists for determining soil organic carbon, and each one has its own advantages and limitations. Dry combustion method is an accurate method to measure total soil carbon, it is rather expensive. Therefore, wet oxidation is widely used. This study aimed for an advanced wet oxidation method for the determination of soil organic carbon and their relationship with soil mineralogy and texture. In the proposed method soil organic carbon is determined using nitric-sulphuric- potassium per chlorate digestion. For this study five tropical soil sample from 0-15 cm. depth were collected from different regions of India. The highest estimate of soil organic carbon was established in this new method in comparison with Walkley Black, Modified Walkley Black, Mebius, Schollenberges, Tube digestion and Tyurin methods. The data obtained using the proposed method co-rrelate strongly (r= 0.96-99 , p≤0.05) with the data obtained from other methods. Soil mineralogy interfered with the determination of soil organic carbon. Key word: Soil organic carbon determination, wet oxidation, dry combustion, Walkley-Black.

Keywords: Key word: Soil organic carbon determination, wet oxidation, dry combustion, Walkley-Black.
Financial support:

(7712 - 272) Benefits of biochar application to tropical soils: greenhouse gas emissions, soil improvement and crop yield

Carlos Eduardo P Cerri[1]; Tatiana F Rittl[1]; Thalita F Abbruzzini[1]; Mariana D O Zenero[1]; Sarah V Novais[1]; Rafaela F Conz[1]; Sara J Duarte[1]
University of São Paulo, Luiz de Queiroz College of Agriculture (ESALQ/USP)[1]

Researchers are pointing out the importance of greenhouse gas (GHG) emission reduction and increase carbon sequestration in the soil. Biochar, the solid product of pyrolysis, has been proposed as part of agronomic and environmental management to simultaneously improve soil properties and address climate mitigation. Although research on biochar has now accumulated an appreciable volume of data regarding effect of biochar in GHG emissions, soil properties and crop yields specially in temperate conditions, much less has been done for addressing these questions in tropical conditions. This study evaluated the benefits of applying biochar to soils under i) laboratory incubations under controlled conditions, ii) greenhouse pot experiments and iii) cultivation of sugarcane in field conditions in a sandy tropical soil. We used biochar produced from different organic materials (poultry litter, sugarcane straw, rice hull, sawdust and *Miscanthus*) pyrolysed at final temperatures of 350˚C, 450˚C, 550˚C and 650˚C. The effect of temperature and feedstock type on the variability of physicochemical properties of biochars was evaluated through measurements of pH, electrical conductivity, cation exchange capacity, macronutrient content, proximate and elemental analyses, Fourier transform infrared spectroscopy, thermogravimetric analyses, GHG emissions and biological analyses. We assess not only aspects related to the mitigation of GHG emissions to the atmosphere, but also changes in soil chemical, physical and biological attributes and crop productivity. The main findings of this research, indicate that the application of biochar can improve soil conditions and therefore help to enhance agricultural production system, reconciling high energy efficiency and contribute to the mitigation of GHG emissions to the atmosphere.

Keywords: soil carbon sequestration, Brazil, sugarcane
Financial support: CNPq Project Number 404150/2013-6; Post Doc Fellowship FAPESP 2015/10108-9

(9084 - 1330) Carbon stock losses and decomposition in riparian and well- drained areas under lowland rainforest transformation systems on Sumatra, Indonesia

Nina Hennings[1]; Thomas Guillaume[2]; Michaela Dippold[3]; Yakov Kuzyakov[1]
Soil Science of Temperate Ecosystem Science, University of Göttingen[1]; 2École Polytechnique Fédérale de Lausanne[2]; Biogeochemistry of Agroecosystems, University of Göttingen[3]

Tropical deforestation for agricultural land use changes soil organic carbon (SOC) dynamics. Indonesia´s forest ranked among the three largest rainforests areas worldwide experiences a severe forest loss since the 1970s, which alters an old and large carbon pool. Carbon stocks in soils of riparian zones are strongly affected by forest conversion that lead to changes in water regime and water level drops. We investigated the effects of rainforest transformations in riparian and well-drained areas of Sumatra, on soil C content, stocks and decomposability. C losses after conversion of rainforests to rubber and oil palm plantations in riparian areas were compared to that in plantations in well-drained mineral soils. C content in Ah-horizons of well-drained soils under oil palm and rubber plantations

decreased for 70% and 62% after forest conversion. In riparian soils, C content decreased between 25% and 66% after land use change. There, soil C content is not only dependent on vegetation inputs, but also on a complex riparian soil pedogenesis. Carbon stocks in well-drained soils decreased by conversion from forest to oil palm plantations for about 42% and in rubber plantation for about 40%. In riparian soils carbon stocks decreased from 269 Mg C ha^{-1} to 46 Mg C ha^{-1} (68%) in oil palm and 43 Mg C ha^{-1} (71%) in rubber plantations. $\delta^{13}C$ signature in riparian soils shows an inhomogeneous depth profile ranging from -26 to -31‰, whereas well-drained soils show a homogenous picture with more enriched $\delta^{13}C$ signature with increasing depth. This inhomogeneous depth profile in riparian soils indicates that erosion and deposition dynamics overlie the decomposition effects on the SOC isotopy.

Keywords: SOC, land use change, decomposition
Financial support:

(6800 - 1958) Carbon storage along a climosequence of soils developed from contrasting granites in northeast Brazil

Marina Monteiro Feitosa[1]; Clístenes Williams Araújo do Nascimento[1]; Ygor Jacques Agra Bezerra da Silva[1]; Caroline Miranda Biondi[1]; Peter van Straaten[2]; Valdomiro Severino de Souza Jr.[1]; Tiago Osório Ferreira[3]; Yuri Jacques Agra Bezerra da Silva[4]; Franklone Lima da Silva[1]

Agronomy Department, Federal Rural University of Pernambuco (UFRPE), Dom Manuel de Medeiros street, s/n - Dois Irmãos - 52171-900 - Recife, PE – Brazil.[1]; Professor Emeritus, University of Guelph, Guelph, Ontario, Canada.[2]; Department of Soil Science, Federal University of São Paulo (ESALQ/USP), Av. Pádua Dias 11, Piracicaba, São Paulo 13418-900, Brazil.[3]; Agronomy Department, Federal University of Piaui (UFPI), Planalto horizonte, 64900-000 – Bom Jesus, PI – Brazil.[4]

I-type granites are originated from melting of igneous source rocks, whereas S-type granites result from melting of sedimentar sources. This gives rise to differences in mineralogical and geochemical characteristics of the rocks. The objective of this study was to address the effect of petrology and mineralogy of I- and S-type granites on total organic carbon stocks across a climosequence. The study area lies in the Borborema Province (Pernambuco State), northeastern Brazil. Three soil profiles and the underlying rocks (from both I- and S-type granites) were sampled under native vegetation in the three climatic zones. The total organic carbon stocks were calculated using the equation: TOC stocks = total organic carbon (%) x bulk density (g cm^{-3}) x sampling depth (m). The type of parent material governed the rates of carbon accumulation in soils. The mean TOC contents were always higher in soil profiles developed on I-type granites. These soil profiles showed mean TOC values of 17.2, 12.0, 13,4 g kg^{-1} for humid, sub-humid and dry zones. On the other hand, the mean TOC values for S-type granite soils were only 10.2, 2.6, 2.8 g kg^{-1}. As a result, TOC stocks in the I- and S-granite soils showed a clear climatic zonation with increasing values from the dry zone to the humid zone. It is important to highlight that, regardless climate, the highest TOC stocks were recorded in soil profiles developed from I-type granite soils (46 to 207 Mg ha^{-1}); S-type granite soils presented TOC stocks ranging from 23 to 150 Mg ha^{-1}. This finding demonstrates that the parent material rather than the climate plays the most significant role on determining the soil carbon stocks. This outcome can result from both the natural higher soil fertility that allows biomass increasing and the higher clay contents in I-type soils.

Keywords: Granitic rocks; Tropical soils; Carbon sequestration
Financial support: Federal Rural University of Pernambuco (UFRPE)

(5975 - 1494) Characteristics of Biochar produced from water hyacinth in different pyrolysis temperatures

Luana Bottezini[1]; Deborah Pinheiro Dick[2]; Daniel Hanke[3]; Alberto Wiesniewski Junior[4]; Heike Knicker[5]; Ingred Suellen Carvalho Carregosa[4]; Fernanda Carolina de Santana Oliveira Apolônio[4]
Federal University of Rio Grande do Sul, 7712, Avenida Bento Gonçalves, Porto Alegre, 91540000, Rio Grande do Sul (luanabott@gmail.com)[1]; Federal University of Rio Grande do Sul, 7712, Avenida Bento Gonçalves, Porto Alegre, 91540000, Rio Grande do Sul[2]; Federal University of Pampa, Dom Pedrito, Rio Grande do Sul[3]; Federal University of Sergipe, Av. Marechal Rondon, São Cristóvão, 49100000, Sergipe[4]; Institute of Natural Resources and Agrobiology, 10, Av. Reina Mercedes, Sevilla, E-41012, Spain[5]

The production of Biochar (BC) from agroindustry wastes, with the goal to use it as soil conditioner, has grown in the last years. Water Hyacinth (WH) is a plague that, due to water eutrophication, occurs frequently in rivers and estuaries along the Brazilian Coast hampering port activities and navigation. WH may contain a significant phosphorus (P) concentration, and that makes it a potential source for soil P fertilization. Our work aimed to determine chemical and molecular composition of WH biochars (WHBC) produced in different temperatures in order to identify the adequate conditions for soil conditioners production. WH samples from Sergipe (BR) were air-dried and submitted to controlled pyrolysis under N_2 (5 L min^{-1}) at 400, 500 and 600°C. In WH biomass and in WHBC's, elemental composition was determined by EDX spectroscopy (EDX-720/800HS) and C and N content by dry combustion (Flash EA1112). Molecular composition was investigated by ^{13}C and ^{31}P NMR CP/MAS (Bruker DSX 200) and by FTIR (Shimadzu 8300 FTIR) spectroscopy. From 400 to 500°C both C and P content increased and then decreased for temperature of 600ºC. On the contrary, N content decreased steadily from 400 to 600°C, indicating a continuous N loss until 600ºC. The C/N ratio varied from 13 to 18, and the values are relatively low in comparison to that of high temperature BC's. From the ^{31}P NMR spectra, phosphate was identified in all WHBC's. The proportion of O/N-alkyl C group decreased from 15.8 ($WHBC_{400}$) to 6.4 % ($WHBC_{600}$) following the behavior of N content. Up to 500°C alkyl C increased from 31 to 38% and decreased to 20% at 600°C, while that of aromatic C gradually increased reaching 66% in $WHBC_{600}$. Carboxyl C decreased from 6.2% to 5.7 % with temperature rise, while carbonyl C increased slightly (1.8 to 2.3%). It seems that heating from 400 to 500°C carbohydrates are the main consumed structures while alkyl and aromatic structures get enriched. By further temperature rise, an increase of aromatic C occurs mainly at the expenses of alkyl C. In the WHBC's, the chemical form of P is absorbable by plants, but its real availability should be further tested with bioassays. Based on the P concentration, the sample most adequate for soil conditioner would be $WHBC_{500}$. However, by considering the C/N ratio and the proportion of Oxygen containing groups, $WHBC_{400}$ appears as a better choice. Incubation experiments with plants as bioindicators should be performed in order to elucidate this question.

Keywords: Soil conditioner, phosphorus, chemical composition
Financial support: CAPES

(3869 - 2641) Characterization and bioactivity of humic acids from different origins in rice plants.

Tadeu Augusto van Tol de Castro[1]; Ricardo Luis Louro Berbara[1]; Orlando Carlos Huertas Tavares[1]; Marcos Gervasio Pereira[1]; Andrés Calderín García[1]

Universidade Federal Rural do Rio de Janeiro[1]

Humic substances are widely distributed over the Earth and are the major constituent of organic matter, being classified in: humic acids (HA), fulvic acids (FA) and humin. Biological activity of these supramolecules is directly associated with their origin, molecular size, composition, structure and concentration, therefore the characterization of humic substances is necessary to understand the different functions and properties of these compounds. In this work were characterized HA extracted from different sources of origin: histosol (HASOIL), vermicompost (HAVC) and sediment of Rio Negro-AM (HARN), and the effects on root system development and in the biomass of rice (*Oryza sativa* L.) of the BRS Esmeralda variety, cultivated in a growth chamber were evaluated. The HA was obtained following the International Society of Humic Substances extraction methodology and characterized by ^{13}C isotope nuclear magnetic resonance spectroscopy with cross polarization and magic angle spin (CP MAS ^{13}C NMR). Three experiments were carried out, occurring application of HA of different origins in the root system, using six treatments with different concentrations of this substance, equivalent to 0, 2, 5, 10, 30 and 50 mg $HA.L^{-1}$. Experimental design was a completely randomized design with five repetitions. After seven days of humic acids application was evaluated the length (mm) and quantity of roots. The results obtained on the structural characteristics of HA shows that HASOIL is more aromatic and hydrophobic than HARN and HAVC, presenting a high degree of recalcitrance. The HARN also has a high amount of recalcitrant structures, but with predominance of non-functionalized aliphatic carbons. The HAVC is the most polar, explained by the high functionalization of aliphatic and aromatic carbons. It has also been observed that HAVC has the greatest effects on the quantity of roots this may indicate that the root emission in rice plants responds to the effects of structures with higher polarity and lower hydrophobicity. On the other hand, root elongation appears to be more responsive to structures with more recalcitrant properties. Data also showed that higher polarity and lower hydrophobicity are not structural properties responsible for biomass production, whereas structures with a certain recalcitrance degree can stimulate the biomass production both in leaves or roots.

Keywords: Keywords: Humic substances. Spectroscopy. Effects on plants.
Financial support: CNPq (Process number: 168782/2017-0)

(6608 - 3047) Charcoal contribution to umbric epipedons of Ferralsols in Brazilian cerrado biome

Marina Justi[1]; Judith Schellekens[2]; Pablo Vidal-Torrado[2]
UFLA[1]; ESALQ/USP[2]

Ferralsols with humic properties (umbric Ferralsols) are characterised by a thick (≥100 cm), dark A horizon rich in organic matter (OM) and occur next to Ferralsols without humic characteristics. Our purpose was to contribute to the understanding of the stability of carbon in these soils. To this end we focussed on the Cerrado (Brazilian savanna) biome, which has a natural association with wildfires. Profiles were selected in Grão Mogol (Minas Gerais) and sampled according to pedogenic horizon, including two humic Ferralsols (HF1, HF2) and a nearby Ferralsol without humic characteristics, i.e., a reference profile (TF). Macroscopic charcoal fragments (> 2 mm) were quantified for all samples, while micromorphology was studied for samples of selected horizons to evaluate micro-charcoal and biological activity. The contribution from black carbon (BC) to other soil OM fractions was determined by analytical pyrolysis, and included the free (FLF) and occluded (OLF) light fractions, the NaOH extractable OM (EXT) and the remaining residue (RES). The light fractions represent relatively intact BC (i.e. charcoal), the EXT contains more decomposed material and the RES represents residual OM that is difficult to decompose. All profiles contained two visible charcoal layers with radiocarbon dates up to 8600 yr BP and reflecting past fire events. The macroscopic charcoal content was larger in HF1 and HF2 than in TF. Micromorphology showed that HF1 and HF2 also had more microscopic charcoal fragments than TF. In addition, intense bioturbation, charcoal fragmentation and incorporation in soil matrix were observed from thin sections of all three profiles. Analytical pyrolysis showed a larger contribution from BC in HF1 and HF2 than in TF in the FLF, while no such difference was observed in the other fractions (OLF, EXT, RES). Thus, it was concluded that BC plays a major role in the formation of umbric epipedons in the Brazilian Cerrado. The larger contribution from charcoal to the HF profiles may be due to differences in input (more woody plants) or in the degree of decomposition (less decomposed charcoal). All three profiles showed a similar relative increase of BC with depth in the RES, in agreement with the recalcitrance of BC in the soil environment and demonstrating no significant difference in decomposition between HF and TF. A larger contribution from woody plants in Cerrado may suggest that soil humidity controls local differences in vegetation composition.

Keywords: black carbon, humic, organic matter, pyrolysis
Financial support: Fapesp

(8407 - 430) Comparison of three methods to determine organic matter in alluvial soils cultivated with cocoa

Salomon Barrezueta-Unda[1]; Jenner Becerra-Leon[1]; Antonio Paz Gonzalez[2]
University Technique of Machala[1]; University of A Coruña[2]

The aim of the research was to compare the values obtained of soil organic matter (SOM) by dry combustion (DC) with Walkley Black methodology (WB) and weight loss by Ignition (LOI) by four temperatures (300°C, 350°C, 430°C and 600°C) in some soils with cocoa plantations. The starting point of this research was selecting randomly 30 cultivated plots with cocoa of alluvial soil origin, located in El Oro province, Ecuador. To determine SOM, the sample was dried and sifted by using a 2 mm sieve previously the use of the methods below: Dry combustion (DC), wet oxidation of Wlakley and Back (WB) and loss for ignition (LOI), which consisted of weighing 5 g of soil for sample that were placed on a heater to 105 ºC for 3 hours (h) to eliminate moisture; Then, the samples were cooled in a drying apparatus and its weight was registered. After they were placed in a muffle furnace which maintained 80 °C as initial temperature, then the muffle was programmed to maintain the temperature for 2 h, the proposed maximum status that were 300, 350, 430 and 600 °C. The following step was to transfer the muffle furnace to a dryer and the weight was registered again. The SOM was calculated by differentiating the weight at different temperatures. The linear regression analysis was carried out between the results DC as a dependent variable with the data of the average derivative from the method WB and the four temperatures of the LOI method as independent variables. The results of SOM statistical means were DC 3,19 g kg-1 ±1,75 >; WB 3,38 g kg-1±1.86 >; LOI300 3,51 g kg-1±1,55 >; LOI350 4,91 g kg-1±1,84 >; LOI430 4,99 g kg-1±2,07 >; LOI 8,47 g kg-1 ±3,33. With ranges of 0,84-8,29 g kg-1 for DC and 2,25-17,41 g kg-1 for LOI600. The Pearson matrix showed high DC correlation with the WB method (0,981 * *), followed by LOI300 (0,725 * *), LOI430 (0,698 * *), LOI350 (0,674 * *) and LOI600 (0,648 * *). The best R2 was between WB and DC with an 0,962. In the case of LOI, the adjustments were: LO300 R2=0,526; LOI350 R2=0,454; LOI430 R2=0,454; LOI600 R2 0,323. ANOVA among the methods was significant with a p≤0,000. Tukey's test grouped 5 subsets (DCa, WBab, LOI300ab, LOI350bc, LOI430c, LOI600d). To conclude, the methods DC and WB are recommended for alluvial soils cultivated with cocoa, although the method LOI is not discarded, being necessary to extend the study with lower temperature or diminish the ignition times, up to reaching a R2>

0,9.

Keywords: Ignition temperature, dry combustion, wet combustion, linear regression

Financial support: University Technique of Machala, Ecuador: Project: Comparison of analytical methods for estimating organic carbon in soil samples of alluvial origin

(1464 - 2830) Contribution of roots and shoots from summer crops on physical fractions of soil organic matter in two lowland soils

Bruno Chaves[1]; Sandro José Giacomini[1]; Douglas Adams Weiler[1]; Mariana Ferneda Dossin[1]; Lethícia Rosa Neto[1]; Rafael Alexandre Bick[1]; Roberta Lago Giovelli[1]

Federal University of Santa Maria[1]

Sorghum (*Sorghum bicolor*) and soybean (*Glycine max*) are being cropedd in rotation with flooded rice (Oryza sativa) in Rio Grande do Sul state as an alternative to reduce weeds pressure and increase profits and land use efficiency. Little is known about the effects of these crop residues on soil carbon (C) stabilization in physical fractions of soil organic matter (FF-SOM) in lowland soils. The objective of this study was evaluate fate of C from sorghum, soybean and rice residues (roots and shoots) in FF-SOM in two Planosols (A – 9.9% clay, 15,5% silt and 74.6% sand; B – 17.3% clay, 28,7% and 54% sand). We incubated soil and crop residues ^{13}C labelled during 360 days: in the first 180 days, soil was kept moist through frequent irrigations; from 180 to 360 days soil was flooded to reproduce an irrigated rice system. Shoot residues were kept on soil surface while roots were incorporated to the soil. Soil was physically fractionated by size of >250 µm, 250-53 µm and < 53 µm at zero, 30, 180 and 360 days of incubation. There was a three-way interactive effect of soil, residue and physical fraction on soil C. In general, the fate of the majority of the residue-derived C in the soil in first 30 days of incubation was in the >250 and 250-53 µm fractions. The residue-derived C recovered at 30 days in these fractions range from 41.2 to 100% and from 63.9 to 82.9% of total C incorporated to the soil by shoots and roots, respectively. The contribution of <53 µm fraction to total soil carbon increased over the incubation. At 360 days, the residue-derived C recovered in <53 µm fraction range from 28.7 to 52.8% and from 10.6 to 53.5% of total C incorporated to the soil by shoots and roots, respectively. Rice shoot in Planosol B had the highest residue-derived C recovered (27.4%) at the end of incubation. The root-derived C in Planosol B was higher in soybean (48.3%) and sorghum (38.9%) than rice (21.2%) treatment, but there is no difference among the residues in Planosol A at 360 days. Physical fractionation showed higher shoot-derived C recovery in Planosol B than Planosol A, but root-derived C recovered was higher in Planosol B only for soybean residues. Our results showed that sorghum and soybean residues might contribute for C incorporation on lowland soils, especially in soils with higher stabilization matrix. Sorghum and soybean are more efficient to soil C incorporation in initial stages of residues decomposition.

Keywords: ^{13}C isotope, lowland soils, SOM fractions, crop decomposition, roots.

Financial support: The work was supported by National Council for Scientific and Technological Development – CNPq

(9535 - 2081) Correction and maintenance of phosphorus available in Oxisoils under no-tillage at different levels of fertility

Joana Schroeder de Souza[1]; Tales Tiecher[1]; Cimélio Bayes[1]; Magno Batista Amorim[2]; Sandra Mara Vieira Fontoura[3]; Renato Moraes[3]

Federal University of Rio Grande do Sul[1]; Federal Institute of Rondônia[2]; Agraria Foundation[3]

In consolidation system of no-tillage, due to the superficial application of limestone, it is not recommended to apply rock phosphate. In addition, with increasing demand for fertilizers, especially in areas of high production potential, new sources of phosphorus in the market are offered to producers without proper scientific evidence. This study was carried out on Oxisoils in the center-south region of Paraná, with the goal of evaluating how different sources of P could modify the available phosphorus in the soils in SPD with different levels of P. Field experiments were conducted with seven sources of P (Super Simple-SS, Super Triple-ST, Yoorin, Yookarin, FN Bayóvar, Shell TSPS and Mosaic MES9) at three sites with low, medium and high soil P levels. The treatments consisted in the annual application of the recommended dose(115, 190 and 350kg ha-1 of P2O5 for soils with high, medium and low, respectively)based on the soluble P contents of each source and on two special fertilization programs (System and Culture), with three replicates in a randomized block design. Three years after the installation of the experiments, the content of phosphorus available was evaluated by the resin method at 0-20 cm depth. The application of 115 kg ha-1 to the soil with high P content did not alter the levels of available phosphorus of soil, since this is just maintenance rate. For soil with a mean P content only the Yoorin source did not increase the phosphorus content to the critical level (45 mg dm-3) after the annual application of 190 kg ha1, totalizing 570 kg ha-1 of P2O5. However, the soluble sources increased P available content by resin method to the critical level, demonstrating that the recommended dose was effective in correcting soil phosphorus deficiency. In soil with low P content, the correction of available phosphorus content per resin to the critical content was not possible even with the application of 1050 kg ha-1 of P2O5, regardless the source used. The results indicate that the available soil P content is evolving in this soil, where fertilization increased, on average, from 4 mg dm-3 to 20 mg dm-3. Regarding the fertilization program, there was no difference in available soil P for all sources. In general, we can conclude that in soil deficient in P with medium and low content, the correction must be made with soluble sources of P, since the yield of the crops is dependent on the supply of this nutrient.

Keywords: Rock phosphate, critical level of phosphorus, different sources.

Financial support: Private Foundation of Agricultural Research (FAPA) da Cooperative Agrária Ltda.

(1737 - 2864) Cuantification and characterization of humics acids by ^{13}-nmr solid state spectroscopy and ir in andisols under different use systems

William Chavarriaga Montoya[1]; Juan Carlos Montoya Salazar[2]; Juan Carlos Menjivar Flores[3]

Caldas University[1]; Manizales University[2]; UNIVERSIDAD NACIONAL DE COLOMBIA-PALMIRA[3]

Humic Substances (SH) are materials with a high degree of transformation, grouped in Humic Acids (AH), Fulvic Acids (AF) and Humins (H). Andisols are characterized by high accumulations of SOM, constituting very stable complexes with allophane, Fe and Al. The AH extracted from a Typic Melanudands and a Typic Haplustands (0-10cm.), Bellow cover of Forest, Coffee-sun (*Coffea Arabiga* Var-Caturra), Café-Walnut (CA-*Cordia alliodora*) and Grass (*Brachiaria* sp.) were analyzed by ^{13}C-NMR spectroscopy in solid state, IR, and E4/E6 ratio. The Oxidable-C (Walkley-Black) was determined in the bulk, fine and humified fractions of the soil. The SOM was separated by shaking in jars equipment (180rpm) and then by sieves of 106 and 53µm in vertical shaker (50hz). Suspensions were dried (55°C) and sequential extraction was carried out in $Na_2B_4O_7$, $Na_4P_2O_7$ and NaOH 0.1 N and HA was separated in HCl (6N), which were purified using XAD-16, REXIN-101H and dialysis membranes (10,000 Da). The highest OM-Humified contents were recorded in Forest and decreased with the change in land use; Humins predominated in Coffee-Sun and Grass. %OC and number of extractions performed (>13) indicated a higher retention strength of the HS in the Typic Melanudands. The Optic coefficients (>0.38) and E4/E6 (>0.72) indicated were higher in

the Typic Haplustands. ^{13}C-NMR spectra of the HA revealed high contents of COOH groups in Typic Haplustands and aromatics groups in Typic Melanudands; COOH and OH-alcoholic groups contents in Forest are more highly; The IR specter confirmed the differences between the systems evaluated. E4/E6 values indicated differences in molecular condensation of both Andisols for AH (<4.4 and 5.3-6.9). Hydrophobicity indexes were high in all systems and higher in Forest soils (2.22 and 1.91), confirming this characteristic.

Keywords: Andisols, Humic substances, ^{13}C-NMR; E4/E6, Fractionation
Financial support: Caldas University and Manizales University

(2706 - 1379) Decomposition of Eucalyptus leaves in dystrophic soil in phytophysiognomy of the Cerrado

Sarah Camelo da Silva[1]; Marco Bruno Xavier Valadão[1]; Jonas Inkotte[1]; Karla Monique Silva Carneiro Valadão[2]; Alcides Gatto[1]; Reginaldo Sérgio Pereira[1]
UNB[1]; UNEMAT[2]

In Brazil Eucalyptus is a species with rapid development, but for being an exotic species has little knowledge about its use in the recovery of degraded areas, such as the impact on the balance of edaphic processes. The use of exotic species in the recovery of degraded areas has gained greater visibility after the last modifications occurred in the Forest Code in 2012, by Law 12.651. The restoration of permanent preservation areas and legal reserve, both consolidated, with the planting of exotic species interspersed with native species, where the area reconciled with exotic species cannot exceed fifty percent (50%) of the total area to be recovered. This study aims to analyze the speed of eucalyptus leaf decomposition in a commercial stand, and in a Cerrado Típico area, so as to be able to tell if there is a significant difference in leaf decomposition. The study was carried out at the Fazenda Água Limpa (FAL), which belongs to the University of Brasília, located in the Federal District (15 ° 56'-15 59 'S and 47 ° 55'-47 58' WGr.). The planting of the hybrid *Eucalyptus grandis* x *Eucalyptus urophylla* has 49 months old, planted in 3x2m spacing. At stand, the soil was classified as Red-Yellow Latosol (Oxisol). The soil of the Cerrado Típico was Red Latosol (Oxisol), both areas have dystrophic soils. In each area, 15 litter bags with 20 cm² and 20 g of eucalyptus leaves were randomly placed. The litter bags were rescued after 30 and 60 days of exposure in the field. The results obtained showed a difference in the decomposition with both 30 days and 60 days. At 30 days leaf decomposition in the Cerrado Típico was faster (3.37g) than the eucalyptus stand (1.86g) ($p < 0.05$). The same was observed in the collection with 60 days where the Closed Typical area has a decomposition of 5.97g, and in the eucalyptus area, the decomposition was 4.64g ($p < 0.05$). This difference in decomposition may occur due to soil water content, quantity and quality of microfauna and chemical attributes in general. The results demonstrated that a Cerrado dystrophic soil is able to assimilate more quickly the vegetal organic material of exotic origin. In areas to be recovered this capacity can accelerate carbon and nutrients entering the soil, thus improving its physical and chemical properties.

Keywords: litter bags, Oxisol, exotic species, consolidated legal reserve
Financial support:

(7237 - 3141) Determination of Oil in Contamined Soil by Low-Field Nuclear Magnetic Resonance (NMR)

Etelvino Henrique Novotny[1]; Catarina Mendes Rebello[2]; Silvio Roberto de Lucena Tavares[1]
Embrapa Soils[1]; Universidade Federal do Estado do Rio de Janeiro (UNIRIO)[2]

Antropic contamination of soils by oil is an recent issue, which had the XIX century as the begin of oil exploration, and has grown exceptionally ever since. This activity has the potential to be very problematic in its impacts, causing high local degradation. These impacts can affect a large population, such as being a drastic damage to the environment, due to the possibility of acting as central nervous system depressants and presenting chronic toxicity, as well as reaching the groundwater and contaminating it with benzene, toluene, ethylbenzene and xylenes, which are components of oil. For this reason, the management of this product requires the adoption of a high standard of socio-environmental responsibility, once the components of this oil take hundreds of years to be decomposed in nature, being an imminent danger. Several techniques for the recovery of these degraded areas were developed, but one of the most prominent would be phytoremediation, an effective technique for the minimization of these pollutants in the environment, which utilizes plant species. And then, the monitoring of contaminated area and under remediation is necessary. However, the available analytical methods are very expensive, time consuming and usually require dangerous reagents (e.g. GC-MS). Therefore, the present work proposes a new methodology for the quantification of oil in soil using low field Nuclear Magnetic Resonance (NMR). The use of low-field NMR has proved to be very efficient, since it is a low-cost technique, presents rapid quantification measures, and performs measurements in the intact soil, without any preparation. Therefore, preliminary studies were carried out and a calibration curve of the oil in dry soil, from 0.2 till 30% of oil (w/w) was performed, obtaining an excellent model with coefficient of determination (R^2) of 0.9996.

Keywords: Contamination; Oil; Petroleum; low field Nuclear Magnetic Resonance; Relaxometry
Financial support: Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) and FIT Instrument

(6822 - 3090) Determination of the parameters: Organic Matter, Density and pH of the soil in areas of plant suppression in the Municipality of Altamira-Pará-Brazil

Samia Cristina de Lima Lisboa[1]; Sandra Andrea Santos da Silva[1]; Rainério Meireles da Silva[1]; Davi da Silva Teixeira[1]; Yuri Rafael da Silva Rodrigues[1]
Universidade Federal do Pará, Campus Altamira[1]

The anthropic use of the soil, brings varied changes on the attributes, be they chemical and / or physical. Among the attributes of soil assessments, organic matter and pH, have been suggested as key indicators in soil quality, influencing soil performance and functions. Due to the intense exploitation of natural resources caused by urbanization, vegetation suppression, among other mitigating factors, the Forest region of the municipality of Altamira in the state of Pará has suffered a significant environmental crisis due to the implementation of Collective Urban Resettlement due to the construction of the Hydroelectric Power Plant Belo Monte. In 2015, an area of secondary vegetation located near the banks of the Xingu River was suppressed for the construction of an indigenous resettlement, leading to the stacking of wood, with the area known as a storage yard. The objective of this work was to determine soil physicochemical parameters in areas subject to vegetation suppression (T1) and storage yard (T2) in comparison to secondary vegetation (T3) in the city of Altamira-Pa. The study area is located 8 km from the city of Altamira, in the west of the State of Pará, at an altitude of 111 meters above sea level. The soil samples were collected from January to March 2017 in three treatments, and the physical-chemical parameters evaluated were: density, pH and organic matter. According to the values of the density amplitude that corresponds to the soil type (clayey, it ranges from 1.00 g/cm³ to 1.25 g/cm³, sandy from 1.25 g/cm³ to 1.40 g/cm), the average density in the area of vegetation suppression and secondary vegetation were 1.13 g/cm³ and 1.04 g/cm³ respectively, the storage yard presented the average

of 1.32 g/cm³, high density value indicating a certain local compaction level (T2). The amount of organic matter is high in all treatments, being higher in the secondary vegetation, observing that, even suppressing vegetation occurred, there was no total organic matter decline, since there is still a presence in the superficial layer influencing positively in the characteristics related to soil fertility. The pH had a high level of acidity in all treatments, such result may have been influenced due to rainwater, since the samples were collected in the rainy months. Statistical analysis reveals that there was no significant difference between treatments, which may be justified by the time of suppression in the area.

Keywords: KEY WORDS: Organic matter, suppression, quality.
Financial support: Universidade Federal do Pará

(1264 - 1027) Does soil management system affect C content of a coarse sandy loam Amazonian Acrisol?

Itauane Oliveira de Aquino[1]; Deborah Pinheiro Dick[1]; Falberni de Souza Costa[2]

Federal University of Rio Grande do Sul[1]; Brazilian Agricultural Research Corporation[2]

The impact of No-till on the soil C content in comparison to Conventional Tillage (CT) depends greatly on the soil type, climate and initial C content. The main goal of this work was to investigate the effect of conservation soil management systems on the C content and humification in an Acrisol profile, Acre State, BR. The experiment was conducted randomized blocks with three repetitions, for NT and CT (main parcels), employing the succession manioc/green manure/maize. For each system, three treatments (subparcels) were established: Control: slash and burn (C); *Mucuna aterrima* as cover crop (M); as cover crop with addition of P-fertilizer and limestone (MPL). N and C content (dry combustion, C_{DC}, and Walkley-Black, C_{WB}) and humic substances (HS) were determined in samples collected after 10 years within 100 cm. C_{DC} content in the 0-5 cm depth ranged from 13.9 to 16.5 g kg^{-1} and did not differ between treatments. As expected, C_{DC} decreased with depth reaching values between 3.9 and 5.1 g kg^{-1}. C_{WB} values were always smaller than the respective C_{DC}, indicating that part of soil organic matter (SOM) was not susceptible to oxidation. The index C_{WB}/C_{DC}, a proxy for chemical recalcitrance, varied between 0.7 and 0.9 in the 0-5 cm and decreased to values around 0.5 at 75-100 cm depth. No correlation was found between this index and clay content, indicating that chemical recalcitrance was not related to organo-mineral interactions. C/N ratio varied between 11.7 and 16.0 and no difference was detected between treatments. Cation exchange capacity (CEC) increased linearly ($0.75 < R^2 < 0.98$) with C_{DC} evidencing the important role of SOM on the fertility of these soils. Interestingly, liming increased pH and CEC only under NT, but showed no effect for CT. Probably, soil plowing under CT, by removing the protection of cover crop, favored liming wash out along the coarse sandy loam profile by high rainfall (1600 to 2700 mm y^{-1}). The proportion of humin fraction (C_{HU}/C_{DC}) varied between 0.4 and 0.6 and did not differ between treatments. Furthermore it did not correlate with clay content, suggesting that organo-mineral interactions were not determinant on the stabilization of SOM in depth. The AH/AF ratio decreased drastically with depth indicating a possible migration of fulvic fraction in all sites. Our results showed that soil conservation management systems did not affect SOM content and dynamics in a coarse sandy loam Amazonian Acrisol within 10 years.

Keywords: chemical recacitrance, humic substances, no-till
Financial support: CNPq (Brazil)

(3620 - 368) Early stage litter decomposition across biomes

Ika Djukic[1]; Sebastian Kepfer-Rojas[2]; Inger Kappel Schmidt[2]; Klaus Steenberg Larsen[2]; Claus Beier[2]; Björn Berg[3]; Kris Verheyen[4]
Swiss Federal Institute for Forest, Snow and Landscape Research WSL, Birmensdorf, Switzerland[1]; Department of Geosciences and Natural Resource Management, University of Copenhagen, Denmark[2]; Department of Forest Sciences, University of Helsinki, Finland & Section of Biology, University of Gävle, Sweden[3]; Forest & Nature Lab, Department of Forest and Water Management, Ghent University, Belgium[4]

Through litter decomposition enormous amount of carbon is emitted to the atmosphere. Numerous large-scale decomposition experiments have been conducted focusing on this fundamental soil process in order to understand the controls on the terrestrial carbon transfer to the atmosphere. However, previous studies were mostly based on site-specific litter and methodologies, adding major uncertainty to syntheses, comparisons and meta-analyses across different experiments and sites. In the TeaComposition initiative (Fig. 1), the potential litter decomposition is investigated by using standardized substrates (Rooibos and Green tea) for comparison of litter mass loss in 336 sites (ranging from -9 to +26 °C MAT and from 60 to 3113 mm MAP) across different ecosystems worldwide. In this study we tested the effect of climate (temperature and moisture), litter type and land-use on early stage decomposition (3 months) across nine biomes. We show that litter quality was the predominant controlling factor in early stage litter decomposition, which explained about 65 % of the variability in litter decomposition at a global scale. The effect of climate, on the other hand, was not litter specific and explained < 0.5 % of the variation for Green tea and 5 % for Rooibos tea, and was of significance only under unfavorable decomposition conditions (i.e. xeric versus mesic environments). When the data were aggregated at the biome scale, climate played a significant role on decomposition of both litter types (explaining 64 % of the variation for Green tea and 72 % for Rooibos tea). No significant effect of land-use on early stage litter decomposition was noted within the temperate biome. Our results indicate that multiple drivers are affecting early stage litter mass loss with litter quality being dominant. In order to be able to quantify the relative importance of the different drivers over time, long-term studies combined with experimental trials are needed.

Keywords: Teabag; Green Tea; Rooibos Tea; Carbon Turnover; TeaComposition Initiative
Financial support: ILTER Initiative Grant; ClimMani Short-Term Scientific Missions Grant (COST Action ES1308); INTERACT (EU H2020 Grant No.730938); UNILEVER.

(7305 - 2255) Effect of dissolved organic matter and humic substances on transport of ions and low molecular weight molecules by liquid membranes

Mayra Mora[1]; Manuel Palencia[2]; Jaime L. Mercado[3]
1-GI-CAT, Department of Chemistry, Universidad del Valle, Cali, 25360, Colombia; 2-Mindtech Research Group (Mindtech-RG), Mindtech S.A.S, Cali, 25360, Colombia[1]; GI-CAT, Department of Chemistry, Universidad del Valle, Cali, 25360, Colombia[2]; Department of Agricultural Engineering and Rural Development, Universidad de Cordoba, Montería, 230002, Colombia[3]

Soil organic matter can be classified according to different criteria, including solubility in water, state and susceptibility to biodegradation and other. In general, the transport of inorganic and organic substances in water and soil can be strongly influenced by the mobility of natural dissolved organic matter (DOM) and by the contents of humified organic matter (HOM). On the other hand, liquid membrane systems are complex structures formed by liquid phase which can be used to produce a partition of different substances in function of diffusion properties and under different conditions. In this work, liquid

membranes systems were used to promote the molecular differentiation of humic acids and fulvic acid in order to ease the structural characterization. For that, water/oil/water (w/o/w) emulsion systems were prepared using n-decane as membrane liquid and Span 80 and Tween 80 as stabilizing agents. Systems were prepared in a ultrafiltration system and deionised water was used to produce the diafiltration (washing method at constant volume). Samples of humic and fulvic acids were obtained from different soils previously characterized. Permeate fractions were analysed by ultraviolet and infrared spectroscopy. In addition, major and minor elements were used in the feed in order to identify the changes and the concentration in function of the time. Similar experiments were performed using low molecular weight species (naphthalene acetic acid which is a phytohormone used to promote the growth of plants). Results evidenced a marked effect of different type of humic substance on transport of ions. Effect of pH was clearly identified being lower the interaction at low pH.

Keywords: humic acid, fulvic acid, hydrogen bonds
Financial support: Mindtech s.a.s. and Universidad del Valle (MT-004-2016)

(4778 - 701) Effect of litter nitrogen storage and nitrogen release of litter decomposition on soil nitrogen in *Pinus koraiensis* mixed forests

Jiang Yi[1]; Chen Lixin[1]; Duan Wenbiao[1]; Bu Fan[1]; Sun Shuanghong[1]; Li Fanfan[1]; Xu Yifan[2]
College of Forestry, Northeast Forestry University[1]; [2]

The influences of nitrogen storage and nitrogen release from decomposition in undecomposed litter layer(H), fermentation layer(F), humus layer(H) and surface soil layer(S) on soil nitrogen in spruce-fir-Korean pine mixed forest and birch-Korean pine mixed forest in XiaoXing'anling Mountains were studied by the direct harvesting method from May to October of 2012. The results showed that during the period of study, the litter standing crops of two forest types were 19.43-27.25 and 21.25-24.28 $t \cdot hm^{-2}$, nitrogen storage were 287.21-418.22 and 274.81-351.21 $kg \cdot hm^{-2}$, respectively. The nitrogen concentrations of different layers in two forest types were ranked in the decreasing order of L, F, H, and S. In *spruce-fir-Korean pine* mixed forest, both litter standing crops and its nitrogen storage in each layer peaked in May and September; monthly nitrogen storage increased from L to F layer; the nitrogen released from litter decomposition was easily enriched in F and H layers, but less leached into the soil. However, in *birch-Korean* pine mixed forest, both litter standing crops and its nitrogen storage in each layer peaked in May and October; nitrogen storage decreased from L to F layer; nitrogen was easily transported among all litter layers, nitrogen transported from litter layer into the soil was more than that in *spruce-fir-Korean pine* mixed forest. In two forest types, significant positive correlations were found between the litter standing crops (in L, F and H layers) and nitrogen in S layer, between nitrogen in H layer and nitrogen in S layer, and between the litter standing crops (in L and F layers) and nitrogen in H layer.

Keywords: XiaoXing'anling Mountains; *Pinus koraiensis* mixed forest; Litter standing crops; Nitrogen storage; Nitrogen return.
Financial support: National Natural Foundation of Science of China(31670627; 31770656; 31270666)

(7176 - 1622) Effect of prescribed burns on soil organic carbon forms in Histosols of the Itatiaia National Park

Robson Altiellys Tosta Marcondes[1]; Lúcia Helena Cunha dos Anjos[1]; Daniel Costa de Carvalho[1]; Elias Mendes Costa[1]; Luiz Alberto da Silva Rodrigues Pinto[1]
Universidade Federal Rural do Rio de Janeiro[1]

The Itatiaia National Park (INP) is a conservation unit located in Rio de Janeiro state and it is the first park of Brazil, set to preserve important ecosystems of the Atlantic Forest biome. Among the soils in the high altitude areas of INP, Histosols have a significant presence, and they function as reservoirs of organic carbon and nutrients for some endemic plants and fauna as water retention, which is important to river resources in INP. On the other hand, Histosols present great environmental fragility. In natural environments, where natural or human induced fires can occur specially in the driest periods of the year may contribute to their degradation. The objective of this study was to evaluate the effect of prescribed burns on organic carbon forms in Histosols, in selected areas of the INP high altitude plateau. Samples were taken in three depths (0 - 0.1, 0.1 - 0.2 and 0.2 - 0.4 m); in different periods of time: previous to burning, followed by 10, 30, and 90 days after that; and in two distinct sites, with different relief (plain lowland and hillside). The contents of total organic carbon (TOC) and labile carbon (LC) were evaluated by Yeomans & Bremner (1988) and Glover Laboratories and Barbercheck methodologies, respectively. The results were submitted to ANOVA and Tukey test with significance of 5%. The TOC and LC fractions showed different patterns according to topography and time. In the plain lowland, ten days after burning, there was a reduction of TOC and LC in all depths, followed by increases of TOC with time but not returning to the initial values. After 90 days there was a tendency of stabilization of LC values in all depths with a slight increase at 0.2 - 0.4 m. Regarding to the hillside area, values of TOC increased after 90 days in all depths when compared to the initial contents (previous to burning). An increase in LC was observed with time for the 0.0 - 0.1m depth, from 5.59 to 6.06 $g\ kg^{-1}$. The influence of prescribed fire was more intense in Histosols from the lowland area. These soils are under hydromorphic conditions most of the year, which reduces the transformation and mineralization of the organic material, thus making them less stable and with less recalcitrant organic substances. Results indicate that the practice of prescribed burn needs different protocols according to the Histosols conditions of formation, in order to maintain the ecological functions associated to the organic matter content in these soils.

Keywords: Soil organic matter; prescribed burn; soil quality; conservation units.
Financial support: CPGA-CS; UFRRJ; CNPq; FAPERJ; INP.

(4974 - 583) Exploring properties of soil organic matter at the microscopic level using molecular dynamics and an upgraded Vienna Soil-Organic-Matter Modeler

Yerko Escalona[1]; Drazen Petrov[1]; Chris Oostenbrink[1]
Institute of Molecular Modeling and Simulation (MMS), Department of Material Science and Process Engineering (MAP), University of Natural Resources and Life Sciences Vienna (BOKU), Muthgasse 18, A-1190, Vienna, Austria[1]

The Vienna Soil-Organic-Matter Modeler (http://somm.boku.ac.at/; VSOMM) is an online tool dedicated to generating condensed phase models of humic substances (HS), one of the most important constituents of Soil-Organic-Matter (SOM). This tool has permitted us to investigate the structure and dynamics of different SOM systems, including the Standard Leonardite Humic Acid, as well as, their interaction with small organic compounds. One of the challenges associated with the development of these systems, is to create a representative environment of the humic substances, at a nanoscale, taking into account that HS are composed of complex and heterogeneous organic compounds produced by biological degradation. For that reason, the modeler use a database of organic fragments called building blocks (BBs). Each BB has a different chemical structure, which, in combination, are able to reproduce the carbon distribution estimated by ^{13}C NMR. Here, we have constructed a number of new BBs with the current parameter set 54A8 of the GROMOS force field, including BBs with Methoxyl-C and Alkyl-C groups that improves the agreement with the NMR data.

Additionally, an improved core algorithm of VSOMM was developed and written using PYTHON, which allows us to automatically generate and equilibrate multiple models of greater chemical and geometric diversity. Using the new version of VSOMM, we extend our investigation from the Standard Leonardite Humic Acid to several other experimentally available HA samples, including the Suwannee River II, Elliott Soil, Elliott Soil IV and Pahokee Peat Humic Acids. We characterized these systems by doing a plethora of analyses in order to observe differences in their structure and dynamics. The binding of pollutants and pesticides affects the erodibility, moisture retention and soil structure of SOM impacting possibly the carbon cycle, reducing the Carbon storage on soil. We also investigated the sorption of these systems.

Keywords: Humic substances (HS); Soil-Organic-Matter (SOM); Molecular models; Molecular Dynamics (MD).
Financial support: FWF (grant no. P30224)

(9382 - 1843) Factors controlling organic carbon storage in tropical soils

Kenta Ashida[1]; Tetsuhiro Watanabe[1]; Arief Hartono[2]; Method Kilasara[3]; Antonie Mvond Ze[4]; Shinya Funakawa[1]
Kyoto University[1]; Bogor Agricultural University[2]; Sokoine University of Agriculture[3]; Dschang University[4]

In this study, we identified the soil component with the strongest contribution to storage of soil organic carbon (SOC) and investigated the effects of the soil component, climate, and geology on SOC storage in tropical soils. Soils from A and B horizons in Thailand, Indonesia, Tanzania, Cameroon, and Japan were analyzed. Total carbon contents as organic carbon contents and soil components that would contribute to SOC storage (clay + silt, acid ammonium oxalate extractable Al and Fe: $Al_o + Fe_o$, sodium pyrophosphate extractable Al and Fe: $Al_p + Fe_p$), were measured. The total contents of elements that reflect geology were determined. Correlation analysis was applied to compare the contribution of soil components to SOC storage. Effect paths and the relative contribution of the soil components and climatic (e.g., mean annual temperature: MAT, mean annual precipitation, net primary production) and geological (e.g., total Si) factors were analyzed by covariance structure analysis. The results of correlation analysis indicated that $Al_p + Fe_p$ and $Al_o + Fe_o$ contributed to SOC storage in both A and B horizons. In A horizons, $Al_p + Fe_p$ was strongly correlated with SOC for moderately and strongly weathered soils, but less correlated for weakly weathered soils from cooler regions, indicating that other factors, such as aggregation, may contribute to SOC storage in weakly weathered soils. The model used for covariance structure analysis explained 56% and 74% of the variance in A and B horizons, respectively. In B horizons, the total effect on SOC was highest for $Al_o + Fe_o$ (0.75) and MAT (−0.63). $Al_o + Fe_o$ had a direct effect (direct effect: 0.75, indirect effect: n.s.), whereas MAT had an indirect effect (direct effect: −0.12, indirect effect: −0.51) mainly via $Al_o + Fe_o$. Geological factor (total Si) affected SOC indirectly mainly via $Al_o + Fe_o$ (direct effect: n.s., indirect effect: −0.23). In A horizons, the total effect on SOC was high for MAT (−0.65) and $Al_o + Fe_o$ (0.24), where MAT had more direct effected on SOC than that in B horizons (direct effect: −0.47, indirect effect: −0.18). $Al_o + Fe_o$ and net primary production also directly affected the SOC in A horizons. We conclude that $Al_o + Fe_o$ controls SOC storage, and temperature indirectly affects SOC via $Al_o + Fe_o$ in B horizons, whereas climatic conditions that affect input and decomposition of organic matter directly control SOC, the effect of which were stronger than $Al_o + Fe_o$ in A horizons.

Keywords: Active Al and Fe; climate; geology
Financial support: JSPS KAKENHI Grants no. 17H06171 and 24228007

(4619 - 856) Fire influences on litter decomposition: C chemistry and N transformations in thermally altered *Pinus radiata* needles.

Erinne Stirling[1]; Timothy R. Cavagnaro[1]; Ronald J. Smernik[1]; Lynne M. Macdonald[2]
The University of Adelaide[1]; CSIRO (Commonwealth Scientific and Industrial Research Organisation)[2]

As climate change proceeds, a change in the frequency and intensity of fire events is expected to affect soil organic matter (SOM) transformations within forestry systems. While the effect of fire on woody materials has been extensively studied, less is known about thermal alteration of non-woody plant materials such as leaves. In this study, non-woody OM was exposed to a thermal gradient to determine the effect of temperature on SOM C chemistry and N transformations. Methods: Live Pinus radiata needles <1 year old were collected from a managed forestry plantation. Needles were dried at 40°C ('air dried') before being further heated for 1 hour in a muffle furnace at a range of temperatures >40°C (max. = 320°C), and then coarsely ground and screened (0.5-1.0 mm fraction retained). These needles were characterized for C and N content, extractable N pools (mineral, potentially mineralizable, and microbial biomass), C chemistry (solid-state 13C NMR), and general spectral differences (MIR). An incubation experiment (14 d) was performed to assess the impact of the different litters on soil N transformations. Results: C loss started at 200°C and increased to 56% of the C content at 320°C; N losses started at 260°C and were lower than the C losses (30% at 320°C). While temperatures <178°C (low Temp) resulted in small changes in C chemistry, needles heated to >200°C (high Temp) decreased in O-alkyl groups, and increased in aryl and O-aryl groups; alkyl groups increased slightly until 260°C before decreasing at 320°C. High Temp treatments in the incubated soils generally maintained a larger microbial biomass but had lower microbial activity than low Temp treatments. Although mineral N was rapidly depleted in the low Temp treatments, it is not clear what form it became as nitrate was not detected. Potentially mineralizable N was initially positive for high Temps and negative for low Temps; however, all treatments were positive by day 3. Discussion: The results indicate a step change in the effect of heating on pine needles, with a critical change occurring at or before 200°C. Below 200°C, C and N differ little compared to air dried needles; above 200°C needles experience significant chemical changes, but do not appear to influence soil N transformations to the same degree as air dried needles. From this experiment it is clear that in a laboratory setting, thermally altered non-woody inputs to the soil affect processes governing SOM transformations.

Keywords: Organic matter, 13C NMR, N transformations, microbial biomass
Financial support: This project was supported by The Holsworth Wildlife Research Endowment and The Ecological Society of Australia.

(4330 - 2444) Glomalin Related Soil Protein from the Itataia phosphate-uranium deposit in the Brazilian semiarid

Laura Victoria Márquez Cataño[1]; Maria Eugenia Ortiz Escobar[1]; Cleyton Saialy Medeiros Cunha[1]; José Igor Almeida Castro[1]; Antonio Yan Viana Lima[1]
Federal University of Ceara[1]

Glomalin Related Soil Protein (GRSP) refers to a glycoprotein produced by mycorrhizal fungi and is recognized as a soil carbon pool. High contents have been found in natural systems (2-15 mg g^{-1}) while lower contents are generally reported for soils under frequent tillage as well as in semiarid regions (0.1-1 mg g^{-1}). GRSP is positively correlated with soil quality parameters such as aggregate stability, porosity and soil organic matter (SOM). Moreover, it has been related to heavy metal stabilization in polluted soils. The Itataia phosphate-

uranium deposit comprises approximately 1.54 km^2, considered the largest uranium reservoir of South America, still conserved under native vegetation, known as Caatinga, located in the Brazilian semiarid where have been reported varying levels of heavy metals. This study aims to determine GRSP concentrations of this area in its natural equilibrium condition (prior to industrial extraction activities) and provide information for programs of soil remediation in areas under the influence of ore extraction. We collected 52 simple soil samples from the first 10 cm depth, for the determination of GRSP (sodium pyrophosphate 0.1 M) and total organic carbon - TOC (wet oxidation with external heating). Results are the mean of three replicates and are expressed on dry soil mass basis. Descriptive statistics and Pearson correlation analyses were performed in R software. GRSP concentrations along the area ranged from 0.34 to 11.64 mg g^{-1}, with a mean of 4.72 mg g^{-1}. Mean value of TOC along the area is 24.4 mg g^{-1}, considered high for Brazilian Semiarid. Significant correlation ($p>0.001$) was found between GRSP and TOC ($r = 0.92$), corroborating that factors involved in SOM accumulation also stimulates mycorrhizal fungi propagation, enhancing GRSP concentrations as has been widely suggested by scientists. The levels of GRSP in this study are considered high when compared to other samples from semiarid regions, and are in agreement with reports of high GRSP in heavy metal polluted soils.

Keywords: Heavy metals; soil organic matter; Caatinga
Financial support: The National Council for Scientific and Technological Development (CNPq), Coordination for the Improvement of Higher Level Education (CAPES)

(8193 - 2582) How soil C:N ratios vary with depth, particle size and soil fertility in Brazilian forest soils

Marla Alessandra Araujo[1]; Yuri Lopes Zinn[2]; Rattan Lal[3]
Depto. de Agronomia, Centro de Ciências Agrárias, Universidade Estadual de Londrina, Campus Universitário, Londrina, PR 86057 970, Brazil. E-mail: marlaalessandr@gmail.com[1]; Depto. de Ciência do Solo, Universidade Federal de Lavras, Lavras, MG 37200 000, Brazil[2]; Carbon Management and Sequestration Center, The Ohio State University, 2021 Coffey Road, Columbus, OH 43210-1085, USA[3]

Among the many proxies to assess the quality of residues and soil organic matter, C:N ratio is certainly the easiest to determine. However, in regard to bulk soils and particle size fractions, interpretation of C:N ratios is not simple as for organic residues, mostly due to organic interactions with mineral components. In order to study soil factors affecting soil C:N ratios, we sampled 8 soils with contrasting texture and mineralogy, formed from alteration of 8 rocks (quartzite, mica-schist, gabbro, itabirite, serpentinite, limestone, gneiss and phyllite), near Lavras-MG, Brazil. Aiming to provide a *ceteris paribus* sampling, all soils were under native semi-deciduous forests, located on midslopes, and under similar warm temperate humid climate. In each soil, samples were taken in triplicate, in 6 layers from 0 to a 1 m depth. Soil C:N ratios were computed after C and N dry combustion in bulk soils (sieved <2 mm) and in clay, silt and sand separates. Bulk soil C:N ratios in each soil varied relatively little with depth, between 10 and 18, although different soils varied slightly in their C:N profiles. Clay C:N ratios also varied little with depth, and were always ~10 (<10 in 3 soils), whereas in sand fractions C:N ratios increased to 20-60 below the 40 cm depth. Silt fractions C:N ratios were similar to those of bulk soils. Interestingly, in the 0-5, 5-10, 10-20 and 30-40 cm depths, bulk soil C:N ratios were correlated with various fertility indicators. Significant, negative correlations occurred with KCl-extractable Ca (r^2=0.52 to 0.81), sum of bases (0.50-0.80) and base saturation (0.46-0.70). Concurrently, C:N ratios were positively correlated with KCl-extractable Al and H+Al at pH 7. In other words, in the top 40 cm depth, soils richer in base cations had lower C:N ratios, i.e. higher N in relation to soil organic carbon (SOC), suggesting also a higher fertility in regard to N supply to plants. These results are remarkable since the soils did not differ in SOC retention but differed widely in soil fertility (Araujo et al., Geoderma 300, 1, 2017). Although soil C:N ratios per se are weak indicators of soil quality changes upon land use change in Brazil (Zinn et al., Agric. Ecos. Env. 255, 62, 2018), these results suggest that C:N ratios can be useful to study mechanisms of SOC retention in soils and clays. Apparently, ammonia groups in SOC molecules are sorbed to mineral surfaces and thus favor SOC stabilization.

Keywords: C sequestration; soil organic nitrogen, ammonia groups; soil profile; particle size fractionation
Financial support: Capes Foundation sponsored the first author (Grant nº BEX 2929/12-0), Minas Gerais State Foundation for the financial support for research (Fapemig, Grant nº CAG-APQ 720–12, 778–15) and for CNPq Foundation.

(5152 - 236) Humic substances and total organic carbon of an inceptisol after 21 years under different soil tillage

Luiz Paulo Rauber[1]; Andréia Patrícia Andrade[2]; Barbara Bagio[2]; Neuro Hilton Wolschick[2]; Walter Santos Borges Júnior[2]; Ildegardis Bertol[2]; Álvaro Luiz Mafra[2]
Universidade do Oeste de Santa Catarina-UNOESC[1]; Universidade do Estado de Santa Catarina-UDESC[2]

Soil sustainability depends on its manegement and it may be related with organic matter concentration. The objective of this study was to evaluate chemical and physical fractions of organic carbon in a Humic Dystrudept after 21 years under no tillage and conventional tillage in an experiment established in 1995 in Lages-SC, southern Brazil, conducted in a completely randomized desing with eight replicates. The treatments evaluated were conventional tillage (CT), using one plowing followed by two disking before summer and winter crops and no tillage (NT). During 21 years of the experiment, grass and legume crops were intercropped and rotated among them, using oats, fodder radish and vetch in the winter, and maize, soybeans and beans int the summer. Soil samples were collected in November 2016, at 0-2.5, 2.5-5, 5-10 and 10-20 cm depths and analyzed for the chemical fractionations to separate humin and humic and fulvic acids, and to determine total organic carbon (TOC) and particulate organic carbon (POC). The carbon management index (CMI) and carbon stock were calculated considering a native grassland (NG) as a reference area, according to the equivalent mass basis. The results were submitted to analysis of variance by the F test and the means were compared by the Tukey test ($P<0.05$). The carbon content in the humic fraction of NT was similar to NG in the two surface layers, representing the most stabilized form of the organic matter. NT had 73% more carbon in the humin fraction than the CT in the 0-2.5 cm layer. NT presented 35% more TOC and 48% more POC than the CT in the 0-2,5 cm layer, meaning that the NT sequestrated carbon in the particulate fraction due to the maintenance of crop residues and minimal soil disturbance. TOC increased 9% in the 0-20 cm layer after 21 years NT, resulting in a stock increment of 7 Mg ha^{-1}, while under CT there was a reduction of 3 Mg ha^{-1} in the carbon stock in this period. The CMI was higner in NT than in CT in the 0-5 cm layers, evidencing the negative impact of the mechanical soil disturbance on the organic matter in the surface soil.

Keywords: Humic acids; Soil tillage; Organic carbon, Carbon stock.
Financial support: National Council for Scientific and Technological Development

(3593 - 2208) Influence of eucalypt residue (root and shoot) and N (internal and external) to C and N incorporation in soil organic matter fractions

Emanuelle Mercês Barros Soares[1]; Rafael da Silva Teixeira[1]; Rodrigo Nogueira de Sousa[1]; Gustavo Conforti Ventura Mayrink[1]; Ivo Ribeiro da Silva[1]

UFV[1]

Eucalypt forests have the capacity to sequester atmospheric CO_2, immobilizing it in its biomass, and later transferring the C to the soil. Root and shoot residues are the main input of C to the soil and their stabilization will depend initially on the decomposition process, which is influenced by residues quality and the N availability. The goal of this work was to evaluate the contribution of eucalypt root and shoots residues with different internal N levels for soil organic matter fractions (SOM) when submitted to external N application. Eucalypt hybrids were previously enriched with ^{13}C and ^{15}N and grown with different N supplies. The experiment was conducted in an incubation room (25 ± 1^{o}C, in the dark) for 119 days. The treatments were based on an incomplete factorial (2 x 2 x 2) + 2: two residues (Eucalypt shoot and Eucalypt root); two internal N levels (High internal nitrogen - HIN and Low internal nitrogen - LIN); two external N levels (0 [-N] and 50 mg dm^{-3} NH_4NO_3-N [+N]) and two soils without residues addition but with application of two external N levels (0 [-N] and 50 mg dm^{-3} NH_4NO_3-N [+N]) arranged in a randomized block with four replicates. Soil samples (0-20 cm; Hapludox) cultivated with pasture (C_4 plant) was used for incubation. During the 119 days of incubation the CO_2-C and CO_2-^{13}C emissions were determined by the CRDS. In addition, after 119 days the soil was removed and C (%), $\delta^{13}C_{PDB}$ (‰), N (%) and the atom in excess of ^{15}N (%) in the particulate organic matter fraction (POM) and minerals associated organic matter (MAOM) were determined by a coupled CN elemental analyzer to an isotope ratio mass spectrometer. The external N application decreased the CO_2-C derived from the HIN Eucalypt shoot residue (3.9%; P = 0.003) and HNI Eucalypt root residue (7.5%; P <0.001). Consequently, it promoted the preservation of POM-C in the addition of HIN Eucalypt shoot residue (11.6%; P = 0.007) and HNI Eucalypt root residue (7.8%; P = 0.014). However, the external N application did not cause contributions to the MAOM-C. Eucalypt root residue presented lower decomposition than Eucalypt shoot residue, independent of internal N levels and external N application. In addition, Eucalypt shoot residue provided higher contributions of residue derived-C and -N to the more stable fraction of SOM (MAOM) in relation to the Eucalypt root residue.

Keywords: Particulate organic matter - POM, Mineral associated organic matter - MAOM, residue derived-CO_2-C, eucalypt residue-^{13}C and -^{15}N.

Financial support: Financial Support: Conselho Nacional de Desenvolvimento Científico e Tecnológico – CNPq 486043/2013-4; NUTREE UFV Group

(5797 - 1509) Influence of magnesium silicate on the persistence of the straw of *Brachiaria brizantha* cv. Piatã in no-tillage

Izabela Richena Barbosa[1]; Alessandra Mayumi Tokura Alovisi[2]; Alves Alexandre Alovisi[2]; Luana Gonçalves Perondi[2]; Giuliano Reis Pereira Muglia[2]; Gustavo Henrique Leite Mota Piesanti[2]; Robervaldo Soares da Silva[2]

Federal university of Grande Dourados[1]; [2]

In regions of tropical climate, with high decomposition of plant residues, the application of magnesium silicate can be an alternative to increase the persistence of straw on the soil in no-tillage, interfering with the availability of nutrients to crops. The objective of this study was to evaluate the dry mass production, the percentage of soil cover, as well as the persistence of the straw of *Brachiaria brizantha* cv. Piatã on the ground. The experiment was conducted at the Experimental Farm of Agricultural Sciences of the Federal University of Grande Dourados (UFGD) in a Red Distroferric Oxisol. The experimental design was a randomized block design and the treatments were arranged in a 5x2x5 factorial, involving five doses of magnesium silicate (0, 2, 4, 8 and 16 Mg ha-1), (0 and 300 g ha-1) and five collection times (30, 60, 90, 120 and 150 days after the deposition of the litter bags on the soil), with four replications. Proportional samples of the brachiaria dry mass were conditioned in litter bags, which were arranged on the soil, being collected and weighed every 30 days, up to 150 days after installation, to evaluate the persistence of straw, after forage management. The experimental data were submitted to analysis of variance with the aid of the statistical program ASSISTAT. The application of magnesium silicate linearly increased the dry matter yield of the aerial part of the forage. This greater production provided the permanence of greater amount of straw on the soil over time. The remaining dry mass of B. *brizantha* up to 90 days after its management, associated with the application of magnesium silicate at the dose of 16 Mg ha-1, is enough to provide the amount of straw that must be added annually to the soil surface in the Planting System Direct. The persistence of the straw on the soil persists up to 124 days after forage management, with soil cover percentage above 80%.

Keywords: Key words: serpentinite, decomposition of vegetal residue, bioactive

Financial support: FUNDECT and UFGD

(4643 - 2391) Influence of the organic matter on the availability of heavy metals in the soil in vegetable gardens of the Metropolitan area of Belém/Pa.

Nayara Kelly Feitosa Ferreira[1]; Antonio Rodrigues Fernandes[2]; Joselito Santiago de Lima[1]; Angleson Figueira Marinho[1]; Cássio Furtado Lima[1]

Federal Institute of Education Science and Technology of Pará/Óbidos[1]; Federal Rural University of Amazonia[2]

Influence of the organic matter on the availability of heavy metals in the soil in vegetable gardens of the Metropolitan area of Belém/Pa.

Nayara Kelly Feitosa Ferreira[1], Antonio Rodrigues Fernandes[2], Joselito Santiago de Lima[1], Angleson Figueira Marinho[1], Cássio Furtado Lima[1]. [1]Federal Institute of Education Science and Technology of Pará/Óbidos, Av. Nelson Souza, S/N, Óbidos, 68250-000, Brazil (nayara.ferreira@ifpa.edu.br); [2]Federal Rural University of Amazonia, Av. Presidente Tancredo Neves, 2501, Belém, 66077-830, Brazil. The cultivation of vegetables is usually used organic matter high doses. Organic matter (OM) influences the availability of metals in the soil. The main aim this studywas to evaluate the influence of OM on the available concentrations of Cu, Zn, Mn, Cr and Fe in soils cultivated with vegetables. In those areas were collected, the soils in the planting lines of three species most consumed, such as lettuce (Lactuca sativa L.), cabbage (Brassica oleracea L. var. Acephala) and caruru (Talinumesculentum, Jacq.). In each line were collected 10 simple soil samples, to form a composite sample, at a depth of 0-20 cm. The available concentrations were determined with the solution of Mehlich 1. In order toverify the influence of the MO was used Spearman' analysis of correlation between the available levels and the MO of the soil. The MO content found was 96,68; 97.68; 68.18 g kg-1, in Ananindeua, Marituba and Santa Isabel, respectively. It was found that the available concentrations of Mn presented a significant correlation with soil OM (ρ = 0.789) at the 5% probability level (p <0.05).The high availability of this element can be justified by the high decomposition of the organic matter, which is strongly influenced by the pH found in these soils, in the range of (5.0 to 6.5).Besides, the complexation process (chelation) of Mn for organic acids of low molecular weight may increase the availability of this element, because the chelate becomes a form of accumulation of Mn in the soil and, with the fast decomposition by the microorganisms, it is released continuously and gradually to the plants. No significant correlations

were found among OM and available concentrations of Cu, Zn, Cr and Fe metals. In this way, the increment of the OM in the soils was able to increase the availability of Mn. Keywords:plant contamination; available concentrations, toxic elements Financial Support: PPGA/UFRA, CNPQ and IFPA

Keywords: plant contamination, available concentrations, toxic elements
Financial support: PPGA/UFRA, CNPQ and IFPA

(5382 - 2098) Leaching of cations and eucalyptus growth under complementary fertilization with K^+ and Na^+

ANÁLIO, Caroline M.[1]; LOTTI, Marina N. N.[1]; AMORIM, Helen C. S.[1]; FERREIRA, Matheus A.[1]; GARDIOLI, Luiz Fernando N.[1]; SILVA, Ivo R.[1]
Federal University of Viçosa[1]

Potassium (K^+) is one of the most deficient nutrients in tropical weathered soils. The maintenance of productivity of eucalyptus plantations depends on the application of high doses of potassic fertilizers, increasing production costs. An alternative to reduce these costs would be the partial substitution of K^+ by sodium (Na^+) in fertilization. The objective of this study was to evaluate the mobility of K^+ and Na^+ in the soil profile, their losses by leaching and the effect of K^+ substitution by Na^+ on the diametric growth of a eucalyptus stand (?) o que eh stand???. The experiment was carried out in a randomized block design with three treatments (100 kg ha^{-1} of K^+ as KCl, 100 kg ha^{-1} of Na^+ as NaCl, and a control treatment without additional fertilization) and three replicates, totalizing nine experimental units.Zero voltage lysimeters were installed in the experimental units at 70 cm depth for the monthly collection of percolated water. Steel dendrometers were installed in the trunk of the trees that contained a lysimeter, to accompany the diametric growth over time. Sixty days after application of the treatments, soil samples were collected in the 0-20, 20-40 and 40-60 cm depth to determine the available K^+ and Na^+ content. Samples of percolation water were collected monthly for the determination of K^+ and Na^+ contents. Monthly readings were performed on the dendrometers to evaluate the diametric increase.Data were submitted to regression analysis. The available K^+ and Na^+ contents were higher in the KCl and NaCl treatments, respectively. The 20-40 cm layer of the KCl treatment and the 0-20 cm layer of the NaCl treatment showed the highest levels of K^+ and Na^+ available, in that order. The treatments with KCl and NaCl caused higher leaching of K^+ and Na^+, respectively, with higher losses up to 66 days after the installation of the experiment, for both cations. The treatment with NaCl had a higher diametric increase up to 66 days; after this period, all the treatments showed decreased increments. The treatment with KCl showed higher average growth during the experimental period. Na^+ is the most vertical cation in soil and can reduce the diametric growth of the trees during a period of water restriction. The partial replacement of K^+ by Na^+ was not fully supported in this study.

Keywords: potassium fertilization; cation mobility; diametric growth
Financial support: Veracel

(8352 - 396) Long Term Dynamics of Soil Organic Carbon Pools in Oil Palm Plantations following Land Use Change: Insights from Physical Fractionation and natural ^{13}C abundance

Juan Carlos Quezada RIvera[1]; Thomas Guillaume[1]; Alexandre Buttler[1]
École polytechnique fédérale de Lausanne, EPFL; The Swiss Federal Institute for Forest, Snow and Landscape Research, WSL[1]

Quantifying changes in soil organic carbon (SOC) storage is an important step towards identifying more sustainable land use change (LUC) options. However, determining the turnover rates of specific functional SOC pools can provide better insights into the dynamics of SOC. Furthermore, when distinct SOC pools are examined along with changes in natural $\delta^{13}C$ abundance due to vegetation shifts, mechanisms of SOC dynamics can be elucidated. At the moment, LUC to oil palm (OP) plantations is a major pressing issue in the tropics and it has been heavily criticized. Here, we studied SOC dynamics following conversion of tropical pastures into OP plantations. Soil samples from pastures and a chronosequence of OP plantations ranging from 12 to 56 years after pasture conversion were used. We separated SOC by density fractionation obtaining: free light fraction (FLF), occluded light fraction (OcLF) and heavy fraction (HF). Carbon, N contents and $\delta^{13}C$ and $\delta^{15}N$ values were determined as well as mean residence times (MRT) values for each SOC density fraction. Replacement of pasture areas by OP plantations gradually reduced overall $\delta^{13}C$ values with time (from -14‰ to -28‰ in the 56 years plantation). Our preliminary results showed that rates of isotopic changes in the three separated pools decreased in the following order: FLF>OcLF>HF. No pasture-derived C was found in the LF fraction after 18 years of OP cultivation, indicating a very fast decay of pasture derived C. Conversely, about half of total SOC was still pasture-derived in the HF after two rotation cycles. The C content in the OcLF decreased sharply after plantation establishment, but it started to increase again after OP plantation renovation during the second cultivation cycle, indicating a long-term resilience of this fraction against LUC. Apparently, physical protection of SOC within stable soil aggregates is due to almost no soil tillage in OP plantations, together with a significant pulse of OM input following plantation renovation. Nevertheless, whole SOC stocks were depleted by almost 50% after 56 years of pasture conversion. Our results suggest that despite enhanced physical protection of SOC in aggregates, which can increase MRT of SOC, after plantation renovation, OP cultivation following pasture conversion reduces SOC stocks over two rotation cycles. Reductions in overall SOC stocks was directly correlated to significant reductions in the C content of the HF that contained most of the total SOC.

Keywords: $\delta^{13}C$ natural abundance, land use change, density fractionation, mean residence time.
Financial support:

(7135 - 1489) Long-term changes in the composition of organic matter

Kerttu Tammik[1]; Alar Astover[1]; Karin Kauer[1]
Estonian University of Life Sciences, Chair of Soil Science[1]

Organic matter consists of fractions with various degree of decomposition and stability. FTIR spectroscopy is a technique used for distinguishing the principal chemical classes in soil organic matter without extraction solvents which may distort the results. The absorption intensity reflects the proportional amounts of functional groups. This is particularly important in assessing labile organic C fractions which include water-soluble organic C. The aim of this study is evaluate the effect of plant cover on the composition of the soil organic matter (SOM) using data gathered from a longtime experiment located in Estonia. The experiment was established in 1964 using 19 different treatments. From the experimental location, the soil was removed until 1m depth (BC horizon) and replaced with a homogeneous material with a low initial C content (1.28 g kg^{-1}) derived nearby. For analyzing the composition of SOM, samples collected at the start of the experiment (1964) and again after 50 years (2014) were used, allowing to assess the long-term changes in related to vegetation. The vegetation treatments under investigation were bare fallow since 1964 (F), barley (B), a mixture of grasses (G), hybrid lucerne (H) and galega (Ga). F, B and G treatments have remained unchanged since the beginning of the experiment, H and Gg have previously been a mixture of clover and grasses, named cultures have

been sown in 1995. Differences in composition of SOM were analyzed with Fourier Transform Infrared (FTIR) spectroscopy using absorption peaks recorded at 995 cm^{-1} (Si-O vibrations of clay minerals), 1428 cm^{-1} (carboxylic C), 1633 cm^{-1} (aromatic C), 3619 cm^{-1} and 3694 cm^{-1} (stretching of the inner and other hydroxyl group of kaolinite, gibbsite). The peak intensity of carboxylic C was the highest in the beginning of the study and lowest in B treatment. F and other grasses had no significant differences. The intensity of the peak characterizing aromatic C has risen compared to the start of the experiment – it was the highest in H and Ga treatments and lowest in F treatment. The aromatic C compounds considered a representative of the stable C fraction due to resistant bonds between particles. Treatments B and G had no differences. Formation of different groups depends on vegetation, namely the composition of C input. The differences are more pronounced concerning carboxylic and aromatic C groups, bonds describing mineral composition are not affected as much.

Keywords: SOC, FTIR, LTE, aromatic, carboxylic
Financial support:

(9947 - 1922) Long-term effect of fertilizer and crop residues management under cassava production on changes in soil organic carbon storage

Somrutai Tancharoen[1]; Kobkiet Paisancharoen[2]; Somkuan Klongchang[1]; Chayant Pakdeethai[2]; Suphakarn Luanmanee[1]; Sainam Udpuay[1]; Piyanan Wiwatwittaya[1]; Takeshi Watanabe[3]
Agricultural Production Sciences Research and Development Division, Department of Agriculture. Thailand[1]; Field and Renewable Energy Crops Research Institute. Department of Agriculture. Thailand[2]; Japan International Research Center for Agricultural Sciences. Japan[3]

Fertilizer and crop residues management is important not only for increasing crop production but also sustaining soil productivity. Soil organic carbon is a key indicator of soil fertility and productivity. However, it needs a long period to distinguish the changes in soil organic carbon. Therefore, a long-term field experiment was conducted in 1976 in Yasothon soil series sandy loam; fine loamy, siliceous, Oxic Paleustult, at Khon Kaen Province in northeast of Thailand. The experiment consisted of 8 treatments with 4 replicates laid in randomized complete block design. The treatments varied in fertilizer and crop residues management i.e. without fertilizer application (No CF), No CF with cassava residues incorporation (No CF+R), fertilizer application at rates of 50-100 kg N/ha (N), N 50-100 kg/ha P_2O_5 50 kg/ha (NP), N 50-100 kg/ha K_2O 50-100 kg/ha (NK), N 50-100 kg/ha P_2O_5 50 kg/ha K_2O 50-100 kg/ha (NPK), NPK with 12.5t/ha compost (NPK+C) and NPK with 18.75t/ha cassava residues incorporation (NPK+R). This study investigated the long-term effect on changes of soil organic carbon at 0-20 cm depth during 1985 to 2017. The result showed that fertilizer and crop residues management significantly affected the status of soil organic carbon. The application of NPK fertilizer with 12.5t/ha compost was the most effective management to increase the soil organic carbon about 94 kgC/ha/year. The soil organic carbon under the application of NPK fertilizer with 18.75 t/ha cassava residues incorporation (NPK+R) increased about 28 kgC/ha/year inferior to the NPK+C. This was due to easily decomposition of fresh cassava residues as compared to highly stability of compost. If the soil was applied with chemical fertilizer the soil organic carbon hardly increased about 2 kgC/ha/year. In contrast to those practices, the soil under cassava production without fertilizer application either with or without cassava residues incorporation showed that the soil organic carbon drastically decreased about 43 and 107 kgC/ha/year, respectively. This can be concluded that using cassava production in sandy soil without fertilizer and organic materials application can cause reduction of soil organic carbon over the years whereas using chemical fertilizer can slow down the depletion of soil organic carbon. However, addition of organic materials to the soil by using composts and crop residues is the most effective to maintain the level of soil organic carbon and sustain the soil productivity.

Keywords: cassava, soil organic carbon, soil productivity, sandy soil
Financial support: Royal Thai Government. Department of Agriculture, Thailand.

(7109 - 2716) Macaúba (*Acrocomia aculeata* Mart.) contribution to soil organic carbon

Sandro Lucio Silva Moreira[1]; Heitor Eduardo Campos Ferreira Morato Filpi[1]; Aristides Osvaldo Ngolo[1]; Hewlley Maria Acioli Imbuzeiro[1]; Leonardo Duarte Pimentel[1]; Gilberto Chohaku Sediyama[1]; Raphael Bragança Alves Fernandes[1]
Universidade Federal de Viçosa[1]

Macaúba (Acrocomia aculeata Mart.) is a native palm from Brazil, which presents great potential for biodiesel production and for providing food for human and animal consumption. This palm has been the focus of a wide range of studies in the last decade. In general, the palms present a fasciculated root system, and most part of roots tend to concentrate in the upper soil layer, therefore, contributing to soil carbon accumulation. The aim of this study was to evaluate the total soil organic carbon contents (TOC) provided by Macaúba root system. Soil sampling was carried out in a Macaúba cultivated area during five years in Araponga, Minas Gerais State, Brazil. The area influenced by the palm canopy cover was delimitated and the samples were taken considering three different distances from the Macaúba stem (0-0.9 m, 0.9-1.8 m, and 1.8-2.7 m). For each distance, four different soil depths were sampled (0-0.2 m, 0.2-0.4 m, 0.4-0.6 m, and 0.6-1.0 m). The total organic carbon (TOC) contents of all soil samples were quantified in the laboratory. Data were evaluated by analysis of variance and means were compared by post hoc Tukey test ($P<0.05$). Results obtained indicated the distances from the palm stem did not affect the total soil organic carbon content (TOC varying from 2.4 to 2.8 %), whereas different soil depths influence TOC. The highest TOC located on surface and depth reduce its contents. TOC contents varied from 3.8 % (0-0.2 m) to 1.7 (0.4-1.0 m). The highest total organic carbon content of the soil occurs in the initial layers of the soil.

Keywords: Soil carbon; palms; roots
Financial support: Universidade Federal de Viçosa, CAPES, and Acrotech

(9766 - 1928) Methods for the determination of organic carbono in soils of Alagoas State, Brazil

Deni Rafaela Silva Barros[1]; Gilson Moura Filho[1]; Stoécio Malta Ferreira Maia[2]; Adriano Barboza Moura[1]; Leila Cruz da Silva Calheiros[1]
Universidade Federal de Alagoas - UFAL[1]; Instituto Federal de Alagoas - IFAL[2]

Currently, different methodologies for the determination of soil organic carbon have been used without taking into consideration the risks they may offer to the environment, neither the high costs involved in carrying out these analyzes. Given the need of adopting an alternative method that is less polluting, has a lower cost and more practicability, new procedures are being tested. The objectives of this work is to determine soil carbon and organic matter by different methods, apply descriptive statistics to the data, correlate the methods and determine the similarity or difference between alternative methods and Elementary Analysis (standard method). Additionally, due to its widespread usage, Walkley-Black modified method was used as a standard and compared with the others. The work was carried out with native forest soils of the Sertão, Agreste and Litoral Alagoano regions. 48 composite samples were collected in

the 0-20 cm layer. Soil carbon contents were determined by wet combustion methods - Walkley - Black modified and Colorimetric, and dry combustion - Elementary and Gravimetric Analysis. The data were evaluated through the descriptive statistical analysis, the coefficients of determination and correlation of the curve and Graybill's F tests, t-test for the mean error and the test of the analysis of the linear correlation coefficient in comparison to the mean-error. The modified Colorimetric and Walkley & Black methods tend to underestimate organic carbon, respectively, at 55.44 and 16.27%, while Gravimetric tends to overestimate total carbon contents by 15.02% compared to Elementary Analysis. The Gravimetric method presented identity with the Elementary Analysis. Although no identity was observed in the comparison between the colorimetric and the other methods, high values for its correlation coefficients were noted indicating the possibility of use to replace the modified Walkley-Black and Elementary Analysis methods.

Keywords: Carbon, Organic Matter, Colorimerty
Financial support: CAPES

(5365 - 545) Microscopic analysis of the structure, dynamics and absorption properties of the standard Leonardite humic acid using molecular dynamics simulations

Drazen Petrov[1]; Daniel Tunega[1]; Martin H. Gerzabek[1]; Chris Oostenbrink[1]

University of Natural Resources and Life Sciences Vienna, Austria[1]

Humic substances (HS) are abundant in the environment and play an important role in a number of biogeochemical processes including microbial activity, soil aggregation, plant growth, the retention and release of nutrients, the environmental fate of pollutants and carbon storage. They are flexible, relatively small molecules forming supramolecular structures through weak interactions. Despite the great importance of understanding their behavior at the atomic level, computational modeling, a premier high-resolution technique providing great level of detail, has been surprisingly little employed to study humic substances. Here, we use the recently developed Vienna-Soil-Organic-Matter Modeler to create representative models of a real HS sample, the standard Leonardite humic acid. The strength of sorption was estimated for a range of small organic compounds in a dry and fully hydrated Leonardite model. Strikingly, our results show a remarkable level of matching with experimental sorption data. Moreover, molecular dynamics simulations were used to probe the structure and dynamics of the system at a range of hydration levels, where the studied systems were characterized in terms of their physico-chemical properties, including density, dielectric properties, hydrogen bonding, etc.

Keywords: molecular modeling absorption SOM structure and dynamics
Financial support: FWF (grant no. P30224)

(5973 - 2631) Multivariates analysis of mangroves soils attributes from Parnaiba's delta, Piauí, Brazil

Mirya Grazielle Torres Portela[1]; Gustavo Souza Valladares[1]; João Victor Alves Amorim[2]; Jéssica Cristina Oliveira Frota[1]; Andréa Maciel Lima[1]

Universidade Federal do Piauí[1]; Universidades Federal do Piauí[2]

Mangroves are typical ecosystems of tropical and subtropical coastal regions and present high biological productivity and ecological complexity, observing the constant variation in the physical, chemical and biological attributes, besides the existing biodiversity, rich in endemic species. The mangrove soils are hydromorphic and are form from the deposition of sediments brought by the waterways. These factors confer great variability on the physical, chemical and biological attributes of these soils. The evaluation of these parameters is important for the understanding of the dynamics of this environment, mainly in environmental preservation areas (EPAs). Therefore, this study aimed to apply multivariate analysis to group soil profiles under mangroves in the EPA of the Parnaíba's Delta, state of Piauí, from some physical, chemical and biological attributes of these soils. Samples were collect in 5 soil profiles classified as Gleissolos (4 profiles) and Organossolo (1 profile), at depths of 0-10cm for determination of total organic carbon (TOC), carbon stock (Cstock), granulometry, density, carbon of the microbial biomass (MBC), basal respiration and microbial (Q_{co2}) and metabolic (Q_{met}) quotients. Multivariate analysis by clustering test and principal component analysis (PCA) were apply to the data set. In the analysis of clusters, it was observe that, assuming a Euclidean distance of 0.5, the selected variables grouped the profiles studied into three distinct groups. The first group was composed of profile 1, isolated from the other groups and correlated with TOC, MCB, Cstock and Q_{co2}. The second group was form by profiles 02 and 03 that correlated with silt and clay contents and the third group was form by profiles 04 and 05, which correlated with respiration, density and Q_{met}. In the analysis of principal components, the first two main components (CP1 and CP2) were responsible for 82,57% of the total variance, 52,23% for CP1 and 30,34% for CP2. It is conclude that, through the multivariate analysis, profiles of the same classification have properties of soil with characteristics that allowed to group them in different groups, although they are present in the same ecosystem.

Keywords: mangroves; soil properties; soil dynamics; PCA.
Financial support: Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES); Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq); Universidade Federal do Piauí (UFPI)

(9724 - 2655) Natural, agricultural and contaminated ecosystems exhibit glomalin in soils with different structural characteristics

Andrés Calderín García[1]; Luiz Gilberto Ambrósio de Souza[1]; Camila Pinheiro Nobre[2]; Florencia Varela[3]; Sael Sanches Elias[1]; Fabiana Soares dos Santos[4]; Ricardo Luiz Louro Berbara[1]

Universidade Federal Rural do Rio de Janeiro[1]; Universidade Estadual de Maranhão[2]; Universidade de Buenos Aires[3]; Universidade Federal Fluminense[4]

Glomalin (Glo) is a glycoprotein produced by root-colonizing arbuscular mycorrhizal fungi. Information about the relationship between the structure of Glo and its properties and functions in the soil is still scarce. As a component of soil organic matter, Glo may present different structural characteristics according to the type of ecosystem where it is found. To test this hypothesis, the present study aimed to characterize Glo from three types of ecosystems (agricultural: Argentina- Typic Hapludoll, natural: Brazil- Oxisols and heavy metal-contaminated: Cuba- Oxisols) using spectroscopy (^{13}C CP/MAS NMR and FTIR) and microscopy (SEM microscopy) combined with chemometric data analysis. The present study showed that Glo possesses a characteristic glycoprotein structural pattern that allows its recognition as an independent component of soil organic matter. In addition, the glycoprotein structural pattern of Glo responds to the type of ecosystem in which it is produced. The ^{13}C NMR presented peaks that could be attributed to carbohydrates (peaks close to 71.7 ppm: C_2-OH -carbon contiguous with the anomeric carbon of pyranose monosaccharides, peaks at 90-94 ppm: anomeric C_a/C_b from monosaccharide structures) and amino acids (10-20 ppm: methyl $-CH_3$; 38-45 ppm: methylene $-CH_2-$; 113-130 ppm: aromatic carbons; 173-177 ppm: carbonyl -C=O; and 178-181 ppm: carboxyl -COOH). Glo from the natural ecosystems presented an aromatic character, which could indicate higher structural stability in undisturbed ecosystems. Glo from the disturbed ecosystem was enriched in oxygenated groups (-C=O and -COOH), indicating preservation of structures that are more apt to interact with heavy

metals in contaminated soil and Glo from the agricultural ecosystem was enriched in anomeric carbons. Glo of natural ecosystems presented a similar superficial morphology (2 µm) and grain size (10 µm) and a different morphology from Glo of agricultural and polluted ecosystems. The grain morphology of Glo from polluted ecosystems exhibited a less amorphous appearance, and the superficial morphology of Glo from agricultural ecosystems was more compact (less irregular).The present study is especially important because it shows that ecosystem management affects the properties of organic molecules that are important for the biological-physical and chemical balance of soils.

Keywords: Glycoprotein, Organic matter, Arbuscular mycorrhiza, Chemometry

Financial support: CNPq (Postdoc support, Nº 168782/2017-0); FAPERJ (Postdoc Nota 10); CPGA-CS (CAPES-PROEX)

(5198 - 2820) Organic fertilization in the dragon fruit production

Alexandre Dias Silva[1]; Verônica Andrade dos Santos[1]; José Darlan Ramos[1]; Ana Claudia Costa[1]; Rene Martins Medeiros[1]; Ellison Rosario de Oliveira[1]; Fábio Oseias dos Reis Silva[1]; Leonardo Pereira da Silva Brito[1]; Ranieri Reis Laredo[1]

Federal University of Lavras[1]

The nutrient supply is important for fruit production, especially in tropical soil where the nutrient availability is low. The use of organics fertilizer is a sustainable alternative of nutrient supply for the crops. The dragon fruit is among the tropical fruit with high economic potential, but there is few study regarding to this fruit, mainly related to its nutrient requirement. Thus the objective of this this study was to evaluate the organic fertilizer supply in the white pulp dragon fruit production in the field. For this, eight treatments were performed, (1-control; 2-cattle manure; 3-chicken manure; 4-marine biofertilizer; 5-cattle manure + chicken manure; 6-cattle manure + marine biofertilizer; 7-chicken manure + marine biofertilizer; 8-cattle manure + chicken manure + marine biofertilizer). The supply of chiken manure + cattle manure + marine biofertilizer showed higher productivity in tones per hectare in fruit number per plant, being the best combination to be used.

Keywords: Organic fertilization; *Hylocereus undatus*; Productivity

Financial support: CNPq; CAPES; FAPEMIG

(1086 - 436) Organic matter content in agricultural soils along main geomorphological units of Vojvodina Province, Serbia

Jordana Ninkov[1]; Snežana Jakšić[2]; Srđan Šeremešić[3]; Jovica Vasin[1]; Stanko Milić[1]; Borislav Banjac[3]; Aleksandra Mihailović[4]

Instute of Field and Vegetable Crops[1]; Institute of Field and Vegetable Crops[2]; University of Novi Sad, Faculty of Agriculture[3]; University of Novi Sad, Faculty of Technical Sciences[4]

Vojvodina Province in the northern part of Serbia represents its most important agricultural area. Regarding the distribution of soil types, as much as 60% of the Vojvodina Province soil is chernozem, and other soil types with considerable areas include hydromorphic black soils (16%), and the alluvial soils (9%). Regarding the pedogenesis of Vojvodina soils, the relief is the dominant factor for development of appropriate soil properties compared to other pedogenetic factors. Alluvial plains (AP) and mountains (M) have higher geological and pedological diversity, unlike sandy areas (SA), loess plateaus (LP), upper Pleistocene terraces (UPT) and alluvial terraces (AT). The aim of this study was to access the content of organic matter (OM) in agricultural soils and its spatial distribution along main geomorphological units of Vojvodina Province. A grid superimposed on Vojvodina soil by means of a GIS tool (GIS ArcView 10) has divided study area into 4 × 4 km units, each representing an area of 16 km^2. Total number of 1,370 bulked soil samples (0-30 cm depth) were taken from agricultural land and analyzed for organic matter content by soil oxidation using the sulphochromic oxidation method by ISO 14235 (1998). The average concentration of OM in soil of Vojvodina Province was 3.05%, with median 3.07%, which is lower than in survey from 1991 when average OM was 3.41%. Causes of OM loss in Vojvodina soils include primarily insufficient use of organic fertilizers and inadequate cultivation practices. Average values of OM concentrations for soils formed on different geomorphological units were: 2.26% for SA, 2.57% for AT, 2.94% for M, 3.03% for AP, 3.12% for UPT, and 3.18% for LP. According to significance of the differences in the OM content between the geomorphological units, UPT, LP, M and AP were in one group, while SA and AT were in two separate groups. OM content in agricultural soil is arranged in a logical sequence along different geomorphological units, except mountainous (M) areas. The obtained results indicated that beside visible anthropogenic influence on OM there is a considerable background in natural and morphological systems. Therefore, the prediction of the future OM trend must encompass geomorphological properties of larger areas.

Keywords: Soil; organic matter; geomorphological units

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(4338 - 2853) Patterns of change in soil organic matter along a latitudinal gradient in Atlantic volcanic Islands

Zulimar Hernández[1]; Tomás de Figueiredo[2]; Juan Pedro Pérez Trujillo[3]; Pilar Carral[1]; Ana Mª Álvarez[1]; Gonzalo Almendros[4]

Dpto. Geology and Geochemistry, Autonomous University of Madrid, Spain[1]; Instituto Politécnico de Bragança (IPB), Portugal[2]; Dpto. Chemistry, University of La Laguna, S/C Tenerife, Islas Canarias, Spain[3]; MNCN, Spanish Council of Scientific Research, Madrid, Spain[4]

Volcanic ash soils have been classically considered as active C sinks due to their potential to stabilize organic colloids at mineral surfaces. This function has been attributed to the dominance of non-crystalline minerals. However, this is not the case with all volcanic soils. When subjected to intense tillage, these soils suffer long periods of drought, which increase the loss of soil organic matter (SOM). The above could reduce the cementing capacity of amorphous oxides. This research aims to determine the patterns of change in SOM quantity and quality in volcanic soils, along a latitudinal sequence from wet-cold to dry-warm climates, in the ecoregion known as Macaronesia (between 40º and 14º NL in the Atlantic Ocean). The soil sampling was carried out in representative islands: a) Pico Island (Azores), b) Tenerife, Hierro and Lanzarote (Canary Islands) and, c) Fogo Island (Cape Verde), where the oldest wine-growing regions were selected as study area. Routine physicochemical properties (such as pH, EC, ECEC, SOM, amorphous oxides, available nutrients, texture and aggregate stability) were analyzed using spectroscopic techniques previously calibrated with analytical databases. Chemical composition of SOM was analyzed by pyrolysis. Different statistical treatments were applied in order to evaluate the role of the mineral fraction in soil C sequestration. The results showed that the amount of SOM to large extent is driven by the presence of variable charge minerals. However, the same did not occur with the SOM quality. Pyrolysis showed that different sources of SOM (plant biomass, microbial activity and organic amendments) and degree of soil C stabilization were related to the latitudinal gradient. In Pico Island, with high amount of SOM (>80 g/kg) there was a dominance of easily-biodegradable organic compounds from microbial activity stabilized by amorphous oxides. In the Canary Islands, as expected due to an older agricultural history, the decline in soil C levels is related to the intensity of farming practices. Here, low values of SOM and higher proportion of pyrolytic products from plant

biomass were described. Finally, in Fogo Island, medium values of SOM (<40 g/kg) and low proportion of lignin-derived SOM pointed to high microbial activity, against the expected for aridic climate; which is possible due to the existence of buried soils under volcanic ashes.
Keywords: Allophane, Macaronesian, infrared spectroscopy, pyrolysis, lignin
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(3821 - 2148) Physical fractionation of organic soil matter in different systems of use and management

Ésio de Castro Paes[1]; Fabiane Pereira Machado Dias[1]; Iara Oliveira Fernandes[1]; Elisângela Gonçalves Pereira[1]; Davi Ney Santos[1]; Greice Helen da Cunha Moreira Lima[1]; Júlio César Azevedo Nóbrega[1]
Universidade Federal do Recôncavo da Bahia[1]

Organic matter plays a fundamental role in the chemical, physical and biological properties of the soil, it has been the object of many studies in order to understand its dynamics in agroecosystems. The present study had the objective of evaluating the impact of different systems of use and management on soil organic matter contents through physical fractionation. The study was developed in experimental areas of the municipality of Cruz das Almas, Bahia, in a Oxisol. The treatments consisted of a conventional cassava (MD) system, pasture (PA), agroforestry systems with 7 and 12 years of management (S7 and S12) and native forest (MT). Deformed samples were collected at depths of 0.0-10, 0.10-0.20, 0.20-0.40 m, in five replicates. The total organic C (TOC) was determined by colorimetry and the granulometric fractionation of the organic matter was obtained, obtaining organic C (C-MOP) and organic C associated with minerals (C-Am). TOC levels ranged from 14.17 to 25.06 g kg^{-1}, with no significant difference in surface area. For the 0.10-0.20 m layer the TM presented higher content than the others. What can be attributed, possibly the great density of roots. In the depth of 0.20-0.40 m the MT, SA12 and SAF7 presented higher TOC levels. This may be related to the soil rotation in the MD system, which favors the rapid oxidation of the organic matter, causing the soil aggregates to break down. The levels of C-MOP ranged from 4.06 to 5.98 g kg^{-1}, at depths of 0.0-0.10 and 0.20-0.40 m, and did not detect changes due to management systems. For the depth of 0.10-0.20 m, it was verified that the SAF12 presented higher levels than the other treatments, demonstrating the importance of this system for the maintenance of microbial activity and nutrient cycling, since C-MOP can be considered the labile fraction of the organic matter of the soil. The C-Am contents varied from 6.60 to 22.70 g kg^{-1}, representing around 60 to 80% of the COT, similar to the C-MOP contents, there was no significant difference between the treatments at the different depths, which was already expected, since C-Am is a fraction not affected by the management system, with the exception of the MT system that showed superiority in relation to the others in the 0,10-0,20 m layer, which can be attributed to the higher degree of humification, and MD which was lower by 0.20-0.40 m. The results showed that agroforestry systems tend to recover and/or increase C levels in the long term.
Keywords: Carbono orgânico, Recuperação, Qualidade do solo
Financial support: UFRB, CAPES

(1339 - 2099) Relation of total and relative cost of nutrient losses among different pasture management

Rafaela Ramos Bertuani[1]; Kamila Cabral Mielke[1]; Paulo Roberto da Rocha Junior[1]
Universidade Federal do Espirito Santo[1]

Most of the cattle ranching areas were formed after the clearing of the forest areas, aiming at the production of milk and meat. However, the use of burning and excessive soil preparation associated with high stocking rates over the years resulted in a decline in nutrient content in soils under pasture, influenced by erosion processes. In this sense, the objective was to study the total and relative cost of nutrient losses in different pasture management. Six pasture managements were studied: control, fire, prepared, managed, fertilization and ILPF. Costs were separated into inputs and services. The input cost calculation was based on six years of work for final calculation of eucalyptus production (m3 ha-1) and meat production (@ ha-1), with bi-annual pasture maintenance practices. The nutrient loss was based on the average data obtained by Bertol et al. (2007). Evaluating the total and relative costs of nutrient losses, it was verified that fire management provided the highest losses (R $ 1,353.40), while the lowest losses were observed in the area of pasture fertilized (R $ 87, 43). The increase in costs of nutrient losses in the pasture area burned in relation to the pasture fertilized was 93.54%, the smallest difference being observed when compared to the prepared area (33.33%). The values of lower costs of nutrient loss found in the area of pasture fertilized is related to the greater coverage of the soil and greater production of dry mass, associated to the absence of soil management practices. Observing the costs obtained with losses in the managed pasture area (R $ 423.43), it was verified that the losses presented soil losses of 31.17% higher than the management with ILPF (R $ 291.43) and 53.08% lower than the prepared pasture (R $ 902.27). In the area managed with ILPF, due to the adoption of no-tillage, an even smaller soil movement is observed, promoting lower loss values. For the relative cost, for all treatments, the highest losses were with K, with no trend when P and Ca + Mg were evaluated. In relation to K, the soil management commonly used for the renewal of pastures, such as plowing and harvesting, are the main responsible for increasing the losses of this nutrient, mainly by surface runoff.
Keywords: Production; economic viability; degradation.
Financial support: Nenhuma

(2011 - 3169) Response Surface of Humic Acids on Rice Roots

Orlando Carlos Huertas Tavares[1]; Leandro Azevedo Santos[1]; Andres Calderin Garcia[1]; Manlio Silvestre Fernandes[1]
UFRRJ[1]

The objective of the study was to evaluate morphological parameters of the root system changes in response to humic acid (HA) from vermicompost application, on the rice roots seedlings in the absence of nutrientes, using the response surface model. The study was carried out in a growth chamber in Department of Soils of Federal Rural University of Rio de Janeiro. The treatments consisted of the humic acid extracted with KOH application, in increasing doses: 0, 20, 40, 60, 80, 110, 150 mg HA L^{-1}, with minimum $CaSO_4$ medium at ¼ ionic strength. Then three seedlings were collected at 24h, 48h, 72h, 96h, 120h and 144h and stored in 50% alcohol at -20 °C. The root system of rice seedlings was analyzed in WinRhizo software. The different root characteristics measured were: total length, total surface area, total volume and total number of roots, number of branches and mean root diameter, as well as within diameter classes (superfine, fine and thick roots). The analyzes were performed through generations of the standard response surface models and the suitability verification of these models through the RSM package in the R software. The response surface model was adequate to analyze dose response experiment. The stimulus pattern of increasing doses of humic acid on root morphology of rice seedlings var. Piaui, for the most part, was quadratic response surface, presenting high statistical significance ($p < 0.0001$). Therefore humic acids modify the root morphology (length, area, number of tips and root volume) of the rice plants
Keywords: Response surface methodology, class roots, WinRhizo
Financial support: CAPES, CNPQ, FAPERJ

(8868 - 1574) Root composition and soil properties determine CO2

efflux from root residue mineralization

Julius Jose Koritschoner[1]; Edgar Ariel Rampoldi[1]; Susana Hang[1]; Yakov Kuzyakov[2]
Universidad Nacional de Córdoba. Facultad de Ciencias Agropecuarias. Departamento de Recursos Naturales.[1]; Department of Soil Science of Temperate Ecosystems, Department of Agricultural Soil Science, University of Goettingen, Buesgenweg 2, 37077 Goettingen, Germany[2]

Abstract The aim of this study was to explore the effects of root and soil properties on mineralization root residues: Sorghum halepense L. (SA), Sorghum bicolor (L.) Moench. cv. Biosilero INTA (SB), Sorghum bicolor (L.) Moench. cv. Pakari (SP), Glycine max (L.) Merr. (SY), and Zea mays L. (MZ). Soils with wide variability in their physical and chemical properties were sampled in the first 15 cm and characterized. The roots were characterized by their elemental and biochemical composition. The C-CO2 evolution in the soils (control) and in the soil + root treatments was followed via incubations under laboratory conditions over 28 d and related to soil and root properties. The design was bifactorial, with fifteen levels of soil factor and five types of roots. During the first 3 d, the root factor explained 84% of the mineralization process, and between 6 - 49% of the C-CO2 flow occurred during that time. Over the course of incubation, the soil factor increased its contribution, explaining more than 50% of the total variation observed at 14 d and remains stable thereafter. The cumulative C-CO2 averaged over all soils shown the following decreasing order: SP > SB> SA > MZ > SY. The roots with the highest concentration of soluble fraction (SOL) and greatest C-to-N ratio were those that produced a relatively high daily flow of CO2. The lignin (LIG) content did not provide decisive information, although the lowest C mineralization was associated with the root residue having the highest LIG content. The soils with a relatively high total N (Nt) content favoured the mineralization of root residues. CO2 efflux from roots with high lignocellulose content showed a delay phase, and the maximum mineralization rate was reached on day seven. Although cellulose (CEL) was negatively related to the C-CO2 flow, a interaction was obtained between pH and CEL (soil-residue interaction), lower pH of soils favored the decomposition of roots with higher content of cellulose suggesting that in the intermediate stages of root residue mineralization, the microbial attack on less labile forms would be regulated by soil conditions.
Keywords: root mineralization carbon flows biochemical composition soil-root interactions
Financial support: The National Scientific and Technical Research Council (CONICET), Argentinian National Scientific and Technological Promotion Agency (ANPCyT-PICT2014-1071)

(5472 - 332) Slow-cycling fractions are more sensitive to temperature than fast-cycling fractions during long-term turnover of soil organic carbon

Guoan Wang[1]; Yufu Jia[1]
China Agricultural University[1]

The temperature sensitivity of soil organic carbon (SOC) decomposition has been a crucial topic in global change researches, yet it remains substantial uncertainties. One of the possible causes to the uncertainties is interference from other factors, especially precipitation. In this study, the temperature sensitivity of decomposition of four fractions (light fraction (LF), particulate organic matter (POM), acid hydrolizable fraction (HF) and recalcitrant fraction (RF)) was investigated for 12 sites along a temperature gradient with 400 mm of mean annual precipitation (MAP) on the Qinghai-Tibet Plateau of China. ^{14}C analyses of the SOC fractions combined with a model provided estimations of their turnover time and decomposition rate. After minimizing the effects of other factors, such as precipitation, vegetation, parent material, topography, time and human activity, this study shows that the turnover time is LF < POM < HF < RF, and the Q_{10} value is RF > HF > POM = LF. This indicates that stable fractions are more sensitive to temperature than labile fractions. The analyses of Fourier Transform Mid-infrared Spectroscopy (FTIR) reveals that protection mechanisms rather than molecule structure controls SOC turnover. A new conceptual model of SOC decomposition of temperature sensitivity was proposed based on our results, i.e. apparent sensitivity is primarily determined by de-protected sensitivity, and intrinsic sensitivity has a secondary contribution to apparent sensitivity of SOC fractions. This study also reveals that, compared with the estimation based on the Q_{10} values of SOC fractions obtained in this study, the flux of released carbon from the grasslands on the Qinghai-Tibet Plateau is underestimated while the stock of soil carbon is overestimated in the next 100 years based on one-pool model (Q_{10} = 2) or bulk soil (Q_{10}= 5.93). Therefore, the estimation based on one-pool model or bulk soil would exaggerate the negative feedback of soil carbon to global warming.
Keywords: soil organic matter, decomposition, temperature sensitivity, ^{14}C technology, soil fractions
Financial support: This research was supported by the National Natural Science Foundation of China (No. 41772171).

(7037 - 2884) Soil carbon dynamics under silvopastoral systems in Northern Minas Gerais/ Brazil

Leidivan Almeida Frazão[1]; Luana Larrisa de Souza Almeida[1]; Paula Franciele Melo[1]; Juliana Martins Ribeiro[1]; Álvaro Luiz de Carvalho Veloso[2]; Ângela Maria Quintão Lana[1]
Universidade Federal de Minas Gerais[1]; FUNORTE[2]

Conventional management systems alter the dynamics of soil organic matter, leading to losses in productivity over the years. As a proposal, the integrated production systems were introduced to improve soil quality and promote increase in productivity per unit of area. So, this study aimed to compare the soil carbon dynamic under native vegetion of Cerrado (NV), abandoned pasture (PA), and after the introduction of silvopastoral systems in Northern Minas Gerais, Brazil. The arrangement of silvipastoral systems wih four years of implantation consisted of a consortium of Eucaliptus cloeziana + Urochloa brizantha cv. Marandu (SP1) and Eucalyptus urograndis + Urochloa brizantha cv. Marandu (SP2). We measured total organic carbon (TOC), microbial carbon (Cmic), basal respiration of the soil (SBR) and efflux of CO2 from the soil and calculated the metabolic (qCO2) and microbial quotient (qMIC). Soil samples were carried out in January (wet season) and in July (dry season) in 0-5; 5-10 and 10-20 cm soil deph layer, while CO2 efflux and Wflux were measured using a infrared gas analizer (IRGA) by a soil respiration chamber LCpro-SD. The values of COT, Cmic, qMIC, CO2 efflux and Wflux were higher in the wet season (January) for all evaluated systems, whereas SBR and qCO2 were lower in this period. In July, the climatic conditions with water deficit and low temperatures impacted the activity of soil microbial biomass, causing an increase in SBR and qCO2 in this period. Comparing the evaluated systems, it was observed that the silvopastoral systems (SP1 and SP2) presented similar results to NV in both evaluated periods. The analysis of canonical variables indicated that the soil attributes Cmic, SBR and TOC were the most sensitive indicators to explain the variability between the treatments and the evaluated periods. In addition, we found that integrated production systems promoted positive changes in soil carbon dynamics, since the indicators used in this study presented similar values to those observed in the native vegetation.
Keywords: Microbial carbon, soil basal respiration, soil organic carbon, integrated livestock-forest system
Financial support: CAPES, CNPq and FAPEMIG

(4534 - 317) Soil Labile Carbon and Carbon Management Index under different land use and management systems in the Brazilian Cerrado

Fabiane Pereira Machado Dias[1]; Rodrigo Hübner[1]; Flávia de Jesus Nunes[2]; Wilson Mozena Leandro[1]; Francisco Alisson da Silva Xavier[3]
Goiás Federal University[1]; Federal University of the Recôncavo of Bahia[2]; Embrapa Cassava and Fruticulture[3]

Soil organic matter (SOM) is considered a suitable indicator of soil quality since it is involved with most important chemical, physical and biological processes in the soil. Labile SOM fractions are more sensitive to the changes promoted by soil management, so that can be considered as good indicators of soil quality. We aimed to evaluate the impact of different management systems on the labile C contents of an Oxisol in the Brazilian Cerrado. The study was carried out in the Nossa Senhora Aparecida farm, situated in Hidrolândia municipality, state of Goiás, Brazil. Soil samples were collected from the follow land-use or management systems: 1-Native forest (NF); 2-Degraded grassland (GRAS); 3-No-tillage system (NT) (maize, peanuts, soybean); 4-Conventional tillage (CT) (maize); 5-ORG10; 6-ORG8; 7-ORG6 and 8-ORG2, areas under organic cultivation over 10, 8, 6 and 2 years, respectively. In each selected system, soil samples were taken in four replicates in the 0-10, 10-20 and 20-40 cm depths, and analyzed for total soil C (TOC) and labile C (Lab-C) by using potassium permanganate method. Based on the results of TOC and Lab-C it was calculated the carbon management index (CMI) to evaluate the impacts of soil management practices on organic matter quality. Soil TOC contents were significantly affected by management and varied from 11 to 29 g kg^{-1}. In the upper soil layer, NF and CT areas showed highest TOC contents. Lab-C varied from 0,27 to 1,16 g kg^{-1}, representing around to 4% of TOC. For all soil layers, Lab-C was higher in the CT system followed by NF area. In general, organically cultivated soils presented similar Lab-C contents, with exception in the 20-40 cm depth in which ORG-2 and ORG-6 showed higher Lab-C compared to ORG-8 and ORG-10. The CT system presented the highest values of CMI (> 100) for all evaluated soil layers. This result suggests recovering of SOM quality and enhancement of C sequestration. Organically cultivated sites showed intermediate CMI among studied areas, in which ORG6 was the only site that presented CMI > 100. In GRAS and NT soils CMI values were lower than 100 for all evaluated layers, indicating decreasing of SOM quality and C storage. Our results showed that CT and ORG systems recover SOM levels and increases C lability, while NT and GRAS contribute to SOM depletion. Labile C and CMI reflected recent impacts of management on the SOM levels.
Keywords: organic production, pasture, no-tillage, Latosol.
Financial support: National Council for Scientific and Technological Development (CNPq)

(8833 - 202) Soil microbial biomass and humic substances under Eucalyptus cultivation of different age

Wesley Machado[1]; André Sarabia Zamarian[1]; Maria Elvira Simionato[1]; Gabriela Machineski[1]; João Tavares Filho[2]
Universidade Norte do Paraná[1]; Universidade Estadual de Londrina[2]

Humic substances result from the degradation of organic compounds by microbial activity and play an important role in soil structure and CTC. In fast-growing tree species cultivation, such as Eucalyptus, the input of litter in soil interferes with the dynamics of these substances, which together with microbial biomass might be used as indicators of soil quality. Despite that, changes in soil chemical and biological attributes in Eucalyptus plantation are still poorly understood. Thus, the purpose of this work was to evaluate soil humic substances and microbial biomass attributes in Eucalyptus plantations of different ages in Brazil. Soil samples were collected in São Sebastião da Amoreira-Paraná state, in Eucalyptus plantations of 3, 6 and 15 years-old from 0.0-0.1 m and 0.1-0.2 m depth. Organic matter, humic and fulvic acids fractions and the microbial biomass attributes: microbial biomass carbon and nitrogen and microbial respiratory activity were determined. Organic matter, fulvic acids and microbial respiratory activity were not influenced by the different ages of eucalyptus plantation. The content of humic acids increased significantly (p<0.05, Tukey test) in the oldest areas of Eucalyptus plantation, with the highest concentrations found in 15 years-old area, means of 5.32 mg g $soil^{-1}$ and 5.18 mg g $soil^{-1}$ at depths of 0.0-0.1 m and 0.1-0.2 m, respectively. Microbial biomass carbon was significantly higher (p<0.01) in 3 years-old area at 0.0-0.1 m depth, means of 24.94 mg g $soil^{-1}$, while at 0.1-0.2 m depth, the highest levels of microbial biomass carbon (p<0.01) were found in 6 years-old area, 15.35 mg g $soil^{-1}$, followed by 15 years-old area, 8.68 mg g $soil^{-1}$. Microbial biomass nitrogen in 15 years-old area at 0.0-0.1m depth was significantly lower (p<0.05), 10.87 µg g $soil^{-1}$, than in 3 and 6 years-old, 15.23 and 12.21 µg g $soil^{-1}$, respectively, but there was no significant difference at 0.1-0.2m depth. These results indicate different patterns of microbial biomass dynamics in soil layer. In addition, longer eucalyptus cultivation time increases litter and mineralization of organic compounds and, consequently, tend to increase humic acid storage and to reduce levels of microbial biomass carbon in the soil superficial layers.
Keywords: humic acids; fulvic acids, organic matter, microbial respiratory activity.
Financial support: UNOPAR

(5408 - 495) Soil organic carbon content in topsoil of croatia

Stjepan Husnjak[1]; Aleksandra Bensa[2]; Danijela Jungic[2]
University of Zagreb, Faculty of Agriculture[1]; University of Zagreb Faculty of Agriculture[2]

The main goal of this paper is to present the state of the soil organic carbon (SOC) content in the topsoil of Croatia considering agricultural regions and land use. The data of humus content in the surface horizon of 5.023 soil profiles from the Basic Soil Map of Croatia in scale 1: 50.000 which was made in the period 1965-1985 were used as a source of data. Agricultural regions (Pannonian, Mountainous and Adriatic) were allocated according to Basic et al. (2001) and the inventory of soil profiles under forests, grassland and arable land based on land use map (DZZP, 2004). Data were statistically analysed by analysis of variance with Tukey-Kramer test. The average SOC content in all samples was 2.53% and varied in the range of 0.06-7.56%. Statistically significant differences in SOC content were found between all regions, with a decrease from Mountainous (3.28%), over Adriatic (2.52%) to Pannonian region (1.94%). The average SOC content in grassland and forest were moderate (2,69 and 3.09% respectively) and in arable land was low (1.97%), with statistically justified differences between all class of land use. The most significantly differences between the regions were found in forests, where the SOC content varies from 2.40% in Pannonian to 3.81% in the Mountainous region. The least differences were found in arable land where the SOC content varied from 1.44% in Pannonian to 2.61% in Mountainous region. Considering the age of the data used, the paper points to the necessity of determining their reliability as well as possible changes in relation to today's state.
Keywords: Croatia, SOC, topsoil, agricultural regions
Financial support:

(5603 - 1757) Soil organic carbon, microbial biomass and microbial basal respiration of Amazon soil under different use and management

Henildo de Sousa Pereira[1]; Marta Justen[2]; Guilherme Souza Rezende[2]; Vinicius Marchioro[3]; Getulio de Freitas Seben Junior[4]; José Eduardo Corá[5]
P.h.D student in Agronomy (Crop Production), São Paulo State University - Campus of Jaboticabal. Via de Acesso Prof. Paulo Donato

Castellane, s/nº, CEP 14884-900, Jaboticabal, SP, Brazil. E-mail: enildop@gmail.com[1]; Undergraduate student Forest Engineering, Mato Grosso State University - Campus of Alta Floresta[2]; Master student in Agronomy (Soil Science), São Paulo State University - Campus of Jaboticabal[3]; Professor at Soil Science Department, Mato Grosso State University - Campus of Alta Floresta. Rodovia MT 208, Km 147, Jardim Tropical, CEP 78580-000, Alta Floresta, MT, Brazil[4]; Professor at Soil Science Department, São Paulo State University - Campus of Jaboticabal. Via de Acesso Prof. Paulo Donato Castellane, s/nº, CEP 14884-900, Jaboticabal, SP, Brazil[5]

Natural ecosystems show balance between soil organic matter accumulation and decomposition. However, human actions promote changes in this balance, interfering in the activities of micro-organisms and consequently reducing its activity. To measure the degree of the changes, one of the most used ways is to assess the microorganisms activity responsible for the decomposition of organic matter. The aim of this work was to evaluate the microorganisms activity on Amazon soil under different use and management. The work was carried out in the northern State of Mato Grosso. The treatments were: teak (*Tectona grandis*) homogeneous plantations with 12, 14, 16, and 19 years old; teak (7 years old) intercropped with *Urochloa brizantha* cv. Marandú grass (19 years old), degraded pasture due to sudden death, and native forest, used as reference. The studies sites were adjacent each other. Three soil samples were collected randomly at 0 - 0.10 m depth within each soil use field. To determine CO_2 basal respiration (BR), the soil samples were incubated for 137 days under controlled temperature and humidity, was measured in each soil sample 15 times, with higher frequency in the beginning of the incubation period. Were too evaluated organic carbon (SOC), and microbial biomass (MBC). The data were submitted to analysis of variance and the treatment averages compared by the Tukey test at 5% of probability. Higher values of SOC (67.48 g C/kg soil^{-1}) were observed in the native forest, followed by the intercropped teak/*Urochloa brizantha* (61.60 g C/kg soil^{-1}). Homogeneous teak plantation showed the lowest SOC values, independently of the age. The MBC values ranged from 54.70 to 271.82 mg C/kg soil^{-1}, with the lowest values observed in the homogeneous Teak (16 years old) and the highest values observed in in the native forest and in the intercropped teak/*Urochloa brizantha*. The lower values of BR were observed in degraded pasture (130.90 mg CO_2/kg soil^{-1}) and in the homogeneous Teak (16 years old) (115.28). The largest BR values were observed in the native forest (453.64). Overall, the results showed that the soil microorganisms activity of the intercropped teak/*Urochloa brizantha* is similar to that of the native forest, indicating balance between soil organic matter accumulation and decomposition, by the microbial community. Probably, the low soil microorganisms activity observed in the teak plantation is due to the accumulating of plant material of low diversity and quality.

Keywords: Biological Indicators, integration between agriculture and Livestock, soil organic matter.
Financial support:

(9050 - 3079) Soil organic matters in agroflorestais and pastagem systems, in the municipality of Brazil novo-Pará-Brazil

Wemerson Shimon Ladeira da Costa[1]; Sandra Andréa Santos da Silva[1]; Rainério Meireles da Silva[1]; Delziane Araújo Bezerra[1]; Rylla Bryanne Moraes[1]; Ronilson de Sousa Santos[1]
Universidade Federal do Pará, Campus Altamira[1]

The knowledge of the behavior of the soil attributes allows the establishment of appropriate practices in its management that provide the productivity and quality of the crops, this work had the objective to diagnose soil organic matter in pasture agroecosystems and agroforestry systems, under different depths during the rainy season. The soil samples were collected in a property located in the municipality of Brasil Novo – Pará – Brazil, in the treatments with agroforestry system (SAF) and a planted pasture area (PP), in each of the areas were sampled deformed samples, each treatment consisting of two replicates at depths of 0-20 and 20-40cm. The chemical analyzes were performed by the Laboratory of Agronomic, Environmental Analysis and Preparation of Solutions - Fullin. The identification of the existence or not of statistically significant variations between the treatments was performed using the Wilcoxon test. When analyzing the ecosystems separately, it was observed that in the SAF there was a difference in the amount of organic matter compared to the PP at the depths studied, being the highest contribution found in the superficial layer of 0-20cm SAF (2.1dag/kg) and PP (1.65dag/kg), which is due to the accumulation of biomass incorporated in the soil due to the greater number of species in the agroecosystem. For grazing at the same depth was altered, but it was observed that the results of the 20-40cm layer of the same are medium, which allows the recovery of pasture.

Keywords: AGROECOSYSTEMS, SOIL FERTILITY, PLANTED PASTURE
Financial support: Universidade Federal do Pará

(3155 - 979) Soil Texture and organic carbon fractions in ARID-semiarid soils of Argentina

Mirko schiavi[1]; Perla Pesatti[1]; Sergio Quichan[2]; Martin Alejandro Luna[1]; Roberto Melchor Martinez[1]
National University of Rio Negro. Atlantic headquarters.[1]; National Institute of Agricultural Technology (INTA)[2]

The amount of oxidizable organic carbon (OCox) under different oxidation conditions is a sensitive indicator of soil quality; this parameter can change according soil texture and vegetation type. The objective was to determine changes in the amount and quality of the soil organic carbon in sites with different soil textures and vegetation types. Using satellite images, four sites with different type of vegetation cover were selected in the north Patagonia of Argentina (Lat. 41º 58´ S; Long. 62º-50´ O). The area is characterized by a transition from sub-temperate to arid-semiarid climate, and frequent winds, where the natural vegetation is “Monte”, with xerophyte species, and shrub steppes with dominance of *Larrea spp.* (Zygophyllaceae). The mean annual precipitation is 350 mm and the mean annual temperature of 15 ºC. The main soil orders are Aridisols and Entisols. Extensive grazing in natural grasslands is the main production activity in the area. Each site was classified in four conditions: Dispersed vegetation (S1), Low Forest (S2), Low shrubs (S3) and Grassland (S4). In each zone, a composite soil sample was collected at three sampling points at 0.30 m soil depth. The soil samples were air-dried and passed through a 2 mm sieve. Textural composition was determined by Bouyoucos, and the oxidizing conditions for oxidizing C determination were stablish by using different amounts of sulphuric acid: 0.75 mL (fraction 1), 1.5 mL (fraction 2) and 3 mL (fraction 3) specified by Walkley and Black method, resulting in three acid-aqueous solution ratios of 0.5:1,1:1 and 2:1. The four conditions represented a soil-texture gradient, from 8.6% to 54.3% of clay + silt: S4~S1>S3>S2, ($p<0.05$). The amount of oxidizable organic carbon accounted under different oxidizing conditions also showed significant difference. In all cases, S4 site presented the highest values, with 9.19 mg g^{-1} in fraction 1, 14.96 mg gr^{-1} in fraction 2 and 17.30 mg g^{-1} in fraction 3. The average values for the three fractions were 71%, 53% and 24% for S3, S1 and S2, respectively, of the S4 value. The OCox/(clay + silt) ratio was higher in S2 site. Using this ratio for fraction 1 allows to differentiate S4 (higher) from the other sites. The combined use of the textural composition together with different OCox fractions could represent a better indicator to evaluate the soil quality, and to minimize variations associated to texture.

Keywords: Soil texture; Soil quality; Organic matter; Land conservation.
Financial support: Scholarship holder CIN. National University of Rio Negro. Atlantic headquarters.

(2652 - 2160) Space variability of carbon stock and organic carbon of soil with cupuaçu cultivation in south of Amazonas, Brazil

Ludmilla Colares Rodrigues[1]; Anderson Vieira Rodrigues[1]; Milton César Costa Campos[1]; José Maurício da Cunha[1]; Sabrina Isabela da Silva Fernandes[1]; Elilson Gomes de Brito Filho[1]; Juliana Malta de Assis[1]; Elyenayra Nogueira Pinheiro[1]; Carlos Henrique Gima Relvas[1]; Ludimila Souza Oliveira[1]
Federal University of Amazonas[1]

The Amazon is an important biome for the world, highlighting high and rich biodiversity that is one of its great attractions and interest to researchers, much of this biome is concentrated in the state of Amazonas. Soils of the Amazonas have as characteristics soil with a high degree of weathering, presenting predominance of the Latosols and Argisols class, with high aluminum content, low CEC and light, great values of organic matter and verify the behavior of certain attributes is crucial to be it may be possible to understand its characteristics. The objective of this work was to verify the spatial variability of the carbon and organic carbon stock of the soil in an area under cupuaçu management in the South of Amazonas. The study is located in the in Canutama municipality in southern Amazonas, Brazil, where he was selected an area with management cupuassu and held a mesh of 80 points with an area of 70x90 me 10 m spacing between points where these were georeferenced with a device of GPS, and in each point samples were collected in three depths 0.00-0.05; 0.05-0.10 and 0.10-0.20m. After samples were taken, they followed the shed where the leftovers were dried and then discharged, to carry out the analyzes of soil density(Ds), organic carbon (CO) obtained by calculation from the organic matter and soon after the carbon stock (est C). The results were submitted to analysis of variance, descriptive statistical analysis, and finally, the spatial variability was evaluated using geostatistics. By the descriptive statistics it was observed that the mean and median were close having a symmetrical distribution two data, where also the asymmetry and kurtosis were close to zero. The values obtained for R^2 and VC indicate perfect adjustment of the semivariograms, all being higher than 0.7. The spherical and exponential models were the ones that best fit the variables analyzed, thus confirming these models as the ones that best apply to studies within soil science. At the degree of spatial dependence, these were in moderate and strong degree of spatial dependence, and the scopes were higher in the attributes of Est. C, Organic Carbon and soil density in the depth of 0.00-0.05m evidencing a high variability and consequently a low degree of correlation. Thus, the highest reaches were found in the soil surface layer, as well as the highest values of organic carbon.

Keywords: Amazonian soils; geostatistics; Carbon.
Financial support: Foundation for Research Support in Amazonas (FAPEAM), National Council for Scientific and Technological Development (CNPq)

(4836 - 1847) Spatial variations and influencing factors of soil organic matter contents in different layers and agricultural land uses in Taoyuan, Taiwan

Xiao-Nan Liu[1]; Chun-Chih Tsui[2]; Horng-Yuh Guo[3]; Zueng-Sang CHEN[2]
Guangdong Institute of Eco-environmental Science & Technology[1]; Department of Agricultural Chemistry, National Taiwan University[2]; Division of Agricultural Chemistry, Taiwan Agricultural Research Institute, Council of Agriculture[3]

More and more studies focus on spatial variations and influencing factors of soil organic matter (SOM) in different agricultural land uses. In this study, SOM contents and other soil properties were obtained from a detail legacy soil survey data by Taiwan Agricultural Research Institute (TARI). 1163 soil profiles with different agricultural land uses (paddy field, dry land, orchard, and abandoned agricultural lands) were sampled by soil auger to 0-15 and 15-30 cm depth. Annual average Normalized Difference Vegetation Index (NDVI) was calculate by the NASA's Vegetation Indices 16-Day L3 Global 250m data. Slope, Curvature, Topographic Wetness Index (TWI), and Terrain Roughness Index (TRI) were calculated by 20-m grid resolution DTM. Correlation and regression analysis was performed by SAS 9.4 software. Results showed that the distribution of SOM contents, CEC, and other nutrient elements were higher in the 0-15 cm layer. The elevation and CEC were significantly correlated with SOM in both 0-15 and 15-30 cm soil layers ($p<0.001$), and pH was significantly correlated with SOM in 15-30 cm layer as well. Regression analysis by using the DEM(elevation), CEC, and pH, 52%, 69%, 35%, and 71% of variation on 0-15 cm SOM can be explained in land uses of paddy field, dry land, orchard, and abandoned agricultural lands. In 15-30 cm layer, 52%, 55%, 48%, and 64% of SOM variation can be explained in land uses of paddy field, dry land, orchard, and abandoned agricultural land, respectively. The different explaining ability between land uses may be caused by different farming management. Taoyuan is the mainly origin of rice and fruits, and farmers used many intensive management methods such as weed control, irrigation and drainage control for higher yields of rice and fruits. Therefore, the SOM contents may be more agree with the natural situation on abandoned agricultural land and dry land. Moreover, the explaining ability was lower on paddy filed and orchard, and higher abandoned agricultural land and dry land. These results can help us estimate SOM contents and stocks more accurately and efficiently between different agricultural land uses.

Keywords: Soil organic matter, spatial variations, correlation analysis, regression analysis, agricultural land uses
Financial support: National Natural Science Foundation of China (41201543)

(1932 - 1860) Stock of organic carbon in spodic horizons of Brazilian Spodosols

Andressa Rosas de Menezes[1]; Ademir Fontana[2]; Lúcia Helena Cunha dos Anjos[1]; Marcos Gervasio Pereira[1]
Soils Department – Federal Rural University of Rio de Janeiro[1]; Embrapa Solos[2]

Soils classified as Spodosols in Brazil occur at different landscapes, from coastal plains to high altitude areas. Although they are present in different environments, these soils are formed mainly under humid climates, from sandy parent materials, and usually with shrub and grasses vegetation. They differ from Spodosols from the cold climates and under coniferous forests, from where the concept of podzolization process derived. This order of soils is defined by the Brazilian Soil Classification System (SiBCS) by the presence if a spodic horizon, which must have organic carbon (C org) accumulation in relation to the overlying horizons. To highlight the importance of the preservation of these soils due to their storage of carbon in subsurface, among other reasons related to the flora and fauna they support, the objective of this work was to estimate the organic carbon stock (Ec) of spodic horizons in Brazil. From an extensive bibliographical search, 38 profiles identified as Spodosols according to the SiBCS were selected, and the C org in g kg^{-1}, bulk density (Ds) in Mg m^{-3} and thickness (E) in cm of the spodic sub-horizons data was organized in a spread sheet for evaluation of descriptive statistics. The Ec in Mg ha^{-1} was estimated according to the equation: Ec = (E.Ds.C org) / 10. The thickness of the 67 spodic sub-horizons ranged from 1 to 95 cm, with a mean of 26 cm and a median of 20 cm. The Ds varied from 1.14 to 1.93 Mg m^{-3}, indicating that the spodic horizons varied

from high porosity to dense ones, the last are the cemented types. The mean and median values of Ds were 1.49 and 1.47 Mg m^{-3}, respectively. The levels of C org ranged from 0.4 to 99.2 g kg^{-1}, with the mean and median being 17.2 g kg^{-1} and 14.4 g kg^{-1}, respectively. As for the Ec of the spodic sub-horizons, the mean was 52.9 Mg ha^{-1} and the median was 41.7 Mg ha^{-1}. The maximum value of Ec was of 220.5 Mg ha^{-1} and the minimum value of 0.7 Mg ha^{-1}. Although the tropical climate favors the intense cycling of organic matter added to the soil in the surface, and thus reduce the amount available for translocation and thus accumulation of C org in sub-surface, the spodic horizons showed overall high carbon stock in depth, which is them protected from losses to the atmosphere by emission of CO_2. Thus the safeguarding of areas with Spodosols, besides the preservation of important ecosystems, contributes to minimize the effects of global warming in the regions where these soils occur.

Keywords: Spodosols; SiBCS; carbon stock in soils.
Financial support: CNPq; Embrapa Solos; PPGA-CS/UFRRJ

(2586 - 1550) Structural study of humin and its interaction with humic acids by Fourier-transform mid-infrared spectroscopy

Manuel Palencia[1]; Enrique Combatt[2]; Angélica García[1]
Universidad del Valle[1]; Universidad de Córdoba[2]

Soil organic matter (SOM) is a complex mixture of molecules with different physicochemical properties, with humic substances being the main component. Humin is the insoluble component of SOM that remains after extraction of the other humified components that are soluble in alkaline aqueous solutions (humic acids). Humin usually makes up a substantial component of humified organic matter, but its lack of solubility and intractable nature have made it difficult to study. On the other hand, attenuated total reflectance spectroscopy (ATR) in the mid-infrared is a promissory technique for the study of characteristic functional groups on organic molecules, as well as, as for the study of intermolecular interactions by the analysis of the change in the vibration spectrum of molecules. The aim of this work was to study, by Fourier-transform mid-infrared spectroscopy, the structural features of humin and its interaction with humic acids (fulvic and humic acids, FA and HA, respectively). For that, different soil samples were selected from different zones and characterized physicochemical. FA and HA were extracted by alkaline dissolution, fractionated by acidification and purified by ultrafiltration. Sequential washed were performed in order to remove all humic substance and obtain the clay-humin system. FA, HA and humin were analysed by ATR. Interaction between humic acids and humin was studied by mixtures of humified components with humin in different proportions. In order to achieve a major structural resolution of humin different interactions with different low-molecular weight molecules were performed (acetic acid and sorbitol). Spectra were analysed by Pearson spectral similarity index and Functionally-enhanced derivative spectroscopy. It is concluded that the composition of humin differs considerably from the alkaline-soluble components of the SOM, in addition, supramolecular aggregates are formed mainly by the formation of hydrogen bonds.

Keywords: Infrared spectroscopy, humic acids, humin, hydrogen bonds
Financial support: Mindtech s.a.s. and Universidad del Valle (MT-004-2016)

(9741 - 1635) Study by attenuated total reflectance spectroscopy of structural changes of humified organic matter by chemical perturbations via alkaline dissolution and peroxidation

Manuel Palencia;[1]; Diego Restrepo[1]; Víctor J. Palencia[2]
GI-CAT, Department of Chemistry, Universidad del Valle, Cali, 25360, Colombia[1]; Mindtech Research Group (Mindtech-RG), Mindtech S.A.S, Cali, 25360, Colombia[2]

The humified organic matter is an important parameter for physicochemical description of soils; the cationic exchange capacity (CEC), pH buffering capacity, ability to form particle aggregates, porosity, water storage and other properties are defined or influenced by HOM contents. The objective of the present work was to evaluate the applicability of the attenuated total reflectance spectroscopy (ATR), in the medium infrared, for the description of changes in the spectral response of soil samples subjected to controlled perturbations by chemical methods of humified organic matter and to explore its potential use for quantitative applications: determination of the CEC. For this, six types of soil samples were characterized in terms of physicochemical properties (pH, content of HOM, CEC, exchangeable cations, salinity and texture, as well as by ATR in the mid infrared. Soil samples were chemically disturbed by two methods: alkaline dissolution with NaOH and chemical oxidation with H_2O_2. Chemical treatments were performed at different concentrations and contact different times. Later, samples were analysed by ATR and infrared spectra were analysed by spectral correlation analyses in function of pH, MO and texture using Pearson spectral similarity index and Functionally-enhanced derivative spectroscopy of Fourier-transform infrared spectrum. Finally, CEC for all samples were calculated by perturbation-ATR results and compared with results obtained by ammonium acetate method. It is concluded that the use of the ATR in conjunction with chemical perturbation techniques of the MOH is a promising method for the simple and fast monitoring of the CEC and the study of HOM in soils.

Keywords: Infrared spectroscopy, cationic exchange, chemical perturbation, humified organic matter
Financial support: Mindtech s.a.s. and Universidad del Valle (MT-004-2016)

(1959 - 530) Study of the molecular structure of peat and humic substances from peat soils

Roman Vasilevich[1]; Evgeny Lodygin[1]
Institute of Biology, Komi Science Center, Ural Branch, Russian Academy of Sciences[1]

Raw peat and humic substances from the mire peat soils of the forest-tundra zone of the European northeast part of Russia have been characterized in terms of molecular composition. This was accomplished using solid-state ^{13}C NMR techniques and ESR spectroscopy. The composition depended on the intensity of cryogenic processes in the active layer, the quality of the humification precursors (the degree of peat material transformation), and the biochemical selection of aromatic fragments during humification. It was shown that climatic factors are the main driver of the formation of soil organic matter (SOM) as well as the quality and degree of natural polymer destruction. These parameters are reflected in the functional groups and molecular compositions of the humic substances studied in both relic and modern formed peat layers. Humic acids (HAs) and fulvic acids (FAs) of the permafrost peat soils presented low-density molecular structures with a low portion of carbon species from aromatic fragments (15,2-36,3% for HAs and 1,6-12,8 for FAs). In comparison with the mineral soils, the content of carboxylic groups was lower in the peat materials. This reflected the anaerobic conditions in the permafrost peat soils. The content of functional groups and molecular fragments in the HAs illustrated a trend of decreasing paraffin groups and the accumulation of aromatic species of HAs, as well as carboxylic groups from FAs along the depth of the peat soils profile. This resulted from the higher degree of SOM transformation. Transformation of the linear aliphatic fragments leads to the cyclization of paraffin chains with the formation of stabile aromatic fragments. As a result of the low biochemical activity of the permafrost peat soils, labile fractions of carbohydrates demonstrate a

low transformation rate. The effects of low temperatures result in increment of the aromatic fragments of HAs extracted from the layers in contact with the permafrost. The highest indexes of biological activity from bare permafrost peatlands indicate possible climate changes in cases of increased soil temperatures. This results in a stronger alteration of the SOM content in the solum active layer. We conclude that the data on SOM content and molecular quality can be used as an indicator of the degree of organic matter alteration in the sequence of vegetated and bare permafrost peat soils.

Keywords: permafrost; forest-tundra; humic acids; fulvic acids
Financial support: This study was supported by Federal Budget (Institute of Biology KomiSC UrB RAS).

(4057 - 2227) The effect of biostimulants on the yield, water and nutrient use efficiency of wheat in drought stress condition

M.M. Tehrani[1]

Soil and Water Research Institute[1]

The experiment was carried out in field of Soil and Water Research Institute, Karaj, 2016-2017. The main factor of irrigation regime was in two levels (full irrigation and 35% less than plant water requirement), the sub factor includes fulvic acid sprayed on three levels (0, 5 and 10 per thousand water) in three growth stages of tillering, stem elongation and heading and soil application of humic acid on two levels (0 and 20 Kg per hectare) in plant emergence and stem elongation stages. The results displayed that the drought stress caused a significant reduction in yield and concentration of the phosphorus in grain and increased concentration of the potassium and water use efficiency in control plots. Application of fulvic acid (5 per thousand) with humic acid on all trial plots had a significant increase of quality and quantity factors such as seed yield, seed kernel weight, shoot and panicle height, number of grains per panicle, concentration of nitrogen, phosphorus, potassium, iron, manganese, zinc, copper and grain protein, nitrogen and phosphorus use efficiency and water use efficiency. The results showed that in drought stress plots, soil application of humic acid increased grain yield in comparison with control treatment of full irrigation. Fulvic acid with a concentration of 10 per thousand had 25 percent increase in grain yield in stress condition compare to control treatment of full irrigation. Therefore, in drought stress conditions using organic acids could resist the wheat against drought stress and increase plant growth and yield.

Keywords: nutrient efficiency, water efficiency, biostimulant, wheat, drought stress
Financial support: SWRI, AREEO

(8350 - 3181) The forest systems influence in the dynamics of the carbon and nitrogen in soils of Tabasco and Campeche, Mexico.

Aaron jarquin sanchez[1]; Lorena Del Carmen Hernández Nataren[2]; Miguel de Jesús de la Rosa Carrillo Perez[1]; Consuelo Sarracino Vázquez[1]

El colegio de la frontera sur[1]; programa de Ciências do solo da Univeridade Federal de Lavras[2]

The contents of Carbon and nitrogen in the soil are important components of the fertility and play an important paper in the mitigation of the greenhouse gases, these contents are determined by the type of predominant vegetation in the zone of study. The total Carbon (Ct) and the total Nitrogen (Nt) in the forest soils are generated by the contributions of the communities of plants and the interaction by the climatic present conditions. In the forest zones of the conditions of Tabasco and Campeche, sites under influence of tropical climate the dynamics of mineralization are constant, for what there becomes important the evaluation of the contents of these elements in them, sites under these influences. The study was realized in 1240 samples of soil of different depths: litter, fermentation and mineral horizons. The average Ct of the soil was of 13.38 ± 13.31 % with minimal values of 0.03 and maximums of 46.56 %. In case of the Nt the average is 0.76 ±0.59 % with minimal values of 0.01 and maximums of 3.11 %. The relations Ct/Nt were 20.16 ±30 with minimal values of 0.12 and maximums of 475.5. For the carbonates the average value was 13.35 ±29.29 with minimal values of 0.02 and maximums of 96.92 %. In general, the carbon represents 67.55 % and the carbonate 32.45 %, of the total carbon of the soils of these conditions; the relations Ct/Nt indicate that there is an important dynamics of recycling of vegetable residues and mineralization. What they return to these vulnerable ecosystems.

Keywords: vegetation, depth soil, carbon, nitrogen
Financial support: Comisión Nacional Forestal

(2086 - 1256) The properties and age of organic matter in soils developed under conditions of rapidly retreating Arctic glaciers

Elya Zazovskaya[1]; Nikita Mergelov[1]; Vasiliy Shishkov[1]; Andrey Dolgikh[1]; Alex Cherkinsky[2]; Evgeniy Abakumov[3]; Nikolay Osokin[1]; Sergey Goryachkin[1]

Institute of Geography Russian RAS, Moscow[1]; University of Georgia, Center for Applied Isotope Studies Athens, GA, USA[2]; Saint-Petersburg State University, Saint-Petersburg , Russia[3]

Recent climate warming has caused rapid thawing of Arctic glaciers and the development of soil-forming processes on freshly exposed substrates. Sediments that have accumulated over the lifetime of these glaciers have mostly aeolian genesis and include both minerogenic and biogenic components. Such sediments are termed cryoconites and act as a storage of organic carbon within glaciers formed during the Pleistocene-Holocene. The retreat of glaciers is accompanied by the release of cryoconite material into water flows that carry and deposit such material usually within areas sheltered from winds. In comparison to other deposits within the modern periglacial zone of the Arctic, the cryoconite parent material of soils has special properties such as a high content of biogenic compounds and fine texture, which favour the colonization by higher plants and the development of pedogenesis. The study sites were located within the glacio-nival system of the rapidly retreating Aldegonda Glacier (its snout was reduced by 2 km in the last 100 years) and on third marine terraces of the East-Fjord in Svalbard, Norway (77.98 N, 14.11 S). The objects studied were as follows: (1) soils formed on moraines of different ages (free from glacial ice for either 18, 70 and over 100 years), (2) fine earth and moss residues in cryoconite holes on glacial ice surface and (3) soils on marine terraces that were free from glaciers for the entire Holocene, according to palaeogeographic data, and, therefore, unlikely to contain any carbon of cryoconite origin. Data were obtained on C and N contents (dry combustion), C and N isotopic compositions, radiocarbon ages of TOC and of densitometric fractions and magnetic properties (NMR-spectroscopy). Results of this study led to the conclusion that cryoconites served as a source of organic matter for the soils on moraines and, as was shown by the radiocarbon dating, such organic matter was originated from deep layers of the rapidly thawing glacier. In soils formed either with or without cryoconite material, densitometric fractions with >1.6 g/cm^3 densities were older than light fractions. In soils with cryoconite material the heavy fractions were dominant and significantly more ancient than in soils without such material. Thus, carbon deposited by glaciers thousands of years ago has been included into carbon exchange cycle, with its properties being retained for over hundred years.

Keywords: radiocarbon dating, densitometric fractions, NMR-spectroscopy, cryoconite, Arctic
Financial support: Investigations were partly financially supported by RFBR project N 17-05-41157 РГО and by RFBR project 17-04-01475

(9645 - 1405) The role of Humic Substances in the root growth of

lettuce plants

Andressa Classer Bender[1]; Deborah Pinheiro Dick[1]; Daniel Hanke[2]
Federal University of Rio Grande do Sul[1]; Federal University of Pampa[2]

It is estimated that by 2050 world food production will increase 60%. The use of plant growth promoters derived from humic substances is an alternative to increase plant productivity. The aim of this work was to investigate the effect of commercial products GrowMate Soil (16% humic acids, HA) and GrowMate Plant (35% fulvic acids, FA) on root growth of lettuce plants. Sterilized lettuce seeds (*Lactuca sativa*, veronica variety) were conditioned on germination paper, in dark at 25 ºC for 4 days. After germination, seedlings were transferred to the following nutritive growth solutions: Saruge nutrient solution + 16% m / m HA (SN + 16HA), Saruge nutrient solution + 8% m / m HA (SN + 8HA), distilled water + 16% m / m HA (H_20+16HA), distilled water + 8% m / m HA (H_20+8HA), Saruge nutrient solution + 35 % m/ m FA (SN + 35FA), Saruge nutrient solution + 17.75% m / m FA (SN + 17FA), distilled water + 35% m / m FA (H_2O + 35FA), distilled water + 17.75% m / m FA (H_2O + 17FA). A solution with Saruge (SN) and another with distilled water (H_2O) were used as control treatments. The experimental design was completely randomized design (CRD) with 5 replicates. Plants were harvested at 20 days after implantation. Root growth evaluation was performed using Safira software for root digitized-images. Volume (mm^3), area (mm^2) and root average diameter (mm) were determined. Variance analyses (ANOVA) was performed to evaluate root parameters. The difference among treatments was determined by Tukey's test ($p < 0.05$). In relation to root volume of lettuce seedlings, treatments with HA, addition (SN + 16HA, SN + 8HA, H_20 + 16HA and H_2O + 8HA) showed the highest values. When nutrients were available in the solution, 50% of the recommended HA dose was sufficient for a higher root yield when compared to SN treatment. In the absence of nutrients, the use of 100% of HA dose it is recommended, since the treatment H_2O + 8HA did not differ from SN and H_2O treatments. In relation to the root area, treatment SN + 8HA presented a higher value in comparison to the treatments without HA. On the opposite to HA, FA decreased the root development of lettuce plants. The average root diameter did not differ among treatments. The use of HA directly in nutritive solution significantly increased root development and surpassed the effect of the nutrient solution . On the other hand, the FA present an inhibitory effect, and its application is not recommended at this stage of lettuce growth.

Keywords: Synergism, growt promoter, leonardita.
Financial support: CNPQ

(8923 - 582) Variations of organic carbon and phosphorus in ARID-semiarid soils of Argentina

Luna Martín Alejandro[1]; Juan Alberto Galantini[2]; Liliana Suñer[3]; Juan Manuel Zeberio[1]; Roberto Melchor Martínez[1]
Universidad Nacional de Río Negro. Sede Atlántica.[1]; Comisión de Investigaciones Científicas (CIC) - CERZOS-UNS.[2]; Universidad Nacional del Sur. Departamento de Agronomía.[3]

Organic carbon (OC) and phosphorus (OP) are key elements of soil quality and health. Both are influenced by the input of organic material to the soil. The aim of this research was explored variations of OC and OP to different depth in natural soils of the Patagonian. Six sites were selected, from satellite images, with different type cover vegetation, of northeast Argentina (Lat. 40º-41º S; Long. 62º-63º O). The climate is arid- semiarid, with average precipitation and temperature of 400 mm and 14,5 °C respectively, and frequent winds. The vegetation that characterizes this area is of the typical Monte, with xerophyte species; shrub steppes with dominance of *Larrea spp.* (Zygophyllaceae) are the most common landscapes. The main soil orders are Aridisols and Entisols. Each site was classified in: forest (F), shrub (S) and shrub-forest (SF) according to their physiognomy, in all of them three plots of 10x10 m were delimited. Five soil samples were taken in each plot to different depths: 0-0.01; 0.01-0.05; 0.05-0.10; 0.10-0.30 and 0.30-0.60 m. All samples were wet sieving, obtaining two particle size fractions: between 2000-53, and lower than 53 µm. In each fraction the concentration of OC by humid combustion and OP by Saunders and Williams method was determined. The type of vegetation influenced on relationship between the most labile fractions ($OC_{2000-53}$) with respect to most stabilized ones ($OC_{<53}$); this relationship in general was higher in the S, and in deeper layers these ratios were significantly different. In F were obtained 9.10 and 9.08 mg OC gr^{-1} soil for the 0.30 and 0.60 m. of depth; F presented a 75.5 and 123% more OC<53 that S in those depths, and SF an 8.5 and 48% less. Whereas, $OC_{2000-53}$ not showed significant different. The OP was strongly influenced by the particle size, the particles less than 53 µm ($OP_{<53}$) presented the highest concentration of OP. The average concentration of $OP_{<53}$, was of 140.7 mg OP gr^{-1} soil for entire profile, whereas to $OP_{2000-53}$ was of 37.4 mg OP gr^{-1} soil. These results indicate that the variations of OC and OP respond differently in environments according to place characteristics: vegetation type, soil and climate variations, uses different, etc.

Keywords: litter; soil fraction, fertility; land conservation; patagonia soil
Financial support: National University of Rio Negro. Atlantic headquarters.

(8146 - 2329) Vertical phosphorus (P) mobility in soil under natural pasture

Vanessa Dias[1]; Frederico Costa Beber Vieira[2]; Alisson de Mello Deloss[2]; Joscelina Paranhos Rosa de Vargas[1]
Federal University of Santa Maria[1]; Federal University of Pampa[2]

Natural pastures represent a wealth for the state of River Big of South, and some of these fields are poor in phosphorus. They are currently under threat due to some poorly managed handling practices. In this sense, it is important to seek a balance between productivity and conservation of natural resources, and therefore strategies for intensification of forage production should be sought in a way that improves production without deteriorating the natural pasture environment. Phosphate fertilization and the insertion of forage species are interesting options for such intensification. The objective of this work was to verify the vertical mobility of phosphorus after surface application and to demonstrate the effects of natural pasture interference strategies on soil chemical quality. The experiment was installed in 2014 in a natural pasture area belonging to the Anacreonte Ávila de Araújo Research Center (FEPAGRO Forage), in a Red Argissolo, in the municipality of São Gabriel, RS. The experiment has four treatments: 1) natural pasture (PN); 2) PN + liming + mineral fertilization of phosphorus (P) and potassium (K); 3) PN + liming + PK + ryegrass + legumes; and 4) PN + liming + PK + ryegrass + N mineral. In order to evaluate soil chemical attributes, the soil was sampled in 2014, 2015 and 2016, to the depth of 40 cm, stratified every 2 cm to a depth of 20 cm. The samples were air dried, ground and the phosphorus content determined. The results were submitted to analysis of variance, and when significant were compared by the Tukey test. The phosphorus content at 3 months did not show a response between the treatments. In treatment 3, the phosphorus content was higher in relation to the others in the more superficial layer, decreasing to a third of this content in the subsequent layer and demonstrating the low mobility that P presents in the soil. At 18 months, the effect of P fertilization was more evident, and the treatment without phosphate fertilization (PN) showed a significantly

lower P content than fertilized treatments.
Keywords: natural pastures, phosphorus and forage plants
Financial support: Thank you to CNPQ

(7022 - 2663) Zn, Ni, Pb and Cu contents in two organo-soils of Rio de Janeiro state.

Talita de Santana Matos[1]; Sidnei Julio Beutler[1]; Marcos Gervasio Pereira[1]; Everaldo Zonta[1]
Universidade Federal Rural do Rio de Janeiro[1]

The objective of the present study was to evaluate the alteration of the chemical element contents (Zn, Ni, Pb and Cu) as a function of the subsidence rate in two organic soils located in Rio de Janeiro state. The experiment was conducted under greenhouse conditions. Undisturbed samples were collected using PVC tubes in two profiles of *Thyomorphic organosols*, one in Santa Cruz neighborhood (Profile SC, and the other one in Magé (Profile MG). Three levels of drainage were evaluated at 30, 60 and 100 cm depth. And soil samples were collected at layers of 0-10, 10-20, 20-30 and 30-40cm. The first evaluation was done at the experiment implantation and the second 365 days later. After the sample preparation, pseudo total digestion was performed by SW-846 3050b method (USEPA, 2007). Chemical elements contents were determined by Atomic Absorption Spectrometry. The parameters average obtained was compared by Tukey's test at 5% probability in a completely randomized design, using the R software. In both profiles no significant differences were observed between the two evaluation times. However, different behavior was observed in drainage blade and in the profile height. In the SC profile soil, the Ni contents presented a significant difference between the depths in the drainage level of 100 cm, in the 30 - 40 cm depth different from the others. The Cu concentrations showed similar behavior when compared to Pb. For Pb, differences were observed between the height of the water blade and the profile depths, with the 100 cm blade showing the lowest value. For Ni, the highest levels were found in the first 20 cm of the soil profile. The Zn contents varied according to the profile depth, with the largest differences found in the layers of 0-10 and 10-20 cm. By evaluating the MG profile it was observed that the behavior between the two profiles is quite similar exception made for Ni and Pb contents. These results indicate a significant interaction between water blade height and the profile depth at the level of 60 cm, with the 30-40 cm depth showing the lowest values. Therefore, deeper drainage has contributed to increase element contents in the most superficial layer of the soil profile, possibly by interference of adsorption in the element dynamics.
Keywords: Histosols, trace elements, subsidence rate.
Financial support: Coordination of Improvement of Higher Level Personnel-CAPES, Foundation for Research Support in the State of Rio de Janeiro-FAPERJ.

C2.2.2 - Life on the interphase: interactions between soil geochemical and biological traits

(9079 - 993) Acidity levels and diazotrophic bacteria in upland rice production in the Cerrado Oxisol

Wlly Cristiny Mendes de Oliveira[1]; Julia Maria Ferreira Freiberg[1]; Salomão Lima Guimarães[1]; Edna Maria Bonfim-Silva[1]
UFMT[1]

The hydrogenionic potential, commonly referred as pH, is one of the limiting factors for the establishment of any agricultural culture, including the rice. Soils with low pH, as well as most of the soils of the Cerrado, may be difficult to adsorb the nutrients and make them available to plants. The effect of pH on microbial activities in both the soil and the plant are of the utmost importance to mitigate errors in management and optimize the agricultural processes. In view of this, the objective was evaluate the effect of inoculation of diazotrophic bacteria and acidity levels on the production of non-irrigated rice grown in Oxisol. For that, the experiment conducted in a greenhouse, at Federal University of Mato Grosso, Campus of Rondonópolis. The treatments were composed of two factors, being them, levels of acidity (4,8, 5 and 6) and sources of nitrogen (urea, H2-strain - Bacillus sp., and commercial inoculant-composed by AbV5 and AbV6 strains of Azospirillum brasilense), resulting in a 3x3 factorial scheme, with four repetitions, in completely randomized design, totaling 36 experimental units. For differentiation of the treatments, after the solo collection, set to achieve the predetermined pH. The soil was allocated in vases of 9 dm3 and before sowing the seed pelleting was carried out, using peat as vehicle of inoculation. The duration of the experiment was 117 days after sowing. The variables analyzed were the 100 grain weight and grain dry mass. Initially, the spikelet of rice were collected and had their grain removed. The grains were counted and weighed in the semi-analytical balance. Then, the grains were allocated in paper bags, and then taken to an oven at 65°C for 72 hours or until reaching constant weight. The statistical program used for analysis of the data was the SISVAR, and the averages submitted to the test of Tukey at 5% of probability. There was interaction between the factors (acidity levels and nitrogen sources), however, no significant difference was observed among treatments. For the 100 grains weight and grains dry mass, the treatments consisting of the pH 5 and 6, relating to nitrogen sources, demonstrate that inoculation can supply up to 68% the need of nitrogen required by rice crop. With this, it is concluded that at all levels of soil acidity, inoculation with diazotrophic bacteria were able to meet, the need for nitrogen required by rice plants.
Keywords: Inoculation, soil pH, Oxisol, Oryza sativa L.
Financial support: CNPq

(5825 - 547) Bioenergy sub-products as fertilizers: C, N and P soil dynamics after biochar and digestate application

Gastón Alejandro Iocoli[1]; Luciano Orden[2]; Maximiliano Garay Schiebelbein[3]; Marisa Anahí Gómez[1]
Centro de Recursos Naturales Renovables de la Zona Semiárida (CERZOS), Universidad Nacional del Sur (UNS)-CONICET, Bahía Blanca, Argentina[1]; EEA H. Ascasubi, Instituto Nacional de Tecnología Agropecuaria (INTA), Buenos Aires, Argentina[2]; Departamento de Agronomía, Universidad Nacional del Sur (UNS), Bahía Blanca, Argentina[3]

Amendments incorporated to soil of arid and semi-arid environments are quickly mineralized, with little incorporation into the stabilized soil organic matter. Anaerobic digestates contain a high proportion of available nutrients but a vestigial C content, while Biochar provides C whit great stability. The objective of this research was to evaluate the advantages of the combined use of biochar and digestate for soil fertilization through the C, N and P mineralization in a microcosms assay. Biochar was obtain by slow-pyrolysis *of Aspidosperma quebracho-blanco,* while anaerobic digestate of pig slurry was collected from a pig farm (SW Buenos Aires, Argentina). The parameters C, N and H (CHN 440 Analyzer), TKN, NH_4^+-N and NO_3^--N (semi-micro Kjheldal) were determined. The H/C atomic ratio and C/N mass ratio were calculated. Two sets of microcosms were prepared with 100 g of sandy-loam Entic Hapludoll soil. The treatments were: unamended soil; biochar (B); pig digestate (PD), and the combination of both (B+PD) (with three replicates), levelled according to the TKN content (6.5 g 100 g^{-1} soil). One set of microcosms was sampled repeatedly to follow C mineralization, while for the other set a destructive sampling was used to evaluate N and P dynamics periodically during 119 days. The CO_2 released was captured in a NaOH solution and was determined by back titration

with HCl. The parameters NH_4^+-N, NO_3^--N, water soluble P (Ps) and extractable P (Pe) were determined. Data were subjected to ANOVA followed by Fisher LSD for mean comparison. The B presented a lower H/C that the PD (0.51 and 1.66 respectively), indicating a lower degree of saturation (greater aromaticity), and a greater C/N (53.82 and 1.97) as consequence of high inorganic-N content of PD. B showed a short-lived primer effect at the beginning of incubation, possibly as a result of the presence of short-chain organic acids resulting from low pyrolysis temperature. As consequence of the higher proportion of recalcitrant C this period is short-lived. B presented increased CO_2 accumulated, DC presented a decreasing trend ($p>0.05$), but it was lower than B and B+PD ($p<0.05$). B+PD increased the initial mineralization rate of biochar, reducing the average life time and improving stabilization; reduced C mineralization, increased N availability; and increased labile P. Overall this results show performance improvements of B+PD with regard to the single amendments and the control.

Keywords: pyrolysis anaerobic digestion nutrient dynamic organic amendments

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(1647 - 578) Chemical description of the soils of environments occupied by Euphorbia hirta L. (Euphorbiaceae)

Thalia Inês Aleixo Barbosa[1]; Victor Barros Damacena[1]; Giovana Fornaciari Moreira[1]; Jeferson da Silva Muniz[1]

Instituto Federal de Mato Grosso - Campus Profº Olegário Baldo[1]

A current problem that haunts the integrity and diversity of ecosystems and characterized by the dynamics of exotic species, which due to favorable environmental conditions, settle and colonize the environment in a systematic and dominant way. In addition to ecological damage, such behavior often causes economic damage to various crops. At this juncture, the edaphic quality and directly affected in terms of levels of organic matter. In the middle of the above, this study aimed to analyze the chemical characteristics of the soils of areas invaded by Euphorbia hirta. For this, six areas with the occurrence and monodominance of the species were selected. The research areas are located in the Brazilian Midwest, state of Mato Grosso in the municipality of Araputanga. The geographical position is defined by the coordinates of latitude 15º28'16 "S and longitude 58º21'11"W (altitude of 200 m). The samples were collected in areas where the soil is classified as Eutrophic Red-Yellow Argisol. The collection was carried out in two institutions and three depths. The first time obtained under and between the projections of plants, a second vertically in the strata (0-5, 5-10 and 10-20 cm). The samples (composites) were obtained from six simple samples. As an emissary, they were sent to the laboratory, where they were air dried and sealed in a 2mm mesh for chemical analysis. A chemical characterization made from pH in water, phosphorus (P), potassium (K), sodium (Na), soil acidity ($H + Al^{+3}$), exchangeable aluminum (Al^{+3}), calcium (Ca^{+2}), magnesium(Mg^{+2}), sum of bases (SB), effective CTC (e), CTC pH7 (T), aluminum saturation (m%) and base saturation (V%). The experimental design used for the integrated storage in subdivided plots. Present the institutions (under and between the projections of plants) in the subplot and sub-plot were studied the depths. The averages were compared by the Tukey test at 5% probability. All statistical analyzes were performed using software R. As for soil pH, there are no significant features as areas. However, these showed variability in soil fertility, which indicates an adaptability of E. hirta. In relation to areas not belonging to the area of the areas. Evaluating the depths of the highest pH value in the 0-5 cm layer. Finally, it was verified that I released singles as projections of the species holds higher levels of P.

Keywords: Soil, Chemical Description, Euphorbiaceae

Financial support:

(6762 - 2215) Effects of U*rochloa sp.* invasion on soil chemical properties in riparian forests edges

Giovanna Gomes Cordeiro[1] ; Gabriela Bielefeld Nardoto[1]

Universidade de Brasília – Brasília DF[1]

Biological invasions have the potential to dramatically change the functioning of natural ecosystems. Invasive species have morphological traits that favor their establishment in environments under anthropogenic pressure. Grasses of the genus *Urochloa* are invasive alien species widely used for livestock settlements in Brazil. When cultivated near to Cerrado fragments or riparian forests, *Urochloa* outcompete native species, expanding their distribution. Because of its different C:N ratio compared to tree species, they may modify nutrient cycling. In addition, edge effects may facilitate biological invasions because of changes in local abiotic conditions, such as the light availability. The goal of this study was to evaluate the effects of biological invasion on soil chemical properties at the edge of riparian forests under pressure of pastures established for more than 30 years. The study was conducted in a watershed located in the Cerrado biome of Brazilian Central Plateau. Soil samples were collected in three sampling points (one in pasture, one in forest edge and one in wet forest area) at 0-20 and 20-40 cm depth, in five study sites (riparian forests). Soil fertility was determined by common chemical analyzes. The forest edge was more similar to the wet forest ($r = 0.65$) than the pasture ($r = -0.14$). There was no difference between the forest edge and the wet forest for any of the variables ($p > 0.05$). The forest edge had higher available phosphorus (P), potential acidity ($H+Al^{3+}$), cation exchange capacity (CTC) and organic carbon (OC), while lower remanent phosphorus (P-Rem) compared to the pasture. Soils with lower CTC retain less cations increasing nutrient losses by leaching, which may explain the lower levels of P in pasture soils. The highest value of P-Rem in the pasture indicate the long-term establishment period of these grasses. The higher OC content in the soil at the forest edge compared to pasture and wet forest may indicate that this ecotone also has higher C:N ratios and carbon stock, which may be influenced by invasion. These results suggested that the presence of *Urochloa* at the forest edge did not modify soil chemical properties. However, differences in organic carbon content in the forest edge indicate that the decomposition process may be changing in the face of biological invasion.

Keywords: Pasture; wet forest; organic carbon; phosphorus.

Financial support: CNPq

(9318 - 2922) Estimation of potencial acidity by the SMP method in representatives soils of Alagoas, Brazil.

Wendel Cristephan Carapeba Coelho[1]; Gilson Moura Filho[1]; Adriano Barboza Moura[1]; Leila Cruz da Silva[1]; Lucas da Silva Lopes[1]; João Batista Melo Santos[1]

UFAL[1]

In order to obtain the lime requirement, it's necessary to know the soil potencial acidity to proceed with the appropriate amount of limestone in its correction. The SMP pH is a method which obtains the equilibrium pH in a suspension between the soil and the SMP solution. SMP is one of the most utilized methods to analyze acidity. The objective of this work was to estimate the values of potencial acidity in representative soils of Alagoas through pH measures by the SMP solution method. This work was carried out at the Laboratório de Solo, Água e Planta of the Centro de Ciencias Agrárias of the Universidade Federal de Alagoas. The soil sampling was done beforehand in a study with the use of Zoneamento Agroecológico do Estado de Alagoas (ZAAL) software in order to identify, quantify and locate the most representative soils of the state. 50 soils samples were collected in the

0-20 cm layer. The samples were taken to a soil drying oven at 38 degrees Celsius for 4 days and later were sifted and stocked in plastic bags. pH in water, pH in $CaCl_2$ were determined and, in both cases, using the relation 1:2,5. In order to extract the potencial acidity (H+Al), calcium acetate was used at 0,5 mol L^{-1} ph 7,0, the latter determined by the NaoH titration 0,025 mol L^{-1}, adjusted to pH 7,0 with an acetate acid solution. 5 cm^3 of air-dried fine sand, posteriorly added to a 125 ml erlenmeyer together with 75 mL of the calcium acetate extractor solution. After that, the final solution was stirred for 15 minutes and left to rest for one night, together with a blank proof. At the end of that period, 25 ml of the supernatant was removed for the titration with 0,025 mol L^{-1} NaOH with three drops of alcoholic phenolphthalein 10 g L^{-1}. The SMP pH was dettermined according to the methodology proposed by Raij and Quaggio (1983). With the data in hand, a significant correlation was verified between the H + Al values measured with the SMP pH, thus showing that the potential acidity can be estimated by the SMP pH method. The sensitivity of the SMP pH method was higher when the equilibrium pH was determined in the 10:25:10 ratio, and the pH was determined in water using the equation $Y = a + b / x^2$

Keywords: Potencial Acidity, SMP pH, Soils of Alagoas
Financial support:

(3258 - 951) Evaluation of the development and productivity of maize culture in different fertilization managements in a direct planting system

Amanda Silveira Reis[1]; Ana Maria Conte[2]; Marcos Rafael Nanni[1]; Pedro Francisco da Silveira Reis[2]; Luiz Carlos Reis[2]; Teresinha Esteves da Silveira Reis[2]

Universidade Estadual de Maringá[1]; Universidade Estadual do Norte do Paraná[2]

In Brazil there was an increase in the production and cultivation of maize, destined for both human and animal consumption, but it is still considered low when compared to the United States and China, first and second largest producers, respectively. This is due to the management practiced by the producers, because proper practices of correction and fertilization of the soil require a complex decision-making process, where the caracteristics of the plants and soil, climate, among others, should be taken into account. The objective of this work was to evaluate the technical feasibility of the modes of application of sowing fertilization in the direct planting system, in the phytometric parameters and in the productivity of the maize culture. The experiment was carried out in the experimental farm of the State University of Northern Paraná, in the city of Bandeirantes/PR, using the culture of maize, implanted in the year 2015. The experimental design was in randomized blocks with 7 treatments, being T1 (without fertilization), T2 (application of NPK to the haul), T3 (application of NPK on line), T4 (NP in the haul and K on line), T5 (NP in line and K to the haul), T6 (NK to the haul and P on line) and T7 (NK on line and K to the haul), with 4 repetitions. The parcels consisted of 6 lines of maize, 6 m long by 4.5 m in width resulting in 27 m^2, considering as a useful area the 4 central lines and despising one meter from each end of the parcel. The treatments were performed with application in the sowing of 20 kg ha^{-1} of N, 80 kg ha^{-1} of P_2O_5 and 40 kg ha^{-1} of K_2O, using the fertilizers urea, simple superphosphate and potassium chloride. For fertilization in coverage applied 90 kg ha^{-1} N, parceled in two applications. Phytometric parameters have been evaluated: plant height, leaf number, stem diameter, ear and cob, ear weight, the cobs and 100 grain size of cob, dry weight of shoot and productivity. The data were compared by Duncan's test at 5% probability, using the SASM-Agri software. The results allowed to conclude that the method of application of NPK affected significantly the productivity, the application of the NP haul + K line presented the highest productivity and between the treatments NPK line and NPK haul, the application to the haul obtained the best result for the productivity.

Keywords: *Zea mays*, soil fertility, conventional planting
Financial support: Capes

(9147 - 2224) Lettuce production under the residual effect of the interaction between selenium and sulfur

Patriciani Estela Cipriano[1]; Maria Ligia de Souza Silva[1]; Anderson Ricardo Trevizam[1]; Matias Siuéia Junior[1]; Luiz Roberto Guimarães Guilherme[1]

Universidade Federal de Lavras[1]

The study of the residual effect of the fertilization is of great importance, since it can promote a better utilization of the nutrients by the plants. Se is not essential for higher plants, but all plants absorb and metabolize this element. Little is known about the residual behavior of selenium fertilization in the soil, but since selenate and sulphate make the same path in plant transport, the objective of this study was to evaluate the residual effect of the interaction between Se and S on lettuce (Lactuca sativa) after onion cultivation (Allium cepa L.). The experiment was carried out in a greenhouse, in a randomized design, in a factorial scheme of 5 x 3, with five doses of Se (0.0, 0.3, 0.6, 1.2 and 2.4 mg dm^{-3}) and three doses of S (0, 20 and 40 mg dm^{-3}) with three replicates. Se and S were supplied in the form of sodium selenate and calcium sulfate, respectively. Pots with 4 dm^{-3} of soil were used, filled with samples from the 0-20 cm layer of a dystrophic Red-Yellow Latosol typical of medium texture. The cultivation of onion cv. Diamantina was made, at the end of the cycle the harvest was made. Then, the lettuce seedlings cv. Veronica. After 40 days the lettuce plants were harvested, and the plant material was divided into shoots and roots, the shoots being measured for the determination of fresh matter production. The data was submitted to analysis of variance, to evaluate significant differences between the treatments. When the interaction between Se and S was significant, a multiple regression analysis was performed using the Euler Backward method. The results show that the fresh mass production was influenced ($p < 0.05$) by the residues of the interaction between the doses of S and Se. The maximum dose of Se applied when not applied S was responsible for the lower values obtained in the fresh mass produced. The maximum fresh mass production (76.6 g $plant^{-1}$) would occur in a combination of approximately 25.7 and 1.8 mg dm^{-3} of S and Se, respectively. It is concluded that the residual effect of the interaction between Se and S, possibly affects lettuce production.

Keywords: Lactuca sativa, selenate, ionic interaction
Financial support: CAPES, CNPq and FAPEMIG

(9729 - 2909) Modification of Nonexchangeable Potassium Extraction Method in Calcareous Soils

Kambiz Bazargan[1]; Mojgan Yegane[1]; Karim Shahbazi[1]
Soil and Water Research Institute, Agricultural Research, Education and Extension Organization (AREEO), Karaj, Iran[1]

Potassium (K) is an essential plant nutrient. Soil K is often subdivided into soluble, exchangeable, nonexchangeable, and structural or mineral forms. Nonexchangeable K constitutes a slowly available reserve that may significantly influence K fertility of soils. It is held between adjacent tetrahedral layers of dioctahedral and trioctahedral micas, vermiculites, and integrated clay minerals such as chloritized vermiculite. The most common method for extraction of nonexchangeable potassium from soils is using boiling 1M HNO3. Because of low precipitation and parent materials, most of the arable soils of Iran are affected by nonsoluble or lowly soluble salts such as CaCO3. Reaction between CaCO3 and HNO3 consumes part of acid and can affect the amount of extracted K in these soils. Different levels, 0-50%, of CaCO3 and neutral sand were added to a

noncalcareous soil separately and non exchangeable K was extracted with conventional method using 1M HNO3 in all samples. Comparing results, improved the effect of different CaCO3 levels on the soil nonexchangeable potassium extraction. Experiments showed that increasing acid/soil ratio to 40, improved the effect of CaCO3 on extraction of soil K. New extraction method with 100ml HNO3 added to 2.5g soil was compared with old method in 70 noncalcareous soil samples. Results showed that new method extracted higher amounts of K comparing with the old method, but the extracted K amounts by two methods were highly correlated. It improved that new method can substitute the old one to be suitable for calcareous and noncalcareous soils.

Keywords: Nonexchangeable Potassium, Nitric acid, Extraction method

Financial support:

(9080 - 2856) Multivariate analysis of chemical attributes in anthropic soils under forest at different positions gives landscape in Amazonian

Fernando Gomes de Souza[1]; Alan Ferreira Leite de Lima[1]; Milton Cesar Costa Campos[1]; José Mauricio Cunha[1]; Douglas Marcelo Pinheiro da Silva[1]; Marcelo Dayron Rodrigues Soares[1]; Eduardo Antonio Neves do Santos[1]; Thalita Silva Martins[1]; Elyenayra Nogueira Pinheiro[1]; Elilson Gomes de Brito[1]; Estefani de Souza Oliveira[1]; Rafael Jorge do Prado[2]

Federal University of Amazonas[1]; Federal University of Roraima[2]

In the Amazon, anthropic soils known as Terras Pretas de Índios (TPIs) have a very peculiar characteristic, with high natural fertility, possibly resulting from prolonged anthropic occupation and the incorporation of pyrogenic coal incorporated in the soil surface horizons matrix. In the simultaneous analysis of many variables, multivariate statistics it is efficient tool, which can help in decision making on the use and proper management of the soil, based on the variations of soil attributes. Thus, the objective of this work was to perform the multivariate analysis of the chemical attributes in anthropic soils under forest area in different positions of the landscape. A mesh with 88 collection points was delimited with the following dimensions: 60 x 42 totaling an area of 2,520 m2, with regular spacing between the collection points of the soil of 6 x 6 m. Were collected soil blocks in layers 0.0-0.05 m, 0.05-0.10 m and 0.10-0.20 m, with a preserved structure in the form of a clod dry that, the analyzes based on the methodology proposed by EMBRAPA (2011), followed by analysis of variance multivariate of (MANOVA), through factorial and cluster analysis, in order to find statistical significance of the sets of soil chemical attributes. Using the multivariate analysis, it was possible to observe the attributes of the soil that suffered the greatest change when the soil slope. From the percentage of variance explained, in the 0.001-0.05 m layer the CP1 is responsible for 44.22% of the total variance, while CP2 is responsible for 25.91% in the 0.05-0.10 m layer CP1 accounts for 38.79% of the total variance, while CP2 accounts for 30.80% and in the 0.10 - 0.20 m layer the CP1 is responsible for 37.37% of the total variance, while CP2 accounts for 28.99%. Both the first and second factor have a percentage of explanation for the chemical characteristics of the soil. Thus, the discrimination between the strands refers to these characteristics, with CP1 representing the chemical characteristics COT and P for three studied layers, while CP2 to the chemical characteristics pH and Al + H in the three layers studied. The techniques of multivariate analysis showed that the upper medium showed the attributes better pH, COT, P and Al + H. The use of multivariate techniques in soil studies can be an important tool in environmental monitoring.

Keywords: Soil Attributes, Terra Preta de Índio (TPIs), Amazon.

Financial support: UFAM

(5295 - 1409) Soil chemical and mineralogical attributes of altered forest by pasture and agricultural use in the north Amazonia

Valdinar Ferreira Melo[1]; Luciana da Silva Barros[1]; Taline Katlen de Oliveira Nunes[1]

Federal University of Roraima[1]

The agriculture practiced in the extreme north of Amazon forest still maintains the conventional production system, by slash and burn, with posterior use of the ashes as a fertilizer in the first year of cultivation. However, this practice leads to the loss of soil quality. The characterization of soil chemical and physical attributes and their response to forest/agriculture/pasture conversion will provide responses of a better sustainability of a land-use system that maintain soil quality. The objective of this work was to characterize the soil chemical and physical attributes from a forest and from altered forest areas by pasture and conventional agricultural system use in at the northern Amazon. The soil samples were collected at two pasture areas (degraded pasture - DP and well managed pasture - WMP), two agricultural areas (corn under conventional cropping system after pasture - CT and subsistence agriculture with intercropping - SF), freshly burned land for pasture (FB) and forest (For). Samplings were performed at three different depths (0-5, 5-15 and 15-30 cm) and four replication each. The soil acidity presented by all areas (DP, WMP, CT, FB and For) reflected the advanced degree of soil weathering, as well as the mineral exhaustion caused by the inadequate soil management. The burn used at FB area contributes to raise the pH only at the first 5 centimeters of soil layer. The highest levels of exchangeable cations (Ca^{2+}, Mg^{2+} and K^{+}) and P in surface (0 - 5 cm), especially at FB area, which represents the ash contribution to increase the availability of nutrients. The soil organic carbon levels found in this study demonstrate that the conversion of forest areas to pasture and forest areas to agricultural areas did not change over time. The highest soil bulk density were recorded at PGD and PGC areas, associated with the management applied to the areas, however, they are still below the critical limit for the development of plant roots. The abandonment of pastures with time, promote the resurgence of spontaneous plants creating conditions similar to native forest. The agricultural areas in function of slash and burnet, soil disturbance with aggregate breaking and soil particle spraying were very different of the native forest.

Keywords: deforestation by burning, soil quality, land use

Financial support: Financial Support: Fundação CAPES, Projeto Pró-Amazônia (Project number 23038.000715/2013-63)

(6679 - 1161) Stratified chemical analysis in soils submitted to different fertilization management.

Lucimara Rodrigues Padilha[1]; Lethícia da Rosa Neto[2]; Luiz Clery Burin Fruet[3]; Rudinei Balem[4]; Willian Garzon de Freitas[5]; Cleudson José Michelon[4]

Instituto Federal Farroupilha Campus Júlio de Castilhos, Júlio de Castilhos-RS, 98130000, Brasil (luci.r.padilha@gmail.com).[1]; Universidade Federal de Santa Maria, Santa Maria-RS, 97105-900, Brasil.[2]; Universidade Federal de Santa Maria Campus Frederico Westphalen, Frederico Westphalen-RS, 98400-000, Brasil.[3]; Instituto Federal Farroupilha Campus São Vicente do Sul, São Vicente do Sul-RS, 97420-000, Brasil.[4]; Instituto Federal Farroupilha Campus Júlio de Castilhos, Júlio de Castilhos-RS, 98130000, Brasil.[5]

The objective of this work was to analyze the changes in the chemical attributes of a typical Dystrophic Red-Yellow Argisol, cultivated with soybean in no-tillage system, submitted to two fertilization treatments in the last 10 years of cultivation: fertilization added in the sowing line and fertilization added on surface. Two properties were evaluated, one located in Júlio de Castilhos / RS and the other in Tupanciretã / RS. The samples were collected at depths of 0.0-0.10 m and 0.10-0.30 m. The analyzes were carried out in the laboratory of

the IFFar Campus SVS, following a methodology described by Tedesco et al, 1995. In this work the results of the potassium (K) and phosphorus (P) contents are presented. The P content was 64 mg dm^{-3} and the K content was 60 mg dm^{-3}. At the depth of 0.10-0.30 m, the content of K were 40 mg dm^{-3}. When the management of the fertilization was on a surface at a depth of 0.0-0.10 m, the P content was 50 mg dm-3 and that of K was 160 mg dm-3. At the depth of 0.10-0.30 m, the content of P were 4 mg dm^{-3}. With the accomplishment of the work it was observed that when the management of the fertilization in the sowing line was used, a more uniform distribution of P and K occurred between the evaluated depths. In the management of the fertilization on the surface, there was concentration of the P and K in the superficial layer. These results show that surface fertilization may favor the contamination of water sources due to the ease of nutrient loss due to the superficial runoff of the water, besides that, in this management of fertilization, in conditions of water stress, the culture may have a greater limitation of yield because your root system tends to focus on the soil surface.
Keywords: Glycine Max; depth of fertilization; no-till system.
Financial support:

(7777 - 1954) The iron isotopic fractionation in human-polluted river from soil to the ocean

Zih-Jie Lin[1]; Kuo-Fang Haung[2]; Shan-Li Wang[1]; Der-Chuen Lee[2]
National Taiwan University, No. 1, Sec. 4, Roosevelt Rd., Taipei 10617, Taiwan[1]; Institute of Earth Sciences Academia Sinica, No. 128, Sec. 2, Academia Road, Nangang, Taipei 11529, Taiwan[2]

The iron isotopic fractionation in human-polluted river from soil to the ocean Zih-Jie Lin[1]; Kuo-Fang Haung[2]; Shan-Li Wang[1]; Der-Chuen Lee[2]
[1] National Taiwan University, No. 1, Sec. 4, Roosevelt Rd., Taipei 10617, Taiwan (r06623004@ntu.edu.tw); [2] Institute of Earth Sciences Academia Sinica, No.128, Sec. 2, Academia Road, Nangang, Taipei 11529, Taiwan Abstract Iron is a limiting micronutrient for marine organism, and is crucial to boost ocean production and regulate global climate. Soil may contribute considerable iron to the ocean, but the transformation of iron species during riverine transportation has not been well understood. To have insight into the iron transformation during the transportation from soil to ocean, river water was collected from different sites in the Dan-shuei River, which flows through the high population city, Taipei (~9,000 people / km^2). Sampling was carried out in wet and dry seasons. The concentration of total organic carbon (TOC), dissolved organic carbon (DOC) and chlorophyll a in water samples were measured. The results of iron isotopic fractionations show significant transformation of iron phase in the areas with high population density. High concentration of chlorophyll a was detected in the same area, where phytoplankton plays an important role on iron isotopic fractionation. This study reveals the fractionation of iron isotope during the transportation in river and the contribution of iron from soil to the ocean. Key words: iron isotope; fractionation; soil; river transportation
Keywords: iron isotope; fractionation; soil; river transportation
Financial support:

(8900 - 2598) Phosphorus and silicon fertilizer rates effects on dynamics of soil phosphorus fractions in oxisol under common bean cultivation

Alessandra Mayumi Tokura Alovisi[1]; Ademar Pereira Serra[2]; Alves Alexandre Alovisi[1]; Luciene Kazue Tokura[3]; Elaine Reis Pinheiro Lourente[1]; Robervaldo Soares da Silva[1]; Silvia Corres Santos[1]; Livia Maria Chamma Davide[1]
Universidade Federal da Grande Dourados (UFGD)[1]; Brazilian Agricultural Research Corporation (EMBRAPA)[2]; Universidade Estadual do Oeste do Paraná[3]

The purpose of the research was to evaluate the effects of P and Si fertilizer rates in dynamic of P fractions in clay soil under greenhouse. The research was carried out in a Dystroferric Red Latosol of a very loamy texture from Lavras city, Minas Gerais State, Brazil. The experimental design was entirely randomized, arranged in 4 x 3 factorial design, with four repetitions. The treatments included four inorganic fertilizer P rates (0, 110, 330 and 560 mg dm^{-3}) and three Si rates (0, 110, 330 and 560 mg dm^{-3}). The preview application of Si fertilizer did not contribute to decrease P desorption. Possibly, the silicate has lower affinity with the bound sites of adsorption than phosphates. The effects of inorganic fertilizer P were higher in increasing the moderately labile P fraction and labile P fraction. Among the organic P fractions, the $NaHCO_3$-Po fraction was the only one that contributes to plant nutrition. The Hedley sequential phosphorus fractionation promoted information about different pools where P was accumulated in the soil after common bean cultivation. The highest amount of P was obtained in stable P fraction, followed by moderately labile and labile P fraction. The moderately labile P fraction decreased after common bean cultivation possibly due to the time of P contact in the soil and redistribution to stable P fraction. The labile form was the lowest P pool in soil, nevertheless the increase in P fertilizer rates increases the amount of P content in labile fraction.
Keywords: P fertilizer, Si fertilizer, nutrients interaction, *Phaseolus vulgaris*
Financial support: CNPq, FUNDECT e UFGD

C2.2.3 - Soil and water pollution: dynamics and evaluation

(1536 - 574) Adsorption isotherms of Mn, Zn, Cu, Pb AND Cd in soils and sediments within la villa river Basin-Panama

Jose Ezequiel Villarreal Nuñez[1]; Neldis Ballesteros[2]; Adolfo Santos Pineda[1]; Jhon Villalaz Perez[1]
IDIAP[1]; USMA[2]

The present study was carried out within La Villa river basin (provinces of Herrera and Los Santos). In these lands historically a great agricultural activity has been developed standing out the prodcution of corn, tomatoes, melons, watermelons, beans, chilli peppers, sugarcane, beef cattle and milk. They are lands subjected to an intensive use of agrochemicals and influenced by discharges of waste waters of some industrial and agroindustrial companies located within the basin. The objective of the study was to determine by Langmuir isotherms the maximun adsorption capacity of Mn, Zn, Cu, Pb and Cd in soils and sediments of areas with intensive agricultural activity within the La Villa river basin. Ten samples of soil and sediments were taken in lands of farmers in the rainy season (june-november 2016) and ten in the dry season (january-april 2017). The total heavy metals concentration was determined by extraction with HNO_3 + HCl (3:1) using continuous source atomic absorption equipment. The trace metal isotherm were determined in soil and sediments in the samoples taken in both seasons by applying different metal concentration in a 0.01 M $CaCl_2$ solution. In general, the total concentration it was below the levels considered toxic in all the sites.The soils of the area are characterized by having a pH higher than 6 on average, high concentration of Mn and Fe and are classified in order alfisols, ultisols and inceptisols. The Mn isotherm showed low values and a high adsorption strenght, Cu and Zn showed high values of adsorption but with low retention energy. For the Pb, high values of adsorption were observed, but very low retention strenght, contrary to the Cd that obtained low values of adsorption but with a higher strenght. This behavior has a lot of relation with the texture of the soil, in general, those that showed the greatest retention strenght

are more acid soils with a higher content of clay and organic matter. The sandy soils showed low values of maximun adsorption and lower retention energy, with the sediments being the main ones that presented lower metal adsorption strenght, which implies theat if the metal concentration increase and the aqueous and interchangeable phase of the these sediments could cause greater environmental problems of the ecosystem.

Keywords: Pollution, bioavailability, environmental regulations, soil adsorption

Financial support: Secretaria Nacional de Ciencia, Tecnología e Innovación (SENACYT). Project ITE06-15

(4362 - 2789) Anatomical characteristics of adult eucalyptus plants irrigated in the molting phase with wastewater

Thaís Andrade de Carvalho Silva[1]; Joiran Luiz Magalhães[2]; Arthur Almeida Rodrigues[1]; Douglas Almeida Rodrigues[1]; Sebastião Carvalho Vasconcelos Filho[1]

Goiano Federal Institute of Education, Science and Technology (IFGoiano), Campus Rio Verde[1]; University of Rio Verde - Campus Rio Verde, Farm Sources of Knowledge[2]

The rapid economic development associated with accelerated population growth and urbanization has led to scarce water resources, restricting the sustainable development of agriculture. Thus, the use of irrigation of forest species cultivated for fuel and wood with waste water is an alternative, which can help in the proper disposal of effluents and in the fertirrigation of crops. The objective of this study was to evaluate the anatomical characteristics of eucalyptus (GG100 and 3335) after six years of field cultivation, irrigated in the seedling phase with wastewater from the treatment plant (WTP). Initially seedlings with approximately 30 days were irrigated with soybean WTP and urban WTP wastewater at concentrations of 25%, 50%, 75% and 100% dilution and a control with 0% for a period of 165 days, after this period, the seedlings were transplanted to the field where they were cultivated for six years. Subsequently, leaf samples were collected from the middle region of the last fully expanded leaf of all the eucalyptus plants of the varieties GG100 and 3335 and performed an anatomical analysis of leaf surface. The eucalyptus (GG100 and 3335) varieties have anisthymatic leaves, with uniseriate epidermis, dorsiventral mesophyll formed by one to two layers of paliçadic parenchyma and prominent lacunal parenchyma, with secretory cavities dispersed in the mesophyll under the epidermis. The WTP waste water treatments and urban sprawl did not affect the leaf anatomy of the GG100 variety eucalyptus. However, the eucalyptus 3335 presented mesophilic expansion with the increase of wastewater concentrations from the overwhelming WTP and urban WTP. Thus, it is concluded that irrigation with wastewater of the eucalyptus GG100 and 3335 in the molting phase did not affect the anatomical characteristics of the plants after six years of cultivation.

Keywords: agriculture; plants; water reuse.

Financial support: Goiano Federal Institute of Education, Science and Technology, Universidade de Rio Verde, Coordination for the Improvement of Higher Education Personnel (CAPES).

(2923 - 3065) Andisol top-soil as support of a biopurification system to treat water contaminated with atrazine

Marcela Levío[1]; Felipe Gallardo[2]; Olga Rubilar[3]; Maria Cristina Díez[4]

Biotechnological Research Center Applied to the Environment (CIBAMA-BIOREN). University of La Frontera[1]; Biotechnological Research Center Applied to the Environment (CIBAMA-BIOREN) and Chemical Sciences and Natural Resources Department. University of La Frontera[2]; Biotechnological Research Center Applied to the Environment (CIBAMA-BIOREN) and Chemical Engineering Department. University of La Frontera[3]; Biotechnological Research Center Applied to the Environment (CIBAMA-BIOREN) and Chemical Engineering Department. University of La Frontera[4]

The pesticides use in the world for agricultural activities has generated the water contamination producing a decrease in water quality and reducing the use for human consume. In this sense, arise the importance and interest to find new technologies for the treatment of wastewater contaminated with this pollutants and the use of sustrates like andisol soil as support in the degradation and adsorption process. Therefore, the present work evaluated the operation of a packed bed reactor using an organic biomixture composed in volumetric proportion with Andisol soil to treat water contaminated with atrazine pesticide. The biomixture has a capacity of adsorb and degrade pesticides and was prepared mixing an Andisol topsoil (37% sand, 34% silt, 28% clay, 7% organic carbon, pH 5.4), commercial peat (36% organic carbon), and wheat straw (34% organic carbon) in a proportion of 1:1:2 by volume. The reactor was made of high quality glass material (15 cm x 8 cm) packed with the biomixture (ρ 0.35 g mL^{-1}).The stock solution was prepared with commercial atrazine (ATZ) at a concentration of 500 mg L^{-1} in water. This reactor was operated at different hydraulic loads (10, 30 and 50 mL per hour) and concentration of ATZ (5, 10 and 15 mg L^{-1}). Finally atrazine concentration and degradation products in the effluent were analysed by HPLC. Data obtained were evaluated through the surface response methodology (RSM). From the results obtained it was demonstrated that the most important factor in the process was pH. Because, to acidic pH (pH 4), atrazine removal was greater (>90%) without significant differences ($p < 0.05$) according to concentration and flow rate analysed. While, at alkaline pH (pH 8) atrazine removal was lowest (19.96%). The adsorption process is more significant at pH 4 than pH 6 and 8, with optimum result of 152.22 mg atrazine adsorbed per gram of biomixture under operation conditions: pH 4, 15 mg L^{-1} and 50 mL h^{-1}. Thus, packed bed reactor to atrazine removal is a viable alternative for wastewater treatment contaminated with atrazine and similar characteristics pesticides, since the removal can be increased considering optimum reaction conditions: pH 4.07, atrazine concentration of 7.18 mg L^{-1} and flow rate of 34.23 mL h^{-1}, which would be reflected in a 97.83 % atrazine removal.

Keywords: Andisol Topsoil, Packed bed reactor, Wastewater treatment, Pesticide atrazine

Financial support: CONICYT/FONDAP/15130015, FONDECYT 1161481 and DIUFRO DI16-2015 projects.

(7936 - 912) Arbuscular Mycorrhizal Fungi community in areas affected by iron ore tailings from the Mariana Disaster – MG

Thuany Cerqueira Jordão[1]; Paulo Prates Júnior[1]; Marliane de Cássia Soares da Silva[1]; Nayron Diogo Vilela[1]; Raphael Bragança Alves Fernandes[1]; Maria Catarina Megume Kasuya[1]

Universidade Federal de Viçosa[1]

The iron ore tailings released with the disruption of the Fundão Dam, owned by Mineradora Samarco, located in Mariana - MG, Brazil, in November 2015, reached 600 km from the Rio Doce Basin to its mouth and removed 1469 hectares of vegetation. This disaster changed the physico-chemical and biological characteristics of soils, difficulting the natural restoration of vegetation. Revegetation is considered essential for the recovery of degraded areas and micro-organisms such as arbuscular mycorrhizal fungi (AMF) can accelerate this process, provide innumerable benefits to plants such as increased nutrient uptake and abiotic stress tolerance. The objective of the present work was to evaluate the profile of AMF community and the physico-chemical characteristics of the areas affected by the iron ore tailings. Samples of soil/tailing were collected in the municipality of Paracatu de Baixo, a region affected by the disaster, in February 2017. Three areas were selected for sampling: natural forest of the region (UND);

two areas affected by the tailing, being one with natural recovery process (REC 1) and other with revegetation process (REC 2). The structure of AMF community was evaluated by extracting DNA from the soil and analyzed by PCR-DGGE. The dendrogram was constructed using Cosine Coefficient-Ward by the Bionumerics program. A Principal Component Analysis (PCA) was performed using DGGE results and soil physico-chemical characteristics. Diversity indices were calculated. The dendrogram showed that the areas were separated into three distinct groups, being that REC 2 present higher similarity with UND than REC1. There was no difference in the diversity indices between UND and REC 2, and REC 1 presented lower diversity index. The PCA showed that changes in the physical and chemical characteristics of the soil, caused by the disaster, altered the profile of the AMF community. Iron, copper, manganese and phosphorus presented effects on the AMF community structure in REC 1, while organic matter, litter and a cation exchange capacity influenced the AMF community structure in UND. We can conclude that the revegetation process adopted after the tailings dam rupture has been effective for reestablishing the structure of FMA community.
Keywords: AMF, Revegetation, Environmental Recovery, Samarco disaster.
Financial support: CNPq, CAPES, Fapemig.

(3394 - 1401) Assessment of nonylphenol monoethoxylates and nonylphenol bioavailability in soils treated with biosolids

Inés Ahumada, Loreto Ascar, Francia Pérez[1]

Universidad de Chile, Facultad de Ciencias Químicas y Farmacéutica.[1]

The addition of biosolids to soil is beneficial due enriching soil with essential nutrient elements, allowing the improvement of the physical features and productivity of agricultural and forest soils and the recovery of degraded soils. Biosolids also could contain trace elements, organic compounds that could be transfer these into terrestrial and aquatic environments, giving rise to possible accumulation in plants. Examples of these organic compounds are alkylphenols (APs), synthetic organic compounds that are not found naturally in the environment. These are used in the surfactant industry, paints and wetting agents in products for personal. The APs are considered endocrine disruptors, which simulates the action of steroidal hormones. In addition to entering the organism, they can generate reproductive problems, particularly found in animals of marine origin. The environmental risk of the alkylphenols contained in the biosolids depends on the concentration, persistence, lability, biotoxicity and capacity to incorporate these the trophic chain. The objective of this study was to evaluate the bioavailability of 4-nonylphenol mono-ethoxylate (NPE) and its degradation product 4-n-nonylphenol (NP) in three soils treated with biosolids. The bioavailable fraction of these two compounds was determined throuth bioassays using wheat plants, and this result was compared with a bioavalability predictive method using hydroxypropyl-β-cyclodextrin. Three agricultural soils (Codigua, Pomaire and Ostolazas) obtained from the Metropolitan Region of Chile were treated with unspiked and spiked biosolids at 10 mg kg^{-1} with NPE and NP, at rate 90 Mg ha^{-1}. NPEs and NP were determined in biosolids, soil and plants using a QuEChERS-based extraction procedure and gas chromatography coupled to mass spectrometry. Only the nonylphenol monothoxylate was found in a concentration of 25.7 ± 2.6 mg kg^{-1} in the biosolids. The bioavailable fraction of both compounds was obtained through a bioassay with wheat plants. The results showed that the NPE was found mainly concentrated in roots rather than shoots. The predictive capability of the hydroxyprolyl-β-cyclodextrin (HPCD) extraction was assessed using a simple linear correlation test, for NPE concentration in wheat plants. The study yielded a linear relationship, which demonstrated the validity of the chemical method as a biosimulation technique.
Keywords: alkylphenol, bioavailability, biosolids, endocrine disruptors
Financial support: Acknowledgments: The authors thank FONDECYT 1150502

(4119 - 2690) Assessment of trace element accumulation in soils with mining influence

Tapia-Sánchez, X.[1]; Bobadilla-Ballesteros, M.D.[1]; García-Calderón, N.E.[2]; Fuentes-Romero, E.[2]; Velázquez-Rosas, N.[3]
Licenciatura en Ciencias de la Tierra (Ciencias Ambientales) , Unidad Multidisciplinaria de Docencia e Investigación- Campus Juriquilla, Facultad de Ciencias, Universidad Nacional Autónoma de México[1]; Laboratorio de Conservación y Rehabilitación del Recurso Edáfico, Unidad Multidisciplinaria de Docencia e Investigación- Campus Juriquilla, Facultad de Ciencias, Universidad Nacional Autónoma de México Boulevard Juriquilla 3001, CP 76230, Querétaro, Qro.[2]; CITRO-Universidad Veracruzana, Xalapa, Veracruz, México.[3]

In México, mining activities are among the main sources of increasing trace metal concentration. The aim of this study was to assess the accumulation of trace elements in organic and mineral fractions from soil profiles with mining influence. This research was conducted inside the "Biosphere Reserve of Sierra Gorda, Guanajuato", in a toposequence covered by deciduous low forest and xerophytic scrub, close to a former mining area in Xichú, Gto. With a warm and semi-dry climate, mining tailings were deposited along the lower part of the steep slope, close to the Xichú riverbed. Samples were selected from profiles previously classified as Calcaric Protic Endoleptic Regosol in the upper part of the slope, in the middle part as Calcaric Endoleptic Cambisol and in the lower part as Epileptic Spolic Technosol. For total trace element (TTE) analysis soil samples were crushed and sieved though <53 µm. Total soil organic carbon (TOC) and dissolved organic carbon (DOC) were determined. Granulometric fractions were quantified by Bouyoucos and laser diffraction methods. TTE were extracted by 4H1a1 USDA, 2014 method. As, Cd, Cu and Pb were measured by ICP-OES Thermo Icap 6500 Duo View and Zn by AAS Perkin Elmer Analyst 3000. Data were analyzed by Spearman correlation (p>0.5) in statistica v11. The total trace elements showed the following concentration sequence Technosol>Cambisol>Regosol. From them in the surface horizons of the Regosol and Cambisol the sequence was Zn>Pb>As>Cu>Cd (243.13~2.93 mg kg^{-1}); meanwhile, in the Technosol was As>Zn>Pb>Cu>Cd (1791.69~19.98 mg kg^{-1}). In the Cambisol and Technosol subsurface horizons TTE were Zn>As>Pb>Cu>Cd (3730.52 ~4.37 mg kg^{-1}), and Regosol showed Zn>Pb>Cu>As>Cd (107.94 ~ 2.53 mg kg^{-1}) concentration. From them, Cd and TOC had a higher concentration on the soil surface. Data analysis showed strong correlation between silt, TOC and clay with As, Cd and Zn in the surface horizon of the Cambisol, also between the mineral fraction and the TTE assessment. In the Technosol a lower interrelation between clay and DOC with Pb and Zn was obtained; otherwise, in the subsurface Regosol horizon, Pb and Zn were related with clay. Higher TTE concentration in the soil could be associated with a high risk potential for As and Pb pollution according with the limits of NOM-147 country soil legislation. Assessment of the sink potential on these soils seems to be favoured by pedogenetic and soilscape processes through the toposequence.
Keywords: Pollution, Arsenic, soil organic carbon, clay
Financial support: Acknowledgements: To the MSc Carolina Muñoz-Torres of the Laboratory of Environmental Geochemistry of the Center of Geosciences, UNAM-Campus Juriquilla, for support in the handling of equipment and the determination of trace elements.

(6466 - 2040) Availability of Cr, Cu, Pb and Zn in soils under *Laguncularia racemosa* from a tropical estuary – Brazil

Djennyfer Karolaine de Melo Ferreira[1]; Caroline Miranda Biondi[1]; Paula Renata Muniz Araújo[1]; Arthur Felipe Valença Araújo[1]; Franklone Lima da Silva[1]; Fernando Bruno Vieira da Silva[1]

Universidade Federal Rural de Pernambuco[1]

The estuary of the Botafogo river, located in the north coast of the State of Pernambuco, Brazil, is a site of fishing activities and it contains the largest hydrographic basin fully inserted in the region. Previous studies have shown that there is contamination in the mangrove areas by heavy metals. However, investigations about the dynamic and potential availability of metals are necessary to base analysis of risk to the environment and human beings. The objectives of this study were to determine the total contents of chromium (Cr), copper (Cu), lead (Pb) and zinc (Zn) and to evaluate their availability to the environment. Based on previous data, three areas under *Laguncularia racemosa* vegetation in the Botafogo Estuary and one area without contamination were selected. In each area, there were four collected profiles of soil (0-50 cm). Analysis for organic matter (MOS), particular size distribution and total digestion (HNO_3, HF, $HCLO_4$ and HCl) were performed in samples of 0-4, 4-8, 8-12, 12-16, 16-20, 20-30, 30-40 and 40-50 cm. The potential of availability of metals in the environment was evaluated by sequential extraction of the soil from the area of high contamination. The average levels of Cr, Cu, Pb and Zn (0-50 cm) were found to be higher than the reference area and it was not found to be decreasing with the depth of the soil. The average variation within depth (0-50 cm) was 31%, 60%, 41% and 39% for Cr, Cu, Pb and Zn. Elevated variations of metals can be attributed to the variations in texture (32%) and MOS (32%) observed among the profiles, especially in the third area where the layer 40-50 cm is predominantly sandy (sand: 668 g kg^{-1}) and confirmed with the positive correlations between MOS, clay and metals ($p < 0.05$). From the sequential extraction (soil of second area), it was verified that Cr, Cu, Pb and Zn were mainly associated with the residual fraction (metals associated with silicates and organic matter). However, 27% of total Cu was associated with the pyrite fraction. In anoxic conditions, this fraction is stable. About 18% and 32% of Pb and Zn were associated with amorphous iron oxide and carbonate fractions. The Pb-carbonate association is stable near neutrality as found in the analyzed soil (pH: 6.57). The contents of Cr, Cu, Pb and Zn were found above the reference area, however, they are associated with stable fractions of soil, indicating the low potential of availability of these elements to the environment.

Keywords: Contamination; heavy metal; mangrove.
Financial support: CAPES, FACEPE.

(6439 - 2881) Availability of heavy metals and other elements in soils under influence of the Itataia uranium-phosphate deposit in Brazil

José Igor Almeida Castro[1]; Cleyton Saialy Medeiros Cunha[1]; Maria Eugênia Ortiz Escobar[1]
Federal University of Ceara[1]

Heavy metals and other potentially toxic elements in soils might pose risks to humans or ecosystems even in small concentrations. Although the knowledge of the total content of heavy metals in soil is important, there is still concern related to the available forms of these elements, which are able to be absorbed by the living beings and thus enter the trophic chain. The objective of this work was to evaluate the levels of heavy metals and other elements available in soils under influence of the uranium-phosphate deposit of Itataia, considered the largest uranium reservoir in South America. Simple deformed soil samples were collected at 53 points in the 0-20 cm layer, and the available levels of Al, B, Cd, Co, Cu, Fe, Hg, Mn, Mo, Ni, Pb, Ti, Zn e Zr were extracted (Mehlich 1) and determined using inductively coupled plasma-atomic emission spectrometry (ICP-AES 6300 DUO).Were found available levels of Cd, Hg, Ni, and Pb in all samples, and no values of Cu, Ti or Zr were detected. Available B and Co was detected in more than 80% of samples, and for Mo, Al, Zn, Mn and Fe in less than 60% of the samples. The results showed many extreme values and asymmetric distribution for most of the data and no normality was observed after the Kolmogorov-Smirnov test. Pb was the element that presented the highest levels in the area, with a median of 16.35 µg kg^{-1}. Al although detected in only 40% of samples, was the element that showed the highest extreme value, 431.92 µg kg^{-1}. The available heavy metal contents showed the following decreasing order: Pb> Ni> B> Hg> Co> Mo> Cd> Al> Zn> Mn> Fe> Cu, Ti, Zr. The available content was compared with the total content of these elements in the soil. In this way, Lead was the element that presented the largest amount available in relation to its total content (approximately 25%), then Cd> B> Mo> Ni> Zn> Co> Mn> Al> Fe. The low availability of the metals in the area can be due to pH (7.43) and soil organic carbon (26.56 g kg^{-1}). The present study indicated that due to the low levels of heavy metals and other elements of soils from the Itataia deposit, there is no risks of pollution to the local environment.

Keywords: Soil pollution. Heavy metals availability. Mining.
Financial support: The National Council for Scientific and Technological Development (CNPq), Coordination for the Improvement of Higher Level Education (CAPES)

(5879 - 831) Biochar from biosolids microwaved-pyrolysis: Characteristics and potential for use as growing media amendment

Bhawana Bhatta Kaudal[1]; Cristina Aponte[1]; Graham Brodie[1]
University of Melbourne[1]

Biochar, produced from biosolids using microwave pyrolysis technology, is energetically a more efficient alternative to that produced with conventional convective heating. However the potential of microwave generated biochar as a growing media amendment has not been sufficiently explored. Here we produced biochar from biosolids using microwave energy. The pyrolysis experiments were conducted in two stages, initially using a custom built single mode chamber to explore the energetics and product distribution of the pyrolysis process at different temperatures and secondly in a 1 m3 6 kW multi-mode chamber, to explore potential scale-up of the process. The second phase of the pyrolysis experiments was focused on biochar generation for use in the remainder of this research. Microwave pyrolyzed biochar (MB) was characterised for its chemical and physical properties. Then, we conducted a greenhouse experiment, where we compared the ability of four growing media mixes that combined pine bark with (i) sphagnum peat and fertilizers; (ii) 20% MB and fertilizers; (iii) 60% MB and fertilizers; and (iv) 60% MB and no fertilizers, to promote plant growth and nutrient uptake and to minimise leaching losses. MB had high mesoporosity (average pore width of 4.46 nm), moderate surface area (75 m2 g−1), elevated nutrient content and low heavy metal concentrations as compared to other biosolids biochars reported in literatures. Substitution of peat with 60% MB on volume basis reduced leaching loss of nitrate and phosphate from the media but increased leaching loss of ammonium. Addition of MB in conjunction with fertilizer increased plant growth and plant nitrogen and phosphorus use efficiency. Our study has shown microwave pyrolysis as a promising technology for pyrolyzing biosolids and also has demonstrated the synergistic interaction of MB and fertilizer which results in greater plant growth and nutrient uptake and use efficiency.

Keywords: Microwave pyrolysis Characterization Biosoilids Energy Plant growth
Financial support:

(9218 - 2053) Biogas and biofertilizer production from dairy cattle manure under organic and conventional production systems in Seropedica, Rio de Janeiro (Brazil)

Camila F. Matos[1]; Érika Flávia Machado Pinheiro[1]; David Villas Boas de Campos[2]
Federal Rural University of Rio de Janeiro (UFRRJ)[1]; Embrapa Solos[2]

The production of milk in Brazil stands out as one of the main agricultural activities. The quality and efficiency standards in the milk production have been required in recent years with the objective of intensify even more the production system. As a consequence, there is an increase in the amount of residues generated during the milk productive chain which can lead to a contamination of the soil, the water and the air. The goal of this study was to evaluate the production of biogas potential and biofertilizer resulting from the anaerobic biodigestion of dairy cattle manure under organic and conventional production system. The experiment was built eight prototypes of benchtop biodigesters, being the supply system discontinuous. The treatments evaluated were: a) CMOS - cattle manure under organic production system, from Agroecological km 47 Farm; b) CMCS - cattle manure under a conventional production system, from the dairy cattle sector of the Agricultural Research Company of the State of Rio de Janeiro. Analyzes were performed based on the methodology described by APHA (2005), United States Environmental Protection Agency and CONAMA 357/06. After the anaerobic biodigestion process it was observed that the concentrations of thermotolerant coliforms were below than the limit established by law. The cumulative biogas production was 6.18 L and 11.15 L, when using the CMOS and CMCS, respectively. DBSO and DBSC biofertilizers presented a carbon content (392.4 and 411.9 g kg^{-1}) to be considered an organic fertilizer. Magnesium, potassium and iron contents were higher in DBSO biofertilizer but calcium, manganese, copper, zinc and barium contents were higher in DBSC. DBSC biofertilizer had cadmium content above that allowed by organic fertilizers law. The organic and conventional management production of milk influenced the production of biogas. CMCS presented a higher accumulated biogas production with higher energy potential when compared to CMOS. The management adopted can have influenced the production of biogas through the feed supplied to the animal, demonstrating that in the conventional management a feed based on concentrate, roughage and commercial feed contributed in a more significant way for biogas production in relation to the one where the animals fed only from a roughage-based feed produced on organic property. On the other hand, dairy cattle manure from CMOS showed greater potential to be used as organic fertilizer when compared to the CMCS.

Keywords: Soil pollution, anaerobic biodigestion, biodigester, agricultural waste.
Financial support: Federal Rural University of Rio de Janeiro (UFRRJ) and Paraíba do Sul River Basin Agency (AGEVAP).

(3037 - 2241) Building of probe-type passive sampler to study the contents of heavy metals in the aqueous phase

Viviana Garces Villegas[1]; Manuel Palencia[1]; Tulio Lerma[2]
Universidad del Valle[1]; Mindtech Research Group[2]

"Dissolved" concentrations of contaminants in the soil provide a more relevant description for risk assessment than the total concentrations. But also, the perturbation of the soil during sampling process must be highly minimized in order to obtain the best results regarding the real field conditions. In this context, passive sampling methods for estimating "Dissolved" concentrations offer the potential for cost-efficient and accurate in situ characterization of pollutants in the soils, exactly, the aqueous phase. In this work, the building of probe-type passive sampler to study the contents of heavy metals in the aqueous phase of soils was developed. For that, clay (montmorillonite) was immobilized on the poly(vinyl chloride) surface by thermal methods. Next, surface functionalization or chemical activation was performed by chemical insertion of vinyl units easily polymerizable by free-radical polymerization. Later, poly(sodium vinyl estearate) chains were inserted using ammonium persulphate as radical initiator and deionised water as reaction phase. Different chain lengths were promoted by the modification of initiator amounts. In all cases, materials were characterized by infrared, scanning electron microscopy, thermogravimetric analysis and contact angle measurements. Retention properties were evaluated as a function of pH and ionic strength using Pb^{+2}, Hg^{+2} and As^{+2} as target ions. Aqueous extract of soil samples were used to identify the effect of composition on retention properties. Results demonstrate that probe-type passive samplers can be made by described methodology; in addition, retention of ions was identified to decrease as pH is decreased and affected by metal speciation as pH is increased.

Keywords: humic acid, fulvic acid, hydrogen bonds
Financial support:

(6371 - 1158) Cadmium buffer capacity in Chilean soils with different reactivity

Belen Henriquez Caurapan[1]; Laura Navarro Vigueras[2]; Susana Valle Toledo[3]; Dante Pinochet Tejos[3]; Mauricio Pereira Carvajal[1]
Escuela de Graduados, Instituto de Ingeniería Agraria y Suelos, Facultad de Ciencias Agrarias, Universidad Austral de Chile[1]; Instituto de Ingeniería Agraria y Suelos, Facultad de Ciencias Agrarias, Universidad Austral de Chile[2]; Instituto de Ingeniería Agraria y Suelos, CISVo, Facultad de Ciencias Agrarias, Universidad Austral de Chile[3]

The cadmium availability for plants is related with their mobility, transport and distribution of the metal in the soil. This availability is determined by the soil buffer capacity, which depends on their reactivity. Cd dynamics is described by sorption and desorption processes which depend of the chemical form of the metal and the soil intrinsic characteristics. This study aimed to assess the variation of the Cd buffer capacity (CP) among different agricultural soils. Three types of soils (Ultisol, Andisol and Alfisol) which present differences in their reactivity were characterized. Each soil was enriched with 5 different amounts of CdCl (0, 10, 50, 80, 120 mg kg^{-1} Cd; estimated in function the Cd input to the soil related to the use of fertilizers and agricultural residues) and incubated during 17 days (at 25°C and 50% humidity). The available Cd was determined at days 1, 9 and 17 during the incubation. The available Cd was extracted by EDTA (0.05 M), pH 7.0, at soil:solution ratio of 1: 2, $MgCl_2$ (1M), pH 7.0, 1: 2; and, $CaCl_2$ (0.01). M) 1: 2. Differences in the Cd buffer capacity of the studied soils were observed, with Andisol (CP = 0.4) < Alfisol (CP = 7.2) < Ultisol (CP = 50). These results suggest that the soil reactivity is an important factor in the fraction of Cd available for plants. However, the amount of Cd extracted was different between the three methods evaluated. However there are certain equivalences between them, e.g., $CaCl_2$ extracts 50% less of Cd comparing with EDTA and $MgCl_2$, where the two last extractantes showed differences of 2-10% in the available Cd extracted from the three soils. There was no significant effect of the times considered in this study on Cd buffer capacity evaluated.

Keywords: Cadmium buffer capacity, soil reactivity, sorption-desorption, Soils of Chile
Financial support: Instituto Ingeniería Agraria y Suelos

(5559 - 2807) Cerium content in roots of arabica coffee cultivated in soil amended with phosphogypsum

Pedro Renato leandro de Souza[1]; Luís Paulo Patente Tanure[1]; Joésio Leandro de Souza[1]; Jaime Wilson Vargas de Mello[1]; Carlos Roberto Bellato[1]
Universidade Federal de Viçosa - UFV[1]

Phosphogypsum is used in coffee plantations to favor the deepening of the plants roots. However, in addition to the nutrients, the phosphogypsum present low amounts of rare earth elements (REE), like cerium (Ce), which is generally found in higher concentration. There are scientific evidences of diseases pulmonary, neurological, and even cancer in animals due to chronic exposure to high

concentrations of Ce. Therefore, absorption of Ce by coffee plants, from soils amended with phosphogypsum, increases the risk of human exposure to this element. In this context, this research aimed to evaluate the accumulation of Ce in roots of arabica coffee (*Coffea arabica* L.) due to high doses of phosphogypsum applied to soil, under field conditions. The study area was a commercial plantation of arabica coffee in Minas Gerais State, Brazil. Five doses, 0 (control), 9, 16, 24 and 48 t ha^{-1} were considered in a randomized block design, with four replications. The roots were collected from 0 to 60 cm deep, in trenches at 20 cm from the stem of the plants. After collection, the roots were washed, oven dried (65 ° C) and ground in a Willey mill. Samples of roots (1 g) were then submitted to nitric-perchloric digestion. Cerium concentrations in the extracts were determined by inductively coupled plasma mass spectrometry (ICP-MS). The results indicate a significant increase in Ce content in the roots of the coffee plants due to application of high doses of phosphogypsum. Nevertheless, the rate of recovery of Ce by the roots of coffee under field conditions was low.

Keywords: Soil conditioner, mineral nutrition, contamination, *Coffea arabica* L.
Financial support: CAPES, CNPq, FAPEMIG.

(1297 - 2517) Contents of Pb, Cu and Zn in soils cultivated with parsley the in municipality of Nova Friburgo, state of Rio de Janeiro - Brazil

Júlio César Ribeiro[1]; Uliana Ribeiro Silva[2]; Nelson Moura Brasil do Amaral Sobrinho[3]; Everaldo Zonta[3]
Federal Rural University of Rio de Janeiro, Postgraduate Program in Agronomy - Soil Science.[1]; Federal Rural University of Rio de Janeiro, Agronomy student.[2]; Federal Rural University of Rio de Janeiro, teacher of the Department of Soils.[3]

The mountain region of Rio de Janeiro - Brazil leads the production of vegetables in the state, and the municipality of Nova Friburgo is one of the main pole producing of parsley of agriculture of Rio de Janeiro that supplies the metropolitan region of the same state. However, the production process has been sustained by the high contribution of agrochemicals in order to meet the nutritional requirements of the plants, in addition to pest and disease prevention and control. In view of the above, the present study aimed to determine by means of the 3050B method (USEPA, 1996), the pseudototais Pb, Cu and Zn contents of the soil cultivated with parsley at the depth of 20-40 cm of 10 family farms in the municipality of Nova Friburgo, RJ, Brazil. The results compared to the guideline values recommended by the National Council for the Environment - CONAMA (2009). The soil Pb ranged from 10,19 mg.kg-¹ to 42,07 mg.kg-¹, with an average content of 25,64 mg.kg-¹. Cu ranged from 14,62 mg.kg-¹ to 63,11 mg.kg-¹ among the properties, with a mean content of 32,22 mg.kg-¹. The Zn content ranged from 29,06 mg.kg-1 to 105,56 mg.kg-1, with an average content of 57,02 mg.kg-1 of the evaluated properties. For the pseudo-values of Pb and Zn determined in soil samples cultured with parsley, it was verified that 100% of the properties presented values below the Prevention Value (PV) recommended by CONAMA (2009). Only for Cu; 10% of the properties evaluated presented value above that recommended by CONAMA (2009). The levels of Pb, Cu and Zn in the majority of evaluated properties are below the values of prevention recommended by the current legislation established by CONAMA. However, soil monitoring should be periodic, since the agrochemicals supply in the study region is very high and may lead to future contamination.

Keywords: heavy metal; ground contamination; *Petrosolium sativum*.
Financial support: Postgraduate Program in Agronomy and Soil Science - PPGA-CS - Federal Rural University of Rio de Janeiro - UFRRJ; Coordination of Improvement of Higher Level Personnel - CAPES; Foundation for Research Support of the State of Rio de Janeiro - FAPERJ.

(2129 - 2566) Depth distribution of Glyphosate and AMPA, "pseudo-persistent" pollutants, in long-term experiments under no-till and conventional tillage

Virginia Carolina Aparicio[1]; Jose Luis Costa[2]; Eduardo De Geronimo[1]
INTA, EEA Balcarce, CONICET[1]; INTA, EEA Balcarce[2]

Glyphosate (N-(phosphonomethyl glycine) is a post-emergence, non-selective, foliar herbicide. More than 200 million liters of this herbicide are applied every year in Argentina, where the main agricultural practice is no-till (NT), accounting for 78 % of the cultivated land. In this work, we studied the distribution of glyphosate in long-term experiments (more than 15 years) at different locations under NT and conventional tillage (CT). Samples from 0-2, 2-5, 5-10, 10-15, and 15-20 cm depth were taken with four replication and two treatments NT and CT at 6 locations: Balcarce (BA) a loam soil, Bordenave (BO) a sandy loam soil, Marcos Juarez a silty loam soil (MJ), Parana Vertisol a clay soil, Paraná Mollisol a clay loam soil y Pergamino a silty loam soil. No difference between tillage practices was found regarding glyphosate concentration, significant differences were observed among locations and depth and interactions between depth and locations. Nevertheless, the concentration of AMPA at 0-2 cm depth was 1.6 times higher in no-till than in conventional till. To our knowledge, this study is the first dealing with the accumulation of glyphosate and AMPA in soils under different tillage systems. In the present study, it was demonstrated that glyphosate and AMPA are present in soils under agricultural activity with maximum concentration in the first two cm of soil and the AMPA concentration at this depth is greater in NT than in CT.

Keywords: Keywords: Glyphosate, AMPA, soil pollutants, no-till.
Financial support: Financial Support: INTA, Project Number.12134044.

(3034 - 966) Determination of Carbon in São Paulo state soil sample by Near Infrared Spectroscopy

Catarina Celeste Duque[1]; Aline Reneé Coscione[2]; Felipe Bachion de Santana[3]
Agronomic institute[1]; Agronomic Insitute[2]; University of Campinas[3]

Soil organic matter (SOM) is an important component in soils because it contributes to the improvement of water retention capacity, decreases soil density and is a source of carbon and nitrogen for soil microorganisms. The quantification of MOS is done, indirectly, with the determination of organic carbon form or total carbon. Among the conventional methods of carbon analysis are the Mebius method, using visible or titrated spectrophotometry (Walkley-Black method adaptation) or the Elementar Analyzer (CN). The Near Infrared Spectroscopy (NIRS) has been used in soil analysis as a quick, non-destructive practice that does not require expensive reagents or inputs, which contributes to the elimination of waste generation and waste of natural resources. In the present work, the soil carbon was determinated with the use of the NIRS together with the multivariate calibration with the partial least squares (PLS) regression modeling was performed. A total of 106 soil semples from the State of São Paulo were used, components of the MOS calibration curve of the Laboratoty of Chemical Analyzes of the Soil for Fertility Purposes of the Agronomic Institute (IAC) currently in use, macerated to pass through a 100 mesh sieve. Models were constructed and compared using the values obtained by titration with Mebius or with the CN. To obtain the spectra the ground samples were oven dried at 65ºC (±5º) and spectra were collected in the total wave lenght of the spectrometer, being 400 to 2500 nanometers (nm). The models were evaluated using the quadratic mean calabration and prediction errors (% RMSEC and RMSEP) and correlation analysis between the values of rganic carbon predicted by the model and the respective reference value (Mebius or CN). For the model with Mebius the RMSEC was 5.3%

and the RMSEP was 11.3%, respectively, while for the CN were 3.1% and 6,5%. Both models presented a coefficient of correlation superior to 0,95. Tho model based on the elemental analyser is slightly superior to that with Mebius. This can be attributed because of the greater accuracy of the analysis of the CN method in relation to the Mebius. Even though, the NIRS can be indicated to routine procedure to SOM quantification in soil samples.

Keywords: carbon, NIR spectrosocpy, chemometrics
Financial support: CAPES Foundation

(8530 - 2465) Determination of tetracyclines by electrochemical methods, to its application in the adsorption on the clay fraction of volcanic soils

Constanza Venegas[1]; Mónica Antilén[1]; María Angélica del Valle[1]
Pontificia Universidad Católica de Chile[1]

The tetracycline family is formed by Tetracycline (TC), Chlortetracycline (CTC), Doxicycline (DX) and Oxitetracycline (OTC). These antibiotics are used in the livestock industry as growth agents, but especially for treating infections. However, between 25 and 70 % is excreted by the animal through its urine or feces in their active way, reaching the soils and the groundwater. The inorganic fraction of the soil presents interactions with the antibiotics, because it is the most reactive part of soil, since it confers charge and is the responsible of the cationic exchange capacity (CEC). In this work, a new analytical method based on electrochemical methods has been developed, with the aim to determinate the tetracycline family in an aqueous system, considering its applicability in the evaluation of adsorption/desorption of these antibiotics on the clay fraction of volcanic soils (Andisol, Osorno series). The chemical-physical properties, pH and electric conductivity have been measured according recommended methods for Chilean soils and, the variable charge, by electrophoretic migration. Recently, some electroanalytical techniques have been used for Tetracycline determination, since different soils fractions do not act as interferences in the measurements. The electrochemical measurements were carried out by cyclic voltammetry, at 100 $mV \cdot s^{-1}$, in a certain window of potential and by using 0.1 mol L^{-1} KNO_3 as supporting electrolyte. The results show that the clay fraction coming from an Andisol soil does not have an electrochemical response, so it does not interfere in the antibiotics determination. Then, in the analytical method developed, it is observed an oxidation peak current that it is dependent of the analyte concentration which allows to evaluate the adsorption/desorption of these antibiotics in the clay fraction by the analysis of a calibration curve.

Keywords: Clay fraction, Adsorption, Tetracycline, Cyclic voltammetry
Financial support: Fondecyt 1141158, Facultad de Química UC and CONICYT PIA/ACM170002

(7067 - 367) Digital mapping of the natural contents of heavy metals in soils of the Serrana Region of the State of Rio de Janeiro

Leonardo Durval Duarte Guimarães[1]; Nelson Moura Brasil do Amaral Sobrinho[1]; Helena Saraiva Koenow Pinheiro[1]; Erica Souto Abreu Lima[1]
UFRRJ[1]

The study was developed in a hillslope area from Rio de Janeiro (Região Serrana). The area comprises a great agricultural center, embracing family farmers and producers of vegetables for supplying the Metropolitan Region of the State. The actual knowledge about soil heavy metals contents is based on natural contents (reference values to natural occurrence on the environment). Which are commonly used to study the impacts of the anthropic activities on the environment, as well regarding the soil contamination and pollution. The objective was to analyze the spatial distribution of heavy metals natural contents at two depths (0-0.2 m and 0.2-0.4 m) by using geostatistical analysis comparing the performance of two softwares. A dataset with sixty-one representative pointswere collected, at both depths, in sites with none or low anthropogenic activity.. From those soil samples were obtained data regarding soil fertility and soil geochemical fractionation to determine the metal contents (Fe, Mn, Zn, Cr, Al, Co, Cu, Ni, Cd and Pb). The geostatistical analysis (normal kriging) were performed in GeoEst and R software. The final maps of natural contents for both depths were created with support of ArcGIS Desktop v.10.4. The modelling evaluation was based on cross-validation through the statistical indexes Root Mean Square Error (RMSE), Mean Bias Error (MBE), coefficient of determination (r^2), and the Pearson correlation coefficient (r) were also calculated. Results showed no difference between softwares suggesting that regardless of the choice of software the final product are statistically equal. Based on the relative semivariogram the concentrations of metals (Fe, Mn, Zn, Al, Co, Cu, Ni and Pb) showed spatial dependence for a range of 35.0 km. Isotropy was observed for all metals under study. The theoretical spherical, exponential and Gaussian models were those that represented the best adjustments to the points of the experimental semivariograms, agreeing with the literature consulted. The analysis of spatial distribution of the natural contents based on the maps for both depths reveals a remarkable influence of lithology, soil type and relief on the contents of the studied metals, to the studied area.

Keywords: Heavy metals, soil mapping, geostatistics.
Financial support: FAPEMAT e FAPERJ.

(4009 - 710) Effect of anthropization in the water table level change of mountain tropical peatlands

Uidemar Morais Barral[1]; Alexandre Christofaro Silva[1]; Christiano Christofaro Matosinhos[1]; Camila Rodrigues Costa[1]; Aparecido de Penafort Abreu Filho[1]; Geisla Mendes Macedo[1]
UFVJM[1]

Peatlands are ecosystems formed by the accumulation of plant tissues, which are slowly decomposed due to anaerobic conditions. Its importance is related to your environmental services: carbon and water storage and palaeoenvironmental reconstitution. In Brazil, peatlands occupy an estimated area of ~5554,730 km^2, which corresponds to 0.6% of the national territory. In the northern portion of the Serra do Espinhaço Meridional, Minas Gerais State, they occupy 142 km^2 corresponding to 1.2% of the total area. Fluctuations of water table are crucial for the maintenance of the tropical peatlands, since they control the dynamics of the accumulation and decomposition of the organic matter. The aim of this study was to evaluate the change of the water table levels in two montain tropical peatlands. The peatlands are located at the head of the Araçuaí river, main tributary of the Jequitinhonha river. These are the only two perennial water courses in the semi-arid region of the northeast of Minas Gerais State. The peatland 1 (P1; 23 K 067719 S 7982972 W), with 3.6 ha, is protected by the Rio Preto State Park. The peatland 2 (P2; 23 K 0678749 S 7982411 W), with 11.2 ha, is used by extensive livestock and burnings are frequent. Four and three piezometers were installed with level meters, model U20L-01 with 1 cm precision, respectively in P1 and P2. In P1, the measurements were carried out from September 26, 2016 to November 16, 2017. For the P2, the measurements were carried out from October 23, 2016 to November 16, 2017, interval between measurements of 30 minutes. The results show that the water level of the two peatlands suffers the highest positive changes from November to May. Negative changes occur mainly from June to October. For P1 (protected), the maximum elevation and lowering of the surface water table level were respectively 37.2 and 4.7 cm, regarding to the reference level in the piezometer located near the outlet of the microbasin. For P2 (anthropized), the maximum elevation and lowering of the water

table levelwere 22.4 and 19.1 cm, respectively, regarding to the reference level, in the piezometer located near the outlet of the microbasin. Anthropization is reducing severely the water retention capacity of the P2.
Keywords: spring of the Araçuaí river, water retention, organosols.
Financial support: Fapemig (CAG PPM 00568-16 and CAG APQ 01614-14), CNPq and CAPES.

(3495 - 1944) Effects of electrochemical changes on barium content in flooded soil

Douglas Gomes Viana[1]; Amanda Duim Ferreira[1]; Fábio Ribeiro Pires[1]; Fernando Barboza Egreja Filho[2]; Kerwin Araújo Costa[1]; João Carlos Madalão[1]; Paulo Roberto da Rocha Junior[3]; Robson Bonomo[1]
Universidade Federal do Espírito Santo[1]; Universidade Federal de Minas Gerais[2]; Fazenda da Toca[3]

Barium is a toxic metal and the main anthropogenic input form this element into ecosystems is the contamination by oil drilling fluids. This fluids contains barium sulphate, which is low in toxicity due to its low solubility, being relatively immobilized in the soil and biologically unavailable. However, under poor drainage conditions, the sulfate and sulfide residues may release the most toxic form of barium (Ba^{2+}) into the environment, potentially contaminating water courses and introducing barium into the trophic chain. We aimed with this study to evaluate how the changes eletrochemical of soil along 180 days altered the bioavailability of barium in the soil. The experiment was conducted in a randomized complete block design in a greenhouse located at the Experimental Farm of the Federal University of Espírito Santo - Campus São Mateus, evaluating the pH, Eh and content of barium in two layers of the soil (0 to 0.1 m and 0.1 to 0.2 m). The evaluations were carried out in seven times,at 60, 75, 90, 105, 120, 150 and 180 days. The data obtained were submitted to correlation analysis between the parameters pH, Eh and soil barium content. In both soil layers the correlation between pH and Eh was negative, that is, the reduction in Eh was followed by increase in pH. This increase in pH is typical of soils subject to flooding due to consumption of protons, and as a result, a change in pH is expected. The barium content in the soil was variable in the two soil layers. In the depth of 0.0 to 0.1 m was observed high and negative correlation, but not significant, between pH and barium content in the soil. The correlation between barium content and Eh was high and positive, but also not significant. In the 0.1 to 0.2 m layer, the Eh correlated with the barium content in a negative, high and significant way, as expected, since it is known that in low values of Eh the reduction of sulfate in sulfide by bacteria in the soil can occur, leading to the availability of barium to the water courses and the entire trophic chain. The barium content in soil remained constant throughout the period of conduction of the experiment, with non-significant variations. Therefore, we can conclude that in the saturated soil condition, the barium mobility can be increase due the change in the Eh, independent of pH values.
Keywords: Soil pollution, baritine, oxi-reduction
Financial support: CAPES

(8482 - 2741) Effects of sewage sludge application in a soil with high natural contents of Cd, Zn, and Pb

Rafaella Campos[1]; Maurício Paulo Ferreira Fontes[1]
Universidade Federal de Viçosa[1]

The use of organic wastes as amendments in soils contaminated with heavy metals is a sustainable alternative to reuse these materials. However, depending on their properties, they may increase the heavy metal bioavailability. Knowing that different organic wastes acting in different ways on the heavy metal bioavailability, this study aimed to evaluate the bioavailability of heavy metals after the application of sewage sludge (SS) in a soil with naturally high contents of Cd, Pb, and Zn. A greenhouse experiment was carried out with six doses (0.0; 1.0; 2.5; 5.0; 7.5; and 10 % w/w) of SS, with three replicates. To evaluate the bioavailability, the *Canavalia ensiformes* L. (pork bean) was used. The metals concentration present in the soil solution was monitored by rhizon (soil solution samplers). At the end of the experiment, the heavy metals content in the above-ground portion of the plants and dry biomass was determined and a sequential extraction was carried out in the soil samples. The sequential extractions results pointed out that SS significantly increased the availability of Cd, Pb, and Zn and the increases were proportional to the dose used. The dose of 10% increased in four-fold the soluble Cd; five-fold the soluble Zn; and 19% the exchangeable Pb. These results were ratified by the heavy metals contents found in the soil solution collected by the rhizons. As consequence, there was an increase of Cd in above-ground portion of the plants equal to 107, 245, 250, 335 and 276% for the doses of 1.0; 2.5; 5.0; 7.5, and 10%, respectively. The magnitude of these increases for Zn was 48, 76, 128, 106, and 70%. The increase of metals in the plant tissue was accompanied by the reduction of dry mass produced, which reached 85% of reduction for the dose of 10%. These results may be a consequence of the pH reduction promoted by SS application and of the high content of soluble carbon presents in the SS, which may be promoted the availability increase of the heavy metals. These results permit us to state that the sewage sludge was not a suitable amendment to reduce the bioavailability of Cd, Pb, and Zn in the studied soil.
Keywords: organic wastes, heavy metals, amendment, immobilization
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(9804 - 2669) Emissions and releases from primary mercury mining activities into terrestrial systems of the Sierra Gorda, Querétaro, México

G. Hernández-Silva[1]; S. Martínez-Trinidad[2]; N. García-Calderón[3]; S. Solís-Valdez[1]; P. Scharek[4]; C. Centery[5]; L. F. Vassallo[1]
UNAM, Centro de Geociencias[1]; UNAM, Instituto de Geografía[2]; UNAM, UMDI-J, Qro.[3]; MAFI, Hungary[4]; Szent Iztvan University, Hungary[5]

The cinnabar (HgS) mining exploitation for over two thousand years in the mineralized zone of Sierra Gorda, Querétaro, México, has affected the terrestrial systems (soil, water, air and biota) and the human health. The extensive use of Hg in the last and present centuries has increased its potential risk for exposure in ancient and present inhabitants and in the environment as well. The study area occupies 175 km^2 in the San Joaquin municipality; and the region is composed of several Mesozoic marine formations. Our goal is to contribute with the Minamata Convention to protect the human health and environment from anthropogenic emissions and releases of mercury. 103 soil and sediment samples, were analyzed by AMA 254; 19 maize plant structures was determined by ICP-OES. Hg° in vapor phase was measured in two sampling sites (TEKRAN 2537A). Two rainwater collectors were used to analyze 24 samples (ICP-OES). Soil carbon sequestration was determined in 38 soil samples. To construct maps the ArcView 8.1 was used. An approach of flow of total Hg interactions within the terrestrial systems and some landscape ecology characteristics are presented. Three groups of mining tailings showed the highest Hg with a maximum of 4164 mg/kg. 46 % of agricultural soils sampled are above the permitted limit by NOM-2004; 17 % of total Hg in grain maize sampled, is higher than values allowed by WHO-2004. Hg in rainwater ranged from 1 to 339µg l^{-1}, too high compared to a pristine areas of 1-2 µgl^{-1}. Levels of Hg found in air showed an extremely high content, from 5.3 to 415.8 µg/ m^3 (<1 µ/m^3 by WHO-2002). Most of the area with a medium level is shown in the

soil carbon sequestration map. Due to continuous volatilization of Hg-enriched soils and HgS tailings, the inhabitants of the region keep a constant direct contact with Hgº through inhalation. On the other hand, Hg in agricultural soils and maize grains is a continue risk into the food chain. Therefore, a constant monitoring of Hg emissions are necessary in a long term, to determine the scope of the environment and health Hg problems.

Keywords: Mercury, terrestrial systems, environment and health, Sierra Gorda, México

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(5921 - 3228) Engineering Trees into Site Remediation: Case Studies of Using Eucalyptus in Brazil

Lawrence Morris[1]; Diego Barcellos[1]; Aaron Thompson[1]; Daniel Moura[1]; Tiago Moura[1]; William Hall[1]; William Odle[1]; Aristides Ribeiro[1]; Bruno Furtado[1]; Nairam Barros[1]

University of Georgia[1]

Contamination of soils and groundwater by organic compoundsare common problems at industrial sites worldwide. Phytoremediation with tree planting can be part of a successful remediation strategy for contaminated sites. We demonstrate this using examples from Brazil. The first example is an industrial site near Porto Alegre, RS. Soil and groundwater of this site were contaminated bychlorobenzene and benzene. Primary remediation of this site consisted of both excavation and injection of sodium persulfate for in-situ chemical oxidation. To further treat contaminants after in-situ oxidation, Eucalyptu surograndis were planted. We first demonstrated the potential of Eucalyptus to accelerate removal of these compounds in a greenhouse study. A solution of chlorobenzene and benzene at concentrations of 50 mg.L-1 each was added to large columns planted with Eucalyptus or maintained as a no plant control. In the absence of Eucalyptus, contaminant mass in leachate decreased 50-60%. In the planted Eucalyptus treatment, contaminant mass in leachate decreased 91-98%. At the end of the experiment, ~1% of the added contaminant remained in plant components or the substrate. In the field site, Eucalyptus seedlings were planted in bored holes downgradient from the sodium persulfate injection zone. They grewup to 10 m height in 3-4 years. We were unable to directly measure the contribution of phytoremediation to overall remediation; however, we estimated the 200 m2 Eucalyptus plantation had the potential to remove 4.53 kg.year-1 of chlorobenzene and 0.93 kg.year-1 of benzene. A second example is for a site contaminated with Aldrin and Dieldrin near Paulína, SP. On this site, the primary remediation was designed to control groundwater movement to a nearby river. A network of wells was installed as part the primary pump-and-treat remediation approach. To investigate the potential to augment this approach with Eucalyptus plantings, we instrumented mature Eucalypts and native forest trees with stem-flow collars and monitored soil water with TDR to 2.3 m depth. Due to the shallow depth to the water table, transpirational patterns of vegetation had a significant impact on potentiometric surfaces and groundwater movement. Field measurement and modeling showed that a zone of mature Eucalyptus could play a significant role in reducing the potential movement of contaminants to the river and remediating contaminated soils.

Keywords: bioremediation; phytoremediation; contamination

Financial support:

(5331 - 2461) Estimate of the sorption atrazine (ATZ) in horizontal samples of a red-yellow latosol

Alba Rocio Aguilar Piratoba[1]; Antônio Alberto Da Silva[1]; Claudio Ferreira Lima[1]; Gustavo Antônio Mendes Pereira[1]; Natalia Milena Escobar Marulanda[1]; Marcos Santana Miranda Júnior[1]

Universidade Federal De Viçosa[1]

Agronomic efficiency and environmental risk of herbicides applied directly to the surface of the soil depends on its ability to be dripped by soil colloids. This capacity depends on the attributes of the soil which vary according to the type and management used for planting the crops. Knowledge of the dynamics of a herbicide in the soil becomes, still, more important for the pesticides that have history of groundwater contamination, as is the case of ATZ. In this research was estimated, by biological method, the sorption of the ATZ in samples of a red-yellow latosol collected in the Horizons A, B, C, mixtures AB and ABC; beside to an inert substrate (sand). Physicochemicals characteristics of the soil samples evaluated concerning horizons A, B, C, AB and ABC were respectively pH: 5.4, 5.3, 5, 5.3 and 5.3; Clay content: 43, 56, 5.0, 56 and 37; Organic matter (MO): 3.1, 1.7, 0.86, 2.18 and 1.97. The assay was conducted in DBC in 6x8 factorial with 4 repetitions, substrate factor (5 soils and sand) and dose factor (8 levels of ATZ in g ha^{-1}). Experimental units were vases of 0.33 dm^3, filled with substrates. In these were applied the doses of ATZ on the surface of the soils with sprayer. Then the species *Cucumis sativum* was sown to detect the free herbicide in the substrate solution. At 21 days after the emergency of the indicator plant was determined the dry matter (MS) of the aerial part of these plants. Non-linear log-logistic model of Seefeldt et al., (1995) was using to estimate the concentration of the applied herbicide which reduced by 50% the accumulation of plant droughts. Before the sorption ratio was calculated (RS). Symptoms of intoxication of the indicative plants by the ATZ were characterized chlorinese in the tissues of the plant that evolved for necrosis and plant death. The dose of ATZ able to reduce by 50% (C_{50}) the accumulation of MS of cucumber plants went from: 209.9; 21.4; 9.7; 47.8; 54.1 and 2.3 g ha^{-1} for A, B, C, AB, ABC and sand respectively. RS in the soils followed the ascending order of C<B<AB<ABC<A. The C_{50} and RS data have a positive correlation with the MO content. This concluded that the sorption of the ATZ by colloids in differents depths of the profile of a soil varies according to the physicochemicals characteristics of each horizon. According to this, it is noted that for studies that consider sorption to classify the movement of the herbicide in the soil, special attention should be paid to the samples to be evaluated.

Keywords: Environmental contamination, organic matter, sorption ratio

Financial support: CAPES, CNPq, Fapemig, UFV

(1611 - 2867) Evaluating the pollutant removal potential of swales for the treatment of metaldehyde and other pesticide pollutants within agricultural surface runoff.

Lloyd Cockram[1]; David Hopkins[1]; Ian Grange[1]

Royal Agricultural University[1]

Metaldehyde pollution of surface and drinking waters is presently a matter of particular concern to the UK water industry due to its intractable nature; furthermore there is a drive, in both science and policy, toward finding nature based solutions to water treatment and the utilisation of the catchment based approach. The use of swales (vegetated conveyance channels) for the treatment of a wide variety of pollutants in surface waters is reasonably well established within the literature, no study has yet however evaluated the applicability of such an approach for the removal of pesticides. Moreover, previous studies have focused primarily on evidenced pollutant removal efficiencies, with little or no attention to understanding the mechanisms of swale water treatment. Through a theoretical consideration of swale dynamics, as well as an evidence based analysis of the potential application regarding metaldehyde and

other pesticide pollutants, this study aims to fill these knowledge gaps while making a case for more integrated management of water resources within the water and agricultural industries. In such a way this work can investigate the application of swales as a nature based solution to a contaminant of particular concern, while also better elucidating the concept of swales as a whole, aiding future theoretical and experimental considerations of other potential applications.
Keywords: Pesticide; Metaldehyde; Swale; Runoff; Pollution.
Financial support: Thames Water

(8440 - 2642) Extraction of heavy metals from contaminated soils and sediments using different surfactants

Ingrid Hagarová[1]; Marek Bujdoš[1]; Martin Urík[1]; Peter Matúš[1]; Filip Polák[1]; Martin Šebesta[1]
Slovak Spectroscopic Society, member of the Association of Slovak Scientific and Technological Societies; Comenius University in Bratislava, Faculty of Natural Sciences, Institute of Laboratory Research on Geomaterials, Ilkovičova 6, 842 15 Bratislava[1]

In this work, synthetic non-ionic surfactants such as Triton X-100 and Triton X-114 (*octylphenoxypolyethoxyethanol* with PEO chain length of 9.5 and 7.5, respectively), biosurfactant saponin (isolated from *Quillaja saponaria*), and metabolites of microscopic fungi (*Aspergillus niger*) were compared for extraction of heavy metals (such as Cu, Pb, Ni, and Zn) from contaminated soils and sediments. In this case, batch experiments were performed for evaluation of removal efficiency. While non-ionic surfactants and metabolites of *Aspergillus niger* have shown weak capability to remove the studied metals (removal efficiency less than 6 % in all cases), natural plant-based biosurfactant saponin can be considered as a promising biodegradable agent for remediation of Cu, Ni, and Zn from contaminated soils and sediments. The removal percentage was in the range of 14 – 46 %. Maximal removal yields were achieved at saponin concentration of 2 % (m/v) and removal incubation time of 24 hours. Higher concentrations and longer incubation times have shown no improving in removal efficiences. Now, a sequential extraction study is made on the soils and sediments before and after washing to determine from what fraction the saponin removed the heavy metals.
Keywords: soil, sediment, heavy metal, surfactant, extraction
Financial support: The work was supported by the Scientific Grant Agency of the Ministry of Education, Science, Research and Sport of the Slovak Republic and the Slovak Academy of Sciences under the contract VEGA 1/0153/17.

(2291 - 408) Fe and Al (hydr)oxides mineralogical phases resulting from co-precipitation with Rare Earth Elements

Gisely Souza Barcelos[1]; Jaime W. V. de Mello[1]; Massimo Gasparon[2]
Universidade Federal de Viçosa[1]; The University of Queensland[2]

Trivalent cations of rare earth elements (REE) present quite similar chemical and physical properties. Cerium and europium, however, can also be found as Ce^{4+} and Eu^{2+}. The REE present an unusual behaviour named “lanthanide contraction” which leads to a decrease in the atomic radii with increasing in atomic number. The use of such elements is related to the development of new technologies due to their applications in high-tech industry. Consequently, REE mining has grown, which leads to environmental concern due to effluents of mining processes. Thus, methods to remove or stabilize such contaminants from wastewater are warranted. Use of lime is an usual technique to neutralize AMD, which also leads to precipitation of Fe/Al (hydr)oxides. The aim of this study was to characterise mineralogical phases resulting from treatment of wastewater containing La, Ce, Nd, Eu and Ho by co-precipitation with Fe/Al (hydr)oxides. Five sets of 60-day experiments using individual REE were carried out with different Fe:Al:REE molar ratios in order to assess the efficiency of water treatment, as well as the mineralogical phases precipitated. Co-precipitation of Fe/Al (hydr)oxides was obtained by increasing pH, which was periodically buffered with 5.0 mol L^{-1} KOH. X-ray diffraction was used to identify the crystalline phases in precipitates, using Co Ka (λ = 0.1789 nm), from 4 to 70° 2θ at 1º s^{-1} rate. For lower REE concentrations, the most common mineral precipitated was magnetite in the absence of Al. As REE concentration increased, goethite became more common, excepted treatments with higher Al concentrations where gibbsite was also present. REE concentrations influenced the mineralogical phases irrespective to Fe:Al molar ratios. High REE concentrations favoured lepidocrocite precipitation in detriment of magnetite. La and Ce studies presented lanthanite and cerianite, respectively, as segregated phases. On the other hand, for Nd, Eu and Ho such segregated phases were not noticed, suggesting that the decrease in the atomic radii of such elements favours their association to Fe/Al (hydr)oxides structures.
Keywords: wastewater, co-precipitation, mining
Financial support: CNPq, FAPEMIG, CAPES

(6214 - 1062) Feasibility of the Bio-sulfur for Soil Remedial Amendment

Hyuck Soo Kim[1]; Jong Geon Lee[1]; Sang Phil Lee[1]; Seung Min Oh[1]; Seok Soon Jeong[1]; Jae E. Yang[1]
Kangwon National University[1]

‘Bio-sulfur (Bio-S)’ is defined as the solid phase byproduct generated in the chemical and biological desulfurization processes of landfill gas. Approximately 5,000 tons of Bio-S have been generated annually in the Seoul Metropolitan landfill site, Korea and it is expected to increase in the future. This necessitates the recycle of the Bio-S as the environmentally acceptable ways. The Bio-S has high pH and EC values with the S-containing functional groups which have a high affinity for metal ions. This research assesses the feasibility of the Bio-S for treatments of metals in water and soil. Experiments of batch, soil treatment and bioassay were conducted to evaluate the efficiency of the Bio-S in complexing or immobilizaing metals in aqueous solution and soil on which to base the criteria for the remedial agents to be used in the contaminated water and soil. The efficiency of the Bio-S was comparatively assessed with that of the activated carbon in the batch experiments. Results showed that the removal efficiencies of the Bio-S for Cd (25 mg L^{-1}) and Pb (300 mg L^{-1}) removal were 73% and 56%, respectively, after 360 min in the aqueous batch reaction. The respective efficiencies of the activated carbon were 26% and 17%. The SEM-EDS and XPS data reveal that the main mechanism was the complexation of metals with S-containing functional groups in Bio-S. Kinetics of such complexation were very fast to stabilize within 5 to 10 min ranges depending upon the kind of metals. When the Bio-S was treated in the metal contaminated soil, the bioavailable fractions of metals were decreased but those of unavailable fractions were increased, indicating a possible immobilization of metals in the soil. The 0.1 M HCl extractable Cd and Pb concentrations in 5% (w/w) Bio-S applied soil were 11% and 8%, respectively, lower than those of the control soil after 48 hours incubation. In bioassay, treatments of the Bio-S (2 and 5%, w/w) to the metal contaminated soil could not germinate the young radish seed (*Raphanus sativus* L.) possibly due to a high NaOH in the Bio-S inherent from the desulfurization process of the landfill gas. However, the Bio-S washed with the distilled water showed 76% seed germination rates at 5% treatment after 10 days while the germination of young radish seed in control soil was 40%. Consequently, it was concluded that the Bio-S could be used as a remediation material for the removal of Cd and Pb from water and soils.
Keywords: Bio-sulfur, Heavy metal, Remediation, Contamination
Financial support:

(6388 - 2665) Fractionation of aluminium in acidified soils

Peter Matúš[1]; Jana Kubová[1]; Marek Bujdoš[1]; Ján Medveď[1]; Martin Šebesta[1]; Filip Polák[1]; Michaela Matulová[1]; Bence Farkas[1]
SSS, member of the Association of Slovak Scientific and Technological Societies; Comenius University in Bratislava, Faculty of Natural Sciences, Institute of Laboratory Research on Geomaterials, Ilkovičova 6, 842 15 Bratislava, Slovakia[1]

Aluminium occurs in various chemical species, of which free Al^{3+}, $AlOH^{2+}$, and $Al(OH)_2^+$ species were found to be the most crucial to evaluate its toxicity and to predict the impact of proton inputs on soils and surface waters. The concentration of such Al species may be difficult to determine directly. For that reason these species are determined in one or more fractions. Generally, these fractions are defined operationally and according to the method of determination are termed reactive or labile aluminium. An optimised BCR three step sequential extraction procedure (SEP), several single extractions (with water, KCl, NH_4Cl, $CaCl_2$, $BaCl_2$, $LaCl_3$, NH_4F, NTA, EDTA, DTPA, $(NH_4)_2C_2O_4$, HCl solutions) and the reactive aluminium (Alr) determination in water extracts after solid phase extraction by chelating ion-exchanger Iontosorb Salicyl (cellulose resin containing covalently bound salicylic acid functional groups) were used for the fractionation of Al in ten acid soil samples (1-10, pH~1.8-3.6) from a mining area with sulphidic deposits (Šobov, central Slovakia). The precision, accuracy and repeatibility for all steps of the optimized BCR sequential extraction procedure were checked on various reference materials (CRM BCR 483 freshwater sediment, SRM 2710 and 2711 Montana soils). The aluminium amounts released by used extraction procedures were valuated and discussed from aspect of Al contents in plants (grass) growing on five acidified soils (A-E, pH~2.8-5.1) from the same locality. The calculation of the aluminium toxicity indexes (ATI) and determination of reactive aluminium in soil extracts were used for assessment of Al toxicity to plants. The ATI is defined as the ratio of nutrient cations (Ca, Mg, K, Na) sum to Al concentration. It can be concluded, that acid extractable Al fraction is most Alr selective from optimised BCR three-step SEP. The dilute HCl extraction can be the alternative for routine monitoring of Al mobility instead of optimised BCR three-step SEP when the phase associations estimation is not necessary. Some simple salt extractants, mainly $CaCl_2$ seem to be suitable for the estimation of labile and reactive Al species in acid soils and they can be a rapid tool in some applications of Al fractionation. The determination of Alr (samples 1-10, A-E) and calculation of ATI data (samples A-E) are most useful simple tools for the estimation of Al availability and toxicity to plants.

Keywords: Aluminium, fractionation, acid soils
Financial support: The work was supported by Scientific Grant Agency of the Ministry of Education, Science, Research and Sport of the Slovak Republic and the Slovak Academy of Sciences VEGA under the contracts No. 1/0836/15, 1/0153/17, 1/0164/17 and 1/0146/18.

(9562 - 875) Heavy metals contents in agricultural and forest fragment soils of the city of Nova Friburgo, RJ

Diogo Muniz Alexandre[1]; Daniele Rodrigues Barbosa[1]; Erica Souto Abreu Lima[1]; Nelson Moura Brasil do Amaral Sobrinho[1]
Universidade Federal Rural do Rio de Janeiro[1]

The heavy metals occur naturally in soils, and their contents depend on the soil parent material on which the soil formed and on formation processes. However, in search of an increase in agricultural productivity, with the indiscriminate use of agrochemicals and improper land management, the processes of soil physical and chemical degradation are favored, resulting in serious impacts to the environment. Therefore, the purpose of this study is to evaluate the levels of Cd, Ni and Pb in agricultural and native forest soils of Nova Friburgo, RJ, and thereby verify which factors are responsible for increasing these elements in the environment. The study was carried out in family farming properties in Nova Friburgo, RJ. For the determination of heavy metal contents, samples were collected in depth of 0-20 cm and were submitted to the of EPA digestion method 3051A. The resulting extracts were analyzed by atomic absorption spectrometry. It also determined the chemical attributes of the soil, according to Donagemma et al. (2011). Descriptive statistic analysis was performed of the contents of the metals, in addition principal component analysis (PCA). The contents of Cd, Ni e Pb detected in soils with agricultural activity presented wide variation, with maximum values 1.42, 16.89 e 31.78 mg kg^{-1}, minimum values of 0.08, 1.20 e 17.20 mg kg^1, and average of 0.47, 9.10 e 24.25 mg kg^{-1}, respectively. Comparing with the levels obtained in areas of forest fragment (0.001, 0.54 e 7.31 mg kg^1), there were a very high increase of the analyzed elements. Pointing out the anthropogenic contribution, mainly through the indiscriminate use of fertilizers, it presents high levels of metals in their composition (Amaral sobrinho et al.,1992). When compared to the guiding values established by CONAMA (2009), it is observed that in only one property the value of Cd was higher than the PV (Prevention Value) (1.3 mg kg^{-1}). However, the values found are above the QRVs (Quality Reference Value) proposed by (Matos, 2016) for the region, that for the G3 are of 0.04, 8 e 27 mg kg^1. Through the PCA it was verified a close relationship between the contents of metals and of P and K, ratifying what was previously discussed. The obtained results allow to conclude that there was an increase of metals analyzed in the areas with agricultural activity compared to the areas of forest fragment, which was possibly caused by an anthropogenic activity in the region.

Keywords: Soil contamination, trace elements, environmental monitoring.
Financial support: FAPERJ

(3952 - 1481) Heavy metals in floodplains affected by collapse of the Samarco's dam: a comparison between mine waste and non-affected soils.

Rafael Biscotto Davila[1]; Mauricio Paulo Ferreira Fontes[1]; Anderson Almeida Pacheco[1]; Raphael Bragança Alves Fernandes[1]; Matheus da Silva Ferreira[1]
Federal University of Viçosa[1]

At the end of 2015, a dam of the Samarco mining company collapsed, releasing about 40 million m^3 of iron ore tailings into Doce river basin, Minas Gerais State, southeastern Brazil. The first area hit by the mud, between the district of Bento Rodrigues and the Candonga dam had the most affected flood plains, comprising 15 km^2 of soil covered along the rivers Gualaxo do Norte, Carmo and Doce. Two years after the incident, there is still a concern about heavy metal contamination by the deposited material. The aim in this study was to analyze the concentration of the heavy metals As, Ba, Co, Cr, Cu, Ni, Pb, V and Zn in the tailings deposited on floodplains and to compare with uncontaminated river sediments of the same area. Thus, mine waste on floodplains and sediment from non-affected areas were collected from 38 sites along the Gualaxo do Norte and Carmo river until Candonga dam. These were digested according to EPA 3051A method and the heavy metals content were further determined by ICP-OES. The mean values obtained for the mine waste and sediments from non-affected areas were, respectively: As (5.2 and 37), Ba (37.5 and 119.5), Co (3.6 and 12.9), Cr (19.5 and 52.4), Cu (7.9 and 25.7); Ni (5.3 and 21.3); Pb (10 and 12.3); V (17.7 and 51.8), Zn (22.8 and 33.9) mg kg^{-1}. For all elements analyzed, the concentration of sediments from non-affected areas were higher than for the mine waste. The heavy metals content from mine waste were compared with the regulatory guidelines for soils according to the quality reference values established for the Minas Gerais state (Brazilian environmental laws).

The result showed that only one sample had Ba and Co levels higher than the limit (1.3 and 1.2 times higher, respectively) and three samples presented higher levels of As (up to 6 times higher). For the sediments from non-affected areas, all samples showed Co and As levels higher than the guidelines, up to 5.6 and 13.8 times higher, respectively. Three samples showed high values of Ni and Ba (up to 1.8 and 4.2 times higher) and one sample had Cr and Cu levels higher than the guidelines (1.2 and 1.3 times). Therefore, we conclude that although the disaster has caused serious social and environmental damage, there is strong evidence that the released mine waste poses no risk of contaminating the environment with heavy metals. It is important to highlight the need to control potential sources of contamination that have been present in this area for some decades.
Keywords: Heavy metals; Samarco disaster; Mine waste; EPA 3051A; ICP-OES.
Financial support: CAPES; FAPEMIG.

(3566 - 2272) High copper and zinc doses in acid soil changes the physiological state in young grapevines (*Vitis vinifera*)

Tadeu Luis Tiecher[1]; Hilda Hildebrand Soriani[2]; Lessandro De Conti[2]; Paulo Ademar Avelar Ferreira[2]; Isley Cristiellem Bicalho da Silva[2]; Edicarla Trentin[2]; Letícia Morsch[2]; Daniela Facco[2]; Adriele Tassinari[2]; Gustavo Brunetto[2]
Federal Institute Farroupilha[1]; Federal University of Santa Maria[2]

The Campanha Gaúcha is one of the main wine regions of Brazil that suffers from climatic factors favorable to the development of fungal diseases on the leafs of the grapevine (*Vitisvinifera*). Generally, the control of these diseases is carried out with successive applications of copper-based (Cu) fungicides, such as the Bordeaux mixture, which generates Cu accumulation in the soil up to toxic levels for the vines. In the vineyards of the Campanha Gaúcha, the Cu toxicity to plants is observed at relatively low Cu-levels in the soil, compared to other wine growing regions of the world, due to the characteristics of the soils from this region, that are generally sandy, acidic and have low soil organic matter (SOM) content. In order to reduce the amount of Cu applied in the vineyards, Zn-based fungicides have been used as an alternative to replace the Bordeaux mixture that have zinc (Zn) in its formulation. As the number of fungicide applications is still high, a quick increase in soil Zn content has been observed in vineyard soils that already have a high Cu content. The objective of the study was to assess the effects of high Cu and Zn contents in a sandy acid soil on the physiological state in young grapevines. We collected a Typic Hapludalf soil, with 5.4% of clay and 0.9% of SOM, of a natural field of Rio Grande do Sul, the southernmost state of Brazil. Soil treatments were addition of 0, 30, and 60 mg Cu kg^{-1}, and addition of 0, 15, 30, 60, 120, and 180 mg Zn kg^{-1} for each copper dose. The study was carried out in pots containing 4.0 kg of soil, and a seedling of grapevine per pot was grown for 60 days. After that, we measured root and shoot dry matter, Cu and Zn content in roots and shoots, chlorophyll *a* fluorescence, photosynthetic pigments, and peroxidase and superoxide dismutase activity. Young grapevines showed high Cu and Zn concentrations in the roots, decreasing translocation to the shoots. However, at the highest doses of Cu and Zn, we observed decrease in plant growth and in photochemical efficiency associated with the decrease in photosynthetic pigment content. Furthermore, the activity of antioxidant enzymes increased in intermediate doses of Zn, which indicates activation of the antioxidant system. However, the stress condition in treatments with high levels of Cu and Zn was not reversed.
Keywords: Vineyard soils. Phytotoxicity. Antioxidant enzymes. Chlorophyll fluorescence. Photosynthetic pigments.
Financial support: Brazilian National Council for Scientific and Technological Development—CNPq, process number 473376/2013-0.

(4168 - 501) Immobilization of agricultural phosphorus in Midwestern floodplain soils in the U.S.

Yuji Arai[1]; Mary R. Arenberg[1]
University of Illinois at Urbana-Champaign[1]

Nutrient losses from the Mississippi watershed are exacerbating the growth of the hypoxic zone in the Gulf of Mexico. Located within the highly agricultural Piatt County, IL, Allerton Park encompasses a riparian forest that receives an influx of phosphorus (P) via surface runoff and leaching during spring flooding. The objective of this study is to investigate the ability of the forest soil to buffer agricultural P losses through immobilization using experimental biogeochemistry, ^{31}P-nuclear magnetic resonance (^{31}P-NMR) spectroscopy and P K-edge XANES analysis. If P is effectively sequestered, it may also lead to improved tree growth in woody biomass. To analyze the system's response to flooding, samples were collected within the bottomland and surrounding upland of the forest in April. Organic P, microbial P, phosphatase activity, and total P were quantified to assess P mineralization-immobilization dynamics. First, total P ranged from 338 to 819 mg kg^{-1}, averaging at 580 mg kg^{-1}, in the bottomland and from 113 to 370 mg kg^{-1}, averaging at 245 mg kg^{-1}, in the upland. Next, organic P spanned from 90 to 457 mg kg^{-1}in the bottomland, comprising an average of 45% of total P, and ranged from 42 to 191 mg kg^{-1}in the upland, comprising an average of 36% of total P. Furthermore, microbial P averaged 5.23 µg g^{-1} in the bottomland and 2.75 µg g^{-1} in the upland. Finally, acidic phosphatase activity averaged 13 µmol PNP/g·hr in the bottomland and 11 µmol PNP/g·hr in the upland while alkaline phosphatase activity averaged 24 µmol PNP/g·hr in the bottomland and 8 µmol PNP/g·hr in the upland. Greater concentrations of total P, organic P, and microbial P in the bottomland compared to the upland suggest that the floodplain immobilizes agricultural P. This observation is further evidenced by a higher organic P percentage in the bottomland. Nevertheless, greater alkaline phosphatase activity was observed in the bottomland than upland, which needs to be further researched but may be explained by the influx of nitrogen fertilizer in the floodplain. Overall, greater P immobilization in the bottomland indicates the floodplain's capacity to buffer agricultural P in the early spring.
Keywords: Phosphorus, immobilization, floodplain soil, riparian, nutrients
Financial support: USDA-NIFA McIntire-Stennis fund

(8596 - 2833) Impact of soil sterilization on mercury contents in a Latosol grown with common beans

Francielle Roberta Dias de Lima[1]; Aline Oliveira Silva[1]; Isabela Cristina Filardi Vasques[1]; Mateus Moreira Engelhardt[1]; Gabriel Caixeta Martins[1]; Rayner Hugo Cassa Louzada dos Reis[1]; Jakeline Rosa Oliveira[1]; Ediu Carlos da Silva Júnior[1]; Luiz Roberto Guimarães Guilherme[1]; João José Granate de Sá e Melo Marques[1]
Universidade Federal de Lavras[1]

Mercury is a potentially toxic trace element. Its soil availability depends largely on its chemical specie, which is a function of soil attributes such as cation exchange capacity (CEC), pH, redox potential and microbial activity. The objective of the present study was to investigate the effect of soil sterilization on Hg retention when cultivated *Phaseolus vulgaris* (common beans). The experiment was carried out in a greenhouse with a typical Dystrophic Red-Yellow Latosol (LVAd): pH (H_2O) = 4.9; T = 6.1 $cmol/dm^3$; and OM = 21 g/kg; And a typical clayey Dystroferric Red Latosol (LVdf), pH (H_2O) = 4.4; T = 11.7 $cmol/dm^3$; and OM = 40 g/kg, where common beans were sown. Three kilograms of both soils were sterilizated and, posteriorly

kept at rest for 21 days, with daily stirring. It is expected that sterilizating may have deeply impacted de soil biota, which plays a major role in Hg chemistry. Afterwards, two experiments were carried out in pots with 500 cm^3 of soil that received application of $HgCl_2$ at concentrations 0 and 80 mg of Hg per kg of dry soil, for 21 days. The treatments were natural soil (NS) at concentrations 0 and 80 mg/kg and sterilizated, sterile soil (SS) at concentrations 0 and 80 mg/kg, for each soil class. We had four treatments and three replicates in a completely randomized design. The Hg content was determined using the USEPA 3051A method with atomic absorption spectrophotometer with hydride generation using the certified reference material NIST SRM 2710a - Montana Soil and blanks as quality controls. The method detection limit (MDL) was 0.14 mg/kg. The recovery rate of the CRM was 70.4 %. Data were submitted to variance analysis ($p < 0.05$) and Tukey test ($p < 0.05$). Mercury in the treatments without addition of Hg, i.e. native Hg, was below the MDL. For the treatments where Hg was applied, the mean values of Hg were 19.3 and 1.7 mg/kg for LVAd and LVdf, respectively and for SS were 33.8 and 22.8 mg/kg for LVAd and LVdf, respectively. The portion of the Hg lost in unsterilized soil was 28.8 μ kg^{-1} h^{-1} and 41.9 μ kg^{-1} h^{-1} for LVAd and LVdf, respectively. The high levels of Hg in SS can be attributed to the soil microbiota removal, since it participates in the transformations of the biogeochemical cycle of Hg, reducing Hg^{2+} to Hg^0, which is volatile at room temperature. The reduction of the microbial community through the soil sterilization process directly affects the Hg levels in the soil.

Keywords: trace elements; sterilization; mercuric chloride
Financial support: CAPES, CNPq and FAPEMIG.

(4759 - 1132) Influence of Aluminum and Arsenic in Fe and Al (hydr)oxides mineralogy

Isabela Cristina Filardi Vasques[1]; Renato Welmer Veloso[2]; Vanessa de Paula Ferreira[3]; Jaime Wilson Vargas de Mello[4]
UFLA[1]; IFRO[2]; UFV[3]; UFV, INCTacqua[4]

Studies on co-precipitation and adsorption of As onto Fe and Al (hydr)oxides are of major environmental interest, considering their abundance in oxisoils. This study addressed the co-precipitation of Fe and Al (hydr)oxides in the presence of arsenate and arsenite at different Fe:Al molar ratios. High concentrations of soluble of As were considered in order to simulate highly contaminated environments. Some adaptations were considered in order to simulate the treatment of acid mine drainage contaminated with As. Sulfates salts were used as source of Fe (II), Fe (III) and Al at three Fe:Al molar ratios: 100:0, 80:20 and 60:40. Suitable amounts of these salts were added to vessels with different solutions containing As (V) and (III) and then, the pH was buffered to induce (hydr)oxides precipitation. Mineralogical phases in precipitates were identified by X-ray diffraction and by Scanning Electron Microscopy Coupled to Energy Dispersive X-ray Spectroscopy (SEM/EDS). At the absence of Al, maghemite and magnetite were identified in Fe (II) treatments, but only at 50 mg L^{-1} of As. At higher As concentrations (500 mg L^{-1}), lepidocrocite and goethite were identified in the absence of Al, as well as at the 80:20 Fe:Al molar ratio. Isomorphic substitution in these Fe (hydr)oxides is also considered as widely reported in the literature. The Al segregation as gibbsite was only detected at 60:40 Fe:Al molar ratio. In Fe (III) treatments, hematite was only identified in absence of Al and at 50 mg L^{-1} of As. In the presence of Al and high As, ferrihydrite and gibbsite were identified by XRD. It can be considered that higher concentrations of Al and As slow down phase transformation. It is worth of note the characteristic peak of hematite even better defined in the presence of 50 mg L^{-1} than in absence of As. The SEM analyses showed that As is evenly associated to Fe (hydr)oxides. However, at higher concentration of As there is no oxygen or aluminum associated to Fe and As in some particles. This suggests the formation of compounds such as ferric arsenate not detected by X Ray. The presence of aluminum and arsenic arise considerable influence in Fe and Al (hydr)oxides mineralogy. It is suggested that phase transformation of ferrihydrite to hematite is delayed by the presence of tese elements. In general As precipitates evenly associated to Al and Fe (hydr)oxides, but at a 20:1 (Fe+Al):As molar ratio it segregates as ferric arsenate.

Keywords: wastewater, magnetite, lepidocrocite, hematite, ferrihyidrite
Financial support: CNPq, CAPES and FAPEMIG

(5163 - 475) Influence of mercury concentrations on ph in tropical soils of different textures

Jakeline R. de Oliveira[1]; Geila S. Carvalho[1]; Jade G. Alacoque[1]; João José Marques[1]
Universidade Federal de Lavras[1]

Soil pH determines mercury speciation and, in the long run, its accumulation in the soil. The aim of this work was to study changes in the pH of tropical soils contaminated with $HgCl_2$. The experimental design was completely randomized in a factorial scheme 6 x 5, corresponding to four mineral soil textural classes (sand, loam, clay, heavy clay), an organic soil, and pure zeolite at five equilibrium solutions (1:10) with 0, 0.1, 0.4, 1.2, and 2.4 mg/L of Hg, as $HgCl_2$, with three replicates. The soils were collected in areas with no anthropogenic action and were then dried and passed through a 2 mm sieve. For the experiment, 1.5 g of soil were weighed and placed in plastic tubes; 15 mL of 15 mmol/L NaCl solution were added along with the concentrations of Hg. The samples were vigorously shaken with a glass rod for 1 min. and remained standing for one hour. The pH readings were performed on the supernatant. Data were submitted to analysis of variance and the comparison of means by the Skott-Knott test. There was a significant interaction between soils and Hg concentrations for soil pH. It was observed that, at the zero concentration of of Hg, the soil with the lowest pH (4.6) was the organic soil; and the zeolite showed the highest pH (8.8). The same pattern was kept until the concentration of 0.4 mg/L Hg. At the concentration of 1.2 mg/L of Hg, the lowest pH value (4.5) was obtained in the sandy soil. The increase of the Hg concentration in the solution up to 2.4 mg/L altered the soil pH values; the sandy and the organic soil had the lowest values, 4.7 and 4.6, respectively. Concentrations of Hg in the equilibrium solution above 0.4 mg/L altered the pH values of soils regardless of their textural class. The results suggest a possible specific sorption mechanism for Hg adsorption in these soils.

Keywords: Hg in soil, soil pollution, zeolite
Financial support: Conselho Nacional de Desenvolvimento Científico e Tecnológico-CNPq

(7443 - 2204) Inorganic and organic phosphorus in sediments in the Walnut Creek watershed of central Iowa, USA

Suroso Rahutomo[1]; John L. Kovar[2]; Michael L. Thompson[3]
Indonesian Oil Palm Research Institute[1]; USDA Agricultural Research Service[2]; Iowa State University[3]

The dynamics of phosphorus (P) reactions in stream water are important because of their potential to trigger eutrophication. This study aimed to explore the nature of P in sediments associated with Walnut Creek in central Iowa, USA. The Walnut Creek watershed supports row crop production, grazing, and riparian buffer zones. The alluvial cross section is composed of a sequence of sediments that contribute differentially to the amounts and forms of P entering the stream. Twenty-five sediment samples collected near Walnut Creek (classified as bank, in-stream, and floodplain deposits) were sequentially extracted for P. Across all 25 samples, the inorganic P (*Pi*)

fractions followed the order: Fe-bound *Pi* > Ca-bound *Pi* > reductant-soluble *Pi* > Al-bound *Pi* > soluble and loosely bound *Pi*. For the organic (*Po*) fractions, the order was nonlabile *Po* > fulvic acid-bound *Po* > humic acid-bound *Po* > labile *Po* > moderately labile *Po*. The ranges of total P (TP), Mehlich-3-extractable P ($P\text{-}M_3$), and ammonium oxalate-extractable P (P_{ox}) were 386 to 1,134, 5 to 85, and 60 to 823 mg kg^{-1}, respectively. Among the sample groups, the highest concentrations of TP, $P\text{-}M_3$, and P_{ox} were in the in-stream deposits. Total P was significantly correlated with Fe oxides, clay, and soil organic matter, especially in the bank and floodplain deposits. Because of the potential release of P from these sediments, we can speculate that changes in land use within the riparian areas may, at least initially, have little direct effect on soluble or particulate P concentrations in Walnut Creek. Still, if P inputs from eroded bank sediments are reduced, whether by riparian management, stream bank stabilization, or some other practice, it is likely that P loads in Walnut Creek can be gradually reduced as well.

Keywords: stream sediments, phosphorus loss, eutrophication, sequential extraction, soil organic phosphorus

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(9531 - 1200) Ions mobility in oxisol cultived with maize irrigated with swine wastewater treated in anaerobic biodigester

Sarah Mello Leite Moretti[1]; Edna Ivani Bertoncini[2]; Cassio Hamilton Abreu-Junior[1]

University of São Paulo, Center for Nuclear Energy in Agriculture[1]; São Paulo's Agency for Agribusiness Technology, Secretariat of Agriculture and Food Supply of São Paulo[2]

The daily volume of liquid swine manure generated from the pig stalls cleaning is high and its agricultural use can represent important source of nutrients and water. However, this waste presents high organic load, heavy metals presence and ions that can be accumulated in soil and leached. This study aimed evaluate ions contents in soil solution amended with swine wastewater (SWB), 1:50 (v/v) diluted swine wastewater (SWBD) and the conventional management. The field experiment was conducted in clayey Oxisol, using an experimental design in completely randomized blocks with three replications. Winter and summer maize crops were cultivated, evaluating the following treatments: T1-control; T2-mineral fertilization without irrigation, T3-irrigation with SWB, T4-irrigation with SWBD, T5-mineral fertilization and irrigation with water. Maize irrigation was performed considering the crop water requirement and soil matric potential measured by tensiometers installed in each plot. After each harvest, it was evaluated ions mobility by saturation paste method in two soil depths (0-0.20 m and 0.20-0.40 m). The SWB use increased K^+, Na^+ Ca^{+2}, $N\text{-}NO_3^-$ and $N\text{-}NH_4^+$ contents in both soil depths, after winter and summer maize cultivation, when compared to others treatments, except to Na^+ contents that in summer conditions was equal to T4 and T5 treatments. Also, in summer it was observed that the $N\text{-}NO_3^-$ content in subsurface was higher than surface irrigated with SWB, indicating for both ions their leaching. It is emphasized that NO_3^- contents in soil solution of all treatments were higher than limits established for groundwater by São Paulo State legislation, which is equal to 10 mg L^{-1}. After two maize cultivation irrigated with 250 mm of treated swine wastewater, it was observed that SWB can supply some nutrients for plants, however, these ions leaching could represent groundwater contaminations risks. Thus, agricultural use criteria should be established, mainly, considering possible leaching of K^+, Na^+, $N\text{-}NH_4^+$ e $N\text{-}NO_3^-$ when swine wastes are used in agricultural soils.

Keywords: swine manure, maize, soil chemistry, salts leaching, groundwater

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(1174 - 2463) Kinetics and Adsorption parameters related to Ciprofloxacin adsorption on a volcanic ash derived soil: Effect of organic matter

Cristian Urdiales[1]; Mauricio Varas[1]; Jonathan Suazo[2]; Carmen Pizarro[3]; Mauricio Escudey[3]

Pontificia Universidad Católica de Chile[1]; Universidad de la Frontera[2]; Universidad de Santiago de Chile[3]

To fight diseases and improve animal growth, fluoroquinolones family antibiotics are prescribed for veterinary use and administered through the feed. Antibiotics are not fully metabolized in the gastrointestinal tract, being the soil one of their final destination through manure amendments. Volcanic ash derived soils present a high organic matter (OM) content which may play a significant role in the soil-antibiotic interaction. To establish the importance of (OM) the Ciprofloxacin (CIP) adsorption on Santa Barbara soil (SB, Andisol) with and without OM was studied. The OM was removed with hydrogen peroxide (30% v/v); the treatment efficiency was established by following the variation of the isoelectric point (IEP) of sample determined from electrophoretic mobility studies carried out in a Zeta Meter 4.0 equipment using 10-20 mg of sample suspended in 200 mL of 10^{-3}M KNO_3 solution. Adsorption kinetics study was performed by determining Ciprofloxacin concentration in KNO_3 solutions, after suspending 500 mg of soil sample in 10 mL of a $5.0x10^{-1}$ mmol L^{-1} Ciprofloxacin solution, using batch assays, ranging from 5 to 120 min. The Ciprofloxacin equilibrium concentration (Ce) was determined by square wave voltammetry, through Potential (E) vs Current (I) measurements, using a Ce x Ip (current pick) calibration curve. Different kinetic models were applied to the experimental data, the pseudo-second-order model best fits the experimental results being the calculated C*m* value close to that experimentally obtained. The IEP was used to establish the equilibrium concentration range where CIP adsorption proceeds through the formation of mono or multilayers. The Langmuir-Freundlich model fits the adsorption isotherms data better than Langmuir and Freundlich models do. The CIP adsorption in SB is higher than in SB without organic matter showing the importance of Ciprofloxacin interaction with carboxyl, phenyl, o-alkyl OM functional groups during the adsorption process, evidencing the role of OM not only in the soil-antibiotic interaction but also the OM importance in the transport in depth of Ci in volcanic soils.

Keywords: Ciprofloxacin, adsorption, isotherms

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(8638 - 352) Land use effect on stream water quality, an case study in an agricultural watershed of Central Hokkaido, Japan.

Ryusuke Hatano[1]; Mako Abe[1]; Kanta Kuramochi[1]

Hokkaido University[1]

Nutrient management in agricultural field and land use proportion are main factors to keep water quality. Silicon (Si) is important element for diatoms feeding fishes. Unbalance between Si and nitrogen (N) or phosphorus (P) induces eutrophication, and the molar ratios of Si/N less than 2.7 and Si/P less than 54.3 in water are critical level for diatoms growth. Organic soil is low in Si supply. Land use should be considered soil characteristics. Purpose of this research was to clarify the influence of land use and soil type on stream water quality. Ishikari

river watershed is the second largest in Japan and the largest in Hokkaido (14,330km^2 in area and 268km in length). Climate is semi boreal with deep snow in winter (November to April), mean annual precipitation is 1,126 mm and mean annual temperature is 8.9ºC. Land use is composed of forests (63%) , arable lands (31%), and urban area (3%). Soil type is composed of forest soils (68%) in hilly and mountain sides, and lowland soils (23%) and peat soils (5%) along the stream. Water sampling was carried out at 20 points from upstream to downstream of the main stream of Ishikari river at three times in 2016, on May 18 to 20 (seeding period after snow melting season), August 10 to 12 (crop growing season), and November 9 to 11 (winter season), and water quality was analyzed. In May and August, stream nutrient loads were positively correlated with proportions of paddy field and upland field, and negatively correlated with forest proportion, but not significantly correlated with urban proportion. In November, there was no significant correlation between land use proportions and the stream loads. Stream loads of SS, TP, TN and TOC were significantly increased to downstream in May than in August and November, due to surface runoff with snowmelt as well as agricultural activities. In August, stream loads of NO_3^-, NO_2^-, SO_4^{2-}, HCO_3^-, Ca^{2+}, Mg^{2+} and SiO_2 significantly increased with upland proportion. Molar ratios of Si/N and Si/P less than threshold of eutrophication (2.7 and 54.3, respectively) were found from middle stream in May and from upper stream in May and August, respectively. This may be ascribed by the peat soils distributed along the stream from the middle stream to downstream, which have a low Si supply power and a high N and P release with peat decomposition. Reducing fertilizer application, drainage and tillage in peat land is important to conserve the water quality in global warming.

Keywords: land use; nutrient management; peat soil; water quality; watershed
Financial support: Hokkaido University

(1725 - 2003) Leaching of hexazinone + diuron in different Brazilian cerrado soils

Kerwin Araujo Costa[1]; Rafael Ramos Bertuani[1]; Larissa Pinto Seiberti[1]; Douglas Gomes Viana[1]; Amanda Duim Ferreira[1]; Kamila Cabral Mielke[1]; Fábio Ribeiro Pires[1]; João Carlos Madalão[1]; Paulo Henrique Ramos Cabral[2]; Adriano Jakelaitis[2]
Universidade Federal do Espirito Santo[1]; Instituto Federal Goiano - Campus Rio Verde[2]

The expansion of agribusiness in Brazil has boosted the use of agrochemicals, but when applied improperly, such compounds represent a high risk of environmental contamination. The herbicide movement and its interaction in the sorption and desorption processes are still poorly understood in Brazilian soil and climate conditions. Therefore, it was evaluated the leaching of the hexazinone + diuron herbicide in soils of the sugarcane region of southwestern Goiás. Samples of five soils collected at depths of 0.0 to 0.2 m were used. Soil A was collected in an area with conventional cultivation history, soils B, C and D with no till system and soil E collected in a native forest. The soils were packed in polyvinyl chloride columns 0.5 m long, then the 700 g ha^{-1} dose of the active ingredient hexazinone + diuron was applied to the top of the columns. Twelve hours after application of the herbicide, a single 60 mm rain slide was simulated. After this step, the columns remained in the upright position for 72 hours. For the confirmation of herbicide leaching in each treatment, soil samples were collected at depths of 0.0 – 0.5 - 0.1 - 0.15- 0.2 – 0.25 – 0.3 – 0.35 – 0.4 – 0.45 – 0.5 m. Each fraction was placed in a pot, where the bioindicator Cucumis sativus was planted. At 21 days after emergence, phytotoxicity scores were given, and the dry matter of the aerial part of the bioindicator was quantified. Data from the biological analyzes related to herbicide leaching were submitted to analysis of variance and regression. Soil A is characterized by low clay content, Cation Exchange Capacity and Organic Matter (OM), due to this fact, hexazinone + diuron leached OMre in this soil. In soil B the herbicide was detected up to the depth of 0.2 m, however, at this depth the phytotoxicity symptoms in the bioindicator plants were lower, and also the dry matter of the bioindicator was higher in those depths, compared to the soil A. The hexazinone + diuron leached less in soil C, being detected in the depths of 0.0 – 0.5 m ; 0.5 - 0.1 m. In soil D, the leaching was high despite the good contents of OM and Cation Exchange Capacity, possibly due to the high pH value. In the soil E the hexazinone + diuron leached to the depth of 0.15 m, that is to say, in this soil the leaching was intermediate between the other soils.

Keywords: Herbicide, phytotoxicity, bioassay
Financial support:

(4979 - 2564) Lead accumulation in different plant species cultivated in a contaminated soil

Letícia Cristina Freitas Silva[1]; Helen Carla Santana Amorim[1]; Felipe Zablith[1]; Maurício Paulo Ferreira Fontes[1]; Ivo Ribeiro da Silva[1]; Leonardus Vergutz[1]
UFV[1]

Lead (Pb) pollution is one of the most concerning problems to environmental and human health in developing countries. The irregular disposal of lead mining and smelting residues heavily increases Pb concentration in soils, damaging agricultural activities and limiting the land use. Cultivating fast-growing and accumulator plant species in contaminated sites is an alternative to reduce Pb levels in soils and mitigate its impacts in the environment. Therefore, the main objective of this study is to assess the Pb accumulation in different plant species cultivated in a highly contaminated site by lead smelter particulate material. Soil samples (0-5 cm and 5-15 cm) from a Typic Hapludert were collected near to an inactive lead smelter in Santo Amaro, Bahia, Brazil. The soil samples were physically, chemically and mineralogically characterized, and used in a glasshouse experiment. The current work is part of a bigger Pb bioavailability experiment; it was mounted in a randomized block design, in a factorial scheme (2x(1+3)) corresponding to the two soil depths, three plant species (*Eucalyptus urograndis*, *Brachiaria brizantha* cv. Marandu or *Brassica juncea* L.), and a control treatment without plant. Six repetitions of each treatment were assembled. Each plastic pot was filled with 2.5 kg of soil, received seeds or seedling of each plant specie, and basic phosphorus fertilization (300 mg dm^{-3} of P). After 14 weeks, the experiment was unmounted; soil samples had their total Pb content determined through microwave digestion (USEPA 3052), roots and shoots were harvested, washed, dried at 65°C for 48 hours, weighed, and had the dry matter recorded. The dried plant material was submitted to acid digestion (5 ml of HNO_3 + 2 ml of H_2O_2) to determine the total Pb content. Differences in total Pb content in plant material were tested using ANOVA followed by Tukey ($p<0.05$). Pb content in the 0-5 cm soil depth is 2122 ppm, and 1313 ppm for the 5-15 cm depth. Pb is mostly accumulated in the roots of the three plant species for both soil depths. *Brassica juncea* is the plant specie that most accumulates Pb in roots despite of the total Pb content in soil (41 mg kg^{-1} and 38 mg kg^{-1} of dry matter for the 0-5 and 5-15 cm depths, respectively) and in the shoot for the 5-15 cm soil depth (7.78 mg kg^{-1} of dry matter). Due to its high potential to accumulate Pb, *Brassica juncea* may be used in remediation of Pb contaminated soils.

Keywords: Lead bioavailability; accumulator plants; *Brassica juncea.*
Financial support: Capes

(2780 - 2139) Lead fractions in a contaminated soil cultivated with different plant species

Helen Carla Santana Amorim[1]; Felipe Zablith[1]; Mauricio Paulo Ferreira Fontes[1]; Ivo Ribeiro da Silva[1]; Leonardus Vergutz[1]
Universidade Federal de Viçosa[1]

Poorly regulated lead (Pb) mining and smelting operations have led to an increased contamination of soil and water in the last decades. Although roughly immobile in soils, Pb may become soluble due to acidification processes occurred in the rhizosphere of the plants, enter in the food web via plant uptake, and damage environmental and human health. By assessing Pb forms in soils under bulk and rhizosphere conditions is possible to predict the fate of the contaminant in the environment. The main goal of this study is to assess the Pb fractions in a soil contaminated by lead smelter particulate material, under bulk and rhizosphere conditions. The current work is part of a bigger Pb bioavailability experiment; soil samples (0-5 cm and 5-15 cm) from a Typic Hapludert were collected near to an inactive lead smelter in Santo Amaro, Bahia, Brazil. The soil samples were physically, chemically and mineralogically characterized, and had the Pb fractions determined by a modified BCR sequential extraction procedure (SEP). Four fractions were obtained in this procedure: F1 (water soluble, exchangeable and bound to carbonates), F2 (bound to amorphous Fe- and Mn- (hydr)oxides), F3 (bound to organic matter), and F4 (residual, bound to Fe- and Al-(hydr)oxides). A pot experiment was mounted in a randomized block design, in a factorial scheme 2x(1+3) corresponding to the two soil depths, three plant species (*Eucalyptus urograndis*, *Brachiaria brizantha* cv. Marandu or *Brassica juncea* L.), a control treatment without plant, and six repetitions. Each pot was filled with 2.5 kg of soil, received seeds or seedling of each plant species, and 300 mg dm^{-3} of P. After 14 weeks, the experiment was unmounted; rhizosphere soil samples were collected near to the plant species' roots, and a soil sample from the control treatment was considered the bulk soil. Pb fractions were determined in the bulk and rhizosphere soil samples by the BCR procedure. Differences in Pb fractions were tested using ANOVA followed by Tukey ($p<0.05$). In the original and cultivated soil samples, for both soil depths, Pb fractions decreased in the order: F2 > F4 > F3 > F1. In the 0-5 cm soil depth, there is no difference between the Pb fractions in the original, bulk and rhizosphere soils. In the 5-15 cm soil depth, all three rhizosphere soils showed a decrease in the residual fraction compared to the original soil, indicating that the presence of plants and its rhizospheres may alter previous stable Pb forms.

Keywords: Pb fractionation, toxicity, rhizosphere processes
Financial support: Capes

(1524 - 1696) Long-term effect of the application of correctives on soil acidity

Jocelina Paranhos Rosa de Vargas[1]; Danilo Rheinheimer dos Santos[1]; Marília Camotti Bastos[2]; Vanessa dos Santos Dias[1]; Pedro Bolzan Parisi[1]
Universidade Federal de Santa Maria[1]; Université de Lorraine[2]

The main interest of the soils acidity correction is to neutralize the exchangeable Al^{3+}, since the presence of this form of Al in the soil causes restriction of root growth and consequently the decrease of the productivity of sensitive crops. Thus, monitoring the advance of attributes related to soil acidity in depth in cultivated areas is fundamental to assist in the decision of reapplication of acidity corrective forms. The aim of this study was to quantify the chemical changes in the soil caused by lime application calcitic and dolomitic, in a superficial and incorporated form after 141 months of its application. The experiment was installed in 2004 under native field in an Typic Hapludalf. The statistical design was a two-factor type with two types of application forms (incorporated and superficial) three types of correctives (control, calcareous calcitic and dolomitic. In July 2016, soil samples were collected at depths of 0 to 60 cm. In the soil layer of 0 to 10 cm the soil samples were collected every 1 cm, in the layer of 10 to 25 cm the soil samples were collected every 2.5 cm and in the layer of 25 to 60 cm the samples of were collected every 5 cm. The analysis performed were: values of pH in water in the ratio 1: 1, TSM and Ca, Mg and Al exchangeable. From these results the saturation by Al and bases was calculated. The simple deposition of the dolomitic corrective on the surface of the soil, twelve years after the application, allowed changes in the attributes related to soil acidity in the profile, similar to the incorporation. The use of the calcitic corrective provided more significant alterations in the attributes related to soil acidity in the profile compared to the dolomite, following its greater solubility in relation to dolomite. Almost twelve years after the natural acidity correction of the soil following the recommendations of the Soil Chemistry and Fertility Commission -RS / SC (2016), a slight reacidification of the soil of the 0-5 cm layer is observed, whose aluminum saturation is still less than 5% in the first 10 cm. Even almost twelve years after the corrective application, superficial or incorporated, still significant migration of the alkalinizing front in the soil profile to depths greater than 20 cm is perceived.

Keywords: No-tillage Soil acidity Liming
Financial support: Conselho Nacional de Desenvolvimento Científico e Tecnológico – CNPq

(2425 - 757) Monitoring of heavy metals content in arable soils and plants in Central Black Earht Regions of Russia

Lukin Sergei[1]
Belgorod State University[1]

In the Russian Federation carrying out the state agro environmental monitoring of agricultural lands is the purpose of agrochemical service subordinated to the Ministry of Agriculture. The objective of our researches consisted in carrying out ecological assessment of content of heavy metals (Cd, Cr, Cu, Ni, Zn) in the agrocenosis of a forest-steppe zone of a south-west part of Central Chernozems areas where the soil generally represented by Luvic Chernozems. Studies were conducted on 20 reperny sites representing the field or the site of the field with 4 to 40 hectares. The main source of most heavy metals entering the agrocenosis are organic fertilizers. For example, the cattle manure moist contains an average of zinc - 18.9, copper -5.7, nickel -2.77, chromium -2.39, cadmium -0.084 mg/kg. In the course of the research it was established that the average gross content in the arable layer (0-20 cm) of leached zinc was 37.1, nickel - 24.9, chromium - 21.0, copper -0.11, cadmium -0.08mg/kg. The average gross content in the arable layer (0-20 cm) of Luvic Chernozems zinc is 37.1, nickel -24.9, chromium -21.0, cadmium - 0.32mg/kg. The average content of mobile forms of zinc was of 0.74, nickel - 0.63, chromium - 0.44, copper -0.11, nickel -0.08 mg/kg. The average content of zinc in beans of soybean was 34.4, copper - 11.7, nickel -5.15, chromium - 0.42, cadmium -0.072mg/kg of absolutely dry matter. The content of zinc, copper, nickel and chromium in the soybean straw was lower than in beans, with values respectively of 6.12, 3.58, 0.70, 0.38 mg/kg. The cadmium content in the straw was of 0.083mg/kg which is higher than in bean. Soy is one of those crops that characterized by high accumulation.

Keywords: Luvic Chernozems, zinc, chromium, cadmium
Financial support: FSDI «Agrochemical Service Center «Belgorodsky»

(8417 - 1392) Morphopedologic characterization of landscapes under direct and indirect influence of vulcanic flows and water quality in the hydrographic basin of Ribeirão Areado, alto São Francisco-MG, Brazil

Juberto Babilônia de Sousa[1]; Flavio Rodrigues do Nascimento[2]; Celia Alves de Souza[3]
Instituto Federal de Educação, Ciência e Tecnologia do Estado de Mato

Grosso – IFMT, Campus Cáceres, Brasil[1]; Universidade Federal do Ceará - UFC, Fortaleza, Brasil, departamento de geografia[2]; Universidade do Estado de Mato grosso – UNEMAT, Cáceres, Brasil, departamento de geografia[3]

The objective of this study was to determine in the landscape units developed or influenced by volcanic tuffs, their pedological characteristics and the chemical functioning, in order to interpret the influences on the surface water quality. With the superposition of geological, geomorphological and pedological maps, units of relatively homogeneous landscapes were delimited. Morphological descriptions were carried out and samples of nine soils and rocks profiles were collected for physico-chemical analysis. Fifteen water points were collected to determine their chemical qualities, in the dry and rainy periods. The results showed three morphopedic compartments. The compartment I is represented by the tabular planing surface, rocks of the Areado Group and volcanic tuffs of Mata da Corda Group. Association of Latosol-Yellow Dystrophic (ferric) in relief of flat slopes occurs, Disrupting Tb Disruption Tb Cambisol in relief of well-marked ruptures. The compartment II consists of the dissected surface with a strong degree of rock carving of the Areado Group. The association of Red and Yellow Distrophic Latosol (ferric) and Eutrophic Red-Yellow Argisol in relief of short and smooth undulating slopes, Tb Distrophic Hash Cambisol and Lithographic Distrophic Neosol in relief with more severe ruptures occurs. The compartment III is composed of bottom of valleys embedded with wavy tops and rocks of the Bambuí Group. There is an association of Eutrophic Red-Yellow Argisol in short and smooth undulating slopes, Dystrophic Red-Yellow Latosol (ferric) in slopes of flat and long tops, and Haplotype Tb Dystrophic Cambisol in slopes with pointed tops. The morphological and physico-chemical characteristics of the soils associated to the local climate, relief and geology conditioned different degrees of weathering /pedogenesis of the profiles with influences on the chemical functionality of the morpho-pathological units in sample areas of the basin. The chemical composition of the water showed a different behavior in the two analyzed periods, with a higher concentration of chemical elements during the dry season. Concentrations of the chemical elements in the water were above the values considered normal by the Brazilian legislation, suggesting a possible chemical contamination of the surface waters of the basin, which leads to contamination of the environment and, above all, to a possible public health problem for the residents in the basin.

Keywords: Soil attributes, Landscape functionality, Trace elements, Water contamination.
Financial support: CAPES, CNPq and IFMT

(3498 - 465) Natural levels of heavy metals in different soil types from Paraná 3 Watershed, Brazil

Juliane Maria Bergamin Bocardi[1]; Sueli Pércio Quinaia[1]; Adelmo Lowe Pletsch[2]; Fábio Luiz Fronza[2]

UNICENTRO - Universidade Estadual do Centro-Oeste[1]; UTFPR - Universidade Tecnológica Federal do Paraná[2]

Natural background concentrations of heavy metals in the soil refer to the levels of these elements in the environment, under natural conditions, on which they depend on pedogenetic processes and degree of soil development. The area of study covered the region located in the west of the Paraná State, the Paraná 3 Watershed (PW3). A total of 73 composed samples were obtained, of surfasse soils from Conservation Area and Forests Remnants of the 28 cities that are partially or totally inside the PW3. The soils of PW3 include two distinct lithologic groups, in which it was possible to identify six soil types: Red Latosol, Red Nitosol, Regolithic Neosol, Haplic Gleysol, Rendzic Chernosol and Red Alfisol. The heavy metals of the soil samples were extracted by partial digestion with concentrated nitric and hydrochloric acids (3:1), according to the procedures described in USEPA 3051A. The determination of the contents of the heavy metals (Ag, Ba, Cd, Cr, Cu, Fe, Ni, Pb, and Zn) was performed by Coupled Plasma-Optical Emission Spectrometry (ICP-OES) Emission Spectroscopy with Induced Plasma (ICP-OES) and analyzed by soil types. The concentration of most of the elements varied considerably between the different soil types. In the Regolithic Neosols, there were higher medians in the contents of the Ba, Cu, Ni and Zn when compared to the Red Latosols and Red Nitosols (types that predominated in this study). These results may be associated with the nature and thickness of these soils. The Haplic Gleysol had lowest Fe contents, related to the reduction reactions, typical of flooded soils, favoring the formation of more soluble forms of Fe. The Rendzic Chernosols showed that for a large part of the elements (Ba, Cd, Cu, Ni and Zn) their concentrations medians were higher than the other soils types. On the other hand, all elements determined in the Red Alfisol, had in lower concentrations than the other soils types. These results were associated with the parental material. In general, the levels of heavy metals (Ag, Ba, Cd, Cr, Cu, Fe, Ni, Pb, and Zn) presented significant differences among the found soil types, being possible to relate these contents to the main pedological characteristics of each order. The results of this research represent the study area in terms of geological and soil type variations and reflect the natural levels of heavy metals that can serve as reference parameters in other environmental studies.

Keywords: Natural levels, heavy metals, soil types.
Financial support: CAPES, FINEP e CNPQ

(3400 - 1142) Nature of boron and minerals in a Japanese hot spring area

Kazuki Kobayashi[1]; Yohey Hashimoto[1]

Tokyo University of Agriculture and Technology[1]

Boron (B) is recognized as one of the pollutants because of its dose-dependent toxicity. The discharged water from some hot springs in Japan contains high levels of boron (B) that exceeds an effluent standard criterion of 10 mg L^{-1} (Water Pollution Prevention Act, Japan). Boron in the aqueous environment is often associated with aluminum and iron (oxy)hydroxides, calcitic minerals and phyllosilicates, depending on their abundance and chemical properties of water. Elucidation of B behavior in the natural environment is critical for a better water management and remediation strategy in the hot spring area. The aim of this study was to investigate the concentration gradient of B and mineralogy of sediment from the gushing point of hot spring to the downstream of water passage. Discharged water and river sediment samples were collected from the upstream (gushing point) to downstream of river in Matsushiro, Japan. Ionic concentrations of water and mineralogical properties of solids were determined in relation to B. The B concentration in the discharged water was 174 mg L^{-1} at the gushing point of hot spring and decreased to 15.3 mg L^{-1} at the sampling point at 300 m downstream. The decrease of dissolved B concentration toward the downstream indicates that B is (ad)sorbed on or incorporated in minerals. Iron (Fe) and calcium (Ca) concentrations in the discharged water were 14.4 and 832 mg L^{-1} at the gushing point, respectively, and decreased with increasing the distance from the gushing point. In particular, the concentration of dissolved Fe decreased rapidly to 0.09 mg L^{-1} at a distance of 20 m from the gushing point. Color of the sediment samples were gradually changed from brown to white with distance from the gushing point. The XRD data showed that the white-color sediment contained calcites, whereas the minerals in the brown-color sediment consisted mostly of amorphous compounds that were identified as ferric oxides by synchrotron-based scanning transmission X-ray microscope. These Ca and Fe minerals formed in the path of water stream may retain B and decreased dissolved B concentrations.

Keywords: hot spring; drainage; sediment; natural attenuation

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(8847 - 1608) Nitrate leaching in a maize-cover crop rotation in Mediterranean Central Chile.

Alicia Galdames[1]; Manuel Casanova[1]; Yasna Tapia[1]; Ranvir Singh[2]; Miguel Quemada[3]; Osvaldo Salazar[1]
Departamento de Ingeniería y Suelos, Facultad de Ciencias Agronómicas, Universidad de Chile[1]; Institute of Agriculture and Environment, Massey University, Palmerston North 4410, New Zealand[2]; Departamento Producción Agraria, Universidad Politécnica de Madrid, 28040, Spain[3]

In Mediterranean climate regions of the world, the irrigated maize fields with high nitrogen (N) fertilization doses represent a high risk of diffuse nitrate-N (NO_3-N) pollution of receiving water bodies. We, in a large soil leaching columns experiment, studied the losses of NO_3-N from maize cultivation on a coarse-textured soil (Entic Haploxeroll) in Mediterranean Chile. The combined effects of cover crops (CC) and inorganic N fertilisation rates were evaluated on NO_3-N leaching in soil percolation from the soil columns. The study was conducted in a temperature-controlled glasshouse (25°C), on undisturbed soil columns packed in PVC tubes (0.2 m diameter, 0.5 m long), at the Antumapu Experimental Station (33°34'S, 70°38'W). A total of 52 soil columns (13 treatments x 4 replicates) were established and monitored over a period of 2 years (August 2015 to January 2018) to evaluate NO_3-N leaching from: 1) continuous fallow (F) compared with a continuous CC (*Lolium multiflorum* or *Trifolium repens*), with 0 or 150 kg N ha^{-1} applied; and 2) maize-F and maize-CC rotations with two different N doses (250 or 400 kg N ha^{-1}) for the maize and CC (*L. multiflorum* and/or *T. repens*). We found that N-NO_3 concentration in the soil percolation for the continuous *T. repens* was on average 15 mg N-NO_3 L^{-1}, a two-fold higher than the average N-NO_3 concentration in the soil solution for the continuous *L. multiflorum* with 7 mg L^{-1}. Moreover, *L. multiflorum* tended to display higher biomass than *T. repens*. These results highlight that *L. multiflorum* grass species takes up more NO_3-N from the soil solution, resulting into the lowest concentration of NO_3-N leaching in the soil percolation. The presence of the legume (*T. repens*) increased the NO_3-N concentration in the soil solution through N-fixation, hence increased the availability and leaching of NO_3-N in the soil. As expected, excessive N fertilizer application (400 kg N ha^{-1}) increased the NO_3-N concentrations in the soil percolation. The maize cultivation with excessive N fertilization and *T. repens* as a CC resulted into the highest concentration (32 mg N-NO_3 L^{-1}), while the maize cultivation with optimal N fertilization (250 kg N ha^{-1}) and *L. multiflorum* as a CC resulted into the lowest NO_3-N concentration (13 mg N-NO_3 L^{-1}) leaching from the soil columns. It is concluded that the *L. multiflorum* takes up more N from the soil solution, resulting into the lowest concentration of NO_3-N leaching in the soil percolation solution.
Keywords: Agriculture; Water quality; Non-point pollution.
Financial support: Fondecyt Regular 2015, Project Number 1150572

(9453 - 1492) Nutrients enrichment in soils irrigated with treated wastewater

Riat, Martha Cecilia[1]; Cremona, María Victoria[2]; Tanzer, Laura[3]; Velasco, Virginia[4]; Sánchez, Matías[1]; Magnin, Santiago[3]
UNRN[1]; INTA EEA Bariloche[2]; DPA Río Negro[3]; INTA AER Jacobacci[4]

The use of treated wastewater in irrigation is considered an interesting alternative to avoid disposal into water bodies. Water reuse becomes more critical in arid areas where water scarcity obliges to do an efficient use of it. Nevertheless, irrigation with water containing high levels of salts and nutrient contents involves environmental risks that should be contemplated. We conducted this research with treated wastewater coming from the sludge treatment plant of Ingeniero Jacobacci (Río Negro-Argentina, 41°19'19.51"S – 69°30'36.88"), placed in an arid zone with 150 mm of mean annual precipitation . The experiment consisted in a split plot design, comparing the effect of irrigation with well water-WW and treated wastewater-TW, on the soil of a natural vegetation and an alfalfa crop. We took soil samples every 20 cm up to 80 cm depth, at the beginning of the experiment and 9 months after start of irrigation, when crops were fully developed. Apart from other parameters not reported here, we analyzed ammonia- NH_4^+ and nitrate- NO_3^- (Bremner) and available phosphorus-P (Olsen) in all soil samples. We also evaluated dry matter production. We performed an ANOVA with the two types of water as the main factor of interest. Differences of soil nutrients concentration between sample dates were analyzed. In both types of vegetation, soils irrigated with WW showed a reduction of NO_3^- (on average for all depths: -4.2±2) and on P (-4.6±3), and showed similar values of NH_4^+(0.6±0.6) , in agreement with the high demand of the growing vegetation. In plots with TW, differential nutrient contents were in all cases positive (NH_4^+ 10.1± 4.4; NO_3^- 8.8±5.2; P 15.7±3.7), and significantly higher than plots with WW ($p<0.05$), showing an increasing nutrient load with this treatment. Maximum absolute values were found in TW treatment: 12 -NH_4^+, 30 -NO_3^- and 34 –P mg/kg. Dry matter production was similar in both treatments in alfalfa (circa 23000 kgMS/ha), and it was higher in TW than in WW (17000 vs 6600 kgMS/ha) in natural vegetation. Although the maximum values observed do not represent environmental risks yet, a clear trend to a soil nutrient load in treatments with TW irrigation was made evident. These experiments will provide the information needed to develop a precise crop and water management that seek to transform this nutrient load into dry matter production. Anyway, these data show that a rigorous monitoring of environmental impacts is also needed.
Keywords: treated wastewater, irrigation, environmental impacts, mineral nitrogen, phosphorus
Financial support: PI-UNRN 2014; INTA PRET 1281102; DPA

(8118 - 409) Pesticides and Soil

Rojas-Cabezas Edgar[1]
Colegio de Ingenieros Agrónomos de Costa Rica[1]

A high percentage of the pesticides that are applied in agronomic systems do not reach the target organisms, and even a large portion of those that do reach their target organism reach the environment before undergoing physical-chemical transformations. Once the pesticides are incorporated into the environment, they can be transformed in a variety of ways: chemical decomposition, photochemical decomposition, microbial decomposition, volatilization, and movement and physiological decomposition. There are different processes that determine the degree to which these pesticides pollute the environment, the most prominent ones being accumulation, degradation, transport, and microbiological. The vast majority of these processes occur in the soil and are explained as follows: a) Accumulation processes: ion exchange, hydrogen bonds, replacement (chelation), charge transfer, physical forces, hydrophobia. b)Degradation processes: hydrolysis, degradation, hydroxylation, condensation, redox, photodecomposition. c)Transport processes: drag, diffusion, evaporation, leaching.

d)Microbiological processes. Persistence: All pesticides remain in the environment for different periods of time, which are determined by: a)Pesticide-related factors: chemical structure, volatility, solubility, adsorption, formulation, dose, pH. b)Soil characteristics: 1.Clays: Parent material, lamellar load, Cation exchange. 2.Organic matter: exchange capacity, pH, structure, microorganisms. b) Environment-related factors: temperature, precipitation, vegetation cover. c)Other aspects: secondary metabolites, influence on microflora and microfauna, risk of contamination of groundwater. The environmental and edaphic contamination generated by pesticides can be prevented or reduced by applying concepts such as: integrated control, minimum doses, equipment calibration, pesticide selection and rotation of ingredients. Once the environmental/edaphic soil contamination processes have occurred in a severe way, some practices can help to reduce the problem. In recent years, the pesticide industry has made efforts to avoid or reduce environmental/edaphic soil pollution, directing many of its resources to concepts such as: new ingredients, changes in action mechanisms, new formulations, changes in inert ingredients, dose reduction, application technologies, and elimination of uses and ingredients.

Keywords: Soil and recycling, agricultural production
Financial support:

(2676 - 2219) Phytolith production in forage grasses grown in soils contaminated with nickel

Enilson de Barros Silva[1]; Múcio Mágno de Melo Farnezi[1]
Universidade Federal dos Vales do Jequitinhonha e Mucuri[1]

Phytoliths production is directly related to the plant species and the availability of silicic acid in the soil solution. The vegetables absorb the silica when it is in the form of monomeric silicic acid. The polymerization process, acid is transformed into gel and opaque, being deposited in plant tissues as phytoliths. Phytoliths can play an important role in agricultural activities and the preservation of the planet, reducing the problems of plant poisoning in soils contaminated with heavy metals. The species of the family Gramineae presents great capacity to accumulate silica, forming substantial quantities of phytoliths in tissue. The objective of this work is to evaluate the phytoliths production in three forage grasses cultivated in soils contaminated with nickel. The experiment was conducted in a greenhouse in Diamantina (18º14' S, 43º36' W; 1.250 m a.s.l.), Minas Gerais, Brazil. The experiment was carried out in a completely randomized design in the 3 x 3 x 4 factorial scheme, with three soil types classified as Typic Quartzipsamment (TQ), Xantic Hapludox (XH) and Rhodic Hapludox (RH), three forage grasses *Urochloa decumbens* cv. 'Basilisk', *Urochloa brizantha* cv. 'Marandu' and *Megathyrsus maximum* cv. 'Mombaça' and four soil Ni doses (0, 20, 40, and 120 mg kg^{-1}) as pure nickel chloride for analysis with three replicates. At 120 days, the dry weight of shoots of the grasses was influenced by the increasing Ni doses applied to the soil with increase in the first Ni doses in the soil and subsequent decrease with the elevation of these doses. The evaluated cultivars presented a positive response to the increase of Ni doses applied to the soil, presenting a quadratic response to the increase of Ni concentration in the three evaluated soils. The positive response was observed in the growth of the cultivars up to the 40 mg kg^{-1} dose applied to the soil. The cultivars showed good phytolith production capacity with a reduction of production at the dose of 20 mg kg^{-1} with subsequent increase with increase of the Ni concentration in the three types of soil. The sequestration of Ni in phytoliths is of great relevance, since it may explain the non-detection of phytotoxic effects of these metals on the grass, besides excluding them from the trophic web. The high production of biomass and phytoliths by the evaluated forage grasses potentiates them for use in cropping systems in soils contaminated with nickel.

Keywords: soil chemistry, heavy metals, phytoextraction, environmental pollution
Financial support: CNPq, Fapemig, Capes

(7813 - 2277) Phytoremediation of Cadmium by Khaya ivorensis A. Chev. Critical level of toxicity and factors of bioaccumulation and translocation.

Cândido Ferreira de Oliveira Neto[1]; Josilene do Carmo Mescouto de Sousa[1]; Thays Correa Costa[1]; Jessica Taynara da Silva Martins[1]; Liliane Correa Machado[1]; Denilson Pontes Ferreira[1]; Vitor Resende do Nascimento[1]; Susana Silva Conceição[1]; Ana Ecídia de Araújo Brito[1]; Waldemar Viana de Andrade Júnior[1]
Universidade Federal Rural da Amazônia (UFRA)[1]

Soil contamination by cadmium represents a potential agricultural, food-producing, and environmental hazard throughout the world. Faced with the problems caused by this and other metals it is necessary to remove or stabilize the same of the soil, so that there is no contamination of the ecosystems. One of the options for recovering the activity and the diversity of these environments is phytoremediation. With this, the objective of this work was to evaluate the growth responses, physiological and biochemical characteristics of plants of Khaya ivorensis A. Chev. submitted to different doses of $CdCl_2$. The experiment was conducted at the Federal Rural University of Amazonia (UFRA), Belém campus, from December 2015 to April 2016. A completely randomized experimental design with 5 treatments (Control, 10 $ClCd_2$ mg/L^{-1} , 20 $ClCd_2$ mg/L^{-1}, 30 $ClCd_2$ mg/L^{-1}, 40 $ClCd_2$ mg/L^{-1}) and 7 replicates. With increasing doses of the metal, the Khaya ivorensis A. Chev. plants, presented as a response a decline in the biometric, physiological and biochemical parameters, but did not cause the death of the plants. The treatment with the dose of 10 $ClCd_2$ mg/L_{-1} obtained the highest values for both the translocation factor and the bioaccumulation factor, none of the treatments presented a critical level of toxicity. The Khaya ivorensis A. Chev species proved to be an excellent alternative for the phytoremediation method in areas contaminated with cadmium.

Keywords: Ecophysiology, African mahogany, bioaccumulation.
Financial support: CAPES and Federal Rural University of Amazonia (UFRA)

(3183 - 3103) Phytoremediation of contaminated soil with 2,4-D + picloram in eastern Amazon

Jéssica Paloma Pinheiro da Silva[1]; Douglas Pereira Ferreira[2]; Sandra Andréa Santos da Silva[1]; Samia Cristina de Lima Lisboa[1]; Rainerio Meireles da Silva[1]
UFPA[1]; UEPA[2]

The residual effect presented by part of registered herbicide have caused a series of modifications for the environment. For face the contamilation of soil by xenobiotic compounds, an of strategies used is the phytoremediation, which use plants for the extraction/softening of polluting compound. The object this research is evaluate the potential of capim-Braquiarão and capim-Mombaça, largely used in Amazon region, in phytoremediating treated soil with 2,4-D+picloram herbicide, using the radish like bioindicator plant. The experiment was driven in vegetation house, in design fully in two stage. In the first stage the treatment were compounds by cultivation of capim-Braquirão and capim-Mombaça treated with and whitout the dose of herbicide, with five repetition in each treatment. In the second stage, the treatment consisted in cultivation of radish Crimson Gigante in: soil free of herbicide residue; contaminated soil with herbicide with previous cultivation of species capim-Braquiarão; contaminated soil with herbicide with previous cultivation of species capim-Mombaça; and contaminated soil with herbicide without the previous cultivation

of gramidea, with five repetiton each treatment. Vases was used with 8 dm³ and without hole, which received the treatment with 2,4-D+picloram herbicide, of individual form in surface of each vase, in pre-emergency, fifteen days after application proceeded itself the seeding of gramíneas. At fifty days after seeding, the forages were harvested and evaluated their phytoremadiator potential. This was segregated in part area and root, analyzing the parameter of fresh biomass (g), dry biomass (g) and height (cm) of segregated parts for each treatment. After the withdrawal of phytoremediation plants, it was accomplished the transplant, in each vase, of radish. At five, ten, fifteen and twenty days after the emergency (DAE) was evaluated the visual phytotoxicity of radish plants and at twenty DAE it determined itself the accumulation of green and dry material (g), height of plant (cm), the analyzes were used following the same analyze procedure of forages. The results demonstrated that the evaluated gamineas present phytoremediator characteristic for auxinic herbicides, with highlight at capim-Braquiarão. The radish present itself as bioindicator potential of presence from 2,4-D+picloram herbicide, presenting pronounced symptoms at five DAE, when cultivated in contaminated soil without previous acting of gramíneas.

Keywords: Herbicide, Contamination, Urochloa brizantha cv. Braquiarão, Panicum maximum cv. Mombaça, Bioindicator.
Financial support:

(8343 - 1223) Planosols developed under rainfall gradient in the Brazilian semi-arid region

Sebastiana Maely Saraiva[1]; Vânia da Silva Fraga[2]; José Coelho de Araújo Filho[3]; Roseilton Fernandes dos Santos[2]; Raphael Moreira Beirigo[2]; Faed Ribeiro Batista[1]
[1]; UFPB[2]; EMBRAPA[3]

In regions with limits imposed by climatic conditions, such as in the arid and semi-arid regions, soils are poorly developed in the pedogenetic point of view and are generally shallow to little deep. The objective of this work was to evaluate the influence of the rainfall gradient on the and development of three Planosols, in diferente soil forming enviroments, in the state of Paraíba, considering three climatic subtypes according to the annual average: very dry (≤ 400 mm), dry ≥ 400 and ≤ 600 mm) and sub-humid (≥ 600 mm). In each climatic subtype, where trenches were open for sampling of soil, which were characterized as their physical properties (particle size distribution, clay dispersed in water, soil and particle density, flocculation degree and porosity). and chemical (Ca, Mg, Na and K, Al, H + Al, COT, P and pH). It was not possible to observe the relationship between soil depth and the climatic conditions because they are soils formed from rocks of differential resistance to weathering. On the other hand, rainfall was important in the formation of diagnostic horizons (Bt), with clay content proportional to rainfall; there was no clear influence of climate on the availability of nutrients. In some horizons of the studied soils, high levels of salinity were verified in the deeper horizons (B and C), with predominance of Na. This element in high concentrations can impair the productive capacity of soils, as it promotes clay dispersion, pore obstruction and makes it difficult to infiltrate water and air in soils, besides the toxic effects on plants. Considering the values of CTC it is possible to verify that a behavior related to the humidity conditions of each environment, with lower value present in the soil of the subhumid condition, this possibly is due to the base leaching promoted by the higher precipitation indices. The imperfect drainage conditions, due to the presence of impermeable layers especially in arid or semi-arid regions, with low rainfall and high evapotranspiration contribute to increase the concentration of soluble salts in the soil solution (salinity) and, or increased sodicity (PST), interfering with the normal development of plants. The Planosols studied have a salic character, that is, electrical conductivity greater than 7 dS / m within 120 cm of the soil surface.

Keywords: soil classification, pedogenessis, soil fertility
Financial support:

(5943 - 2908) Principal Component Analysis for urban groundwater characterization

Camila Marcon de Carvalho Leite[1]; Edson Wendland[1]
Sao Carlos School of Engineering (University of Sao Paulo)[1]

Groundwater for public supply is a usual alternative, which has grown worldwide. However, different land uses, such as urban, agricultural and manufacturing activities, have modified the chemical properties of groundwater. Quality monitoring and preservation of aquifers are indispensable, in order to maintain their sustainability.This work assesses the chemical characteristics variation of groundwater from 27 wells used for public supply located in the northeast of Guarani Aquifer System, in São Carlos(SP), Brazil.Specifically, we aimed to identify parameters affected by human activities.For the chemical characterization, the following parameters were analyzed: pH, electrical conductivity, redox potential, temperature, major ions and metals in groundwater samples collected from pumping wells, according to Standard Methods for the Examination of Water and Wastewater (APHA, AWWA).A set of quantitative analytical data from the Guarani Aquifer System was processed by descriptive statistical analysis and a multivariate statistical method; Principal Component Analysis (PCA), in order to investigate the groundwater composition.The experimental matrix consisted of 25 physical and chemical variables, determined in 27 groundwater samples. PCA allowed finding out associations between variables, thus reducing the dimensionality of the data table in a 2D matrix.The samples were distributed in two main groups in a Principal Component Analysis (PCA) describing 62.7% of the total samples variability.In the first group, 14 groundwater samples were assigned to 38.7% of the variability, related to geochemical evolution processes, which are characterized by: bicarbonate, calcium, dissolved organic carbon, pH, electrical conductivity, sodium, temperature and magnesium. The second group (5 samples) represents 24% of the variability and consists of chloride, nitrate, Eh, potassium, sulfate and fluoride, which may be associated to anthropogenic origins.It was observed nitrate in 6 samples varying from 0.26 to 2.68 $mg.L^{-1}$ of $N\text{-}NO_3$. Although the concentrations are below the maximum value allowed by CONAMA 357/2005 standard (10 $mg.L^{-1}$), it is important to identify their source since groundwater in a confined aquifer should not be in contact with human sources of contamination.This preliminary groundwater characterization may assist the water resources management by the local Water Supply Company and support future studies on the identification of environmental contamination sources.

Keywords: Hydrochemistry Water quality conservation PCA Contaminant
Financial support: CNPq – Chamada Universal, Project Number: 427579/2016-3

(4749 - 398) Quality reference values for trace elements in soils of Alta Floresta – Mato Grosso, Brazil

Jessica Borges da Veiga[1]; Maria Aparecida Pereira Pierangeli[1]; Marco Antônio Camillo de Carvalho[1]; Antonio Carlos Silveiro da Silva[1]
Universidade do estado de Mato Grosso, UNEMAT[1]

Differences between quality reference values (QRV), established at the state and regional level, have been described in the literature. In this context, the objective was to quantify the natural concentrations and establish QRV for As, Cd, Cu, Fe, Mn, Pb and Zn in typical soils of Alta Floresta, Mato Grosso, Brazil. It was collected twenty soil samples in native forest area with minimal human influence, the layer of 0.00 to 0.20 m. The digestion of the soil samples was based on the SW-846 3050B method, and the determination was carried out by ICP-AES. The results were submitted to descriptive analysis and agglomerative hierarchical cluster analysis (AHA). The QRV, in mg kg^{-1}, obtained from

the 75th percentile were: Fe (26172), Mn (348), Zn (17.3), Pb (<5.5), As (<2.3), Cu (<9.0), Cd (<0.14). These values are below those obtained for some Brazilian and international soil. However, by the AHA, Alta Floresta soils were similar to the national soil. The low contents of As, Pb, Cu, Zn, and Cd are due to soil formation factors of the region: developed on granitic-gneiss rocks, shales, amphibolites and many weathered granites, whose soils evolved due to laterization and podzolization processes. These results confirm the overestimation or underestimation of trace elements at the state and regional level. In this regard, regionalized studies are required to define QRV in order to mitigate these problems.

Keywords: Heavy Metal, Environmental monitoring, Tropical soils, Amazonian biome

Financial support: Mato Grosso Research Support Foundation – FAPEMAT

(6824 - 895) Quantification of nonpoint phosphorus losses derived from soluble fertilizer and cow manure in the Uruguayan Santa Lucía River Basin

Florencia De Lucca Agrelo[1]; Carlos H. Perdomo[1]

Facultad de Agronomía, Universidad de la República[1]

The concentration of specialized dairy-farming systems in the Uruguayan Santa Lucía River Basin has led to an increase in the nutrient concentrations of water bodies, mainly phosphorus (P), accelerating the process of water eutrophication. It has been estimated than more of 80% of P inputs to watercourses and lakes come from nonpoint sources, associated with the P transport by water runoff. Several indexes have been developed to quantify P losses from nonpoint sources, such as the Phosphorus Index (PI). This index estimates P losses from agricultural fields in both the particulate and dissolved forms. Nevertheless, it has been observed that under No Till, where erosion is under control, and with surface fertilizations, dissolved P losses acquire greater relevance. The quantification of these losses under field conditions would contribute to the development of the PI for Uruguay, and made possible to prioritize the application of management practices to the zones of greatest risk of P exportation, resulting in a greater resource use efficiency. The objective of this work is to quantify and compare P losses from soluble phosphate fertilizers and cow manure, both applied on the soil surface without incorporation. These losses will be assessed using runoff plots under natural rainfall conditions. The treatments consist of similar P rates applied as soluble P fertilizer and cow manure, and a control treatment without fertilization. The generated information will be used to design primary P loss reduction systems applicable to management units previously identified as having a high risk of P exportation.

Keywords: eutrophication; nonpoint source pollution; runoff

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(7883 - 2572) Rare earth elements in soil correctives and P-containing fertilizers marketed in Brazil

Fernando Bruno Vieira Da Silva[1]; Clístenes Williams Araújo Do Nascimento[1]; Paula Renata Muniz Araújo[1]

Federal Rural University Of Pernambuco[1]

The mineral exploration of rare earth elements (REEs) and their entry into the soil by pollution or fertilizer application has generated concern about possible environmental impacts and human health. In this sense, we evaluated 60 samples of agricultural inputs (limestone, gypsum and phosphate fertilizers) marketed in Brazil in order to characterize their contents, signature and solubility of REEs. The fertilizers from igneous origin presenting the largest accumulation of REEs. Regardless of origin, the accumulations of the light REEs (Ce, La, Nd, Pr, Sm and Eu) were larger than the heavy ones (Y, Dy, Gd, Er, Yb, Ho, Tb and Lu). The solubility of fertilizers produced from sedimentary sources was greater than that of igneous sources. The mean annual REEs contribution of SSP and organo-mineral + phosphate rock (both of igneous origin) to soils was > 4000 t $year^{-1}$ and the highest additions were for Ce, La, Nd and Y. The limestone contributed 250 t of Gd, more than any other source. Thus, phosphate fertilization and liming were considered to be significant sources of REEs and soils receiving continuously high doses of these inputs are likely to be enriched in REEs.

Keywords: rare earth; phosphate fertilizers; agricultural soil; contamination

Financial support:

(4246 - 642) Sequential extraction of metals in soil and sediments with intensive agricultural activity within the basin of la Villa River-Panama

Adolfo Santo P[1]; Jose E Villarreal[2]; Neldis Basllesteros[3]; Jhon Villalaz[1]

Instituto de Investigación Agropecuaria de panama[1]; Instituto de Investigación Agropecuaria de panama[2]; Universidad Catolica Santa Maria La Antigua[3]

The present study was carried out within the basin of the La Villa river (provinces of Herrera and Los Santos). In these lands historically, a great agricultural activity has been developed, standing out the production of corn, tomatoes, melons, watermelon, beans, chili peppers, sugarcane, beef cattle and milk. They are lands subjected to an intensive use of agrochemicals and influenced by discharges of products of some industrial and agroindustry companies located within the basin. The objective of the study was to determine the environmental risk represented by the concentrations of trace metals in soil and sediments in areas with intensive agricultural activity within the La Villa river basin. 21 samples of soil and sediments were taken from farms of farmers in the rainy season (June-November 2016) and 20 in the dry season (January-April 2017). The total trace metal concentration was determined by extraction with HNO_3 + HCl using continuous source atomic absorption spectrophotometer. The content of Zn, Fe, Mn, Cu, Ni, Pb, Cd, As and Cr was sequentially extracted following the procedure of Keller and Védy to determine to which phase the heavy metal (hydrosoluble, exchangeable, associated with oxides of Fe and Mn, to the organic matter and residual) is bound. Using the procedure of comparison of means of Student's T, the results of the sequential extraction found in both periods were compared according to location within the basin (high, medium and low basin) with a 95% probability. In general, the total concentration was below the levels considered toxic at all sites. When sequencing the Cd, Pb and As showed higher concentrations in the fractions that have greater bioavailability as they are: soluble in water and interchangeable, for the other metals there was a predominance of the residual fraction, showing greater stability and lower risk of Water contamination. When comparing means, in general, the values were kept above 90% probability of staying less or equal to the average value of each fraction, both in rainy and dry seasons. Only the Cr, Ni and As, presented levels of probability above 40% of becoming higher than the average found in the water soluble and interchangeable fractions.

Keywords: pollution, bioavailability, environmental regulations, soil fractions

Financial support: Secretaria Nacional de Ciencia, Tecnología e Innovación (SENACYT). Proyecto ITE06-15.

(6067 - 628) Sharing of fungal species in areas affected by iron tailings after disruption of Fundão dam in Mariana, MG, Brazil

Isabelle Gonçalves de Oliveira Prado[1]; Marliane de Cássia Soares da Silva[1]; Betania Guilhermina Pedrosa[1]; Cynthia Canêdo da Silva[1];

Catarina Megumi Kasuya[1]
Universidade Federal de Viçosa[1]

Fungi are involved in the physical, chemical and biological process in the soil. Therefore, the evaluation of fungi community along the time can be a biological indicator of recovery process, like in areas affected by iron mining disaster, occurred in Mariana, MG, Brazil, in Nov/2015. So, we evaluated the fungi richness in four areas: undisturbed forest (UND-as control) and 3 areas under different stages of recovery (REC1, 2 and 3). Soil samples were collected in Feb/2016 (1st) and Sep/2016 (2nd). These samples were used for routine chemical and molecular analysis. Fungi community profiles were evaluated after total DNA extraction and sequencing of ITS1 region by Illumina Mi-Seq. The results of this sequencing were performed using the QIIME Software, according to BMP protocol, UPARSE method and UNITE database. Venn diagrams were performed in JVENN software to display list of fungi species. Canonical Correspondence Analysis (CCA) was used to analyze the abundance of species joining soil chemical parameters, in different periods of collection and areas. In both period of collection, UND presented highest fungi richness, may be by the absence of disturbance. During 1st collection, in REC1 there was no vegetation and lowest fungi richness. In REC2 and REC3 the revegetation processes have been introduced and intermediate fungi richness was observed. In the 2nd collection, REC1 presented the spontaneous plants growth and it was observed an increase in fungi richness. In REC3, fungi richness was also increased, while in REC2 and UND it was maintained. The fungi richness in the core portion remained constant, but the shared species tended to increase in the 2nd collection, due to the better vegetation covering after 6 months. The CCA showed difference between the UND and REC areas in both collections. REC areas was more influenced by pH, base saturation and P and UND areas by organic matter, K, Mg, Ca and cation exchange capacity. We can concluded that revegetation process has provided an increase in the fungi richness in the recovery areas, but it is distant from the UND by chemical parameters vision. Future functional analyzes of fungi species can elucidate their activities in these environments and follow the change of chemical parameters along the recovery process.

Keywords: diversity, revegetation, soil chemical analysis
Financial support: FAPEMIG, CAPES, CNPq

(3181 - 618) Soil phosphorus vertical mobilization in a Regosol from the semiarid region of Paraiba, Brazil

Kalline de Almeida Alves Carneiro[1]; Marianne Costa de Azevedo[1]; Bruno de Oliveira Dias[1]; Vânia da Silva Fraga[1]; Ignacio Hernán Salcedo[1]; Tancredo Augusto Feitosa de Souza[1]
Universidade Federal da Paraíba[1]

In sandy soils, phosphorus vertical mobilization (PVM) could be very dangerous for environment and water quality. We hypothesized that in a sandy soil, as a Regosol, with high contents of soil phosphorus available in water (Pw), soil P leaching could be promoted by soil P mobilization through its transport from soil surface to deepest layers. Our aim here, was to evaluatedsoil PVM in a sandy soil using soil columns (10 cm depth) during steady saturated water flow, and correlated PVM with soil Fe and Al oxides contents and forms.Our soil samples were collected in four different areas in field conditions. The soil was classified as a Regosol, and the studied areas were characterized as smallholder farming systems.We analyzed and extracted the soil phosphorus available in water and the forms of Fe and Al oxides with high and low crystallinity. The application of miscible displacement technique to soils was used to promote soil P leaching, and the P was quantified by colorimetry. In our field study, we have detected three soil conditions: a) high contents of P_w(20.20 mg kg^{-1}); b) medium contents of P_w (14.00 mg kg^{-1}); and c) low contents of Pw (<12 mg kg^{-1}). We found that the area with the highest P_w content showed the highest P loss. In the other hand, the lowest P loss was found in soil samples from areas that showed low content of $P_w$associated with the highest contents of $Al_2O_{3(ox)}$, $Al_2O_{3(dit)}$, $Fe_2O_{3(ox)}$ and $Fe_2O_{3(dit)}$ (0.98, 0.60, 0.44 and 0.60 g kg^{-1}, respectively) and high crystallinity. There is no significant different between areas with medium and low P_w content for PVM. We also observed that where the contents of Fe and Al oxides were high, there were influence of these oxides on P adsorption resulting in a low P loss. Also, in our study we can assume that there are two main ways where phosphorus vertical mobilization could be influenced by $Fe_{(ox)}/Fe_{(dit)}$ratio and $Al_{(ox)}/Al_{(dit)}$ ratio. Frist, we found higher P loss in soil conditions with high $Fe_{(ox)}/Fe_{(dit)}$ratio (8.34 dag kg^{-1}), when compared with soil conditions with low $Fe_{(ox)}/Fe_{(dit)}$ratio (4.84 dag kg^{-1}); and second, we found higher P loss in soil conditions with low $Al_{(ox)}/Al_{(dit)}$ ratio (4.84 dag kg^{-1}), when compared with soil conditions with high $Al_{(ox)}/Al_{(dit)}$ ratio (13.27dag kg^{-1}). So, we conclude that (1) there are a strong relationship with high contents of P_w with high rates of PVM; and (2) the forms of Fe and Al oxides with low crystallinity can influence PVM in a Regosol.

Keywords: Keywords: phosphorus leaching, sorption, soil colloids.
Financial support:

(6911 - 2243) Soil-mimicking hybrid composites based on clay, polymer and nitrogen-fixing bacteria for the development of remediation systems of degraded soil

Tulio Lerma[1]; Manuel Palencia[2]; Enrique Combatt[3]
1- GI-CAT, Department of Chemistry, Universidad del Valle, Cali, 25360, Colombia; 2-Mindtech Research Group (Mindtech-RG), Mindtech S.A.S, Cali, 25360, Colombia[1]; GI-CAT, Department of Chemistry, Universidad del Valle, Cali, 25360, Colombia[2]; Department of Agricultural Engineering and Rural Development, Universidad de Cordoba, Montería, 230002, Colombia.[3]

The constant deterioration of the soil as a consequence of natural and anthropogenic processes causes the loss of the clayey fraction and humified organic matter, leading inevitably to the formation of nutrient-poor soils with low fertility and low agricultural productivity. It is suggested by us that an efficient and easy restoration of soils can be possible by addition of materials structurally and functionally like to soil particles. Thus, the objective of this work was to develop soil-mimicking materials from polymer-clay hybrid composites in conjunction with nitrogen-fixing bacteria for the development of remediation systems of degraded soils. For this, montmorillonite was chemically modified with trichlorovinylsilane in order to produce surface activation of clay to promote the covalent links of poly(acrylic acid) which is a soil polymer conditioner. Acrylic acid was polymerized by free radical polymerization in the presence of modified clay and using ammonium persulfate as initiator. Units of sorbitol and citric acid were chemically incorporated in the polymer matrix by sequential esterification. Later, the bacterium *Azotobacter chroococcum* (nitrogen-fixing bacterium) was inoculated in the matrix previously hydrated by direct swelling with water. Finally, system was dried and activated to verify the bacterial reactivation. Parallel experiments were performed without the use of microorganisms, without esterification and in absence of clay-polymer composites. The material obtained was characterized by elemental analysis, thermal analysis, infrared spectroscopy and scanning electron microscopy. In addition, absorption water capacity, capacity of cationic exchange, capacity of buffering and ability of microorganisms to be metabolically

activated by addition of water were analyzed. From of results, it is concluded that through the proposed methodology it is possible to synthesize soil-mimicking hybrid systems, in structure and functionality, using as model the supramolecular ensemble clay-humin-humic acids. In addition, it is demonstrate that this artificial system can be used as potential suitable means for the development of microorganisms that promote plant growth, such as *Azotobacter chroococcum*.

Keywords: Soil polymeric conditioner, humified organic matter, degraded soils

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(4700 - 2105) Soil-plant transfer factors and risk analysis of potentially toxic elements in vegetables and garden soils

Eloa Moura Araujo[1]; Clistenes Williams Araujo do Nascimento[2]; Luís Reynaldo Ferracciú Alleoni[1]

Luiz de Queiroz College of Agriculture, 11 Pádua Dias Ave., Piracicaba, 13418-900, Brazil[1]; Federal Rural University of Pernambuco, n/n Manuel de Medeiros St., Recife, 52171-900, Brazil[2]

Vegetables have different abilities to uptake and accumulate potentially toxic elements (PTEs). Soil attributes and the farming system (conventional or organic) play an important role in the PTEs' phytoavailability and influence the risk for human health. Our aims in this study were to: (i) determine the levels of Ba, Cu, Mn, Ni and Zn in soils and in vegetables produced under organic and conventional systems; (ii) investigate the transfer of PTEs to plants through soil-plant transfer factors; and (iii) estimate the human health risks associated to consumption of these vegetables as affected by farming systems. Samples of edible parts of organically and conventionally produced lettuce (*Lactuca sativa*), onion (*Allium sepa*), bell pepper (*Capsicum annuum*) and tomato (*Solanun lycopersicum*) were collected in the state of Pernambuco (Brazil). Soil samples were collected from the uppermost soil layer (0 – 20 cm). PTEs in plants were extracted through HNO_3 and H_2O_2 digestion. The pseudototal fraction of the PTEs in soils was extracted by a 1:3 $HCl:HNO_3$ (v/v) solution; reactive fraction was extracted by 0.43 mol L^{-1} HNO_3, and DTPA extracted the available contents of PTEs. The ratio of the content of PTEs in the soil samples (pseudototal, reactive and available fractions) and the total PTEs concentration in vegetables were used to estimate the transfer factors. Soil-plant transfer factors and risk concentration were calculated to assess the interaction of PTEs concentrations in plant and soil with human health risk. In general, vegetables accumulated Zn and Cu, and excluded Ba, Mn and Ni. Lettuce leaves presented the highest ability to accumulate PTEs. Contents of PTEs were higher in vegetables grown on conventional as compared to organic farming. Soil-plant transfer factors obtained from different soil extractants had contrasting results when organic and conventional systems were compared. The use of human risk assessment provides good information to complement the traditional environmental studies based on the PTEs concentrations in plants and soils. Regardless of the scenario considered, children and adults in contact to vegetables from the organic system had a lower health risk than individuals exposed to lettuce leaves conventionally produced.

Keywords: heavy metals; production system; horticultural crops; BCF; human health

Financial support: São Paulo Research Foundation (FAPESP), Project number 2015/25416-0; National Council for Scientific and Technological Development (CNPq).

(1495 - 1217) Sorption of clomazone by soils formed on calcite and calcite-dolomite bedrock (Piva Mountain)

Petar Raičević[1]; Lazar Kaluđerović[1]; Zorica Tomić[1]; Rada Đurović-Pejčev[2]; Jovica Vasin[3]; Snežana Jakšić[3]; Aleksandar Đorđević[1]

Department of Soil Management, Faculty of Agriculture, University of Belgrade, Nemanjina 6, Belgrade 11000, Serbia;[1]; Laboratory of Chemistry, Institute of Pesticides and Environmental Protection, Belgrade 11000, Republic of Serbia[2]; Laboratory for Soil and Agroecology, Institute of Fields and Vegetable Crops, Maksima Gorkog 30, Novi Sad 21000, Serbia[3]

This paper provides preliminary information about the sorption of the pesticide clomazone by two different soil types, calcomelanosol (Mollic Leptosols, Barni Do locality) and calcocambisol (Cambisols, Babići locality). These two types of the soil represent two phases in soil evolution on carbonaceous geological substrate. Clomazone sorption was examined using batch adsorption method. Clomazone isotherms for all samples showed non-linearity. All samples showed L-type adsorption isotherms. Mineral composition of the clay fraction was examined using XRD diffraction method. Results indicated that difference in sorption rate could be explained with mineral composition of the clay fraction in soil. In the clay fraction of all samples (>0,002), high content of the kaolinite and vermiculite was established, as well as small amount of smectite and mixed layered silicates. Better adsorption of clomazone on the sorption centers of the sample 26, when compared with samples 29A and 29B was indicated by the higher log *Kf* value. This Freundlich coefficient was 0.562 in sample 26, while in the samples 29A and 29B was 0.357 and 0.512, respectively. Batch adsorption experiment showed that the mineral composition of the clay fraction affect clomazone sorption in the soil. Based on the analysis of the mineral composition and based on the batch adsorption analysis, it can be concluded that the sorption of clomazone in these samples depends primarily on the content of the smectite and decreases in the order 26 > 29B > 29A, as well as the content of smectite in these samples. Transformation of micas led to the release of K^+, and dissolution of calcite led to the release of Ca^{2+}. Exchange of K^+ ions with Ca^{2+} ions in the interlayer space led to the transformation of micas to vermiculite, mineral that usually doesn't occur as typical in the soils formed on carbonaceous geological substrate.

Keywords: calcomelanosol (Mollic Leptosols), calcocambisol (Cambisols), adsorption, pesticide, XRD

Financial support: This work was supported by the Ministry of Education, Science and Technological Development of the Republic of Serbia (Project No. 176010 and Project No. 31043).

(1918 - 3076) Spatial econometric modeling of soils with high cadmium content in cocoa producing areas of Yacopí, Colombia

Heidy Soledad Rodríguez Albarrcín[1]; Aquiles Enrique Darghan Contreras[1]

Facultad de Ciencias Agrarias, Universidad Nacional de Colombia sede Bogotá[1]

Cadmium (Cd) is a highly toxic heavy metal that causes harmful effects in soils, plants, microorganisms and humans. Plants take cadmium from available forms of this element in the soil. In Latin America, Cd contents have been reported in cocoa beans superior to those allowed by international standards in processed products, which generates monitoring alerts in order to assure the safety of the product. Based on a preliminary study on cocoa production systems in a region of Colombian Andean zone in which the soil levels of total Cd, available Cd, and Cd in plant tissue were characterized; the relationship of the element and some chemical properties of the soil with the plant contents was evaluated by spatial econometrical models, and areas with higher concentrations were identified, showing high Cd contents in the locations with the highest pH (4.9 - 6.7) and higher Zn concentration (59 - 119 ppm). Four farms with Cd in cocoa beans contents higher than 3 mg / kg were selected over these zones, and the total Cd (extracted with aqua regia), and available Cd (extracted

DTPA) at two depths of the soil, 0-30 and 60-100 cm, was determined, and the available fractions of the element at 0-30 cm, making use of sequential extraction techniques. It was observed that when going from the depth of 0-30 cm to 30-60 cm the levels of the element (available and total) were reduced, and it was found by spatial econometric modeling with delay in explanatory variables that up to 30 cm of depth the contents of almond Cd was statistically associated to Cd in leaves, litter, total and available, as well as the pH of the soil. In reference to fractionation, the almond Cd showed high correlations with respect to the interchangeable Cd (r = 0.78), Cd associated with carbonates (r = 0.71), Cd in manganese oxides (r = 0.65), residual Cd (r = 0.62) and Cd in organic matter (r = 0.45). More than 90% of the total Cd is distributed in the fractions easily and moderately available for the plant, finding high correlations between the available Cd, exchangeable (r = 0.9), in carbonates (r = 0.94), in manganese oxides (r = 0.87) and organic matter (r = 0.8). Soils with the highest total Cd content are mainly associated with carbonates and high concentrations of Cd in the parent material, which suggests an adequate management of fertilization based on a preliminary soil study to avoid increasing Cd concentrations.

Keywords: Cacao bean, spatial econometrics, fractionation, leaf litter
Financial support: Subproject of the project "Improvement of the technology of production of cocoa in the provinces of Rionegro and Alto Magdalena, Cundinamarca" of CTA Derivado-2, financed by the Government of Cundinamarca and the Mayor of Bogotá D.C.

(5809 - 2637) Sulfonamide and fluoroquinolone electro-oxidation and their vinculation with kinetic and computational parameters.

Danilo Ramos[1]; Camila Canales[1]; Angélica Fierro[1]; Mónica Antilén[1]
Pontificia Universidad Católica de Chile[1]

In the livestock industry, a big quantity of antibacterials belonging to the group of fluoroquinolones and sulfonamides has been used, with the aim of treating diseases in animals. In this context, these drugs are not completely absorbed by the organism, they are excreted in the feces, reaching the agricultural soils and observing an important presence in the environment, without losing their pharmacological activity. Due to the above, this work aims to establish the connection between computational parameters and a kinetics-electrochemical study of a group of sulfonamides (sulfachloropyridazine, sulfadiazine, sulfamethazine, sulfamerazine, sulfamethoxazole and sulfathiazole) and fluoroquinolones (ciprofloxacin, danofloxacin, enrofloxacin, norfloxacin and sarafloxacin), in order to understand adsorption processes on the organic fraction of volcanic soils. The use of cyclic voltammetry as electrochemical technique allows us to find the optimal working pH (7.0), since it requires a lower overpotential to carry out the oxidation reaction of antibiotics. In relation to the electrochemical study, it was determined that the oxidation reaction for these molecules corresponds to an irreversible process controlled by diffusion, in all cases. In this way, through the analysis of the slope between the peak current (Ip) versus the square root of scan rate ($v^{1/2}$), as suggested by the Randles-Sevcik equation for an irreversible process controlled by diffusion, it is possible to obtain the number of electrons transferred in the whole reaction. Then, an antimicrobial was selected from each family to determine the analytical parameters such as the average calibration curve, R^2, limit of detection (LD) and limit of quantification (LQ). Parallel to this, the HOMO-LUMO gap was obtained using quantum calculations, observing a clear difference between fluoroquinolones and sulfonamides, being the last one with greater magnitude between 2 and 3 eV of difference as well as a wide difference between the dipolar moments presented by each family of antimicrobials. Comparing the results obtained from both studies it can be seen that each drug has a similar dipole moment for each family due to the conformational structure. This latter observation has a close relation with the peak oxidation potentials due to the electron-availability of the molecule to carry out the oxidation reaction.

Keywords: Cyclic voltammetry, Fluoroquinolones, Sulfonamides, Electrochemical kinetics.
Financial support: CEDENNA FB-0807, Facultad de Quimica UC, CONICYT PIA/ACM170002

(3776 - 1571) Sulfur supply on growth of lettuce plants exposed to barium toxicity

Arnon Afonso de Souza Cardoso[1]; Ana Paula Pereira Nunes[1]; Éder Rodrigues Batista[1]; Lorena Carmen Hernandez Nataren[1]; Márcio Felipe Pinheiro Neri Nunes[1]; Valdemar Faquin[1]; Maria Ligia de Souza Silva[1]
Federal University of Lavras[1]

Barium (Ba) is a non-essential element for plants, but it can accumulate to toxic levels. Availability of Ba in soil can be reduced by sulfur (S), through barium sulfate formation. Thus, we aimed to evaluate S supply on growth of lettuce (*Lactuca sativa* L.) under barium toxicity. Plants were grown in pots (2.5 dm^3) with Oxisol under greenhouse conditions. Soil received combinations of five Ba rates (0; 150; 300; 450 and 600 mg dm^{-3}) with three S rates (0; 40 and 80 mg dm^{-3}), in randomized block design, with four replications and two plants per pot. At 30 days after transplanting, plants were harvested for shoot and root dry matter evaluation. Shoot and root dry matter shown linear reduction with increasing Ba rates. Inhibition on dry matter production by Ba levels was stronger in plants with lower S supply, mainly with application of 600 mg dm^{-3} of Ba. S supply alleviated toxic effect of Ba on dry matter production, mostly with S rate of 80 mg dm^{-3}. When 600 mg dm^{-3} of Ba was added in soil, we observed increase of 80% in shoot dry matter production of plants grown under 80 mg dm^{-3} of S compared with plants without S addition. S supply attenuate toxicity of Ba on lettuce growth, and can used as alternative management for soils contaminated with high levels of Ba.

Keywords: *Lactuca sativa*; phytotoxicity; soil contamination.
Financial support:

(4757 - 936) The chemistry of legacy phosphorus in US Mid-Atlantic agricultural soils

Kathryn D. Szerlag[1]; Donald L. Sparks[1]
University of Delaware[1]

Phosphorus is an essential plant nutrient and is applied to agricultural soils as fertilizer or manure to promote optimal crop yield. Unfortunately, phosphorus loss to both fresh and salt water ecosystems can be extremely detrimental to aquatic life and water quality due to eutrophication caused by nutrient enrichment. By determining the phosphorus species present in soils, we are able to better understand phosphorus availability to plants and environmental susceptibility to nutrient enrichment. Although phosphorus in soil has been extensively researched, little direct evidence exists for the solid phase species of phosphorus that occur. Direct speciation of phosphorus will allow for improvement in fertilizer recommendations, updated best management practices, and informed remediation strategies to prevent phosphorus losses to aquatic environments. Until the recent application of synchrotron based light sources to investigate phosphorus in soils, there has not been a direct method to accurately determine phosphorous speciation. This research utilizes multiple tools including stirred-flow methods to analyses phosphorous release kinetics, and synchrotron based techniques to directly investigate the chemical forms and stability of legacy phosphorus (in excess of 800 mg/kg) from agricultural soils located on the Delmarva peninsula (Delaware, USA). Mineralogical characterization (XRD) of the soils will be presented. Soils will also be subjected to the Hedley sequential extraction to

investigate phosphorus contributions from different pools, such as metal oxide or phyllosilicate associated phosphorus. Phosphorus K-edge X-ray absorption near edge structure (XANES) data from bulk soils will be presented. High resolution, micro X-ray fluorescence (m-XRF) mapping of phosphorus "hot spots" within the soil sample and their association with iron, calcium, and aluminum will also be presented. Micro XANES (m-XANES) will probe these "hot spots" to directly determine phosphorus speciation. By using these methods, we will be able to determine the types of phosphorus (i.e., surface adsorption or precipitation) occurring within the soil, which ultimately dictate phosphorus availability and mobility to both crops and the environment.

Keywords: legacy phosphorus, eutrophication, phosphorus speciation
Financial support: USDA

(5026 - 609) The effects of growth stage and iron oxides deposited on rhizosphere soil on the accumulation of cadmium by rice grains of different genotypes

Chien-Hui Syu[1]; Pin-Ming Chen[2]; Yu-Cheng Lai[2]; Kai-Wei Juang[2]
Agricultural Chemistry Division, Taiwan Agricultural Research Institute, Council of Agriculture, Executive Yuan, Taiwan[1]; Department of Agronomy, National Chiayi University, Chiayi City, Taiwan[2]

Rice consumption is a major pathway of cadmium (Cd) exposure to the human for the population of Asia, and the intake of Cd through the food chain may lead to serious health effects such as cancer and kidney problems. Therefore, developing the suitable practical countermeasures to reduce the Cd uptake by paddy rice is an important and urgent task nowadays. This study investigates the effects of growth stage and iron oxides deposited on rhizosphere soil on the accumulation of cadmium by rice grains of different genotypes. Twenty-seven cultivars commonly planted in Taiwan including 6 indica and 21 japonica rice were used in a field experiment. The sample of rice plants and rhizosphere soils were collected at grain-filling and mature stages, and the amounts of Cd and iron (Fe) in iron oxides of rhizosphere soil and iron plaque, and those elements in rice plants (root, shoot and brown rice) were measured. The results showed that the average Cd concentration in brown rice for indica rice was higher than that for japonica rice. Around half of the used rice genotypes including 5 indica and 8 japonica rice were found accumulating Cd in brown rice exceeding the tolerable level 0.4 mg kg^{-1}. And there was the significant positive correlation between the Cd concentrations in brown rice and the raises of Cd concentration in the shoot from grain-filling to mature stages. This suggested that the growth period from grain-filling to completely mature was the key stage for accumulating Cd in brown rice. In addition, the relative tendency of Cd sequestration toward rhizosphere soil was negatively correlated with the Cd concentrations in brown rice; however, the root surface to form iron plaque showed stronger affinity to soil-available Cd than did the iron oxides deposited on rhizosphere soil. Consequently, the rice genotypes with higher iron oxides deposited on rhizosphere soil would have less Cd accumulation in rice grains. Moreover, the enhancement of iron oxide deposits on the rhizosphere soil at grain-filling stage could be as a practical countermeasure to reduce Cd accumulation in rice grains grown in Cd-contaminated soils.

Keywords: Cadmium、Rhizosphere soil、Irox oxide、Iron plaque、Paddy rice
Financial support:

(1782 - 1471) The impact of redox potential and salinity on As cycling and mobility in goethite systems

Joshua Z. Sanchez[1]; Jason W. Stuckey[2]; Donald L. Sparks[1]
University of Delaware[1]; Multnomah University[2]

Climate change and subsequent sea level rise (SLR) are global issues, especially since population and industry are heavily concentrated in coastal areas. Contaminated soils are commonly located along the shorelines, which can be problematic due to future flooding events caused by storm surges and SLR. Soil contaminants, such as arsenic (As), may be desorbed and released into solution as a result of flooding and/or salinization of the current freshwater conditions. Previous findings by our group from an As-contaminated field site (Wilmington, DE) suggested freshwater facilitated higher mobilization of As from contaminated soils than seawater. However, geochemical controls governing As cycling in variable saline and brackish water environments are largely unknown and warrant further research. To address this knowledge gap, model systems consisting of goethite (a common soil mineral), arsenate [As(V)], and arsenite [As(III)] were reacted in state-of-the-art microcosms over salinity and redox gradients to probe As cycling processes. In order to determine As distribution independent of redox potential, separate batch sorption experiments as a function of As concentration, salinity, or pH were first carried out. Sorption data revealed that seawater systems retained more As(V) on the solid phase at a higher pH compared to freshwater systems. Utilizing the microcosm experimental setup, redox potential was abiotically decreased from +200 to -300 mV while collecting slurry samples every 100 mV. Solid phase samples were analyzed via As and Fe K-edge XANES and EXAFS spectroscopy to determine As/Fe speciation, goethite structure, and local As bonding environment. Results from this study will improve the current understanding of As cycling and contribute to As management strategies in coastal communities with SLR impacted soils.

Keywords: sea level rise, arsenic geochemistry, trace metal cycling
Financial support: National Science Foundation EPSCoR Grant No. IIA-1301765, the State of Delaware, the Delaware Environmental Institute

(2772 - 2601) The influence of different mining compounds on phytotoxicity of Cu in field-collected soils

Pedro Mondaca[1]; Carlos Guzmán[2]; Alexander Neaman[1]
Pontificia Universidad Católica de Valparaíso[1]; Universidad de Castilla-La Mancha[2]

Environmental problems historically associated with Cu mining are widely known. Particularly, smelter dust and tailing sand are common Cu-rich particles in mining areas of central Chile. Previous studies demonstrated that Cu has higher solubility in soils spiked with smelter dust, in comparison with soils spiked with tailing sand. However, this difference could be masked in the field if Cu reaches an equilibrium state with the soil through aging processes. Thus, this study aimed to (1) elucidate the long-term behavior of Cu from smelter dust and from tailing sand in soils, and (2) compare the phytotoxicity of these two mining compounds in historically contaminated soils. Thereby, 21 agricultural topsoils contaminated with smelter dust and 21 agricultural topsoils contaminated with tailing sand were collected in a semiarid region of central Chile. All soils were historically contaminated (more than five decades). Physicochemical characteristics were determined by using routine methods. Additionally, total and soluble concentration of Cu, Zn, Pb, and As were determined by atomic absorption spectrometry (AAS). Besides, phytotoxicity of each soil was assessed through a bioassay with ryegrass (*Lolium perenne* L.). After 21 days of growth on each soil, shoot length of ryegrass was measured and the aerial part was harvested and used to determine foliar Cu content. Laboratory analyses showed that soil total Cu and soil soluble Cu were statistically similar in both areas. However, shoot length of ryegrass did show differences between two studied areas. Specifically, regression analyses revealed that shoot length of ryegrass decrease in function of the total Cu concentration in soils contaminated with smelter dust, but this correlation was not significant in soils contaminated with tailing sand. In soils contaminated with smelter dust, it was possible to determine EC_{10}, EC_{25}, and EC_{50} of total Cu in the soil of 336 mg

kg^{-1}, 429 mg kg^{-1}, and 533 mg kg^{-1}, respectively, using the shoot length as a response variable. These results suggest that Cu phytotoxicity thresholds based only on the soil total Cu concentration can overestimate environmental risks. In consequence, this study conclude that it is crucial to distinguish the type of mining compound in soils contaminated by Cu mining industry in Chile.
Keywords: Copper, smelter, bioavailbility, effective concentration.
Financial support:

(6291 - 668) The potential use of *Lolium perenne* L. as cover crop in alleviating Copper toxicity in vineyard soils.

Gustavo Brunetto[1]; Stefano Cesco[2]; Tanja Mimmo[2]; Youry Pii[2]; Fabio Valentinuzzi[2]; George Wellington Bastos de Melo[3]; Carlos Alberto Ceretta[1]; Lessandro De Conti[4]

Universidade Federal de Santa Maria[1]; Libera Università di Bolzano[2]; Embrapa Uva e Vinho[3]; Instituto Federal Farroupilha[4]

High levels of copper (Cu) in agricultural soils can cause toxicity to commercial crops as grapevines. The use of Cu tolerant cover crops might help alleviating Cu toxicity of the commercial crop via different rhizosphere processes. Thus, this study aimed at assessing the mechanisms involved in the mitigation of Cu phytotoxicity. Seedlings of *Lolium perenne* L. were hydroponically grown in controlled conditions with 4 different levels of Cu (0.2, 5, 25 e 50 µM) for 14 days. Furthermore, iron (Fe) was supplied as either Fe-EDTA or Fe-EDDHA. The pattern of root exudates has been determined during plant growth. At harvest, roots and shoots were separated assessing both fresh and dry weight and their nutrient content. Root morphology parameters were measured and root content of organic acids and total phenols was also determined. Results showed that the release of total phenols and chelating compounds and the root content of total phenols increased with increasing Cu concentration. Lolium plants showed slight Cu toxicity symptoms at the highest dose diagnosed by the reduction in dry matter yield and morphological changes in the roots (reduced root lenght and volume). Copper was mainly accumulated in roots, yet lolium plants were also able to translocate significant Cu concentrations to the shoots. The source of Fe had a small influence on plant growth parameters, nutrient accumulation and root exudation being restricted to the highest Cu concentration (50 µM). At this Cu level, FeEDTA presented lower Cu concentration in both shoots and roots: most likely part of the Fe chelate (EDTA) interacted with Cu complexing Cu^{2+} and consequently reducing its bioavailability. These results highlight the importance of the nutrient source affecting not only the uptake and accumulation of the nutrient itslef but also of other nutrients. In conclusion, our results suggest that *Lolim perenne* expresses two different mechanisms to alleviate Cu toxicity of the neighbouring plants by a) promoting Cu translocation and its compartmentalization at the shoot level and b) reducing Cu bioavailability as a consequence of the release of Cu-complexing exudates.
Keywords: copper toxicity; cover crops; rhizosphere; root exudates.
Financial support: Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) through the Programa de Doutorado Sanduíche no Exterior (PDSE - Edital nº 19/2016). Free University of Bolzano (TN2053, 2081).

(7161 - 1724) Toxicity of pesticide used in the forest system in the survival of the species *Folsomia candida*

André Junior Ogliari[1]; Carolina Riviera Duarte Maluche Baretta[1]; Isabela Aparecida Giordani[1]; Elizeu Moizés Bonfim[1]; Talyta Zortéa[2]

Universidade Comunitária Regional de Chapecó - UNOCHAPECÓ[1]; Universidade Tecnológica Federal do Parana – UTFPR[2]

The demand for wood products in Brazil has led to the expansion of silviculture, making it necessary to use pesticides in monocultures to avoid pests that may affect the development and survival of seedlings (LE et al., 2012). It is not known the real impact caused by the use of pesticides on the terrestrial biota, or even on organisms that play important roles in the decomposition of organic matter, such as the springtails (DAMÉ et al., 1996). This study aimed to evaluate the toxicological potential of a pesticide used in a forest system, on the survival of the specimens *Folsomia candida*. The experiment was conducted in a completely randomized design using Tropical Artificial Soil (TAS) as a standard soil, composed of sand, coconut fiber and kaolin. The lethality test was performed with the specimens *F. candida*, which followed the recommendations of ISO 11267 (1999), with six replicates for each concentration of the Comet® (pyraclostrobin) defensive, based on the application recommendations for forest species (0, 58, 140, 350, 525 and 875 µL). Each experimental unit received 30g of contaminated soil and ten individuals aged 10-12 days. The tests were maintained at temperature 20±2 °C and photoperiod of 12:12h (light/dark). The survival assessment was performed at 28 days. The results were submitted to analysis of variance (ANOVA One-way), followed by the Dunnett test ($p < 0.05$). Acute toxicity (lethality) tests met the validation criteria in accordance with the respective guideline. The survival of springtails in the control was greater than 80% and the coefficient of variation was less than 30% (CV = 12.5%). The survival of *F. candida* was not significantly affected by the tested concentrations of the Comet®. There are no other studies testing the toxicity of pyraclostrobin, the active ingredient of Comet®, in *F. candida*. We suggest to extend the study to the effect of the product in natural soil, to prove the effects obtained in artificial soil. Toxicological assays with aquatic invertebrates and fish indicated a highly toxic potential of this fungicide for such organisms (BRINGOLF, et al., 2007; ZHANG et al., 2017). It is concluded that the commercial product Comet®, was not able to cause toxicological effects in the survival of organisms of the species *Folsomia candida* in the concentrations tested.
Keywords: terrestrial ecotoxicology; *Folsomia candida*; pesticides.
Financial support: CAPES - Coordenação de Aperfeiçoamento de Pessoal de Nível Superior

(1963 - 2694) Trace elements in sediments and water quality of rivers affected by the rupture of Fundão Dam

Fábio Fernandes Maia[1]; Jaime Wilson Vargas de Mello[1]; Renato Welmer Veloso[2]

Universidade Federal de Viçosa[1]; Instituto Federal de Rondônia[2]

The Doce River is formed by the confluence of Carmo and Piranga rivers. It crosses the east of Minas Gerais and the Espírito Santo states, passing through cities where it plays important role maintaining the riparian ecosystems and water supply. In November 2015, the Fundão tailing dam, located at Mariana City in Minas Gerais state, ruptured and released around 40 million m^3 of iron ore tailings in Carmo River. It caused environmental impacts and compromised the water supply for many cities. The objective of this study was to evaluate the water quality, the trace elements contents in sediments, as well as to investigate the mobility of these elements in the rivers Carmo and Doce. Water and sediment samples were collected at 8 sites in these rivers. Dissolved oxygen, pH, true color, turbidity, *Escherichia coli*, total suspended solids and As, Cd, Co, Cr, Cu, Mn, Ni, Pb and Zn concentrations were assessed in water samples. In the sediments were quantified the contents of As, Cd, Co, Cr, Cu, Hg, Mn, Mo, Ni, Pb, V and Zn. Acid digestion as requested by USEPA methods SW-846 3015A and SW-846 3051A were used to obtain the concentrations of the elements in the water and in the sediments, respectively. Exchangeable, reducible, oxidizable and residual fractions of the chemical elements in the sediments were evaluated by sequential extraction by BCR protocol. For the two rivers evaluated, the values

obtained for pH, true color and total suspended solids were in agreement with the tolerance range established by the Brazilian environmental rules. However, the values of dissolved oxygen, turbidity and *E. coli* were above the established limits. The soluble As in both rivers were also above the established threshold for fishing and aquaculture, but within the tolerance range for irrigation and water supply. Soluble Mn exceeded the maximum value in two sites collected at Doce River and soluble Zn in only one site of Carmo River. These result indicated local contaminations of these elements. The sediments of Carmo and Doce rivers presented similar chemical composition for the analyzed elements. High levels of Cd compared to the investigation value (VI) were detected in sediments. Additionally, Hg levels were above the prevention value (VP). Most of the elements in the sediments, excepted Mn, were associated to the residual fraction. The data indicates the low mobility of these elements, due to its association in the minerals crystalline network.

Keywords: Mariana City, Doce River; water pollution; acid digestion; sequential extraction
Financial support: CAPES and FAPEMIG

(2707 - 971) Transfer Factors by Cadmium, Lead and Cobalt from Soil to Tomato Plants Cultivated in Nova Friburgo Region – Rio de Janeiro

Fábio Freire de Sousa[1]; Margarida Goréte Ferreira do Carmo[1]; Erica Souto Abreu Lima[1]; Nelson Moura Brasil do Amaral Sobrinho[1]
UFRRJ[1]

Indiscriminate use of agrochemicals to increase productivity coupled with inadequate soil management in agricultural areas, can be considered one of the main sources of input of heavy metals into soil and food chain. This study aims to identify soil contamination by Cd, Pb and Co and the main factors that were contributed to the transfer of these elements to the tomato plants (Solanum lycopersicum). The experiment was carried out in a family farm, in Barracão dos Mendes watershed, Nova Friburgo-RJ. The EPA 3050B methodology was applied for quantification of pseudototals metals levels in soil and agrochemical samples, and the EPA 3050 methodology for plant samples analysis. The pollution index (PI) was calculated for Cd, Pb and Co in relation to reference values established for the hillslope region ("Região Serrana") of the State (Matos, 2016). Pollution index data, slope and topographic wetness index (TWI) obtained by the program ArcGis 10.1 and SAGA 2.5, respectively, were submitted to statistical analysis using the program SAS (2010). It was observed that highest IP values were found for Cd, with a maximum value of 39.63 and mean of 10.36. Lead showed maximum IP values of 3.43 and for Co the value was 2.65. These results demonstrate an enrichment of these metals in tomato growing areas. Regards to the accumulated content in tomato plants, the maximum values was obtaining for Co (11.29 mg plant^{-1}), Pb (3.13 mg plant^{-1}) and Cd (0.22 mg plant^{-1}), thereby, the metal accumulated in foliar tissues represented the greater part of the total accumulated in the tomato plants. Through principal components analysis, it was verified that Cd, Co and Pb contents presented a close relation with Fe and Al contents and with the slope. Highlighting strong influence of the relief and the transport of soil particles, exposing the subsurface layers of the soil more rich in oxides, hydroxides and oxyhydroxides of iron and aluminum present in the source material. These factors associated to the anthropogenic contribution, mainly due to excessive use of agrochemicals over the years, contributed to the accumulation of these metals in tomato plants. Slope and TWI variables were important tools for understanding the factors that contributed to the increase heavy metals levels in soil and tomato plants.

Keywords: Soil contamination, environmental monitoring, agrochemicals
Financial support: UFRRJ, CAPES, FAPERJ

(3527 - 783) Urban impacts over the sediment pollution in Lake Guaíba, Southern Brazil

Leonardo Capeleto de Andrade[1]; Lawrence Morris[2]; Flávio Anastácio de Oliveira Camargo[1]
UFRGS[1]; UGA[2]

The high population density in metropolis leads to socio-environmental impacts that directly affect local water resources. Urban lakes are important to the maintenance of anthropic ecosystems and the quality of life of the population; however, they suffer major impacts from development in surrounding areas. Lake Guaíba has historical, economic and cultural importance to Porto Alegre, Southern Brazil, and its metropolitan region. With a large drainage area, Lake Guaíba accumulates impacts of different water bodies. Currently, the lake has multiple uses such as water supply source (to almost 2 million people), effluent dilution, navigation, recreation, and fishing. Guaíba is a large urban lake, fed by rivers (Jacuí, Sinos, Caí, and Gravataí) wide spread through a large part of the state, suffering many impacts. The aim of this study was evaluate the urban impacts of the metropolitan region over the pollution of sediments in Lake Guaíba. The sediment was sampled in different parts of, including the lake margins, the region near to Jacuí's Delta (forming rivers meeting), besides the historical monitoring results by municipality department. Sediment samples were dried and sieved. The samples were evaluated for: electrical conductivity, pH, densities, particle-size, organic carbon, phosphorus, nitrogen; and pseudo-total metals. The historical pollution from tributaries can be verified by the increasing (in monitoring results) of metals Zn, Cu, Pb, Cr, Ni, and Hg in the surface sediment near to Jacuí's Delta. Near to this region Cu and Ni concentrations exceeded the Brazilian guiding values for sediments. Sediment in the margins of Lake Guaíba presents indications of pollution with Pb, Cu, Cr, Ni, TOC, TKN, and P, mainly derived from urban streams that flow into the lake. The sites with more heavy metals (Zn, Cu, Ni, and Pb), C, N, and P concentrations were the places near to polluted urban streams outflows. These parameters have direct and indirect connection with the urban pollution commonly present in metropolitan regions. Metals and other pollutants enter the aquatic environment from various ways and sources (natural and anthropogenic), such as runoff, sewage, atmospheric deposition, and vehicular traffic. The quality of sediments in Lake Guaíba is linked with the tributaries and streams that flow to the lake. In order to solve these environmental liabilities, public actions should not focus only on the lake, but also in control the sources of this pollution.

Keywords: contamination; organic compounds; heavy metals
Financial support: CNPq; CAPES; UFRGS; UGA

(4124 - 2381) Variable surface charge Humic acid-ferrihydrite composite: Influence of electrolytes on Ciprofloxacin adsorption process

Monica Antilen[1]; Loreto Villacura[2]; Manuel Gacitua[2]; Carmen Pizarro[2]; Mauricio Escudey[2]
Pontificia Universidad Catolica de Chile[1]; Universidad de Santiago de Chile[2]

Impacts arising from antimicrobial-compounds present on environmental matrices, like soils and water, have become a worldwide concern. Synthetic humic acid/iron oxide composites (HA/FeO) combining the multifunctionality of humic acid with the adsorption potential of iron oxides (associated to its structural and superficial characteristics), will present enhanced antibiotics adsorption capacity than what has been previously reported. However, it is important to consider the composition of the soil-solution, which could interfere in the process of adsorption-removal of these antimicrobial-compounds. In this work the objective is to evaluate the influence of the electrolyte, in the efficiency of the adsorbents, through the evaluation of their effect on ciprofloxacine adsorption dynamics, through adsorption kinetics and adsorption

isotherms assays, employing a methodology previously developed. The adsorption isotherms of ciprofloxacin on different adsorbents, carried out in KNO_3 and phosphate buffer solution show differences, both in their form and in the maximum adsorption registered, evidenced through different adsorption models (Langmuir, Freundlich and Langmuir-Freundlich). These results can be explained considering the surface charge of the adsorbents (measured through electrophoretic migration), which indicates the importance of the electrostatic interactions in the adsorption mechanisms.

Keywords: Phosphate, Humic Acids, Ferrihydrite, electrophoretic migration

Financial support: Fondecyt 1130094, Facultad de Quimica UC (DIPOG), DICYT 021742PA, CONICYT PIA/ACM170002

C2.3 - Soil biology

C2.3.1 - Soil microbiological processes and nutrient cycling under crop rotation

(8824 - 1927) Acacia changes litter and soil microbial indicators associated with C and N cycling in intercropped Eucalyptus plantations

Bruna A. B. Lopes[1]; Arthur P. A. Pereira[1]; Maurício R. G. Zagatto[1]; Carolina B. Brandani[1]; Denise de L. Mescolotti[1]; Simone R. Cotta[1]; José L. M. Gonçalves[1]; Elke J. B. N. Cardoso[1]

ESALQ/USP[1]

Forest management strategies, like intercropping Eucalyptus plantations with nitrogen-fixing Acacia can improve C and N inputs, stimulating biogeochemical cycling and nutrient availability in the soil. However, our knowledge on the participation of the microbiota in specific parts of these processes is still incipient. In an effort to understand the C and N dynamics going on in pure and intercropped *Eucalyptus grandis* and *Acacia mangium* plantations, we decided to characterize the microbial and enzymatic activity in soil and litter and the metabolic profile of the soil microbial community, looking for correlations between them. We collected bulk soil samples (0-20 cm) from a field experiment with four treatments, pure *E. grandis* (E) and *A. mangium* (A) plantations, pure *E. grandis* with N fertilizer (E+N) and an intercrop of *E. grandis* and *A. mangium,* 27 and 39 months after planting. The soil organic fraction (OF) presented a higher mass in A and E+A, with a greater N and C content. Microbial C was significantly lower in the E and E+N and higher in the A and E+A stands, at 27 months after planting, with a higher *q*Mic-C index. The metabolic quotient (qCO_2) increased with time and in both epochs, and there was a tendency for higher values in E and E+N. Urease and amidase activity were always significantly higher in the E and E+N treatments and there were no significant differences between treatments regarding the degradation potential of the evaluated C substrates by the microbiota. However, we verified significant differences in the amounts consumed of some of the C sources when comparing periods, mainly in the A (16 sources) and E+A (5 sources) treatments. A canonical redundancy analysis showed interactions between litter and soil attributes and some soil microbial attributes, separating A and E+A from the others, in both periods. These results allow us to infer that C and N accumulations in OM fractions of intercropped plantations are due mostly to a great stimulation of all microbial processes by Acacia trees. This phenomenon is of utmost importance in areas with sandy soils containing extremely low levels of organic matter, because it improves nutrient availability in the soil and results in better tree nutrition.

Keywords: forest soil, soil biology, mixed-systems, C-N cycles, organic matter

Financial support: FAPESP

(9336 - 308) Acid phosphatase activity and removing and replaced the rainforests with pine forests, anual or perennial crops

Arzuaga, Silvia Amanda[1]; Toledo, diana Marcela[1]; Contreras Leiva, Stella Maris[1]; Vazquez, Sara[1]

Universidad Nacional del Nordeste[1]

The objective of this research was to assess the effects of removed the rainforests and replaced with pine forests, anual or perennial crops on the acid phosphatase activity and its relationship with the organic carbon and available phosphorus. The assay was performed in Oxisols soils in the province of Misiones, northeast of the Argentine Republic. The experimental design was completely randomized, with four treatments: subtropical rainforest (Sv), pine forests (*Pinus sp.*) of 17 years (Pi), corn crop under conventional tillage (*Zea mayz*) (Mz) and tea cultivation (*Camellia sinensis*) (Tea). Twelve plots were located per treatment and samples were taken of the following depths: 0-0.10, 0.10-0.20 and 0.20-0.30 m. Texture, pH, acid phosphatase activity (APA), soil organic carbon (CO) and available phosphorus (P) were determined. The results were analyzed through an ANOVA, a Duncan test ($P \leq 0.05$) and a Pearson's correlation test ($P \leq 0.05$). These soils showed acid reaction and their clay content was over 710 g kg^{-1}.The APA was higher in Sv, in the three studied depths with mean values of 671.26; 265.72 and 186.33 mg of p-nitrophenol $kg^{-1}h^{-1}$ ($P<0.0001$). The lowest APA was found in tea at all depths with means of 197.31; 125.87 and 84.36 mg of p-nitrophenol $kg^{-1}h^{-1}$ ($P<0.0001$). The CO was higher in soils under Sv in the three depths, with no significant differences between the cultivated soils. The P of surface was higher in pristine soils ($P<0.0001$), while in the second and third depth the availability of this nutrient was higher in the Sv and Pi treatments. APA and CO correlated positively and significantly at the three depths, characterized in depth of 0 to 0.10 m with an r: 0.77 and a $P<0.0001$; at higher CO increased phosphatase activity. Acid phosphatase activity and P correlated positively and significantly only at the first depth (R: 0.36; P=0.02). The soils under Sv presented the highest values of APA, and then in decreasing order Pi, Mz and Tea. When replacing the forest by afforestation with pine, tea crops or maize crops, there was a decrease in CO, P and APA indicating a degradation of the soil.

Keywords: Acid phosphatase enzymes - changes land-use - soil quality

Financial support: University National of Northeast

(5749 - 2501) *Acidobacteria* community responses to nitrogen dose and form in Chinese fir plantations in southern China

Caixia Liu[1]; Yuhong Dong[1]; Lingyu Hou[1]; Nan Deng[1]; Ruzhen Jiao[1]

Research Institute of Forestry, the Chinese Academy of Forestry, Beijing, China[1]

Acidobacteria is a new bacterial group, identified by molecular research, that is widely distributed and has specific ecological functions in forest soil. In this study, we investigated *Acidobacteria* response to N input, and the effects were related to N form and dose. The experimental design included two N forms (NH_4^+-N and NO_3^--N) and five levels of N deposition (0, 20, 40, 60, 80 kg N ha^{-1}) for 2 years. Research into the *Acidobacteria* community was conducted using 16Sr RNA gene-based high-throughput pyrosequencing methods. *Acidobacteria* OTUs and N had a negative relationship in 0–60 kg $ha^{-1}y^{-1}$; however, at N doses beyond a certain size, nitrogen might promote an increase in *Acidobacteria* OTUs. The *Acidobacteria* relative abundance under NH_4^+-N treatment was higher than under NO_3^--N treatment. *Acidobacteria* relative abundance decreased with increasing of NH_4^+-N dose, but increased with increasing NO_3^--N dose. Overall, 13 different *Acidobacteria* subgroups were identified, with Gp1, Gp2 and Gp3 being dominant. Significant differences in *Acidobacteria* distribution were primarily caused by N

input and pH value. The environmental factors of N were all negatively related to *Acidobacteria* distribution in low N dose treatments (0–20 kg $ha^{-1}y^{-1}$), but were positively related in response to N dose treatments (40–80 kg $ha^{-1}y^{-1}$).

Keywords: Keywords: *Acidobacteria*, subgroup, ammonium, nitrate, N dose, forest soil

Financial support: [1] National Key Research Program of China (No.2016YFD0600302) and [2] Research Institute of Forestry, the Chinese Academy of Forestry (No.CAFYBB2012026).

(5144 - 1535) Agricultural soils zoomed in: response of nitrogen-cycling microorganisms and nitrous oxide emissions to stabilized N-fertilizers

Micaela Tosi[1]; Shannon Brown[1]; Claudia Wagner-Riddle[1]; Kari Dunfield[1]

School of Environmental Sciences, University of Guelph, 50 Stone Rd., Guelph, Ontario, N1G 2W1, Canada[1]

In agroecosystems, the efficient use of fertilizers is key to optimizing productivity and reducing nutrient losses that can be detrimental for the environment. Soil microbial communities play a major role regulating nutrient fate, like emissions of the greenhouse gas nitrous oxide (N_2O) through denitrification. Stabilized N-fertilizers are a strategy to reduce losses by inhibiting specific microbial groups, but not enough studies have followed their effect on soil microorganisms once they are applied in the field. To fulfill this gap, our study follows the response of soil N-cycling microorganisms to a stabilized fertilizer and relates it to *in situ* N_2O emissions. The study was carried out in experimental corn plots located in SE Ontario, Canada, where N_2O was monitored continuously by tunable-diode laser absorption spectroscopy. Corn was side-dress fertilized with urea-ammonium nitrate with or without Agrotain Plus®, a stabilizer inhibiting urease activity and ammonia-oxidation. In 3 transects per plot, 10 samples (0-10 cm) were taken between the application line and the crop, homogenized and immediately froze. We sampled 10 d before and 2, 6, 9, 13, 16, 20 and 23 d after fertilization. Soil DNA and RNA were extracted to quantify, using qPCR, genes targeting total bacteria (16S rRNA) and N-cycling functional groups: ureolytic (*ureC*), ammonia-oxidizers (bacterial and archaeal *amoA*), nitrite-reducers (*nirK* and *nirS*) and N_2O-reducers (clade I and II *nosZ*). Preliminary results showed responses in gene abundance 9 d after fertilization. Among direct targets of the stabilizer, only ammonia-oxidizing bacteria and archaea were affected (37.8% and 56.6% lower than the control, respectively). Similarly, the stabilizer caused a reduction in total bacteria (-41.2%) and denitrifiers, both nitrite-reducers (~-46%) and N_2O-reducers (~-43%). Differences in day 9 were caused by an increase in the non-stabilized treatment but, overall, both treatments had similar dynamics over time. The stabilizer did not prevent an initial N_2O flux but did reduce emissions during days 4-9. This shift between N_2O and microbial data suggests a delayed effect on microbial abundance, which might be preceded by changes in microbial activity, or even an artifact caused by N flowing towards the sampling spot. Through microbial communities, we can understand the mechanisms underlying different agricultural practices and optimize their benefits for plant productivity and environmental health.

Keywords: Agroecosystems; soil microbiome; quantitative PCR; denitrification; ecosystem services.

Financial support: Natural Sciences and Engineering Research Council of Canada (NSERC) and Canada First Research Excellence Fund (CFREF)

(2913 - 1456) Agronomic efficiency of nitrogen-fixing bacteria in symbiosis with cowpea

Márcia Rufini[1]; Dâmiany Pádua Oliveira[1]; Fábio Aurélio Dias Martins[2]; Jacqueline Savana da Silva[1]; Thiago de Assis Pereira[1]; Priscilla Aguida Cassiano de Oliveira[1]; Otacílio Gomes Filho[3]; Polyanna Mara de Oliveira[3]; Abner José de Carvalho[4]; Fatima Maria de Souza Moreira[1]

Federal University of Lavras[1]; Agricultural Research Company of Minas Gerais, Epamig Sul[2]; Agricultural Research Company of Minas Gerais, Epamig Norte[3]; State University of Montes Claros, Campus Janaúba[4]

The cowpea (*Vigna unguiculata* L. Walp) has great social and economic importance in the North and Northeast regions of Brazil, with increasing expansion to the Central-West region. Currently, Brazilian bean exports have been mainly cowpea, destined for the markets of India, Egypt and Pakistan. As it is a culture with high nutritional value and versatile, it presents potential of growth in the country. Therefore, studies of an efficient symbiosis with nitrogen fixing nodulating bacteria (NFNB) are essential, aiming at good yields and reduction of production costs and environmental impacts. Thus, the objective of this work was to evaluate the efficiency of NFNB strains in the biological nitrogen fixation in symbiosis with cowpea cultivated in Northern Minas Gerais, Brazil. Two field experiments were installed in Janaúba and Jaíba, in a conventional system and under conventional sprinkler irrigation. A randomized block experimental design was used with four replications and seven treatments: three efficient strains in test (*Bradyrhizobium* sp. UFLA 03-153, *B. brasilense* UFLA 03-320 and UFLA 03-321), two controls with approved strains as inoculant for the crop (*Bradyrhizobium* sp. UFLA 03-84 and *B. elkanii* INPA 03-11B) and two controls without inoculation with or without fertilization with mineral N (70 kg ha^{-1} N). The inoculant was prepared with peat, inoculating 250g of the inoculant for each 10kg of seeds and observing the legal minimum number of viable cells per seed. The cultivar of cowpea used was BRS Itaim and the sowing density was 15 seeds per meter. All plots received phosphate and potassium fertilization based on 70 kg ha^{-1} P_2O_5 and 40 kg ha^{-1} K_2O. The analyzed variables were: number and dry matter of nodules, shoot dry matter, grain yield, production components, N content and accumulation in shoot and grain. A variance analysis was performed using the statistical software Sisvar. Despite the smaller number of nodules, the productivity of Jaíba was three times higher than that of Janaúba. There was a significant effect of the treatments only for grain yield. In this case, the strains UFLA 03-320 (1088 kg ha^{-1}), UFLA 03-321 (956 kg ha^{-1}) and UFLA 03-84 (960 kg ha^{-1}) were similar to fertilization with mineral N (1020 kg ha^{-1}), surpassing the others. These results suggest an efficient symbiosis of some strains tested in cowpea and further tests will be carried out aiming at its recommendation and approval to be used as inoculants.

Keywords: *Vigna unguiculata*; strains selection; biological nitrogen fixation; *Bradyrhizobium.*

Financial support: Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq), Fundação de Amparo à Pesquisa do Estado de Minas Gerais (FAPEMIG) e Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES).

(3316 - 2555) ***Are soil microbial community associated with irrigation management practices? - A potato production case study.***

Thiago Gumiere[1]; Silvio J. Gumiere[2]; Guillaume Létourneau[2]; Jean-Pascal Matteau[2]; Alain N. Rousseau[1]

Institut National de la Recherche Scientifique[1]; Laval University[2]

In agriculture, water consumption for crop production represents 69% of all water use. Therefore, precision irrigation systems based on soil water content have been developed to reduce crop water requirements. However, the impact of different water contents on soil organisms, such as the microbial community, remains unclear. Here, we evaluated the effect of four irrigation management practices (wet,

optimal, dry and very dry) on the soil microbial community across three potato cultivars and two soil types (silt and sand). The results have indicated that irrigation management practices and microbial community composition were correlated. For silt and sand, irrigation management practices could explain 15.39% and 12.65% of the community structure, respectively (PERMANOVA, p<0.001). From the wet irrigation practice to the very-dry irrigation practice, we observed a decreasing pattern in the relative abundance of the phyla bacteria *Actinobacteria*, *Proteobacteria* and *Gemmatimonadetes*. Other phyla bacteria, such as *Acidobacteria*, *Chloroflexi* and *Firmicutes*, and also *Thaumarchaeota* (Archaea phyla), showed an opposite pattern, with higher relative abundance for the dry and very-dry management practices. We also observed differences in the predictive functionality analyses for the different irrigation practices. For example, the wet-irrigation practice showed the lower prediction for the gene *AmoCAB* (Nitrification process), and higher prediction for the gene *CysND* (Assimilatory sulfate reduction process). Regardless of soil type and potato cultivar, the irrigation management practice affected both the composition and the predicted functionality of the soil microbial community. These findings could be useful to further advance our understanding of microbial community dynamics under different irrigation practices. We believe the findings of this study have the potential to lead to the development of an innovative irrigation paradigm in potato production based on soil microbial community knowledge.

Keywords: *Keywords: irrigation, microbial community, soil, water, nutrient cycles*

Financial support: CRSNG - Conseil de recherches en sciences naturelles et en génie

(8414 - 3222) Association between soil biological attributes and coffee yield in the Cerrado Region of Minas Gerais State

Osnar Obede da Silva Aragão[1]; Silvia Maria de Oliveira Longatti[1]; Polyana Santos de Castro Caputo[1]; Diego Henrique Oliveira Araújo[1]; Márcia Rufini[1]; Gladyston Rodrigues Carvalho[2]; Fatima Maria de Souza Moreira[1]

Federal University of Lavras, Department of Soil Science, Lavras, 37200-000, Brazil, (osnar.silva@gmail.com)[1]; Agricultural Research Company of Minas Gerais, west.[2]

Microbiological indicators can be useful for predicting the rates and the direction of changes in soil quality. The evaluation of these indicators can guide farmers in their decision about how to manage their production systems, resulting in higher soil quality and, consequently, in better crop yield. Among these is the coffee production system, which has high economic and social importance in Brazil. Coffee is a major crop in the state of Minas Gerais, one of the greatest producers in the country. The objective of this work was to evaluate the relationship between soil biological indicators and yield of different coffee cultivars in the cerrado region of Minas Gerais state, Brazil. The work was carried out with soil samples collected in the mesoregion of Alto Paranaíba (18 ° 59 '26 "S and 46 ° 58' 9.5" W). In the sampling area, six plots with different yields were selected, each with two cultivars: Catuai 99 (E and A), Catuaí 144 (C and R), and Rubi (F and M). The E, C and F plots presented the highest yields and the A, R and M plots, the lowest yields. Crop productivity was calculated as the average productivity from years 2014/2015, 2015/2016, and 2016/2017. The experimental procedure consisted in the collection of five composite samples in each plot, and each of these composite samples was formed by pooling four subsamples taken at a depth of 0-10 cm in the projection of the plant crown. The following microbiological attributes were evaluated: microbial biomass carbon (MBC), basal respiration, and fluorescein diacetate hydrolysis (FDA). The data were submitted to normality tests before the analysis of variance, and the means were compared by the Scott-Knott test at the 5% significance level. The statistical analysis was carried out with the Sisvar program. The MBC was significantly different between plots with the same cultivar. It was 57.5% superior in plot E compared to plot A, 43.3% superior in C compared to R, and 32.3% superior in F compared to M. No significant differences in basal respiration were observed. For the FDA, a significant difference was observed only between plots F and M, with an enzymatic activity 42.8% superior in F. Among the microbiological indicators evaluated, the MBC presented a higher correlation and better discrimination of areas with different coffee yields.

Keywords: Bioindicators, Coffea arabica, productivity.

Financial support: Coordination for the Improvement of Higher Education Personnel; Foundation for Support of Research in the State of Minas Gerais and National Council for Scientific and Technological Development.

(1562 - 193) Breaking paradigms for agricultural sustainability utilizing plant-growth promoting bacteria and their metabolites: perspectives for the next decade

Mariangela Hungria[1]; Marco Antonio Nogueira[1]

Embrapa Soja[1]

The high cost of chemical fertilizers, in addition to a general view of long-term sustainability, of mitigation in the emission of greenhouse gases and of improvement of soil quality, have opened many opportunities for research with plant-growth promoting bacteria (PGPB), including traditional symbiotic rhizobia, phytohormones producers, and via other microbial processes. We have performed field trials in which we identified two new *Bradyrhizobium* strains for the soybean (*Glycine max* (L.) Merr.) crop with an excellent performance in the main producing areas of Brazil, that should fully supply the N-requirements of highly-productive genotypes; in addition, we have broken paradigms of autoregulation of nodulation by the host legume, defining strategies to increase soybean nodulation. Co-inoculation of rhizobia and *Azospirillum*, as well as the addition of microbial metabolites in both soybean and common bean (*Phaseolus vulgaris* L.) have consistently resulted in grain yield gains, indicating that combinations of microbes and microbial molecules are far better than single inoculations. For cereals, the inoculation with strains of *Azospirillum brasilense* selected by our research group has consistently improved root growth and yield. In addition, we have detected benefits from inoculation of *Azospirillum* that go beyond phytohormone production and nitrogen fixation, including the expression of plant genes related to tolerance to abiotic and biotic stresses, that impact plant performance under water, saline and temperature stresses. Interestingly, co-inoculation of selected strains of *A. brasilense* and *Rhizobium tropici* improved maize (*Zea mays* L.) growth in comparison to single inoculation with *Azospirillum*. Two *A. brasilense* strains and other PGPB have been selected and promoted growth of *Brachiaria* (=*Urochloa*), and their use can boost the recovery of degraded pastures. Our results indicate that microbes and microbial molecules have residual benefits, and instead of using inoculants for single crops, one should consider the whole cropping system. Our field trials evaluating the partial or full replacement of N-fertilizers using our selected elite strains result in estimates that 80 million tons of CO_2-equivalents can be mitigated annually considering the soybean, common bean, maize and brachiaria production.

Keywords: biological nitrogen fixation; phytohormone production; Bradyrhizobium; Rhizobium; Azospirillum

Financial support: Embrapa (02.13.08.003.00.00), INCT-Plant-Growth Promoting Microorganisms for Agricultural Sustainability and Environmental Responsibility (CNPq 465133/2014-2/ Fundação Araucária-STI/CAPES)

(4921 - 533) Changes in activity of soil microbial community is altered due to plant invasion on the ecosystems of eastern Slovakia

Lenka Bobuľská[1]; Lenka Demková[1]

Department of Ecology, Faculty of Humanities and Natural Sciences,

University of Prešov[1]

Invasive species are a major threat to community composition and ecosystem processes worldwide. Recent studies on invasive species have revealed a wide variety of their impact on soil ecosystems, native plants and soil organisms, including microbial population and its composition. Soil microbial community is an important component of ecosystem response to environmental changes, yet is little know about how microbial activity, structure and function respond to disturbances. The study assessed the effect of *Heracleum mantegazzianum* and *Heliantus tuberosus* invading eastern sites of Slovakia on soil microbial indices. Obtained data were compared with non-invaded adjacent sites (grasslands). Microbial properties such as soil respiration and soil enzyme activities (urease, acid phosphatase, alkaline phosphatase, FDA and beta-glucosidase) were determined. Additionally, soil organic carbon, soil moisture and soil reaction were also performed. Both plant species showed very similar values of microbial properties. Activity of soil microbial community differed between soils under invasive species and those under native plants. In contrast, invaders did not changed the rate of soil organic carbon that is relatively stable soil parameter and soil reaction showed higher values compared to the sites under non-invaded species. Microbial parameter that was most effected by invasive species was acid and alkaline phosphatase that may be also explained by soil reaction changes as phosphatases are very sensitive to soil pH variations. There are several studies focusing on soil biological activity of invasive species and assessing their global impact on ecosystems. Some paper confirm the negative influence on activity and composition of microbial community, the others state that microbial community is unaltered by plant invasion. Therefore, the reaching of general conclusion is vague and there is more need for detailed explanation of processes in the soil ecosystems.

Keywords: soil enzymes, soil properties, non-native plant species, environmental changes

Financial support: The study was supported by project Slovak scientific agency VEGA (Grant No. 2/0013/16)

(1502 - 919) Co-inoculation of *Rhizobium* and *Bradyrhizobium* on common beans (*Phaseolus vulgaris*) enhances plant growth and nodulation

Rafael de Almeida Leite[1]; Adelson Paulo Araújo[1]; Ederson da Conceição Jesus[2]

UFRRJ[1]; Embrapa[2]

The common bean (*Phaseolus vulgaris* L.) is known to nodulate with a wide range of rhizobia. Amongst these, Bradyrhizobia is a group that induces the formation of inefficient nodules. Nevertheless, strains of this genus have been previously reported as able to enhance the performance of the symbiosis when co-inoculated with efficient rhizobia strains. Our objective was to evaluate whether the co-inoculation of Bradyrhizobia and *Rhizobium* can improve plant growth and nodulation of common bean plants, testing the consistency of these reports. A Leonard jars experiment was carried out to assess the effects of different strains of *Bradyrhizobium* on plant growth promotion when co-inoculated with the reference strain CIAT 899 of *Rhizobium tropici*. The inoculant was grown in YMB medium. Common bean seeds (cultivar Pérola) were surface sterilized and pre-germinated. Two plants were grown per jar, and each received a dose of 10^8 colony-forming unities per seed of the respective strain. Plants were harvested 42 days after seeding, and shoot, root, and nodule dry weight and number were assessed. Co-inoculated plants showed an overall increase in growth and nodulation. One of the *Bradyrhizobium* co-inoculated strains led to a significant increase in shoot biomass (stem and leaf) and root biomass, when compared with the efficient CIAT 899 strain alone, reaching a 63% increase in total shoot biomass. One of the strain combinations effectively induced the formation of more nodules, with an increase of 50% compared to the CIAT 899 strain alone. Two of the strains combinations accumulated 45 to 55% more nodule dry mass. This data shows a positive effect of the co-inoculation *Rhizobium-Bradyrhizobium* on plant growth and nodulation of common beans. The mechanism behind this effect remains to be unveiled.

Keywords: Plant growth promotion, Bradyrhizobium, inoculation

Financial support: CAPES, Emrbapa

(3444 - 2125) Common bean genotypes respond to inoculation with rhizobia strains selected for efficiency in biological n_2 fixation

Jacqueline Savana da Silva[1]; Damiany Pádua Oliveira[1]; Márcia Rufini[1]; Fábio Aurélio Dias Martins[2]; Thiago de Assis Pereira[1]; Maria Vitória Batista Duque Guttierrez Baptista[1]; Celso Leandro da Silva Junior[1]; Antônio Edrey de Castro[1]; Messias José Bastos de Andrade[1]; Fatima Maria de Souza Moreira[1]

Universidade Federal de Lavras[1]; Empresa de Pesquisa Agropecuária de Minas Gerais[2]

The use of plant genotypes efficient in establishing symbiosis with rhizobia on a property is a relevant strategy for capturing and utilizing the N_2 fixed. For its part, the genotype of the rhizobia may affect the response of the host plant. With the use of responsive cultivars and efficient strains, satisfactory yields that are equivalent to or even better than those obtained from nitrogen fertilization can be expected. Knowledge of these factors can therefore guide not only breeding programs involved with biological nitrogen fixation (BNF), but also direct farmers in determining what plant material and nitrogen source to be adopted in the crop. Thus, the aim of this study was to verify the performance of commercial genotypes of common bean (BRSMG Uai, BRSMG Madrepérola, and Pérola) not inoculated, inoculated with a recommended strain (CIAT 899 of *Rhizobium tropici*) or with a strain in the selection phase (UFLA 04-195 of *Rhizobium* sp.), or receiving mineral fertilization with 80 kg ha^{-1} of urea N. The experiment was conducted in the field in the 2017 winter crop season in the municipality of Patos de Minas, MG, Brazil. A randomized block experimental design was used in a 3x4 factorial arrangement (cultivars x N sources), with four replications. All the plots received base phosphate and potassium fertilization according to soil analysis. The inoculant was prepared with sterilized peat at the ratio of 3:2 of peat and cultures prepared in liquid 79 medium, adopting the rate of 25 g of inoculant per kilogram of seed. Nodulation, plant biomass, and N concentration and accumulation in the shoots were evaluated at flowering. Grain yield and productivity of primary components were determined at maturity. All the data were subjected to analysis of variance (ANOVA) and, when necessary, the data were transformed in $(x+0.5)^{0.5}$. In the cases of significant effect of the treatments, the Scott-Knott test was used to cluster the levels of the factors. In terms of yield, the cv. BRSMG UAI responds more to nitrogen fertilization than to BNF. The cvs. Madrepérola and Pérola are as responsive to inoculation as to mineral fertilization, with high and equal yields obtained from both N sources (introduced rhizobia and mineral N). The strain UFLA 04-195 shows satisfactory performance in the three cultivars tested and is as efficient as the strain CIAT 899. For that reason and other good results, the strain has potential for recommendation as an inoculant for common bean.

Keywords: *Phaseolus vulgaris* L.; common bean cultivars; biological N2 fixation; Rhizobium strains.

Financial support: CNPq, CAPES, FAPEMIG

(3087 - 716) Correction of soil acidity with the use of dairy industry residues

Edenara De Marco[1]; Danilo Dufech Castilhos[1]; Thaís Thürmer[1]; Matheus Schneider Klaus[1]

Universidade Federal de Pelotas[1]

The dairy industry generates waste that, without due mitigation, has the potential to generate environmental impacts. The disposal of organic waste to the soil has as purpose a form of disposal of material, aiming at reducing environmental contamination. This practice can consider the waste as a raw material potencial, which, if well managed, benefits the properties of the soil. The objective of the present work is to evaluate the alteration in pH of the soil after application of increasing doses of sludge from the dairy industry. The biological sludge of the dairy industry had the following characteristics: Neutralizing capacity 16,4%; Organic C 380 g kg^{-1}; N 66,3 g kg^{-1}; P 34 g kg^{-1}; K 2,2 g kg^{-1}; Ca 35,9 g kg^{-1} and Mg 2,9 g kg^{-1}. The soil used in this study, classified as Albaqualf soil (Planosol), presented: pH in water 4,0; Organic matter 2,62%; Clay 21%; S 38,2 mg dm^{-3}; P (Mehlich) 11,5 mg dm^{-3}; K 21 mg dm^{-3}; Al 3,7 cmol dm^{-3}; H + Al 17,3 $cmol_c$ dm^{-3}; $CTC_{affective}$ 5,5 $cmol_c$ dm^{-3} and SMP 4,8. The experiment was conducted in the Laboratory of Soil Microbiology of the Federal University of Pelotas, arranged in a completely randomized design, with three replications. An experimental unit was used 500g of soil disposed in a polyethylene bag. The recommended dose of 36 Mg ha^{-1} of sludge from the dairy industry was defined by the need for N, as recommended by the Commission on Soil Chemistry and Fertility - RS/SC (2016) for maize. From this dose different percentages were established that determined the following treatments: 1- 0 Mg ha^{-1}; 2- 18 Mg ha^{-1}; 3- 36 Mg ha^{-1}; 4- 42 Mg ha^{-1}; 5- 108 Mg ha^{-1}; 6- 144 Mg ha^{-1}. The samples were collected at 16, 22, 29, 39 and 51 days of incubation. Data were submitted to analysis of variance at 5%, and regression analysis was performed. There was a quadratic behavior at all doses throughout collection times. All treatments that received sludge from the dairy industry showed a corrective effect on soil acidity, the treatment 6 had a higher effect, raising pH to 4,82 at 16 and 22 days of incubation. From the 39 days of incubation, the pH value decay was observed in all treatments, demonstrating the loss of the corrective potential of the sludge from the dairy industry. It can be concluded that the sludge from the dairy industry does not have sufficient neutralization potential to raise the pH to an ideal value for the development of plants, requiring limestone complementation.

Keywords: sludge; dairy; pH
Financial support: Universidade Federal de Pelotas, CAPES

(6651 - 2079) Cover crops diversity improves soil microbilogy on crop rotations systems

Bruno Poloto Lopes[1]; Carlos Felipe dos Santos Cordeiro[1]; Leonardo Vesco Galdi[1]; Fábio Fernando Araújo[1]; Fábio Rafael Echer[1]

Universidade do Oeste Paulista (UNOESTE)[1]

Diversification of plant species, whether cultivated or under cover crops, in a production system affect soil properties, especially soil microbiology. The objective of this study was to evaluate the effect of different crop rotation systems on soil microbial activity. The experiment was carried in the field in Presidente Bernardes-SP, Brazil, in a completely block randomized design, with five replications. The treatments consisted of single or intercropping of cover crops cultivated in the 2017 winter: 1) black oats (*Avena strigosa*) and lupine (*Lupinus albus*); 2) black oats, lupine (*Lupinus albus*), Mombaça (*Panicum maximum jacq.*) and stylosanthes (*Stylosanthes macrocephala*; 3) Mombaça (*Panicum maximum jacq.*); 4) Mombaça (*Panicum maximum jacq.*) and stylosanthes and 5) fallow. The soil for the microbiological analysis was sampled at of 0-10 cm depth, on 10/10/2017 (120 days after cover crops sowing), and the evaluated characteristics were: activity of the enzyme dehydrogenase, soil respiration, microbial biomass nitrogen, microbial biomass carbon, remaining shoot dry matter and root dry matter weight (0-20 cm). The means of the treatments were compared by the Tukey's test (P<0.05). The dry matter weight of the remaining straw was higher in the Mombaça and stylosanthes treatments (4.4 Mg ha^{-1}); (4.2 Mg ha^{-1}) and in the consortium oats, lupine, Mombaça and stylosanthes (3.9 Mg ha^{-1}) compared to the fallow (1.6 Mg ha^{-1}). The root dry matter mass was higher in the treatments with cover crops (1.7 Mg ha^{-1}), compared to the fallow (0.8 Mg ha^{-1}). The enzyme dehydrogenase showed higher activity in the oat and lupine consortium (3.9 ug TTF g^{-1} soil) compared to the fallow (1.8 ug TTF g^{-1} soil). On the other hand, soil respiration was higher in the fallow and Mombaça (4.9 and 3.8 mg CO_2 kg^{-1} of soil day^{-1}, respectively), compared to the oat and lupine consortium (2.4 mg CO_2 kg^{-1} of day^{-1} soil). Nitrogen and carbon from microbial biomass were higher in the soil cultivated with oats, lupine, Mombaça and stylosanthes (20.8 and 422 mg kg^{-1}) compared to fallow (6.9 and 141 mg kg^{-1}). In conclusion, increasing the diversity of cover species in the rotational systems improves the biological activity of the soil.

Keywords: straw, microorganisms, crop rotation.
Financial support:

(9680 - 1361) Dark septate fungi inoculation and fertilization with organic nitrogen source benefit the growth of tomato plants

Jerri Zilli[1]; Carlos Vergara[2]; Karla Emanuelle Campos Araujo[2]; Segundo Urquiaga[1]; Nivaldo Schultz[2]; Fabiano de Carvalho Balieiro[3]; Peter Soares Medeiros[2]; Leandro Azevedo Santos[2]; Gustavo Ribeiro Xavier[1]

Embrapa Agrobiologia[1]; Universidade Federal Rural do Rio de Janeiro[2]; Embrapa Solos[3]

Dark septate endophytic (DSE) fungi can be used as plant growth promoter. However, several ecological functions of DSE fungi need further clarification. The present study investigated the effects of DSE fungi inoculation on nutrient accumulation and growth of tomato plants fertilized with organic and inorganic N sources. Experiment was carried out under greenhouse conditions in a randomized blocks design, with five replicates of tomato seedlings. Tomato seedlings (cv. Santa Clara I-5300) inoculated with DSE fungi (isolates A101and A105) and without DSE fungi (control) were transplanted to pots filled with 12 kg of soil which had previously received finely ground plant material (Canavalia ensiformis [L.]) or ammonium sulfate. Growth indicators and nutrient content in the plants were quantified 50 days after transplanting. The treatment inoculated with DSE fungi and supplied with an organic N source showed significantly higher N, P, K, Ca, and Mg content, plant height, and shoot dry matter increased. In contrast, no positive effects were observed in the presence of an inorganic N source. Inoculation with A101and A105 promoted the growth of tomato using organic N source.

Keywords: Solanum lycopersicum (L.) nitrogen DSE fungi phosphorus
Financial support: Empresa Brasileira de Pesquisa Agropecuária. Coordenação de Aperfeiçoamento de Pessoal de Nível Superior. Conselho Nacional de Desenvolvimento Científico e Tecnológico. Fundação Carlos Chagas Filho de Amparo à Pesquisa do Estado do Rio de Janeiro

(7281 - 1951) Density and diversity of edaphic mites de in an integrated crop-livestock system after 15 years under different grazing intensities

Hazael Soranzo de Almeida[1]; Ângela Denise Hübert Neufeld Vieira[2]; Lisiane Sobucki[1]; Paulo César de Faccio Carvalho[3]; Rodrigo Josemar Seminoti Jacques[1]

Universidade Federal de Santa Maria[1]; Universidade Regional Integrada do Alto Uruguai e das Missões[2]; Federal University of Rio Grande do Sul[3]

Integrated crop-livestock systems (ICLS) when correctly managed, they are examples of an intense and sustainable agriculture. However, the excessive weight on the soil of the animal in the grazing may damage chemistry, physics and biologic proprieties of soil and environment quality. The edaphic mites behave such as organic waste transformers and regulators of soil biota. Furthermore, they are sensitive bioindicators and may indicate changes to soil quality. The aim of study was to evaluate the density and diversity of edaphic mites in an integrated crop-livestock system after 15 years under different grazing intensities. The experiment was conducted in a Rhodic ferralsol clayic over a 15-year period in a 23-ha area, characterized by the crop succession *Glycine max* (summer grain production) and *Avena strigosa + Lolium multiflorum* (winter pasture). The treatments consisted of four grazing height: 10-cm (intense), 20 and 30-cm (moderate), 40-cm (light) and no grazing (control plots). A randomized block experimental design was used, with three replicates per treatment. The size of the plots with grazing varied from 0.9 to 3.6 ha. The entire plots had continuous grazing in winter and three tester animals, resulting in the different grazing heights tested. Four samplings were performed between 2014 and 2016, two following the grazing season and two following the soybean harvest. The soil samples (0-3 cm) were collected in five points per plot and packed in plastic bags with a Sand Auger. In the mites extraction of soil was used a Berlese funnel – Tullgren tool modified. Incandescent bulbs of 25W provided the illumination for 96 hours. For counting and identifying of mites were used a stereomicroscope microscope and classification keys. The density after grazing of collected mites was 5.790, 10.001, 3.500, 3.633 e 9.827, after soya grazing was 2.225, 3.534, 1.699, 1.981 e 2.679 for the grass heights of 10, 20, 30, 40 cm and without grazing area, respectively. For the collecting after grazing were find, the orders Gamasida and Oribatida at all pasture heights. Actinedida and Acarida occurred exclusively at a height of 30-cm. With the exception of the height of 30 cm, the others presented the same order diversity. The highest density occurred in the period after grazing.

Keywords: Integrated crop-livestock systems (ICLS)
Financial support:

(7117 - 466) Differential biological activity along a soil sequence used for coffee cultivation in the Brazilian Cerrado

Cátia Aparecida Simon[1]; Armando Cavalcante Franco Dias[2]; Dorotéia Alves Ferreira[2]; Gabriel Nuto Nóbrega[1]; Luis Norberto Pascoal[3]; Isabela Pascoal Becker[3]; Tiago Osório Ferreira[1]; Fernando Dini Andreote[1]
Department of Soil Science, "Luiz de Queiroz" College of Agriculture, University of São Paulo (ESALQ/USP), Piracicaba, SP, Brazil.[1]; Andrios Assistance and Training in Soil Microbiology, Piracicaba, SP, Brazil.[2]; Bioterra Academy, Daterra Sustainable Coffee, Patrocínio, MG, Brazil.[3]

The biological attributes in soils are highly connected to the soil structure, soil usage and crop management. The natural variance of such attributes is poorly understood, especially the correlation between soil type and biological indicators, such as enzymatic activities. By using such approach in cropped areas, we can gain insights on the role of crop management upon the functionality of soil biology. The challenges to use indicators of soil biology quality or proxies of soil biology functionality have been recently advanced, by the validation of enzymatic activity as a reliable marker for broad scale studies. Here we used this approach, by analyzing the natural variation in the activity of arylsulfatase along a soil sequence (Anionic Acrudox-Typic Acraquox -Plinthic Acrudox) in 220,30ha, under a coffee (*Coffea arabica* L.) field newly installed, in the South of Minas Gerais State, Brazil (the Brazilian Cerrado). Three soil samplings were performed (September/2016, January and July/2017), when 74 sampling sites (geographically determined) were assessed by the collection of soil samples from the 0-10 cm layer. The data were interpolated in order to map the biological activity of soils along the soil sequence. Results revealed a higher activity of arylsulfatase in the Anionic Acrudox in September/2016 and January/2017 (98.0 and 86.6 mg p-nitrophenol.kg^{-1} of soil.h^{-1}, respectively), replaced by the higher values found in the Plinthic Acrudox during July/2017 (165.00 to 182.00 mg p-nitrophenol.kg^{-1} of soil.h^{-1}). These values can be related to the organic matter content of the soil, in which the area constituted by Plinthic Acrudox showed higher content of organic matter (values between 3.70 and 7.40 %) when compared with Anionic Acrudox (values between 2.80 to 4.90 %). However, the shift in the activity ranking was also correlated to the implementation of the new coffee plantation, established in the area of Anionic Acrudox previously to the last sampling. A continuous monitoring of this area will shed light on the effect of coffee cultivation upon the biological activity of soils, supporting innovative management strategies in the field.

Keywords: Soil mapping; *Coffea arabica* L.; soil enzymes; biological indicators; crop management.
Financial support: Bioterra Academy, Daterra Sustainable Coffee.

(9258 - 727) Does agricultural development increase microbial diversity and decrease soil carbon in Zambia?

Toru Hamamoto[1]; Meki Chirwa[2]; Imasiku Nyambe[2]; Yoshitaka Uchida[1]
Hokkaido University[1]; University of Zambia[2]

Changes in soil biological community structures due to the cultivation of natural lands into agricultural lands can cause some changes in soil's functions. However, little is known about the effect of land use changes on soil microbial community structure in sub-Saharan Africa. Therefore, the aim of this research was to investigate the relationships among soil characteristics and soil animal/microbial communities during the conversion of natural ecosystems into cultivated lands in Zambia, and to link soil carbon (C) dynamics to the changes in soil biodiversity. We sampled soils from four different land use types within a farm located in central Zambia, namely, native forest, grassland, watermelon farm, and maize farm. Fourteen different types of soil animals were collected by pitfall traps. Crop pests such as crickets were observed only in the maize sites. Decomposers such as earthworms mostly existed in the forest and grassland sites. Decomposers' presence or absence may influence the contribution of soil animals to soil C stock process. Soil DNA was extracted from soils sampled at each site to investigate the soil bacterial communities and their relationships with soil chemical properties. In results, *Gammaproteobacteria* had a higher relative abundance in the maize sites (15%) and *Bacilli* had a higher relative abundance in the forest sites (20%). The increase in *Gammaproteobacteria* at these sites may be explained by lower C in the maize farm site. According to previous studies, dissolved organic matter inputs drive high rates of soil respiration in the soil bacterial community, particularly among members of *Gammaproteobacteria*. Therefore, the lower soil C levels in the maize sites may have been due to increased soil microbial respiration rates with cultivation. Comparison of the Shannon diversity indices based on the soil microbial classes indicated that microbial diversity was relatively higher in maize sites (2.4) compared to other sites. This indicates that the cultivation of natural soils does not necessarily reduce the diversity of soil microbes (1.6 and 1.8 in the forest and grassland, respectively). In conclusion, changes from national ecosystems to cropland in Zambia changed the soil animal communities and increased soil bacterial diversities. The changes potentially influence C dynamics in soils. This basic information may further develop to investigate the biological indicators for the

sustainable development of sub-Saharan African soils.
Keywords: land use change, soil microbial community, soil fauna, soil carbon, Zambia
Financial support: This work was financially supported by Global Leadership Training Programme in Africa (GLTP) from United Nations University.

(6307 - 1738) Domestic sewage application effects on microbiological characteristics of a latosol cultivated with Solanum lycopersicum.

Giovana Fornaciari Moreira[1]; Victor Barros Damacena[2]
Instituto Federal do mato grosso - campus Caceres/ professor Olegário baldo[1]; IFMT campus caceres[2]

The lack of water in Brazil is not about its supply, the problem goes beyond and is related to the inequalities of distribution and its quality. The pressure about the use of the water resources is enhanced with linear and increasing growth of the Brazilian population. For that matter, the reuse of domestic sewage holds high potential as a source of water and nutritional and organic matter, in addition to minimizing the release of liquid waste without direct treatment in water courses. Considering this, this study aimed to investigate the effects of domestic sewage application on microbiological characteristics of a latosol cultivated with Solanum lycopersicum. The research was conducted in an experimental area of 882 m², with geographic coordinates of 15º 31 '22 "S and 58º 15' 57" W (230 m altitude), in S. J. dos Quatro Marcos - MT (Brazil). On this experiment, 35 plots were used, in which the treatments were summarized in the application of domestic sewage (DS) and water supply (WS), with five different proportions: T1- 100% DS and 0% WS, T2-75 % DS and 25% WS, T3-50% DS and 50% WS, T4- 25% DS and 75% WS and T5-0% DS and 100% WS. Soil samples were collected in the 35 plots after harvesting S. lycopersicum in the 0 to 20 cm, 20 to 40 cm and 40 to 60 cm layers for microbiological analysis at the laboratory. These were then weighed (10g), filled into 90 mL vials of 8.5% saline solution (NaCl), shaken manually and withdrawn a 1 mL aliquot of the material into which cultivation medium (petrifilm plates). The plates were incubated in an oven to 44.5 °C for 48 hours. Subsequently, they were taken to the colonies counting of thermotolerant and total coliforms using a magnifying glass. To detect and quantify the helminth eggs, 100 g of the homogenized soil sample was used. Hereupon it was immersed in a sedimentation cup, containing water at 45 ºC. The material was sedimented for 24 hours, followed by centrifugation at 2000 rpm for two minutes. Sample slides were prepared, stained with aqueous iodine (Lugol's iodine) and checked under microscopy. The experiment was set up in a randomized block design with five treatments and seven replications. The results showed that the system favored removals of more than 70% of the characteristics of total and thermotolerant coliforms; and higher levels of thermotolerant coliforms and helminth eggs in the soil occurred in the highest proportions of domestic sewage (Treatment 1 and Treatment 2).
Keywords: soil, microbiology, tomatoes
Financial support:

(5235 - 2102) Earthworms intestinal bacteria strains in sugar cane crops

María Cristina Picon[1]; Ernestina Susana Teisaire[2]
Fundación Miguel Lillo[1]; Universidad Nacional de Tucumán[2]

Earthworms play an important role in soil ecology; they act on its physical, chemical and biological properties, such as: texture, organic matter decomposition and biochemical regulation cycles. These actions are favored by the microbial activity of the communities that inhabit the digestive tube of these organisms. However, since there is a lack of taxonomic information about these organisms, we will try to determine communities of the intestinal microflora of the earthworm species that are found in sugar cane crops in the province of Tucumán. For that purpose, collections were made in May 2012 in a sugar cane field in Chicligasta, located in National Route 38 km 745. The material was obtained by dissection of the earthworms, previously identified, and the microorganisms were extracted from the intestine by dissection and posterior maceration in saline solution. The strains were isolated and identified by classical biochemical techniques according to Bergey's manual and the use of molecular techniques with 16S gene sequencing. The following earthworms and the microorganisms associated to each one were identified: Family Glossoscolecidae: - a) *Pontoscolex corethrurus: Bacillus circulans, Paenibacillus lautus, Bacillus sp., Micrococcus sp., Micrococcus lateus y Lysinibacillus boronitolerans; -b) Enantiodrilus borellii: Micrococcus luteus, Bacillus sp., Bacillus cereus, Bacillus thuringensis, Micrococcus luteus, Pseudomonas nitroreducens, Brevibacterium casei, Bacillus sp, Micrococcus sp., Bacillus thuringiensis, Pseudomonas sp., Bacillus megaterium y Lysinibacillus sp*. Family Megascolecidae: - *c) Metaphire californica: Micrococcus luteus, Bacillus sp., Bacillus cereus y Bacillus thuringensis;* These results show a tendency in both species of Glossoscolecidae to the presence of a greater diversity of bacteria strains, which will indirectly affect the different functions as growth-promoting plant, such as phosphorus solubilization, auxin production, gibberellins and siderophores and nitrogen fixation.
Keywords: Earthworms Bacteria Intestinal
Financial support: FML – UNT

(2130 - 3145) Effect of *Azospirillum brasiliense* associated with organic fertilization on off-season maize crop in the region of Parecis - MT

Michael Ortigara Goulart[1]; Andre Tavares de Vasconcelos[1]; Guilherme Bariviera[1]; Leilane Marisa Hunhoff[1]; Marcela Vieira Paulo[1]; Roberto Antonio Savelli Martinez[1]; Bianca Nathiele Favetti Chagas[1]
University of the State of Mato Grosso[1]

Corn is one of the world's top agricultural products, as well as being a highly nutritious crop. Aiming for a more sustainable agriculture with less dependence on mineral fertilizers, which can be attributed to contamination of groundwater by eutrophication and a rise in agricultural production costs, some practices such as organic fertilization and inoculation by beneficial microorganisms are important. They are used as conservationist production tools However, there is little information on the joint use of organic fertilizers and *Azospirillum brasiliense* on that crop. Thus, to evaluate the effect of the interaction of the fertilization with the inoculation of *A. brasiliense* on the agronomic characteristics of maize cultivated in the off-season in the region of Parecis – MT an experiment was implemented. The experimental design of a randomized complete block design in a 2 x 5 factorial scheme with 4 replicates, two doses of chicken litter (0 and 2.5 tons ha^{-1}), combined with five commercial doses of *A. brasiliense* (0; 10; 15; 20 and 25 ml kg^{-1} of seeds) was used. The corn hybrid used was Formula Viptera, spaced of 50 cm between lines, with a population of 50 thousand plants per hectare. The number of spikes per meter, length and diameter of spikes, productivity, as well as the chlorophyll content in V6, V7, V8 and VT were evaluated. There was an important interaction for the ear corn length and productivity. Spikes diameter were not influenced by the factors studied. For the chlorophyll content, only in V6 the chicken litter dose presented statistical difference. The inoculation of *A. brasiliense* promoted an increase of 11.58% on corn ear length using a dose of 13.61 ml of the commercial product, when compared to the control without application in the absence of chicken litter. The inoculation of *A. brasiliense* did not promote productivity increase in the presence of the chicken litter; however, in the absence of the organic compound there was a linear increase as the inoculant dose increased.

Keywords: inoculation; chicken litter; productive characteristics
Financial support: University of the State of Mato Grosso

(8616 - 1183) Effect of different carbon substrates and phosphorus addition on microbial carbon use efficiency, gross nitrogen mineralization and N_2O emission from a grassland soil

Kazi R. Mehnaz[1]; Paola E. Corneo[1]; Claudia Keitel[1]; Feike A. Dijkstra[1]
Sydney Institute of Agriculture, School of Life and Environmental Sciences, The University of Sydney, 380 Werombi Rd, Brownlow Hill, NSW 2570, Australia[1]

The quantity and chemical composition of soil organic carbon (C) are the primary factors controlling the growth and activity of soil microorganisms. However, availability of phosphorus (P) can also limit microbial activity in soil because of its high requirement for nucleic acids, phospholipids and ATP synthesis. Little is known about the effect of P availability relative to the availability of C varying in chemical composition on soil microbial activity. In this study, we assessed the effect of different C substrates (glucose, oxalic acid and phenol), with and without P on microbial C use efficiency (CUE), microbial respiration, gross nitrogen (N) mineralization and nitrous oxide (N_2O) emission from a grassland soil. Soils were treated with 20 atom% ^{13}C-labeled glucose, oxalic acid or phenol (50 mg C kg^{-1}) with and without P (5 mg P kg^{-1}) after the addition of labelled (30 atom% $^{15}N\text{-}NH_4^+$) and nonlabelled ($^{14}N\text{-}NO_3^-$) N (15 mg N kg^{-1}), and incubated for 20 days at 25% (g/g) soil water content. Gas samples were collected at day 0, 1, 2, 8 and 20 of incubation to assess the carbon dioxide (CO_2) and N_2O emission rates. Another set of similarly treated soil was also incubated for 20 days in a closed jar containing sodium hydroxide to capture CO_2 and later being analyzed for total C and ^{13}C. Microbial CUE of the different C compounds added was assessed by following the ^{13}C tracer into microbial biomass and respiration. Furthermore, similarly treated soil was incubated with and without addition of ^{18}O-labeled water for 48 hours to determine microbial CUE based on incorporation of ^{18}O into microbial DNA (a substrate independent method). Gross rates of N mineralization were measured during a 48 hr incubation of similarly treated soil using the ^{15}N isotope pool dilution technique. Microbial biomass ^{13}C and ^{15}N and soil ^{15}N recovery were measured after 48 hr and 20 days of incubation. Samples still need to be analyzed but we hypothesize that the variation in recalcitrance among C substrates will change the efficiency of microbial C utilization and thus respiration, and the differences in degradation of C substrates will also affect gross N mineralization and N_2O emission from heterotrophic denitrification. We also hypothesize that the alleviation of P limitation of soil microbes will positively contribute to all microbial processes assessed in this study.

Keywords: Microbial carbon use efficiency; gross N mineralization; microbial respiration; denitrification; N_2O emission

Financial support: Australian Research Council (FT100100779)

(3365 - 3037) Effect of native arbuscular mycorrhiza isolated from acidic volcanic soils on wheat root traits and phosphorus uptake

Pedro Campos[1]; Paula Aguilera[1]; Natalia Aguilera[1]; Sebastián Meier[2]; Fernando Borie[1]; Alex Seguel[1]
Universidad de La Frontera[1]; INIA Carillanca[2]

Wheat is one of the most important food crops in the world and the annual crop most harvest in Chile. However, wheat production is highly dependent on phosphorus (P) fertilizers. Arbuscular mycorrhizal (AM) symbiosis is most common and widespread mycorrhizal symbiosis, which improves acquisition of soil water and nutrients, particularly P. Nevertheless, there is little information about the effects of different AM species in wheat root physiology and development in order to understand the high variability of growth responses found in the literature. The aim of this work was to study the effect of two mycorrhizal isolated from acidic volcanic soils on biomass production and root development and physiology of wheat plants. A pot and a rhizobox experiment using autoclaved sand:vermiculite (1:1) as substrate were performed using winter wheat (cv. Tukan) inoculated with *Claroideoglomus claroideum* (CC), *Rhizofagus intraradices* (RI) and non-inoculated plants as control. Plants were grown for 33 days under greenhouse conditions and watered with Taylor and Foy nutrient solution with low P supply as needed. At the end of the experiment, roots were scanned and organic acid (OA) exudation were measured through filter disks set over three different points of the root system on plants grown in rhizoboxes. At harvest, yield, soil acid phosphatase, OA exudation in rhizospheric soil and P concentration were measured. Mycorrhizal colonization by CC increased shoot and root biomass and P concentration, root specific area, secondary root number and length compared to non-inoculated plants. In other hand, RI plants presented a smaller root system compared to the control, and lower response on biomass production. Colonization by both fungi decreased acid phosphatase activity, while colonization by RI increased total and localized oxalic acid exudation. Overall, CC was more effective in promoting P acquisition from substrate, mainly because to the higher root development promoted by this isolate. The higher oxalic acid exudation observed by plants colonized by RI could comprehend an important mechanism in soils with high content of residual P. Acknowledgment: FONDECYT project Nº 11160385 (A. Seguel) and CONICYT Scholarship (P. Campos).
Keywords: Arbuscular mycorrhizal fungi, Phosphorus uptake, Root architecture
Financial support: FONDECYT project Nº 11160385

(1557 - 1373) Effects of Biofertilizer on the root colonization of soy and corn by arbuscular mycorrhizal fungi

Luis Eduardo Azevedo Marques Lesacano[1]; Tatiane Gonçalves Bordim[2]; Gabriel Ferreira de Paula[3]; Leopoldo Sussumu Matsumoto[3]
Unviersidade Estadual do Norte do Paraná[1]; Universidade Estadal do Norte do Paraná[2]; Universidade Estadual do Norte do Paraná[3]

Exploitation of benefits of arbuscular mycorhyzal (AM) in agriculture has been compromised by lots of agricultural practices which decrease the number of mycorrizal propagules in the soil and the diversity of arbuscular mycorrizal fungi (AMF) species. An alternative is the search for agricultural inputs that stimulates the colonization by the native community of AMF in the soil. Studies conducted in vegetation house have demonstrated that biofertilizers influence positively the mycorrizal colonization. In this context, the objective of this study was to analyze, under field conditions, the influence of continuous application of a liquid biofertilizer in the AFM roots colonization of soy and corn. Trials with two culture were conducted at the North Paraná State University (UENP - Bandeirantes in the harvest 2015/1016, with five treatment (control and increasing doses of foliar application 50, 75, 150 and 225 L ha^{-1}) and four replicates. It was observed that application of the biofertilizer promoted an increase in the mycorrhiza colonization of soybean roots, with percentage values in the control and doses 50, 75, 150 e 225 L ha^{-1} corresponding to 50%, 51% 58%, 61% e 69%, respectively. Unlike soybeans, the application of biofertilizers doses did not change the percentage of mycorrhizal colonization of corn roots, whose values were 60%, 55%, 54% and 55% in the control and dosages 50, 75, 150 and 225 L ha^{-1} respectively,. The increase in mycorrizal colonization of soybean roots suggests a positive effect of the biofertilize in mycorrhizal colonization in roots of this species. The results of this study demonstrate the absence of deleterious effects of this product on the AFM community under experimental conditions

adopted in this study, unlike chemical fertilizers and others agricultural inputs, which may cause a reduction in mycorrhizal inoculum potential and, in the benefits obtained by the plant through AM.

Keywords: arbuscalar mycorrhizal; agricultural imput; agriculture
Financial support: Fundação Araucária; CNPq

(4807 - 1146) Effects of bokashi fertilizer and rice straw on greenhouse gas emission and rice yield in paddy field

Kazuyuki INUBUSHI[1]; Takashi NAGASAWA[1]; Zanyang Wang[1]; Qian Li[1]
Chiba University[1]

Bokashi fertilizer (bokashi), mixture of organic and inorganic materials and fermented, is used in Japanese paddy field for organic farming. Rice straw is also incorporated to soil after harvesting. These organic materials improve soil fertility. However, applying such organic materials in paddy field may increase CH_4 emission. Therefore, we conducted incubation and pot experiments to see the effects of bokashi and rice straw on greenhouse gas emission. Soil was sampling in paddy field in Chiba, Japan in March. Rice straw was powdered or chopped into 2 - 3cm pieces. Bokashi was made by Kogo Beikoku Co., Ltd. (Mixture ratio; Rice bran: Oilcake: Chicken Manure: Eggshell: Bone mill = 5: 4: 1: 1: 1). We conducted aerobic incubation (4 weeks) and then anaerobic incubation (16 weeks). Six treatments were set up with 2 application timings with or without organic materials (rice straw and/or bokashi). In this experiment, CO_2, N_2O, Soil Microbial Biomass Carbon (MBC) in aerobic incubation and CH_4 in anaerobic incubation were analyzed. In pot experiment, aerobic condition maintained for 3 weeks. Two treatments were set up with 2 application timings with or without organic materials (rice straw and/or bokashi). In this experiment, CO_2, N_2O in aerobic condition and CH_4, Eh, Soil pH, and Soluble Organic Carbon (SOC) after transplanting and flooding were measured, and rice yield were analyzed. In aerobic incubation, CO_2 was produced rapidly in treatments with rice straw. MBC of treatment A (with rice straw and bokashi before aerobic incubation) was the highest during aerobic incubation. In anaerobic incubation, Treatment B (with rice straw before aerobic incubation and bokashi after aerobic incubation) produced more CH_4 than treatment A. In pot experiment, treatment A (with rice straw and bokashi before aerobic period) produced more CO_2 than treatment B (with rice straw before aerobic period and bokashi before flooding and transplanting). After flooding and transplanting, CH_4 emission in treatment B was larger than treatment A before drainage. However, CH_4 emission after drainage in treatment A became larger than treatment B. Incorporated rice straw to soil with bokashi produced more CO_2 than rice straw only. Microbial growth in soil was active by using nutrients of bokashi as nitrogen sources. However incorporation of organic materials increased CH_4 emission, their decomposition in aerobic period decreased early stage of CH_4 emission after flooding.

Keywords: Bokashi; CH_4; CO_2; Microbial biomass; Organic materials;
Financial support:

(5798 - 2733) Effects of long-term cultivation of forages on microbial soil attributes

Guilherme M. Moreira[1]; Guilherme L. S. Xavier[1]; Maria Catarina M. Kasuya[1]; Dilermando M. Fonseca[1]; Ivo R. Silva[1]; Raphael B. A. Fernandes[1]
Universidade Federal de Viçosa, Brazil[1]

Forages are one of the most important cultures cultivated in Brazil, however, the effect of its long-term cultivation on soil microbial attributes remains unclear. This study aimed evaluated the effects of continuous cultivation for > 10 years of forage species on soil microbial attributes. We evaluated the following species: Andropogon (Andropogom gayanus), Tanzania (Panicum maximum vr. Tanzânia), Massai (Panicum maximum cv. Massai), Marandu (Brachiaria brizantha cv. Marandu), Mulato (B. decumbens x B. ruziziensis cv. Mulato), Xaraés (B. brizantha cv. Xaraés), Colonião (Pennisetum americanum x Pennisetum purpureum cv. Paraiso), Mombaça (Panicum maximum vr. Mombaça), Capim gordura (Melinis minutiflora), Amendoim Forrageiro (Arachis pintoi), Ruzizienses (B. ruzizienses), Humidícola (B. humidicola), Cameroon (Pennisetum purpureum cv. Cameronn), Decumbens, (B. decumbens), Tifton (Cynodon dactylon cv. Tifton 85), Pueraria (Pueraria phaseoloides), and Stilosantes (Stylosanthes guianensis). The study was carried out in Universidade Federal of Viçosa, Viçosa, MG, Brazil. Soil microbial quality was evaluated by the microbial biomass carbon (MBC) and nitrogen (MBN) contents, and microbial metabolic quotient (QBIO). Statistical analysis was performed by analysis of variance and post hoc Tukey test ($P<0.05$). The soil MBC contents were higher in Humidicola and Cameroon grasses and lower in Tifton, Amendoim forrageiro and Mulato. The soil MBN contents were increased with Mombaça and Ruziziensis cultivation and reduced with Stilosantes, Tifton and Capim gordura cultivation. The QBIO indicated better microbial habitat in the soil with Andropogom , Massai and Stilosantes, and worse one associated with Amendoim Forrageiro and Xaraés. Differences among forage species were identified in soil contents of MBC and MBN, and the lowest values were observed associated with the soil with Tifton. Results obtained are related to the presence of different groups of microorganisms associated with different forage species, which can affect CBM and NBM contents (eg, the fungal microbiota normally has lower N contents than the bacterial microbiota). Results of QBIO suggest that microbial habitat conditions are probably more related to other soil attributes modified by the plant species than to MBC and MBN contents (with the exception of Amendoim Forrageiro and Xaraés). Data obtained indicate homogeneity in soil microbial quality after long-term cultivation of 16 forage species.

Keywords: soil microbiology quality, tropical pastures, soil biology
Financial support: CNPq, CAPES and Fapemig

(4239 - 1640) Evaluation of groundnut genotypes for variations in their response to phosphorus sources in three agro-ecological zones of Nigeria

Ado Adamu Yusuf[1]; Jamila Aliyu[2]; Fatima Hassan[3]; Hauwa Abdulkareem Yusuf[4]; Muhyideen Oyekunle[3]
Department of Soil Science, Faculty of Agriculture/Institute for Agricultural Research, Ahmadu Bello University, P.M.B. 1044, Samaru, Zaria, Kaduna State, Nigeria[1]; Department of Soil Science, Faculty of Agriculture/Institute for Agricultural Research, Ahmadu Bello University, P.M.B. 1044, Samaru, Zaria, Kaduna State, Nigeria[2]; Department of Plant Science, Faculty of Agriculture/Institute for Agricultural Research, Ahmadu Bello University, P.M.B. 1044, Samaru, Zaria, Kaduna State, Nigeria[3]; Department of Agricultural Extension and Rural Development, Faculty of Agriculture/Institute for Agricultural Research, Ahmadu Bello University, P.M.B. 1044, Samaru, Zaria, Kaduna State, Nigeria[4]

Groundnut (*Arachis hypogaea* L.) is an important grain legume for yield stabilization in the cereal dominated cropping systems of Nigerian savannas. However, its productivity is limited by low phosphorus (P) content of the soils despite active breeding programme to develop high yielding pest and disease resistant varieties. The pod and haulm yields of 16 groundnut genotypes comprising 7 released, 6 advanced breeding lines, 2 local and 1 non-nodulating were evaluated for their response to 30 kg P/ha as single superphosphate (SSP) fertilizer and Sokoto rock phosphate (SRP) in

three agro-ecological zones – Southern Guinea (SGS), Northern Guinea (NGS) and Sudan savannas (SS) of Nigeria. Soil samples were analyzed for initial characterization of the experimental sites before trial establishment. The trials were laid out in a split-plot design with the P source in the main plot and the genotypes in the sub-plot replicated three times. The combined analysis of variance indicated the significance of the location, P source, genotype and their corresponding interactions on pod yield. Stability and genotype superiority for pod and haulm yields was determined using GGE biplot analysis. According to location by P source interaction, the highest pod yield (3359 kg/ha) was obtained at Samaru in NGS with the application of SSP. The yield of the control treatment in this location (2326 kg/ha) was significantly higher than all the treated plots in the other locations except at Minna (SGS) where the yield was at par with the application of SRP (2349 kg/ha). Among the genotypes, advanced breeding lines for aphid and rosette virus resistance ARRORS ICGX-SM and ARRORS ICGX that received SSP outperformed the remaining 14 in the genotype by P source interaction. Similarly, these genotypes gave the highest pod yield at Samaru in the genotype by location interaction. The higher influence of the NGS location on pod yield was attributed to its higher soil fertility indicators such as organic C, Ca and clay. The non-nodulating genotype ICGL 5 was the least productive due to lack of symbiosis with soil bacteria responsible for fixing atmospheric nitrogen. A polygon view of the GGE biplot analysis indicated that ARRORS ICGX-SM and ARRORS ICGX were the most stable and desirable genotypes in terms of pod yield while these same genotypes together with three released genotypes SAMNUT 10, 21, 23 and a local material, *Mai Bargo* are recommended for haulm production in all the three locations.

Keywords: Arachis hypogaea, pod, haulm, GGE biplot, groundnut, agro-ecological zone
Financial support:

(7854 - 1553) Evaluation of soil microbial community changes under different agricultural land uses in eastern montana, USA

Joshua J. Steffan[1]; Eric C. Brevik[1]; Billi Jean Petermann[1]
Dickinson State University[1]

The composition of the soil microbial community within different land uses or land management techniques and systems remains an unanswered question. Scientists increasingly recognize that microbial diversity improves soil structure, nutrient availability, and helps facilitate air and water movement in the soil to keep soils functioning to provide ecosystem services. Thus, it is imperative to further understand the diversity of soil microbial communities under different conditions and their role within those ecosystems. For example, an increased bacterial diversity may indicate active communities, abundant resources, and the ability to support higher trophic level organisms. In this study, three different land management strategies are compared to determine how the microbial communities are responding to these different conditions and how these different microbial communities affect basic physical and chemical soil properties and overall soil health. The study is being conducted in Dawson County in Eastern Montana, USA. The first management site was previously enrolled in the Conservation Reserve Program (CRP) for over thirty years, has been untouched (rested) over that time period, and represents long-term perennial cover. The second site has history similar to site 1, but was converted to no-till production agriculture starting in fall of 2015. The third site also has similar history, but was converted to no-till production agriculture beginning in the fall of 2014 and is grazed by livestock over the winter months following the harvest of the agronomic crop. Soil samples were taken during the spring and fall for the past two years. Herein, we report the results of the soil samples which underwent Phospholipid Fatty Acid Analysis at three soil depths (0-5cm, 5-15cm and 15-30cm). Overall, total microbial biomass and diversity appear to increase in both the no-till management sites compared to continuous CRP land.

Keywords: Soil microbial community land-use changes no-till production agriculture
Financial support: This research was supported by the National Science Foundation under Grant Number IIA-1355466.

(9200 - 2158) Exotic arbuscular mycorrhizal fungi reduce mycorrhizal colonization rate in cowpea plants

Marco Aurélio Gabriel da Silva[1]; Ingrid Alexssandra Neris Lino[2]; Danielle Karla Alves da Silva[3]; Antônio Félix da Costa[4]; Leonor Costa Maia[2]; Adriana Mayumi Yano Melo[3]
Universidade Federal de Uberlândia[1]; Universidade Federal de Pernambuco[2]; Universidade Federal do Vale do São Francisco[3]; Instituto Agronômico de Pernambuco[4]

Arbuscular mycorrhizal fungi (AMF) are obligatory biotrophic that colonizing roots of the majority of land plants. In this associations, fungus transfer nutrients (mainly P) to the plant, and in exchange receives photosynthates. About 80% of land plants form symbiosis with AMF, including cowpea [*Vigna unguiculata* (L.) Walp.], which constitute an important protein resource in the diet of people from developing countries, and it can be naturally colonized by AMF. Considering colonization as a key factor of symbiosis, and that it can be affected by several factors, we aimed to evaluate the effect of inoculation with different exotic AMF in the colonization of cowpea (cv. Miranda IPA 207) and in the sporulation of AMF. The experiment was performed during 70 days in greenhouse using soil-inoculum (containing about 3,000 infective propagules per pot, applied under the seeds) from three AMF isolates - *Acaulospora longula* URM-FMA 07 (AL), *Claroideoglomus etunicatum* URM-FMA 03 (CE) e *Gigaspora albida* URM-FMA 11 (GA). The experimental design was completely randomized with four treatments: T1= Control (uninoculated soil containing only native AMF from field samples), T2= inoculation with AL; T3= inoculation with CE e T4= inoculation with GA, with5 replicates. The data were submitted to the analysis of variances (ANOVA) and the averages were compared by Tukey test (5% of probability). There were no significant differences in the glomerospores number in comparison to the control ($p>0.05$). On the other hand, greater colonization rates (82.4%) were observed in the control plants (native AMF) comparing to plants inoculated with *A. longula* (75%), *C. etunicatum* (67.2%) and *G. albida* (75%). In general, it is known that AMF inoculation contributes to improving mycorrhizal colonization rates, however, in our study, the opposite was observed, and the native AMF were more efficient in colonizing the host than to the AMF introduced. A disturbance in the native AMF community may have been generated by the introduction of the exotic, justifying the reduction in the colonization rates. Futhermore, there may have been a competition effect for the root system between microorganisms. Studies that aim to know the best inoculants for cowpea crops should be continued since inoculation practices alter the mycorrhization of these plants.

Keywords: AMF; Soil; Mycorrhizal; Symbiosis
Financial support: CNPq, FACEPE

(5953 - 1612) How deep can ectomycorrhizae go? A case study down to 4 meter depth in a Brazilian eucalyptus plantation under rainfall reduction.

Robin A[1]; Pradier C[1]; Sanguin H[2]; Mahé F[2]; Dini Androte F[3]; Jurandy Bran Nogueira Cardoso E[3]; Plassard C[4]; Laclau JP[5]; Hinsinger P[4]; Jourdan C[5]
CIRAD, UMR Eco&Sols, BR-13418-900 Piracicaba SP, Brazil[1]; CIRAD, UMR LSTM, FR-34398 Montpellier, France[2]; ESALQ, Univ São Paulo, BR-13418-900 Piracicaba SP, Brazil[3]; INRA, UMR Eco&Sols, F-34398 Montpellier, France[4]; CIRAD, UMR Eco&Sols, F-34398 Montpellier,

France[5]

Most often, it is recognized that mycorrhizae are only occurring in the first layers of soil and decrease drastically with depth. Unfortunately, the vertical distribution of mycorrhizal associations remains poorly understood and very few studies have investigated these symbiosis in very deep layers, the majority of studies focusing on the topsoil. In a context of climate changes that predicts more frequent drought events, it is of great interest to take into account the functioning of the deep roots in relationship with this fungal symbiosis, which could play an important role in water acquisition and in the exploration of the soil with their extraradical hyphae network. In this work, we characterized, in a 5-year-old *Eucalyptus grandis* plantation in Brazil, changes in fungal community within soil profiles and whether these changes are influenced or not by a water stress using a throughfall reduction experiment. This research was conducted at the experimental station of Itatinga (ESALQ-USP, São Paulo state). Root samples were collected between May and June 2015. Fine roots (< 2 mm) were sampled carefully layer per layer during the digging of a pit (1.5 x 4 meters) in order to prevent any contaminations between two consecutive soil depths. Ten soil layers have been sampled from 0 to 4 meter depth. An Illumina sequencing of the Internal Transcribed Spacer (ITS2) was carried out on DNA extracted from root samples to study fungal community composition and diversity. We showed that the fungal communities were dominated by ectomycorrhizal fungi (ECM).The fungus *Pisolithus* represented more than 80% of the fungal community. For the first time, both ECM sequences and ECM root tips were observed along the profiles down to 4 meters. By subsampling the root tips of *Pisolithus*, we showed that *Pisolithus* populations responded strongly both to the depth and to the rainfall reduction. This work represents a step forward in the microbial ecology with the evidence, for the first time, of the occurrence of ECMs down to a depth of 4 meters. These results highlight the importance to work more on this subject and to expand these researches to other tropical perennial plants of major interest in order to evaluate the genericity of our observations made on eucalyptus. One of the challenges for future research will be to take into account the role of deep fine roots in plant nutrition but also in the carbon cycle considering the quantity of C allocated in these assemblages.

Keywords: Deep soil, ECM fungi, Pisolithus, tropical forest plantations, eucalyptus, drought stress

Financial support: CRESI CIRAD, SOERE F-ORE-T / ANAEE

(2741 - 534) Indigenous mycorrhizae enhances carbon and nitrogen uptake by sweet sorghum genotypes grown under two divers soil ecological zones

Ibrahim. A. M. Ahmed[1]; Ibrahim Ortaş[2]; Celal Yucel[3]

Department of Soil Science and Plant Nutrition, University of Cukurova, Adana, Turkey. Department of Soil and Environment Sciences, Faculty of Agriculture, University of Khartoum, Khartoum, Sudan.[1]; Department of Soil Science and Plant Nutrition, University of Cukurova, Adana, Turkey[2]; Eastern Mediterranean Agriculture Research Institute, Adana, Turkey.[3]

Arbuscular mycorrhizal fungi (AMF) have the capability to improve crop yields by increasing plant nutrient and water supply. It is less known the contribution of indigenous mycorrhizae effects on carbon (C) and nitrogen (N) up take by sweet sorghum genotypes. Therefore, this study was undertaken in a greenhouse to investigate the effects of indigenous mycorrhizae inoculums which were collected at rhizosphere soil in two divers ecological zones. Sixteen sweet sorghum genotypes (collected from USA) and two Turkish soils (Haran (South Anatolia Region) and Arık (Mediterranean Region) soils series) were used in this investigation. Sweet sorghum genotypes growth response, root colonization, mycorrhizal dependency, C and N uptake as well as mitigation of carbon dioxide (CO_2) in plant tissue under sterile soil conditions were determined. Indigenous mycorrhizal inoculated sweet sorghum genotypes had more plant biomass than non-mycorrhizal plants. Likewise, Haran soil produce greater shoot and root dry matter than plant grown in Arık soil. In Haran soil, plant biomass fixed CO_2 on several sweet sorghum genotypes varies from 83.7 to 123.3 Mg/ha for mycorrhizae amended soil. Whereas, plant biomass CO_2 fixation varies from 49.6 to 78.1 Mg/ha for non-mycorrhizae amended soil. In Arık soil, plant biomass fixed CO_2 on several sweet sorghum genotypes varies 83.28 to 107.3 and 67.8 to 94.7 Mg/ha for mycorrhizae and non-mycorrhizae treatment, respectively. In Haran soil, total N uptake by several sweet sorghum genotypes varies 1.14 to 1.64 Mg/ha and 0.71 to 1.22 Mg/ha for mycorrhizae and non-mycorrhizae treatments, respectively. In Arık soil, total N uptake by several sweet sorghum genotypes varies 1.18 to 2.07 Mg/ha and 0.92 to 1.32 Mg/ha for mycorrhizae and non-mycorrhizae amendment, respectively. Root colonization of several sweet sorghum genotypes varies 33.3 to 63.3% and 33 to 73% in Arık and Haran soil, respectively due to indigenous mycorrhizae amendment. Similarly, mycorrhizal dependency varies 1.6 to 14.6% and 11 to 46% in Arkil and Haran soil, respectively. It has been concluded that indigenous mycorrhizae has the potentiality to increase diverse C and N uptake as well as mitigated CO_2 in between sweet sorghum genotypes which were grown under two ecological regions soil.

Keywords: Sorghum genotypes, carbon fixation, mitigation of CO_2, root colonization and mycorrhizal dependency.

Financial support: Çukurova University Research Foundation project no: FDK-2017-9014

(7716 - 1175) Influence of grazing intensities in integrated crop-livestock system on microbiological attributes in soil

Andrea S. Scaramal[1]; Gabriel E. Freitas[1]; Breynner G.P.Bertagnoli[1]; Maria F. Guimarães[2]; Arnaldo Colozzi Filho[1]

IAPAR[1]; UEL[2]

The Integrated crop-livestock system (ICLS) is an alternative for crop diversification and reduction of the environmental impact of the productive agricultural system, with potential to promote the recovery and conservation of soil quality. ICLS grazing intensity may interfere at soil quality, and depending on the amount of plant residues left in the system and the management of the animals. In order to verify the influence of the ICLS on microbiological attributes, were collected some samples of soils in the 0-10 cm layer in the treatments with different grazing intensities: 10; 20; 30; 40 cm pasture heights remaining (GI-10, GI-20, GI-30 and GI-40, respectively), and no grazing (NG). The microbiological attributes analyzed were carbon and nitrogen from microbial biomass (MBC e MBN), microbial respiration (MR), metabolic quotient (qCO_2), microbial quotient (qMIC) and β-glucosidase enzyme activity. After three years of ICLS, there was an increase in MBC, MR and qCO_2, and that pasture management with moderate intensities of animal grazing (GI-20) presented higher MBC contents than others management. About the relation to qCO_2 values, the GI-20 was significantly lower than the GI-10, being 2.5 times smaller than high grazing intensity (GI-10) and 1.91 times lower when compared to the GI- 30, GI-40 and NG. After grazing cycle, β-Glucosidase presented significant differences (p<0.05) between areas. The highest activity occurred in GI-40 and NG (211 and 217 µg PNH g^{-1} h^{-1}, respectively), which were significantly (p<0.05) higher than GI-10, GI-20 and GI-30. There were no significant differences in MR, MBN and qMIC values. Moderate grazing intensities (GI-20, GI30) resulted in a good vegetation cover, greater grazing renewal, which stimulates the microbial biomass as a result of the release of organic substances, besides having provided conditions of lower thermal variation and greater availability of water which favored the biomass and microbial activity of the soil.

Keywords: enzymatic activity, microbial biomass, biological attributes, soil quality.
Financial support: Agronomic Institute of Paraná (IAPAR) and Nacional Researcher Council – CNPq.

(9085 - 1199) Inoculation of phosphate solubilizing bacteria enhance growth and nutrient accumulation of *Vigna unguiculata* (L.) Walp in an Oxisol

Leandro Marciano Marra[1]; Silvia Maria de Oliveira Longatti[1]; Cláudio Roberto Fonsêca Sousa Soares[2]; Fatima Maria de Souza Moreira[1]
Universidade Federal de Lavras[1]; Universidade Federal de Santa Catarina[2]

Lack of available phosphorous in tropical soils is one of the most limiting factors for plant yield. Therefore, high rates of phosphate fertilizers are needed to increase crop yield. Low availability is mainly due to immobilization of phosphorus with other soil components through precipitation, which forms insoluble phosphates. Microorganisms are capable of solubilizing phosphate precipitates, as well as phosphate from rocks, increasing nutrients in the soil solution for plant growth. The aim of this study was to evaluate the efficiency of bacteria isolated from cowpea bean [*Vigna unguiculata* (L.) Walp.] nodules in enhancing growth and phosphorus nutrition of this species grown in an Oxisol fertilized with Araxá rock phosphate (ARP). The strains studied were UFLA 03-08 (*Rhizobium tropici*), UFLA 03-09 (*Acinetobacter* sp.), UFLA 03-10 /UFLA 03-106 (*Paenibacillus kribbensis*), and UFLA 03-116 (*Paenibacillus* sp.). The treatments consisted of inoculation of the strains, separately, in pots in an Oxisol (2 dm^{-3}) containing 6.0 g of ARP (equivalent to 600.0 mg pot^{-1} of phosphorus), a control with ARP without inoculation, two controls containing 300.0 and 600.0 mg pot^{-1} of soluble phosphorus applied as triple superphosphate fertilizer without inoculation, and a control without the soluble phosphorus addition, ARP, and without inoculation. All the inoculated strains were capable of increasing the shoot dry matter, root dry matter and phosphorus and nitrogen content in the aerial part compared with the control ARP without inoculation. The UFLA 03-09 strain had the best performance among them; increases in shoot dry matter and phosphorous and nitrogen content were 600%rfh, 511.5%, and 747.4%, respectively. Thus, these strains clearly contribute to the growth of cowpea bean through rock phosphate solubilization, improving phosphorus and nitrogen nutrition. Use of these bacteria is recommended for future experiments under field conditions.

Keywords: cowpea bean; phosphorus, rock phosphate.
Financial support: Coordination for the Improvement of Higher Education Personnel [Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES)]; Foundation for Support of Research in the state of Minas Gerais [Fundação de Amparo a Pesquisa no Estado de Minas Gerais

(5640 - 2295) Inoculations with efficient nitrogen fixing bacteria increase yields of common bean genotypes grown in separate areas

Maria Vitória Batista Duque Guttierrez Baptista[1]; Bruno Lima Soares[1]; Fábio Aurélio Dias Martins[2]; Damiany Pádua Oliveira[1]; Márcia Rufini[1]; Fatima Maria de Souza Moreira[1]; Messias José Bastos de Andrade[1]
Universidade Federal de Lavras - UFLA[1]; Empresa de Pesquisa Agropecuária de Minas Gerais-EPAMIG SUL[2]

The adoption of cultivars responsive to N_2 fixation that provide significant yields can lead to savings in production costs and result in greater financial return to farmers. However, their responses may be conditioned on the genotype of the nitrogen-fixing bacteria involved in the symbiosis. It is important to carefully select strains with affinity to the host genotype and that are highly efficient in the symbiotic process. Other factors, such as soil fertility and soil and climate conditions, cannot be ignored. The aim of this study was to evaluate the agronomic efficiency of common bean cultivars (IAC Alvorada, BRS Estilo, BRSMG Madrepérola, and BRS Notável) not inoculated (without mineral N or with 20 or 80 kg ha^{-1} of urea N) or inoculated with a recommended strain (CIAT 899 of *Rhizobium tropici*) or with a strain in the selection phase (UFLA 02-100 of *R. etli*). Four experiments were conducted in the field in the rainy crop season in Lavras, Patos de Minas, and two different areas of Lambari, MG, Brazil. A randomized block experimental design was used in a 4x5 factorial arrangement, with four replications. Fertilization with P_2O_5 and K_2O were defined by soil analysis. The rate of peat inoculant containing $\pm 10^9$ cells of *Rhizobium* per gram was 25 g per kg of seed. After individual and combined analysis of variance of the data, lower crop yield was found in Lambari. The effect of plant genotype on yield was conditioned on the source of N. The cv. IAC Alvorada, for example, produced more when fertilized with a high concentration of urea N or inoculated with the strain UFLA 02-100, whereas the yield of cv. BRSMG Madrepérola was greater with inoculation with CIAT 899. The good performance of the cv. BRS Estilo without inoculation and without mineral nitrogen fertilization indicates that it is ideal for adoption when there are no resources for inoculation. The cv. BRS Notável, in turn, appears to be less responsive to the different sources of N. However, its mean values when not inoculated and not fertilized with mineral N do not reach the high levels of the cv. BRS Estilo in the same situation. Although the effects of the sources of N on yield are dependent on the cultivars and growing location, the highest increases occur when there is inoculation or fertilization with 80 kg ha^{-1} of urea N. Therefore, the inoculation technique is viable and the strain UFLA 02-100 has potential for recommendation for the genotypes tested.

Keywords: *Phaseolus vulgaris* L.; common bean cultivars; biological N_2 fixation; Rhizobium strains
Financial support: CAPES, CNPq, and Fapemig

(5526 - 1465) Liming may affect *in vitro* AIA yields of *Digitaria eriantha* endophytic bacteria

Lira Junior, Mario Andrade[1]; Carvalho, Eric Xavier[2]; Barreto, Maria Carmo Silva[2]; Mendonça, Johny Jesus[1]; Alves, Michelle Justino Gomes[1]; Oliveira, José Paula[2]; Silva Junior, Josemir Ferreira[2]
UFRPE[1]; IPA[2]

There is an increasing tendency to use biological means to increase plant yield, and thus enhance sustainability. One of the most promising means is the inoculation with plant-growth promoting bacteria. Currently inoculants for corn and wheat, are second only to soybean inoculants in Brazil, indicating this technique immense potential. On the other hand, mechanisms of bacterial influence and major limitations are not as well understood for these systems. One of the major mechanisms is supposed to be increased nutrient absorption efficiency, due to a larger root system, through production of AIA by the endophytic bacteria. At the same time, the bacterial inoculant industry is based, among other aspects, on the continuous search for new genetical material, most frequently depending on the huge diversity of bacteria. There is currently a project under way evaluating the endophytic population of *Digitaria eriantha* which is a forage grass established in different areas of Pernambuco State, Northeast Brazil, mostly not receiving any fertilizers, and for which there are areas known to be under continuous coverage without major pasture degradation for over 30 years. As part of this project our team has isolated over 500 strains of endophytic bacteria from rhizospheric soil, colm, leaves and roots of these plants under dry and wet seasons, on areas limed or not, and using different nitrogen-free culture media. These were phenotypically characterized and grouped, and 80 representative strains were randomly selected for the evaluation of *in vitro* AIA yields using L-tryptophan enriched TSB

media and Salkowsky and light absorbance measured on a UV-VIS spectrophotometer at 520 nm, according to standard procedures. AIA yields were used to group the 80 strains into five groups at a 90% similarity level, based on Ward´s method, with the group means differing according to 95% confidence intervals. Grouping of the strains by isolation conditions (season of the year, plant part, soil liming, or N-free media used) indicate that groups formed by season, plant part or media did not differ, according to the respective 95 confidence intervals, while strains from limed soils presented significantly higher AIA yields. Groups of the strains by phenotypical characteristics (culture media pH changes and mucous production) indicated found that strains forming mucous in the Petri dishes had higher AIA yields, also according to the confidence intervals.
Keywords: PGPR, tropical semiarid, plant growth promoting
Financial support: CAPES, CNPq, FACEPE

(9544 - 871) Mesofauna and soil quality in forest systems with leguminous tree

Maurício Rumenos Guidetti Zagatto[1]; Arthur Prudêncio de Araújo Pereira[1]; Rafael Fabri Pereira[1]; Renan Viccino Lopes[1]; Luis Fernando Baldesin[1]; Elke Jurandy Bran Nogueira Cardoso[1]
ESALQ/USP[1]

The cultivation of leguminous nitrogen-fixing tree species improves soil chemical properties, especially with regard to N, and has been identified to be ecologically and economically interesting in intercropped systems with Eucalyptus spp. However, the effect of this management system on soil invertebrates is still unknown, and this is our main reason for evaluating soil mesofauna parameters, trying to establish correlations between the soil invertebrates and soil chemical and microbiological attributes, as well as to create a general indicator of soil quality for pure plantations of *Acacia mangium* (AC), *Eucalyptus grandis* (EU) and for mixed plantations of those tree species (M). Therefore, we evaluated abundance, diversity and richness of soil mesofauna, microbial carbon, soil moisture, dehydrogenase activity, soil respiration qCO_2 and Cmic / Ct in two seasons: October 2015 (dry weather) and March 2016 (rainfall), while soil chemical analyses were performed only in October. The mean values of each attribute in each of the three forest systems were compared, and regression and multivariate analyses were performed to derivate a general indicator of soil quality. Therefore, we established the main interactions occurring between mesofauna and chemical or microbiological attributes. Few differences were observed between the forest treatments, but we found higher microbial activity and soil quality in the rainy season. In the dry season, there were some positive correlations between mesofauna and soil microbiological parameters, evidencing prevailence of mutualistic interactions between mesofauna and microorganisms.
Keywords: soil fauna, microbial activity, seasonality, mutualistic interactions, intercropped plantation.
Financial support: CAPES and CNPq.

(6626 - 878) Metabolic quantity of edaphic microbiote in different soil uses in the region of the central cerrado of brazil

Lídia Justen[1]; Talita Maia Freire[1]; Nayara Monteiro Rodrigues[1]; Danilo Marcelo Aires dos Santos[1]; Alexandre Uhlmann[2]; Michele Ribeiro Ramos[1]
Universidade Estadual do Tocantins[1]; Embrapa Florestas[2]

Intensive and inadequate soil use can lead to degradation, which is often irreversible. In this way, it is necessary to monitor them in order to preserve their quality so that it can provide good productivities. Biological attributes are used with this function. The objective was to evaluate the metabolic quotient obtained through biomass and microbial respiration in different soil uses in the cerrado region, a biodiversity hotspot on the planet. The evaluated treatments were: pasture, forest planting of Eucalyptus spp., Organic banana and plowed soil. Soil samples were collected from horizon A. The metabolic quotient was calculated by the ratio between basal respiration and the carbon of the microbial biomass. Microbial respiration (RMS) was determined by the NaOH solution capture method of CO_2 evolved from the soil using incubation chambers. Soil microbial biomass (BMS) was determined by the Substrate Induced Breathing (RIS) method. The mean values found for RMS were: 0.28 C-CO_2 mg Kg^{-1} h^{-1}, 0.84 C-CO_2 mg Kg^{-1} h^{-1}, 1.08 C-CO_2 mg Kg^{-1} h^{-1}, 54 C-CO_2 mg kg^{-1} h^{-1}, respectively, plowing, pasture, forest planting and organic banana cultivation. The higher release of CO_2 in the latter is due to greater biological activity, caused by the greater availability of organic material. For BMS, the average result was 65.21 µg C g^{-1}, 181.2 µg C g^{-1}, 237.3 µg C g^{-1} and 237.3 µg C g^{-1}, respectively eucalyptus, grassland, and organic banana. Similar result in the last two treatments, justified by the higher amount of organic matter, due to the organic fertilization and manure of the animals in the pasture. The low values in the eucalypt forest are justified by the presence of antimicrobial substances in litter that hinder the survival and growth of some microorganisms. Plowed soil showed the lowest value due to soil exposure, no vegetation cover, greater application of agrochemicals and greater soil rotation. Absence of vegetation on the soil surface, maintains absence of microbial activity and therefore the lowest metabolic quotient. In the cultivation of banana and forest the quotient were the largest, due to the greater presence of organic material and soil cover. Incorporation of crop residues increases the metabolic quotient. Plowed soil had the lowest metabolic activity. And the eucalyptus forest and organic banana cultivation are releasing more carbon, lowering the carbon content in the soil.
Keywords: Microbial biomass; Microbial respiration; Soil quality
Financial support: Tocantins State Government

(2235 - 344) Microbial Biomass Carbon and Edaphic Fauna under the influence of Coverage Plants with the use of Calder Ash.

Rodrigo Roani[1]; Jonas Guerra[1]; Wilson Galli[1]; Luís Carlos Iuñes de Oliveira Filho[2]; Cristiano Nunes Nesi[1]; Mauricio Vicente Alves[1]
(UNOESC) University of West of Santa Catarina[1]; Santa Catarina State University[2]

Adequate soil management that contributes to the increase or conservation of quality is important in current agricultural practices, seeking alternatives such as the use of cover crops together with ash being an ally to the soil as a good secondary material. The study was implemented at the experimental unit of Unoesc - Xanxerê, from July 2016 to March 2017. The soil of the region is classified as a dystrophic Red Latosoil (Oxisoil). Four treatments were implanted: 1) Fallow (without cover plants and without application of ash); 2) Fallow + ash; 3) Cover crops without ash application (CC); and 4) CC within ash application. In the CC plots, a consortium was used between vetch (40 kg ha^{-1}) and oat (50 kg ha^{-1}), grown under no-tillage system. In the treatments with ash application, the dosis applied was 10500 kg ha^{-1}, being calculated according to the content of K present in the ash along with the need for the crop. The ash used was provided by the boiler of a pulp mill. The edaphic fauna was evaluated in two seasons; the first in the cover plants flowering, and a second sampling in the corn crop, using *pitfall traps traps*, in each plot with 8x10 mts measures, a trap was installed. At the same time the Carbon of the Microbial Biomass (CMB) was evaluated. Samples 0-20 cm of soil depth were taken in the same treatments of the fauna, and the samples composed of 7 points per plot were collected on the same day of the allocation of the fauna traps during the winter season. After sampling and screening, the indexes of Richness and abundance, Dominance,

Simpson, Shannon, Evenness, Margalef, Equitability were evaluated. The use of ash and cover crops did not influence the abundance and richness of the edaphic fauna in the winter. However in the summer the vegetal remains of the previous cultures served as food for the fauna and influenced in these indices: Richness; Abundance; Evenness. The CC + ash treatment is more abundant with greater richness than the others and with greater diversity of species. For the Evenness and Equitability index showed that there was no pattern of distribution of the species. Regarding CMB, the use of CC + ash, and ash favored the development of soil microbial biomass in relation to other treatments. It can be observed that ash favored microbial activities along with cover crops. For the fauna of the soil the positive effect of the CC + ash happened in the summer season.

Keywords: Microbial Activity. Bioindicators. Ecological indexes.
Financial support: Scholarship Art. 170, FAPESC, Celulose Irani S.A, Unoesc – Xanxerê

(2720 - 1618) Native rhizobia effectiveness from legume-based silvopastoral systems

Adriana Bezerra dos Santos[1]; Mario de Andrade Lira Junior[1]; Giselle Gomes Monteiro Fracetto[1]; Felipe José Cury Fracetto[1]; Carina Vasconcelos Moreira Tavares[1]; Leandro Reis Costa Santos[1]; Aleksandro Ferreira da Silva[1]
Universidade Federal Rural de Pernambuco[1]

Forage tree legumes on silvopastoral may contribute to the systems by biological nitrogen fixation, since most form rhizobial symbiosis. This study aimed to evaluate the relative efficiency of 69 rhizobial strains isolated from such systems. These were captured from soil samples from silvipastoral systems formed by *Gliricidia sepium* ((Jacq.) Steud) or *Mimosa caesalpiniifolia* (Benth.) with signal grass (*Brachiaria decumbens* (Stapf.)) or by sole signal grass, under greenhouse conditions, and including a nitrogen fertilized treatment with the equivalent to 50 $kg.ha^{-1}$, and two strains recommended for commercial inoculant production (BR3267 and BR3262) on cowpea (*Vigna unguiculata* ((L.) Walp)). Harvest was 35 days after inoculation, and measured Shoot (SDM), Root (RDM) and Nodule (NDM) dry masses, nodule number, relative efficiency to nitrogen control (RENC), to uninoculated control (REUC) and to recommended strains (RERS). When strains were grouped based on the silvipastoral system, those isolated from the sole signal grass presented higher SDM, NN, RDM, RENC and RERS than those from the silvipastoral systems. These may be due to the highly promiscuous nature usually attributed to cowpea rhizobia, coupled with the presence of several native forage legumes as infestants in the sole signal grass pasture, and natural selection by these legumes for more efficient strains due to the competition with the grass for available nitrogen. On the other hand, it is now recognised that Brazilian *Mimosa* species tend to form most of the symbiotic associations with β-rhizobia, which are not usually as infective on cowpea, but this is not well understood for *G. sepium*.

Keywords: Biological nitrogen fixation; pasture; relative efficiency
Financial support: CAPES, CNPq, FACEPE

(1307 - 867) Phosphatase activity in sugarcane fields after application of organic compost and inoculation of P solubilizing bacteria

Antonio Marcos Miranda Silva[1]; German Andres Estrada Bonilla[1]; Elke Jurandy Bran Nogueira Cardoso[1]
ESALQ/USP[1]

Phosphorus (P) is an essential element for microbial metabolism and plant growth. However, in tropical soils, most of the P is unavailable, present in a form adsorbed to soil colloids. Inoculation of P solubilizing bacteria (PSB) into a mixture of composting wastes of the sucro-energetic industry (filter cake and ashes) was shown to produce an organic compost enriched in P, which can substitute for synthetic fertilizers, constituting a biotechnological alternative for the synthetic fertilizers used in traditional sugarcane cultivation. The P enriched compost was applied in a field experiment with sugarcane, in a randomized block design with a (3 x 2 + 1) factorial scheme. The first experimental factor was the P source, either compost produced without additional P (C), or compost prepared with Araxá rock phosphate (C+RA). The second factor was with or without field inoculation of PSB. The additional treatment consisted of the traditional formulation of synthetic fertilizers. We monitored the activity of acid and alkaline phosphatases in the soil at 6 and 12 months after sugarcane planting. There was no difference between the traditional and the biotechnological treatments for enzyme activity, but we found a significant interaction (Tukey's test $p \leq 0.05$) between P source and bacterial inoculation, only in the activity of the alkaline phosphatase, at both harvesting periods. At 12 months after planting, the treatments C and C+RA, with bacterial inoculation, did not differ in alkaline phosphate activity. Without bacterial inoculation, however these two treatments differed, C+RA showing higher values than C. Inoculation together with C+RA showed a 1.6 times higher phosphatase activity, varying from 30.75 to 49.41 µg PNF. g^{-1} soil . h^{-1}, while in the treatment C, inoculation increased phosphatase activity by 2.4 times, varying from 17.98 to 43.17 µg PNF. g^{-1} soil . h^{-1}. This increase in the activity of alkaline phosphatase may be the result of an increased demand of P to sustain the metabolism of the inoculated bacteria or even of other interacting microorganisms. Since this effect was found only for the alkaline phosphatase, these data highlight the supposition of many alkaline microsites present during the composting process.

Keywords: organic compost, plant biomass, Phosphate
Financial support: FINEP

(7590 - 830) Potential of Plant Growth Promoting Rhizobacteria biofertilizer to increase plants production efficiency

Kunlayakorn Prongjunthuek[1]; Suphakarn Luanmanee[1]; Phatchayaphon Meaunchang[1]
Department of Agriculture[1]

Department of Agriculture (DOA), Thailand has developed Plant Growth Promoting Rhizobacteria (PGPR) biofertilizer which is categorized into 3 products i.e. PGPR-I for corn and sorghum, PGPR-II for rice, and PGPR-III for sugarcane and cassava. Since each product contains different species of rhizobacteria, the product efficiency to each crop was investigated. First, an investigation of PGPR-I efficiency on growth and yield of maize and sweet corn grown on sandy loam and clay loam was carried out during 2011 to 2013. The results showed that maize and sweet corn differently responded to the PGPR-I. Application of the PGPR-I in sandy loam showed highly response of maize and sweet corn to PGPR-I than in clay loam. This could reduce N, P and K fertilizer application by 50% of the recommendation rate. Second, a study of PGPR-II efficiency on rice growth and yield was conducted in dry and rainy seasons during 2015 in comparison to none application of the PGPR-II. The results showed that there were not significant different in percentage of filled grain but the application of PGPR-II significantly increased straw dry weight and grain yield. This could reduce production cost about 22.5%. Third, a determination of the PGPR-III efficiency on growth and yield of sugarcane grown on sandy loam soil was carried out during 2010 to 2011. The result showed that the PGPR-III inoculated did not significantly promote height, stalk diameter and aboveground fresh weight. However, it was found that the PGPR-III application significantly increased stalk number per tiller, cane yield and sugar yield about 36%, 11.2% and 13.8%, respectively. In addition, the use of PGPR-III can decrease N and NPK fertilizers application about 50% and 25% of recommendation rate, respectively. Forth, efficiency of PGPR-III application on growth and yield of cassava grown on sandy soil was

investigated. The result showed that the application of PGPR-III significantly increased plant height, fresh root yield as well as starch yield about 5.1%, 5.8% and 4.2%, respectively as compared to non PGPR-III application. Moreover, the application of the PGPR-III in combination with chemical fertilizer at 100% of recommendation rate showed increasing of fresh root yield about 8.98% as compared to application of only chemical fertilizer. This could reduce N fertilizer application for cassava production in sandy soil by 20% of the recommendation rate and subsequently reduced production cost.

Keywords: Plant Growth Promoting Rhizobacteria (PGPRX biofertilizer; maize; sweet corn; rice; casava

Financial support: Royal Thai Government, Department of Agriculture, Thailand.

(7192 - 1865) Response of N cycling microbes to a urease inhibitor and a nitrification inhibitor in 3 land uses

Aineah Obed Luchibia[1]; Suter Helen[1]; Shu Kee Lam[2]; Jizheng He[2]

The University of Melbourne[1]; [2]

The application of N-(n-butyl) thiophosphoric triamide (NBPT) and 3,4-Dimethylpyrazole phosphate (DMPP) has been shown to be effective in mitigating nitrogen (N) loss from agricultural systems. However, there is still need for more information on how these chemicals affect N-cycling processes and dynamics of associated microbes in the soil. To assess the effect of the application of urea fertilizer amended with NBPT or DMPP on N transformations in soil and dynamics of associated microbial communities, a 28-day microcosm incubation experiment was established at 25^{O}C and 60 % water-filled pore space (WFPS), using 5 soil types with different physiochemical properties from three land uses. The treatments included Control, urea, Urea + NBPT, Urea+ DMPP and Urea + NBPT + DMPP. Data was collected by destructive sampling of soil to study mineral N dynamics on days 0 (4 hours), 1, 2, 4, 7, 14, and 28, after treatment application, and DNA extraction for microbial studies on days 0, 7, and 28, after treatment application. Urea addition significantly increased ammonium and nitrate concentration in soil compared to control. However, addition of urea amended with NBPT significantly reduced soil ammonium concentration but had little or no effect on nitrate concentration, size of ammonifying and nitrifying microbes. Addition of urea amended with DMPP significantly reduced nitrate concentration and size of nitrifying microbes, but significantly increased ammonium concentration compared to urea alone. The effect of the inhibitor chemicals on mineral N dynamics did not last long in the soils with higher organic carbon and low pH compared to those with neutral to alkaline pH and low organic carbon and this was linked to the varied microbial activities in the soils and the sorption of these chemicals to soil particles, influencing the activity and degradation rates of NBPT and DMPP.

Keywords: 3,4-dimethylpyrazole phosphate (DMPP). N-(n-butyl) thiophosphoric triamide (nBTPT). Ammonia-oxidizing archaea.Ammonia-oxidizing bacteria. Abundance. Community composition

Financial support: Melbourne International Research Scholarship.

(8223 - 662) Rice rhizosphere and nitrogen input influence microbially mediated nitrogen loss and retention in Australian rice paddies

Arjun Pandey[1]; Helen Suter[1]; JiZheng He[1]; Hang-Wei Hu[1]; Deli Chen[1]

The University of Melbourne[1]

Microbial nitrogen (N) transformation such as denitrification, anaerobic ammonium (NH_4^+) oxidation (anammox), biological N_2 fixation (BNF), and dissimilatory nitrate (NO_3^-) reduction to ammonium (DNRA) can influence the N use efficiency of rice paddies. These processes are often studied separately which makes it difficult to understand their relative importance in N cycling. In addition, the rhizosphere and non-rhizosphere of rice and the N input affect denitrification and BNF but limited information is available about how these factor affect DNRA and anammox. Therefore, we investigated the processes rates and the related microbial gene abundance using paddy soils from the Finley, Jerilderie and Coree in Australia. Rice was grown in pots in glasshouse with (+N) and without (-N) for 75 days and the soils from the rhizosphere and non-rhizosphere were collected separately and used for $^{15}NO_3^-$ tracer, acetylene reduction assay (ARA) and qPCR assay in laboratory. The results showed that the denitrification dominated the N_2 production, consuming 14-30% of the NO_3^- available in the soils. Anammox was only detected in the Finley soil and used only 1.5% of the soil available NO_3^-. Denitrificaion was significantly lower ($p < 0.05$) in the rhizosphere than in the non-rhizosphere in all the soils. Denitrification was also significantly lower in the +N treatment than in the –N treatment. The abundance of the *nosZ* gene in denitrifiers followed the similar trend as denitrification. Anammox activity and the associated gene, *hzsB*, abundance did not show any effect of the N input or the rhizosphere and non-rhizosphere. There was no significant difference in DNRA between the rhizosphere and non-rhizosphere but the N input reduced DNRA in all the soils. DNRA consumed 12-20% of NO_3^- available in the paddy soils. The *nrfA* gene abundance responsible for DNRA activity was similar between the rhizosphere and the non-rhizosphere except in the Jerilderie and the gene abundance mostly remained unaffected by the N input. The ARA showed that the BNF added 0.02-0.25 µg N g^{-1} soil day^{-1}. The rhizosphere and non-rhizosphere did not have any effect on the BNF and the associated, *nifH*, gene abundance. Similarly, the N input had no effect on the BNF and the *nifH* gene abundance except in the Coree soil. This study demonstrates that the localized conditions in the rice paddies affect N loss but not the N retention, and the N input enhances the N loss and reduces the N retention in rice paddies.

Keywords: Rice paddies, biological nitrogen fixation, DNRA, denitrification, anammox

Financial support: Australian Centre for International Agricultural Research

(5226 - 2939) Soil Enzyme Activities as a Soil Quality indicator under Tillage and No-Tillage Management

Nicola Lorenz[1]; Linda K Dick[1]; Nathan R Lee[2]; Cliff Ramsier[3]; Richard P Dick[2]

The Ohio State University[1]; The Ohio Stae University[2]; Ag Spectrum[3]

The condition of soils is fundamental for delivering ecosystem services, particularly for agriculture. Standards for soil quality indicators have been difficult to establish because of the complexities of the interrelated physical, chemical, and biological properties of soils. To be useful and guide land management, measures are needed that detect changes rapidly (a few years); can be calibrated and interpreted independent of soil type (a major obstacle for soil measures as soil quality indicators); have high throughput capability, being cost-effective, and have seasonal stability. We evaluated different farmer's fields in the US (Ohio, Illinois, and Iowa) under *Zea mays* (corn) and *Glycine max* (soybean) to compare their tillage systems (no tillage and tillage). A total of 298 soil and crop yield samples were collected in 2015, 2016 and 2017 at four different spots on a single field by considering a functional soil classification by using the Agsoil Analytics functional map technology. To further broaden the study, we collected 368 complementary soil samples from long-term crop management research sites across the US (19 states). Selected enzyme assays were run and enzyme activity ratios were calculated and will be presented (activity per unit soil organic C or clay) and will be assessed for their calibration potential to detect land management practices, independent of soil type. Furthermore,

mechanistic understandings of enzyme activity as a soil indicator will be determined by profiling microbial communities and comparing and correlating enzyme data with soil chemical and soil physical properties. Finally, soil properties will be correlated with yield and soil quality indicators will be presented.
Keywords: Soil enzyme activities; No-Tillage; Tillage; Soil Quality
Financial support: Ag Spectrum, NRCS, The Ohio State University

(2786 - 1930) Soil fauna in different forage plants fertilizer systems in the northwest region of Rio Grande do Sul

Danni Maisa da Silva[1]; Divanilde Guerra[2]; Julio Cesar Grasel Cezimbra[3]; Eduardo Lorensi de Souza[4]; Ângelo Munaretto Krynski[5]; Renan Bianchetto[6]; Daniel Erison Fontanive[7]; Douglas Wegner Kunz[8]
State University of Rio Grande do Sul (Uergs), Unit Três Passos, 47 Street Cipriano Barata, Três Passos, Brazil (danni-silva@uergs.edu.br)[1]; Uergs, Unit Três Passos (divanilde-guerra)[2]; Uergs, Unit Três Passos (julio.cezimbra@outlook.com)[3]; Uergs, Unit Três Passos (eduardo-souza@uergs.edu.br)[4]; Uergs, Unit Três Passos (munarettoangelo@hotmail.com)[5]; Uergs, Unit Três Passos (renan.bianchetto@hotmail.com)[6]; Uergs, Unit Três Passos (danielfontanive76@yahoo.com.br)[7]; Uergs, Unit Três Passos (douglaskunz@gmail.com)[8]

A dairy cattle of great importance for the Northwest Region of Rio Grande do Sul (RS), where predominantly family farmers have increasingly sought to optimize an activity, reducing costs and improving pastures. Soil fauna plays important roles in soil, essential for forage productivity and quality. However, is little understood the influences of the pasture species under different fertilization systems on a soil fauna. The objective of this work was to study a composition of the edaphic fauna in areas with forages submitted to different fertilization systems, in the Northwest Region of RS. The State University of RS (Uergs), Unit Três Passos, carried out the research. The experiment was carried out in a randomized complete block design with 4 replicates, with treatments as follows: T1: Jiggs (J) + PS (pig slurry); T2: J +CM (cattle manure); T3: J + NPK; T4: J + Without Fertilizer (WF); T5: Forage Peanut (FP) + PS; T6: FP + CM; T7: FP + NPK; T8: FP + WF; T9: Consortium (J + FP) + PS; T10: Consortium + CM; T11: Consortium + NPK; T12: Consórcio + WF, with T13: fallow (F) and T14: native forest (NF), as a parameter. In order to survey the edaphic fauna, catch traps are installed following the PROVID method (ANTONIOLLI, 2006), in two seasons (winter and spring). To abundance, diversity and wealth of edaphic fauna were determined, in addition to the Shannon (H) and Simpson (Is) Diversity indices. The data were submitted to analysis of variance (ANOVA) and as averages compared by the Tukey test ($p < 0.05$). In relation to abundance there was no statistical difference between treatments, however, with the exception of T3, T5, T9, F and NF, in the winter, the youngest presented the highest abundance in the spring collection, with emphasis on T1, with 579 organisms. For a richness it is not a differential between the treatments, however, T8, T7 and T2 presented superior richness in the spring collection, in relation to winter. The H was numerically higher in the T11, T9, T3 and NF, respectively, in the winter collection, considering the other treatments and both collection season. The Is was numerically higher in the T1, T11, NF, and T7, respectively, in the spring collection, considering the other treatments and both collection season. There was no influence of pasture species or fertilization systems on an edaphic fauna, which varied according to a collection season.
Keywords: Edaphic fauna; soil biology; pasture.
Financial support: Pro-rector of research and postgraduate Uergs (PROPPG)

(5737 - 1825) Soil microbial activities are affects by straw of cover plants cultivated in the savannahSoil microbial activities are affects by straw of cover plants cultivated in the savannah

Lizandra de Sousa Luz Duarte[1]; Sarah Priscilla do Nascimento Amorim[1]; Daniela Fernandes de Oliveira[1]; Cíntia Bezerra Rocha[1]; João Carlos Medeiros[2]; Adriana Miranda de Santana Arauco[1]; Cácio Luiz Boechat[1]
Cinobelina Elvas Campus, Federal University of Piauí[1]; Federal University of Sul da Bahia[2]

Cover crop straw is important because it influences the microbiological attributes of soil, provides the highest carbon levels in humic fractions, increases water infiltration, reduces surface runoff and erosion, and serves as a primary form of organic matter input that enhances soil biological activity. The objective of this study is to evaluate the effect of straw of different plant covers on the microbial activity in Cerrado Biome soil. The experiment was conducted using a BOD incubator at a controlled temperature of 28 ± 2 ^{o}C. The amount of straw incorporated into each treatment was 10 Mg ha^{-1} providing an amount of 16 to 24 kg N ha^{-1} and 51 to 54 kg C ha^{-1}. Treatments were distributed in a completely randomized experimental design in a factorial scheme 8 x 7 + 4, with seven types of straw from cover plants (MI) millet (*Pennisetum glaucum*); (BR) *Brachiaria brizanta*; (CS) *Crotataria spectabilis*; (CO) *Crotalaria ochroleuca*; (GA) Guandu anão (*Cajanus cajan*); (GF) guandu Fava (*Cajanus cajan*) and (MP) *Mucuna aterrima* incorporated into the soil and soil without incorporation of straw (control), evaluated at 7; 14; 21; 28; 42; 63 and 105 days after incubation, with three replicates plus four blank controls (without soil and straw). Soil basal respiration (SBR) at 7, 14 and 105 days after incubation was lower in the control treatment (soil without plant cover straw) and higher values were found in the other treatments with values ranging between 66.45 (CO) to 86.29 (CS) at 7 days; between 107.71 (BR) to 133.17 (GA) at 14 days and, between 46.04 (MP and GA) to 75.18 mg CO_2 100 g^{-1} h^{-1} (MI) at 105 days. At 21 days of incubation the SBR were higher in the BR, CS, CO and GA treatments, followed by MI, MP and GS and lower SBR were observed in the control treatment. At 28 days no significant differences were found between studied treatments, except in the MP, followed by the control with worse results for this variable. The same results were found for MP and MI at 42 days, followed by the control. At 63 days of incubation the higher values were observed in the MI, CS, CO and GF treatments and the lowest value in the control. In the tropical climate the soil microbial stimulation was highly sensitive to the quality of the organic residues, for the C/N ratio. Organic material applied to soil by cover plant straw increases soil microbial activity, measured by the release of carbon in the form of carbon dioxide (C-CO_2), both with legumes and grass straw.
Keywords: Soil basal respiration; Organic matter; Legumes; Grasses; C/N ratio
Financial support: UFPI, CAPES.

(1778 - 406) Soil microbial biomass and activity in an integrated crop-livestock system after 15 years under different grazing intensities

Ângela Denise Hubert Neufeld[1]; Hazael Soranzo de Almeida[1]; Daiane Dalla Nora[1]; Ibanor Anghinoni[2]; Rodrigo Josemar Seminoti Jacques[1]
Department of Soil Science, Federal University of Santa Maria, Roraima Avenue, 1000, Santa Maria, RS, 97119-900, Brazil[1]; Department of Soil Science, Federal University of Rio Grande do Sul, Bento Gonçalves Avenue, 7712, 91501-970, Porto Alegre, RS, Brazil[2]

Integrated crop-livestock systems (ICLS) can improve soil chemical, physical and biological characteristics. However, intensive grazing may outweigh these benefits and cause serious damage to ICLS. Microorganisms are sensitive bioindicators and may indicate changes to soil quality. The aim of the present study was to investigate the

effects of 15 years of intensive grazing in an integrated soybean-beef cattle system on soil microbial biomass and respiration, identifying which edaphic factors most affect these parameters. The experiment was conducted over a 15-year period in a 23-ha area, characterized by the crop succession *Glycine max* (summer grain production) and *Avena strigosa + Lolium multiflorum* (winter pasture). The treatments consisted of four grazing intensities: intense (10-cm grazing height), moderate (20- and 30-cm grazing heights), light (40-cm grazing height) and no grazing (control plots). A randomized block experimental design was used, with three replicates per treatment. The size of the plots with grazing varied from 0.9 to 3.6 ha. All plots had continuous grazing in winter and three tester animals, resulting in the different grazing heights tested. Four samplings were performed between 2014 and 2016, two following the grazing season and two following the soybean harvest. The soil basal respiration and microbial biomass carbon content were evaluated. The soil chemical and physical parameters and plant cover parameters were measured for correlation. Soil respiration and microbial biomass carbon content were highest for the treatments without grazing and with higher grazing heights. Negative effects on physical soil characteristics were observed for the treatment with the lowest grazing height, resulting in decreased soil moisture and microbial biomass and activity.

Keywords: microorganism, metabolic quotient, bioindicators, soybean-beef cattle system, sustainability.

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(5154 - 2538) Soil microbial biomass carbon under alternative forage crops over weather seasons

Igor Alexandre de Souza[1]; Nicholas D. Warren[2]; Jörg Schnecker[2]; Adalfredo Rocha Lobo-Jr[1]; Richard G. Smith[2]; A. Stuart Grandy[2]; Andre F. Brito[2]

Federal University of the Jequitinhonha and Mucuri Valleys - UFVJM[1]; University of New Hampshire - UNH[2]

Even in small amounts, microbial biomass plays a fundamental role in soil organic matter dynamics. Microbial biomass is positively related to the return of carbon to the soil. This research investigated how alternative forage crops and weather seasons influence the soil microbial biomass carbon. The study was conducted at the University of New Hampshire Kingman Research Farm in Madbury, NH (43°11'N 70°56'W), during spring, summer and autumn of 2015. The dominant soil type is a sandy loam, with an average annual temperature of 8.1°C and annual precipitation of 1108 mm. Based on previous studies 14 alternative forage crop species were selected according to seasonal specificities. Spring were selected wheat, triticale, barley, cereal rye and hairy vetch. Summer were, BMR Sorghum, buckwheat, teff, millet, oats and chickling vetch. For fall were, forage radish, oats, canola, wheat, triticale, and crotalaria. The experimental design and arrangement of blocks and treatments were randomly allocated. Seeds were purchased and the seeding rate defined according to the recommendations. Samples for spring were collected on the same day when the plants were harvested. Soils collected in summer and autumn were collected at the seeding day, in the middle and at the end of the cycle of the plants. We collected three soil cores, 15 cm deep by 9 cm diameter, at each time point. Soil microbial biomass carbon (MBC) were determined using the chloroform fumigation and extraction method. The extracts were analyzed on a TOC analyzer and the extraction efficiency factors 0.45 was used. ANOVA were performed, according to a randomized complete block design ($p < 0.05$). For the spring the MBC averages ranged from 304.8 to 387.3 µg C g soil^{-1}. The summer cultivated plants did not have conditions to influence the communities or the activity of the decomposing microorganisms, the contents ranged from 662.1 to 847.6 µg C g soil^{-1}. The MBC content found at 10 days after seeding was 909.5 µg C g soil^{-1}, and was higher than the other times. For the fall MBC, the variation was particularly interesting, because during the time of collections reduced and increased ($p<0.05$). At 7 days after seeding the MBC was 600.4 µg C g soil^{-1}, at 36 days decreased ($p <0.05$) to 236.0 µg C g soil^{-1}, and increased again ($p <0, 05$) to 808.3 µg C g soil^{-1} at 66 days. The microbial biomass does not change considerably when the soil is cultivated by the forage species studied and the seasons can change de MBC levels.

Keywords: Alternative forages crops; microbial biomass carbon; weather seasons.

Financial support: University of New Hampshire – UNH; Research Supporting Foundation of Minas Gerais (FAPEMIG)

(5352 - 1155) Soil Microbial Community Assessment of Highland Vegetable Production Systems in La Trinidad, Benguet, Philippines

Karen S. Bautista[1]; Jacqueline S. Rojales[1]; Vicky T. Dimaano[1]; Digna R. Allag[1]; Luis Angelo A. Cortez[1]; Jerry Paul P. Arciaga[1]; Melody M. Orogo[1]

Bureau of Soils and Water Management[1]

Soil microorganisms are considered as sensitive indicators of soil health. Community-Level Physiological Profile (CLPP) analysis is an innovative, sensitive, and rapid method to assess functional diversity and rate of activity of soil microbial community. During the April 2016 and 2017 dry seasons, soil samples were collected from vegetable farms practicing organic (ORG), low-external input (LEI), and conventional (CON) production systems in La Trinidad, Benguet, Philippines. The samples were properly labeled, stored, and brought to the laboratory for soil microbial CLPP analysis using the Biolog^{TM} Microstation System. Shannon Index of Diversity (H) and Average Well Color Development (AWCD) were determined. H quantifies the functional microbial diversity, while AWCD quantifies the overall rate of activity (in terms of density and carbon use capability) of the microbes inhabiting the soil. Using a two-way ANOVA, results showed that while there were significant differences found for H values per year ($p < 0.001$), there were no significant differences seen for the value in terms of production system ($p = 0.0552$), which is coupled with it not having any significant interaction with the year ($p = 0.5610$). However, in terms of AWCD, a significant interaction was noted ($p = 0.0288$), which prompted an additional analysis of simple main effects for the metric. Results of the aforementioned analysis yielded the following: firstly, AWCD values were generally higher from farms collected during the 2017 dry season with the exception of ORG farms, which remained statistically similar to the value it had the year before; secondly, during the 2016 dry season, ORG farms exhibited a significantly higher AWCD compared to the other two systems; and lastly, no significant differences for AWCD was seen per production system during the dry season of 2017. These results suggest that environmental factors exert a greater influence on soil microbial diversity regardless of production system. The production system affects the rate of density, activity, and carbon use capability of inhabiting soil microbes. As seen during the 2016 dry season, a lesser rate of microbial activity was found in LEI and CON farms as compared to ORG farms. Since environmental factors are also dynamic, their contribution to microbial activity is not constant on a yearly basis, which explains the lack of significant differences in AWCD per production system during the 2017 dry season.

Keywords: Soil health, CLPP, DA-BSWM, Biolog^{TM} Ecoplate, soil microbial community

Financial support: Department of Agriculture- National Organic Agriculture Program

(5723 - 1862) Soil microbial ecology of Laurel-Leaved and Cryptomeria japonica Forests

Ayuko Itsuki[1]; Sachiyo Aburatani[2]
NITNC[1]; NIAIST[2]

In forest ecology, microorganisms decompose organic soil matter from plant residue as a source of nourishment, which they then absorb. During this process, microorganisms produce enzymes that convert organic matter to carbon dioxide, water, and other compounds. The biochemical metabolism of microorganisms can therefore be indirectly investigated by measuring the activities of these enzymes. We assessed the soil microbial ecology (microbial numbers, enzyme activities, and soil respiration rate) of the organic and mineral soil layers of laurel-leaved and Cryptomeria japonica forests in the Kasugayama Hill Primeval Forest (Nara, Japan). The numbers of bacteria and fungi, and soil respiration rate were higher in the deeper horizons (F and H) of the organic layer than in the mineral soil layer. This suggests that active microbial metabolism preferentially occurs in organic soil layers. The uppermost L horizon consists of high levels of fresh plant residue and high C/N ratio, but low levels of moisture content and microorganisms. In the F horizon, the proportion of microorganisms that absorbed plant nutrients increased as decomposition progressed. In the H horizon, which contains decayed organic matter, the proportion of these microorganisms in the soil decreased. The laurel-leaved organic layers exhibited more soil microorganism activity than C. japonica organic layers, possibly due to differences in forest vegetation, which appear to influence several salient soil properties—particularly the pH and C and N content in the F and H horizons. This result is consistent with the fact that laurel-leaved forest soil generally contains more easily decomposable organic matter, such as water-soluble polysaccharides, hemicellulose, cellulose, and protein, and less decomposable organic matter, such as lipid and resin.

Keywords: Bacterial numbers, Enzyme activities, Forest soil, Soil respiration rate
Financial support:

(5312 - 998) Soil quality in Integrated Crop-Livestok-Forest systems can be evaluated by biochemical indicators

Leciana de Menezes Sousa Zago[1]; Samantha Salomão Caramori[1]
Universidade Estadual de Goiás, Câmpus CET, Laboratório de Biotecnologia, Anápolis, CEP: 75132-903, Brazil.[1]

Land use changes alter the diversity of microorganisms in the soil, microbial processes, nutrient cycling and consequently the soil quality. The replacement of some conventional crop systems by integrated crop-livestock-forest systems (ICLFS) can input nutrients in the soil and provide better conditions to both agricultural and native ecosystems. Here we evaluated the enzymatic and microbial activities associated with carbon cycling, phosphorus, nitrogen and sulfur in soils in ICLFS areas, in comparison to conventional livestock and native Cerrado. Three soil composite samples were collected from five areas (ICLFS after three years (ICLFS3), five years (ICLFS5) and eight years (ICLFS8), livestock and native Cerrado), at the 0-10 cm, in Cachoeira Dourada, Goiás, totaling fifteen composite samples. The enzyme activity was monitored spectrophotometrically at 400nm (β-glucosidase, acid phosphatase, arylsulfatase), at 405nm for glycine aminopeptidase and at 460nm for phenoloxidase using specific substrates. In addition, the variations on microbial biomass carbon (MBC) were evaluated. Data were analyzed using ANOVA and Tukey test ($p < 0.05$). The behaviour of the five enzymes showed variations ($p<0.05$) in the different sampling areas. The activity of β-glucosidase and acid phosphatase were higher in soils of native Cerrado and ICLFS3, respectively. Both enzymes presented the minor values for ICLFS8, which can be explained by the absence of fertilization since four years ago. For arylsulfatase and glycine aminopeptidase, the major values were in native Cerrado soils, followed by ICLFS systems. Phenol oxidase was the only enzyme to respond better in ICLFS8, probably due to the prevalence of lignin in comparison to the other nutrients in soil. The MBC was higher in native Cerrado soils, but presented significant values in fertilized ICLFS areas. In general, pasture soils presented the minor enzyme activity values and the minor MBC values. The soil biochemical analyzes showed that hydrolase activities (β-glucosidase, acid phosphatase, aminopeptidase), oxidorreductase (phenol oxidase), sulfatase (arylsultase), and MBC are under land use and tillage conditions and can be altered as long as ICLFS is established. Moreover, those results demonstrate the potencial of use soil enzymes in order to evaluate the quality of agricultural production integrated systems.

Keywords: ICLFS, fertilization, hydrolases
Financial support: UEG/ CAPES N. 817164/2015, PROBIP/UEG

(7848 - 778) Spider community response to grazing in an integrated crop-livestock system

Joice Aline Freiberg[1]; Cristian de Sales Dambros[1]; Everton Nei Lopes Rodrigues[2]; Paulo César de Faccio Carvalho[3]; Rodrigo Josemar Seminoti Jacques[1]
Federal University of Santa Maria[1]; University of Vale do Rio dos Sinos[2]; Federal University of Rio Grande do Sul[3]

Soil tillage, sowing, harvesting, pesticide application, and the removal of plant cover can reduce the abundance and richness of soil invertebrates that are essential to soil health. Spiders are among the most important top predators in crop systems and, as predators, have the potential to regulate the dynamics of entire food webs. In spite of their importance, no study has investigated the dynamics of these predators in integrated systems that have a potentially lower impact on species diversity than traditional cultures. We investigated the effect of grazing intensification on the abundance and species richness of soil spiders in an integrated crop-livestock system (ICLS). The study was conducted in an ICLS in São Miguel das Missões county, Rio Grande do Sul (RS) State, Southern Brazil (28°56'14.00 ''S, 54 °20'45.61''W, 417m). Since its installation in 2001, the experiment is cultivated with the rotation of mixed oat (*Avena strigosa* Schreb.) and annual ryegrass (*Lolium multiflorum* Lam.) for continuous cattle grazing in winter and soybean (*Glycine max* L.) for grain production in summer. The treatments were based on five grazing intensities: 10, 20, 30 and 40 cm of grazing height and control plot (no grazing), distributed in a randomized complete block design with three replications. Spiders were sampled with pitfall traps immediately after cattle removal from pasture in November 2014 and November 2015. Nine pitfall traps were sampled in grazing plots and three to seven pitfalls were sampled in non-grazing plots. The effect of grazing height on the average abundance of spider species was tested using a generalized linear mixed effect model (GLMM), with a Poisson error distribution. We collected 1,385 individuals and 34 species. Most species were rare and showed a weak association with grazing intensity. Nevertheless, the lower pasture heights favored species such as *Laminacauda montevidensis* Millidge, 1991 and *Mermessus* sp., whereas *Glenognatha lacteovittata* (Mello-Leitão, 1944), *Ostearius melanopygius* (O. Pickard-Cambridge, 1880) and *Styposis selis* Levi, 1964, responded positively to increased pasture height. These five spider species can be used as bioindicators of grazing intensification in ICLS.

Keywords: Araneae; intensification; pasture; soil fauna.
Financial support: Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq); Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (Capes).

(8524 - 287) Straw biochar amendment suppressed Phytophthora blight of pepper by changing soil microbial community with proper application technology

Yan Ma[1]; Guangfei Wang[1]; Roshini Govinden[2]; Hafizah Yousuf

Chenia[2]
Institue of Agricultural Resources and Environment, Jiangsu Academy of Agricultural Sciences[1]; School of Life Sciences, University of KwaZulu-Natal[2]

Biochar functions potentially to improve soil performance. Phytophthora blight is one of the most widespread and severe soil-borne diseases for pepper production around the world. To ascertain the control effect of biochar against Phytophthora blight of pepper and its underlying microbial mechanisms, we carried out the pot experiment using straw biochar with different properties and application technologies and proposed the microbial mechanisms for disease control. Straw biochar with high nutrient-related indices such as electric conductivity (EC), ash content, and available P and K content had a high control efficacy. The application rate and application time of biochar had significant influence on disease control of Phytophthora blight of pepper . An optimal application technology were obtained based on pot experiment. Biochar had different impact on various microorganisms of soil. A significant change of the soil fungal community structure was observed, and the relative abundances of beneficial fungi and pathogenic fungi were impacted with opposite change trend. However, biochar had an insignificant influence on the soil bacterial community structure. Biochar application increased not only the populations of *Trichoderma spp.*, *Penicillium spp.*, *Aspergillus spp.*, *Chaetomium globosum*, *Bacillus spp.*, and *Pseudomonas spp.*in soil according to both plate cultivation and RT-PCR determination but also the proportion of antagonistic fungi and bacteria . All the potential biocontrol microorganisms were screened out from biochar- amended soil and their ability for suppression of Phytophthora blight of pepper was confirmed by subsequent pot experiments. Our results showed that biochar-mediated pepper blight control is a comprehensive effect of the improvement of soil properties. However, the improvement of soil microbial property is the main mechanism. This study provides approaches for biochar selection and application to facilitate the control of Phytophthora blight of pepper and other soil-borne diseases, and offers a theoretical data to strengthen biochar-mediated disease control effect .

Keywords: biochar; application technology; soil microbial community; Phytophthora blight; pepper; biocontrol microorganism
Financial support: National Natural Science Foundation of China(31471949)

(3214 - 3122) Sugarcane straw removal does not change C and N dynamics from sugarcane trash mulch

Guilherme Dietrich[1]; Adriane Luiza Schu[1]; Patrick Leal Pinheiro[1]; Sylvie Recous[2]; Douglas Adams Weiler[1]; Mathias Roberto Leite Rambo[1]; Sandro José Giacomini[1]
Federal University of Santa Maria[1]; Université Reims-Champagne Ardenne[2]

The partial straw removal (SR) from field after sugarcane harvesting in the green cane trash blanketing system should affect the mulch decomposition and C and N dynamics, because it increase the proportion of straw in contact with soil. However, recent studies indicate that the decomposition is not altered with SR and in conditions of high amount of straw the decomposition may be greater without than with SR. The causes of these results are uncertain. Here, we studied the dynamics of decomposition and C and N loss over a year from three trash quantities (4, 8 and 12 Mg ha^{-1}) left on soil surface, in Santa Maria, Rio Grande do Sul state, Brazil. We specifically investigated how trash quantities creates a spatial heterogeneity on C and N loss within of the mulch. Thus, after sugarcane cane plant harvest, we placed the trash into open-wooden frames with a 2-mm aperture mesh at the bottom and we stacked either a single layer of 4 Mg DM trash ha^{-1} (L/T), or 2 layers (L+T) or 3 layers (L+M+T) on soil surface. L (low), M (medium) and T (top) layers were separated by a malleable 10-mm synthetic mesh with wide aperture to allow each layer to be sampled independently. Plots were fertilized with 100 kg N ha^{-1}, 53 days after trash addition on soil surface. We quantified C and N contents and humidity of the remaining mulch in each layer. Soil volumetric water content was measured continuously using sensors. The decomposition and C and N loss was not affected by SR and by N fertilization. C and N loss of 4 Mg ha^{-1} was similar to T layers of 8 and 12 Mg ha^{-1} after a year (71% for C and 49% for N); although the trash of the T layer was not in contact with the soil in latter treatments; in contrast C loss from L layers of 8 and 12 Mg ha^{-1} trash quantities was around 78 e 85%, respectively, and N loss was 57 and 68%. These differences were explained by the higher humidity in the straw of L layers and higher soil water content in 8 and 12 Mg ha^{-1} trash quantities than 4 Mg ha^{-1}. Our results suggest that higher soil-trash contact of 4 Mg ha^{-1} treatment (mulch with lower thickness) could be offset by higher loss of straw and soil water content, supporting microbial activity for shorter periods compared to 8 and 12 Mg ha^{-1} treatments. These results suggest that the dynamics of the mulch is primarily driven by the dynamics of water in the soil and mulch. Therefore, the partial SR after sugarcane harvesting does not change the decomposition and C and N loss from the trash mulch.

Keywords: GCTB, Carbon Mineralization, Nitrogen Mineralization
Financial support: The work was suported by Coordination for the improvement of higher level education

(6574 - 1446) Technological viability of rhizobia inoculation in the planting furrow in common bean

Damiany Pádua Oliveira[1]; Márcia Rufini[1]; Fábio Aurélio Dias Martins[2]; Jacqueline Savana da Silva[1]; Thiago de Assis Pereira[1]; Maria Vitória Batista Duque Batista Guttierrez Baptista[1]; Celso Leandro da Silva Junior[1]; Lourdes Cláudia da Silva[1]; Messias José Bastos de Andrade[1]; Fatima Maria de Souza Moreira[1]
Universidade Federal de Lavras[1]; Empresa de Pesquisa Agropecuária de Minas Gerais-EPAMIG SUL[2]

Common bean producers that adopt a high level of technology have shown interest in liquid inoculation through the planting furrow, above all through the practically of the operation in large-scale production. However, publications on this matter are not found for common bean, which requires investigation to assist the producer in choosing the inoculation method to be adopted and in determining the suitable application rates for good performance of biological nitrogen fixation. For this purpose, two field experiments were conducted in the winter crop season 2017 (one in a *Latossolo Vermelho eutrófico* in the municipality of Lavras, and the other in a *Latossolo Vermelho distroférrico* in Patos de Minas, Minas Gerais, Brazil. Both crops were planted over maize crop residue in irrigated areas without a previous record of inoculation for common bean. A randomized block experimental design was used with four replications and seven treatments: liquid inoculation in the furrow (rates of 0.875, 1.75, and 3.50 L ha^{-1}), peat (10 g kg^{-1}) or liquid (4.0 mL kg^{-1}) inoculation on the seed, and two controls without inoculation (without and with 80 kg N-urea ha^{-1}). All the plots were fertilized with P_2O_5 and K_2O, defined by soil analysis. The cultivar used was BRSMG Madrepérola at a density of 15 seeds per linear meter, and the strain used was CIAT 899 of *Rhizobium tropici*, approved as an inoculant for the crop by the Brazilian Ministry of Agriculture. The inoculants contained ±10^9 cells of *Rhizobium* per mL or gram. Inoculation on the seed was performed a short time before sowing. Distribution in the

planting furrow was made with a manual backpack sprayer with a conical nozzle, and the spray application rate was 350 L ha^{-1}. Data were subjected to analysis of variance. In the cases of significant effect of the treatments, the means were clustered by the Scott-Knott test. The levels of the locations were compared through the F test since this factor has only two levels. In spite of the large number of nodules registered in Lavras, there was a higher yield in Patos de Minas. Inoculation in the planting furrow at the rate of 3.5 L ha^{-1} provided higher yields than inoculations on the seed, and also ensured yield of around 1,900 kg ha^{-1}, equivalent to the treatment with mineral N. Due to operational practicality, therefore, inoculation in the planting furrow is the most advantageous of the inoculations tested, regardless of the soil and climate conditions of the crop.

Keywords: *Phaseolus vulgaris* L.; biotechnology; biological N_2 fixation

Financial support: CAPES, CNPq, and Fapemig

(6660 - 362) The impact of post-fire salvage logging on microbial nitrogen cyclers in Mediterranean forest soil

Lily Pereg[1]; Jorge Mataix-Solera[2]; Mary McMillan[1]; Fuensanta García-Orenes[2]

School of Science and Technology, University of New England, Armidale, NSW 2351, Australia[1]; GEA – Environmental Soil Science Group, Department of Agrochemistry and Environment, University Miguel Hernández. Elche, Alicante, Spain[2]

Forest fires are a regular occurrence in the Mediterranean basin. High severity fires and post-fire management can affect biological, chemical and physical properties of soil, including the composition and abundance of soil microbial communities. Salvage logging is a post-fire management strategy, which involves the removal of burnt wood from land after a fire. The main objective of this work was to evaluate the impact of post-fire salvage logging and microaggregation on soil microbial communities, specifically on the abundance of nitrogen cyclers and, thus, the potential of the soil for microbial nitrogen cycling. The abundance of nitrogen cyclers was assessed by quantification of microbial nitrogen cycling genes in soil DNA, including *nifH* (involved in nitrogen fixation), *nirS/K* and *nosZ* (involved in denitrification), *amoA*-B and *amoA*-Arch (involved in bacterial and archaeal nitrification, respectively). It was demonstrated that salvage logging reduced bacterial load post-fire when compared to tree retention control and resulted in significant changes to the abundance of functional bacteria involved in nitrogen cycling. Microbial gene pools involved in various stages of the nitrogen cycle were larger in control soil than in soil subjected to post-fire salvage logging and were significantly correlated with organic matter, available phosphorous, nitrogen and aggregate stability. The microaggregate fraction of the soil, which has been associated with greater organic carbon, was shown to be a hotspot for nitrogen cyclers particularly under salvage logging. The impact of post-fire management strategies on soil microbial communities needs to be considered in relation to maintaining ecosystem productivity, resilience and potential impact on climate change. This work has been recently published (2018) in the journal: Science of the Total Environment 619-620: 1079-1087

Keywords: Nitrogen cycle genes; Nitrification *amoA*; Nitrogen fixation *nifH*; denitrification *nirK/S nosZ*; post fire management; Salvage logging

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C2.3.2 - Molecular techniques as a useful tool to reveal soil biodiversity and biotechnological potential of microbial genomes

(3822 - 2695) 16s rRNA gene sequencing reveal microbiome variations during different fertilisation practices

Loredana Canfora[1]; Elisa Vendramin[2]; Barbara Felici[2]; Luigi Tarricone[2]; Alessandro Florio[3]; Anna Benedetti[2]

[1]; CREA[2]; LEM INRA[3]

Fertilisation practices are increasingly recognised as factors influencing the soil microbial communities, and they have a pivotal role in maintaining soil fertility and regulating ecosystem functions. Soil microbial communities react to different fertilisation practices and environmental conditions. It is known that vineyards harbour a specific set of microorganisms. The vineyard microbiome has been extensively investigated to decipher the associated microbial populations in soil, as well as the dynamics of microorganisms in grapes and the phyllosphere. Wine harbours a wide range of microorganisms originating from the belowground environment, many of which are recognised for their role in driving the grapevine quality. This study evaluates the long term-effect of two fertilisation practices (mineral, MD and organo-mineral, OMD) on the soil bacterial community in a nine-year-old vineyard. Sequencing was done on environmental DNA soil samples to amplify the hypervariable region V3-V4 of the 16S rRNA gene using an Illumina platform. The results provide information on the distribution of different bacterial groups in relation to fertilisation practices and temporal variability. Our work reveals that the assortment and distribution of microorganisms in agricultural systems depend on several factors, underlining the importance of fertilisation strategy in the overall management of soil quality and fertility.

Keywords: soil microbiome, fertilisation, 16S ribosomal gene, bioindicators

Financial support: no

(1385 - 2418) Bacterial communities monitoring from different uses of Amazon soils focusing on the metanotrophs group.

Bresciani, L.[1]; Santos, D. G.[1]; Pylro, V. S.[1]; Tsai, Siu Mui[2]; Andreote, F. D.[1]

ESALQ/USP[1]; CENA/USP[2]

The Amazon forest is the biggest tropical forest and hosts the largest biodiversity in the world, representing fundamental importance in biogeochemical cycles. Nevertheless, the increasing anthropic interference in the Amazon Forest in the last decades has been causing major damages in the resident biological diversity. Beyond the ecological dynamics changes, another change involves the gases related to the greenhouse effect, such as methane. Here we aim to measure the total bacterial communities and which are able to consume methane, named methanotrophic, in the Forest and grassland soil. The draft was conducted comparing the bacterial communities of soils of primary, secondary forest and grassland sampled in the region of Tapajós National Forest (Brazil). The total DNA was extracted from the soil samples, the communities were quantified by real-time quantitative PCR using 16S rRNA gene, followed by the 16S rRNA gene sequencing. The results show that the total quantification of communities was similar between the treatments, however, the 16S rRNA gene sequencing shown differences between the composition of the sample of primary forest, secondary forest, and grassland. Alphaproteobacteria and Verrucomicrobia were more abundant in forest samples than in grassland samples, whereas Actinobacteria, Chloroflexi, and Firmicutes were more abundant in the last one. On methanotrophic communities, we notice that the relative abundance in the forest soils was similar than in grassland. Although, the 16S rRNA gene sequencing suggests that methanotrophic community present differences in their composition between the treatments. Therefore, these results imply that grassland soil lodge a different community than forest, including the methanotrophic group, which is relevant to improve our knowledge about Amazon soil diversity and methane emission in the Amazonia. Moreover, these results show the effect of

different land uses in Amazonia on bacteria biological activity and methane oxidation.
Keywords: Methane; Amazonian; soil; bacteria
Financial support: FAPESP

(7625 - 358) *Bradyrhizobium brasilense* sp. nov., a symbiotic nitrogen-fixing bacterium isolated from Brazilian tropical soils

Elaine Martins da Costa[1]; Amanda Azarias Guimarães[2]; Rayssa Pereira Vicentin[2]; Paula Rose de Almeida Ribeiro[2]; Aniele Carolina Ribas Leão[3]; Eduardo Balsanelli[3]; Liesbeth Lebbe[4]; Maarten Aerts[4]; Anne Willems[4]; Fatima Maria de Souza Moreira[2]
Universidade Federal de Mato Grosso do Sul[1]; Universidade Federal de Lavras[2]; Universidade Federal do Paraná[3]; Ghent University[4]

Four strains of rhizobia isolated from nodules of *Vigna unguiculata* (UFLA 03-321^T, UFLA 03-320 and UFLA 03-290) and *Macroptilium atropurpureum* (UFLA 04-0212) in Brazilian soils were previously reported as a new group within the genus *Bradyrhizobium*. To determine their taxonomic position, these strains were characterized in this study using a polyphasic approach. The analysis of the 16S rRNA gene grouped the strains with *Bradyrhizobium elkanii* USDA 76^T and *Bradyrhizobium pachyrhizi* PAC 48^T. However, the concatenated sequence analysis of the two (*recA* and *glnII*) or three (*atpD*, *gyrB* and *recA*) housekeeping genes indicated that these four strains represent a novel species of *Bradyrhizobium,* which is very closely related to *B. elkanii* USDA 76^T and *B. pachyrhizi* PAC 48^T. Genomic relatedness analyses between strain UFLA 03-321^T and *B. elkanii* USDA 76^T and *B. pachyrhizi* PAC 48^T reveled an average nucleotide identity below 96% and values of estimated DNA–DNA hybridization (using the genome-to-genome distance calculator) below 70%, confirming that they represent genomically distinct species. Analysis of MALDI-TOF MS (Matrix-assisted laser desorption ionization-time-of-flight mass spectrometry) profiles and phenotypic characteristics allowed also the differentiation of the novel species from its two neighboring species. In phylogenetic analysis of *nodC* and *nifH* genes, UFLA03-321^T presented maximum similarity with *B. tropiciagri* CNPSo 1112^T. Based on the data presented, it is suggested that these strains represent a novel species, for which the name *Bradyrhizobium brasilense* sp. nov. is proposed, with UFLA03-321^T (= LMG 29353 =CBAS645) as type strain. G+C content in the DNA of UFLA03-321^T is 63.9 mol%.
Keywords: Bradyrhizobium, Vigna unguiculata L., polyphasic taxonomy, Genomics, MALDI-TOF MS.
Financial support: CNPq, CAPES, Fapemig.

(1913 - 2765) Denitrification potentials and riverbank soil bacterial structures along Shibetsu river, Japan

Yoshitaka Uchida[1]; Hirosato Mogi[1]; Toru Hamamoto[1]; Miwako Nagane[1]; Misato Toda[1]
Hokkaido University, JAPAN[1]

Riverbank soil ecosystems are important zone in terms of transforming inorganic nitrogen (N), particularly nitrate (NO_3^--N), in soils to gases. Better understanding of the factors controlling the variability of the denitrification potentials may result in the more accurate evaluation of ecosystem services provided by riverbank soil ecosystems. Thus, we investigated the denitrification potentials along Shibetsu river, Hokkaido, Japan. We sampled riverbank soils from eight sites and their denitrification potentials with added glucose-carbon (C) and NO_3^--N varied from 4.73–181 μg N kg^{-1} h^{-1}. Some soil samples responded positively to C and N addition, regarding the denitrification potentials, but others did not. The increase of the denitrification after the addition of C and N was negatively controlled by soil pH and positively controlled by soil NH_4^+-N levels. Then, we investigated the changes in 16S rRNA bacterial community structures before and after an anaerobic incubation with added C and N. We found that the genus *Gammaproteobacteria Aeromonadaceae Tolumonas* was markedly increased, from 0.0 ± 0.0% to 16 ± 17%, before and after the anaerobic incubation with the excess substrates. Although we could not find a significant interaction between the denitrification potential and the increase rate of *G. Aeromonadaceae Tolumonas*, our study suggested that along the Shibetsu river, bacterial response to added excess substrates was similar at the genus level. Further studies are needed to investigate whether this is a universal phenomenon even in other rivers.
Keywords: River, denitrification, 16S rRNA, bacterial community structures
Financial support: The Environment Research and Technology Development Fund S15 (Japan)

(8613 - 2596) Diversity of fungi associated with the rhizosphere of *Canavalia ensiformis* and *Crotalaria juncea* in soils treated with herbicide sulfentrazone

Karen Caroline Ferreira Santaren[1]; Isis Capella Soares[1]; Ana Luiza da Rocha Fortes Saraiva[1]; Ana Carolina Roos Pinheiro[2]; Esequiel Santos[2]; Fábio Ribeiro Pires[2]; Irene da Silva Coelho[1]
Universidade Federal Rural do Rio de Janeiro[1]; Centro Universitário Norte do Espírito Santo[2]

The indiscriminate utilization of herbicides is a potential source of environmental contamination. Sulfentrazone is an herbicide used for selective weed control in different crops, such as soybean and sugarcane, being considered persistent in soils, besides having high leaching potential. Phytoremediation stands out as an alternative to minimize this problem. This technique involves plants and their associated microbiota, which, combined with certain agronomic practices, are able to remove, immobilize or reduce the toxicity and harmfulness of these contaminants in the environment. From this perspective, the present work aims to evaluate the impact of the herbicide sulfentrazone on fungal diversity in rhizospheric and non-rhizospheric soils from the plants *Canavalia ensiformis* and *Crotalaria juncea*. These two species were cultivated for 75 and 110 days, respectively, in substrate containing three concentration levels of herbicide sulfentrazone (0, 200 and 800 g ha^{-1}). After this period, samples of rhizospheric and non-rhizospheric soils of each treatment were collected. Total DNA was extracted from the soil samples and the amplification of the fungal 18S rRNA gene by Polymerase Chain Reaction (PCR) was performed. The products of the PCR reactions were separated on a polyacrylamide gel with concentration gradient between 30 and 40%, by the DGGE (Denaturing Gradient Gel Electrophoresis) technique. According to the average of the bands number observed in the gels, rhizosphere soils of *C. juncea* presented higher richness of fungal populations in the three herbicide doses, when compared to the non-rhizospheric soils submitted to the same treatments. A similar result was observed for *C. ensiformis*, except for the herbicide dose of 0 g ha^{-1}, where the diversity was higher in the non-rhizosphere plant. In addition, the fungi population remained stable despite the dose of the herbicide, varying mainly according to the cultivated plant and with a rhizospheric or non-rhizospheric condition. The maintenance of fungi profiles, even at high concentrations of sulfentrazone, emphasizes their role, with the plant, in herbicide degradation, presenting high bioremediation potential of soils contaminated with sulfentrazone.
Keywords: 18S rRNA gene; Bioremediation; Denaturing Gradient Gel Electrophoresis; Phytoremediation; Polymerase Chain Reaction.
Financial support: CAPES, CNPq and FAPERJ

(6999 - 2888) DNA concentration of the soil may be affected by herbicide applications in high weathered soils

Marco Aurélio Pessoa-de-Souza[1]; Hugo Delleon da Silva[2]; Elisângela de Paula Silveira-Lacerda[2]; Evandro Novaes[2]; Virgínia Damin[2]
Pontifícia Universidade Católica de Goiás; Universidade Federal de Goiás[1]; Universidade Federal de Goiás[2]

Savanna Tropical soil has a tendency to be weathered due intensive climatic characteristic. These condition may offer a specifically condition of charges exposure contained in the external sites of the clay minerals. Herbicide, frequently used in Brazilian crop production, may interact with soil charges and microorganisms of the soil, and this relationship is dependent of molecular and soil physic-chemical profile. Microbiote is sensitive parameter and biological indicator to prognosticate soil management especially when assessments are at the molecular level. In this way, our aim was evaluate soil capacity to extraction Soil DNA when submitted to herbicide application. The experiment were established in factorial design 4 X 4 (three herbicides – Oxyfluorfen, Sulfentrazone e Diclosulam – and control, and four soil classes - LATOSSOLO VERMELHO Ácrico (LVw), LATOSSOLO VERMELHO Distrófico (LVd), GLEISSOLO MELÂNICO (GM) and NEOSSOLO QUARTZARENICO (RQ)). Soils were collected in 30 cm of profundity, sieved 2 mm and disposed in black vases with near of 1000 ± 20 g, considering soil density. Before DNA extraction procedure, samples were prepared by 8 months in semi controlled site, with application time intervals of the 2 months, with humidity control (60%) e temperature (30 ± 5°C). Extraction was procedure using Fast DNA^{TM} SPIN KIT for Soil$^{®}$ (MPBio), and DNA concentration was mesure by Digital Fluorimeter FD-570, 0.02 mg·L^{-1} precision. The main results point to two ways: soil and herbicide effects. Among the soils, the organic character (GM) was the most affect reached the highest levels of DNA concentration and with herbicide application low DNA levels. RQ had low DNA concentration. All herbicides decreased the DNA concentration for all studies soils, following the order GM > LVw > LVd > RQ. Finally, we conclude the herbicide may impact negatively DNA concentration and microbiota persistence.

Keywords: DNA Quantification, DNA interaction, Pesticides, Environment
Financial support: FAPEG

(5664 - 1181) Fish processing effluent discharges influenced chemical properties and microbial diversity in arid soils from Patagonia

María Belén Vallejos[1]; Magalí Marcos[1]; Cristian Barrionuevo[1]; Nelda Lila Olivera[1]
Instituto Patagónico para el Estudio de los Ecosistemas Continentales (IPEEC-CONICET)[1]

Even though fish processing industry uses large amounts of water, there is scarce knowledge about the possibility of its reuse for irrigation. In the arid Patagonian Monte, there are sites where fish processing effluents are discharged, resulting in a visible stimulation of native vegetation. We analyzed soil chemical properties and microbial diversity in a site where fish processing effluents are discharged (ES) and in a control site not disturbed (CS). At each site, 5 surface soil samples were randomly taken under plant-covered patches. We determined soil moisture, pH, electric conductivity (EC), sodium adsorption ratio (SAR), total C, inorganic C, total N, and concentrations of ammonium and nitrates+nitrites. Bacterial 16S V4 rDNA region was amplified and sequenced using MiSeq® Illumina platform. Operational taxonomic unit (OTU) clustering was performed with mothur using the Silva database. ES showed significantly higher values ($p<0.05$) of soil moisture (ES 12.9±0.7, CS 9.4±0.3%), EC (ES1.2±0.5, CS 0.6±0.2 mmhos/cm), total C (ES 0.86±0.10, CS 0.42±0.03%), inorganic C (ES 0.46±0.12, CS 0.10±0.02%), and nitrates+nitrites (ES 74.1±48.2, CS 4.26±0.13 µg/g) than CS. No significant differences were detected for pH, SAR, ammonium, and total N between sites. A total of 874,827 high quality reads were obtained for 10 samples (GOOD´s coverage > 94%). Effluent discharges induced a diminution of bacterial richness (OTUs) and diversity (Inverse Simpson). Dendrogram (Bray-Curtis distance) as well as principal co-ordinate analysis show that control samples clustered together, while some samples from ES clustered with control samples and others with themselves. LEfSE analysis showed 580 biomarker OTUs with significantly differential abundances between sites, which were classified into 16 phyla. This analysis showed that Archaea, mainly represented by *Nitrososphaeraceae*, were more abundant in CS. Besides, bacterial lineages enriched in CS included *Acidobacteria*, *Actinobacteria*, *Chloroflexi*, *Gemmatimonadetes*, *Nitrospirae*, *Planctomycetes*, *Alphaproteobacteria*, *Deltaproteobacteria*, and *Verrucomicrobia*. Biomarker OTUs from *Gammaproteobacteria* were more numerous in ES. Fish processing effluent discharges increased heterogeneity of soil chemical properties, reducing bacterial diversity and inducing shifts in the structure of the microbial community. This would be considered, and hence monitored, to preserve soil fertility when proposing fish effluent reuse for irrigation.

Keywords: fish processing effluents, microbial diversity, arid soils
Financial support: PICT 2015-1689 (FONCyT, Argentina) and PUE IPEEC 22920160100044 (CONICET-Argentina).

(7721 - 1593) In situ cultivation and 16S rRNA-based identification of rhizobacteria associated with wheat seedlings grown in a Chilean Andisol

Jacquelinne Acuña[1]; Luis Marileo[1]; Anchi Punolef[1]; Slava Epstein[2]; Milk Jorquera[3]
Applied microbial ecology laboratory, Scientific and Technological Bioresource Nucleus, Universidad de La Frontera, Temuco, Chile[1];

College of Science, Northeastern University, Boston, USA[2]; Applied microbial ecology laboratory, Departamento de Ciencias Química en Recursos Naturales, Universidad de La Frontera, Temuco, Chile[3]

The use of next-generation sequencing technologies have revealed that rhizosphere harbours thousands of different bacterial taxa, which living in a constant interaction with the roots of their host plant. However, it is widely accepted that only a minor portion (≤1%) of rhizobacterial populations can be cultured under laboratory conditions. This limitation underestimates the total diversity of rhizobacteria, particularly of bacterial groups defined as 'rare taxa' or 'unculturable', and commonly present in low abundance. Novel culture techniques have recently been focused on mimicking of the natural environment to unravel the diversity, activity and biotechnological potential of rare or unculturable bacterial portion. In this sense, diffusion chambers for in situ cultivation is one of the most promissory advance for the cultivation and isolation of previously unculturable environmental bacteria. In this study, we used the in situ cultivation using micro-well chambers to isolate rhizobacteria associated with wheat seedlings grown in a Chilean Andisols. Samples of 1 g of rhizosphere soils were serially diluted in sterile distilled water. Distilled water supplemented with agar (1.5% and 60ºC) was used for 10^{-3} dilution, which was then inoculated into a micro-well chambers. The micro-well chambers were incubated in the rhizosphere of wheat seedlings (previously grown for 1 month) and maintained for 2 months under greenhouse conditions (2 months at 20ºC). A total of 236 isolates were obtained by in situ cultivation and 206 isolates were able to identified based on partial sequencing of 16S rRNA genes. Taxonomic analysis revealed that 70% of isolates were identificated as belonging to Proteobacteria, following by Firmicutes (24%), Actinobacteria (4.4%), and Bacteroidetes (1.5%). At the order level, higher abundance were predominated by isolates belonging primarily to Bacillales (24%), Pseudomonadales (22%), Burkholderiales (21%) and Xantomonadales (17%). Isolates with lower abundance (<10

isolates) were dominated by Rhodospirillales (4%), Rhizobiales (3%), Corynebacteriales (2%), Actinobacteriales (2%), whereas only the 1% of isolates were classified as Enterobacteriales, Flavobacteriales and Sphinogomonadales. The use of micro-well chambers showed to be an attractive strategy to traditional culture techniques for explore and characterize novel isolates from rhizospheres of cereal crops in southern Chile.

Keywords: Cultivation techniques, Rhizobacteria, Biodiversity, PGPR.
Financial support: Acknowledgments: This study was financed by FONDECYT Iniciacion Project No. 11160112 and FONDECYT Regular Project No. 1120505.

(4085 - 3223) Increased enzymatic activity and decreased microbial diversity of rice paddy under a long-term no-tillage soil management system

Filipe Selau Carlos[1]; Naihana Schaffer[1]; Roberta Mariot[1]; Luis Riesch[2]; Flavio Anastácio de Oliveira Camargo[1]
Universidade Federal do Rio Grande do Sul (UFRGS)[1]; Universidade Federal do Pampa (Unipampa)[2]

Soil management systems cause many changes in the soil microenvironment that directly affect soil microorganism activity and diversity. This study evaluated the microbial enzymatic activity and diversity in an Entisol cultivated with rice under different managements for more than 20 years. The experiment started in the 1994/95 growing season. Treatments included no-tillage, conventional, and pre-germinated management systems. Soil samples were collected before and after harvest for enzymatic analysis in 2014/15 and 2015/16 and for carbon and nitrogen content determination in September 2015. Microbial C and N, basal respiration, fluorescein diacetate (FDA) hydrolysis, acid phosphatase, urease, and β-glucosidase were also measured. To quantify microbial diversity, total microbial DNA was extracted from soil samples, amplified by polymerase chain reaction (PCR), and sequenced using the V4 region of 16S rRNA gene as target. After 20 years, the data obtained on most of the evaluation dates indicated that no-till increased microbial carbon, nitrogen, and enzyme activity. The enzyme activity was correlated with the soil organic carbon content and particulate fraction. Despite the relatively high enzyme activity with no-tillage, microbial diversity was reduced in this soil management system. The results suggest that no-tillage is an important management tool in the recovery of irrigated rice areas whose soil has undergone microbiological degradation. No-tillage increases soil carbon and extracellular enzyme (EE) activity, which are essential for soil quality maintenance and sustainable medium- and long-term food production.

Keywords: microbial activity, carbon, microbial diversity, no-tillage, Oryza sativa L.
Financial support:

(4249 - 1929) Isolation and genetic identification of diazotrophic bacteria in *Eucalyptus* sp.

Kamila Cabral Mielke[1]; Dany Roberta Marques Caldeira[2]; Roberlan Ferreira da Silva[3]; Kerwin Araujo Costa[1]; Rafaela Ramos Bertuani[1]; Andréia Lopes de Morais[1]; Jéssica Rodrigues Dalazen[1]
Universidade Federal do Espirito Santo[1]; Instituto Federal de Rondônia[2]; Universidade Estadual do Sudoeste da Bahia[3]

The studies to optimize forest production have been increasing, and the use of beneficial microorganisms in this sector has become an option to improve this production. Despite the commercial and economic importance of *Eucalyptus*, there are few studies on microbial communities in their ecosystems, and little is known about how soil microorganisms interact and benefit *Eucalyptus* plants. The beneficial effect of the application of rhizobacteria on rooting, growth and biocontrol of diseases in *Eucalyptus* was demonstrated. The aimed in this work was isolate diazothrophic bacteria of roots of the spontaneous hybrid of *Eucalyptus urophylla,* clone I144 and to realize the genetic identification of the isolates found. The isolation process was carried out at the Federal Institute of Education, Science and Technology of Rondônia, Campus Colorado do Oeste as described by Döbereiner (1995). The molecular and functional characterization of the bacterial strains was performed at the Laboratories of Genetics and Biochemistry, Grasses and Molecular Biology in the National Center for Agrobiology Research (EMBRAPA Agrobiologia), Seropédica - RJ. It were isolate twelve bacterial strains, seven in LGI medium and five in the JMV medium. No isolates were obtained in the NFb and JNFb media. Among the isolates *Azospirillum amazonenese, Stenotrophomonas maltophilia, Pantoea agglomerans, Herbaspirillum frisingensee* and *Ideonella dechloratans* were identified. All the isolates presented amplification of the nifH gene, showing ability in nitrogen fixation. The isolates studied were able to synthesize indole compounds (Indole Acetic acid IAA). There was a significant difference between the isolates, showing a greater synthesis capacity for the IFROJV5E-*Pantoea agglomerans* strain (70.1 ug of indolic compounds mg of protein-1 in 24 h time). It were obtained increased auxin synthesis after 48 h (45.6 ug of indolic compounds mg of protein -1) by the IFROJV4E - *Pantoea agglomerans*, IFROJV3E -*Ideonella dechloratans* and IFROL4E - *Azospirillum amazonense* strains. The lowest auxin production was approximately 4,0 ug of indolic compounds mg protein-1, synthesized by the *Azospirillum amazonense* strains. The presence of auxins production in the studied strains is positive; showing that the strains have the capacity to stimulate cell division, increase of roots, stimulate plant growth, showing positive effect on the development of quality seedlings to initial establishment.

Keywords: Eucalyptus; strains; microbiological diversity
Financial support: Instituto Federal de Educação, Ciência e Tecnologia de Rondônia

(5308 - 2989) Land use change and soil moisture alter the methanogenesis process in the Amazon Rainforest

Alexandre Pedrinho[1]; Fabiana de S. Cannavan[1]; Lucas W. Mendes[1]; Fernando D. Andreote[2]; Jorge L.M. Rodrigues[3]; Tsai Siu Mui[1]
Center of Nuclear Energy for Agriculture, University of Sao Paulo, Piracicaba, SP, Brazil[1]; College of Agriculture "Luiz de Queiroz", University of Sao Paulo, Piracicaba, SP, Brazil[2]; Department of Land, Air and Water Resources, University of California, Davis, CA, USA[3]

Methanogenesis, a microbial process known to reduce carbon compound to methane (CH_4), is highly influenced by soil moisture. It is considered a major biological loss of soil organic carbon and a source of CH_4, a potent greenhouse gas, to the atmosphere. Tropical forest soils are the largest natural source of CH_4, and it is estimated that the Amazon River Basin contributes 7 % of the annual flux to the atmosphere. This tropical forest ecosystem has experienced extensive deforestation and land use change during the past 30 years and previous research has shown that forest-to-pasture conversion results in a series of environmental alterations that include change in the microbial community structure and functional processes associated with the C cycle that lead to increases in CH_4 emissions. Thus, to illuminate the effects of soil moisture in methane production/consumption (and the microbes that mediate them) across land use gradients in the Amazon, we performed a controlled laboratory incubation experiment by varying moisture content of soils collected from primary forest, pasture, and secondary forest, at Belterra, State of Para, Brazil. Soils were incubated under two different water contents, 60% water holding capacity (WHC), close to the original value and 90% WHC for 42 days. CH_4 fluxes were measured throughout the experiment and DNA extractions were

performed in the beginning, middle and the end of the incubation. Quantitative PCR (qPCR) targeting the *mcr*A and *pmo*A genes were used to follow changes in the methanogenic and methanothrophic population, and metagenomic sequencing to assess the diversity and composition is currently in progress. Our results show that CH_4 fluxes and the number of copies of *mcr*A and *pmo*A genes are differently affected according to the land use and water content. Throughout the incubation period, pasture, primary forest, and secondary forest soils under 60% WHC acted as methane sink. Conversely, pasture, primary forest, and secondary soils under 90% WHC acted as methane source. A positive correlation between CH_4 fluxes and water content, *mcr*A and *pmo*A genes were observed across all areas. A combination of metagenomics analysis, CH_4 gas fluxes and qPCR data will aid in the understanding of microbial CH_4 production in Amazonian soils and help to identify the soil microbiome associated with response to land use change and biogeochemical processes.

Keywords: methane; land-use change; DNA

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(1337 - 2405) Metagenomic and metaproteomic analysis to unravel microbe associated processes in ferruginous Canga soils.

Rafael Borges Da Silva Valadares[1]; Gisele Lopes Nunes[1]; Aline Madeira Marques[1]; Isa Rebecca Chagas da Costa[1]; Eder Soares Pires[1]; Ronnie Alves[1]; Jose Oswaldo Siqueira[1]; Guilherme Oliveira[1]

Instituto Tecnológico Vale[1]

In Brazil, Canga refers to an ecosystem generally associated with superficial iron crust, occurring mainly in Minas Gerais and Pará states. It can be classified according to their phytophysiognomies: Rocky outcrops; Shrub-Canga, Vellozia-Canga and Forests. Canga has suffered from intense disturbance caused by iron ore extractions. After mining these land has to be reclaimed in order to bring back vegetation and ecological functions, such as nutrient and energy cycling. In this sense, microbes play key roles in processes that guarantee ecosystem functioning and maintenance. We sampled soil from 12 different locations, at Canga plateau in the mining complex of Carajás, in order to unravel microbial diversity and functions associated to each environment. Samples were kept at 4Cº and brought to the laboratory for metagenomics and metaproteomic analysis. DNA sequencing was performed in Illumina Hiseq sequencer and proteins were analyzed by liquid chromatography and mass spectrometry. A total of 409.917.823 reads, with average length of 75 bp, were obtained in the metagenome analysis and an average of 120 unique proteins were identified per sample. Among detected phyla Proteobacteria, Actinobacteria, Acidobacteria and Firmicutes were the most abundant in all phytophysiognomies. Proteobacteria was predominant group in Forest, Herbaceous-Canga and Shrub-Canga while Actinobacteria was the most present in Velozzia-Canga. Noteworthy, bacterial groups related to N fixation such as *Bradyrhizobium*, *Rhizobium, Mesorhizobium* and *Frankia* were expressively detected in all studied locations. Clustering analyses at genus level revealed that bacterial community structure is very similar within each Canga phytophysiognomies, even when samples were collected at distant plateau. A 60 KDa chaperone was found in all environments whilst an Allophycocianin was specific to Canga Rocky Outcrops. Protein functional characterization showed that the number of active biological processes and molecular functions increases accordingly to environmental complexity, being the soil from Forest the most functional diverse and soil from Rocky Outcrops the less diverse. Our results pointed to key microorganisms mediating essential functions for ecosystem maintenance in Canga environments. Metagenomic and metaproteomic platforms proved to be powerful tolls to unravel soil microbe-associated processes and its importance to knowledge-driven land rehabilitation.

Keywords: Functional genomics, mass spectrometry, diversity, biogeochemical cycling

Financial support: VALE S.A.

(8969 - 1388) Microbial soil diversity: real-time quantitative polymerase chain reaction (qPCR) and phospholipid fatty acid profiles (PLFA) from communities in response to sustainable agricultural intensification.

Dannae Lilia Serri[1]; Carolina Pérez-Brandan[2]; Diego Chavarría[3]; Fernando Salvagiotti[4]; Silvina Bacigaluppo[4]; José Meriles[5]; Silvina Vargas-Gil[6]

Institute of Plant Pathology (IPAVE) - CIAP - INTA[1]; INTA EEA Salta[2]; CONICET[3]; INTA EEA Oliveros[4]; Multidisciplinary Institute of Plant Biology (IMBIV) - FCEFyN - UNC[5]; Institute of Plant Pathology (IPAVE) - CIAP - INTA, CONICET[6]

In agricultural ecosystems, the replacement of natural vegetation by the introduction of high-productivity crop species implies significant changes in the structure of the soil microbial community. The hypothesis of this work was that the reduction in the diversity of plants would simultaneously diminish soil microbial diversity, affecting important ecological functions. To counteract these effects, the sustainable intensification of agricultural systems, through the combination of different plant species and/or the use of winter service crops. This could contribute to the diversification of the system increasing soil microbial diversity. The objective of this work was to evaluate the response of soil microbial diversity to the sustainable intensification of agricultural systems. This study was conducted at the Oliveros Agricultural Experimental Station, Instituto Nacional de Tecnología Agropecuaria (INTA), Santa Fe province, Argentina. The field trial was performed under no-tillage and started in 2006, and soil sampling was carried out in 2015 and 2016. The treatments were different agricultural sequences combining soybean (S), maize (M) and wheat (T) crops, including the alternative of T as a winter service crop (C). In this way, the treatments tending to the sustainable intensification of the agricultural system were: S-S; C-S; M-T / S and M-T / S-C. The structure of soil microbial communities were studied by qPCR and PLFA. Total bacteria (16S rDNA) and total fungi (18S rDNA) were determined by qPCR; and Gram-positive bacteria (GP), Gram-negative bacteria (GN), total bacteria and total fungi, arbuscular mycorrhizal fungi, Actinomycetes and total biomass (TPLFA) by PLFA. A greater abundance of 16S rDNA was registered for M-T/S-C and S-S, being the copies g dry $soil^{-1}$ of 5,6E+26 and 4,9E+26, respectively. Similarly, the abundance of 18S rDNA was significantly higher for M-T/S-C and S-S, recording both treatments the same value (4.2E+28 copies g dry $soil^{-1}$), overcoming in 90% and 47% the values obtained for the treatments M-T/S and C-S, respectively. Regarding PLFA, a significantly higher percentage of GN bacteria was observed in the M-T/S-C treatment, which registered 26% more than soybean monoculture (S-S). The remaining microbial groups did not show statistically significant differences for the sequences under study. Although TPLFA did not present significant differences for the treatments evaluated, there was a lower percentage in S-S.

Keywords: bacteria, fungi, crop sequences.

Financial support: National Institute of Agricultural Technology (INTA) through the research projects PNSUELO 1134043 and CIAC 940140; CONICET PIP No. 11220150100061CO; Secretariat of Science and Technology of the National University of Córdoba (SECyT-UNC).

(8655 - 2004) Phylogenetic analysis of nitrogen fixing bacteria isolated from leguminous tree species

Anita Fernanda dos Santos Teixeira[1]; Bruna Daniela Ortiz Lopez[1]; Amanda Azarias Guimarães[1]; Marcela de Souza Pereira[1]; Bárbara

Luyse Marques Duarte[1]; Fatima Maria de Souza Moreira[1]
Federal University of Lavras[1]

Sequencing of molecular timers is commonly performed to identify nitrogen fixing bacteria (NFB), mainly through 16S rRNA gene sequencing. However, this is a highly conserved region that do not allow differentiation among these NFB species. In order to obtain a more accurate identification, it is necessary to sequencing other chromosomal DNA genes such as the housekeeping. Therefore, the objective of this work was to identify bacterial strains isolated from nodules of leguminous forest species by sequencing the housekeeping *atp*D and *gyr*B genes. Nine strains available from the NFB collection from the Federal University of Lavras (Brazil) were evaluated. These strains were obtained from nodules of *Machaerium nyctitans* (UFLA01-1164, UFLA01-839, UFLA01-1172), *Ormosia arborea* (UFLA01-1156), and *Platypodium elegans* (UFLA01-1127, UFLA01 - 1134, UFLA01-1129, UFLA01-1137, UFLA01-1128). Sequences of the two genes were individually analyzed and compared in a concatenated phylogenetic tree. Phylogenetic trees were constructed using the Kimura 2-parameter model, using a reliable bootstrap analysis with 1000 replicates. The strains evaluated in this work were compared to sequences of type strains available from GenBank (National Center for Biotechnology Information, NCBI) of similar species to those of this work. From the phylogenetic analysis of the housekeeping genes, five different groups of the species described up to the time of the genera *Rhizobium* (3) and *Bradyrhizobium* (2) were formed. All strains isolated from *P. elegans* belong to the genus *Rhizobium*, with 100% similarity between them and 93.9% similarity to the *Rhizobium tropici* type strain (CIAT 899T). The strain UFLA01-1156 isolated from *O. arborea* and strain UFLA01-1172 from *M. nyctitans* also belong to the genus *Rhizobium*, while the other strains isolated from *M. nyctitans* belong to the genus *Bradyrhizobium*. Considering the high degree of conservation of the nucleotide sequences of the housekeeping genes, it can be inferred that these strains are possible new species.

Keywords: Housekeeping genes, *atp*D; *gyr*B; molecular timers
Financial support: Fapemig; Capes; CNPq; Vale

(5728 - 2471) Response of soil bacteria and archaea communities to long-term crop richness in a no-tillage experiment

Jessica Pereira De Souza[1]; Tatiana Suzin Lazeris[1]; Glaciela Kaschuk[1]; Emanuel Maltempi Souza[1]; Eduardo Balsanelli[1]; Rudimar Molin[2]; Fabiane Machado Vezzani[1]
Federal University of Paraná[1]; ABC Foundation Experimental Center for Agricultural Technical Assistance and Advisory Services[2]

The organic compounds enter the soil ecosystem mainly via crops and therefore the microbial population is selected accordingly. This study aimed identifying the response of the structure and diversity of bacteria and archae communities to long-term crop richness in relation to the growing crop in a no-tillage experiment. Long-term experimental plots were settled in Ponta Grossa, Brazil considering crop systems of wheat-soybean and vetch-corn-wheat-soybean. Soil samples were collected from 0.05 to 0.15 m depth in two moments: before wheat harvesting and at soybean flowering. The structure and diversity of soil bacteria and archae communities were analyzed by extracting the DNA and sequencing the V4 region of the 16SrDNA gene, and soil metabolic diversity was assessed with substrate induced respiration using 11 different substrates. Permutational multivariate analysis of variance was performed to determine changes in the structure of bacteria and archae communities due to crop richness (crop systems) and to growing crop. Distinct genera or group of genera from each season were assessed by the IndVal test. Although the crop richness (p= 0.234) over time did not modify the bacteria and archea communities in no-tillage soil, the growing crop (p=0.001) modulated the soil microbiome. Indicative genera before winter harvesting were: *Candidatus Nitrososphaera, Catellatospora, Devosia, Dokdonella, Geodermatophilus, Hyphomicrobium, Kaistobacter, Methylibium, Mycobacterium, Nitrospira, Nocardioides, Pseudonocardia, Rhizobium* and *Streptomyces*; during soybean flowering: *Candidatus Xiphinematobacter, Candidatus Koribacter, Rhodoplanes* and *DA101*. Diversity indexes for bacteria and archae genera were higher before winter harvesting than at soybean flowering. No difference was observed in the metabolic diversity (p = 0.200) of the edaphic microbiota. The changes in structure and diversity of bacteria and archaea communities were probably due to the diversification of the organic composition of the soil. The crop individually is responsible for modulates the bacteria and archaea community in long-term no-tillage soil and not the crop richness over time. Nevertheless, the results do not invalidate the role of a diverse crop system, as each crop at time may affect soil ecosystem in different ways.

Keywords: subtropical; diversity indexes; metabolic diversity.
Financial support: ABC Foundation, CAPES, Agrisus Foundation

(4010 - 2320) Responses of maize to drought stress when inoculated with diazotrophic bacteria and small rnas regulation

Urquiaga, MC[1]; Da Silva, HAP[1]; Thiebaut, F[1]; Carvalho, TLG[1]; Hemerly, AS[1]; Ferreira, PCG[1]
Instituto de Bioquímica Médica, UFRJ[1]

Plants have a complex mechanism of gene expression regulation that influences their response to biotic and abiotic interactions. Small RNAs (sRNAs) have been described as a regulators of gene expression. The role of sRNAs in the grass-diazotrophic bacteria interaction has been described, however their roles when the interaction occurs under drought stress is not well understood. Maize is a worldwide-cultivated crop and suffers often harvest losses due to drought. Also, maize is a good model to study the interaction with diazotrophic bacteria, once it develops a successful association with beneficial bacteria. Moreover, the induction of tolerance to drought stress mediated by *Gluconacetobacter diazotrophicus* PAL5 bacteria has been described for s sugarcane. In this work, we want to understand the effects of the association between diazotrophic bacteria and maize (Zea mays – hybrid UENF 506-11) in a hydric deficit situation. Initially, an experiment was carried out with plants grown in pots, after inoculation with *G. diazotrophicus*. After an acclimatization period of eight days, plants were divided in four groups, based on plants with normal watering and under water depletion. For each condition, roots and shoots were harvested to analyze the bacterial colonization by confocal microscopy, before water deficit starts and five and eight days after the stress. In addition, phenotypic changes of maize plants were monitored along the experiment and a fourth group of plants were grown for additional 22 days. Our preliminary results suggest that *G. diazotrophicus* cannot improve drought tolerance in maize, as observed in sugarcane. However, the acclimatization period before drought stress may be compromising the effect of the inoculation on the tolerance improve, once the late start of the drought in the fourth group of plants showed a remarkable tolerance phenotype in inoculated plants. In the next step, a new experiment will be conducted, starting drought stress in plants with a more advanced growth stage and with a well-established plant-bacteria association. Our perspectives include evaluation of the expression profile of sRNAs involved in responses to abiotic stresses. These analyses will allow us to confirm the hypothesis that maize can trigger specific responses when plants interact with microorganisms to establish a beneficial association, conferring drought tolerance.

Keywords: grass, sRNAs, *Gluconacetobacter diazotrophicus, h*ydric deficit
Financial support: Supported by FAPERJ, CNPq.

(7985 - 931) Silvopastoral systems drive soil´s total bacteria community.

Felipe Martins do Rêgo Barros[1]; Victor Lucas Vieira Prudêncio de Araújo[1]; José Petrônio Mendes Júnior[1]; Tiago de Oliveira Santos[1]; Giselle Gomes Monteiro Fracetto[1]; Felipe José Cury Fracetto[1]; Mario Andrade Lira Junior[1]

Universidade Federal Rural de Pernambuco[1]

Intercropping tree legumes with forage grasses in a silvopastoral system can avoid the pastures degradation and recover them. This soil management has been successfully used in the recovery and maintenance of degraded pastures, with known results on the soil chemical quality, but without information about their influence on the soil microbial communities. We investigated the influence of the silvopastoral system on the community structure from soil total bacteria. The study area is located at the Experimental Station from Instituto Agronômico de Pernambuco (IPA), in Itambé municipality (Pernambuco state, Brazil). The experiment had nine plots of one hectare with tree legumes Sabiá *(Mimosa caesalpinifolia*) and Gliricidia (*Gliricidia sepium*), and a single Brachiaria (*Brachiaria decumbens*), in a randomized block design with three treatments: B + S (Brachiaria intercropping Sabiá); B + G (Brachiaria intercropping Gliricidia) and B (single Brachiaria), containing three replicates. The soil samples were collected at 0.20 m of depth, in June 2016 (winter season). In B+G and B+S the samples were collected at zero (0 m), four (4 m) and eight meters (8 m) from the legumes, while in B the samples were randomly collected. The structure of the total bacteria communities was evaluated by DGGE (Denaturing Gradient Gel Electrophoresis). The differences in structure of the total bacteria communities among the treatments have been assessed by similarity analysis (ANOSIM). The structure of the total bacteria communities was significantly influenced by silvopastoral system. The results of the ANOSIM pairwise test showed significant differences between B + S (collected at 4 m and 8 m) and B (R Statistical = 0.61 and 0.85, respectively; $p < 0.05$) and between B and B+G at all distances evaluated (R Statistical > 0.75; $p < 0.05$), indicating distinct bacterial communities. The analysis among the distances showed significant differences between 0 and 8 meters. Bacterial communities are stimulated by higher enzymatic activity and higher C and N concentration below the canopy of the trees, forming "hotspots". Furthermore, tree legumes in silvopastoral system influence the grazing intensity in the grass, promoting changes in the microbial community, explaining the differences between B + G (collected at 8 m) and B and B + S (collected at 8 m) and B. However, silvopastoral sytems with tree legumes drive the soil community structure of total bacteria.

Keywords: intercropping; tree legumes; brachiaria; 16S rRNA

Financial support: CNPq and Apoio à Pesquisa Institucional – Universidade Federal Rural de Pernambuco, Edital 09/2014.

(6582 - 996) Soil Bacterial and Archaeal community largely reflects changes in soil properties induced by sheep grazing in an arid shrubland of Patagonia

Magali S. Marcos[1]; Mónica B. Bertiller[1]; Nelda L. Olivera[1]

IPEEC - CONICET[1]

The aim of this study was to analyze the diversity of Bacteria and Archaea in arid soils from the Patagonian Monte under different sheep grazing pressures, and their relation with soil physicochemical properties. Upper soil samples associated to vegetated patches (P) and inter-patches (IP) were collected at a grazed site (G) and a non-grazed site (NG) within the field “San Guillermo” (42˚51’S, 64˚54’W). Aliquots of the soil samples were used to determine soil moisture, pH, texture, organic C, total N, C/N ratio, and the concentration of ammonium, nitrate and nitrite. The diversity and community structure of Bacteria and Archaea in DNA extracted from soil samples was analyzed by MiSeq sequencing of 16S rRNA genes. Bioinformatic analyses were performed in QIIME2 software and sequences were classified using the Greeengenes database. Soil moisture was low (< 3.6%), pH varied between 7.8 and 8.3, and texture was sandy loam. Soil organic C, total N, ammonium and nitrite concentrations were higher ($p < 0.05$) at NG (C: 5.79 ± 0.66 mg/g; N: 0.50 ± 0.03 mg/g; NH_4^+: 2.25 ± 0.12 µg/g; NO_2^-: 0.30 ± 0.03 µg/g) than at G (C: 3.29 ± 0.68 mg/g; N: 0.30 ± 0.05 mg/g; NH_4^+: 1.80 ± 0.16 µg/g; NO_2^-: 0.16 ± 0.03 µg/g), but nitrate concentration and the C/N ratio did not differ significantly among samples ($p > 0.05$). Two-way nested analysis of similarities based on the Bray Curtis index detected differences in microbial community composition at G and NG (global R: 0.59, significance 0.3%), and this result was also supported by cluster and MDS analyses. The families with higher contributions to these differences (> 1%) were Gaiellaceae and Rubrobacteraceae (Actinobacteria), Nitrososphaeraceae (Thaumarchaeota), and unclassified families of the phyla Euryarchaeota, Acidobacteria, Proteobacteria and Actinobacteria. Four soil physicochemical variables (moisture, clay percentage, organic C and nitrite concentration) showed the highest correlation (Rho: 0.71, significance 1%) with the Bray Curtis resemblance matrix based on microbial community composition. No differences were detected between P and IP in physicochemical properties, nor in microbial community composition ($p > 0.05$). In this study, grazing disturbance exerted a major effect shaping soil Bacterial and Archaeal community, through their response to changes in soil physicochemical properties, both in vegetated patches and in bare soil areas.

Keywords: arid soils; Patagonia; microbial diversity; microbial community ecology

Financial support: ANPCyT, Project Numbers PICT 2013-1505 and PICT 2015-1689; and CONICET, Project Number PUE IPEEC 22920160100044

(4758 - 1434) Structure of the microbial community in a saline soil from semi-arid region of Pernambuco.

Emanuelle Maria da Silva[1]; Maria Betânia Galvão dos Santos Freire[1]; Giselle Gomes Monteiro Fracetto[1]; Josimar Gurgel Fernandes[2]; Alcione Guimarães Freire[1]; Felipe Martins do Rêgo Barros[1]

UFRPE[1]; IPA[2]

The knowledge of the microbial communities present in saline soils could represent a biotechnological potential for applications in the improvement and conservation of saline environments. Some research has focused on the isolation and characterization of these organisms, but more extensive studies have been needed on their ecology, structure, diversity, and functionality. In this study, the structure and diversity of the microbial communities were evaluated along a salinity gradient (High salinity - 17 dS m^{-1}, Average salinity - 8 dS m^{-1}, Low salinity - 4 dS m^{-1}, Native forest - 0.6 dS m^{-1}) in a degraded pasture area, unused for about 20 years, in the municipality of Caruaru (S 08° 15'00.4 "and WO 35° 52'38.0"). At each salinity level, three samples were collected in the 0-20 cm layer, 2.5 m apart. DNA extraction from the soil was performed with the PureLink ™ Microbiome DNA Purification Kit (Invitrogen). Bacterial communities were analyzed by the 16S rRNA gene using the 341f-GC and 518r primers and for the fungi, the ITS1 region of the 18S rRNA gene was amplified using primers EF4, ITS4, ITS1-F-GC and ITS2. DGGE was performed with a denaturing gradient of 30 to 60% for the 16S rRNA gene, from 30 to 55% for ITS. The similarity index was obtained by the analysis of similarity (ANOSIM). The diversity of the communities was evaluated by Shannon’s diversity index (H') and Simpson’s dominance index (D). ANOSIM pointed out that the four areas were not different from each other, indicating that the salinity was not determinant for the differentiation of the community structure. It is possible that the high variability of the areas has prevented the detection of differences between them. By the factorial analysis by main components, there was a positive correlation between EC and SAR with D index, and

negative correlation with H' index, for the fungal community. This indicates that increasing salinity may reduce fungal diversity, although it has not been sufficient to differentiate the areas from each other. Although there was no statistical difference between the areas, the Mata area presented a higher bacterial richness and higher H' index, followed by the high salinity area, indicating that the molecular diversity of the bacteria does not decrease along the salinity increase gradient and it is possible to maintain a high level in extremely saline environments.

Keywords: Salinity, DGGE, microbial diversity
Financial support: FACEPE, CNPq

(2032 - 2456) Survey of the bacterial community in soils of fruit orchards from all over Japan.

Andre Freire Cruz[1]; Atsushi Nakao[1]; Junta Yanai[1]
Kyoto Prefectural University, Graduate School of Life and Environmental Sciences, Japan[1]

The characterization of the bacterial community is essential at the ecological point of view, as microbes can strongly affect the soil nutrient biodynamics. In order to assess the bacterial community in fruit orchards soils of Japan, 68 soil samples were collected from the surface layer (0–10 cm) all over Japan from each prefecture, taking into consideration the most important fruit in all places. In total 13 kinds of fruits were evaluated in this survey. Based on the 16S RNA genes the soil bacterial community was characterized using the Illumina MiSeq 250bp techniques. The dominant taxonomic groups present in most of the samples were the *Betaproteobacteria*, *Planctomycetes*, *Choloflexi*, *Bacteriodetes*, *Actinobacteria*, and *Acidobacteria*. Although these overarching dominant taxa had occurred, the abundance, diversity, and composition of bacterial communities were sometimes specific according to the fruit type. With special regard to the Mango orchards, it was characterized by a higher abundance of *Actinobacteria* and *Firmicutes*. In most of the cases, the estimated bacterial diversity was generally higher in fruits from northern regions (Cherry and Apple) than in those from southern regions (Mandarin, Pineapple, and Mango). In addition, the Shannon-Wiener index, an indicator of diversity, was positively correlated with pH, extractable Ca and Mg. Such data suggest that soil bacterial community in fruit orchards of Japan depend on land use (fruit species) and may be related to soil chemical properties.

Keywords: Bacteria; Fruits; Illumina; Metagenome; Chemistry
Financial support: Japanese Society for the Promotion of Science - Grants-in-Aid for Scientific Research C - Project Number 16K07645

(5875 - 2489) The microbiome of the high-alpine permafrost and its response to warming

Beat Frey[1]; Carla Perez Mon[1]; Theo Smits[2]; Beat Stierli[1]; Aline Frossard[1]
Swiss Federal Reseach Institute WSL[1]; University for Applied Sciences Wadenswil[2]

Permafrost represents 20-25% of the world land area and harbor a largely understudied genetic resource. Thawing of permafrost with global warming will not only promote microbial carbon turnover with direct feedback on greenhouse gases, but also unlock an unknown microbial diversity. Pioneering metagenomic efforts have shed light on the permafrost microbiome in polar regions, but temperate mountain permafrost is largely understudied. The response of the permafrost microbiota to the predicted rising temperatures in alpine regions may be an important part of the ecosystem ability to deal with climate change. Here, we present a unique experimental design coupled to high-throughput sequencing to characterize the microbiota at the long-term alpine permafrost study site in eastern Switzerland with an approximate radiocarbon age of 12 000 years. Compared to the active layers, the permafrost community was more diverse and enriched with understudied phyla having no cultured representatives. Based on these results, we established an *in situ* experiment in which permafrost soils at a depth of 1.6m were placed into the surface active layer in order to simulate thawing of permafrost as a consequence of warming. Similarly, to evaluate the potential of the permafrost microbiome to adapt to warming we set up a microcosm experiment with permafrost soils and active soil layers incubated at increasing temperatures. Collected soil samples have been evaluated for the changes of the bacterial and fungal communities and its functional abilities by measuring respiration, enzyme activities and carbon utilization patterns. Efforts were also made to recover viable cells from permafrost. Some isolates in particular *Collimonas* sp. showed interesting features (e.g. anti-fungal activity, production of violacein). These data yielded an unprecedented view on microbial life in temperate mountain permafrost, which is increasingly important for the understanding the biological dynamics of permafrost in a warming world and its implications for the C- and N-cycles in high alpine soils.

Keywords: Novel microbial diversity; alpine permafrost; Illumina Miseq sequencing; ribosomal markers; bacteria; eukarya
Financial support: Swiss National Science Foundation, Project number: IZLSZ2_170941

(9069 - 2323) Toward a development of bacterial colonization modelling of soil particles: Effect of humic acids on the formation of nitrogen-fixing bacteria biofilms

Manuel Palencia[1]; María E. Berrio[1]; Sixta L. Palencia[1]
Universidad del Valle[1]

Soil physical, chemical, and biological factors have been shown to affect root colonization, but the detailed mechanisms associated with the adequate colonization of root and microorganisms are not completely understood. Quantitative studies on the distribution of root colonies in time and space are needed to develop mathematical models that describe and predict the root colonization process; being a important factor, to know the effect of inorganic and organic fractions of soils on the ability of microorganisms to form these colonies. Here a methodology to the study of interaction between microorganisms and surface is described and its application for the study of the description of interaction and colonization mechanism between nitrogen-fixing bacteria and particle of soils is shown, special attention is directed toward the effect of humic acids on formation of biofilms. For this, humic and fulvic acids were extracted from two types of soil samples and characterized by infrared by attenuated total reflectance (ATR), thermogravimetric analysis (TGA), contact angle (AC) and volumetric titration (VT). Humic substances were deposited on cellulose previously activated with spectral marker for the mid-infrared and anew characterized. Later, the bacterium *Azotobacter chroococcum* (nitrogen-fixing bacterium) was deposited on the surface by direct contact and in aqueous dispersion. End surfaces were analyzed by ATR, TGA, AC and VT. Analyses by scanning electron microscopy of surfaces were performed. Differentiation between affinity of humic and fulvic acids respect to affinity to be colonized by nitrogen-fixing bacterium were not identified; however, results suggest that different mechanisms associated with nature of surface could be described. It is concluded that the the use of instrumental technique and physicochemical modelling of surface interactions is a promissory tool for the description of process of microbial colonization of soils.

Keywords: Infrared spectroscopy, nitrogen-fixing bacteria, humic substances, biofilm
Financial support:

(7733 - 217) What controls the spatial distribution of microbial communities in agricultural fields?

Bernie Zebarth[1]; Claudia Goyer[1]; Sara Neupane[1]; Sheng Li[1]; Aaron Mills[1]; Sean Whitney[1]; Athyna Cambouris[1]; Isabelle Perron[1]

AAFC[1]

Soil microbial communities mediate many important soil processes in agricultural fields, however their spatial distribution is poorly understood. This study examined the soil physico-chemical properties and topographic features controlling the spatial distribution of soil microbial communities in commercial potato fields in eastern Canada using next generation sequencing and PLFA analyses. Soil was collected from two sites: site 1 was a transect with 83 sampling points approximately 1100 m long in a landscape with rolling topography; and site 2 was a grid with 154 sampling locations in a field with limited topographic variation. Diversity of soil bacterial and fungal communities was evaluated by sequencing the bacterial 16S rRNA gene and the fungal Internal Transcribed Spacer (ITS) region of ribosomal DNA using the Illumina MiSeq system. Sequence analysis was performed in Mothur and Qiime software platforms using the Ribosomal Database Project (RDP) and Unified system for the DNA based fungal species (UNITE) reference databases for bacterial and fungal communities, respectively. At site 1, a significant negative correlation (r = -0.73) between soil pH (range 4.3-7.0) and slope gradient (range 2-12 %) was observed, a finding attributed to greater soil erosion on steep slopes resulting in exposure of low pH subsoil. Proteobacteria, Actinobacteria and Acidobacteria were the three most abundant bacterial phyla, with average relative abundance of 32, 21 and 15%, respectively. Bacterial diversity at the phylum level was found to be primarily related to soil pH. Ascomycota and Basidiomycota were the most abundant fungal phyla, with average relative abundance of 69 and 15%, respectively. Fungal diversity at the phylum level was primarily related to soil organic carbon concentration and soil pH. Semivariogram analyses revealed that the bacterial α-diversity, the relative abundance of most bacterial and fungal phyla, PLFA profiling, pH and slope gradient showed strong to medium spatial autocorrelations with a range between 30 to 92 m. In field site 2, two soil management zones were identified based on apparent soil electrical conductivity that differed in soil texture. The spatial pattern of bacterial diversity in the landscape was closely related to the soil management zones. The soil microbial communities varied in a systematic and predictable pattern in agricultural fields in response to variation in soil physico-chemical properties and topographic features.

Keywords: Bacteria, fungi, microbial diversity
Financial support: Agriculture and Agri-Food Canada

C2.3.3 - Rhizosphere mineral dynamics: soil-plant-microorganism

(1047 - 2728) Abundance of N-fixing and nitrifying microorganisms in soybean rhizosphere under the influence of soil cronossequences

Luis Fernando Merloti[1]; Alexandre Pedrinho[1]; Mariley de Cássia da Fonseca[1]; Tsai Siu Mui[1]
CENA - USP[1]

Soil microorganisms play a fundamental role in terrestrial ecosystem due to their participation in processes such as nutrient cycling, biological nitrogen fixation (BNF), nitrification, denitrification, and other processes present in biogeochemical cycles. However, land intensification can promote various impacts on soil microbial communities over time, as well as influence the functions performed by soil microorganisms. Thus, elucidating the changes on soil microbial community is fundamental to optimize the biological diversity in land areas and to contribute to the functioning of land system. The aim of this work was to identify the key genes associated with BNF and nitrification processes in soybean rhizosphere under different land use sequences. The experiment was performed in a greenhouse at CENA-USP, under controlled conditions, in mesocosms containing RR soybean plants, whose soils were sampled in Santarém-PA, from deforested areas, later converted into land areas following the 2, 5 and 20 years chronosequence. The rhizospheric soil samples were collected at the beginning of soybean pre-flowering stage. After sampling, DNA from microbial community was extracted from soil using *PowerSoilLyzer* DNA kit and absolute quantification of *16S rDNA* from *Bacteria* and *Archaea*, *AOA, AOB* and *nifH* genes were determined by real-time PCR (qPCR) technique. Statistical analysis was performed by analysis of variance (ANOVA) using Tukey test (p = 0.05). The results showed that for the *nifH*, *AOA* and *AOB* genes, no significant differences were observed between the 2, 5 and 20 years treatment (p <0.05). However, a greater number of copies of *AOA* gene (6.04 × 102 ng µL of DNA) than the *AOB* gene (1.43 × 101 ng µL of DNA) were observed, both responsible for nitrification process in soil. For *16S rDNA gene* from *Bacteria* (1.75 × 106 ng µL of DNA) and *Archaea* (8.16 × 103 ng µL of DNA), a larger number of copies were observed for the 20-year treatment (p = 0, 05). In this way, it can be concluded that the rhizosphere of the land with 20 years presented a greater abundance of microorganisms, indicating that areas with a more established land systems can contribute with the increase of soil microbial community. Oxidizing ammonia archaeas indicated to be an important group of microbial community responsible for nitrification process in soil.

Keywords: *Bacteria*, *Archaea*, Nitrification, FBN
Financial support:

(3237 - 2891) Aggregation of soil is influenced by the use of inoculants with arbuscular mycorry fungi?

Marisângela Viana Barbosa[1]; Andy Bernal Fundora[2]; Ramón Rivera Espinosa[2]; Orivaldo José Saggin Júnior[3]; Marco Aurélio Carbone Carneiro[1]
Universidade Federal de Lavras - UFLA[1]; Instituto Nacional de Ciências Agrícola - INCA[2]; Empresa Brasileira de Pesquisa Agropecuária - Embrapa[3]

Intensive use and inadequate management of grazing areas cause degradation of the soil structure, reducing its productive potential and pasture yield. Adoption of alternative technologies is necessary to improve the capacity of use and management of soil, making this system more sustainable. In this context, the objective was to evaluate the inoculation of different species of arbuscular mycorrhizal fungi (AMF) in *Urochloa* híbrido stability of aggregates in a ferruginous nodular Gley soil in Cuba. The experiment was conducted out in the Pastures and Forages Station of Cascajal Villa Clara Province, Cuba, using híbrido *Urochloa* cv. CIAT BR 02/1752, inoculated with three strains of AMF EcoMic® (*Glomus cubense*, *Funneliformis mosseae* e *Rhizophagus intraradices*). The design was in randomized blocks, in a factorial scheme 4x2 with inoculation and not inoculation treatement , four replicates and two times. Soil samples were collected at (end of rainy season (2014) and beginning of rainy season (2017) in the 0-10 cm layer, being evaluated the number of spore (NE), the production of glomalin-related soil protein (PSRG), the quantification of extra-radial mycelia (EM), the coefficient of structural stability of the soil through dry sieving (Kes) and immersed in water (Keh) and the Soil Structural Stability Index (Ie). Greater stability of the aggregates Kes was verified at 140 and 876 days of cultivation, however, there was influence of the inoculation only at 876 days. On the other hand, the lower stability was verified for the water-immersed aggregates Keh, showing the influence of the moisture "kinetic energy" of the water on the soil structure. These results indicate that dry soil aggregates in this study were less susceptible to erosion. Effect of inoculation on the soil aggregates is certainly associated with the observed increases for the 140 days that have a cumulative and cementitious character in the soil and the greater EM observed in the 876 that act on the targeting and folding of the mineral particles and soil organic matter, favoring aggregation. AMF inoculation associated with *U.* híbrido roots contributed to the best le at 876 days of cultivation, with emphasis on *G. cubense* species. Which was also more competitive over time, being verified higher NE

when compared to the other inoculated species. These results showed the importance of inoculation and/or management of the native AMFs for formation and stability of the soil physical structure.
Keywords: *Urochloa* híbrido, extraradicular mycelia, glomalin production, aggregate stability.Marisângela Viana Barbosa
Financial support: CAPES, CNPq, FAPEMIG, UFLA, Embrapa Agrobiologia, INCA

(1228 - 2839) Alelopatic effect of aqueous extracts from pig bean plants on the mamone seed germination

Janildes de Jesus da Silva[1]; Caliane da Silva Braulio[1]; Andreza de Jesus Correia[1]; Maria Santos Conceição[1]; Luciano da Silva Souza[1]
Universidade Federal do Recôncavo da Bahia[1]

The castor bean (*Ricinus communis* L.) is a plant belonging to the family Euphorbiaceae, also known as castor bean, carrapateira, tick and castor, the its main product is castor oil, also called castor oil. Used in popular medicine as purgative, possessing large employment in the chemical industry, due to its use. Allelopathy is related to the release of chemicals capable of naturally stimulating or inhibiting the development of plants and organisms. Thus, the objective of this work was to evaluate the efficiency of the addition of aqueous extracts from leaves, stems and roots of bean from pigs in the germination of castor bean. The experiment was carried out in a greenhouse at the Federal University of Recôncavo da Bahia, Cruz das Almas campus, latitude 12º39'11 "S, longitude 39º07'19" W and altitude of 212 m, hot and humid tropical climate region, and soil of the type Yellow Latosol Distrocoeso. For the evaluation of the bean extracts in the germination of castor bean plants, the experimental design was completely randomized, in a factorial scheme 3 x 4 + 1, being three types of extracts (leaf, stem and root), four concentrations (25%, 50%, 75% and 100%) and one control (without extract) with five replicates. To obtain the extracts the parts of the plants were ground separately in a 10% (w/v) mill (10 g of the dried water sample 100 mL^{-1} of water) and then placed in amber glass vials with 1 L and kept at rest for 24 h at room temperature (28°C), protected from light. After 24h the solution was macerated in mortar, filtered on Whatman nº 1 paper and centrifuged at 2000 rpm for 15 minutes to remove traces of fragments, obtaining the extract by maceration at 10% (w/v). During the first 15 days (stage V0 - V2) the germination speed was evaluated. After germination, the following variables were used: germination percentage (%G), germination speed (VG), germination rate (IG), and mean germination time (MGT). The aqueous extracts and their concentrations influenced ($p<0.01$) the variables VG, IVG, TMG of the seedlings of *Ricinus communis* L. The extracts of bean of pig indicate the existence of allelochemical effect in the germination of castor bean, characterizing beneficial allelopathic effect.
Keywords: Keywords: Allelopathy; Oilseeds; Allelochemical substance.
Financial support: Universidade Federal do Recôncavo da Bahia

(3510 - 3097) Allelopathic extracts of Canavalia ensiformis in the Emergence of Ricinus communis L.

Andreza de Jesus Correia[1]; Maria Santos Conceição[1]; Caliane da Silva Braulio[1]; Janildes de Jesus da Silva[1]; Luciano da Silva Souza[1]
Universidade Federal do Recôncavo da Bahia[1]

Ricinus communis L. is an oleaginous, is resistant to drought, but very demanding in nutrients. Thus, one of the ways to improve the conditions of the soil, for its cultivation, is the consortium with legumes. One of the alternatives is the cultivation in consortium with Canavalia ensiformis. However, it presents an allelopathic principle at its roots capable of benefiting or inhibiting other plants.The allelopathic effect may inhibit the emergence, germination and development of Ricinus communis L. Thus, the objective of the research was to evaluate the allelopathic interference of aqueous extracts of Canavalia ensiformis in the emergence of Ricinus communis L. The experiment was carried out in a greenhouse at the Federal University of Recôncavo da Bahia - UFRB, at the CCAAB campus, located in the municipality of Cruz das Almas. The experimental design was completely randomized, with a factorial scheme 3 x 4 + 1, composed of three types of extracts (leaf, stem and root), four concentrations (25%, 50%, 75% and 100%), a control and five replicates. The soil was collected in the UFRB layer from 0 to 20 cm, placed in plastic bags with a capacity of 3 kg. Five seeds of Ricinus communis L. were placed in each bag. To obtain the extracts, the plants of Canavalia ensiformis were divided into leaves, stem and root, placed to dry in a greenhouse with ventilation at 65 ° C, for 72 hours. Afterwards, they were ground in the proportion of 10% (w / v) (10 g of the dried vegetable sample 100 mL-1 of water), then placed in amber glass flasks with a capacity of 1 L, and kept at rest at ambient temperature (28 ° C), protected from light. After 24h the solution was macerated in mortar, filtered on Whatman n 1 paper and centrifuged at 2000 rpm for 15 minutes to remove traces of fragments, obtaining the extract by maceration at 10% (w / v). To obtain the concentrations the extracts are diluted in water. After sowing, 50 ml of the extracts were applied per replicate and started evaluating the emergence. This evaluation was performed during the first 15 days (stage V0 - V2). With these data, the following variables were calculated: emergency percentage (% E), emergency speed coefficient (CVE), emergency speed index (IVE). The results were submitted to analysis of variance using the statistical program "R". it is concluded that the aqueous extracts of Canavalia ensiformis provided a beneficial allelopathic effect in the emergence of Ricinus communis L.
Keywords: Allelopathy; Concentrations; Oilseeds
Financial support: Federal University of Recôncavo da Bahia

(8747 - 2924) Allelopathy of aqueous extracts of *Canavalia ensiformis* on initial growth of *Ricinus communis* L.

Caliane da Silva Braulio[1]; Janildes de Jesus da Silva[1]; Andreza de Jesus Correia[1]; Maria Santos Conceição[1]; Luciano da Silva Souza[1]
Universidade Federal do Recôncavo da Bahia[1]

Ricinus comuninis L. presents a high socioeconomic value for the Northeast Region, as it has products and by-products used in the chemical industry, being a family subsistence medium, in addition to its potential as a biofuel, through which biodiesel is obtained through the extraction of oil of its seed. The allelopathic effect may generate physiological disturbances in the cells of other plants, inhibiting or influencing their initial growth. The objective of this experiment was to evaluate the allelopathic interference of different extracts of Canavalia ensiformis in the initial growth of Ricinus communinis L. The experiment was carried out in a greenhouse at the Federal University of Recôncavo da Bahia. The soil used in the experiment was the Yellow Latosol Distrocoeso, fertilized with NPK according to the necessity of the cultivation of Ricinus comuninis L. The experimental design was entirely at random, in a factorial scheme 3 x 4 + 1, being three types of extracts , stem and root), four concentrations (25%, 50%, 75% and 100%) and one control (without extract) with five replicates. The plants of Canavalia ensiformis were collected at Embrapa Mandioca and Fruticultura. To obtain the extracts, the plant parts were separately ground in a 10% (w / v) mill (10 g of the dried water sample 100 mL^{-1} of water), placed in amber glass bottles and kept standing for 24 h at room temperature (28 °C), protected from light. The solution was macerated, filtered on Whatman n° 1 paper and centrifuged at 2000 rpm for 15 minutes, the extract being obtained by maceration at 10% (w / v). After fifteen days of germination, thinning was done leaving only one plant per bag, after which 50 ml of the extracts of Canavalia ensiformis were applied. Two more applications were carried out within the interval of fifteen days. The data were submitted to analysis of variance by the statistical program "R", according to the level of significance was applied the test of Tukey to 5% of probability. The aqueous extracts and their doses influenced (p

<0.01) the variables stem diameter, root length and stem dry mass of the Ricinus communis L. seedlings. The highest concentrations of the extracts increased the dry mass of the shoot and the diameter of the stem of plants of Ricinus communinis L. The roots of plants are more sensitive to the allelochemical effects, as the concentrations of the extracts of Canavalia ensiformis was increasing the root length was reducing.

Keywords: Oilseeds; Allelopathic effect; Morphological parameters
Financial support: CAPES

(6085 - 700) An analysis of nematode communities in three habitats invaded by *Fallopia japonica*.

Andrea Čerevková[1]; Lenka Bobuľská[2]; Dana Miklisová[1]; Marek Renčo[1]
Institute of Parasitology, Slovak Academy of Science, Košice, 040 01, Slovakia[1]; Department of Ecology, Faculty of Humanities and Natural Sciences, University of Prešov, Prešov, 080 01, Slovakia[2]

This study determined the hypothesis whether invasive and native plants have different effects on nematode communities and soil microbial indices. Three natural ecosystems were compared: forest, grassland and wetland in the native conditions with adjacent areas mostly monospecific invaded by *Fallopia japonica* (Hout.) R. Decr. The results showed that in the invasive plant *F. japonica* had a considerable effect on abiotic factors as soil moisture content and soil reaction and biological properties represented by soil microbial biomass carbon and soil basal respiration. The effect of *F. japonica* on soil nematode communities was also observed, resulting in a decrease of the abundance and diversity of nematode species.

Keywords: Soil nematode communities, soil characteristics, biological parameters, *Fallopia japonica*, soil disturbance and ecology
Financial support: This study was supported by project Slovak scientific agency VEGA (Grant No. 2/0013/16) (0.6) and "Application Centre to protect humans, animals and plants against parasites (Code ITMS: 26220220018) (0.4) based on the support of the Operational Programme

(9545 - 2002) Arbuscular Mycorrhizal Fungal Diversity in Sugarcane Plantations under Different Management Systems

Rosalba Ortega Fors[1]; Itamar Garcia Ignácio[2]; Eliane M. Ribeiro da Silva[2]; Ricardo L. Louro Berbara[1]; Orivaldo J. Saggin Júnior[2]
Universidade Federal Rural do Rio de Janeiro[1]; Embrapa Agrobiologia[2]

Brazil is the main sugarcane producer worldwide with approximately nine million hectares planted with this crop. Arbuscular mycorrhizal fungi (FMA) (Phylum Glomeromycota) are considered indicators of soil quality. The present work aimed to evaluate the AMF communities associated with different sugarcane management systems. Pre-planting and post-harvest AMF surveys were carried out in sugarcane renovation areas (rotated –RA– or not –MA– with *Brachiaria ruzizensis*) and in a sugarcane expansion area (EA) (previously under pasture). Five composed soil samples were collected in each of the areas and seasons, totalizing 30 samples. AMF spores were extracted from soil by wet sieving and decanting. For each sample, spore density and species richness in 50 cm^3 of soil were evaluated. Identification of the AMF species was based on the morphology of the spores. In total, 21 AMF species were identified, distributed in six families and ten genera, with *Acaulospora* and *Glomus* accounting for the highest number of species. Nine species (43%) were considered exclusive, being seven of them from the EA. Generalist species, present in all the areas and seasons, were *Diversispora tortuosa*, *Acaulospora scrobiculata*, *Racocetra fulgida*, *Gigaspora* sp., *Glomus clavisporum,* and *Ambispora leptoticha*. The species richness was higher in the EA with 18 species, followed by the RA and MA, with 13 and 11 species, respectively. These results might be due to differences in soil fertility. Soil environment conditions resulting from monoculture, such as high P concentrations and changes in soil structure, negatively affect AMF species richness. Rotation with *B. ruziziensis* did not influence the species richness in the MA. Changes in AMF communities depend on the disturbances, considering intensity, frequency, spatial extent, and duration. Spore density (SD) showed variations between the three areas and seasons, with the highest values detected in the EA and after the sugarcane harvest. Variations in water availability between seasons and/or changes in the physiological state of sugarcane plants, as well as seasonal changes in the sporulation of each fungal species, may have led to these differences. It was concluded that prolonged monoculture of sugarcane affects the diversity of AMF communities, as well as their spore density. In addition, rotation with *B. ruziziensis* after years of sugarcane monoculture does not imply short-term recovery of AMF communities.

Keywords: Glomeromycota; Saccharum sp.; monoculture; community; crop rotation.
Financial support: PEC-PG CNPq; Project: EMBRAPA - QUATA S/A – FUNARBE

(1678 - 3003) Arbuscular mycorrhizal fungi and rhizobium is important during Vinhático seedling production

Paulo Prates Júnior[1]; Sandro Lúcio da Silva Moreira[1]; Tomas Gomes Reis Veloso[1]; Emanuelle Burgos Cardoso[1]; Thuany Cerqueira Jordão[1]; Bruno Coutinho Moreira[2]; Marliane de Cássia Soares da Silva[1]; Raphael Bragança Alves Fernandes[1]; Maria Catarina Megumi Kasuya[1]
Universidade Federal de Viçosa (UFV), 36570-900, Viçosa-MG, Brazil[1]; Universidade Federal do Vale do São Francisco, 56300-990, Petrolina, PE, Brazil[2]

The production of seedlings of native forest tree species is an issue that requires more research, especially for species such as Vinhático (*Plathymenia reticulata* Bentham), which presents low survival in the nursery. There is a gap in the knowledge about microorganisms species associated to this plant, and they may be important for its survival and growth. The objective of the present study was to evaluate the growth of the seedlings of Vinhático inoculated with arbuscular mycorrhizal fungi (AMF) and *Bradyrhizobium* sp. in different substrates and to identify the microorganisms present in the substrates. The experiment was carried out during 180 days in plots with the following treatments: (T1) 100% commercial substrate, (T2) commercial substrate plus soil filtrate, (T3) 2/3 commercial substrate and 1/3 soil, (T4) 1/2 commercial substrate and 1/2 of soil, (T5) 1/3 commercial substrate and 2/3 of soil, and (T6) 100% of the soil. The soil used was sampled from root system of an adult plant of Vinhático. All treatments were inoculated with a mixture of AMF spores (*Rhizophagus clarus*, *Claroideoglomus etunicatum*, *Gigaspora albida*) and *Bradyrhizobium* sp. Data of growth measures and diversity indexes were submitted ANOVA and the means compared by Tukey test ($p<0.05$). DNA from the rhizosphere was evaluated by amplicon sequencing (Illumina) and canonical correspondence analysis (CCA) was performed using substrate physical and chemical characteristics. Seedlings of treatments T1 and T2 did not survive and these treatments were disregarded from the following analyzes. Biomass of the shoot and nodulation of treatments T3, T4 and T5 were higher than in T6 treatment. The CCA showed that the community of Fungi (ITS), Bacteria, and Archaea (16S) were correlated to pH, CTC and electrical conductivity of the substrates. The richness of Fungi was (T3 and T4) > (T5 and T6) and the diversity in (T3, T4 and T5) > (T6), while Bacteria and Archaea richness and diversity were (T3, T4 and T5) > (T6). The results revealed the important implications of the physical and chemical characteristics of the substrates on Vinhático growth and the relevance of its association with soil microbiota. We conclude that there is a positive plant-soil feedback, since the addition of soil from an adult plant of Vinhático to the commercial substrate, as well

the inoculation with microorganisms, such as AMF and rhizobium, can guarantee its better survivor and growth.

Keywords: FMA; plant-soil feedback; symbiosis, rhizosphere, *Plathymenia reticulata* Bentham

Financial support: CAPES, CNPq, FAPEMIG – Brazilians Research Agencies

(1096 - 2849) Arbuscular Mycorrhizal status of representative plant species growing in different ecoregions of the Atacama desert, Tarapacá region.

Christian Santander[1]; Pablo Cornejo[1]

Universidad de La Frontera[1]

The symbiosis formed between plant roots and arbuscular mycorrhizal fungi (AMF) has great interest because of its influence on ecosystem processes, its role in determining plant diversity in natural communities and the ability of AMF to induce a wide variety of responses in the plants. The AMF are distributed worldwide as one major component of the natural ecosystems, including arid ecosystems, in which AM symbiosis highlight as the most important biotic components, because AM has an essential role in the survival of plants. In this way, when the desert plants form AM symbiosis have a greater probability of survival to several kind of stress, due to the enhanced nutrient and water acquisitions provided by means of AM symbioses. Based on the above. the objective of this study was to characterize the AM status of representative species of the native flora in different bioclimatic areas of the Atacama Desert, Tarapacá Region. To accomplish this objective, rhizosphere soil was sampled from three ecoregion of Atacama desert: desertic, pre-Puna and Puna ecoregions. In the soil samples was analyzed chemical parameters as pH, electrical conductivity, organic matter and soluble cations. In roots was determined the percentage of AM colonization by the gridline intercept method and staining with trypan blue. In rhizosphere soil was determined the spore density, the mycelium length, and total Glomalin-related soil protein. Of the 48 species sampled, in the 100% was determined presence of AMF propagules. The results showed high rates of mycorrhizal plants (from 12 to 87%), fungal mycelium densities of 0.13 to 20 m g^{-1}, spores densities between 43 and 8500 per 100 g of soil, and T-GRSP contents varied between 0.7 and 9 mg g^{-1}, under natural conditions. The highest spore density and length of mycelium in rhizosphere soils were associated to *Baccharis scandens*, *Werneria pinnatifida*, *Deyeuxia curvula* and *Festuca orthophylla*. The electrical conductivity and soluble cations were positively related with spore density and length of mycelium. These results showed high dependence of plants by the mycorrhizal symbiosis, under the limiting conditions of soil and climate in which are growing. In the same way, the AMF propagules seems to be playing an important role for coping with the salt stress trough the accumulation of toxic ions in fungal structures that deserve to be deeply studied.

Keywords: Puna, Fungal structures, Salt stress

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(3110 - 2245) Bacterial community assemblages associated with the phyllosphere, rhizosphere and leaf litter of *Amphyrrox longifolia* in the Amazon forest

Julio C. F. Moreira[1]; André A. Souza[1]; Silvia E. Barrera[1]; Mauro Brum[2]; Lidiane C. Almeida[3]; Luciana F. Alves[2]; Rafael S. Oliveira[2]; Bruno H. P. Rosado[3]; Marcio R. Lambais[1]

Departamento de Ciência do Solo, ESALQ/USP, Piracicaba, SP[1]; Departamento de Biologia Vegetal, UNICAMP, Campinas, SP[2]; Departamento de Ecologia, UERJ, Rio de Janeiro, RJ[3]

Bacterial communities associated with tree species of the Atlantic forest have been shown to be specific to their hosts and the plant microenvironment (phyllosphere, dermosphere or rhizosphere), suggesting that plant species-specific traits may drive the selection of microbial populations that comprise their microbiomes. Whether this is true for tree species in the Amazon forest is not known. In order to determine whether the bacterial communities associated with trees in the Amazon forest are specific to the plant microenvironment, we sampled the phyllosphere (Phy), rhizosphere (Rhi) and leaf litter (Lit) of *Amphyrrox longifolia*, a very abundant understory tree species broadly distributed in a pristine east-central Amazon forest (Tapajós National Forest, Brazil). Leaf samples were collected from branches at different points in the canopy. Rhi soil samples were collected under the projection of the tree canopy, at 0-10 cm depth. The Lit samples were collected with a 25x25 cm frame positioned at the same site of Rhi soil sampling. Ten individual trees were sampled. To study the bacterial communities, we sequenced the V4 region of the 16S rRNA gene using the Illumina MiSeq platform. A total of 2,934,907 sequences were obtained and processed using the pipeline of the Brazilian Microbiome Project. Sequences were clustered into 26,323 Operational Taxonomic Units (OTUs), and affiliated to taxonomic groups using the Greengenes database as the reference. The structures of the bacterial communities in the Phy were significantly different from that in Rhi soil and Lit ($P<0.05$), whereas no significant differences were observed between Rhi soil and Lit ($P>0.05$). The Phy harbors most of the unique OTUs, whereas the Rhi soil and Lit share most of the OTUs. The Shannon index indicates a diversity of approximately 666, 578 and 436 OTUs in the Phy, Rhi and Lit, respectively. At the class level, the most abundant OTUs in the Phy were assigned to Betaproteobacteria and Gammaproteobacteria, whereas in the Rhi the most abundant OTUs were assigned to DA052 and Acidobacteria, and in the Lit to Gammaproteobacteria and Betaproteobacteria. Our results indicate that the bacterial communities in the Rhi of *A. longifolia* in the Amazon forest is not as diverse as in the Phy, and suggest that different metabolic functions take place in the Phy, Rhi and decaying leaves, which may have specific contributions to the functionality of the forest.

Keywords: Diversity; Bacterial Community Structure; 16S rRNA

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(5964 - 1488) *Burkholderia* spp. strains promote the growth of common bean, cowpea, maize and brachiaria grass

Silvia Maria de Oliveira-Longatti[1]; Leandro Marciano Marra[2]; Teotonio Soares de Carvalho[3]; Pedro Martins de Sousa[4]; Fatima Maria de Souza Moreira[3]

Postgraduate program of Soil Science - Department of Soil Science, Federal University of Lavras, Lavras-MG, Brazil; Postgraduate program of Agricultural Microbiology - Department of Biology, Federal University of Lavras, Lavras - MG, Brazil[1]; Postgraduate program of Soil Science - Department of Soil Science, Federal University of Lavras, Lavras-MG, Brazil, teo.decarvalho@gmail.com; State University of Mato Grosso do Sul[2]; Postgraduate program of Soil Science - Department of Soil Science, Federal University of Lavras, Lavras-MG, Brazil[3]; Postgraduate program of Agricultural Microbiology - Department of Biology, Federal University of Lavras; Federal Institute of Mato Grosso[4]

Inoculation of crops with plant-growth promoting rhizobacteria (PGPR) is a promising biotechnology for reducing the environmental and economic costs of N and P fertilization, especially in tropical environments, where these nutrients are the major limiting factors for plant growth. In this study, we evaluated the ability of five phosphate-solubilizing strains of *Burkholderia* spp. to promote the growth of brachiaria grass (*Brachiaria decumbens* Stapf.) and three crops –

common bean (*Phaseolus vulgaris* L.), cowpea (*Vigna unguiculata*), and maize (*Zea mays*) – under axenic (Leonard jars) and non-axenic (pots filled with nonsterile soil) conditions in two greenhouse experiments. In both experiments, the plants inoculated with PGPR were fertilized with low-solubility P forms: $Ca_3(PO_4)_2$ (applied at 93 mg P_2O_5 per jar) for the experiment with Leonard jars; and Araxá rock phosphate (600mg P_2O_5 per pot) for the experiment with soil. For the experiment with Leonard jars, plants were grown for 40 (maize and common bean), 45 (cowpea), or 105 days (brachiaria grass). For the experiment with soil, cowpea, common bean and cowpea were grown for 50 days; whereas brachiaria and maize were grown for 90 and 30 days, respectively. Under axenic conditions, the total dry matter (TDM) of common bean increased significantly ($P < 0.05$), in relation to the control without inoculation, after inoculation with strain UFLA 04-21 (54% increase) or UFLA 04-155 (21% increase), but neither maize nor brachiaria responded to PGPR inoculation, whereas the root dry matter of cowpea was reduced after inoculation with strains UFLA 04-217, UFLA 04-21, and UFLA 04-195. Under non-axenic conditions, maize was the most responsive species to PGPR inoculation, with significant increases of up to 109% in root, shoot, or total dry matter when inoculated with UFLA 04-233, UFLA 04-21, UFLA 04-195, or UFLA 04-155. The inoculation of cowpea with UFLA 04-217 significantly increased the SDM by about 113% under non-axenic conditions and, although not statistically significant ($P > 0.05$), a similar effect was observed when this crop was inoculated with UFLA 04-155. Also under non-axenic conditions, inoculation of brachiaria with UFLA 04-21 significantly increased the SDM by about 16%. All the tested *Burkholderia* spp. strains were able to promote plant growth to some extent, but among them the strain UFLA 04-21 was the most versatile, increasing the growth of brachiaria, common bean, and maize.

Keywords: phosphorus solubilization, phosphate-solubilizing rhizobacteria; biotechnology; inoculatio

Financial support: Financial Support: Coordination for the Improvement of Higher Education Personnel (CAPES); Foundation for Support of Research in the state of Minas Gerais (FAPEMIG); National Council for Scientific and Technological Development (CNPq)

(9780 - 1797) CAS-Selected Metagenomics: Soil Microbial Mechanisms Involved in Grapevine Micronutrient Nutrition and Chlorosis

Lee Opdahl[1]; Ricky Lewis[1]; Anjuman Islam[1]; Joan Davenport[1]; Tarah Sullivan[1]

Washington State University[1]

Grapevine chlorosis is a common problem in many grape-growing regions of the world, particularly in alkaline soils, often causing reduction in grape yield and quality. While the role of soil microbial communities in plant health and nutrition is indisputable, the precise microbial mechanisms involved in mediating grapevine chlorosis are not yet characterized. Microbes have evolved strategies to increase Fe acquisition (siderophore/organic acid production) that also increase plant Fe uptake when Fe availability is limited. A better understanding of siderophore producing soil microbes could aid efforts to combat Fe deficiency and chlorosis in grapevines. A high-throughput chrome azurol S (CAS) assay was used to isolate siderophore producing bacteria from soil (pH ≥ 8.3) collected from the rooting zone of chlorotic grapevines in a central WA vineyard. DNA was extracted from samples exhibiting strong siderophore production, and next-generation sequencing (NGS; Illumina MiSeq) was used to conduct a metagenomic analysis of CAS-positive soil microbial communities. Seven distinct genomes were assembled from the samples using metaSPAdes in the Department of Energy Systems Biology Knowledgebase (KBase) with between 90-100% completeness. Phylogenetic analysis indicates all genomes most closely related within the *Pseudomonas* genus, including *Pseudomonas* sp. PTA1 and *Pseudomonas* sp. GM78. Genome annotation (RAST) and comparison revealed a total of 3,484 core protein families (2,629 core functions) shared between the seven newly constructed genomes, using *Pseudomonas* sp. PTA1 as a reference genome. Furthermore, nine classes of siderophore-related genes were identified in all seven genomes including siderophore-specific ABC transporters, iron-siderophore receptor/sensor proteins, and siderophore biosynthesis proteins. Five other siderophore-related genes were found in two genomes and included siderophore-specific ABC transporters, siderophore biosynthesis genes, and TonB-dependent siderophore receptors. In this study, the genomes of seven potential siderophore producing bacteria were sequenced, and key genes involved in plant and soil health were identified. Future work should examine the relationship of these novel bacteria with grapevine health status to determine plant growth-promoting potential. Examining the functions of the bacteria in soil Fe cycling could provide additional insight into strategies to alleviate chlorosis in many perennial fruit crops.

Keywords: Metagenomics; Soil Microbial Communities; Grapevine Chlorosis; Siderophore

Financial support: Washington State Concord Research Council

(9938 - 2334) Characterization of rhizobacteria producing Exopolysaccharides (EPS) and Biofilm in sugarcane (*Saccharum officinarum L.*).

Yamina Coentro Montaldo[1]; Crísea Cristina Nascimento de Cristo[2]; Tania Marta Carvalho dos Santos[1]; Beatriz Paes Duarte Brandão[1]; Sybelle Geogia Mesquita da Silva[1]

Universidade Federal de Alagoas[1]; Universidade Federal de Alagoas / Instituto Federal de Alagoas[2]

The improvement of crops under stress conditions can occur with the use of technologies such as the application of bacteria capable of promoting plant growth or beneficial physiological changes to plants. The production of exopolysaccharides (EPS) and biofilm formation are examples of the capacities developed by these microorganisms that allow the adaptation of plants to environmental stresses. The objective of this study was the isolation of rhizospheric soil bacteria in sugarcane cultivation areas for the production of microbial inoculants with the capacity of producing EPS and biofilm. Soil samples were collected in areas of sugar and alcohol plants in the State of Alagoas, from April to June 2016. Twenty-four collections were made, and a soil sample for each sugarcane plant. The samples were sent to the laboratory de microbiologia agrícola at Centro de Ciências Agrárias – Universidade Federal de Alagoas, The bacteria were isolated, identified and passed by qualitative and quantitative evaluation to test the potential for EPS production and biofilm formation on abiotic surfaces, in addition to quantification of the biofilm formed. At the end of the evaluations, it was verified that all the isolates were able to produce EPS, with variation depending on the carbon source used, as well as, the isolates presented biofilm formation capacity. Concluding the isolates have potential for use as a bioinoculant that help increase growth rates and crop yield, even under stress.

Keywords: Phosphate solubilizing bacteria, Environmental stress, Microbial Inoculants

Financial support: Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES)

(6514 - 2522) Co-inoculation of common bean with plant growth promoting microorganisms

Raysa Marques Cardoso[1]; Enderson Petronio de Brito Ferreira[2]; Matheus Messias de Oliveira[2]; Marcos Antônio Rodrigues de Oliveira[2]

UFG[1]; Embrapa[2]

The use of plant growth promoting microorganisms has been a viable alternative for increasing agricultural production without the total dependence of fertilizers and agrochemicals. The diazotrophic

bacteria promote the biological fixation of nitrogen and are an example of this interaction. The objective of this assay is evaluate the interaction of *Azospirillum*, *Rhizobium* and *Trichoderma* co-inoculation in the common bean, considering that this association may result in not only productive but also ecological gains. The assay was implemented in the city of Cristalina, located in the state of Goiás using the cultivar Pérola. The experiment was in randomized complete blocks with four replicates. The plots were composed of 6 lines of 4 m in length, spaced at 0.45 m and having as treatments: 1- Absolute Witness; 2- Rhizobia; 3-Rhizobia and azospirilla; 4- Rhizobia, azospirilla and trichoderma; 5- Rhizobia and azospirilla + N according to NSI (Nitrogen sufficiency index) in V4; 6- Rhizobia, azospirilla and trichoderma + N according to NSI at R5; 7-120 kg ha-1 of N (45 kg ha-1 at the base); 8- 80 kg ha-1 of N + N according to NSI no V4; 9- 80 kg ha-1 of N + N according to NSI no R5; 10- 150 kg ha-1 of N at 10 days after emergence (45 kg ha-1 at the base). In the inoculated treatments the seeds were treated at the planting with a mixture of rhizobia, SEMIA 4077, 4080 and 4088, at the dose of 10 g of the inoculant per kilogram of seed and with Trichoderma sp. in the same dosage. The application of Azospirillum brasiliense was between phenolic stage V2 and V3 of the bean at the dose of 300 ml ha-1. The source of nitrogen used was urea. For the number and weight of nodules, the plants with the best averages were those of treatments 9 with 23.08 nodes plant-1 and 26.49 mg plant-1 and 2 with 22.83 nodes plant-1 and 34.16 mg plant-1. The treatments 6 and 7 obtained the highest averages of relative nitrogen content with 51.65 and 51.35, in V4. The R5 stage the highest averages were treatments 10 and 7 with 55.6 and 54.48 respectively. As for productivity per area, treatments 3, 2, 10 and 1 presented the highest yields, being 243.08 g/m², 247.98 g/m², 251.80 g/m² and 254.02 g/m², respectively. The effect of nitrogen fertilizer use was clear on nodulation, resulting in the lower mean number of plant nodules-1. For the production we observed that the greater the nitrogen attachment, being it by BNF or by fertilization, the higher the productivities.

Keywords: Nitrogen, microorganism, commom bean.
Financial support: CAPES

(3256 - 1402) Dark septate endophitic fungi as plant-growth-promoting

Peter Medeiros[1]; Carlos Vergara-Júnior[1]; Carlos Inácio[1]; Jean Araújo[2]; Jerri Zilli[2]

University Federal Rural of Rio de Janeiro[1]; Embrapa Agrobiology- RJ[2]

The dark septate endophytic fungi (DSEF) are widely distributed in nature by colonizing plant roots and are often isolated from environments with strong abiotic stress. They represent a broad group of microorganisms that are still under-researched in tropical conditions and have significant potential for applicability in agriculture, since they are recognized as plant growth promoters similar to arbuscular micorrhyzal fungi. However, depending on the specific treatment conditions, DSEF may exhibit beneficial, neutral or pathogenic behavior. This work aimed to avaluate new five isolates DSEF strains deposited in collection of mycorrhizal fungi of Embrapa Agrobiology (COFMEA), Seropédica, RJ., concerning to pathogenic characteristics. Under greenhouse conditions, the DSEF strains named AM 101, AM 102, AM 103, AM 104 and AM 105 isolated from rice roots (*Oryza glumaepatula*) were tested compared to ten distinct agricultural crops such as soybean, cowpea, sorghum, tomato, rice, maize, common bean, pumpkin, lettuce and papaya. Prior the test, in the laboratory, the seeds were tested for their germinative ability. For the pathogenicity test in greenhouse, the methodology of the colonized toothpick was carried out. Subsequently, a study was conducted *in vivo* to avaluate whether DSEF isolates would be able to influence seed gemination. Our preliminar results show that neither DSEF isolates presented pathogenicity behavior in any of the cultures, and seeds inoculated with fungal suspension showed no significance, straigtening the hypothesis that these DSEF isolates do not present genotipic pathogenic charachteristics. Others study are being conducted to prove this hypothesis.

Keywords: *Ascomycota*; endophytes; tropical
Financial support: Embrapa Agrobiology, Capes, UFRRJ.

(3812 - 2971) Edaphoclimatic effects on native rhizobial populations in a tropical semiarid zone, Brazil

Vanessa Dina Cavalcante Barros[1]; Mario de Andrade Lira Junior[1]; Aline Medeiros De Arruda[1]; Mércia Virginia Ferreira Dos Santos[1]; Antônio Félix Da Costa[2]; Clayton Albuquerque De Sousa[3]

Universidade Federal Rural de Pernambuco[1]; Instituto Agronômico de Pernambuco[2]; Instituto Federal da Paraíba[3]

Regional climatic characteristics and soil heterogeneity are important agents in the establishment of native rhizobial populations. This study compared rhizobial populations from Neossolo Litólico, Luvissolo and Argissolo Vermelho Amarelo collected each in from three to five points in each of Bom Jardim county, a transition area humid and drier regions and Serra Talhada, a typical semiarid area with low and spatially and temporally irregular rainfall and high day temperatures. Most soil samples were sandy-loam with CEC greater than 27 cmol kg^{-1}, alkaline to slightly acidic with pH in water between 6.3 and 8. However, Serra Talhada soils were closer to neutrality.There also low Na^{+} contents whose higher values were for the Luvissolos of Serra Talhada (0.52 cmolc dm3) which also had the higher P (182 mg dm^{-3}) contents. Total C-organic content ranged between 6.3 and 8.5 g kg^{-1} for all soils, except for Serra Talhada Neossolo Litólico that presented higher C.O., Ca^{+2} and K^{+}. The samples were used to inoculate cowpea (Vigna unguiculata) as bait crop. The nodules were used for rhizobial isolation and morphological characterization followed by grouping with 100% similarity groups using PAST 2.09 Jaccard coefficients and UPGMA method. 479 isolates were obtained, of which 334 were fast growers perhaps as a survival mechanism due to the very short rain season.There were 100 and 175 100% similarity groups in Bom Jardim (244) and Serra Talhada (235), whose higher diversity may be due to the more drastic rainfall deficit under the latter conditions leading to higher microenvironments diversity when combined with soil conditions. Luvissolos had the lowest group-isolate ratio (0.47) with 85 of the 88 groups, maybe due to the higher clay content presented by these soils, since Argissolo vermelho amarelo also had the second lowergroup-isolates ratio (0.70) and second higher clay content. Our results indicate it is probably worthwhile to further investigate these environments as possible sources of new genetic material, since higher overall diversity may lead to higher diversity in rhizobial efficiency, and thus a higher chance of finding superior materials for inoculant production.

Keywords: Vigna unguiculata, Semi-arid, diversity, Ultisol, Entisol, Luvisol
Financial support: UFRPE, IPA, CAPES, CNPq, FACEPE

(7714 - 1700) Effect of indigenous and introduced arbuscular mycorrhizal fungi on growth of *Allium fistulosum* under field conditionEffect of indigenous and introduced arbuscular mycorrhizal fungi on growth of *Allium fistulosum* under field condition

Keitaro Tawaraya[1]; Takumi Sato[1]; Weiguo Cheng[1]

Yamagata University[1]

Phosphorus (P) is one of the essential elements for plant growth and often the first limiting nutrient in soils due to its low availability. Rock phosphate is the raw material of P fertilizer and it is estimated that the world's reserve would last for only 90 years. It is necessary to develop sustainable echnologies for the use of P resources. Arbuscular mycorrhizal (AM) fungi promote the growth of many plants by

enhancing P uptake. However, little is known about effect of AM fungi on growth of crop plant under filed conditions. The purpose of the present study was to investigate effect of indigenous and introduced AM fungi on the phosphorus uptake and growth of *Allium fistulosum* under field condition. The field soil was sterilized with application of fumigant dazomet at the rate of 2000 kg ha^{1}. Superphosphate was applied at the rate of 0, 500, and 1000 kg ha^{-1}. *A. fistulosum* was inoculated with AM fungus, *Glomus* R-10 and grown in a glasshouse. Non-inoculated plants were grown as control. Inoculated and non-inoculated seedlings were transplanted to sterilized and unsterilized field. This field experiment was repeated in 2015, 2016 and 2017. AM colonization, shoot P concentration, and shoot growth were measured. AM colonization in unsterilized field ranged from 37% to 76% in uninoculated plant and from 45% to 86% in inoculated plant at 35 days after transplanting, and was not different between inoculated and uninoculated plants until final harvest. AM colonization in sterilized field ranged from 1% to 19% in uninoculated plant and from 45% to 84% in inoculated plant and was mostly higher in inoculated plant than uninoculated plants until final harvest. Shoot growth of inoculated plant was not different from uninoculated plants in unsterilized field, but shoot growth of inoculated plant was higher than uninoculated plants in sterilized field. This result suggested that dazomet treatment suppressed indigenous AM fungi and introduced AM fungi promoted growth of *A. fistulosum* under sterilized field condition.

Keywords: Arbuscular mycorrhizal fungi phosphorus field
Financial support:

(1664 - 800) Effect of soybean inoculation and nitrogen fertilization on microbiological activity in a sandy soil

Guilherme Dias Batista[1]; Carlos Felipe dos Santos Cordeiro[1]; Bruno de Senna e Silva[1]; Fábio Fernando Araújo[1]; Fábio Rafael Echer[1]
Universidade do Oeste Paulista (UNOESTE)[1]

Sandy soils under high degree of degradation have low microbiological activity due to the low soil organic matter content, which also impairs the establishment of nitrogen fixing bacteria (N) in soybean crops. The objective of this work was to evaluate the microbiological activity of the soil in response to soybean inoculation and nitrogen fertilization. The experiment was conducted in two fields (first and second year of cultivation) in Presidente Bernardes-SP, Brazil, in the randomized block design in a subdivided plot scheme with 4 replications. In the plots the inoculant doses (0, 4, 8 and 12 ha^{-1}) were allocated and it was applied in the sowing furrow, and in the subplot N fertilization (ammonium nitrate) (0, 25, 50 and 100 kg ha^{-1}) in R1 stage. The density of a dose of inoculant was 5 $x10^{11}$ UFC. Soil was sampled at 0-10 cm depth in the R4 stage to quantify soil respiration, enzyme dehydrogenase activity and nitrogen and carbon in the microbial biomass. The statistical analysis consisted of analysis of variance and regression ($P < 0.05$). There was no interaction between treatments on soil respiration and the average of the first and second year fields was 5.8 and 4.6 mg CO_2 kg^{-1} soil day^{-1}, respectively. The enzyme dehydrogenase showed higher activity in the combinations of 12 doses of inoculant and 50 kg ha^{-1} of N on first year field (3.63 µg TTF g^{-1} soil) and 4 doses of inoculant without N application in the second year field (3,58 µg TTF g^{-1} soil). Microbial nitrogen biomass had a linear growth as a response of N rates increase on 8 and 12 doses of inoculant, in both fields. Microbial carbon biomass (C_{bio}) had a linear growth at 12 doses of inoculant and quadratic for the dose 0 in response to N increase in the first year field. In the second year field the application of 12 doses of inoculant without N or 8 doses of inoculant with 100 kg ha^{-1} of N provided the highest values of C_{bio}. In conclusion, nitrogen fertilization and inoculation do not affect soil microbial respiration, but an increase on inoculant rates improves the dehydrogenase activity on the first year field and nitrogen fertilization increases the N content of the microbial biomass associated with 8 and 12 doses of inoculant in both fields and the association of these doses with 100 kg ha^{-1} of N increases the carbon of the soil microbial biomass on first year field.

Keywords: soil respiration, dehydrogenase and microbial biomass.
Financial support: Foundation for Research Support of the State of São Paulo - FAPESP.

(4354 - 3029) Effects of different extracts and neem concentrations in microbiological activity and corn-mycorrhizal relationship cultivated in a soil of the "Sertão do Inhamuns" – Ceará, Brazil

Emanuel Dias Freitas[1]; Dayanne Camelo[1]; Leila Maria de Sousa Tavares[1]; Paulo Furtado Mendes Filho[2]
IFCE[1]; UFC[2]

Neem (Azadirachta indica A. Juss) is a rustic plant species adapted to different regions of the world. Its use is related to insecticidal action, wood production, landscaping and even minimizing problems caused by desertification and soil erosion. Of all the utilities attributed to neem, the insecticidal action is the most documented. However, the results of studies of the action of neem aqueous extracts on edaphic microbial activity is still rather scarce and controversial. This study aimed to evaluate the effects of different extracts and neem concentrations in microbiological activity and corn-mycorrhizal relationship cultivated in a soil of the "Sertão do Inhamuns" – CE. The experiment was conducted in the experimental area of the Instituto Federal do Ceará campus Crateús in a completely randomized design following the factorial arrangement 2x3 + 1. The treatments were: control (T1), leaf extract of neem to 5% (T2), 10% (T3), 20% (T4), seed extract of neem to 5% (T5), 10% (T6), 20% (T7) concentration. Each treatment had 5 replications, totalizing 35 plots. Soil basal respiration, soil microbial biomass carbon, total organic carbon, metabolic quotient, microbial quotient, mycorrhizal colonization in the root cortex and spore density were analyzed. Basal respiration and total organic carbon were higher for soils receiving seed extracts than those receiving extracts from neem leaves. It was observed higher values of metabolic quotient for the concentrations containing 20% of neem seed (T7) when comparing the leaf extracts. The microbial quotient was higher for the treatments with concentrations of 5%, 10% and 20% of leaf in relation to those of seed. The aqueous extract containing 20% of neem seed (T7) was the one that most stressed the microbial activity of the soil, because it reduced the carbon content of the soil biomass (CMS), raised the basal respiration and the metabolic quotient (qCO_2). However, this treatment promoted a higher spore density of arbuscular mycorrhizal fungi in the soil. The mycorrhizal colonization in the root cortex did not differ statistically in the different treatments.

Keywords: Azadirachta indica A. Juss; microbiota edáfica; Fungos micorrízicos arbuscular
Financial support: PIBIC/IFCE

(4751 - 2510) Effects of inoculation on vegetative development of corn

Vinicius Leite[1]; Gustavo Benincá Rodrigues[1]; João Vitor Berner Pereira[1]; José Filipe dos Santos Maciel[1]; Mauricio Rosa Magro[1]; Ana Rosa da Silva França[1]; Camila Köche Wibbelt[1]; Julio Cesar Ariati[1]; Renan Adamcheski[1]; Sonia Purin da Cruz[1]
Universidade Federal de Santa Catarina[1]

Current scenario of agronomy in Brazil raises concerns related to environmental sustainability due to intensive use of chemical fertilizers. Inoculation is an alternative to reduce the amount of fertilizers applied. This technique is based on using plant growth-

promoting bacteria that mainly produce hormones, resulting in higher yield and optimized cost-benefit ratios. The aim of this study was to verify the effects of inoculants on plant height, ear insertion height and stem diameter of corn (*Zea mays*) at R1 stage. The experiment was carried on in Frei Rogério – SC/Brazil, at Salto Correntes. Corn was sown in November 2017, following and completely randomized block design with nine treatments and six repetitions. Plots measured 6.5x4.0m. Treatments included levels of nitrogen ranging from 0%, 75% and 100%. Inoculation treatments included different species of bacteria and fungi. Data were submitted to analysis of variance and no statistical difference was observed among treatments for any studied variable. Based on our findings, we may state that inoculation is not mandatory in order to improve vegetative development of corn. However, further yield analyses are to be conducted to verify feasibility of inoculation as a recommended practice.

Keywords: Keywords: inoculants, *Zea mays*, tratamants.
Financial support: Total Biotecnologia, Rua Emílio Romani, 1.190, Curitiba-PR, 81460-020, Brasil

(5905 - 1279) Effects of wheat-white lupin intercropping on chemical and microbiological properties of soil related to N and P cycles

Ana Beatriz De Oliveira[1]; Philippe Hinsinger[2]; Mustapha Arkoun[3]; Edith Le Cadre[4]
INRA / AII[1]; INRA[2]; AII (Agro Innovation International)[3]; AGROCAMPUS OUEST[4]

Intercropping is a cropping system in which several species are growing in a field during a significant period of their life cycle. This cropping system becomes a promising alternative to intensive agriculture in many countries due to ecological regulations. While benefits of mixed cropping are listed in a large body of literature, only scarce studies focused on the long term consequence of such systems and especially in terms of soil quality. In this study, we estimated if crop association can modify the soil functioning through modifications of the nitrogen (N) and phosphorus (P) cycles. We hypothesize that crop associations can shape microbial activity through plant exudation or litterfall. A pot experiment (pots of 4L with 2,2 kg of soil) was conducted from September 2017 to December 2017 on a calcareous soil with white lupin (*Lupinus albus* var. Feodora) and wheat (*Triticum aestivum* var. Lennox) in both mixing and respective sole crops at three nitrogen levels (N0 = 61 mg kg^{-1} soil; N1 = 92 mg kg^{-1} soil; N2 = 124 mg kg^{-1} soil) to influence plant interactions with seven replicates. At flowering, we measured the nitrogen, phosphorus content of plants (root and shoot) and soil chemical variables (mineral nitrogen, labile phosphorus content after Olsen extraction method and pH) but also soil biological variables (total microbial biomass, abundance of ammonia-oxidizing bacteria (AOB) and archaea (AOA) and microbial carbon, nitrogen and phosphorus contents (MBC, MBN and MBP)). As preliminary results, we measured greater values of MBC, MBN and NH_4^+_N content in rhizosphere compared to bulk in all treatments as expected from other studies. But surprisingly, we measured a significant NO_3^-_N level in the rhizosphere of sole lupin treatment compared to others treatments while NH_4^+_N were similar to mixing crops. We hypothesize that nitrification rate can be modified in the lupin rhizosphere compared to others treatments. Plant and molecular biology analyses planned will confirm this interpretation. If confirmed, it will be interesting to investigate if this nitrification potential is maintained after several cycles of mixing cropping.

Keywords: soil quality; rhizosphere; cereal-legume intercrops; plant-microbe interaction; nitrification
Financial support: ANRT (National Agency for Research and Technology) – France

(8397 - 2937) Efficiency of Streptomyces spp. in growth, nodulation and productivity of cowpea beans

Albert Lennon Lima Martins[1]; Edvaldo Vieira Pacheco Sant'Ana[2]; Rodrigo Silva de Oliveira[1]; Juliana Mariano Alves[3]; Fred Newton da Silva Souza[3]; Weslany Silva Rocha[1]; Thadeu Teixeira Júnior[4]; Weder Ferreira dos Santos[1]; Lillian França Borges Chagas[1]; Aloísio Freitas Chagas Júnior[1]
Universidade Federal do Tocantins[1]; Instituto Federal de Educação, Ciência e Tecnologia do Tocantins[2]; Universidade Estadual do Tocantins[3]; Secretária do Desenvolvimento da Agricultura e Pecuária do Tocantins[4]

Cowpea is a very important food crop; however, it has low productivity due to the level of the technological level. And to achieve better productivity, several studies related to the selection of micro-organisms have been observed. Thus, the present work aimed to select, through agronomic efficiency studies, strains of *Streptomyces* ssp. know as inoculants for a bean cowpea crop in the region and to evaluate the effect of the doses on a crop. A selection of isolates was conducted in a greenhouse with an inoculation of nine isolates of *Streptomyces* ssp. in cowpea beans. Two evaluations were performed without experience, at 20 and 45 days after emergence (AED). After that, the effect of different doses of *Streptomyces* ssp., both in the greenhouse and in the field, was evaluated. A cultivar of Sempre Verde BRS Rouxinol cowpea was used and the treatments consisted of five inoculant doses (0, 100, 200, 300 and 400 mL of *Streptomyces* ssp. inoculant, for each 50 kg of seeds), being reviewed in 20, 50 and 75 DAE in greenhouse and at 20, 50 and 77 DAE in the field. Regarding the evaluation of the selection of the isolates, it was observed that UFT-St06 (4.48 mm) and UFT-St07 (4.17 mm) strains were distinguished for the stem diameter parameter. In addition, UFT-St03, UFT-St06 and UFT-St08 strains showed a better relative efficiency of the isolates (ER), with 23, 30 and 21%, respectively. As for the effect of doses, in greenhouse as better doses of 300 and 400 mL/50 kg seeds for all parameters. And the best observation efficiency with 300 mL treatment in both evaluations (20 and 50 DAE). The field dose experiment confirmed the results obtained without greenhouse experimentation, and a higher grain yield was obtained with a dosage of 300 ml (1.113,5 kg ha^{-1}). Thus, one can observe the genus *Streptomyces* is a promising agent due to the production of several metabolites of interest.

Keywords: *Vigna unguiculata* L.; growth promotion; productivity.
Financial support: Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – Capes

(4674 - 2609) Environmental Remediation Potential of Biological Nitrogen Fixation and Its Application

Ying Teng[1]; Xiaomi Wang[1]; Lingjia Zhu[1]; Wenting Ma[1]; Yongming Luo[1]
Key Laboratory of Soil Environment and Pollution Remediation, Institute of Soil Science, Chinese Academy of Sciences, Nanjing 210008, China[1]

Biological nitrogen fixation is a significant source of nitrogen in agricultural ecosystems, thus playing an important role in agricultural sustainable development. The key to biological nitrogen fixation lies in the resources of nitrogen-fixing microbes. It has been found that nitrogen-fixing microbes are widely distributed in host plants such as leguminous plants and non-leguminous plants, and even exist in some extreme environments. At present, the nitrogen-fixing resources which are widely used in agricultural production include rhizobium-legume symbiosis system, Frank actinomycetes-(non-leguminous) symbiosis system, diazotrophic cyanobacteria-azolla symbiosis system, etc. Among them, the rhizobium-leguminous

symbiosis system is the most classic biological nitrogen fixation system, which has the strongest nitrogen fixation ability. With the deepening of research, researchers also find that biological nitrogen fixation plays an important role in ecological environment restoration. Numerous studies have shown that nitrogen-fixing bacteria not only have prominent abilities in resisting heavy metals and degrading organic pollutants, but also can assist phytoremediation. In addition, the presence of nitrogen-fixing bacteria can also directly or indirectly affect the microbial community in soils, thus promoting the restoration of soil ecological function. Thus, the function of biological nitrogen fixation in environmental remediation should also attract global attention and need further development. This paper summarized the concept, types and principles of biological nitrogen fixation. The emphasis focused on the roles of biological nitrogen fixation in the remediation of ecological environment and its related mechanisms. In addition, current application of biological nitrogen fixation in the field of environmental remediation was introduced. Some suggestions are further put forward to strengthen the potential of biological nitrogen fixation in environmental remediation. We hope that it could provide some green techniques and basis for improving agricultural sustainable development and ecological environment.

Keywords: biological nitrogen fixation ; environmental remediation ; diazotroph ; heavy metals ; organic pollutants
Financial support: National Natural Science Foundation of China, Project Number: 41371309 and 41171249

(5950 - 2490) Evaluation of corn diameter in response to different inoculation treatments through Balanced Incomplete Block Design.

João Vitor Berner Pereira[1]; Gustavo Benincá Gustavo Benincá[1]; José Filipe dos Santos Maciel[1]; Maurício Rosa Magro[1]; Ana Rosa da Silva França[1]; Camila Köche Wibbelt[1]; Júlio César Ariati[1]; Renan Adamcheski[1]; Vinicius Leite[1]; Crysttian Arantes Paixão[1]
Universidade Federal de Santa Catarina[1]

The randomized complete block design – RCDB is commonly adopted when establishing field experiments. This design is based on blocking experimental units that receive studied treatments. Blocks, by definition, must have homogeneous conditions throughout their entire area. In Soil Microbiology, experiments with inoculation are usually carried on with many treatments, which demands large blocks. Therefore, the size of experimental areas is big and hence the possibility of error increases. This causes heterogeneity of environmental conditions and makes adoption of RCBD not feasible. The use of a balanced incomplete block design – BIBD reduces these problems and allows testing of several treatments as it keeps homogeneous blocks characteristics. Rather than disposing all treatments in one block, only a few are disposed and hence experimental areas are also reduced in size. The aim of this study was to evaluate the response of corn (*Zea mays*) diameter when submitted to treatments of inoculation with growth-promoting rhizobacteria. The experiment was carried on in 2017 in Frei Rogério/SC, Brazil. Ten treatments were studied, with 6 repetitions, resulting in fifteen blocks. Treatments included one control and nine different inoculation methods or bacterial species. Each block had 4 experimental units (6.5 m x 4.0 m), hence the disposal efficiency was 83.33% compared to RCDB. Sampling was performed at V3, with 6 plants per experimental unit. Data were submitted to ANOVA at 5% significance level. No statistical difference was detected among treatments. We conclude that inoculation practices here tested are not mandatory in order to improve early development of corn plants.

Keywords: Incomplete blocks; Corn; Inoculation.
Financial support: Total Biotecnologia

(1423 - 3046) Examining the Influence of Wheat Genotype on Root Exudate Composition and Microbiome Recruitment

Ricky Lewis[1]; Jade Ermita[1]; Scot Hulbert[1]; David Gang[1]; Tarah Sullivan[1]
Washington State University[1]

In wheat (*Triticum aestivum*, L.) growing regions of the world, varieties are bred to address specific regional issues including drought, disease, and nutrient deficiencies or toxicities. However, the full environmental implications of traits allowing sufficient yields under these adverse biotic or abiotic conditions are not fully understood, particularly within the wheat microbiome. Given that many wheat genotypes have the capacity to select specific soil microbiomes, examining the role of genotype-specific root exudates in recruitment of microbiomes is critical to understanding and manipulating the mechanisms governing this process. Our work uses the most advanced techniques in root metabolomics, in combination with next generation sequencing (Illumina MiSeq) of the microbiome in order to understand the composition, function, and mechanisms of recruitment within the wheat phytobiome. Six wheat genotypes were targeted for their resistance to soil acidity and aluminum toxicity. A method was developed to culture wheat plants aseptically in bioreactors for up to a month and wheat root exudates were sampled directly from the bioreactors. Exudate samples were then derivatized and subjected to metabolomic analysis via GC-MS and LC-MS-MS. Initial root metabolomics have revealed 54 basic root metabolites including organic acids, amino acids, and sugars in a wheat genotype that demonstrates aluminum tolerance and forms a genotype specific root microbiome in multiple soils from Washington, USA. *Rhizoctonia* (a root-born disease, prevalent in our area) pathogenicity is suppressed in soils associated with additional genotypes that will be assessed in ongoing studies. Our work aims to elucidate the relationship between wheat genotype, root exudate composition, and soil microbial communities in a manner which may inform the understanding of Al tolerance mechanisms in wheat and assist future endeavors in generating and utilizing pathogen suppressive soils.

Keywords: plant growth promoting microorganisms; disease suppressive soils; managing soil health
Financial support: Funding was provided by USDA National Institute of Food and Agriculture, Hatch project 1014527, as well as the Washington State University Emerging Research Issues grant program.

(3761 - 1110) Factors affecting the nematode community and microbial activity in the soil

Marek Renčo[1]; Andrea Čerevková[1]; Erika Gömöryová[2]; Gabriela Barančíková[3]; Erika Tobiašová[4]
Institute of Parasitology SAS, Hlinkova 3, 040 01 Košice, Slovakia[1]; Faculty of Forestry, Technical University in Zvolen, TG Masaryka 24, 960 53, Zvolen, Slovakia[2]; National Agriculture and Food Centre, Soil Science and Conservation Research Institute, Gagarinova 10, 827 13 Bratislava, Slovakia[3]; Slovak University of Agriculture, Department of Soil Science, Tr. A. Hlinku 2, 949 76 Nitra, Slovakia[4]

Nematode and microbial communities are integral parts of soil and their activity is very important to the functioning of soil. Both have a high level of species number and diversity, which is determined by set of environmental conditions. A better understanding of community characteristics among major ecosystem types is necessary before these can be applied to environmental analysis in regional and global scale. Nematode communities and microbial activity were thus measured in the three main soil types Cambisol (CS), Chernozem (CZ) and Stagnosol (SS). Soil samples were collected from undisturbed forests (F), relatively undisturbed permanent meadow (M) and disturbed agricultural lands (A) of all soil types three times per year. Seasonal fluctuation within communities was thus also investigated. The objectives of this study were to: 1) determine the variability in soil properties among and within forest, meadow and agricultural

ecosystems; 2) compare nematode communities and microbial activity among and within ecosystem and soil types; 3) determine if nematode community composition or community indices are able to differentiate soil and ecosystem types; 4) identify seasonal changes of nematode communities and microbial activity within ecosystem and soil types. Overall, the highest nematode numbers had CZ followed by CS and SS. Total nematode abundance differs among soil type within particular ecosystems as well among sampling time within ecosystems. In CZ, the highest nematode number was detected in A followed by F and M ecosystems; in CS (A, M and F); in SS (M, F and A). Results point out that ecosystem type was more important factor affecting nematode species occurrence and diversity than soil type. Different aspects of the presence and activities of microorganisms in the soil e.g. soil respiration, N mineralisation, microbial biomass carbon, catalase activity as well soil properties (pH, C, N content, C/N ratio) also demonstrated significant effect of ecosystem, soil type and season to communities.

Keywords: Ecosystem, soil type, biodiversity, nematode, microorganisms

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(5137 - 1196) From barley to maize: Exploiting the potential of genotype selection to optimize root-soil interactions

Lumbani Mwafulirwa[1]; Liz Baggs[1]; Joanne Russell[2]; Tim Daniell[3]; Jill Cairns[4]; Christian Thierfelder[4]; Nick Morley[5]; Eric Paterson[2]

University of Edinburgh[1]; The James Hutton Institute[2]; University of Sheffield[3]; CIMMYT Zimbabwe[4]; University of Aberdeen[5]

Root-soil interactions are central to C- and N-cycling in soil, and thus to greenhouse gas fluxes and nutrient supply supporting plant productivity. In our previous work on barley, we assessed the potential of root trait selection to promote C-storage and sustainable nutrient supply in soil. In planted experiments, using barley recombinant chromosome substitution lines developed using a wild donor and an elite cultivar, we demonstrated barley genotype-specific impacts on mineralization of native soil organic matter and crop residues mixed in soil, with direct impacts on N-uptake by plants. We also demonstrated a variation in root-C deposition, relative stabilization of this root-derived C in soil, and a strong plant genetic control and heritability of traits mediating the functioning of the barley microbiome. Furthermore, we have started to resolve the bases of genetic control of soil processes in barley, as a first step to manipulate C and N dynamics through germplasm selection and plant breeding. In combination these findings suggest strong potential for genotype selection and variety improvement in crop plants to support sustainable production systems. This concept was developed in a successful proposal to the UK Global Challenges Research Fund and we are now working to further exploit the potential of genotype microbiome interactions to promote sustainable soil health in the context of maize germplasm in southern Africa. Here we present key findings in barley and ongoing research in maize.

Keywords: Carbon and nitrogen cycling; sustainable soil health; root-soil-microbe interactions; variety selection

Financial support: Work in barley was funded by a James Hutton Institute international PhD studentship awarded to LM. Ongoing work in maize is supported by the UK BBSRC under the Global Challenges Research Fund.

(9306 - 941) Growth of *Cymbopogon citratus* inoculated with arbuscular mycorrhizal fungi *Rhizophagus clarus* and *Claroideoglomus etunicatum* under phosphorus levels

Caroline Lermen[1]; Rayane Monique Sete da Cruz[1]; Carlos Henrique de Souza Gonçalves[2]; Glaucia Leticia Sete da Cruz[2]; Giovana Penteado Amaral da Silva[2]; Luiz Renato Marques das Almas[2]; Odair Alberton[3]

Programa de Pós-graduação em Biotecnologia Aplicada à Agricultura; Universidade Paranaense – UNIPAR; Praça Mascarenhas de Moraes; 4282; 87502-210; Umuarama – PR – Brazil.[1]; Graduate students, Universidade Paranaense – UNIPAR; Praça Mascarenhas de Moraes; 4282; 87502-210; Umuarama – PR – Brazil.[2]; Programa de Pós-graduação em Biotecnologia Aplicada à Agricultura; Universidade Paranaense – UNIPAR; Praça Mascarenhas de Moraes; 4282; 87502-210; Umuarama – PR – Brazil, (presenter e-mail: odair@prof.unipar.br)[3]

Cymbopogon citratus Stapf (lemon grass) has high biological potential, which is availed by the perfume, food and pharmaceutical industries. Various factors may affect the metabolism of this plant, such as associations with arbuscular mycorrhizal fungi (AMF) that contribute to increases in water absorption and nutrient uptake (especially phosphorous – P). This study aimed at assessing the AMF symbiotic effect on nutrient uptake and growth of *Cymbopogon citratus,* inoculated with AMF *Rhizophagus clarus* and *Claroideoglomus etunicatum* under different levels of P in the substrate. Treatments were prepared with sterile substrate with high (200 mg kg^{-1}) and low (20 mg kg^{-1}) P levels and with and without AMF inoculation in a greenhouse experiment for six months. A 3 x 2 (3 mycorrhizal x 2 levels of P) factorial experiment in a completely randomized design (8 repetitions) was used in this study. Spore density and root AMF colonization, basal soil respiration (BSR), microbial biomass carbon (MBC), shoot dry matter (SDM), root dry matter (RDM), total dry matter (TDM), N content in the plant (N) and P content in the plant (P) were the variables and parameters analyzed in this assessment. Regardless P levels, no significant AMF symbiotic effect ($p > 0.05$) on the lemon grass growth was observed. The contents of P and N on the shoot and P total increased in the treatments with AMF and high P level, being more evident for the inoculation with *R. clarus*. Spore density, root colonization and MBC were higher with AMF inoculation. The AMF inoculation increased the contents of P and N in the *C. citratus*, but did not affect plant growth.

Keywords: Lemon grass; mycorrhiza; medicinal plants.

Financial support: Universidade Paranaense – UNIPAR e CNPq

(4442 - 676) Growth, nodulation and nutrient concentrations of lucerne in response to inoculation of abscular mycorrhizal fungus and rhizobium

Jianguo Huang[1]; Ling Yuan[1]

Southwest University[1]

Tropical and subtropical soils in South China are often acidic and nutrient deficient due to strong leaching and intensive cropping. Inoculation of rhizobia and arbuscular mycorrhizal fungi could be considered as one of important strategies to improve the growth and quality of lucerne in artificial cultivation. Therefore, a greenhouse pot experiment was conducted to evaluate the effects of rhizobial and mycorrhizal inoculation on growth, nodule formation, and nutrient uptake with lucerne (cv. Victoria) in an acid soil (pH 5.5). The experiment treatments included seedling alone (control, CK), *Sinorhizobium meliloti* inoculation (SM), *Glomus intraradices* inoculation (GI), and mixture inoculation of SM and GI (SM+GI) with factorial design with 6 replications. Lucerne showed the highest mean shoot biomass of about 28 g in SM+GI, followed by SM (24.5 g), GI (22.3 g), and CK with about 20 g $seedling^{-1}$ (fresh weight). There were no nodules found on the roots of seedlings in both CK and GI, but more nodules formed in SM+GI than SM, implying the promotion of nodule formation by GI at the presence of SM. Phosphorus concentrations in lucerne shoots varied in the sequence: GI and SM+GI > MS > CK (no significant difference between GI and SM+GI), which confirmed the fact that mycorrhizal infection increases phosphors uptake. Compared with other treatments, lucerne shoots contained the highest N in

SM+GI, indicating higher protein content. Therefore, mixture inoculation could be a better strategy than either *G. intraradices* inoculation or *S. meliloti* to enhance Lucerne yield and quality in acid soils.

Keywords: rhizobia,abuscular mycorrhial fungi, lucerne
Financial support:

(7980 - 1991) Hydric stress resistant bacteria associated with Pitaya plants rhizosphere (Hylocereus undatus)

Silva, E.L.D.[1]; Isidio, E.L[1]; Freitas, C.G.G[1]; Carvalho, A.S[1]; Teixeira, M.F[1]; Silva, J.M.M[1]; Amorim, A.S[1]; Kuklinsky-Sobral, J[1]
Federal Rural University Of Pernambuco / Garanhuns Academic Unit (Av. Bom Pastor, Cep: 555292-270, Garanhuns-Pe, Brazil).[1]

For the establishment of sustainable agriculture, we need to better understand the dynamics of the relationship between micro-organisms, soil and plant. As water is a fundamental resource, both for plant and for micro-organisms, providing their biochemical activities, and the scarcity of it can become a problem for the production of food. Some plant cultures, such as Pitaya (Hylocereus undatus), have developed evolutionary mechanisms to withstand under water deficit conditions. It is speculated that bacteria present in soil microbiota, or in interaction with the plant, can contribute to plant development, including in these stressful situations, and may be important in the survival and growth of plants in dry environments. Therefore, the present work aims to isolate and evaluate the bacterial population density, total and resistant to the hydric stress, associated to Pitaya plants. Experiments were carried out to isolate bacteria from the rhizosphere and endophytic of cladodes in TSA 10% culture medium and amid hydric stress (plus sorbitol, providing water activity of 0.963 Aw, at 25 °C). Three Pitaya plants were used, cultivated in Garanhuns, Pernambuco, Brazil, and three homogeneous composite samples were collected from the rhizosphere and a cladode of each plant. Population density was estimated after 15 days of cultivation of isolation. It was observed that Pitaya plants present association with rhizosphere bacteria resistant to the hydric stress, with high indices of population density (10^8 to 10^{10} UFC.mL^{-1}), not differing between the means of culture medium used. However, in the cladodes samples evaluated, there was no bacterial growth wit h the methodology used for the isolation of endophytic bacteria. The refore, rhizosphere bacteria associated with Pitaya present potential for future studies of hydric stress.

Keywords: Key words: water deficit, bacteria-plant interaction, cactus.
Financial support: MEC/Sesu – Tutorial Education Program – PET Biotecnologia

(4367 - 677) *In vitro* effect of berberine on soil nitrification

Ling Yuan[1]; Jianguo Huang[1]
Southwest University[1]

Coptis chinensis is a medicine herb in family Ranunculaceae which has been used traditionally as bactericides to treat intestinal infection of human and animals for many centuries in East and Southeast Asia. This medicine plant is now grown commercially but cannot be grown successively in same soil due to autotoxicity and serious diseases. During the growing period, *Coptis chinensis* released numerous allelochemicals into soils. Berberine is the largest contributor of these chemicals, accounting for about 80% of the total allelochemicals entering soils. Thus, a purplish soil was incubated to compare microbial biomass, dehydrogenase activity, nitrification, and bacterial community structures with different concentrations of berberine (without berberine, CK; 10 mg/kg soil, LB; and 20 mg/kg soil, HB). This compound, particularly at HB, decreased significantly soil microbial biomass carbon and nitrogen, dehydrogenase activity, and nitrate content after 4 week incubation. Addition of berberine into soil solutions also decreased the nitrate concentration but showed relatively more nitrate accumulation in soil solution with potassium nitrite than with ammonia sulphate, implying stronger inhibition of ammonia-oxidizing bacteria or ammonia-oxidizing archaea than *Nitrobacter* or *Nitrospira*. The nitrification inhibition could thus be one of mechanisms for the obstacles produced by the cultivation of *Coptis chinensis*. There were 13012, 10657, and 9005 16S rDNA sequences picked up from soils of CK, LB, and HB, respectively, by high throughput sequencing, which were attributed into 562 (CK), 405 (LB), 314 bacterial phylotypes (HB). Berberine could inhibit growth, reproduction, and activity of some bacteria, including those responsible for nitrification. Soils received berberine showed lower bacterial richness and diversity indexes than CK. Less group and number of bacteria present in soils could encourage over reproduction of any single bacterial taxon and thus increase the risk of plant disease occurrence in successive *Coptis chinensis* cultivation.

Keywords: *Coptis chinensis*; berberine; allelochemicals; bacteria; nitrification
Financial support:

(7681 - 2332) Isolation and characterization of rhizobacteria solubilizers of inorganic phosphates in sugarcane (*Saccharum officinarum L.*).

Crísea Cristina Nascimento de Cristo[1]; Yamina Coentro Montaldo[2]; Tania Marta Carvalho dos Santos[2]; João Manoel da Silva[2]; Jose Ubaldo Lima de Oliveira[2]
Universidade Federal de Alagoas / Instituto Federal de Alagoas[1]; Universidade Federal de Alagoas[2]

Phosphorus is one of the elements most required by agricultural crops, however the availability of this nutrient in the soil for plants is limited, requiring the addition of a large amount of synthetic fertilizers, which in addition to the high cost lead to the degradation of environmental resources, contributing to an agriculture that is increasingly dependent on inputs. Considering the concerns inherent in the production of food with less harmful managements in the environment, the objective of this study was to isolate plant growth promoting bacteria from the soil present in the sugarcane rhizosphere to produce microbial inoculants capable of solubilizing phosphate. Soil samples were collected in areas of sugar and alcohol plants in the state of Alagoas, from April to June 2016. Twenty-four collections were made, and a soil sample for each sugarcane plant. the samples were sent to the laboratory de microbiologia agrícola, at the Agricultural Sciences Center – Universidade federal de Alagoas, Bacteria were isolated, identified and underwent qualitative and quantitative evaluation in order to test their potential for solubilization of inorganic phosphates ($Ca_3(PO_4)_2$). The results demontrated that the isolates, with the exception of isolate 4, presented characteristics for the availability of inorganic phosphorus, promoting plant growth, which suggests the biotechnological potential of these isolates. The use of these isolates may reduce or avoid the use of synthetic fertilizers and should be considered future inoculation tests in plants.

Keywords: Phosphate Solubilization, Bioprospecting, Biotecnology.
Financial support: Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES)

(7130 - 2930) Legume-nodulating rhizobia are maize endophytes in Brazilian Semi-Arid

Maria Idaline Pessoa Cavalcanti[1]; Dalila Ribeiro Rodrigues[2]; Adailson Pereira de Souza[3]; Paulo Ivan Fernandes-Júnior[4]
Universidade Estadual da Paraíba/Universidade Federal da Paraíba[1]; Universidade Estadual da Paraíba[2]; Universidade Federal da Paraíba[3]; Embrapa Semiárido[4]

The isolation and characterization of plant growth promoting bacteria (PGPB) for maize (*Zea mays*) are important for the obtainment of efficient bacteria that can be used as new inoculant strains. The isolation and selection of PGPB for non-legumes have been carried out worldwide using the standard N-free semi-solid media, allowing the obtainment of efficient diazotrophic isolates. In the last few years, new approaches have been developed to obtain and characterize other cultivable endophytic bacteria. There is the evidence for the existence of endophytic rhizobial communities in maize roots. To evaluate if in soils from Brazilian Semi-Arid the field-grown maize is colonized by legume nodulating rhizobia, we carried out the isolation of maize endophytic rhizobia (MER) by means of inoculation of surface-disinfected plant extracts on cowpea (*Vigna unguiculata*) seeds in axenic conditions. The maize roots were surface-disinfected with NaClO (2% v/v) and washed eight times in autoclaved water. The last water was inoculated in YMA culture medium to assure the absence of of surface contaminants. The disinfected roots were crushed in NaCl 0.85 % (w/v) and inoculated in surface-disinfected cowpea (BRS Pujante) seeds sowed in sterilized sand. Cowpea was grown for 35 days and were harvested. The rhizobia were isolated in a standard YMA medium and identified through the sequencing of 16S rRNA. The absence of nodules in the control treatments end the negative growth bacteria in the wash water inoculated in YMA medium indicated that the nodules observed were induced by the bacteria from inhabiting the inner of maize roots. A total of 13 bacteria were isolated, and among them, 10 isolates was fast growing and 3 was slow growers with typical rhizobial colonies characteristics. The 16S rRNA sequences showed that the fast growers were classified as *Rhizobium*, mainly within the *R. tropici* clade, close to *R. calliandrae*. The and slow-growing bacteria belonged to *Bradyrhizobium* genus within *B. japonicum* clade. These results indicate the endophytic colonization of maize roots by legume-nodulating rhizobia.

Keywords: Maize endophytic rhizobia Bradyrhizobium Rhizobium Plant growth promoting bacteria Inoculant
Financial support: CNPq; Capes and Embrapa

(7154 - 435) Lima bean nodulates efficiently with *Bradyrhizobium* strains isolated from diverse legume species

Elaine Martins da Costa[1]; Paula Rose de Almeida Ribeiro[2]; Wellington de Lima[2]; Thiago Palhares Farias[2]; Fatima Maria de Souza Moreira[2]
Federal University of Piaui[1]; Federal University of Lavras[2]

Lima bean (*Phaseolus lunatus* L.) is an important legume species that establishes symbiosis with rhizobia, mainly of the *Bradyrhizobium* genus. The aim of this study was to evaluate the efficiency of rhizobia of the genus *Bradyrhizobium* in symbiosis with lima bean, in both Leonard jars and in pots with a Latossolo Amarelo distrófico (Oxisol). In the experiment in Leonard jars, 17 strains isolated from nodules of the three legume subfamilies, Papilionoideae (*Vigna unguiculata*, *Pterocarpus* sp., *Macroptilium atropurpureum*, *Swartzia* sp., and *Glycine max*), Mimosoideae (*Inga* sp.) and Caesalpinioideae (*Campsiandra surinamensis*) and two uninoculated controls, one with a low concentration (5.25 mg L^{-1}) and another with a high concentration (52.5 mg L^{-1}) of mineral nitrogen (N) were evaluated. The six strains that exhibited the highest efficiency in Leonard jars, isolated from nodules of *Vigna unguiculata* (UFLA 03-144, UFLA 03-84, and UFLA 03-150), *Campsiandra surinamensis* (INPA 104A), Inga sp. (INPA 54B) and *Swartzia* sp. (INPA 86A), were compared to two uninoculated controls, one without and another with 300 mg N dm^{-3} (NH_4NO_3) applied to pots with samples of an Oxisol in the presence and absence of liming. In this experiment, liming did not affect nodulation and plant growth; the INPA 54B and INPA 86A strains stood out in terms of shoot dry matter production and provided increases of approximately 48% in shoot N accumulation compared to the native rhizobia populations. Our study is the first to indicate *Bradyrhizobium* strains isolated from the three legume subfamilies are able to promote lima bean growth via biological nitrogen fixation in soil conditions.

Keywords: *Phaseolus lunatus* L.; biological nitrogen fixation; symbiosis
Financial support: CNPq and CAPES

(6016 - 1115) Microaerophilic iron-oxidizing bacterial community in the bulk soil and rhizosphere of paddy field

Kento Kato, Tatsushi Naruse[1]; Yoshinori Ban[2]; Tomofumi Yoshida[2]; Taketo Funao[2]; Takahiro Kato[2]; Mari Namikawa[3]; Tomoki Takahashi[3]; Mizuhiko Nishida[3]; Susumu Asakawa[4]; Takeshi Watanabe[4]
School of Agricultural Sciences, Nagoya University, Nagoya 464-8601, Japan[1]; Field Crop Division, Aichi Agricultural Research Center, Anjo, Aichi 446-0066, Japan[2]; Tohoku Agricultural Research Center, NARO, Daisen, Akita 014-0202, Japan[3]; Graduate School of Bioagricultural Sciences, Nagoya University, Nagoya 464-8601, Japan[4]

Redox cycling of iron (Fe) is the central processes in the biogeochemistry of paddy field soil. Although redox process of Fe is mediated by both abiotic and biotic reactions, significance of biotic Fe oxidation had not been recognized in paddy field soil. However, we previously observed Fe-oxides deposited microbial colonies on paddy soil surface under microaerobic conditions, in which microaerophilic Fe-oxidizing bacteria (FeOB) related to *Gallionella ferruginea* and '*Sideroxydans*' spp. were enriched. We recently isolated a novel microaerophilic FeOB in the family *Gallionellaceae*, *Ferrisolum kumadai* An22, from a paddy field. These findings suggested that *Gallionella*-related FeOB have a potential to participate in the Fe-oxidizing process in paddy field soil. However, their diversity and community dynamics have been unknown. The present study investigated the community structure of *Gallionella*-related FeOB in the bulk soil and rhizosphere of paddy field soils. A primer set targeting 16S rRNA gene of *Gallionella*-related FeOB was successfully developed for the qPCR and PCR-DGGE analyses. Bulk soil samples, which were periodically collected from two paddy fields, rhizosphere soil and roots samples from a paddy field were subjected to the analyses. DGGE analysis of the bulk soil community of two paddy fields showed seasonal shifts of the patterns, that is, the community structures were changed after flooding and drainage. All of the DGGE bands were affiliated within the *Gallionellaceae*, some of which were related to known microaerophilic FeOB, *G. ferruginea*, *F. kumadai*, '*S. lithotrophicus*' and '*S. paludicola*'. qPCR analysis detected 10^5–10^8 copies of the 16S rRNA gene g^{-1} dry soil and the numbers were negatively correlated to the abundance of acetate-extractable ferrous Fe in the soils during the rice cultivation period. The community structure of rice rhizosphere soil was not largely different from that of the bulk soil and didn't change between the tillering and flowering stages, while some FeOB predominantly inhabited the roots. The numbers of 16S rRNA genes were ca. 10^6 copies g^{-1} dry soil in the both bulk and rhizosphere soils in the both stages, while the number was ca. 10^8 copies g^{-1} dry roots. These results indicated inhabitance of considerable number of diverse *Gallionella*-related FeOB in the paddy fields and their involvement in the Fe-oxidizing process, especially during the rice cultivation period.

Keywords: Iron-oxidizing bacteria, paddy field, denaturing gradient gel electrophoresis, qPCR
Financial support: The Japan Prize Foundation, Tokyo, Japan, Institute for Fermentation, Osaka, Japan and JSPS KAKENHI (16H05056 and 17H04619)

(7659 - 3178) pH and extracellular flux of protons in hyphae of *Pisolithus albus* and *Pisolithus tinctorius* grown at different doses of solid particulate iron material

Isabelle Faria Matos[1]; Vivian Ribeiro Pimentel[1]; Alessandro Coutinho Ramos[1]

State University of Northern Fluminense[1]

Due to the large amount of ores exported from the country, there is an intense production of residues such as solid particulate matter (SPM), which consists of a substance subdivided into tiny fractions, small enough to be suspended and carried by the wind in the form of aerosol. The solid particulate material of Fe (SPMFe) affects plants either by physical mechanisms, by disturbing the radiation balance, or by chemical mechanisms, by leaching nutrients from leaves and by affecting pH, nutritional status, and microbiota from soil. In places where acid rain occurs, the availability of Fe2+ increases, leading to a higher accumulation of this metal in the plant tissue. Mycorrhizae are symbiotic fungi that can protect plants against metal toxicity due to their tolerance mechanisms. These fungi also promote plant growth, as they provide plants with a greater ability to obtain nutrients and water. In view of these and other characteristics, mycorrhizal fungi are organisms with a great bioremediation potential, allowing the recovery of areas contaminated with SPMFe. In this context, the objective of this work was to evaluate the proton flux and surface pH in the mycelium of two species of ectomycorrhizal fungi exposed to SPMFe. The ectomycorrhizal fungi, *Pisolithus tinctorius* and *Pisolithus albus*, were grown for 5 days in MMN medium with agar addition, containing three concentrations of SPMFe: 0.0; 4.0 and 8.0 g L-1. Then, the proton extracellular flow and the pH in the fungal mycelium were measured using a proton-selective vibrating microprobe system. In addition, the same fungi were also grown in MMN medium, without agar addition, in the presence of the same concentrations of SPMFe, for 25 days and, afterwards, the dry mass of the fungal mycelium and the profile of organic acids exuded in the culture medium were analyzed. The species presented antagonistic responses in relation to the proton flux, as well as in relation to dry biomass, showing that although they belonged to the same genus, the species present different responses in the stress condition by SPMFe.

Keywords: Ectomycorrhizae, fungi, heavy metal, SIET, H+-ATPase.
Financial support: Carlos Chagas Filho Foundation for Research Support of the State of Rio de Janeiro

(1262 - 2268) Phosphate solubilization by fungi under saline stress

Laura Vieira Xavier[1]; Glécia Junia dos Santos Carmo[1]; Kamila Fernanda Rossati[1]; Larissa Lara Rocha[1]; Vinícius Amaral[1]; Gilberto de Oliveira Mendes[1]

Universidade Federal de Uberlândia[1]

Phosphorus (P) is a limiting nutrient in tropical croplands due to the high P-fixing capacity of most soils in these areas. Phosphate-solubilizing microorganisms (PSM) can improve P availability to plants by releasing acids in the soil and, thus, solubilizing sparingly-soluble phosphate minerals. However, the continuous application of mineral fertilizers in croplands can increase soil salinity and possibly impair the activity of PSM. Thus, the present work aimed at evaluating the phosphate solubilization by *Penicillium islandicum* and *Aspergillus niger* under distinct levels of salinity. The assay was performed in 250-mL Erlenmeyer flasks with 100 mL of culture medium [50 g $Ca_3(PO_4)_2$, 10 g glucose, 5 g $MgCl_2 \cdot 6H_2O$, 0.25 g $MgSO_4 \cdot 7H_2O$, 0.2 g KCl, 0.1 g $(NH_4)_2SO_4$, 1 L distilled water, pH 7]. Saline stress was imposed by addition of NaCl at concentrations of 0, 2.5, 5, 7.5, and 10% (m/v). The flasks were sterilized by autoclaving, inoculated with three mycelium disks of each fungus, and incubated in an orbital shaker during seven days at 150 rpm and 30 °C. The experiment was set up under a completely randomized design with three repetitions by treatment. After the incubation period, the spent medium was filtered and analyzed for pH and soluble P. *Aspergillus niger* achieved the highest concentrations of soluble P in the medium (1539 mg L^{-1}) and the lowest pH (2.3). However, this fungus was more sensitive to increasing salt concentrations (Soluble P = 1539 – 127 [NaCl], R^2 = 0.77) than *P. islandicum* (Soluble P = 711 + 33.8 [NaCl] – 6.8 [NaCl]², R^2 = 0.92). Salt concentrations of up to 5% did not decrease significantly the concentration of P solubilized by *P. islandicum*, and pH of the medium was similar for all salt concentrations (4.4 on average). At the highest salinity level (10%), the solubilization was decreased by nearly 80 and 50% for *A. niger* and *P. islandicum*, respectively. These data suggest that *P. islandicum* could be a promising option for the development of PSM inoculants for saline soils or even for direct mixture with mineral fertilizers.

Keywords: Phosphorus, salinity, microbiology, phosphate.
Financial support: FAPEMIG, CNPq

(6262 - 2135) Phosphate-solubilizing bacteria associated with soil and rhizosphere of cassava (*Manihot esculenta*).

Erivaldo Lopes Isidio[1]; Everlaine Leopoldino Dias Silva[1]; Anderson Silva De Carvalho[1]; Caio Cesar Gomes Freitas[1]; Jose Maciel Mariano Da Silva[1]; Marcos Ferreira Teixeira[1]; Alyson Da Silva Amorim[1]; Julia Kuklinsky Sobral[1]

Universidade Federal Rural de Pernambuco - Unidade Acadêmica de Garanhuns[1]

The existing microorganisms in the soil are responsible either directly or indirectly, by numerous biological processes with great importance for the functioning and productive capacity of terrestrial ecosystems. The phosphorus is the second most important element for plants. However, the brazilian soil has a deficiency of soluble phosphorus. The use of phosphate by plants can be leveraged with the activity of phosphate-solubilizing bacteria (PSB), contributing in this way to plant growth. Therefore, the objective of this work was to isolate and evaluate the total bacterial population density and PSB in soil without cultivation, with cultivation and rhizosphere of cassava (*Manihot esculenta*). Were used three cassava plants, cultivated in Garanhuns, Agreste Pernambucano, Brazil. Three homogeneous samples were collected from the rhizosphere, soil cultivated in the spacing of planting and soil without cultivation of nearby area without the presence of culture. The bacteria were isolated in culture medium containing calcium phosphate insoluble and the population density was estimated after 15 days of cultivation of isolation. It was observed that the cultivated soil and rhizosphere showed the highest population densities of bacteria (10^8 to 10^9 CFU.mL^{-1}), including the able to solubilize phosphate. However, the soil without manioc cultivation also exhibited phosphate-solubilizing bacteria, at a density of 10^9 CFU.mL^{-1}. Therefore, the bacteria isolated from soil under cultivation of cassava and from rhizosphere have potential for studies of plant growth promotion.

Keywords: Bacteria-plant interaction, phosphorus, plant growth
Financial support: MEC/Sesu – Programa de Educação Tutorial

(3020 - 1799) Phosphorus spatial distribution and speciation using low energy µ-XRF and µ-XANES in the rhizosphere of an artificial soil experiment

Luis Carlos Colocho Hurtarte[1]; Andreas Kling[2]; Markus Drechsler[3]; Thomas Huthwecker[4]; Jurgen Thieme[5]; Jorg Prietzel[1]

Technische Universitaet Muenchen[1]; Ludwig-Maximilians-Universität München[2]; Universitaet Bayereuth[3]; Paul Scherrer Institut[4]; Brookhaven National Laboratory[5]

Phosphorus (P) is an essential element for life, with cellular functions ranging from energy transport to being a structural and genetic material component. In many terrestrial ecosystems around the

world, P is a limiting factor for plant growth and biomass productivity, thus ultimately influencing the global carbon balance. Plants can thrive in many terrestrial ecosystems by mining and cycling organic and inorganic P forms in soils. There is still a substantial gap of knowledge with respect to the major pathways of P mobilization from soil minerals and aggregates by plant roots, which handicaps a thorough understanding of the P dynamics in the rhizosphere. The gap is due to the difficulty of accurately probing the rhizosphere, as traditional techniques are unable to resolve the distribution of different P forms and at the same time identify major P-bearing compounds in the soil matrix with high spatial resolution. In this work, we address these gaps by analyzing the soil-root interface of microaggregates of an artificial soil experiment in which *Picea abies* seedlings were grown. The artificial soils were composed of Al saturated Montmorillonite (Al-MT), Calcite, hydroxyapatite or a mixture of either Al-MT and Calcite or Al-MT and apatite, these mixtures where diluted to 5% w/w. Thus, recreating artificial soils derived of calcareous material. The seeds of Picea abies were sown in the artificial soils, with 7 repetitions of each treatment, including a non-planted treatment. After 4 months, the seedlings were cut and the above ground biomass grinded in N2 and analyzed for major elements. The soil solution was sampled and analyzed for organic acids and the root arquitecture analyzed using WhinRhizo. Sections of the root were cryo-freezed by High Pressure Freezing and sectioned. The thin sections were later taken to the PHOENIX X07MA/B beamline at the Paul Scherrer Institut where low energy µ-XRF and µ-XANES spectroscopy at low temperatures was carried out. We analyzed regions of interest (ROIs) of 40 x 40 µm² previously selected. The ROIs were scanned across the energies of C, Si, P, Al, Ca ("element mapping"). Overall, we have observed distinct P spatial distribution and speciation on the different artificial soils through µ-XRF and µ-XANES, mainly due plants actively affecting its surrounding soil. Low-energy µ-XRF and µ-XANES allowed simultaneously localize C and P in the soil matrix and the speciation of P in points of interest.

Keywords: XANES, phosphorus, rhizosphere
Financial support: DFG

(7944 - 2411) Poor seed germination and seedling emergence of wet-direct seeded rice seeds are partly induced by several aromatic carboxylic acids produced in the submerged soil

Shinsuke Mori[1]; Futa Sakakibara[2]; Kenichi Yamazaki[2]; Kazuhiro Takagi[2]; Gen Ishioka[1]; Kazuo Soeno[1]; Daigo Abe[1]
NARO WARC[1]; NARO NIAES[2]

Among the systems for cultivating rice (*Oryza sativa* L.), the direct seeding method is becoming more popular globally than the seedling transplant method due to lower labor and time requirements. However, this cultivation technique has experienced limited use in Japan due to poor seedling emergence and establishment. Our previous results suggested that poor seed germination and seedling emergence of rice plants are induced by the drastic decrease in the soil oxidation-reduction potential(ORP) around direct-seeded rice seeds under the submerged soil conditions with organic matter. However, its precise inhibition mechanisms have not elucidated yet. Here, we report that several aromatic carboxylic acids produced under low ORP conditions can be inhibitors of seed germination and seedling emergence of the wet-direct seeded rice seeds. The objectives in this study were as follows: (1) to reexamine seedling emergence under submerged soil conditions with or without straw. (2) to identify several aroma carboxylic acids produced in the submerged soil. (3) to examine effect of several aroma carboxylic acids on seed germination and coleoptile elongation. When rice seeds were directly sown at 1cm depth under the submerged soil conditions with or without straw, the seedling emergence rate were approximately 10% and 60%, respectively. Furthermore, seed germination and coleoptile elongation were also inhibited by the solution extracted from submerged soil incubated with straw, compared with that without straw. These results suggested that some chemical substances produced in submerged soil incubated with straw inhibited seed germination and seedling emergence. Several unknown organic acid peaks in the soil solution were detected by TQD-UPLC-MS/MS analysis. We finally identified several organic acids as benzoic acid, salicylic acid, phenyl lactic acid, phenyl acetic acid, 3-phenylpropionic acid and others. Additionally, our results elucidated that some aroma carboxylic acids delay seed germination and coleoptile elongation and other organic acids promote seed germination and coleoptile elongation. We will discuss presumed inhibition mechanisms of seed germination and seedling emergence of the wet direct seeded rice.

Keywords: wet-direct rice seeding, poor seedling emergence, organic matter and aroma carboxylic acid
Financial support:

(8103 - 1331) Soil carbon cycling enzymes in ectomycorrhizal fungi under heavy metal stress

Gilka Rocha Vasconcelos da Silva[1]; Vinicius Henrique De Oliveira[2]; Mark Tibbett[2]

Centre for Agri-Environmental Research, School of Agriculture, Policy and Development, University of Reading, Whiteknights, PO Box 217, Reading, Berkshire, RG6 6AH, United Kingdom (g.r.v.dasilva@pgr.reading.ac.uk)[1]; Centre for Agri-Environmental Research, School of Agriculture, Policy and Development, University of Reading, Whiteknights, PO Box 217, Reading, Berkshire, RG6 6AH, United Kingdom[2]

Ectomycorrhizal fungi extend from root to rhizosphere and into the bulk soil. Despite receiving carbon from the autotrophic partner, these fungi have the capacity to access carbon and associated nutrients and from soil by decomposing soil organic residues. As the balance between heterotrophic fungi and these root symbiotic fungi is predicted to shift under climate change scenarios, we were interested to investigate capacity to degrade carbonaceous compounds found in soils. Hence, our objective in this study was to identify the most prolific soil carbon degrading exo-enzymes produced by ectomycorrhizal fungi, which are exuded into the soil solution. We were interested in the relative activities of enzymes that are involved in the breakdown of a range of soil carbon compounds, under unstressed and stressed conditions. The key carbon cycling enzymes we measured were cellulase, cellobiohydrolase, xylanase, mannisidase, galactosidase, arabinosidase, manganese peroxidase and lignase. Enzymes assays were conducted on 12 strain of ectomycorrhizal fungi of species from the basidiomycota and the ascomycota. Fungi were subjected to stress with the amendments of metals (Zn, Cd) at sub-lethal but toxic concentration. The results showed a differential responses of different fungal species to carbon cycling enzymes. Heavy metal stressed ectomycorrhizal fungi had a tendency to produce different amounts of enzyme to unstressed treatments, and enzyme activities were typically repressed under stressed conditions. These finding are discussed in the context of soil carbon cycling in soils and the interactions with metal contaminants.

Keywords: heavy metal; carbon cycling; enzymes; ectomycorrhizal fungi
Financial support:

(9404 - 698) Soil chemical changes after annual pasture species cultivated as mono- and intercrop and in response to phosphorus fertilization

Ana Cristina Martins Boucho[1]; Corina Carranca[1]; Manuel V. Madeira[2]
INIAV[1]; ISA/UL[2]

In Mediterranean areas, sustainable production of rainfed pastures is associated with plant species which withstand low soil fertility and variable annual drought conditions, phosphorus (P) being the primary

limiting nutrient for legume growth and N_2 fixation. A study was undertaken to compare the response of subclover and a new pasture legume (pink serradela) to P supply, in terms of biomass, nodulation pattern, N_2 fixation, P use efficiency and soil chemical changes, using a moderately acid soil, very poor in extractable P. Three pasture species (ryegrass, suclover and pink serradela) were cultivated in pots, under controlled environmental conditions, as monocrop or intercrop and fertilized with four P rates (P0 = 0; P1 = 30; P2 = 60; P3 = 90 kg P ha^{-1}), with four replicates. In the present study, results regarding changes in soil chemical properties are shown. After 103 days of growth (beginning of flowering by pink serradela), a declining of soil pH and exchangeable base cations (Ca^{2+} and Mg^{2+}) was observed, especially under the well nodulated pink serradela. The decreasing of soil pH was accompanied by the increase of legumes biomass, nodules number, N_2 fixation and P-uptake. Unlike, soil organic C decreased after sole and intercrop pink serradela cultivation possibly by its greatest mycorrhization and N_2 fixation rate compared to subclover, with a consequent lower root C exudation. Soil acidity and the level of base cations, and the extractable P concentration revealed to be good indicators for assessment of soil quality status following the installation of improved pastures (with leguminous species). On the contrary, total soil N and non-humified C fraction did not vary with crop species, cultivation system, and P fertilization. Results suggest that more productive and efficient N_2-fixing plants have stronger negative effects regarding soil acidity and base status. Future research, including long-term field studies in different environmental conditions are recommended to confirm present findings, by the presence of studied and other pasture legumes.

Keywords: Exchangeable acidity, exchangeable base cations, extractable P and K, organic carbon, soil pH.
Financial support:

(9226 - 926) Soil macrofauna in arboreal caatinga area managed at the southwest of Bahia

Priscila Silva Matos[1]; Patrícia A. Bittencourt Barreto-Garcia[2]; Rafael Nogueira Scoriza[2]; Mariana dos Santos Nascimento[2]
UFRRJ[1]; UESB[2]

Forest management can lead to numerous changes in the composition and diversity of soil organisms as a result of changes in habitat, food supply, microclimate and intra and interspecific competition. Among the most affected soil organisms, the set of invertebrates that belongs to the macrofauna plays an important role in the system's functionality. These organisms act mainly in the fragmentation of organic matter, nutrient cycling and physical structuring of the soil. In this context, the objective of this study was to evaluate the influence of different types of forest management on the edaphic macrofauna community. The experiment was carried out at National forest Contendas do Sincorá, located at the Southwest region of the state of Bahia. The experimental area consisted of 32 plots of 20 x 20 m, consisting of eight replicates of the following treatments: shallow cut, selective cut of trees with diameter at breast height ≥ 5 cm), selective cut of three species (*Commiphora leptophloeos*, *Pseudobombax simplicifoliu* and *Jatropha mollisima*) and control (unmanaged caatinga). The edaphic macrofauna was sampled by the soil monolith method, in two seasons of the year. The densities, total number of individuals, total wealth, average wealth and the rates of Shannon and Pielou were estimated. The macrofauna of the soil showed to be sensitive to the different practices of forest management, evidencing that the selective cuts are more conservationist systems of use of the Caatinga. Among these, the selective cut by species is more favorable to the maintenance of the fauna of the soil. Both in the Caatinga managed as in the control, the predominant groups in the edaphic fauna were Isoptera, Formicidae, Coleoptera and Chilopoda larvae.

Keywords: soil organisms, sustainable exploitation, diversity of invertebrates
Financial support: CAPES, CNPq

(5982 - 1995) Solubilization of inorganic phosphate by the bacterium UAGF14 *Pseudomonas mosselli* under hydric stress, saline stress and different carbon sources.

Silva, J.M.M.[1]; Teixeira, M.F.[1]; Freitas, C.C.G.[1]; Silva, E.L.D.[1]; Isidio, E.L.[1]; Carvalho, A.S.[1]; Amorim, A.S.[1]; Kuklinsky-Sobral, J.[1]
Universidade Federal Rural De Pernambuco - Unidade Acadêmica De Garanhuns / UFRPE-UAG[1]

Brazilian agricultural soils are subject to adverse conditions, such as water deficit, salinity, nutritional deficiency, decreasing the production of agricultural crops. Some nutrients, such as phosphorus, are essential for plant development, but they are not always assimilable in the soil for plants. Several bacteria of the genus *Pseudomonas*, when associated with plants, have the ability to solubilize inorganic phosphates, making phosphorus available to plants. Therefore, the present work aimed to analyze the bacterium *Pseudomonas mosselli* UAGF14, sugarcane endophytic, as to its capacity to solubilize inorganic phosphate under hydric stress, saline stress and in different carbon sources. For analysis of phosphate solubilization (PS) under hydric stress, the bacterial strain was inoculated in culture medium containing insoluble calcium phosphate (MP) with 285 $g \cdot L^{-1}$ of sorbitol, providing water activity of 0.963 A_w at 25°C. For the SF under saline stress, MP was supplemented with 0%, 1%, 2.5%, 5.0%, and 7.5% NaCl. For the SF under different sources of carbon, the MP was added 1% of: glucose, sucrose and mannitol, regardless. The treatments were incubated at 25ºC for 17 days, totalizing 5 readings. Then, the solubilization index (SI) was calculated, expressed by the ratio of the mean diameter of the solubilization halo to the mean halo diameter of the colony. It was observed that the UAGF14 strain of *P. mosselli* was not able to solubilize the inorganic phosphate under conditions of hydric stress. However, under saline stress, the bacterium presented prominence in the concentrations of 0%; 1% and 2.5% NaCl. Regarding the different carbon sources, UAGF14 presented SI in the presence of glucose and mannitol. However, when sucrose was used, the strain was not able to solubilize. From mode, concludes that the UAGF14 *P. mosselli* presents variations in the expression of the capacity to solubilize inorganic phosphate as a function of the available carbon source, and responds well to saline stress but not to hydric stress. Therefore, the UAGF14 strain may be better exploited for experiments to promote plant growth under saline stress conditions.

Keywords: bacteria-plant interaction, phosphorus, salinity.
Financial support: MEC/Sesu – Tutorial Education Program – PET Biotecnologia

(7529 - 2676) Symbiotic capacity and plant growth promotion by bacteria isolated from nodules of Mimosa spp. in ultramafic soils

Kelly Alves de Sousa[1]; Leide Rovenia Miranda de Andrade[2]; Iêda de Carvalho Mendes[2]; Fábio Bueno dos Reis Junior[2]
União Pioneira de Integração Social -UPIS[1]; Embrapa Cerrados[2]

Ultramafic soils are characterized by excess of potentially toxic heavy metals, such as cobalt, chromium, copper and nickel, as well as low availability of nutrients, such as calcium, phosphorus and nitrogen, resulting in a strong mineral imbalance. In Brazil, ultramafic massifs from the state of Goiás (GO) have great economic importance due to the intense mining activity in these areas. These mining operations result in degradation of extensive areas of native vegetation. Studies on the occurrence and characterization of diazotrophic bacteria in symbiosis with native legumes from this environment may be an important part of strategies to be applied in programs that aim at environmental conservation and recovery of degraded areas, as is

already being done in areas from the Amazon and the Atlantic forest. For Cerrado conditions, especially in mining areas, there are very few studies in this field. The objective of this work was to evaluate the symbiotic capacity and plant growth promotion potential of bacteria isolated from nodules of Mimosa spp. from the ultramafic massif of Barro Alto (GO). Bacteria were isolated from nodules of native plants (M. clausenii and M. somnians) growing in previously selected areas, which were divided into two categories according to the Ni concentration and its bioavailability in soil. A greenhouse experiment was carried out and 13 different bacterial isolates were tested. The bacteria were inoculated in seeds of M. pudica and after a period of 60 days the dry mass of nodules and the increment of roots and aerial part dry matter were evaluated. The inoculated plants were compared with controls without inoculation and with nitrogen fertilization. Isolates of Paraburkholderia tuberum, a beta-rhizobium, showed symbiotic capacity and differential growth promotion potential. Isolates W41, W84 and W38 can be highlighted since the plants inoculated with these bacteria produced approximately four times more roots and fourteen times more shoots than the uninoculated control plants. These results suggest that in the future this symbiosis could be used as part of a program for recovery of ultramafic soil areas degraded by mining activity.

Keywords: Biological nitrogen fixation; beta-rhizobia; Burkholderia spp.; Paraburkholderia spp.

Financial support: Embrapa; CNPq; Anglo American Brazil; INCT - Plant-Growth Promoting Microorganisms for Agricultural Sustainability and Environmental Responsibility (CNPq 465133/2014-4, Fundação Araucária-STI, CAPES)

(7744 - 2462) The Effects of Plant Growth-Promoting Bacteria (PGPB) on the Initial Development of Corn

Gustavo Benincá Rodrigues[1]; João Vitor Berner Pereira[1]; José Filipe dos Santos Maciel[1]; Mauricio Rosa Magro[1]; Ana Rosa da Silva França[1]; Camila Köche Wibbelt[1]; Julio Cesar Ariati[1]; Renan Adamcheski[1]; Vinicius Leite[1]; Sonia Purin da Cruz[1]

Universidade Federal de Santa Catarina[1]

The use of Plant Growth-Promoting Bacteria (PGPB) is a promising and low-impact technology to improve agronomic efficiency and minimize the use of chemical fertilizers, ensuring high rates of productivity with an excellent cost-benefit ratio. The present study aimed to verify the effects of PGPB-based inoculants on maize (Zea mays), mainly in relation to development and productivity up to stage V4. The experimental plot waz located in the FreiRogério-SC, Brazil (27°11'55.24'' South and 50°43'40.15'' West). The experiment was implemented in November 2017. The experimental design was RBD, with nine treatments and six repetitions. Treatments were: T1: control, 0% N without inoculation; T2: 75% N, without inoculation; T3: 100% N, without inoculation; T4: 75% N + AZOTOTAL inoculant (standard); T5: 75% N + ACCELERATE FERTILITY; T6: 75% N + ACCELERATE EFFICIENT; T7: 75% N + BAFZ + additive; T8: 0% N + product AcRh + additive; T9: 75% of the dose of N + product AcRh + additive. We measured stem diameter, and data were later submitted to analysis of variance (ANOVA) at the 5% probability level. No significant differences were identified among treatments. However, PGPBs comprise a group of microorganisms that can be used as a technological and sustainable alternative and may stimulate plant growth and development at later stages.

Keywords: rhizobacteria, inoculants, corn.

Financial support: Total Biotecnologia, Rua Emílio Romani, 1.190, Curitiba-PR, 81460-020, Brasil.

(3208 - 1424) The influence of microbial diversity on maize rhizosphere to phosphorus disponibilization

Yasmin Florentino Rodrigues[1]; Julia Franke Capozzi[1]; Antonio Marcos Miranda Silva[1]; Armando Cavalcante Franco Dias[1]; Fernando Dini Andreote[1]; Simone Raposo Cotta[1]

Department of Soil Sciences, "Luiz de Queiroz" College of Agriculture University of São Paulo - ESALQ/USP[1]

In recent years the paradigm of agriculture has been changing, inserting the concept of sustainability as a central strategy for its development. The use of microorganisms appears in this scenario as an important tool, since these organisms are directly associated with the health of the plant. However, the ecosystem functioning correlated with microbial diversity is still little known. Based on this premise, our hypothesis is that a more diversity microbial community promotes a greater availability of phosphorus to the plants. Phosphorus was used as an experimental model because of its importance in plant nutrition. To test this hypothesis, we developed a gradient of soil microbial diversity using the dilution-to-extinction approach. Microbial communities at different levels of diversity were inoculated into microcosms containing three sources of phosphorus: calcium phytate (FC), Araxá rock phosphate (FA) and triple super phosphate (ST) with and without corn seed. The experiment was conducted in the greenhouse for 30 days and after that period, analyzes were performed regarding plant growth (dry weight, root and shoot measurements) and the microbial community and their activity. In the most available sources of phosphorus (FC and ST), the effect of reducing microbial diversity was more prevalent, where as the diversity is reduced, dry weight (shoot and root) measures decrease. The specific root length (CER) was inversely proportional, where the highest values were found in the less diverse treatments, especially in the AF treatment. In relation to the microbial community and its functions, both acid phosphatase and basic phosphatase activity measurements were reduced in less diverse communities. In addition, abundance of the phoD gene showed a significant positive correlation ($p < 0.05$) with acid phosphatase activity for the rhizosphere environment in all treatments. More studies are being carried out, however, it is possible to observe the importance of the conservation of high levels of microbial diversity for the full functioning of ecosystems, thus reflecting the health of the plant.

Keywords: DGGE; qPCR; BPP; phoC; phoD.

Financial support:

C2.4 - Soil mineralogy

C2.4.1 - Dynamic minerals: shifts in soil mineral composition as a result of soil use and management over the human time scale

(1141 - 1559) Chemical and mineralogical of soils of the metropolitan region of Manaus – Amazonas, Brazil

Matheus da Silva Ferreira[1]; Mauricio Paulo Ferreira Fontes[1]; Anderson Almeida Pacheco[1]; Rafael Biscotto Davila[1]

Federal University of Viçosa[1]

The Metropolitan Region of Manaus is composed of 13 cities that form a large urban complex with a population of more than 2 million people, being the major economic center of the Amazonas state and the northern region of Brazil. However, the demographic occupation of this urban complex has happened in an accelerated way in the last decades, mainly in the cities of Manaus, Iranduba, and Manacapuru where it is concentrated around 90% of the population. Given the national importance of this urban complex and the efforts for the maintenance and preservation, this study aimed to characterize soils collected in natural and urban environments of Manaus, Iranduba, and Manacapuru, to a better understanding of their chemical and mineralogical characteristics. Soil samples were collected at depth of 0-20 cm in urban areas and in representative natural areas, totaling 32 samples. The determination of the soil chemical characterization and mineralogical characteristics were performed. The mean values observed were: 4.4 (pH_{KCl}); 2.73 (Ca^{2+}); 0.21 $cmol_c\ dm^{-3}$ (Mg^{2+});

2.76 $cmol_c$ dm^{-3} (H+Al); 33.03 mg L^- (P – Rem); 1.06 mg dm^{-3} (Cu); 97.81 mg dm^{-3} (Fe); 5.40 mg dm^{-3} (Mn) and 5.53 mg dm^{-3} (Fe). Urban areas have higher nutrient contents than natural soils, but normally the fertility of these soils is low, independent of occupation. The XRD pattern of the clay fraction shown to be composed mainly of kaolinite, gibbsite, goethite, hematite, and smaller proportion of montmorillonite. The presence of 2:1 minerals in amazonian mainland soils are rare and when occurs it is associated with areas with drainage deficiency, constituting an exception in the landscape. Therefore, we conclude that the chemical and mineralogical characteristics is owing to the poverty of the source material and strong weathering conditions of this tropical environment.

Keywords: Kaolinite; Amazon; Alter do chão geologic formation
Financial support: CAPES and FAPEMIG

(6368 - 233) Contribution of amorphous materials in the cohesion of soils of the Barreiras Formation and correlates

Michele Ribeiro Ramos[1]; Vander de Freitas Melo[2]; Alexandre Uhlmann[3]; Renato Antonio Dedecek[4]; Gustavo Ribas Curcio[3]
Universidade Estadual do Tocantins[1]; Universidade Federal do Paraná[2]; Embrapa Florestas[3]; Pesquisador aposentado Embrapa Florestas[4]

The cohesive Yellow Latosols and Argisols developed from sediments of the Barreiras Group and correlates, are distributed in many areas in Brazil, positioned in the north-south direction, with a width ranging from 20 to 120 km and an altitude of 20 to slightly more than 120 m, framing and often covering lands that mostly have gneiss and granitic rocks In order to understand the processes involved in cohesion, a methodology was developed based on the extraction of minerals from the clay fraction consortium to the physical-hydro analyzes in samples undisturbed soil. For this, undisturbed samples were collected only from the BA horizon of cohesive (Macacu Formation) and non - cohesive soils (São Fidélis Formation) on the upper third of two slopes located at the Rio de Janeiro Petrochemical Complex (COMPERJ), Itaboraí, RJ. In the samples, solutions with potential of extraction of chemical elements present in the fractions of the soils were percolated. The solutions with temperature of approximately 60 ^oC were percolated through drippers (DCB, ammonium oxalate (0.2 mol L^{-1}), NaOH (0.2 mol L^{-1} and 0.06 mol L^{-1})) and water deionized, in an individualized and non-sequential manner. The solutions percolated in the samples were collected, measured their respective volumes and analyzed for their concentrations in silica, iron and aluminum. Subsequently, the samples were saturated in trays with deionized water and subjected to a physical analysis sequence to verify their physical attributes. (The results were: (1) although the extractions were mild, the solutions used extracted significant amounts of silica and (2) the results indicated the presence of some material more easily extractable in the cohesive soil, which is not present in the non cohesive soil, (3) there is a possibility that the presence of amorphous materials associated with cohesion

Keywords: hardsetting soils, dense horizon, soil genesis
Financial support: CAPES, PETROBRÁS

(3557 - 792) Could 33 years of K fertilization deprivation alter phyllosilicates and K mineral reserve in the clay fraction of an Oxisol?

Ruan Francisco Firmano[1]; Vander de Freitas Melo[2]; Adilson de Oliveira Junior[3]; João Arthur Antonangelo[4]; Luís Reynaldo Ferracciú Alleoni[1]
University of São Paulo - ESALQ[1]; Federal University of Paraná[2]; Brazilian Agricultural Research Corporation[3]; Oklahoma State University[4]

Highly weathered soils from humid tropics generally present low total potassium (K) and no abundance of K-bearing minerals in the clay fraction. However, there is evidence that non-exchangeable forms (NEF) of K can contribute to plant nutrition even in tropical soils. Special techniques such as X-ray diffraction (XRD) and sequential extraction of minerals from clay fraction efficiently allow the investigation of K-bearing minerals in soils. The clay fraction characterization was applied to soil samples collected from an Oxisol under long-term no-till (NT) fertilized for 33 years with KCl and cultivated with soybean (*Glycine max* L.), maize (*Zea mays* L.), wheat (*Triticum aestivum* L.) and oats (*Avena strigose* L.) in southern Brazil. The mineral K-bearing species were quantified, and the changes resulted from the K fertilizer deprivation were also evaluated. The greater part of the K mineral reserve was contained in the soil clay fraction. The K deprivation for 33 years reduced the mineral reserve of the nutrient associated with 2:1 minerals and dramatically reduced illite peaks in the soil clay fraction. Exchangeable and non-exchangeable forms of K were also reduced in comparison to those in which K fertilization was maintained at rates equal to or greater than 120 kg ha^{-1} $year^{-1}$ of K_2O. Oxides and hydroxides as hematite, Gibbsite, Goethite, and phyllosilicates such as kaolinite dominated the mineralogy of clay fraction. Those minerals were not affected by the three decades absence of K fertilization.

Keywords: X-ray diffraction; Non-exchangeable K; No-till system; Long-term; Potassium forms
Financial support: Coordination for the Improvement of Higher Education Personnel (CAPES), Sao Paulo Research Foundation (process nº 2015/19121-8 and 2015/18952-3), Brazilian Agriculture Research Corporation (EMBRAPA) – Soybeans national study center, LNI-CENA

(4111 - 2395) Description of the mineralogical profile of Oxisols of the Central Amazonia

Jose Zilton Lopes Santos[1]; Tainah Manuela Benlolo Barbosa[1]; Laercio Santos Silva[2]; Renato Eleoterio de Aquino[2]; José Marques Júnior[2]
Federal University of Amazonas[1]; University of São Paulo[2]

The level of crystallinity, isomorphic substitution (IS) and, specific surface area (SSA) are the especific properties that most influence the mineralogical activity of soils. The aims of this study were identify and characterize the minerals of the clay fraction of Oxisols of Central Amazonia and check the relation of these with the remaining phosphorus (P-rem). Samples from the upper layer (0-20 cm) of 10 Dystrophic Yellow Oxisols, under native forest, in the municipality of Manaus, Iranduba, Manacapuru, Rio Preto da Eva and Presidente Figueiredo, in Amazonas state, Brazil. The soils were ordered in four groups, according to P-rem (index that indicate the retention potential of anions in soil) = 5.6; 14.0; 17.7 and 22.2 mg L^{-1}. Were identified the minerals kaolinite (Kt), goethite (Gt), hematite (Hm) and estimated the mean crystal diameter (MCD), IS of iron for aluminum and, SSA. The presence of intense and characteristic diffraction peaks 0.732 nm in Kt; 0.416 nm in Gt and 0.352 nm in Hm, point to dominance of these minerals in the clay fraction of the studied soils, regardless of the P-rem content. The values of Gt ranged from 14.28 to 51.49 while the values of Hm varied from (5.72 to 32.44 g kg^{-1}), being the highest values of Gt and the lowest values of Hm found in soils with higher values of P-rem (22.2 mg L^{-1}). While the lowest and highest values of Gt and Hm, respectively were observed in soils with 14.0 mg L^{-1} of P-rem. The last P-rem level showed the higher content of Hm in comparasion to Gt. We observe a predominance of MCD (110) in retation to MCD (111), regardless of the mineral. In general, the values of MCD (110) were increased at the highest level of P-rem as much as Gt and Hm. We also observed a narrow amplitude of variation of SSA (47 to 90 m^2 g^{-1}) and of IS (20.5 to 41.0 mol%) and, the highest values

of this variables were comparatively higher in soils with higher P-rem., however, the values of IS was inversely related to values of P-rem (5.6 > 14.0 > 17.7 > 22.2). This Behavior also was observed to (MCD 110) of Gt and Hm minerals. The data presented here show that the mineralogy of clay fraction of the Oxisols of Central Amazonia consist of kaolinite, goethite and hematite. The P-rem show strong relationship with levels of cristalinity of goethite and hematite in DMC 110, SSA, IS. The results implie that in spite of these soils occur under the similar climatic conditions, they may vary in their vocation of use.
Keywords: Goethite, hematite, kaolinite, humid tropic
Financial support: Coordination for the improvement of Higher Education Personnel (CAPES) for the support awarded to the second author.

(6395 - 2273) Different types of treatment prior to the granulometric analysis of volcanic soils made it possible to determine a regular distribution with other soil properties according to altitude on the western slope of the tropical island of Réunion.

FEDER[1]
CIRAD[1]

Soils on the western slope of the Piton des Neiges (Réunion Island, Indian ocean) showed the following toposequence: Vitric Andosols and Andic Podzols (16001850 m asl and more); Silandic Andosols (10001600 m asl); Andic Umbrisols and Andic Cambisols (9001000 m asl); Haplic Umbrisols and Cambisols (500900 m asl); Haplic Phaeozem and Leptic Cambisols and Phaeozem (below 500 m asl). According to altitude, evolution of soil properties (pH, organic matter content, cationic and anionic exchange capacity, oxalfe, etc.) is regular, except for the particle size distribution analysis (PSDA) performed with the standard method. On these soils, short-range-order minerals (SROM) such allophane and amorphous aluminosilicates and organo-mineral cements such noncrystalline hydrous oxides of Fe and Al, often prevent soil dispersion before the PSDA. The absence of an efficient and common soil method in this toposequence limits the understanding of pedogenetic processes when granulometry is involved (clay illuviation, etc.). We realize different type of treatments before PSDA for the different soils. To quantify clay minerals on andic horizons, we realize 6 successive dissolutions of SROM with ammonium oxalate. To improve particle dispersion, we also use sonication. Within a group of, a priori, similar andosols, the PSDA, after the destruction of the SROM, separates two groups of andosols. The first group raises a strong clay leaching from the surface horizons (0 - 40 cm, on average 25% clay) to the deep horizons (40 - 90 cm, on average 60% clay). The second group has similar clay contents over the entire profile (between 10% and 15%) but high contents of coarse sand (up to 40%) in the deep horizons; that's incompatible with the textural description. Thus, for some andosols, the procedure for dissolving the SROMs is insufficient to obtain a relevant particle size analysis. At the lowest elevations in the slope, non-Andic soils showes a common tendency to increase clay content with the depth of the horizons (extreme values of 45 to 75%) but less marked because of the already very high values in the surface horizons (extreme values of 40 to 75%). These last PSDA results are similar regardless of the method used (with or without sonication or dissolution of SROM). By choosing the most appropriate PSDA method for each soil type, the spatial distribution on the slope according to the altitude of the granulometric analyses is consistent with the other soil properties.
Keywords: volcanic soils; granulometry; pretreatments
Financial support: European Agricultural Guidance and Guarantee Fund

(6628 - 1665) Formation of hydroxy-interlayered minerals (HIMs) in integrated crop-livestock systems (ICLS)

VANESSA THOMA BERTOLAZI[1]; Alberto Vasconcellos Inda[1]; Laurent Caner[2]; Ibanor Anghinoni[1]; Paulo César de Faccio Carvalho[1]
Federal University of Rio Grande do Sul[1]; University of Poitiers[2]

The complexity and diversification of integrated crop-livestock systems (ICLS) generates synergisms between animal, plant, and soil components, like this, the formation of 2:1 hydroxy-interlayered minerals (HIMs) may be affected by accumulation of animal wastes in soil and grazing intensity. The aim of this work was to assess the effect of grazing intensity, in two different treatments [intensive grazing (IG) and no grazing (NG)], on the formation of 2:1 hydroxy-interlayered minerals of an Oxisol in an integrated crop-livestock system in southern Brazil. The main analyzes used were chemical (organic carbon and cation-exchange capacity) and mineralogical analyzes of the fractions of total clay (<2 µm) and fractionated clay in three particle sizes (< 0.05, 0.05–0.1 and 0.1–2 µm). Two different types of HIM were found in intensive grazed areas: one presented aluminization of the interlayer, and the other presented K-saturated interlayers. The higher aluminization of the 2:1 interlayers observed under intensive grazing may induce lower content of exchangeable and available aluminum and subsequently lower toxicity to plants. The occurrence of HIM with K of the interlayer may be associated with the increased nutrient cycling proportioned by bovine manure; the retention of this element within the soil clay mineral fraction may reduce leaching losses and act as a long-term source of K in the ICLS soils. However, these results demonstrate significant, short-term alterations in soil mineralogy, reinforcing the necessity to consider the response to changes in soil management.
Keywords: 2 :1 phyllosilicates ; sub-fractionation ; aluminization.
Financial support: The authors are grateful to the National Council for Scientific and Technological Development (CNPq) and to CAPES Foundation (Brazilian Ministry of Education)

(1590 - 896) Geotechnical characterization of Vertisols from Bahia State, Brazil

Gustavo Magalhães Nunes Barbosa[1]; Igor Rodrigues de Assis[1]; João Carlos Ker[1]; Eduardo Antônio Gomes Marques[1]; Tony Jarbas Ferreira Cunha[2]; Luciano da Silva Souza[3]; Ullisses Vargas Sobrinho[1]
Universidade Federal de Viçosa[1]; Embrapa Semi-árido[2]; Universidade Federal do Recôncavo Baiano[3]

Despite the existence of vertic soils with predominance of kaolinite is reported around the world, there are few studies shown the influence of this clay mineral in their geotechnical characteristics. The work aimed to perform a geotechnical characterization of Vertisols from Bahia, Brazil, besides understanding the influence of physical, chemical and mineralogical properties on the geotechnical behavior. Three Vertisols were collected in Juazeiro city, in a semi-arid region, one kaolinitic Vertisol and two smectite Vertisols. Other three Vertsols were collected in Recôncavo region, all presented clay mineralogy with codominance of smectite and kaolinite (Sm-K). A geotechnical characterization was carried out in their diagnostic horizons, determining properties such as granulometric curve, clay activity, linear expansion coefficient, compaction capacity, cohesion (c'), and internal friction angle (φ) of saturated soils. We observed that the clay content was the attribute that most influenced the geotechnical characteristics. All soils showed expansion potential above 0.01, considered as very high. The kaolinitic Vertisol showed the lowest clay activity. However, the clay content of 68% contributed to this soil to present an expansion potential similar to the smectite Vertisol with clay content of 35%. The major values of soil compaction were observed for the kaolinitic Vertisol, which presented greater reduction of void ratio and higher density as a function of moisture increase. For this soil, the optimal moisture content (OMC) and maximum dry density (MDD) were 22% and 1.65 g cm^{-3}, respectively. The other soils presented OMC between 18-41% and MDD between 1.75-1.24 g cm^{-3}. These smectite-soils, MDD decreased with increasing of OMC. All soils had low c' values, which is expected for high clay content soils.

The *c*' values increased with increasing of kaolinite and decreased with increasing of clay content. The kaolinite Vertisol showed *c*' of 0.19 kgf cm^{-2}. The *c*' values to Sm-K Vertisols ranged between 0.05-0.11 kgf cm^{-2}. As for smectite-soil, *c*' values ranged between 0.02-0.03 kgf cm^{-2}. Low φ values were observed for all soils, which indicates low shear resistance. In its turn, φ was more influenced by granulometry, in which higher levels of sand and gravel provided higher φ, independently of the type of clay. Vertisols with different mineralogy present different geotechnical characteristics.

Keywords: Smectite; kaolinite; expansive soils
Financial support: Departamento Nacional de Infraestrutura de Transportes – DNIT; Conselho Nacional de Desenvolvimento Científico e Tecnológico – CNPq

(8234 - 2645) Impact of eucalyptus plantation on an Ultisol on chemical properties

Estéfane Chaves[1]; Alberto Vasconcelos Inda Junior[1]; Laurent Caner[2]; Keyrauan Taha[1]

Universidade Federal do Rio Grande do Sul[1]; Université de Poitiers[2]

The current agricultural activity contributed to improve the chemical and physical properties of the soil. However, in some situations some harmful effects, such as soil and ecosystem degradation, are still observed. Recent studies revealed the impact of human activity (e.g. soil management) on physical and chemical properties in cultivated soils. Mineralogy of the clay fraction is an extremely important tool that can help to elucidate the behaviour of soils under different management. Since the forestry sector expanded rapidly in south Brazil, studies viewing actions of preservation and rational use of resources (soil water, fertilizers) and that limit economic and environmental losses are needed. In this context, the goal of the present work was to evaluate chemical and mineralogical changes in soil under eucalyptus plantation in the state of Rio Grande do Sul – south Brazil. Soil samples (yellow Ultisol) were collected in triplicate at the same depth (0-5, 5-10; 10-20, 20-40, 40-60, 60-80 cm) in an eucalyptus plantation with 15 years of cultivation and a control soil as a native meadow. Statistical inferences were made with ASSISTAT version 7.7 pt. and revealed differences between the forest and the native field. To limit acidification and to maintain biomass production the Eucalyptus stand received two cycles of fertilization and liming with application of dolomitic calcareous, natural phosphate, superphosphate and NPK. Chemical analyses showed that pH, sum of bases, exchangeable Ca^{2+} were lower in the eucalyptus soil samples whereas CEC, exchangeable Mg^{2+}, K^{+} and (Al^{3+} + H^{+}) values were higher whatever the soil depths. Liming did not completely limit soil acidification due to litter decomposition and nutrient uptake by eucalyptus trees. Acidification and related release of Al can lead to the formation of hydroxy-aluminum interlayered vermiculite (HIV-Al) from expandable 2:1 clay minerals. For this purpose we have extracted the clay fraction (< 2 µm) and subsequently fractionated it into infra-micrometric subfractions (< 0.05, 0.05 – 0.1 and 0.1 – 2 µm) to study in details the clay minerals by X-ray diffraction. The results of the bulk clay fraction showed abundance of kaolinite and low proportion of 2:1 clay minerals. The study of the subfraction is in progress.

Keywords: Mineralogical changes Eucalyptus plantation X-ray diffraction
Financial support: CAPES, CNPq

(2584 - 1676) Physiological quality of the first sequeiro of sugarcane in the function of potassic fertilization

Aline Franciel De Andrade[1]; Frederico Simões Raimundo De Lima[1]

UFG[1]

Aline Franciel de Andrade[1]; Frederico Simões Raimundo de Lima[1]; Amanda Magalhães Bueno[1]; Rilner Alves Flores[2]

[1]PostgraduateProgram in Agronomy/UFG, Highway - Goiânia - Nova Veneza Km 0, Goiânia,74690-900, Brazil e-mail: (alineandrade418@gmail.com; fredlimaufg@yahoo.com.br; amanda.mabu@gmail.com); [2] Department of soil UFG - e-mail: (rilner1@hotmail.com) Brazil is the word's largest producer of sugarcane, with an estimated production of 647.6 milion tons (2017/18 harvest). Sugarcane, demands a higt amount of nutrients, which has made the practice of fertilization of great importance in soils cultivated with this crop. Among the nutrients, potassium (K) stands out as the most absorbed by sugarcane, acting in several physiological processes of the plant, such as: enzymatic activator; acts on photosynthesis; maintains the turgor of the cells; opening and closing of stomata; translocation of nutrients in the plant. However, most Brasilian soils are natirally K deficient, requiring supplementation througt fertilization. The objective of this work was to evaluate the effect of potassium fertilization on the physiological quality of the first ratoon sugarcane cultivated under Cerrado soil and these climatic conditions. The research being conducted in an experimental area of the Goiasa Plant, Bom Jesus de Goiás municioality - GO, The experiment carried out in a randomized block desing with fives doses of K_2O (0,50,100,150 and 200 kg ha -1) Five replicates. For the determination of the physiological quality, the stomatal conductance, transpiration, internal CO_2 concentration and liqud photosynthetic rate evaluated at 120 days after the isntallation of the experiment. The evaluations performed using a photosynthetic analyzer system (IRGA-Infraed Gas Analyzer with coupled fluorometer model iFL - Integrated Fluorometer and Gas Exchange System). The results were submitted to analysis of variance by the F test, applying the polynominal regression test to the significant variables. A linear reponse observed for the variables transpiration and photosynthesis as a function of the higher potassium supply in the soil, reaching 5.65 mol m^{-2} s^{-1} and 17.95 mmol m^2 s^{-1}, respectively. In relation to the internal CO_2 concentration, a quadratic response observed, with a dose of 150 kg ha^{-1}, which promoted a higher internal CO_2 concentration. The physiological activity of the ratoon sugarcane is significantly responsive to the application of potassium fertilization.

Keywords: SUGARCANE, SEQUEIRO, FERTILIZER, POTASSIUM
Financial support: UFG

(2609 - 2082) Potassium release from organic black shales used as remineralizers: effect of size fraction and acid extractors

Jacqueline Kochan Lepchak[1]; Thais Correa de Assis[1]; Gabriel Ramatis Pugliese Andrade[2]; Antonio Carlos de Azevedo[3]

Universidade Estadual do Centro-Oeste[1]; Universidade Estadual do Norte Fluminense Darcy Ribeiro (UENF)[2]; Escola Superior de Agricultura Luiz de Queiroz - ESALQ-USP[3]

The high demand for nutrients by tropical crops is an economical and environmental challenge. Alternatives for new nutrient sources include the use of rock powders derived from mining co-products, which are able to provide major nutrients to plants. In southern Brazil, organic black shale from Irati Formation (Permian Age) are widely known by their high contents of oil, which is explored for fuel production. It also contains high amount of alkali elements, like potassium (K), that make this shale potentially useful as remineralizer. In this preliminary study, we tested the K release from the powdered Irati shale to evaluate its release after five subsequent extractions in pure water, oxalic acid (0.01 M) and citric acid (0.01 M). The tests were performed in polyethylene tubes, in a rock powder/extractor proportion of 1:4, at 120 rpm in a shaker-over-end device for 14 h. Three different size-fractions of the powdered rock were used: coarse sand (CS, 2-0.2 mm), fine sand (FS, 0.2-0.05 mm) and filler (FL, < 0.05

mm). Samples were analyzed in triplicates and K content determined by flame spectroscopy. Oxalic acid was the more efficient extractor for all size fractions, summing up to 65 mg K L^{-1} in FS fraction after five extractions, followed by 46 mg K L^{-1} in FL fraction and 44 mg K L^{-1} in CS fraction. The K releasing curve was positive and linear only for CS fraction (for oxalic and citric acids), whilst a polynomial behavior express the release from the FL fraction. For FS fraction, an unusual behavior was observed for the two acids: there was a steep increasing until the third extraction, followed by a decrease and a new increase in the values (at fifth extraction). This unusual behavior after successive extractions for coarser fractions may be attributed to the likely abrasion among particles at experimental conditions, during shaking procedure. The behavior for FL fraction seems to be more realistic, since K release progressively increases as illite and other K-bearing minerals (like feldspars) disrupt their lattices by the extractors. Although preliminary, these results show the potential use of the Irati black shales as complementary or alternative soil K source, as well as the role of organic acids on the kinetic of element releasing, which must be further tested at field conditions.

Keywords: acid extraction, nutrient releasing, K-bearing minerals, rock powders

Financial support: Brazilian Research Council, CNPq (grant n. 406600/2013-9)

(9694 - 2941) soil characterization, classification and formation on sedimentary lithology in Gravatai municipality, Rio Grande do Sul state.

Paulo César Do Nascimento[1]; Tatiana Finato[2]; Alberto Vasconcellos Inda[1]; Luis Fernando da Silva[1]; Augusto Koglin Wink[1]; Jessé Rodrigo Fink[3]; Élvio Giasson[1]

UFRGS[1]; EMATER[2]; IFPR[3]

Metropolitan region of Porto Alegre, although great urbanization process, has some localities that can be defined like rural towns, being Gravatai one of the municipalities with bigger expression of this issue. Natural resources knowledgement is an important aspect for sustainable agricultural production systems. With the aim to characterize, classify and evaluate soil – environment relationships, morphologic description and sample colect were made in four representative soil profiles of sedimentary regions, to chemical, physical and mineralogical analysis. Results showed, with exception of P1, profiles with great pedologic development, expressed by subsurface horizons with higher clay content and hydromorphic features in P2. Organic carbon contents were relatively low, due to sandy texture, with acid pH. Ki index and Fed/Fes relationship showed high weathering degree. Soil distribution in landscape seems to show relief and hidrology as major influences. Soil characteristics indicated Lessivage as the major processes, showed by lower floculation degree in transitional horizons, and increase fine clay:total clay relationship values in subsurface horizons. Ferrolysis and Gleization seems to contribute, specially in P2, as indicated by higher Feo/Fed relationship in E horizon.

Keywords: soil-environment; soil classification, pedogenetic processes

Financial support:

C2.4.2 -New techniques for advanced mineral studies

(6761 - 2958) Analysis of the mass attenuation coefficient in granulometric fractions of soils and their effects regarding the mineralogical properties of each fraction

Luis Valério Prandel[1]; Sérgio da Costa Saab[1]; Luiz Fernando Pires[1]; Larissa Macedo dos Santos[2]; André Maurício Brinatti[1]

State University of Ponta Grossa (UEPG)[1]; Federal Technological University of Paraná (UTFPR)[2]

Soils and their granulometric fractions can be characterized using energy dispersive X-ray fluorescence (EDXRF) and the Rietveld Method with X-ray diffraction data (RM-XRD). These results can be correlated to studies on radiation interaction (X-ray and δ) with the matter from the analysis of the mass attenuation coefficient (μ). The measurement of μ from the γ radiation interaction in soils and soil fractions, along with their mineralogical properties, is very relevant since it enables the prediction of physical properties such as total density, water content and porosity. Therefore, the purpose of this research was: to discriminate soil fractions using mineralogical, elemental and physical analyses; and to show, through the use of elemental and mineralogical analyses, which fractions present greater contribution to the characteristics of the γ radiation interaction with the matter. Five soil samples were collected, mashed and sieved (2 mm aperture sieve), dispersed, submitted to coarse sand separation (0.053 mm aperture sieve) and physical fractioning process through sedimentation (Stokes law) to extract the fine sand, silt and clay fractions. Semi-quantitative elemental analysis of the soils was accomplished through EDXRF by using an instrument model EDX-720 (Shimadzu) equipped with an Rh X-ray tube. An XRD diffractometer, model Ultima IV (Rigaku), with CuK_{α} radiation, 40 kV voltage and 30 mA current was employed to collect data for RM-XRD analyses. The μ and other phenomena such as partial cross-sections for Photoelectric Absorption (PA), Coherent Scattering (CS) and Incoherent Scattering (IS) were obtained based on the soil elemental chemical composition through the XCOM software. By using Principal Component Analysis (PCA), PC-1 (57.5 %) and PC-2 (20.9 %), the samples were grouped as a function of their texture, and granulometric fractions were classified in distinct quadrants due to the discrimination between physical, chemical and mineralogical properties. PCA made it possible to discriminate soil fractions through the mineralogical, elemental and textural analyses, correlated with the analysis of μ, photoelectric absorption (PA), coherent scattering (CS) and incoherent scattering (IS).

Keywords: Mass attenuation coefficient; XCOM; Principal Component Analysis

Financial support:

(9411 - 2945) Elemental release analysis of Polyhalite using micro X-ray fluorescence

Wilfrand Ferney Bejarano Herrera[1]; Kiran Pavuluri[2]; Robert Meakin[2]; Hudson Wallace Pereira de Carvalho[3]; Paulo Sergio Pavinato[1]

ESALQ/USP[1]; Sirius Minerals[2]; CENA/USP[3]

Polyhalite is a mineral to supply four macronutrients, including, potassium (K), calcium (Ca), magnesium (Mg), and sulfur (S), and its single crystal nature could provide a differentiate elemental release compared to other commercial fertilizers. The objectives of this study were to evaluate the release of K, Ca and S from polyhalite and muriate of potassium using micro X-ray fluorescence (μXRF) in an Oxisol and to determine the velocity of the horizontal and vertical movement through the profile. Rhizobox experiment was conducted using a Quartzipsamment and washed sand as a control substrate, arranged in a completely randomized design, with four replications, using K, Ca, Mg, S sources; polyhalite (POLY4) and potassium chloride (KCl) combined with phosphogypsum and kieserite, balancing Ca, Mg and S, supplied by POLY4, to reach the dosage evaluated. Bench-top μ-XRF scans were performed on the applied area and the surrounding region to measure K, Ca and S intensities at 30, 60, 120, 240, 480, 720 and 1440 minutes after application (MAA). The intensity was mapped to observe the dynamics of release for each element and the possible interaction between them. Additionally, a laboratory study using μ-XRF spectroscopy was carried out on POLY4 and KCl granules to observe the spatial distribution of the elements. The results showed that K, Ca and S intensities were influenced by source ($p<0.05$), presenting different dynamics of release. Horizontal and vertical

mobility showed that K, and Ca from POLY4 moved rapidly as MOP and phosphogypsum, however, the lower intensities of K in polyhalite demonstrate that is less soluble and released slower than KCl. On the other hand, vertical mobility of sulfur showed that this element moved rapidly when polyhalite is used, indicating that S from polyhalite is more soluble and released faster than the phosphogypsum. The granule of POLY4 showed that S is located all over the analyzed granule area, whereas K, Ca and Mg are distributed in spots, possibly complexed by S, and KCl presented high intensities of Cl and K in the analyzed region. Thus, the results indicated that µ-XRF is an effective technique for fertilizer analysis and the polyhalite is an alternative slow-release source of K, Ca, and S.

Keywords: µ-XRF, potassium, mobility
Financial support: Colciencias

(6369 - 1587) Hematite and goethite proportion in soils of Rio Grande do Sul, Brazil

Keyrauan Taha[1]; Priscila Vogelei Ramos[1]; Alberto Vasconcellos Inda[2]
UFRGS[1]; UFGRS[2]

Iron oxides hematite and goethite are important pigment agents and influence on soil physical and chemical behavior. The aim of this work was to determine soil iron oxides, hematite and goethite, proportion in the Rio Grande do Sul's state, using continuum removal technique, and to establish soils kinds of soils for the hematite/(hematite+goethite) ratio (Hm/(Hm+Gt)). 579 soil samples of the 0-0.20 m layer have been used representing all the physiographic state regions. Samples have been analyzed on a VIS-NIR spectrum with a range from 350 to 2500 nm. For the removal continuum calculations, wavelength between 535-590 nm to hemathite and between 415 –450 to goethite have been selected. From bands intensity relative to each type of iron oxide has been calculated the ratio Hm/(Hm+Gt)*100, for the purpose of classifying RS soils as the ratio obtained. It has been established classes according to the proportion between the two types of iron oxides: goethitic soils = 0-25%; goethitic-hematitic soils = >25–50%; hematitic-goethitic soils = >50–75%; hematitic soils = >75–100%. The results indicate that 22% of RS soils are hematitics, 10% hematitic- goethitics, 13% goethitic-hematitics and 55% goethitics. Its concluded that it is possible to establish, by removal continuum technique, proportion kinds between hematite and goethite, and RS soils are predominant goethitics. In addition, the obtained results in this work could be related to physical (e.g. soil drainage) and chemical attributes (e.g. soil adsorption) of the southern Brazil soils.

Keywords: Iron oxides, soil pigment, soil reflectance.
Financial support: Capes Coordenação de Aperfeiçoamento de Pessoal de Nível Superior

(5908 - 2448) Iron oxide Nanoparticles in clay fraction of tropical soils from Peru: Study by X-ray diffractometry and Mössbauer spectroscopy

Mirian Mejia S.[1]; Jorge A. Bravo C.[1]
Laboratorio de Análisis de Suelos, Universidad Nacional Mayor de San Marcos, Lima, Perú.[1]

Iron (Fe) is the fourth element in order of abundance in the lithosphere, with an average content of about 5% in the Earth`s crust, and is very common soil mineral component (1-10%). The iron oxide particles are related to soil fertility and plant growth, they often occur as aggregates, minerals nanoparticles or as nanoscale coatings on other grains in the soil of both Fe crystalline and poorly ordered Fe oxide minerals [1]. The aims of this work was to identify and extent characterize the main minerals in the clay fractions of soil samples from the Tropical soils from Peru, with emphasis on the iron oxides and iron-bearing aluminum - silicates minerals; which are transformed to nano-size Fe oxides, via weathering processes in natural environment, using analytical techniques such as X ray diffractometry (XRD), transmission Mössbauer spectroscopy (TMS) at room temperature (RT) and at 110 K to determine their mineralogical composition. This work details the results obtained with two selected samples with contrasting characteristics. Where the effect of intense weathering causes the loss of Si, increasing the concentration of Fe and Al sesquioxides, this could explain the different mineralogical composition of the two soils studied. The main Fe sesquioxides found in the soils studied have been identified as hematite and goethite. Reference *Colombo Claudio, Erika di Iorio , Qingsong Liu , Zhaoxia Jiang, and Vidal Barrón (2017) Iron Oxide Nanoparticles in Soils: Environmental and Agronomic Importance, Journal of Nanoscience and Nanotechnology Vol. 17, 4449–4460.*

Keywords: Clay fraction, iron oxides, mineral composition, X-ray diffractometry, Mössbauer spectroscopy.
Financial support: Partial Financial Support: CONCYTEC

(5647 - 2024) Magnetic susceptibility on study of Oxisol derived from sandstone in Brazilian Cerrado

Ronny Sobreira Barbosa[1]; Romário Porto de Oliveira[1]; João de Deus Ferreira e Silva[1]; Erico Vinícius Macêdo de Souza[1]; Raphael Vinicius de Souza Martins[1]; Juvenal Pereira da Silva Junior[1]; Diego Ferreira de Souza[1]; Yuri Jacques A. B. da Silva[1]
Federal University of Piauí[1]

Magnetic susceptibility is a soil property reflected its mineralogical characteristics. It can be defined as being one attribute of simple measure on material magnetized in the presence of a magnetic field. Accordingly, it can be used to indirect determination of some soil attributes that have magnetics interactions. Therefore, the objective of this work was to characterize the magnetic susceptibility relating it wit to the factors and processes of soil formation, and too, check it potential in estimating soil attributes formed in these environments. The study was performed in Palmeira do Piauí municipality (northeast Brazil) located in Cerrado, with Aw type climate according to Koopen classification, with average temperatures of 26.8 ºC and average rainfall of 1054 mm. The predominant soil is Oxisol formed from sandstone (Piauí Formation, Balsas Group) in the Paleozoic era at the top of the landscape (555 m elevation). For the study, were analyzed chemical, physical attributes and the magnetic susceptibility in samples of their different horizons. The data were submitted to descriptive analysis and also to a Pearson correlation analysis of the magnetic susceptibility with all attributes analyzed. Subsequently, pedotransfer functions were calibrate with attributes that showed a significant correlation with magnetic susceptibility. The studied soil showed values of magnetic susceptibility ranging from 1.85 to 2.90 * $10^{-6}m^3kg^{-1}$. Magnetic susceptibility showed significant linear correlation with sand, clay, water dispersed clay, organic matter, cation exchange capacity, aluminum saturation, base saturation and flocculation degree. In all regression models, high determination coefficients were obtained, with R^2 higher than 0.80. The highest values of the magnetic susceptibility found in the surface horizons are possibly dependent on the ferrimagnetic minerals present in the coarse fraction of this soil. It is concluded that the parent material was the most important soil formation factor in the magnetization of this soil and that the magnetic susceptibility can be used in the estimate of chemical and physical attributes in Oxisol of the Brazilian Cerrado.

Keywords: Magnetism, Pedogenesis, Pedotransfer functions, Sandy Soils, Analytical Sustainability
Financial support: Federal University of Piauí

(2150 - 2113) XANES spectroscopy in the study of iron oxides of an Indian Black Earth, Amazonia – Brazil

Anderson Almeida Pacheco[1]; Mauricio Paulo Ferreira Fontes[1]; Scott Fendorf[2]; Juan S. Lezama-Pacheco[2]; Matheus da Silva Ferreira[1]; João Carlos Ker[1]

Department of Soil Science, Federal University of Viçosa, Viçosa, Minas Gerais, 36571-000, Brazil[1]; Environmental Earth System Science, Stanford University, Stanford, California 94305-4015, USA[2]

The Indian Black Earth (IBE) is a soil formed as result of anthropic activity in pre-Columbian Indigenous settlement areas. These soils show features such as high fertility, high level of organic carbon, anthropic dark-colored epipedon, and the presence of lithic artifacts. Furthermore, the IBE is in contrast to other Amazonian upland soils, which are usually poor in nutrients due to intensive weathering and subsequent leaching under the prevailing humid tropical climate. The strong weathering condition this environment facilitates the genesis of crystalline iron oxides in the soils. Thus, iron form and concentration have long been important indicators for studies of soil genesis and adsorption processes. This study aimed to quantify the crystalline and poorly crystalline iron oxide species present in an Indian Black Earth, Amazonas State-Brazil, using geochemical, mineralogical and Fe K-edge XANES spectroscopy analysis. The location of collection of the IBE profile was in 3°14'11.98"S and 60°13'35.75"W. X-ray diffraction (XRD) analyses were performed using a Panalytical X'Pert (CoKα). The Fe content was measured by X-ray fluorescence spectroscopy (XRF). The Fe K-edge XANES data were collected at beamline 11-2 at the SSRL Stanford - USA. The IBE, with a collected profile of a depth of 100+ cm, showed in the horizons A1 and A2, organic carbon of 2.9; 2.1 %, P contents of 101.7; 176 mg kg-1, and color of 10YR 6/6, respectively. The horizon Bt, P content of 163.3 mg kg-1 and color of 10YR 6/1. The XRD patterns from of the clay fraction shown to be composed mainly of kaolinite, gibbsite, goethite, hematite, and in smaller proportions illite and montmorillonite. The Fe content measured by XRF showed the values of 4, 4.5 and 8 % for their horizons, respectively. The linear combination fitting (LCF) of XANES spectra results for the bulk samples showed iron oxide species as hematite, goethite, and ferrihydrite, based discernible spectral feature of standards. The LCF showed the average amount the 10, 29.5, and 53 %, respectively. We conclude XANES spectroscopy was efficient in the study of iron oxides, and the ferrihydrite, a poorly crystalline species, is present in higher proportion, although the environment presents a high degree of weathering. Thus, this study provides baseline data for future studies that evaluate the importance of the formation and stability of the ferrihydrite and its implications in soil adsorption processes in the tropical environment.

Keywords: Ferrihydrite; Anthrosols; X-ray Diffraction; X-ray Fluorescence; Tropical Environment

Financial support: CNPq (National Council for Scientific and Technological Development); CAPES (Coordination of Improvement of Higher Level Personnel); CAPES/PROCAD (National Program for Academic Cooperation) and SSRL (Stanford Synchrotron Radiation Lightsource).

C2.4.3 - Influence of biological process in mineral formation

(4870 - 553) Crystal-chemical transformations and iron reduction in clay minerals of two Brazilian mangrove soils

Gabriel Ramatis Pugliese Andrade[1]; Javier Cuadros[2]; Carmen Partiti[3]; Renato Cohen[3]; Pablo Vidal-Torrado[3]

Universidade Estadual do Norte Fluminense Darcy Ribeiro[1]; The Natural History Museum[2]; Universidade de São Paulo[3]

The formation of clay minerals in mangrove soils is an important key to understand pedogenic and biogeochemical processes. To investigate the chemical transformations and the role of Fe reduction in clays, two Brazilian mangroves were selected: the first in a humid tropical climate in the Amazonian coast (city of Bragança, Pará State - BR), with predominance of kaolinite and pedogenic oxides as deposited minerals; and the second in the semiarid coast of northeastern Brazil (city of Acaraú, Ceará State - AC), where 2:1 clays are also sedimented. Samples of 2-0.2 mm and < 0.2 mm size fractions were studied using modeling of XRD patterns (program ClaySIM®), X-ray fluorescence spectroscopy (XRF) and Mössbauer spectroscopy. There is a mixture of end-member clays and R0 mixed-layered phases in the two size fractions from the two mangroves. The phases are kaolinite-smectite (K-S) with a range of smectite layers (1%, 15-25%, 50% and 80% of S layers), illite-smectite (I-S), Fe-rich illite and Al-rich illite. Kaolinite, smectite and illite layers had high octahedral Fe contents. The 2-0.2 mm size fraction contained more kaolinite-rich K-S and Fe-rich illite minerals, with higher structural order, than the < 0.2 mm fraction, which had more smectite-rich mixed-layered phases. In the AC samples, the Fe-illite content was higher than in BR samples. Fe^{2+}/TotFe proportions, from the combination of XRF and Mössbauer spectroscopy data, is higher in samples of the 2-0.2 mm size fraction (10-16%) than in the < 0.2 mm size fraction (2-3%). The deposited kaolinite is progressively transformed into smectite via K-S. This step includes the formation of a new tetrahedral sheet, gradual substitution of cations in tetrahedral (Al for Si) and octahedral sites (Fe+Mg for Al), and intercalation of cations. It leads to formation of Fe-rich smectite layers. The second step is the illitization of smectite layers, which includes further Fe substitution for Al and and Fe reduction. This is concluded because both total Fe and Fe^{2+}/TotFe proportion in the 2-0.2 mm size fraction correlated very well with Fe-illite contents from XRD. The AC samples have higher Fe-illite content because continental 2:1 clays are deposited in the mangrove and they are transformed more quickly into Fe-illite than kaolinite. We conclude that Fe sequestration and reduction during illitization are important biogeochemical processes operating in mangrove soils.

Keywords: mixed-layered clays, XRD modelling, bioreduction, Fe-clays

Financial support: São Paulo State Research Foundation, FAPESP (grants no. 2011/13924-0 and 201317571-0)

(9298 - 726) Mineral-life interaction in the soil environment

Javier Cuadros[1]

Natural History Museum, Department of Earth Sciences, Cromwell Road, London, SW7 5BD, UK (j.cuadros@nhm.ac.uk)[1]

Soils first formed perhaps as early as 3,000 My ago, when the first bacteria may have invaded the land. Later, from perhaps 1,300 to 450 My ago the sequential incursion of fungi, algae, lichens, plants, and invertebrates made life's role in shaping soil morphology and mineralogy increasingly important. The physiological drive of living organisms and their ability to generate microcosms of "extreme conditions" is likely to override inorganic processes if living organisms are in sufficient concentration. Physical and chemical processes involved in the formation of soils are generally well characterized and relatively well understood. Biological processes are not. Among living organisms developing on rocks and in soils, microorganisms are the most efficient modifiers of inorganic processes because they are the most abundant. Rock weathering and soil types correlate well with climatic zones, which is interpreted as soil development to be controlled by the physico-chemical conditions generated by temperature and precipitation regimes. However, climate and biological activity are also correlated and we may be underestimating the role of biological activity in soil formation and development. Biological weathering (physical disruption of minerals; dissolution or chemical change of minerals) is faster than inorganic weathering (measurements range from similar to orders of magnitude faster). However, biological protection of minerals has been observed to slow down inorganic weathering. Mineral dissolution rate in nature is orders of magnitude lower than in experiments. Reasons of experimental character are partially responsible for this difference. However, if living organisms always accelerate weathering why do we not ever measure faster dissolution in nature? Biological activity may have a net effect of mineral protection in the long term. Two considerations support this hypothesis: the protective effect of polymeric coatings and the possibility to retrieve inorganic nutrients

from biological litter rather than the inorganic soil. Biological activity can change the direction and products of mineral weathering, and can incorporate entirely new minerals that change the character of the soil (e.g., biogenic carbonate). In all microbial activity "encapsulation" is crucial: mineral-microbial interaction takes place in a small volume controlled by the microorganisms. Otherwise, inorganic physico-chemical conditions prevail.

Keywords: Biological activity; microbial activity; mineral protection; mineral weathering.
Financial support: Natural History Museum, London, UK

(4971 - 1804) Physical and mineralogical changes of the soil by the action of termites

Tatiele Fruett Dos Santos[1]; Alberto Vasconcellos Inda[1]; Antonia Finkler Dias Fernandes[1]; Keyrauan Taha[1]
Universidade Federal do Rio Grande do Sul[1]

Termites are predominant organisms of significant importance in soil. Soil termites are seen as "ecosystem engineers" and some as "keystone species" because they are important for survival and maintenance of other species. They are known for their effects of soil bioturbation, moving particles vertically and horizontally. The objective of the study was to verify physical and mineralogical alterations in the soil of termite mounds in relation to the adjacent soil used for the construction. Samples were collected in four Brazilian states: Rio Grande do Sul (RS), Mato Grosso (MT), Piauí (PI) and Minas Gerais (MG). Soil samples were collected in the 0 to 20 cm layer at adjacente area to termite mounds, under natural vegetation condition and without evidence of visible termite action. The samples of termite mounds were collected in the median and top portions. The samples were air dried and passed through a 2 mm sieve to obtain the air-dried fine soil (ADFS). The particle size analysis was performed by the pipette method and clay was collected for the preparation of slides oriented to the analysis of minerals by X - ray diffraction (XRD). The specific surface area (SSA) of the soil was estimated in the ADFS by the water adsorption method. The magnetic susceptibility analysis was performed in low (χLF) and high (χHF) frequency in magnetometer apparatus with dual frequency sensor (MS2 System). The XRD analyzes did not indicate mineralogical changes between the materials analyzed in the soil and in of termite mounds. However, more intense reflections of quartz were observed in the soil samples in relation to the of termite mounds samples. In addition, were observed in the diffractograms of termite mounds more intense reflections related to kaolinite (RS, PI, MG, MT) and gibbsite (MG). These results indicate a selection / preference of termites for smaller particles. This was confirmed both by the textural analysis, which indicated that termite mounds materials presented higher clay content in relation to adjacent soil samples; as by the SSA analysis, which was higher in the samples collected in térmite mounds. Magnetic susceptibility was higher in soil samples adjacent to termite mounds, possibly due to the higher concentration of magnetite in the coarser fractions of ADFS. However, the content of maghemite was higher in the thermals, where the clay contents were higher.

Keywords: Mineralogy, termites, selectivity.
Financial support: CNPq

C2.5 - Soil chemical, physical and biological interfacial reactions

C2.5.1 - Soil interfacial reactions and their control of biogeochemical cycles

(4831 - 2036) A molecular dynamic study of water molecule on mica surface under different surface electrical field strength

Qinyi Li[1]; Gang Yang[1]
Southwest University[1]

The structure and dynamic properties of interfacial water are crucial to many physical chemistry processes in soil, such as adsorption/desorption on mineral surface, ion diffusion in nonpores, etc. Here, we report a molecular dynamic study of interfacial water molecule on mica surface under different electrical field strength. In this study, five different charged mica surfaces implemented by using aluminum atom substitute the silica atom. The result shows that the water molecules near charged surface are highly oriented when the electrical field strength is high, and the dipole orientation of all interfacial water is between 130-150 degrees. This means both hydrogen atoms of water point to the mica surface, so that the water can interact with mica surface directly by forming hydrogen bonds with the surface. When electrical field strength is low, the dipole orientation of water molecule becomes vary which means that the structures of water is less ordered. However, when the mica surface is zero charged, the interfacial water presents a highly ordered situation, while the dipole orientation is around 85 degrees which means that the hydrogen atoms of water are pointed away from the mica surface. This result indicates that the hydrogen atoms of interfacial water will form hydrogen bonds with water molecule other than interact with the mica surface. This is to say that the mica surface becomes hydrophobic when the surface charge comes to zero. The diffusion coefficient of water are also calculated. Under high electrical field strength, water has the lowest diffusion coefficient; and when electrical field strength are zero, the diffusion coefficient of water is a little higher. Nevertheless, when the electrical field strength is low, the water diffusion coefficient are the highest. From those results, we could conclude that the charge on mineral surface may affect the properties of hydrophobic/hydrophilic of the surface. And charges on the surface are not always increase the interfacial water order. It depends on the strength of the electrical field strength near surface. The electrical field strength may make the interfacial water more "active", which to some extent promote the interactions occurred on mineral-water interface.

Keywords: molecular dynamic simulation, mineral, water, interface
Financial support:

(3221 - 1101) An improved method to synthesize pure allophane

Yang Li[1]; Tao Wang[2]; Marta Camps-Arbestain[1]; Qinhua Shen[1]; Catherine Whitby[3]
Institute of Agriculture and Environment, Massey University, Private Bag 11222, Palmerston North 4442, New Zealand[1]; Department of Biology, Microbial Ecology Group, Lund University, Ecology Building, SE-223 62 Lund, Sweden[2]; Institute of Fundamental Sciences, Massey University, Private Bag 11222, Palmerston North 4442, New Zealand[3]

Currently, allophane is most commonly synthesised following a 3-step method that includes the production of allophane precursor, its hydrothermal incubation, and the post-treatment of the resultant allophane with sodium chloride at high pH (ca 10). The post-treatment of allophane is generally conducted by dialysis (DI) or repeated washing with deionised water followed by centrifugation (WC). However, these methods have their own drawbacks; for instance, DI is a very time consuming step for the pH adjustment of allophane due to its high pH-buffering capacity, while WC often has a low product recovery resulting from the loss of unsettled allophane nanoparticles. In order to improve the post-treatment, new methods, adding HCl prior to the use of traditional methods, were used and evaluated based on allophane recovery, time demand, and properties of treated allophane and compared with traditional methods. The results indicated that the improved method, combination of HCl addition and subsequent WC (HCl+WC), could achieve not only a high specific surface area, low salt concentration, but significantly greater recovery (> 80%) in a shorter time period compared with traditional methods. Based on the results obtained, we concluded that the improved protocol (HCl+WC) is the most suitable for the batch production of

synthetic allophane.

Keywords: Allophane synthesis; Post-treatment modification; Allophane recovery; Allophane property; Time demand
Financial support: Massey University Funding and China Scholarship Council

(5113 - 695) Application of biocomposites with Fe hydroxide and extremophilic red microalgae on Pb removal

Yu-Ting Liu[1]; Yen-Lin Cho[1]

National Chung Hsing University[1]

Due to the tolerance for a wide range of temperature (room temp - 56 ℃) and acidity (pH 0.2 - 5), the Cyanidiales are considered as one of few extremophilic red microalgae. In this study, the tested Cyanidiales were collected from the Yangmingshan National Park in Taiwan. Because of the typical mineralogy, the soils and waters in this area are enriched with As and Pb. Given that their abundance is not dependent on the concentrations of As and Pb, the Cyanidiales are proposed as the potential materials for the remediation of heavy metals, especially in the acidic wastewater and soils that received contaminants from mining and industrial activities. While the Cyanidiales form complex with the environmentally ubiquitous Fe hydroxides, the bonding with surfaces of the Cyanidiales hinders the accumulation of nanoparticles of Fe hydroxides, leading to a promoted removal efficiency for heavy metals. Meanwhile, surface functional groups of Cyanidiales would transfer electrons to Fe atoms and thereby increase the redox activity of Fe hydroxides. This attribute enables Fe hydroxides to detoxify heavy metals by redox transformation during the metal removal process. Collectively, this innovative biocomposite material consisting of Cyanidiales and Fe hydroxides shows the promise the optimize efficiency in the accumulation and redox transformation of heavy metals.

Keywords: Cyanidiales; Fe hydroxide; biocomposite material; heavy metal removal
Financial support: MOST 104-2311-B-005 -016 -MY3

(2756 - 2420) Availability of phosphorus in Oxisols in function of incubation time and remaining phosphorus

Tainah Manuela Benlolo Barbosa[1]; José Zilton Lopes Santos[1]; Carlos Alberto Franco Tucci[1]

Federal University of Amazonas[1]

Soils developed under similar moisture and temperature regimes can respond differently to phosphate fertilization. The aims of this study were to evaluate the effect of incubation time of phosphate with Oxisols on availability and uptake of phosphorus by sorghum plants. Nine samples of dystrophic Yellow Oxisols were collected in a depth of 20 cm randomly, under native forest, in Amazonas state, Brazil. The soils were arranged in four groups, according to remaining phosphorus (P-rem): 5.6; 12.5; 17.2 and 22.2 mg L^{-1}, which received 455; 385; 320 and 185 mg dm^{-3} of P (KH_2PO_4), respectively. The P was incubed for five periods (0, 15, 30, 60 and 120 days), at the end of each incubation time the recovered P was determined (anion exchange resin). Sorghum was grown for 50 days in a greenhouse pot-culture study and the P content was determined in flag leaf. Soil with higher level of P-rem provided a higher recovery (67.5%) of P to the 30 days compared to other incubation times, however not significantly different ($p<0,1$) from 15 and 60 days. In the other soils (Prem =17.2, 12.5 and 5.6), the higher recovery of P is associated with lowest times of incubation, specialy in soils with P-rem = 12.2 and 5.6 mg L^{-1}, but there was no significant difference in comparison to 0 and 15 days. In relation to shorter contact times, the soils with 12.2 and 5.6 mg L^{-1} of P-rem had a higher rate of recovery of applied P (≈ 60.5%), while the soil with higher P-rem (22.2 mg L^{-1}) had the lowest rate of recovery of P (43.5%). In general, the lowest levels of recovered P were observed in the longer incubation time, especially in soils with higher P-rem. In longer incubation times, the soil lower P-rem (5.6 mg L^{-1}) presented the higher rate of recovery while the lowest recovery rate was observed in soil with 22.2 mg L^{-1} of P-rem. The P content in leaves of sorghum in the soils with 22.2 and 17.7 mg L^{-1} of P-rem not showed statistically significant diference. In the soil with 12.5 mg L^{-1} of P-rem the highest P leaf content were observed in the shorter time of incubation, but opposite behavior was observed in soil with P-rem = 5.6, which presented the highest values of leaf P in longer incubation time. The results confirm that the effect of incubation time in P availability vary among the soils. There is reduction in phosphorus availability in soils in long incubation time. The P uptake by sorghum plants dependend on nutritional requirement not on the absolute concentration of phosphus.

Keywords: Phosphorus, *Sorghum bicolor* L., recovered P, humid tropic.
Financial support: To coordination for the improvement of Higher Education Personnel (CAPES) for the support awarded to the second author.

(2111 - 255) Can leguminous trees increase soil phosphorus availability? A link between the P and N cycles in tropical forests and agroforests of Brazil

Antonio Carlos Gama-Rodrigues[1]; Seldon Aleixo[1]; Jan Schripsema[1]; Emanuela Forestieri Gama-Rodrigues[1]

Universidade Estadual do Norte Fluminense Darcy Ribeiro[1]

Understanding the role of leguminous trees for phosphorus (P) and nitrogen (N) cycling in tropical soils is relevant for conservation of natural forests as well as the sustainable management of agroforests with low P input in the Atlantic Forest region of Brazil. We assessed the selected sites: 1) 0% leguminous trees mix cover; 2) 75% leguminous trees mix cover; 3) *Acacia auriculiformis;* 4) *Mimosa caesalpinifolia*; 5) *Acacia mangium;* 6) *Gliricidia sepium*; 7) low input of nitrogen fertilizer; 8) secondary forest; 9) spontaneous vegetation and 10) pasture without grazing. Soil P species (0-10 cm) was extracted with a solution of 0.25 M NaOH + 50 mM Na_2EDTA in conjunction with ^{31}P nuclear magnetic resonance (^{31}P NMR) spectroscopy operating with proton decoupling at 202.446 MHz with a 5 mm probe, using a 6.0 µs pulse (30°), an acquisition time of 0.4 s, an delay time of 0.5 s operating at 21 °C. Approximately 30,000 scans were acquired for each sample. Total soil ^{31}P NMR ranged from 192 to 465 mg kg^{-1} (37-83% of total soil P). Soil organic P (Po) ranged from 49 to 199 mg kg^{-1}, with the predominance of phosphate monoesters (P-monoester) ranging from 42 to 133 mg kg^{-1} (65-85% of total Po), while phosphate diester (P-diester), in the DNA form, ranged from 4 to 17 mg kg^{-1} (6-9% of total Po). The highest concentrations of *myo*-hexakisphosphate (*myo*-IHP) were found in the site with low input of nitrogen fertilizer (85.7 mg kg^{-1}) and all leguminous trees sites (mean of 87.6 mg kg^{-1}). There was a positive correlation between *myo*-IHP and *scyllo*-IHP, and both strongly and positively correlated with inorganic orthophosphate (*ortho*-P), pyrophosphate, glucose-1-phosphate and DNA. *Ortho*-P ranged from 123 to 236 mg kg^{-1} (82-89% of total inorganic P), while pyrophosphate ranged from 19 to 38 mg kg^{-1}. The highest concentration of pyrophosphate was found in the site with low input of nitrogen fertilizer (38 mg kg^{-1}), while for all leguminous trees sites the average concentration of this P species was 34 mg kg^{-1}. In conclusion, the results indicated that leguminous trees can be a suitable tool to increase the concentrations of P species (inorganic and organic) in tropical soils.

Keywords: leguminous trees; nitrogen fertilization; solution ^{31}P NMR spectroscopy.
Financial support: CNPQ – Grant 2013/475222-0 (Universal Project).

(8764 - 2897) Carbon contents in aggregates under black oat cultivation in the municipality of Nova Friburgo RJ

Douglath Alves Corrêa Fernandes[1]; Sandra Santana de Lima[1]; Jayna Eloy da Rocha[1]; Adriana Maria de Aquino[2]; Marcos Gervasio Pereira[1]
Universidade Federal Rural do Rio de Janeiro[1]; Empresa Brasileira de Pesquisa Agropecuária[2]

The growing of black oats promotes the contribution of organic matter in the soil and benefits to its structure. The objective of the research was to evaluate the carbon content in different compartments of organic matter in aggregates biogenic and physiogenic in areas with black oats under different management. The research was carried out in the Municipality of Nova Friburgo-RJ in conservationist production systems, located in an area of mountainous relief. Two areas of study were selected: AV-N area - managed with unfertilized black oats since the second half of 2011. Annually the plowing and the replanting of the oat are done at the end of the winter. Before plowing the oats are desiccated through the application of herbicides; area AV-A - managed with black oats since 2012, being fertilized with NPK formulation 4-14-8 (1 Mg ha^{-1}) and an area of forest - fragment of Atlantic Forest without record of anthropic action in the last 60 years. Soil clusters were collected and from these were separated aggregates of soil in 8 and 9 mm sieves. Subsequently the aggregates were classified according to the biogenic and physiogenic formation pathways. The total organic carbon content (TOC) and the particle size fractionation of the organic matter were analyzed by quantifying the particulate organic carbon (POC) associated with the sand and organic carbon fraction associated with the minerals (OCam) of the silt and clay fractions obtained by difference between TOC and POC. Among the areas, the highest TOC levels were observed in AV-A. Regarding the granulometric fractionation only OCam showed a difference, with the highest values observed in the AV-A area. Among the aggregate classes there was no difference between the biogenic and physiogenic aggregates for the TOC, POC and OCam contents, and the values in the cultivated areas close to those of the preserved forest area. The growth of black oats besides adding organic matter to the system also contributes positively to the soil aggregation and the formation of biogenic and physiogenic aggregates in a similar quantity to the area without anthropic action.
Keywords: organic matter; biogenic; physiological
Financial support: CAPES, EMBRAPA

(6952 - 297) CO_2 efflux over a hill with different water contents due to heterogeneities in soil texture

Tiago de Carvalho Pessoa[1]; Vânia da Silva Fraga[1]; Borja Ruiz Reverter[1]; Galileu Medeiros da Silva[1]; Júlia Eudócia de Araújo Monteiro[1]
Universidade Federal da Paraíba[1]

Soil CO_2 efflux is the major component of the carbon released to the atmosphere, but its main drivers and features are still under debate. In our work, we quantified the CO_2 efflux at three different locations over a heterogeneous hill, which presented different water contents due to heterogeneities in soil texture. Static chambers based on absorption by caustic soda (NaOH) were used to collect the CO_2 from soil during 24 horas periods, whose concentration were subsequently determined by acid-base titration. Soil water content was measured by reflectometry at 0-10 cm depth. The soil type of the hill was Acrisol with a clay texture at the shoulder and at the backslope and a sand texture at the footslope. We found that low water contents decrease the carbon releases. In fact, at the shoulder and at the backslope the least carbon emissions (1.5 µmol m^{-2}s^{-1}) were related to 0.05 cm^{3}cm^{-3} of water content and to 0.03 cm^{3}cm^{-3} at the footslope (1 µmol m^{-2}s^{-1}). On the other hand, the highest carbon releases (4 µmol m^{-2}s^{-1} at the shoulder and 5 µmol m^{-2}s^{-1} at the backslope) were found for water contents between 0.11 to 0.16 cm^{3}cm^{-3}, while at the footslope the major carbon releases (7 µmol m^{-2}s^{-1}) took place for water contents between 0.06 and 0.011 cm^{3}cm^{-3}. Maximum carbon emissions were registered for water contents of 0.146 cm^{3}cm^{-3} at the shoulder, 0.107 cm^{3}cm^{-3} at the backslope and 0.068 cm^{3}cm^{-3} at the footslope. These differences in the water content were attributed to soil textures heterogeneities, which influence water retention and water availability for biological activity. Nevertheless, we also found some events of water content above 0.17 cm^{3}cm^{-3} at the shoulder and at the backslope and 0.11 cm^{3}cm^{-3} at the footslope, that decreased the carbon emissions probably due to the filling of the soil pores that, firstly, expel the gases and, second, hinder the CO_2 diffusion. We conclude that heterogeneities in soil texture over our hill influences the content of soil water, which in turn influences carbon emissions, not only by enhancing them, but also by limiting them at high water contents.
Keywords: keywords: CO_2 efflux; soil water content; sloping terrain; soil texture
Financial support: CAPES (Coordenação de Aperfeiçoamento de Pessoal de Nível Superior)

(8939 - 769) Differences in surface elemental composition between intact and homogenized soil microaggregates reflect the specific location of elements

Susanne K. Woche[1]; Stefan Dultz[1]; Robert Mikutta[2]; Joerg Bachmann[1]; Georg Guggenberger[1]
Institute of Soil Science, Leibniz Universität Hannover, Herrenhäuser Str. 2, 30419 Hannover, Germany[1]; Soil Science and Soil Protection, Martin Luther University Halle-Wittenberg, Von-Seckendorff-Platz 3, 06120 Halle (Saale), Germany[2]

Soil microaggregates (SMA; <250 µm) are of special interest as they are considered to be more stable than larger structures and thus potentially sequester more organic matter. Formation as well as stability of SMA likely depend on surface properties (e.g., exposed functional groups, surface charge, wettability) of aggregate building units involved such as small minerals or organic matter. Application of X-ray photoelectron spectroscopy (XPS) to water-stable SMA isolated from Luvisols along a clay gradient revealed some differences in the elemental composition of the surface layers as function of SMA origin (free or occluded SMA), size fraction, and bulk soil clay content. To assess the enrichment or depletion of elements within the surface layer in order to gain more insight in SMA functioning demands comparison of the surface element composition with data from bulk analysis. However, element amounts derived from XPS analysis and common bulk analytical techniques such as e.g. chemical digestion followed by ICP analysis or XRF usually are not directly comparable due to different analytical principles. Here, we suggest a different approach by homogenizing SMA manually in a mortar in order to create quasi-bulk material that can be analyzed by XPS along with intact SMA. First results for 53-250 µm-SMA revealed some marked differences between intact and homogenized SMA. The most striking result was a distinctly smaller N content of the homogenized SMA. This may indicate the surface layer to be the preferred habitat of microorganisms. Along with the decrease in N an increase in C content was observed which may point on some enrichment of C within the

SMA that thus may be more stabilized. Further, the content of Na and K was increased for homogenized SMA, probably indicating the presence of alkali feldspar and illite and/or micas rather within SMA where weathering will be delayed. This may be supported by the slightly decreased Si/Al ratio after homogenization, which at the same time, together with a concurrently slight decrease in O content, may indicate quartz to be more prominent within the surface layer. The results so far suggest manual homogenization to be a useful tool to identify differences in element contents between SMA surface layer and SMA bulk composition. Contrary to surface sputtering, where material is removed from the system, homogenization preserves all compounds present and only destroys their original arrangement.
Keywords: Soil microaggregates, element enrichment, XPS
Financial support:

(8433 - 735) Diurnal variation in soil heterotrophic and total carbon dioxide emission

Jesus Rosario Mancilla Huashuayo[1]; Nisa Novita[2]; Louis-Pierre Comeau[3]; Jodie Hartill[4]
MCF Fredericton Canada[1]; Center for International Forestry Research[2]; Agriculture and Agri-food Canada[3]; University of Aberdeen[4]

Assessment of CO2 emissions are usually made by day-time measurements and only a few studies have measured in situ heterotrophic respiration at night. Therefore, current estimates of annual CO2 fluxes based on day-time measurements may have systematic errors. The goal of this study was to measure the diurnal (i.e. day and night) variation of heterotrophic CO2 fluxes and total respiration from the soil surface, and to compare it between ecosystems. The study sites were deep peat coastal in Indonesia, mineral forest soil in Hong Kong and mineral agricultural soil in Eastern Canada. Soil CO2 fluxes were measured with an infrared gas analyzer in dark closed chambers. Measurements were made every 3 h during a 24 h period. The experiments were conducted twice in each ecosystem. Simultaneously with CO2 flux measurements, water table depth, air and soil temperatures were also recorded. A total of 72 measurement spots were studied. The diurnal CO2 flux pattern of each individual collar was analyzed using the Q10 approach and by fitting a 24h cosinor wave curve to determine the circadian oscillation. Overall, only 12/72 and 14/72 measured units displayed a significant diurnal variation using the Q10 and circadian oscillation methods, respectively. The circadian oscillation method had the advantage over the Q10 approach of automatically estimating the diurnal flux amplitudes and peak emission times. In addition, compared to the Q10 approach, the circadian oscillation analyses were not biased due to delays in the microbial activity response to temperature change and other environmental variables that affect CO2 fluxes. The median peak emission time from the fitted circadian wave curve was between 13:02 and 13:34. The average diurnal flux amplitude from the circadian fitted curves was 0.28 (±0.05) g CO2 m2 h-1. Due to the low number of significant measured units, the observed large range of potential peak emission times and the relatively small amplitude in diurnal fluxes, we conclude that for scaling CO2 measurements to represent a daily flux, the widely expressed concern about temporal variability is not particularly pertinent. Therefore, emphasis in sampling schemes should be on a spatial rather than temporal replication.
Keywords: Circadian rhythm oscillation, Q10, night CO2 emission, greenhouse gases
Financial support: Grant Agreement 226310, European Community's Seventh Framework Programme

(3064 - 2008) Dynamics of greenhouse gas emissions during anaerobic soil disinfestation in vegetable soils

Kun Zhu[1]; Chen Wang[1]; Guitong Li[1]
China Agricultural University[1]

Anaerobic soil disinfestation (ASD) is proposed as an alternative to chemical soil fumigation for the control of several soil-borne diseases, plant-parasitic nematodes, and weeds in a variety of crops. Limited information is available on the impact of ASD on greenhouse gas emissions. The current study aims to investigate the effects of ASD applied using crop residues as amendments, on soil oxygen (O_2), pH, temperature, soil nutrient content, and emissions of carbon dioxide, methane and nitrous oxide (CO_2, CH_4 and N_2O). A laboratory experiment and a greenhouse trial were simultaneously conducted. The O_2-specific planar optode system in lab was employed to continuously monitor soil O_2 profile with high spatiotemporal resolution during the ASD period. The stable isotope ^{15}N labelled KNO_3 was applied in the greenhouse trial to monitor the N transformations. Compared with the treatment without crop residue amendments, addition of crop residues resulted in robust metabolic activity, inducing much larger peak GHG emissions, particularly 800 times higher of N_2O peak emission rates during the first week, and 1000 times higher of CH_4 peak emissions rates during the second week. The monitored O_2 profile in soil clearly indicated that a quick shift of the soil environment from aerobic to anaerobic conditions occurred for the initial few days, which stimulated the denitrification processes. The ^{15}N site preference (SP) and $\delta^{18}O$ of emitted N_2O indicated a mixture of production sources during ASD treatment period. Adding crop residue 5 days before ASD treating process significantly immobilized nitrate in soil, therefore reduced the substrate availability of denitrification, consequently mitigated N_2O emissions. Due to the high capacity of labile carbon sorption on biochar particles, crop residue coupled with biochar addition reduced both CH_4 and N_2O emissions. Those results suggest that both pre-immobilization of nitrogen by earlier crop residue addition and co-application of biochar would mitigate GHG emissions effectively, therefore could potentially improve the strategies of anaerobic soil disinfestation.
Keywords: Biological soil disinfestation, Nitrous oxide emissions, Crop residues, biochar addition
Financial support: Chinese National key R&D plan 2017YFD0200801-02

(3156 - 650) Effect of drought on soil consolidation, and associated changes in decomposition and aggregation

Asmeret Asefaw Berhe[1]; Chelsea Arnold[1]; Teamrat A. Ghezzehei[1]
University of California, Merced[1]

While peatlands are garnering much attention for their greenhouse gas feedback potential in a warming climate, the coupled biogeochemical and hydrological impact of structural and physical changes in these types of systems as a result of drought-induced drying and desiccation has not been studied in detail. The cyclic drawdown/recharge of the water table that exists in most peatland systems impose important controls on organic matter storage and decomposition as well as soil physical properties. In order to better understand how high elevation peatlands will respond to increasingly dry years, we incubated meadow soils collected along a hydrologic gradient at 5 different water potentials and measured the CO_2 flux at intervals for over one year to determine how desiccation of meadow soils (from the Harvey Monroe Hall Research Natural Area at the crest of the Sierra Nevada) influences gaseous fluxes of C, as well as aggregation of the organic-rich soils and distribution of the soil C in different physical pools (macro- vs. micro-aggregate, and silt+ clay fractions). We found that the cumulative carbon mineralization was greatest at the highest (0.1 bar) and lowest (4 bar) water potential,

across all regions of the meadow, indicating the presence of two separate pools of labile carbon that can be accessed only after a threshold of drying is reached in the soil. We also observe important changes associated with aggregate size distributions and fraction of total carbon distributed in three distinct pools.
Keywords: aggregation, green house gas fluxes, drought
Financial support:

(3496 - 1575) Effect of long-term organic matter manipulation on soil biological activity in a temperate oak forest

Zsolt Kotroczó[1]; Katalin Juhos[1]; Imre Berki[2]; István Fekete[3]
Department of Soil Science and Water Management, Szent István University, 29-43. Villányi út,Budapest, 1118, Hungary[1]; Institute of Environment and EarthSciences, University of Sopron, Ady u. 5, 9400 Sopron, Hungary[2]; Department of Soil Science and Water Management, Szent István University, 29-43. Villányi út,Budapest, 1118, Hungary; Institute of Environmental Sciences, University of Nyíregyháza, Nyíregyháza, Sóstói út 31/B Hungary[3]

The DIRT treatments are derived from a project started in 1957 in forest and grassland ecosystems at the University of Wisconsin. The Síkfőkút DIRT (Detritus Input and Removal Treatments) Project (Hungary; N 47°55' E 20°26') joined with the American ILTER DIRT network which was organized by the US-ILTER (International Long-Term Ecological Research).According to the FAO World Reference Base, the soils are Luvisols. The site has *Quercetum petraeae-cerris* community. During our examinations, we studied the effects of modified litter production on the organic matter content of soil. It also studies how the modifications, decreases or increases in litter production influence the biological processes of soils.Our examinations were carried out in spring periods, on the permanent experimental parcels which were established in 2000. According to ourresults, the activity of soil enzymes and soil respiration are rather influenced by the drastically decreasing amount of leaf litter than increasing leaf litter production which has surpassed its natural level. pH values of the soil fulfilled our expectations, since leaf litter withdrawal lead to lower (more acidic) pH values (NL=5.41; DL 6.41; Co6.32). After 5 years there was a significant difference between the treatments in soil respiration (p=0.012) and enzyme activity. In the NL plots (22.348 mgC/m^2/h), the CO_2 emission of the soil was significantly lower than that of C (29.832 mgC/m^2/h). However, the effect of the increased amount of litter has not shown the expected results of the DL treatment(28.963 mgC/m^2/h). Treatments with leaf-litter addition samples showed the highest activities, while treatments with leaf-litter withdrawal could be describedsignificantly lower activities. Remarkably, dominancy of DL (which treated with the largest amount of biomass) against Co and DW could not be detected by none of the examined enzymes. There wa sno significant relationship between treatments in case of *ß*-glucosidase enzyme and the soil respiration (p>0.050; R=0.213). The aryl-sulphatase and saccharase activity of soil in the litter withdrawal treatments (NL, NR, NI) showed lower values than in the other three treatments.
Keywords: soil organic matter; enzyme activity; DIRT treatment; long-term manipulation
Financial support: Project no. 126478 has been implemented with the support provided from the National Research, Development and Innovation Fund of Hungary, financed under the KH_17 funding scheme

(6760 - 407) Effect of soybeans inoculation and nitrogen fertilization on soil nitrogen content in a sandy soil

Carlos Felipe dos Santos Cordeiro[1]; Fábio Rafael Echer[1]
Universidade do Oeste Paulista (UNOESTE)[1]

Nitrogen (N) is the most important nutrient for plants, and for legumes it cames from biological nitrogen fixation (BNF), and also from N availability in the soil. On the other hand, the amount of soil organic matter in sandy soils is low and N content available for plants is very low. The objective of this study was to evaluate the response of soybean to inoculation in interaction with nitrogen fertilization, in an area of first and second year of soybean cultivation. The experiment was carried out in the field in Presidente Bernardes-SP-Brazil. The experimental design was a split plot within a randomized complete block, with four replications. In the plots the inoculant doses were allocated (0, 4, 8 and 12 ha^{-1}) and in the subplots the nitrogen doses (0, 25, 50 and 100 kg ha^{-1}). The inoculation was performed by the spraying in the furrow. The fertilization in the plots that received the nitrogen (ammonium nitrate) was performed at R1 stage. In R4 stage, soil was sampled at depth of 0-20 cm, to determine the amounts of N-organic and N-inorganic (NH_{4+} and NO_{3-}). At soybean physiological maturity, the yield was evaluated, by mechanical harvest of the three central lines of the plot. The statistical study consisted of analysis of variance and regression (P<0.05). In both, first and second year areas of soybean cultivation, the highest N-total contents were achieved with 12 inoculant doses and 100 kg ha^{-1} N, with values of 202 and 234 mg kg^{-1}, respectively. In the control treatment, the N-total content was 45% higher in the older area as compared to the first-year area. NH_{4+} and NO_{3-} contents were similar, representing 6% of N-total. In the first-year area, the highest soil-N contents were achieved with 4 doses of inoculant and 100 kg ha^{-1} of N (NH_{4+} 7.04 and NO_{3-} 6.08 mg kg^{-1}). However, in the second-year area the highest values were achieved with the maximum doses of nitrogen and inoculant (NH_{4+} 9.48 and NO_{3-} 8.72 mg kg^{-1}). The highest yield in the first-year area occurred with application of 12 doses of inoculant and 100 kg ha^{-1} of N (2883 kg ha^{-1}), yet in the second-year area the application of 8 doses of inoculant (2299 kg ha^{-1}) reached the maximum yield. In conclusion, increasing inoculant and nitrogen doses improved soil N-organic and N-inorganic contents in first and second year areas, and enhanced soybean yield in the first-year of cultivation area.
Keywords: biological nitrogen fixation (BNF), mineral fertilizer and first-year soybean area.
Financial support: Foundation for Research Support of the State of São Paulo - FAPESP.

(3668 - 669) Effects of long-term fertilization on the pathways in N supply

Qiang Ma[1]
Institute of Applied Ecology, Chinese Academy of Sciences[1]

Fertilizer N can be conserved through immobilization by microorganisms and fixation by soil clay minerals, and then subsequently remineralized and released. These processes are significantly influenced by soil fertility levels and fertilization history. Based on a long-term *in-situ* experiment, the effects of different fertilization regimes on the seasonal fluctuations of soil microbial biomass N (SMBN) and fixed NH_4^+ were investigated during one maize (*Zea mays* L) growing season, including six treatments, i.e. CK (unfertilized control), M (recycled pig manure), NP (mineral fertilizers N and P), NPK (mineral fertilizers N, P and K), NPK+M (recycled pig manure with mineral fertilizers N, P and K), and PK (mineral fertilizers P and K). The results showed that the response of soil fixed NH_4^+ to chemical fertilizer N application was observed during the growing season. In the treatments containing fertilizer N, the peaks in fixed NH_4^+ achieved after top dressing, accounting for an average of 40.8%

of fertilizer N was fixed by soil minerals. Subsequently, fixed NH_4^+ released slowly and contributed to the N supply. In the treatments receiving fertilizer N, the release of fixed NH_4^+ was 1.1-fold greater on average than the mineralization of SMBN, whereas the latter was 2.3-fold greater than the former in the treatments without fertilizer N. Moreover, the greatest N supplying capacity of SMBN obtained in the M treatment, which received recycled manure alone. Therefore, our study indicates that the pathways in N supply varied according to the fertilization regimes. With N fertilizer application, fixed NH_4^+ pool was the major pathway in N supply, whereas SMBN was the primary approach of N supply when no fertilizer N applied.

Keywords: Long-term fertilization; Fixed ammonium; Soil microbial biomass N; Seasonal dynamic

Financial support: The National Key Technology Research and Development Program (No. 2015BAD05B01) and the National Natural Science Foundation of China (No. 41471250)

(4269 - 261) Effects of rice cultivars on CH_4 emissions and their possible interaction with soil C availability

Weijian Zhang[1]; Yu Jiang[1]

Institute of Crop Sciences, Chinese Academy of Agricultural Sciences, Beijing 100081, China[1]

Breeding high-yielding rice cultivars through increasing biomass is a key strategy to meet rising global food demands. Yet, increasing rice growth can stimulate methane (CH_4) emissions, exacerbating global climate change, as rice cultivation is a major source of this powerful greenhouse gas. Here, we show in a series of experiments that high-yielding rice cultivars actually reduce CH_4 emissions from typical paddy soils. Averaged across 33 rice cultivars, a biomass increase of 10% resulted in a 10.3% decrease in CH_4 emissions in a soil with a high carbon (C) content. Compared to a low-yielding cultivar, a high-yielding cultivar significantly increased root porosity and the abundance of methane-consuming microorganisms, suggesting that the larger and more porous root systems of high-yielding cultivars facilitated CH_4 oxidation by promoting O_2 transport to soils. Our results were further supported by a meta-analysis, showing that high-yielding rice cultivars strongly decrease CH_4 emissions from paddy soils with high organic C contents. Based on our results, increasing rice biomass by 10% could reduce annual CH_4 emissions from Chinese rice agriculture by 7.1%. Our findings suggest that modern rice breeding strategies for high-yielding cultivars can substantially mitigate paddy CH_4 emission in China and other rice growing regions.

Keywords: Methanogenesis, methanotrophy, soil carbon, roots, meta-analysis

Financial support: This work was supported by the National Key Research and Development Program China (2016YFD0300903, 2016YFD0300501, and 2015BAC02B02).

(8276 - 1091) Formation and genesis of natural nanoparticles (NNPs) in flooding Pb-Zn mine tailing soil

Kengbo Ding[1]; Miaoyue Zhang[2]; Man Zhao[3]; Can Feng[3]; Xi Zhong[3]; Yaying Li[2]; Erkai He[2]; Yuanqing Chao[2]; Shizhong Wang[2]; Rongliang Qiu[2]

School of Environmental Science and Engineering, Sun Yat-sen University, Guangzhou 510275, China (dingkb@mail2.sysu.edu.cn)[1]; School of Environmental Science and Engineering, Sun Yat-sen University, Guangzhou 510275, China; Guangdong Provincial Key Laboratory of Environmental Pollution Control and Remediation Technology, Guangzhou 510275, China[2]; School of Environmental Science and Engineering, Sun Yat-sen University, Guangzhou 510275, China;[3]

Nanoparticles (NPs) have high affinity to contaminants in the environment. However, research on natural nanoparticles (NNPs), especially their formation mechanisms, has limited attention. Microcosms containing Pb-Zn mine tailing soil and artificial rainwater were therefore prepared in this study to confirm the hypothesis that microbial dissimilatory reduction could induce the formation of NNPs in soil. Porewater in microcosms was obtained by a MircoRhizons sampler in an anaerobic workstation. The concentrations of lithophile elements and metal elements in nanosized and dissolved fraction of porewater, as well as the concentrations of anions in porewater were analyzed by ICP-OES and ion chromatography, respectively. The morphology, elemental composition, and mineral characteristics of the NNPs were observed by transmission electron microscope (TEM). Pyrosequencing analysis was performed on soil samples from the soil microcosm to obtain microbial information. The results showed that flooding induced tailing soil reduction slowly, exhibiting an increase of pH from 4.0 to 5.0 and a decrease of Eh from 250 to 50 mV in 100 days. The concentration of NO_3^- decreased first, followed by Mn and Fe. However, the concentration of SO_4^{2-} remained unchanged. For lithophile elements, the concentration of Mn increased first (Day 4), followed by Si (Day 10) and Fe (Day 40), while the concentration of Al decreased along the whole experiments. The nano-fraction of Mn, Fe, and Si in soil solution has increased compared to the initial status after filtration and ultracentrifugation analysis, indicating the formation of Mn, Fe, and Si containing nanoparticles. All the elements of Pb, Zn, Cu, and Cd existed in the nano-fraction of soil solution, indicating an adsorption or complexation of these metals in the nanoparticles, which was further confirmed by TEM images. Microbial information will be supplemented to link the formation of NNPs and microbial dissimilatory reduction. These findings indicated that NNPs were formed in the flooding Pb-Zn mine tailing soil due to the effect of microbial dissimilatory reduction by a combination of top-down way (breakdown of aggregates) and bottom-up way (nucleation of inorganic ions). More studies on the transport behavior and ecological effects of NNPs should be studied in the future.

Keywords: natural nanoparticles (NNPs); formation mechanisms; Pb-Zn mine tailing soil

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(7284 - 3093) Geomorphological control of carbon and nitrogen dynamics in agricultural areas in the Brazilian Central Plateau

Mateus de Alencar Ramos Fernandes[1]; Vinicius Vasconcelos[1]; Ray Pinheiro Alves[1]; Renato Henrique Ferrari[1]; Eder de Souza Martins[2]; Gabriela Bielefeld Nardoto[1]

University of Brasília, Asa Norte, Brasília, 70910-900, Brazil[1]; Embrapa Cerrados, BR-040 Km 18, Planaltina, 73310-970, Brazil[2]

The distribution of organic carbon and nitrogen in tropical soils is influenced by topographic attributes and soil types in the landscape while agricultural management usually intensifies the dynamics of soil organic matter. The differences in the nature and dynamics of soil organic matter were characterized using stable carbon and nitrogen isotopes. In this context, the objective of this work was to understand the dynamics of carbon and nitrogen as function of geomorphological aspects in the Rio Jardim Basin, east of the Federal District, in the Brazilian Central Plateau. The predominant land use in the region is agriculture on a large scale. Four toposequences were selected: two were performed on smooth and gentle ramps and two on partially dissected channels along an interfluve. Soil samples were collected up to 40 cm depth along the gradient. They were air-dried and sieved

with a 2 mm mash, milled and analysed for C:N, $\delta^{13}C$, $\delta^{15}N$ and clay content. Both soil $\delta^{13}C$ and $\delta^{15}N$ values at depth 20-40 cm were greater than 0-20 cm. In the interfluves the soils become shallow towards the central part of the basin, with increasing values of carbon and nitrogen isotopes at that same direction for both depths. The ramps presented higher values of $\delta^{13}C$ and $\delta^{15}N$ compared to the channels. The C:N ratios presented higher values in the channels, because of higher concentration of C when compared to the channels. The dynamics of C and N in these agricultural soils under different position in the landscape is being mostly controlled by the geomorphology of the regions that seems to be related to dissection and deposition processes.

Keywords: Stable isotopes, landscape, topossequence, $\delta^{13}C$ e $\delta^{15}N$.
Financial support: CNPq - Conselho Nacional de Desenvolvimento Científico e Tecnológico

(9983 - 2995) How soil carbon and nutrient availability in an integrated crop-livestock-forest system are related?

Janaína de Moura Oliveira[1]; Beata Emöke Madári[2]; Marcia Thais de Melo Carvalho[2]
Post-doc, Brazilian Agricultural Research Corporation – National Rice and Beans Research Center, (EMBRAPA/CNPAF), Rod. GO-462, Km 12, Faz. Capivara, Zona Rural, Santo Antônio de Goiás-GO, Zip Code: 75375-000, P.O. Box: 17, Brazil[1]; Reseracher Scientist, EMBRAPA/CNPAF[2]

Cropping systems integrated with trees and livestock is a potent mitigation strategy in tropical agriculture by increasing soil C stock and producing food, fiber and energy on the same area. In integrated systems, nutrient cycling is more complex and behave differently from monoculture due to the increment in biodiversity. In a previous study (Oliveira et al., 2018), we found up to 30% increment of soil organic C (SOC) stock in a 3-year old integrated crop-livestock-forest (iCLF) system compared to a 20-year old pasture under continuous grazing, especially in samples of the 30-100 cm soil depth located at the tree lines. We believe that such fast increment in total C stock was due to healthy conditions of soil chemical properties, since synthetic fertilization and liming were applied for establishment of the iCLF system. Therefore, in this study we aimed to check the correlations between SOC and nutrient availability at the 0-100 cm soil depth of an Oxisol cultivated with the iCLF system. The iCLF system was established in 2009, with rows composed by three lines of eucalyptus spread at each 20 m in a 4.7 ha, under real farm conditions. Details about field design and data collection can be found in Oliveira et al. (2018). The area is located in the southern Amazon ecosystem, North of Mato Grosso State, Brazil. The SOC and nutrient availability were quantified in the same soil samples collected from 15 trenches, each splitted in eight soil layers from 0-100 cm soil depth. Status of nutrient availability in soil was given by the following variables: pH (water), Ca, Mg, P, K, Cu, Zn, Fe and Mn. Correlations between measured SOC and soil nutrient availability variables within 0-100 cm soil depth (n = 120) were determined with Pearson's correlation coefficient. Analyses were performed using the linear mixed model procedure (Proc Mixed) and the correlation procedure (Proc Corr) of the SAS software (SAS Institute Inc., Cary, NC, USA). Results show that there was no significant correlation between SOC and soil pH in water (R^2: 0.15, p-value: 0.09). However, a positive correlation was observed for all other nutrients, wherein (R^2 and p-value) in order of magnitude: Mg (0.78, $p < 0.001$), Ca (0.76, $p < 0.001$), Zn (0.73, $p < 0.001$), P (0.70, $p < 0.001$), K (0.67, $p < 0.001$), Mn (0.65, $p < 0.001$), Fe (0.59, $p < 0.001$), Cu (0.54, $p < 0.001$). Results confirm that the increment of SOC was favored by soil nutrient availability in the iCLF system.

Keywords: Fertility, cropping systems, agrosilvopastoral system (iCLF)
Financial support: Embrapa, project number 02.11.05.001, CNPq, Project Number 562601/2010-4 and FAPEG, Project Number 20090044900417. We are grateful for CAPES and CNPq for the Ph.D. and postdoctoral fellowships. We appreciate the collaboration of Gamada Farm.

(2221 - 703) Influence of soil water-repellency on co_2 flux upon rewetting

Carmen Sanchez-Garcia[1]; Bruna Oliveira[2]; Jan Jacob Keizer[2]; Stefan Doerr[1]; Emilia Urbanek[1]
Department of Geography, Swansea University, UK[1]; CESAM, Universidade de Aveiro, Portugal[2]

Rewetting of dry soil typically results in a short-term pulse of CO_2 from soil to the atmosphere known as the 'Birch effect'. The displacement of CO_2 air-filled pores with water during wetting has been recognised as one of the sources of this pulse. The Birch effect has been extensively reported under wettable soil conditions but some studies report a lack of such response, suggesting soil water repellency (SWR) as a potential cause. SWR restricts infiltration and affects soil water distribution. Preferential flow paths and increased overland flow are common patterns in water-repellent soils, leaving extensive areas of the soil dry even after substantial rainfall. Future climate scenarios will likely enhance the development and persistence of SWR. Despite this, the effect of SWR on CO_2 efflux after rewetting has never been tested and remains poorly understood. The aim of this research was to test the hypothesis that SWR suppresses CO_2 pulse after rewetting. In the lab, dry homogeneous soils at water-repellent and wettable status were rewetted with different amounts of water. CO_2 efflux in response to wetting was continuously monitored using the LI-COR Li-8100A Soil Gas Flux system. Severely reduced infiltration, overland and preferential flow was observed in water-repellent soils. Typical 'Birch effect' observed in wettable soil was not detected in water-repellent soil. A field study was conducted in a burnt pine stand in Portugal before the first natural rainfall event. Forest fires are known to induce changes in SWR, often increasing its severity and persistence. The study plots were rewetted with water and with water mixed with the wetting agent (Revoltution®, Aquatrols) to simulate inhibited and non-inhibited infiltration, respectively. CO_2 efflux in response to wetting was monitored before and several times after the rewetting event using the soil gas flux system along with changes in soil moisture, infiltration and runoff. The main conclusion from the experiment is that SWR not only affects hydrological relationships but also has an impact on CO_2 fluxes. Hence SWR becomes an important parameter to consider in monitoring and modelling of gas fluxes.

Keywords: soil water repellency, hydrophobicity, CO_2 efflux, CO_2 pulse, wildfires, forest fires, GHG
Financial support: The Royal Society, Swansea University

(5491 - 1520) Iron dynamics in replanted mangrove forest (SE-Brazil): preliminary results

Gabriel Nuto Nóbrega[1]; Hermano Melo Queiroz[1]; Tatiana Scacco Pereira[1]; Xosé L. Otero[2]; Tiago Osório Ferreira[1]
Universidade de São Paulo (ESALQ/USP)[1]; Universidade de Santiago de Compostela (USC)[2]

Concerns over the global C cycle, greenhouse gas emissions (GHGs) and their impacts on the global climate change have led researchers and public agencies to create policies aimed to mitigate the increasing concentration of GHGs in the atmosphere. In this sense, mangroves play a significant role in C sequestration, especially in their soils. Thus, the understanding the dynamic of elements which controlling the recovery of C stocks in these ecosystems is essential. This project aims to evaluate the Fe dynamic in replanted mangrove soils, aiming to comprehend the evolution of the processes that rule C dynamic

(sulfidization and gleyzation). In the Guapimirim Environmental Protection Area (state of RJ), four sectors of mangrove forest with different replanting stage (recently re-planted - NV; 3 and 7 years replanted; and established mangrove - V) were sampled for solid-phase Fe partitioning. Additionally, were measured redox potential (Eh) and pH for soil characterization. Higher Eh values were recorded for the established mangrove (average: 180±197 mV), while lowest values were in the recently planted mangrove (+5±25 mV), whereas the pH values were circumneutral (average: 7.3±0.3 and 7.2±0.2 for NV and V). With regard to Fe dynamic, a higher degree of Fe pyritization (DOP), which indicates the intensity of sulfidization, was recorded the older forest (average: 59.2±21.2 %) compared to NV (average: 34.9±27.5 %). Additionally, at the older replanted mangroves (7 and V), higher pseudo-total Fe content were recorded (average for both sites: 1259.2±477.8 mmol kg^{-1}) compared to NV (average: 607.3±405.1 mmol kg^{-1}) indicating mangroves replanting may affect Fe dynamic to coastal waters. In mangrove restoration practices, the soil characteristics are influenced by age of replanted forest since the recovery of the vegetation affects microbial metabolism favoring less energetic metabolic pathways (e.g., sulfate reduction and sulfidization) thus improving C sequestration. The results of this project are expected provide a basis for funding policies to mangrove restoration projects.

Keywords: Mangrove soils; Fe dynamic; Sulfidization; Gleyzation.
Financial support: Sao Paulo Research Foundation (grant number 2017/08101-1)

(9660 - 2029) Microscopic Mechanisms of Lead Retention on Thermoacidophilic Cyanidiales

Yen-Lin Cho[1]; Pin-Chen Chen[2]; Shao-Lun Liu[2]; Yu-Ting Liu[1]
National Chung Hsing University[1]; Tunghai University[2]

Thermoacidophilic Cyanidiales (red microalgae) are mainly distributed in volcanic areas and capable to survive in extreme environments with wide temperature and pH ranges (25-56℃; pH 0.2-5.0). In this study, the tested Cyanidiales including *Galdieria maxima* (Gm), *Cyanidium caldarium* (Cc) and *Cyanidioschyzon merolae* (Cm) were isolated from the beudantite collected in the Thermal Valley in Taiwan. Due to the tolerance for the concentrated Pb and As, Cyanidiales are suggested as potential materials for heavy metal remediation, especially in the acidic wastewater and soils. Accordingly, we aimed to determine the mechanisms for Pb accumulation on Cyanidiales in terms of sorption capacity, changes of functional groups with algae, and speciation of sorbed Pb. The combination of sorption isotherms and analyses using synchrotron-based spectroscopic techniques including X-ray photoelectron spectroscopy (XPS), X-ray diffraction (XRD), Fourier transform infrared (FTIR), and Pb L_{III}-edge X-ray absorption spectroscopy (XAS) was performed. Results of Pb sorption isotherms showed that the sorption capacity on red algae was in the sequence of Cc (299.36 mg g^{-1}) > Cm (214.04 mg g^{-1}) > Gm (38.20 mg g^{-1}). Possible retention mechanisms of Pb on Cyanidiales are (1) Pb bound with surface functional groups of the algae; (2) Pb complexed with proteins of the algae, and (3) Pb precipitated on the surfaces of the algae. Our collective results indicated that while all three mechanisms controlled Pb retention on Gm and Cm, Pb sorption on Cc was dominated mainly by the formation of organic complexation. The knowledge provided here could improve the application of the Cyanidiales in environmental remediation as an innovative green technology.

Keywords: Cyanidiales, Pb, Sorption, FTIR, XAS.
Financial support: MOST 104-2311-B-005 -016 -MY3

(4837 - 864) Modelling the potential mobility of heavy metals in red soil in Southern China

Mingxia Wang[1]; Wenfeng Tan[1]; Juan Xiong[1]; Fan Liu[1]
Huazhong Agricultural University[1]

The pollution of heavy metals in soil has become a normalcy of soil in China due to sewage irrigation, heavy metal atmospheric sedimentation, pesticide fertilizer use and industrial sludge and municipal solid waste composting and other human producing activities. The bioavailability and toxicity of heavy metals in soil are not only related to the total amount, but more to the species of heavy metals in soil. The Multi-surface model was used to predict the labile heavy metals and their speciations in the soil. The model considered complexation in solution and interactions with soil organic matter (SOM), a clay mineral and hydrous Al, Fe and Mn oxides. The amounts of reactive metals were derived from extraction with 0.43M HNO_3, and the concentration of free heavy metals in the soil which was measured by Donnan Membrane Technique (DMT) for testing the accuracy of prediction. The prediction results of the Multi-surface model using default parameters were consistent with the actual measured values of free Zn, Cu and Cd in the soil solution, while the predicted value of free Pb was much different from the measured value. By the model optimization, several heavy metal forms in the red soil were well predicted. The predicting results of Multi-surface model showed that the SOM and crystalline iron oxides in the soil played the important role for adsorbing Zn, Cu and Cd, while the content of manganese oxide in soil had a great influence on the adsorption of Pb. The fraction of reactive metals, which were interacted with dissolved SOM according to the modelling, was predominantly < 4% for Pb and Cu, < 0.4% for Zn, and < 14% for Cd. We suggest further quantitative and qualitative investigations on the Multi-surface model to the soils with high iron content in southern China to improve the prediction of the potential mobility of heavy metals.

Keywords: Red soil; heavy metals; SOM; iron oxides; Multi-surface model.
Financial support: The National natural Science Foundation of China, NO. 41571229; the National Key Research and Development Program of China, NO. 2016YFD0800403.

(3683 - 1515) Nitrogen availability to corn as a result of long-term use of organic sources and mineral nutrients

Carina Marchezan[1]; Carlos Alberto Ceretta[1]; Gustavo Brunetto[1]; Paulo Ademar Avelar Ferreira[1]; Cledimar Rogério Lourenzi[2]; Ricardo Fagan Vidal[1]; Rodrigo Krammes[1]; Daniela Basso Facco[1]; Rodrigo Knevitz Hammerschmitt[1]; Yohana Porto Calegari Alves[1]
Universidade Federal de Santa Maria[1]; Universidade federal de Santa Catarina[2]

Animal manures are frequently utilized in agriculture as a source of nutrients, especially nitrogen (N). In the long-term, successive and continuing additions of organic residues augment the content of N mineralization in the soil. However, the composition of these residues is a determining factor upon N release to the soil and its availability to the plants. The present study aimed at quantifying the N content in soil solution during the cultivation of corn in areas fertilized with organic and mineral nutrient sources. The study was conducted from a long-lasting experiment established in 2004 in the experimental area of the UFSM Soil Department. The experiment was set in a randomized block design with 4 replications and plots measuring 25 m^2 (5 by 5 m). The treatments were: Control, chemical fertilization (NPK), pig slurry manure (PSM), liquid cattle manure (LCM) and swine deep bedding (SDB). The soil solution extraction was done *in situ* with the help of porous capsules, installed at 10 cm in depth. The collections of soil solution were conducted 16h after raining or irrigating, in periods before and after manure application at 20, 45 e 80 days after corn emergence (DAE). In the soil solution was determined the content of ammonium (NH_4^+) and nitrate (NO_3^-). The

content of NO_3^- in solution was higher than NH_4^+ in all treatments. The higher NO_3^- availability occurred at 20 DAE and decreased according to the plant growth, reaching values of approximately zero at the flowering period. At 20 DAE, the treatments LCM, PSM, and NPK presented 41, 55, and 57 $mg.l^{-1}$ of NO_3^-, while the treatments Control and CSS presented 21 and 9 $mg.l^{-1}$, respectively, on the same date. The low content of NH_4^+ in solution can be explained by the elevated soil solution pH, which was above 6.3 in all treatments, result from the background animal manure applications. Long periods of application of organic residues increased considerably the content of labile organic matter in the soil. This easy-to-decompose material stimulates the multiplication of heterotrophic microorganisms that consume rapidly NH_4^+ present in the soil and in the animal manure, producing more NO_3^- at the expense of NH_4^+. This phenomenon is more pronounced in residues with high C/N ratios. Application of organic sources, especially LCM and PSM, promote higher availability of N in the soil at the initial crop stage. SDB immobilized N present in the soil solution, resulting in its decreased availability to the plants.

Keywords: soil solution; organic fertilizer; manure; NH_4^+; NO_3^-
Financial support: CNPq

(3716 - 2222) Nitrogen isoscapes along a climatic gradient in Alisols in the Northeastern Brazil

Fabio Luis de Souza Santos[1]; Vinicius Vasconcelos[2]; Gabriela Bielefeld Nardoto[2]; Antonio Felipe Couto Junior[2]; Kennedy Nascimento de Jesus[3]; Everardo Sampaio[3]; Jean Pierre Ometto[4]; Rômulo Simões Cezar Menezes[3]
Universidade de Brasília, Campus Universitário Darcy Ribeiro, Asa Norte, Brasília-DF, Brasil (fabio.luis92@gmail.com)[1]; Universidade de Brasília, Campus Universitário Darcy Ribeiro, Asa Norte, Brasília-DF, Brasil[2]; Universidade Federal do Pernambuco, Av. Prof. Moraes Rego, 1235, Cidade Universitária, Recife-PE, Brasil[3]; Instituto Nacional de Pesquisas Espaciais, Avenida dos Astronautas, 1758 Jardim da Granja, São José dos Campos-SP, Brasil[4]

The climate regime is one of the main factors for the formation of ecosystems and regulates their structure and functioning. Temperature and precipitation affect the natural abundance of stable nitrogen isotopes ($\delta^{15}N$). Soil $\delta^{15}N$ across climate gradients provide key insights into organic matter dynamics in the ecosystems, since it can indicate rates of mineralization, decomposition, fixation of nitrogen and losses for atmosphere. The Brazilian northeast region has a single climate regime that reflects the existence of different physiographic regions. In this context, the objective of this work was to evaluate the $\delta^{15}N$ in Alisols of natural forest (Atlantic Forest and Caatinga) along a climatic gradient in the Brazilian northeast. With these values nitrogen isoscapes for the region were produced using multiple regression equations. Soil samples were collected in the 0-10 and 10-20 cm depth along the gradient, which has moist areas - Zona da Mata (ZM), subhumid areas (AG) and semi-arid areas - *Sertão Leste* (SL) and *Sertão Oeste* (SO). Three replicates were collected in each area. The samples were sieved with a 2mm mesh, milled, and analyzed for $\delta^{15}N$ and the concentrations of N through a mass spectrometer for isotopic ratios coupled to the elemental analyzer. The nitrogen isoscapes presented a $\delta^{15}N$ spatial pattern that is similar to the climatic boundaries. The highest %N in native forest was found in areas with highest average precipitation. Soil $\delta^{15}N$ were inversely related to soil %N and was also inversely related to the precipitation. Therefore, the semi-arid areas had higher values than the humid and subhumid areas. Higher temperatures associated with intense precipitation events might lead to higher soil $\delta^{15}N$ due to the intense N isotope fractionation. This variation of soil $\delta^{15}N$ along the climatic gradient indicates differences in nitrogen dynamics in each mesoregion.

Keywords: Atlantic Forest, Caatinga, Temperature, Precipitation
Financial support: CAPES, CNPq, FAPESP

(4146 - 572) Plant growth and plant nitrogen uptake effects on isotopic composition of nitrate leached from pasture systems.

Sephrah Rayner[1]; Timothy Clough[1]; Troy Baisden[2]
Lincoln University[1]; Waikato University[2]

Worldwide there is increasing awareness of the potential risks that pasture grazing systems pose to freshwater, including faecal contamination and enhanced nutrient loadings. Excess nutrient levels, predominately nitrate (NO_3^-), result in a reduction in water quality for recreation, aquifer contamination and reduced drinking water quality, which are costly to mitigate. Attenuation of NO_3^- before it reaches freshwater is a potential management tool in these systems. Dual NO_3^- isotopes signatures ($\delta^{15}N\text{-}NO_3^-$ and $\delta\ ^{18}O\text{-}NO_3^-$) can be used to quantify NO_3^- attenuation, and apparent isotope fractionation factors to differentiate processes such as denitrification and plant/microbial uptake. However, the role that plant growth and associated N uptake plays in the isotopic composition of the NO_3^- from pasture systems is still not fully understood. This study focused on how the presence of plants influenced both the amount of NO_3^- leached from a pastural system and its isotopic signature. Using intact soil columns, the effect of the presence or absence of perennial ryegrass (Lolium perenne L.) under varying rates of bovine urine addition was examined. Drainage volumes, dual NO_3^- isotopes, inorganic N (NH_4^+ and NO_3^-) and dissolved organic C (DOC) were monitored over a 10-month period. Under bovine urine the presence of perennial ryegrass reduced the cumulative leaching of NO_3^-, with the rate of bovine urine significantly affecting the concentration of NO_3^- in drainage. Results for the $\delta^{15}N\text{-}NO_3^-$ and $\delta\ ^{18}O\text{-}NO_3^-$ values under the various treatments will be presented and the implications discussed. This research will help to enable the key effects of plant growth and N uptake, which potentially influence temporal and spatial change in NO_3^- isotopic signatures, to be linked to NO_3^- attenuation models within the landscape. The use of dual NO_3^- isotopes allows the quantification of N attenuation in the landscape and primary N source identification, which can provide a tool for farm management and policy to reduce nutrient loading and retain nutrients on farm.

Keywords: nitrate, isotopes, attenuation, nitrogen, management
Financial support: GNS Science, Environment Southland, Lincoln University

(7553 - 2947) Podzolization processes of Yellow Latosols of tablelands conditioned by neotectonism

Claudia Csekö Nolasco de Carvalho[1]; Fábio de Carvalho Nunes[2]
Universidade Estadual de Alagoas[1]; Instituto Federal de Educação, Ciência e Tecnologia Baiano[2]

The process of transformation of the Yellow Latosoil - Spodosoils with high contents of organic matter were the subject of this study. They developed on the Barreiras Group sediments, in a Recôncavo Baiano tablelandstop located in Santo Amaro county, Brazil of. The starting

point was the toposequencial soils analysis which were characterized regarding the morphology, micromorphology and physical, chemical and mineralogical attributes. The pedological system is complex, showing depressions related to faults and/or fractures crossing that indicate the neotectonism how started process of transformation. The relationships between the oxic and the hidromorphic domain point to Latosoil transformations linked to conditions of cyclic hydric saturation and to the action of organic composites of low molecular weight. The high contents of organic matter accumulated by reduction of mineralization under acids conditions and temporary anaerobiose propitiate the evolution of humus with the formation of mobile organic composites and acids which act on the transformation of the Latosol, through the installation of processes of podzolisation with partial acidolysis, acting from downstream to upstream in the versant. On the pedogeochemical aspect the destruction of primary minerals and the disorganization of the secondaries, indicate a route predominantly organic in the transformation, process, under the influence of reducing environments.

Keywords: Barreiras Group, soils of Coastal Tablelands, acidolysis
Financial support: Universidade Estadual De Alagoas

(3890 - 1012) Rare-earth-element geochemistry in soils developed in different geological settings of Cuba

Ygor Jacques Agra Bezerra da Silva[1]; Clístenes Williams Araújo do Nascimento[1]; Caroline Miranda Biondi[1]; Yuri Jacques Agra Bezerra da Silva[2]; Adriana Maria de Aguiar Accioly[3]; Mirelys Rodríguez Alfaro[4]; Alfredo Montero[4]; Olegario Muniz Ugarte[5]; Juan Estevez[4]
UFRPE[1]; UFPI[2]; EMBRAPA[3]; Instituto de Suelos MINAG[4]; CEADEN[5]

The increased exploitation of rare-earth elements (REEs) over the past few decades and the disposal of various products containing these elements have prompted numerous environmental studies and the need to establish regulatory guidelines. We determined the concentration of REEs in topsoil samples of 33 soil profiles collected from areas of different geological settings in Cuba. The average REE concentrations revealed the following chemical abundances in decreasing order: Ce > Nd > La > Pr > Sm > Er > Yb > Dy > Tb > Lu > Ho > Gd > Eu > Tm. The significant variation in REE levels reflects the geological diversity of Cuba. The highest REE concentrations were observed in Typic Rhodudalf and Rhodic Eutrodox, which are derived from hard limestone. In contrast, the lowest REE concentrations were detected in the Typic Kandiustalf, which originated from mica schist. The lower light REE (LREE) contents in Cuban soils compared with soils from other countries is related to the low abundance of felsic rocks on the island. We also observed a strong positive correlation between REEs and some major elements in soils. This finding implies that the distribution of REEs in soils is partly governed by phosphates and aluminosilicates. The low fractionation between LREEs and heavy REEs is likely related to the predominance of soils developed from carbonates. This finding was also supported by the low LaN/SmN and GdN/YbN ratios and principal component analysis. The spatial distribution of REEs normalized to Upper Continental Crust coupled with univariate and multivariate statistical techniques indicated that parent materials control the prevalence of REEs in Cuban soils. The data presented here represent the first national-wide survey of REEs in Cuban soils.

Keywords: Keywords: Lanthanides; Tropical settings; Cuban soils.
Financial support: Universidade Federal Rural de Pernambuco

(4975 - 1620) Relationship between the content of steviol glycosides in *Stevia rebaudiana* Bert., and edaphologic offer of five regions of Colombia

Enrique Combatt Caballero[1]; Jaime Hernández Burgos[2]; Alfredo Jarma Orozco[1]
Universidad de Córdoba, Colombia[1]; Universidad Nacional Abierta y a Distancia[2]

In Colombia for determine the effect of the nutritional status of the soil and the leaves of Stevia rebaudiana Bert on the concentration of the main steviol glycosides. Were established Investigations in five locations: Montería-Córdoba; Campamento-Antioquia; Palmira-Valle del Cauca; Fonseca-Guajira y Valledupar-Cesar. In each locality two levels of radiation were used, at 100 and 50% of the incident radiation, to evaluate the growth of the crop under the offer of radiation and edaphic conditions. In each locality two levels of radiation were used, at 100 and 50% of the incident radiation, to evaluate the growth of the crop under the offer of radiation and edaphic conditions. A randomized complete block design was carried out in each of the localities. In each locality and level of radiation, five plants and three soil samples of 0 to 20 cm were collected; with the objective of determine the relationship between the nutritional contents in leaves and soil of the following essential and nutritional elements: N, P, S, Ca, Mg, K, Na, Cu, Fe, Zn, Mn and B. In addition, the contents of rebaudioside A and stevioside contained in the leaf. The data were analyzed by analysis of variance combined, for the contents of total glycosides (GT) and the foliar contents of the different nutrients. Also, were analyzed the correlation, between foliar contents and nutrient soil contents and finally multiple linear regression analysis of the foliar contents with the contents of GT, RebA and Stv. The results indicated that the cultivation of stevia tends to adjust the assimilation of nutrients such as N, Ca, Na, Mn and B, the according with environmental and soil factors, different of the radiation and nutrient content in the soil. Likewise the linear regression determined the following models: GT= 63.64N**+13.83S°°+10.72Ca*-26.97Mg*-1,37K*+0.28Zn*+0.08Mn°°+0.75**; RebA=56.24N**+6.55Ca°°-17.42Mg°+0.39Zn**+0.79B°°-0.01Fe°°; Stv=1.11P°+0.66Ca°+0.71B**. The participation of all the elements in the models of the evaluated variables indicates that Stevia needs complete nutrition, to achieve good yields and leaf quality, adjusting the nutrient doses according to the environmental conditions and edaphic of each locality.

Keywords: Stevia rebaudiana, nutrition, incident radiation, soils
Financial support: Universidad de Córdoba-Colombia

(2575 - 2213) Removal of HCH from aqueous solutions and soils using plants and manure derived-biochars

Diego Aran[1]; María Balseiro-Romero[1]; Juan Antelo[1]; Sarah Fiol[2]; Felipe Macías[3]
Instituto de Investigaciones Tecnológicas. University of Santiago de Compostela[1]; Department of Physical Chemistry, University of Santiago de Compostela[2]; Department of Soil Science and Agricultural Chemistry, University of Santiago de Compostela[3]

The application of pesticides in agriculture activities, although it has benefits, it can be considered a source of contamination for the environment. The organochlorine pesticides are resistant to biodegradation, they can be easily bioaccumulated in the food chain, and are stable in water for many years (Shukla et al., 2006). The main mechanism for the removal of pesticides in water and soil systems is adsorption on different materials. Among them, biochar is a promising and economical alternative. The different isomeric forms of hexachlorocyclohexane (HCH) (α-HCH, β-HCH, γ-HCH and δ-HCH) were employed to evaluate the adsorption capacity of three biochars. These biochars were obtained from *Miscanthus*, Corn Cob and Chicken manure and showed different physical-chemical properties. Batch adsorption experiments were conducted with biochar suspensions prepared in a solution of $CaCl_2$ and NaN_3 (5mM). The HCH concentrations used varied between 0 and 10 mg L^{-1}. Additionally, the effect of biochar amendments (0-50% in weight) was studied in soil samples collected from a HCH-contaminated area. For each treatment, the contaminated soil was mixed with different

amounts of biochar in a solution with $CaCl_2$ and NaN_3 5mM. The free concentration of HCH isomers present in the solution was determined by gas chromatography coupled to tandem mass spectrometry (GC/MSMS). The experimental results demonstrate that those biochars showing a major carbon content and superficial area have a larger adsorption capacity. These organic contaminants showed a multilayer adsorption behaviour and the experimental data can be described using empirical models. The use of these materials can be considered a good option for remediation of soils and waters contaminated by HCH. Moreover, the results of the biochar amendment experiments showed that manure biochar can reduce in about 50% the amount of HCH in the soil solution, while plant biochar reduced more than 70%.

Keywords: Biochar, Hexachlorocyclohexane, soil and water remediation

Financial support: Xunta de Galicia (AMBISOL group GRC2014/003)

(8741 - 3006) Residual effect of silicate fertilization and inoculation on the agronomic characteristics of wheat

Jessica Caroline Coppo[1]; Alfredo Alves Neto[2]; Leandro Rampim[3]; jussara conti friedrich[4]; Diego August Fatecha Foiz[2]; Cristiani Belmonte[2]; Antonio Ascencio Dias Neto[2]

State University of Maringá[1]; Western Paraná state University[2]; Central western Paraná state University[3]; Western Paraná state UniversityWestern Paraná state University[4]

In order to minimize the problems of applying too much nitrogen, alternatives have been researched, such as the better use of the benefits provided by the association between diazotrophic bacteria which perform the enzymatic conversion of gaseous nitrogen to ammonia. In addition to that, in order to benefit crop performance there are nutrients as well as silicon which, while not considered essential to plants, are responsible for increasing their resistance to pests, diseases, as well as to various types of abiotic stresses. For this purpose, calcium silicate fertilization and inoculation of seeds with diazotrophic bacteria showed a significant increase in a short period of time. In the light of this, the aim of this work was to evaluate the residual effect of different doses of the fertilization with calcium and magnesium silicate and inoculation on the initial performance of seedlings through the evaluation of agronomic characteristics. The experimental design was a randomized block design, in a 5 × 2 factorial scheme, being the first factor the use of five concentrations of calcium silicate and magnesium: 0,0; 1.0; 2.0; 4.0 and 6.0 t ha^{-1} applied before maize cultivation in a previous experiment. The second factor was the absence and presence of seeds inoculated with *Azospirillum brasilense*, with four replications, totaling 40 plots. The soil used was classified as Eutroferric Red Latosol of clay texture, and after the corn cultivation it was carried out the sowing of wheat only with potassium and phosphate fertilization. For the SPAD index, it was observed the highest and lowest mean values of 39.3 and 32.5 in the treatment with residual and absence of inoculation. After 35 days, the height and stem diameter were analyzed, and subsequently the plants were collected to evaluate the dry matter. For the variable plant height, a significant effect was observed for the interaction between calcium silicate dose and inoculation. The residual effect of fertilization with calcium and magnesium silicate was higher at a dose of 6 t ha-1 with inoculant 39.81 cm. Regarding the diameter of the stalk, it was observed a difference in the presence of silicate and in the higher dose, but without the influence of the residual of the inoculation, being 2.47 and 2.34 mm. The same one observed for numbers of tillers, obtaining the highest average of tiller 3.68 per plant.

Keywords: *Azospirillum brasilense;* calcium silicate and magnesium; inoculation

Financial support: fi nancial support of CNPq (Conselho Nacional de Desenvolvimento Científico e Tecnológico)

(5983 - 876) Response of stoichiometry Characteristics and microbial community to agricultural land use change around Taihu Lake Area in Southeast China

Yan Gao[1]; Yuhan Niu[1]; Weiguo Zhang[1]; Jiangye Li[1]

Institute of Agricultural Resources and Environment, Jiangsu Academy of Agricultural Sciences[1]

Agricultural land use is experiencing unprecedented changes around Taihu Lake Area, one of major grain producing areas in China before. More and more paddy field in this area has been converted to orchard due to farmer's pursuit of profit. Such changes and their associative management practices will alter biogeochemical function in ecosystems. Characterizing susceptibility of biogeochemical function to land use change is badly in needs of understanding the response of elemental stoichiometry, functional stoichiometry and microbial community to different land use. In order to achieve these objectives, we investigated the following parameters of soil from peach orchard and paddy filed: 1) bacteria and fungi abundance and their ratio; 2) bacterial and fungal community composition; 3) elementary stoichiometry, e.g. C/N, C/P, N/P; 4) eco-enzymatic stoichiometry. The results showed that paddy soil had obvious higher mean and average values of C/N, C/P and N/P than Orchard soil. The C/N, C/P and N/P ratios of paddy soil in rice-growing season were consistently higher than that in maize-growing season. The similar changing patterns of elemental stoichiometry were also observed in orchard soil between two different seasons. The mean and average values of C-demand/P-demand enzyme and C-demand/P-demand enzyme of paddy and orchard soil in rice-growing season were consistently higher than that in maize-growing season, which was consistent with the changes of soil C/P and N/P. Paddy soil presented much higher mean and average values of 16SrDNA but lower fungal ITS abundance when compared to orchard soil, resulting in obviously lower fungi/bacteria (F/B) ratio in paddy soil. Land use conversion from paddy field to orchard led to gradual reduction of bacterial and fungal community diversity, especially after 20 years of conversion. The class *Nitrospira* that plays a critical role in the nitrogen cycle had much higher abundant in paddy soil than orchard soil, while *Sphingobacteriia* that plays critical role in cellulose degradation showed an opposite pattern. The soil chemical parameters had a stronger contribution to bacterial dissimilarities than physical parameters. The results provide some valuable information about how soil biogeochemical function in agricultural ecosystems will respond to land use conversion.

Keywords: stoichiometry; microbial community; land use change

Financial support: The State Natural Science Foundation of China (No. 41571458); National keypoint research and invention program of China

(8625 - 238) Soil redox processes coupled dechlorination of pentachlorophenol in flooded condition

Yan He[1]; Min Zhu[1]; Yan Xu[1]; Jianming Xu[1]

Zhejiang University[1]

Reductive dechlorination is the main way for transformation of chlorinated organic pollutants (COPs)under anaerobic conditions, which is basically an electron accepting process initiated by anaerobic respiration of dechlorinators. In flooded soils, there are also many co-occurred natural redox processes that consume electrons, such as Fe(III)/SO_4^{2-} reduction, and methanogensis process. These processes can affect dechlorination through competition of the functional microbial groups that drive soil redox processes for the substrates and survive space with dechlorinators. To illustrate the interaction between COPs dechlorination and soil indigenous biogeochemical redox processes, we conducted a flooded soil incubation experiments, with pentachlorophenol (PCP) that has been used worldwide as insecticide, herbicide and wood preservatives selected as the model

COPs. Dynamics in PCP dechlorination and the main redox couples (such as Fe(III)/Fe(II), SO_4^{2-}/HS^-, CO_2/CH_4) during dechlorination were simultaneous analyzed. The results showed that the dechlorination of PCP was synergistically coupled with Fe(III) reduction and methanogenesis, but competitively coupled with SO_4^{2-} reduction. Meanwhile, biochar showed interesting effect on the coupling between PCP dechlorination and soil redox processes. Dechlorination of PCP wasinhibited, while Fe(III)/SO_4^{2-} reduction were significantly enhanced following biochar addition; the production of methane were also accelerated. Q-PCR, Illumina sequencing and DNA-SIP for analysis of soil bacteria and archaea responses revealed that this might be mediated by the functional microbial groups (including dechlorinators, ferric and sulfate reducers, and methanogens) that responded sensitively but contrastingly to the pollution of PCP and the addition of biochar. Specific function of biochar as electron shuttle was also likely the other mechanism involved, through splitting the limited electrons from the inferior electron acceptors (PCP) to the dominant more competitive ones (Fe(III) and SO_4^{2-}) during anaerobic respiration of the functional microbial groups, under an electron limiting condition. The results of this study would lead to a synthetical understanding regarding biochar's function and provide improved strategy for optimizing the remediation of natural flooded soil polluted by reducible COPs.

Keywords: Reductive dechlorination; Fe(III)reduction;SO_4^{2-} reduction; Methanogenesis; Biochar
Financial support: This research was financially supported by the National Key Research and Development Program of China (2016YFD0800207), and the National Natural Science Foundation of China (41771269 and 41721001).

(2930 - 190) Sorption kinetics, isotherm and mechanisms of PFOS on soils with different physicochemical properties

Changlong Wei[1]; Xin Song[1]; Qing Wang[1]; Zhihao Hu[2]
Institute of Soil Science, Chinese Academy of Sciences[1]; Nanjing University[2]

Perfluorooctane sulfonate (PFOS), an emerging contaminant, is environmentally persistent, bioaccumulative and toxic to human health and ecosystems. It has been widely detected in groundwater, surface water, soil and sediment. So far, very few research has reported on the PFOS sorption behaviors onto soils, one of the primary processes that influence its fate and transport in the subsurface. In this study, the sorption and desorption of PFOS onto six soils with different physicochemical properties were investigated. Kinetic and equilibrium studies of PFOS sorption onto six soils were carried out in batch experiment. The sorption kinetics of PFOS on the six soils demonstrated that PFOS sorption reached equilibrium within 48 h, and the well-fitted pseudo-second-order kinetic model to experimental data suggested that chemisorption was involved in PFOS sorption on soils. The intraparticle diffusion model results indicated that both film diffusion and intraparticle diffusion were the rate-limiting steps for five of the six soil samples, while the intraparticle diffusion was the only limiting step in the PFOS sorption on the sixth soil. PFOS sorption isotherms can be described by the Freundlich model well for all six soils (R^2=0.979-0.999). The correlation analysis between K_F of PFOS and the physicochemical properties of the soils showed that a positive correlation between K_F and Al_2O_3, SOC and Fe_2O_3. The FTIR data demonstrated hydrophobic interaction, ion exchange, surface complexing and hydrogen bonding might all play a role in the PFOS sorption onto soil samples. PFOS sorption onto soil minerals, especially iron oxide minerals, needs to be further explored in future.

Keywords: Perfluorooctane sulfonate; Soil; Sorption behavior; Intraparticle diffusion; LC-MS/MS
Financial support: This work was supported by the National Natural Science Foundation of China (grant number 41571460) and the Key Research Program of the Chinese Academy of Sciences (grant number KZZD-EW-TZ-13).

(2036 - 1491) The effect of humic substances on the trace elements toxicity

L.V. Perelomov[1]; K.B. Chilachava[1]; A.Y. Shvikin[1]; Y.M. Atroshchenko[1]
Tula State Lev Tolstoy Pedagogical University[1]

The introduction of trace elements in the environment can produce considerable harmful impact on microbial communities and their activities. Numerous studies have shown that humic substances (HS) and their fractions are capable of altering both the chemical and physical speciation of trace elements and affecting their bioavailability and toxicity. In the present study we investigated the effect of humic substances and their fractions - humic acids (HA) and hymatomelanic acids (HMA) on the toxicity of Pb and Zn towards different strains of environmentally important bacteria. Sample of mesotrophic sphagnum peat was collected from the small sphagnum bog situated in Tula region, Russia. HS were isolated using alkaline extraction procedure as described by Stevenson (1994). For the preparation of the HA fraction, concentrated HCl was added to the solution of HS to adjust the pH to pH 1. The HMA fraction of the HS was obtained by ethanol extraction. Gram negative natural rhizobacterium *Pseudomonas chlororaphis* PCL1391, Gram negative bacterium *Pseudomonas fluorescens* 142NF (pNF142) and Gram positive soil bacterium *Rhodococsus* RS67 were used in the experiment. Minimum inhibitory concentrations (levels of bacterial resistance) of Zn and Pb (as their nitrate salts) and minimum inhibitory concentrations in the presence of HS and fractions were determined in a modified mineral Duxbury medium (Duxbury, 1981) by a method described Podolskaya et al. (2002). Our results showed that all the three strains had a low resistance to Zn (0.1 - 0.3 mM) and a slightly higher resistance to Pb (0.3 - 0.5 mM). The highest resistance to Pb was characteristic of *Pseudomonas chlororaphis* PCL1391 and *Rhodococcus* RS67, while *Pseudomonas chlororaphis* PCL1391 showed the greatest resistance to Zn. The combined fraction of HS and HA alone reduced Zn and Pb toxicity at all added concentrations of the organic substances (50 – 200 mg L^{-1}) to all microorganisms. On the other hand, the addition of HMA showed a significant increase in the resistance of *Pseudomonas chlororaphis* PCL1391 to Zn and all the three studied microorganisms to Pb only at the maximum concentration of organic matter (200 mg L^{-1}). Thus, under certain conditions, trace elements ion toxicity might be reduced through complexation with humic substances and their fractions. This is particularly true when the metal-organic complexes hold high stability and low solubility.

Keywords: humic acids; hymatomelanic acids; heavy metals; minimum inhibitory concentration; microorganisms
Financial support: The study was supported by Russian Foundation for Basic Research. Project number is 18-04-00274.

(5075 - 2240) Volatilization of n-fertilizer on sandy soil cultivated with sugarcane

Robson Hortêncio de Lima[1]; Ariane Márcia de Sousa Silva[1]; Emídio Cantídio almeida de Oliveira[1]
Universidade Federal Rural de Pernambuco UFRPE[1]

On soil the loss of nitrogen in the form of ammonium by volatilization is dependent on its pH, by the tamping power, and interactions with the environmental temperature, how fertilizer is used, nitrogenous source used, soil texture, humidity and C/N relation. The objective is to quantify and compare the losses of N by volatilization of ammonium in two sources of nitrogenous fertilizers under the management of parcels or complementary fertilization. The

experiment was carried out in an experimental field on the coastal table of Paraíba in Rio Tinto, $6^0$50`35.8"S and $34^0$57`03.2"W, with a variety of RB92579. The experimental parcels were four double lines of ratoon sugarcane with a space of 1.4 m, distributed in causalized blocks, 11 treatments with four repetitions summing 44 experimental parcels. The treatments were nitrogenous fertilization from two sources, nitrate of ammonium (NA) and sulphate of ammonium (SA) and parcels, 100% and 50% of the dose and complement after 60 days of plus 30%, 50% 0r 70%. The treatments were: T1 control zero of N; T2 80 Kg.ha^{-1} of NA; T3 40 Kg.ha^{-1} NA plus 40 Kg.ha^{-1} for complementing; T4 80 Kg.ha^{-1} of NA plus 24 Kg.ha^{-1}; T5 80 Kg.ha^{-1} of NA plus 40 Kg.ha^{-1}; T6 80 Kg.ha^{-1} of NA plus 56 Kg.ha^{-1}; T7 80 Kg.ha^{-1} of SA; T8 with 40 Kg.ha^{-1} of SA plus 40 Kg.ha^{-1}; T9 80 Kg.ha^{-1} of SA plus 24 Kg.ha^{-1}; T10 80 Kg.ha^{-1} of SA plus 40 Kg.ha^{-1}; T11 80 Kg.ha^{-1} of SA plus 56 Kg.ha^{-1}. The ammonium volatilized was caught by 8 cm^2 sponges and volume of 16 cm^3 wet with a solution of phosphoric acid 0,01N wrapped in film PTFE on PVC supports 1cm over the soil surface through the line of fertilization. At laboratory the sponges were washed with deionized water in a Bückner funnel in the vacum, it was taken na alíquota quantitiy of 50 ml and made its distillation (Kjeldahl method) with 15 ml of NaOH 10 mol/L and caught in a solution indicating boric acid at 5% in the output of the distiller. For the determination the output is titrated with HCL 0,02N. Comparing the curve peaks of ammonium volatilization with the pluviosity data it was seen a direct relation in volatilization of both sources NA and SA. After rainy days and drainage of the water excess, the soil was found in reducing conditions and humidity almost the capacity for field, favoring then the microbian activity in the transformations of Nitrogen. The SA was the one which best volitilized N-Fertilizer for getting a reducing means after a heavy rainfall which reduced part of the NA.

Keywords: Sacharum officinarum spp. ; losses of nitrogen; soil fertility; Poaceae
Financial support: CNPq, UFRPE

(8093 - 2239) Weathering rates in soils originated from I- and S-type granites across a climosequence of Brazil

Rayanna Jacques Agra Bezerra da Silva[1]; Clístenes Williams Araújo do Nascimento[1]; Ygor Jacques Agra Bezerra da Silva[1]; Caroline Miranda Biondi[1]; Peter van Straaten[1]; Valdomiro Severino de Souza Jr.[1]; Tiago Osório Ferreira[1]; Yuri Jacques Agra Bezerra da Silva[1]; Franklone Lima da Silva[1]
UFRPE[1]

I- and S-type granites comprise large areas and play a key role in global soil weathering patterns. I-type granites are originated from melting of igneous source rocks, whereas S-type granites result from melting of sedimentar sources. The objective of this study was to address the effect of petrology and mineralogy of I- and S-type granites on weathering rates across a climosequence. The study area lies in the Borborema Province (Pernambuco State), northeastern Brazil. Three soil profiles and the underlying rocks (from both I- and S-type granites) were sampled under native vegetation in the three climatic zones. The results of the major elements (expressed as oxides) were used to calculate the chemical index of alteration (CIA), according to the equation: CIA = [Al_2O_3 / (Al_2O_3 + Na_2O + CaO + K_2O)] × 100. The degree of weathering of soils originating from I- and S-type granites varied systematically in the different climatic zones. Overall, the weathering intensity decreased in the following order: humid zone > sub-humid zone > dry zone. The CIA values in humid zones were higher than 90%. In the sub-humid zone, the mean CIA values were 75% and 81% for soils derived from I- and S-type granites, respectively. The lowest CIA values were found in the dry zone, with mean values of 73% and 61% for soils derived from I- and S-type granites, respectively. The climate effect was clearly expressed on the soil properties regardless the parent material, i.e., soils from the humid zones were subjected to more intensive weathering (mean CIA values of 95%). The higher clay contents (15–31% and 20–25%, for I- and S-types, respectively), higher chroma colors in subsurface horizons (yellowish in S-type and reddish in I-type), lower BS, lower pH values and higher Al saturation percentages also indicate the more intensive weathering process. Our data highlight the importance of the mineralogy and chemistry of granite types in order to understand the relationship between weathering rates and climate conditions.

Keywords: Keywords: Chemical weathering; Granitic rocks; Tropical soils.
Financial support: UFRPE

C2.5.2 - Advances in techniques to investigate soil interfaces to understand interfacial reactions

(2952 - 939) An assessment of near infrared (NIR) spectroscopy for soil organic matter prediction comparing different pre-processing and multivariate calibration techniques in Southern Brazil

Jacques Krticka Carvalho[1]; Tales Tiecher[1]
Federal University of Rio Grande do Sul[1]

The estimation of soil organic matter (SOM) by near infrared (NIR) spectroscopy is a fast and cost-effective alternative to conventional chemical analysis. However, the accuracy of this method is highly affected by the use of proper pre-processing technics and calibration methods. Moreover, these models are highly site-specific indicating a need to develop specific calibration for each region. This study aimed to evaluate the effect of different pre-processing techniques and calibration methods on SOM prediction by NIR spectroscopy. A total of 2388 soil samples from the north of Rio Grande do Sul and east of Santa Catarina states, Brazil, were analyzed for SOM content by wet-digestion using Walkley-Black procedure and for reflectance using a NIR-spectrometer Unity Spectra Star 2400 (1200-2400 nm). The mean of SOM content of samples was 2.5%, ranging from 0.4% to 12.0%. The data set was randomly split in training (70%) and validation (30%) sets. Six pre-processing techniques were applied to the spectra including: Savitzki-Golay derivative (SGD), continuum removal (CR), detrend (DT), binning (BN), smoothing (SM), and standard normal variate (SNV). Multiple linear regression (MLR) and partial least squares regression (PLSR) were used to generate the models. The different combination of pre-processing and calibration methods were compared by the determination coefficient (R^2), ratio of the interquartile distance (RPIQ) and the root mean square error of prediction (RMSE). Results revealed that the best prediction was obtained by pre-processing data with SM coupled with PLSR (R^2 = 0.71, RMSE = 0.50, RPIQ = 2.03). Using PLSR, the worst prediction was found when combined with CR (R^2 = 0.53, RMSE = 0.53, RPIQ = 1.52). When PLSR model were used, only SNV (R^2 = 0.68), SMO (R^2 = 0.71), BN (R^2 = 0.66) and SGD (R^2 = 0.68) improved the prediction comparing with the use of original spectra (R^2 = 0.63). The PLSR models were more accurate for all pre-processing treatments when compared to MLR. DT pre-processing resulted in the best prediction between MLR models (R^2 = 0.62, RMSE = 0.23, RPIQ = 1.69), and the worst prediction was found when SGD pre-processing was applied (R^2 = 0.45). When compared to original data (R^2 = 0.57), only DT and BN improved the SOM prediction for MLR models. Results indicate that NIR spectroscopy is a good alternative to estimate SOM in subtropical Brazilian soils and could be improved with the use of appropriate pre-processing techniques.

Keywords: Organic carbon; Modeling; Reflectance Spectroscopy; Spectral data
Financial support: National Council for Scientific and Technological Development

(9767 - 1663) An optical approach to evaluate the effect of various salts on the sedimentation of clay-rich soil material

Andras Sebok[1]; Attila Nemes[2]; Imre Czinkota[1]; Viktoria Labancz[1]
Szent Istvan University, Hungary[1]; Norwegian Institute of Bioeconomy Research, Norway[2]

Eroded soil particles and free or attached nutrients travel distances from the source area, and may eventually end up in our surface waters and cause undesirable changes to the environment. To slow or prevent this, similarly to many other countries, a number of mitigation measures, such as e.g. sedimentation lakes, dams and wetlands were set up around Norway. This work was motivated by the assumption that coagulation of particles can yield larger effective particle-diameters. This may accelerate sedimentation, and help reduce the amount of material that is effectively lost from the vicinity of the source. Our specific aim was to inspect the effectiveness of various ions in enhancing coagulation and accelerating the process of sedimentation. We experimented with the re-sedimentation of a silty-clay-loam subsoil material of marine origin that was only physically disaggregated, retaining its chemical properties. We used several ions as coagulants to accelerate the sedimentation of this colloid-rich material. In a light and reflection controlled environment, we took high-resolution pictures of the sedimentation columns every 10 minutes over a span of 3 hours and analysed them using custom-developed image analysis software. The cations that we examined were Na^+, Ca^{2+}, Mg^{2+}, Fe^{2+}, and Al^{3+}, in 10, 20, 40 and 80 mg/L doses, and the anions were Cl^-, SO_4^{2-} and OH^- in the amount relevant for the cation doses. As our test material, 1 gram of recurrently ground and sieved soil was dissolved in 500 ml of distilled water. We established a number of metrics to compare the efficiency of ion groups and their concentration on sedimentation time, using e.g. the half-time of the background-adjusted colour of the mixed solutions, as a signal of sedimentation. We will introduce the theoretical background, present results and discuss potential practical implications of this process and knowledge towards sustainable landuse.

Keywords: coagulation, sediment-retention, image analysis, colloidal clay
Financial support: Norwegian Research Council Pr. No. 240663 (SOILSPACE)

(8691 - 2318) Application of micronutrients and biostimulants in sugar cane in successive agricultural cycles

Bruno Bernardes de Souza[1]; André Cesar Vitti[2]; Thiago Antônio Basso do Prado[3]; Hélio do Prado[4]; Hélio Basso do Prado[1]
University of São Paulo[1]; Polo Southern Regional Center - APTA[2]; Federal University of São Carlos[3]; Polo Regional Center East[4]

The application of biostimulants and micronutrients on the sugar cane can support the crops. The purpose of this work was evaluated the technological quality and the productivity of stem with addition of different combinations of organo-mineral fertilizers and micronutrients. The chemistry characteristics evaluated in the soils in the depths of 0-20 / 20-40 cm. was: pH - 5,4 / 5,0; P(res) – 19 / 7, S-SO_4^{2} – 8 / 10, B – 0,14 / 0,15, Cu – 0,3 / 0,3; Fe – 27 / 15, Mn – 7,4/7,0, Zn – 3,8 / 1,4 (mg dm^{-3}); M.O. – 11 / 8, (g dm^{-3}); K^+ - 0,9 / 0,6, Ca^{2+} - 34 / 14, Mg^{2+} - 14 / 5, Al^{3+} - 0 / 0, H+Al^{3+} - 13 / 17, SB – 48,9 / 19,6; CTC – 61,5 / 36,7 ($mmol_c$ dm^{-3}); V – 80 / 53 ; m – 0 / 0 (%); total sand – 726 / 712, clay – 178 / 207, silt – 96 / 81 (g Kg^{-1}); textural classification – medium/medium. The experiment was randomized complete blocks design with 10 treatments and 4 replications, size of each parcel was 75 m^2, composed of 5 lines of cane of 10m each one and spaced 1,5m between rows. The basic fertilization was 600 Kg/ha of the formulated 5-25-20, for all the treatments. The application was realized with costal pulverizer at the equivalent dose 150 L^{-1} of volume solution, for the next treatments: T1/T2 – Control, T3/T4 – 1L/ha Biostimulants + 3 Kg/ha Micronutrients; T5/T6 – 2L/ha Biostimulants + 5 Kg/ha Micronutrients; T7/T8 – Standard (Sugar cane Mill); T9/T10 – 1L/ha Biostimulants + 10L/ha Micronutrients. Biostimulants has as characterization 14, 6, 3, 2, 5 % of organic carbon, Alfa-L free aminoacids, molybdenum water soluble and polysaccharides respectively; micronutrients has as characterization 3,5 , 2,5 , 3, 20 , 12,5 % of boron, copper, manganese, zinc and sulphur water soluble respectively. The foliar applications in the odd treatments with the T3/T4 treatment and the harvest were performed on 04/12/2015 and 12/07/2016 in cane-plant, 28/11/2016 and 06/06/2017 in ratoon cane respectively. The variables were subjected to F test and the multiple comparisons between means by Tukey test at 10% of significance. The results conclude that in the cane-plant cycle the foliar responses were not so obvious in relation to ratoon cane, being verified only the difference of the T3 and T4 in relation to the control for stems productivity and the T5 and T6 to the technological quality. In the second successive agricultural cycle the foliar applications of all the treatments were higher in relation to control treatment. Is evident the importance of successive cycles.

Keywords: Keywords: Fertilizers; biostimulants; micronutrients; sugar cane.
Financial support: Polo Southern Regional Center - APTA; FUNDAG.

(5986 - 201) Assessing the SiO_2, Al_2O_3, Fe_2O_3, P_2O_5 and TiO_2 contents in Brazilian soils via portable X-ray fluorescence equipment

Bruno Teixeira Ribeiro[1]; Nilton Curi[1]; Luiz Roberto Guimarães Guilherme[1]; Bárbara Tenório Simões[1]; Geila Santos Carvalho[1]; Sérgio Henrique Godinho Silva[1]
UFLA[1]

For Brazilian soils classification, mainly for Latosols (Oxisols), the determination of SiO_2, Al_2O_3 and Fe_2O_3 is required. Additionally, the P_2O_5 and TiO_2 are also commonly quantified for soil surveys. The conventional analysis is based on determination by colorimetric, gravimetric, and titration based methods or by using atomic absorption spectrometry (AAS) and inductively coupled plasma emission (ICP) after soil digestion using sulfuric acid. This analysis is completely non-environmentally-friendly, time-consuming and generates a great amount of pollutant residues. The portable X-ray fluorescence equipment (pXRF), still incipient in Brazil, can greatly contribute to soil characterization, in-field or in in-lab conditions. This work used pXRF for determination of SiO_2, Al_2O_3, Fe_2O_3, P_2O_5 and TiO_2 in 156 disturbed air-dried soil samples (< 2 mm). The soil samples were selected from a soil collection of Soil Science Department, Federal University of Lavras, Brazil. In all soil samples the P_2O_5 concentration was below the detection limit. A poor correlation was observed between SiO_2 and Al_2O_3 obtained by pXRF and the conventional analysis. However, an excellent correlation (R^2>0.98) was found for Fe_2O_3 and TiO_2. Others studies indicated that Fe_2O_3 determination by pXRF is not significantly influenced by soil moisture. This is interesting for determination directly in the field any time.

Keywords: tropical soils; soil chemistry; soil proximal sensors
Financial support: Fapemig, CNPq and Capes

(9447 - 2321) Citrus root system preferably uses the macropore space to explore compacted soil

Thais Nascimento Meneses[1]; Luana Laís de Almeida dos Santos[1]; Mauricio Antônio Coelho Filho[2]

University of Recôncavo of Bahia[1]; Embrapa Cassava and Fruiots[2]

Artificial macropores are low resistance pores channels to plant rooting, allowing access to water and nutrients in compacted soils (Yellow Oxisoil Dystrocohesive). We investigated how artificial macropores (AM) and numbers of vertical distribution in column of compacted soil affect plant growth, root system distribution and gas exchange of citrus plant subjected to a continuous soil water extraction. Five treatments were evaluated in a completely randomized design experiment with five replications. A plant of 'Rangpur' lime (C. limonia Osbeck) per PVC tube with 0.15 m of external diameter and 0.5 m of length was the experimental unit. The entirely soil profile of the control treatment (Ctrl) was filled at density of 1.3 g cm-3. The following treatments the shallow profile (0 – 0.16 m) was filled with weak soil (1.3 g cm-3) and underlying (0.16 m to 0.5 m) filled with compacted soil (1,6 g cm-3): no macropores channels (Comp); one vertical macropore (1 mpc); two vertical macropores (2 mpc); three vertical macropores (3 mpc); and five vertical macropores (5 mpc). The artificial macropores (1 mm) builded with wire of stainless steel crossed the compacted profile. The images of root system revealed the preferential way to the macropores when plants were subjected to compacted soil. The macopores relief the effect of strong soils in relation to gas excange root architecture of young plants of 'Rangpur' lime.

Keywords: root system architecture, mechanical resistance, macropore

Financial support: Embrapa Cassava and Fruiots and Foundation for Research Support of the State of Bahia

(9159 - 1557) Computer vision technology applied to soil analysis by digital image analysis based on colour

Victor J. Palencia[1]; Manuel S. Palencia[2]; Alvaro A. Arrieta[3]

Mindtech Research Group (Mindtech-RG), Mindtech S.A.S, Cali, 25360, Colombia[1]; GI-CAT, Department of Chemistry, Universidad del Valle, Cali, 25360, Colombia[2]; Department of Biology and Chemistry, University of Sucre, Carrera Barrio Puerta Roja, Sincelejo, Colombia[3]

A digital image can be considered as a discrete representation of data possessing both spatial (layout) and intensity (colour) information. It is viewed as a two-dimensional matrix whose row and column indices identify a small square area of the image called a pixel. A colour space is a three-dimensional model describing the way colour can be represented typically as three numbers (i.e. RGB). In addition, a computer vision-based image analysis system is composed of a camera to acquire digital images, daylight fluorescent lamps to illuminate the object, and a personal computer to process the image data. For a reliable and reproducible analysis, it is important to create fixed conditions during image acquisition. The aim of this work was to develop and evaluate a quantitative parameter that allows the description of the colour intensity for different analytical application in soils. A measuring instrument was built by the Research Group in Science with Technological Applications of Universidad del Valle and Mindtech-RG of Mindtech s.a.s. The main components of the measuring instrument are: (a) An image capture device (Nikon Coolpix P530 digital camera model with a 42x optical zoom), (b) a cell sample holder (glass cell for spectrophotometry 45x12.5 x12.5 mm, 10 mm pitch., (c) a surface to set a background colour (aluminium foil coated SiO2 for different colours to white, the white surface of SiO2 was coated with black paper not bright), (d) a cabin for analysis with an internal lighting system (Lighting devices were placed around the sample holder), (e) a computer for processing information and (f) a reading software of surface colour index from the captured image (Spectrum 2.0, Mindtech s.a.s., Colombia). Digital images analysis was evaluated using different soils in order to analyse the capacity of description of different physical and chemical properties. Results evidenced that digital image analysis is a promissory technique for the description and soil analysis.

Keywords: Image analysis, soil colour, remote sensing, portable devices

Financial support: Mindtech s.a.s. and Universidad del Valle (MT-004-2016)

(1785 - 1869) Description of colloidal clay particles aggregation in the presence of Hofmeister effects: On the relationship of ion adsorption energy and particle aggregation activation energy

Yaxue Luo[1]; Hang Li[1]

College of Resources and Environment, Southwest University in China[1]

The aggregation of colloidal clay particles is of widespread interest to soil and environmental research, and strongly affects transport, sequestration, and mitigation of ions and contaminant. Particles aggregation is influenced by ion species, concentration, valence and pH, etc. in bulk solution. However, the different ion species especially with the same valence could bring out different colloids stability, usually being referred to as Hofmeister effects, received little attention, and particles aggregation behavior in the presence of Hofmeister effects predicted by the classic DLVO model of Schulz-Hardy rule didn't get satisfying results. Therefore, in our work, a modified description of colloidal clay particles aggregation in the presence of Hofmeister effects based on a theoretical relationship between the ion adsorption energy and aggregation activation energy was established. It indicated that, in the presence of Hofmeister effects, the different additional adsorption energy of cations resulted in the different adsorption affinity with charged surface, which essentially led to the differences in electric field around particles and energy barrier for particle aggregation, and thus the observed ion-specific particle aggregation. Validity of the theory was verified by comparisions of theoretical predicted and experimental critical coagulation concentration (CCC) values in monovalent and divalent electrolyte solutions, and good agreements were achieved. Our findings are helpful for further understanding the interactions of nanoparticles with cations and quantitatively answer how ion-surface interaction affects particle interaction processes.

Keywords: particle interaction; Hofmeister effects; ion adsorption energy

Financial support: This work was supported by the Natural Science Foundation of China (Grant No. 41530855)

(9266 - 1764) Description of intermolecular interactions of humic acids and low molecular weight organic compounds

Manuel S. Palencia[1]; Jina M. Martínez[2]; Enrique M. Combatt[3]

GI-CAT, Department of Chemistry, Universidad del Valle, Cali, 25360, Colombia[1]; Mindtech Research Group (Mindtech-RG), Mindtech S.A.S, Cali, 25360, Colombia[2]; Department of Agricultural Engineering and Rural Development, Universidad de Cordoba, Montería, 230002, Colombia[3]

Humified organic matter is the result of different bio-geochemical processes by thousands of years during soil formation (weathering, transport, accumulation, microbial colonization, colonization by plants, etc.); therefore, humified material is considered as a non-renewable resource which cannot be restored by addition of exogenous organic matter. Differentiation of soil organic matter types is very important to understand the processes of soil formation (geo-transformation), as well as, the processes of soil degradation by loss of organic matter. In particular, the interaction of small organic molecules and humic acids, i.e., humic and fulvic acids, is very important to understand the dynamic of exogenous organic matter in the soils, including amino acids, carboxylic acids and different alcohols which are the main constituents of carbohydrates and biomolecules. Therefore, the objective of this work was to describe the interaction

of humic substances, humic and fulvic acids, with low molecular weight organic compounds by different instrumental techniques. For that, different soil samples were selected from different zones and characterized physicochemical. Humic and fulvic acids were extracted by alkaline dissolution, fractionated by acidification and purified by ultrafiltration. Sequential washed were performed in order to remove ions and low molecular weight species. The clay-humin system was removed by filtration. Humic and fulvic acids were put in contact with different molecules (sorbitol, citric acid and aminoacids) and the resulting systems were analysed by attenuated total reflectance spectroscopy, dynamic light scattering and thermogravimetric analysis. Results evidenced different type of interactions in function of pH, ionic strong and the functional groups on organic molecules. It was evidenced that aggregations of humic acids and fulvic acid is controlled main by hydrogen bond interactions.

Keywords: humic acid, fulvic acid, hydrogen bonds
Financial support: Mindtech s.a.s. and Universidad del Valle (MT-004-2016)

(5262 - 350) Drivers of species diversity on granitic highlands in the mata atlântica of southeastern Brazil

Prímula Viana Campos[1]; Pedro Manuel Villa[2]; Carlos Ernesto Gonçalves Reynald Schaefer[1]; Jaquelina Alves Nunes[3]; Stefan Porembski[4]; Augusto César Rodrigues Santos[5]; Andreza Viana Neri[1]
Universidade Federal de Viçosa[1]; Fundación para la Conservación de la Biodiversidad[2]; Universidade Estadual de Minas Gerais[3]; Universität Rostock[4]; Universidade Federal de Roraima[5]

Rock outcrops are the typical feature of southeastern Brazil. They occur both at low and high altitudes. This work aimed to investigate the influence of altitude and edaphic features on the vegetation structure of three mountain in high altitude grasslands in the Serra do Brigadeiro State Park, Minas Gerais, Brazil. For that, 100 plots (1x1 m) were randomly distributed across each of the three mountaintops, Totem Deitado (1.625 m), Elephant (1.790 m) and Mamooth (1.857 m). The community structure was evaluated using the Braun-Blanquet approach. One soil sample per plot was collected and submitted to chemical and physical analyses. We constructed a series of multivariate linear models to find the most parsimonious models than explain main effect of potential predictor variables on the response of species richness, abundance, and species composition across an altitudinal gradient. To evaluate the correlation among soil properties and vegetation distribution a Canonical Correlation Analysis (CCA) was performed. A total of 9276 individuals belonging to 39 families and 102 species were analyzed. In the multi-model implemented, we found that our best models indicated that elevation and soil are consistently explained more variation in abundance and species composition (ΔAICc < 2). The different predictors analyzed had no significant main effects on species richness. The abundance was significantly affected by elevation among areas (GLM: $z = 2.29$, $p < 0.001$), and also presented significant change with main effects of physical and chemical soils parameters. The linear mixed-effects models between areas showed that species composition is explained by both elevation and soils drivers through six potential models (ΔAICc < 7). Species composition of both sites was significantly associated with positive effects of elevation ($t = 5.6$, $p < 0.001$) and pH ($t = 4.2$, $p < 0.001$). Additionally, a third model that relates elevation, pH, and CEC showed important main effects on species composition. The CCA revealed the existence of two distinct groups indicating the concentration of species in preferential habitats according to the altitude and soil. Therefore, it could be observed that altitude and soil play an important role for the composition and structure of the studied plant communities in highland grassland.

Keywords: mountain vegetation, nutrients, rocky outcrops, upper montane soil, gradient
Financial support: Fapemig

(2964 - 376) Estimation of clay content in Brazilian agricultural soils based on portable X-ray fluorescence data

Tatiane Melo de Lima[1]; Bruno Teixeira Ribeiro[2]; David C. Weindorf[3]; Regina Maria Quintão Lana[1]; Nilton Curi[2]; Luiz Roberto Guimarães Guilherme[2]
Federal University of Uberlândia[1]; Federal University of Lavras[2]; Texas Tech University[3]

Portable X-ray fluorescence analysis (pXRF) has been used worldwide for rapid and low cost soil chemical characterization. Based on pXRF data, many soil attributes have been satisfactory estimated (e.g., soil texture). The mineralogy of tropical soils (Oxisols) is dominated (mainly) by kaolinite and Fe and Al-oxides (hematite, goethite, and gibbsite). Thus, a good correlation between clay content and oxide concentration can be expected. We hypothesized that rapid soil screening using pXRF to assess the oxide concentration could enable the estimation of soil clay content in Brazilian Oxisols under different land uses. One hundred and twenty six surface soil samples (0-20 cm) collected in different farms in the Triangulo Mineiro and Alto Paranaíba regions, Minas Gerais State, Brazil, were used in this study. The soil samples were air-dried and sieved (< 2 mm), and scanned using a Bruker® S1 Titan LE model (Dual Soil mode) pXRF; samples were each scanned for 60 s. The clay content was determined via Bouyoucos hydrometer method. Samples were randomly partitioned with 70% and 30% of soil samples used for modelling and validation, respectively. Based on simple linear regression, the clay content was well correlated to oxide concentration, mainly with ($Al_2O_3 + Fe_2O_3$) and ($Al_2O_3 + Fe_2O_3 + TiO_2$). Using multiple linear regression, the clay content was well estimated ($p<0.01$) by the equation (clay = -67.25 + $1.95Al_2O_3 - 1.76Fe_2O_3$) with R^2 and R values of 0.83 and 0.91, respectively. The data validation resulted a correlation close to a 1:1 line ($R^2 = 0.83$; $R = 0.91$ and RMSE = 79 g kg^{-1}). Thus, we concluded that the Al_2O_3 and Fe_2O_3 concentrations obtained by pXRF were useful estimators of clay content for soils in a representative agricultural area in Brazil.

Keywords: proximal soil sensors; soil analysis; X-ray fluorescence analysis
Financial support: Fapemig, CNPq, Capes and Agrisus (2030/17)

(3178 - 1711) Estimation of the specific surface area in subtropical soils of Brazil

Alberto Vasconcellos Inda[1]; Jessica Souza de Oliveira[1]; Tatiele Fruett dos Santos[1]; Jessé Rodrigo Fink[2]
UFRGS[1]; IFPR[2]

Specific surface area (SSA) is an important property for the physical and chemical behavior of soils. However, although the various methods of SSA determination, this soil property is not commonly reported in the literature due to time-consuming analysis or equipment constraints in most soil laboratories. The aim of this work was to estimate the soil SSA, determined by means of water adsorption method (SSA_{water}), using the following soil atributes: total organic carbon (TOC) determined by dry combustion in a carbon analyser; Fe in pedogenic iron oxides (Fed) obtained by extraction with dithionite–citrate–bicarbonate; Fe in poorly crystalline iron oxides (Feo) extracted with acid ammonium oxalate; and clay content obtained using the pipette method. The determinations were performed using fine earth samples (Æ<2mm) from 76 subtropical soils of contrasting parent materials collected at surface horizons in Rio Grande do Sul, Brazil. The description of SSA_{water} was performed by single and multiple linear regressions using software SigmaPlot-14. Soil SSA_{water} varied from 1.3 to 69.1 $m^2 g^{-1}$. The evaluated attributes

showed expressive amplitudes: TOC varied from 2.0 to 102.8 g kg^{-1}; Fed ranged from 1.2 to 108.2 g kg^{-1}; Feo ranged from 0.2 to 9.9 g kg^{-1}; and clay content varied from 20 to 802 g kg^{-1}. All attributes were positively related to SSA_{water} (P<0.001; n=76), with TOC being the attribute most strongly related (SSA_{water} = 8,175 + (0,738 * COT); R=0.718). The best multiple regression obtained was SSA_{water} = -4,043 + (5,505 * Feo) + (0,0556 * Argila) (P<0.001). This equation explained well the observed values (R=0.861). When TOC and Fed atributes were included as inputs in multiple regressions, the prediction power not increased. The use of equations proposed here to estimate SSA_{water} to soils in the south of Brazil should be validated for other regions due to variations in soil attributes.

Keywords: iron oxides, organic carbon, clay
Financial support: Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq)

(5642 - 2991) FDR sensor calibration for moisture determination in a dystrophic Yellow Latosol from the Savana of Roraima.

Matheus Gonçalves Paulichi[1]; João Vitor Garcia de Lima[1]; Carlos Abanto Rodriguez[2]; Wellington Farias Araújo[1]; Raimundo Lima Soares[3]; Raphael Henrique da Silva Siqueira[3]; Augusto César Rodrigues Santos[1]; Marcus Vinicius Cardoso Trento[4]; João Luiz Lopes Monteiro Neto[1]; Victor Braz Cabral[1]
Universidade Federal de Roraima[1]; Instituto de Investigaciones de la Amazonía peruana-IIAP-Perú[2]; Instituto Federal de Educação, Ciência e Tecnologia do Amazonas[3]; Universidade Federal de Lavras[4]

The determination of soil moisture by humidity sensors helps decision making in irrigation of agricultural systems. However, they are not always accurate since their accuracy is measured by the characteristic of each soil class in addition to the factory calibration itself. Therefore, the objective of this work was to calibrate a commercial FDR sensor for moisture determination in a dystrophic Yellow Latosol from the Savana of Roraima. For the calibration of the data provided by the sensors, undisturbed samples were collected in PVC pipe of 20 cm (height) x 15 cm (internal diameter), calculating three replicates for each treatment and depth of insertion of the sensors. In laboratory, after toilet, the initial weight (Pi) of the samples was fixed. Soon after, the saturation point was reached (water slide up to 2/3 of the volume of the container placed in a tray with distilled water), then the samples were weighed again and their humidity measured with the FDR sensor, obtaining the output reading. After, they were placed in an oven at 60ºC until reaching 35% humidity and then the sensor was inserted again, obtaining by weight difference the water content. The process repeated until reaching 10% humidity of the samples. Then, the samples were dried in an oven at 105ºC to determine the dry weight and generating the values of sensor output and humidity. To estimate dry weight and soil density with reference humidity between 35 and 10%, an extra repetition was collected in the field, which allowed estimating the desired wet weight for the other samples, as described by Silva et al., 2012. The accuracy of the raw data obtained by the sensor readings was verified using the 1: 1 line and the root mean square error calculation. For the adjustment of the data, mathematical models were generated. First all the series of data were used and then they were separated by treatment. The one that best fit was selected due to the lower RMSE (after calibration) associated to the linear model. The accuracy was verified using the model generated by the calibration, where reduced overestimation of the error has a greater proximity of the data to the 1:1 line. The linear model was obtained for each treatment by the transformation of the data of the real humidity sensor that presented, in general, greater accuracy. The mean squared error was reduced to near zero, which provided better accuracy of the moisture data for calibration of the sensors in the dystrophic Yellow Latosol.

Keywords: frequency domain reflectometry; precision; water capacity.
Financial support: CNPq, CAPES, UFRR.

(4763 - 1037) Geochronology for evaluation of stream piracy processes: application in sediments of dry valleys of Guaratuba(SP).

Natalia Nunes Patucci[1]; Deborah de Oliveira[1]; Carlos Batista Silva[1]; Marina Souza[1]
USP[1]

River captures are related to drainages rearrangements processes and occur when part of a course of a river channel moves to join another channel, causing a "Pirated drainage". The phenomenon affects the regional and local morphogenesis, as well as leave observable features in the landscape that allow evaluate the evolution of the process, such as: elbows of capture , dry valleys , beheading, ruptures in the longitudinal profiles, laps, gravel and mineralogical and morphoscopy gravels correlations. The research aims to investigate the different materials of soil formation of the dry valleys of the Guaratuba River (region between the rivers drainages of Guaratuba and Claro through absolute dating using Optically Stimulated Luminescence method (OSL) and radioactive isotopes (14C) in order to assign specific periods of landscape evolution, the origin of these features. Macromorphological, granulometric, morphoscopic and mineralogical aspects of the Dry Valleys coverage material will be searched, as well as the ages of the same shall be verified through absolute dating through (OSL) and (14C). Finally, additional statistical analyses, specifically multivariate and trends, will be applied in the results to analyze the main components (PCA) results. The systemic environmental assessment in conjunction with the use of the proposed methods will develop a pedological/ sedimentological study approaches, that relate the genesis of surface coverage of dry valleys, its chronology and spatial distribution to the process of river piracy. The granulometric analysis indicated the predominance of the sandy fraction in all horizons described; the mineralogical analysis indicated the predominance of the fine sand, quartz and mica fraction. The morphoscopic analysis indicated the smooth surface texture and tendency to sub-rounding and rounding of the grains of quartz observed, which may suggest that these grains past mechanical erosion by current flow, for example. Gleissolos, Espodossolos and Organosols found in the basin divider between the high Guaratuba and Rio Claro present gravel, which means that they can represent the old bed of Guaratuba .Geochronological results demonstrate that the capture occurred in the late Pleistocene, indicating the correlation of the process with the climatic oscillations occurred in the Quaternary.

Keywords: River Captures, Dry Valleys, Sediments,Radioactive Isotope (14C),Optically Stimulated Luminescence(OSL).
Financial support: Fapesp Project 2016/06654-0

(8400 - 3163) Mineral composition of cowpea (*Vigna unguiculata*) plants fertilized with bulk and nanoparticulated zinc oxides

Franklone Lima da Silva[1]; Adriana Alves Batista de Souza[1]; Luiz Henrique Vieira Lima[1]; Clístenes Williams Araújo do Nascimento[1]; Djennyfer Karolaine de Melo Ferreira[1]
UFRPE[1]

The interest in the using of nanoparticles (NP) in agriculture has increased in the last years, especially as micronutrient fertilizers. in this context, the present study aimed to evaluate the effect of doses of zinc oxidein bulk (ZnO) and NP (ZnO-NP) forms onthe nutritional status of cowpea plants(*Vignaunguiculata*).The treatments included the two sources of ZnO applied atfiverates (0, 100, 300, 500 and 800 mg dm^{-3}) in pots containing 5 dm^3 of soil. Soil was fertilized with a solution containing macro and micronutrients as follows: 250 mg kg^{-}

^{1}of N, 240 mg kg^{-1}of P, 150 mg kg^{-1}of K, and 100 mg kg^{-1}of S, in the forms of NH_4SO_2, $NH_4H_2PO_4$ and KNO_3; the micronutrients Fe ($FeSO_4$.7 H_2O), Mn ($MnCl_2$.4H_2O), B (H_3BO_3), and Mo (Na_2MoO_4.2H_2O) were applied in the concentrations of 2, 4, 1, and 0,2 mg kg^{-1}, respectively. Each pot was cultivated for 110 days with two cowpea plants. In order to evaluate the nutritional status of plants, the concentrationsof N, P, K, Zn, Fe, Cu and Mn, besides Zn, were determined. The collected data were submitted to analysis of variance and to the regression analysis using the statistical program Sisvar.Results showed that the Fe concentration in shoots was significantly reduced with the doses increasing of both the NPand the bulk sources ofZnO. This is probably due tothehighamount of Zn available in soil that decreased Fe uptake, since both elements are divalent cations. The K concentration in shoots increased about 45% and 70% for the NP and bulk ZnO, respectively. On average, the bulk source promoted higher K concentration in shoots than the NP source. For the roots, the concentrations of P and Cu were negatively altered by the increase of the oxides doses, regardless the source. The reduction of the P content should be related to the decrease of the available P content in the soil by the precipitation with the soluble Zn. For Cu, similarly to reported for Fe, there was a decrease in concentration owing to antagonistic effects. In general, both ZnO sources caused alteration in the plant's mineral composition.
Keywords: Nanofertilizers; Nutritional status; Zn oxides;
Financial support:

(8710 - 806) On-Farm Assessment of Soil Health in Kumamoto Japan

Toru Nakajima[1]; Takahiko Nakamura[1]; Machito Mihara[1]
Tokyo University of Agriculture[1]

Globally, climate change has major implications for agricultural production. In response, farmers and soil scientists need ways to ensure the resiliency of soybean (*Glycine max* (L.) Merr.) productivity while minimizing the environmental impacts of their management decisions in response to those changes. The resiliency of crop production is a key perspective for increasing agricultural production to meet the pressure of an increasing population. Soil health is the capacity of the soil to function as a living agro-ecosystems that sustains plants, animal, and humans. Soil health index (SHI) assessment is a tool for assessing the impacts of land use and soil management practices in agroecosystems. SHI requires an evaluation of soil physical, chemical, and biological attributes to know how well the resource is functioning. Therefore, in this study, the objectives were 1) to demonstrate SHI for assessing agronomic productivity and 2) identifying soil properties that can serve as key indicators for SHI assessment on-farm-site in Kumamoto Japan. Results showed that hydraulic conductivity and soil organic carbon were identified as key indicators for SHI assessment. SHI values showed a significantly positive correlation with soybean yield suggesting that SHI assessment can be an effective guideline tool for assessing on-farm agronomic productivity in Kumamoto Japan.
Keywords: Soil Health Soybean Resiliency Kumamoto, Japan
Financial support: Strategical Research Project (Tokyo University of Agriculture)

(6328 - 653) Presence of straw in the soil sample increases soil P and MO concentrations

Pâmela Cristina Cassanelli[1]; Jaqueline Pereira Machado de Oliveira[1]; Fabiano Mariani[1]; Luís Carlos Iuñes de Oliveira Filho[2]; Volmir Frandoloso[1]
UNOESC XANXERÊ[1]; UDESC CAV[2]

The aim of this study was to evaluate the concentration of phosphorus, potassium, organic matter and pH in water of a Oxisol, taking in account two types of sampling: sampling with vegetal residue in cover and sampling without vegetal residue (previously the collection was carried out the removal of the cover of the soil). The study area has been conducted under no-tillage system for 4 years. In the area, grazing is used in winter (*Avena sativa*) and corn planting in the summer, and the straw present on the day of collection was from corn planting. Samples were taken with a cutting blade, in the 0 to 10 cm layer. Five samples with straw presence and five samples without straw were collected. Sampling occurred at random, because the work has exploratory. However, it was sampled on the same plot, taking into account the same soil type and even place for the minimum chemical variations to occur, being considered as treatments: T1 - Sampling without presence of straw; and T2 - Sampling with presence of straw. Concentrations of phosphorus (P), potassium (K), soil organic matter (SOM) and pH in water were evaluated. The results obtained were statistically evaluated by *t* test ($P<0.05$). The pH and K variables did not present statistical differences. On the other hand, the P and SOM variables presented differences. The presence of straw provided an increase of 28.8 and 24.4% in the concentrations of P and SOM, respectively, compared to the sampling without straw. In the present study, the values obtained did not influence the recommendation of fertilization of phosphorus and nitrogen. This is because, although the results of both variables showed a difference between the treatments, they are at the same level of recommendation foreseen in the Manual of SC and RS, and the concentrations of SOM considered average and of P considered very high, in soil with clay higher than 60% (typical of the Oxisols). Therefore, the straw interfere in the analytical concentrations of P and organic matter of the soil, not altering pH and K. Considering the need for fertility correction, this study points to the great importance of a well-made and organic-free soil sampling. This could interfere with the amounts and formulas of fertilizers used for correction, depending on the need of each soil, as well as directly affect the costs of the crop.
Keywords: Soil Sampling; nutrients availability; ground cover.
Financial support:

(6494 - 1246) Reasons for the slow emergence of soil meta-proteomics

Siobhan Staunton[1]; Herve Quiquampoix[1]
INRA[1]

The term meta-proteomics was coined about a decade ago and since then the number of studies in this field has increased exponentially for many media, but not for soils. A literature search on Web of Science shows that the vast majority of papers identified with the words soil and proteom* do not in fact involve soils. In contrast to plants, bacteria and the human gut, soils and similarly complex media such as sediments and sludge are not the focus of increasing numbers of papers, indeed the number of papers appears to have peaked and to be declining. A significant proportion of papers concentrate on the potential of proteomics for the understanding of important soil functions, others highlight the experimental difficulties, none present robust techniques or exciting findings that announce a new era of Soil Science. The purpose of this presentation is to present some of the reasons for the slow progress of proteomics in soil. There are two classes of hurdles to the development of soil proteomics: The efficient and un-biased extraction of proteins from soil and the purification of the extracts so that proteins may be separated and characterised, usually by gel electrophoresis then mass spectrometry The identification of sequences of amino acids from libraries of known proteins from soil biota All soil scientists know that soil is a complex heterogeneous material. However, not all soil scientists know that proteins vary in size, conformation and charge characteristics and that the nature and extent of interactions between proteins and other soil constituents are various and complex. Intracellular proteins fulfil specific functions. With reasonable precautions, soil microbes may be removed from the soil matrix and the intracellular proteins solubilised

by cell lysis to obtain a fairly simple medium that can be subjected to protein analysis like other simple biological and environmental matrices. Proteomic study of extracellular proteins released into soil is more difficult. These may have been secreted or released by cell leakage or lysis. Proteomic analysis of extracellular proteins, or the proteins contained in biota that are not easily removed from the soil organo-mineral complex, is fraught with difficulties due to the strong, quasi-irreversible adsorption of proteins on mineral surfaces and the co-extraction of humic material.

Keywords: soil; meta-proteomics; protein
Financial support:

(4956 - 2862) Root Volume by 2D images in soil with different levels of compaction with inoculation of Arbuscular Mycorrhizal Fungi

Raphael Henrique da Silva Siqueira[1]; Matheus Gonçalves Paulichi[2]; João Vitor Garcia de Lima[2]; Luciane Reis Sales[3]; Geanderson Nascimento da Silva[3]; Augusto César Rodrigues Santos[2]; Marcus Vinícius Cardoso Trento[3]; Diogo Francisco Rossoni[4]
Instituto Federal de Educação, Ciência e Tecnologia do Amazonas, Campus Manaus Zona Leste[1]; Universidade Federal de Roraima[2]; Universidade Federal de Lavras[3]; Universidade Estadual de Maringá[4]

Soil compaction causes a decrease in the development of the plant root system when the physical impediment reaches critical levels, making it difficult to absorb water and nutrients. In addition, the destructive analysis of the root system of the plants does not provide data on their behavior and distribution in different soils and management, but also it prevents the continuity of field experiments when the number of plants does not allow a reliable analysis of the variables. Therefore, the objective of this work was to evaluate the development in the volume of Brachiaria roots in soils with different compaction levels inoculated or not with arbuscular mycorrhizal fungi (AMF). The experimental design was a randomized complete block design in a 4x2 factorial scheme with four replications and the treatments being composed of four levels of soil compaction (Ds) represented by the densities 1.08; 1.2; 1.4 e 1.6 mg m^{-3}, and with (CM) or without (SM) AMF inoculation. At the end of the experiment, the root system was analyzed using the trench method to study the crop profile (Brasil et al., 2007). The vessels were cut in half with a circular saw. One of the parts of the vessel under the projection of the brachiaria was used to evaluate the roots. The soil alongside the vessel was scarified, which means that a thin layer of soil (≅ 3 cm) was removed to expose the roots. The acquisition of the digital images was done with a semiprofessional digital camera with a spatial resolution of 32 megapixels. After the acquisition, the images were corrected and aligned with the use of the Adobe Photoshop software CS5 12.0.4; then they were submitted to quantification of the volume (mm^3) of the roots, identified by the Sapphira app (Jorge & Silva, 2010). In vessels inoculated and not inoculated with AMF the root volume is higher in densities 1.2, 1.4 and 1.6 mg m^{-3}, whereas in the density of 1.08 mg m^{-3} there is no variation. The best root distribution in the vessel is observed at densities of 1.2 and 1.6 Mg m-3 with soil inoculated with FMA The best root distribution in the vessel is observed at densities of 1.2 and 1.6 mg m^{-3} in the soil inoculated with AMF. The analysis of roots by 2D images constitutes a promising technique since it allows to evaluate the development of the plants during the cycle without the loss of experimental plots.

Keywords: non-destructive analysis; brachiaria; compaction stress
Financial support: CNPq, CAPES, DCS-UFLA, UFRR, IFAM – CMZL.

(4592 - 904) Soil amendment with ashes generated in wood processing plants - Effect on soil chemical properties

Viviana Falcón[1]; Leticia Rogel[1]; Jorge Hernández[1]; Amabelia del Pino[1]
Facultad de Agronomia, Garzón 780, Montevideo, Uruguay[1]

The forestry sector in Uruguay has recently increased to areas that are appropriate for tree growth, but with important limitations for agricultural use. Soils of the northern region are sandy textured, acid, with low cation and organic matter contents. Moreover, previous studies show soil acidification after some years of afforestation, with pH reduction and increase of exchangeable acidity. As an alternative to maintain the site productivity in the long term, and the nutrient stocks, the use of residues of the forestry industry as soil amendments has been proposed. Our aim was the evaluation of wood ashes as soil amendments, quantifying their effects in chemical properties (pH, exchangeable acidity, exchangeable cations and available P) in a reforestation of *Eucalyptus* (*grandis* x *camaldulensis)*. The field experiment consisted in two fresh ash rates (4 and 8 Mg ha^{-1}) and a control without amendment, which were combined with two fertilizer application levels: 0 and 100 g of diammonium phosphate per plant. From the site preparation the soil was sampled five times (at 0, 2, 6, 12 and 24 months) at 0-20 and 20-40 cm depth. The trees were measured 12 and 24 months after planting (height and diameter at breast height, DBH). No effects of ash application were observed in Eucalyptus height, DBH, or nutrient content of leaves, although there was a positive response of fertilizer application in all of these parameters. Regarding the effect of ash on soil properties one year after application a significant pH increase was observed in the superficial soil layer that reached 0,23 pH units with the highest ash rate, and in the second year a further increase was registered (0,37 pH units). In agreement with these results, a decrease in exchangeable acidity was observed, from the initial 1,85 $cmol_c$ kg^{-1}, to 1,66 $cmol_c$ kg^{-1} (average values of the two ash rates) in the first year, and 1,43 $cmol_c$ kg^{-1} in the second year. Considering exchangeable cations only K showed significant increases after two months of ash application. It was concluded that although ash application was effective to promote positive changes in soil chemical properties, those changes could have been more marked with higher ash rates. It should be remarked the importance of ash characterization before soil application, because its composition is highly variable as a function of the burned material, and particle size, which in turn determines the velocity of the reaction with the soil.

Keywords: Uruguay, Eucalyptus, forestry residues
Financial support: Weyerhaeuser Company

(6591 - 2974) Soil biogeochemical reactions in controlled slash and burn in the western Amazon

Elizio Ferreira Frade Junior[1]; Sarah Vieira Novais[2]; Renato Paiva de Lima[3]; Marcos Siqueira Neto[2]; Mauricio Roberto Cherubin[2]; Izaias Pereira Lisboa[2]; João Andrade Carvalho Junior[4]; José Carlos Santos[5]; Pedro Avelino Maia de Andrade[2]; Fernanda Martins[2]; Stella Cristiani Golçalvez Matoso[6]; Fernando Dini Andreote[2]; Carlos Eduardo Pellegrino Cerri[2]
Federal University of Acre[1]; University of São Paulo[2]; Federal Rural University of Pernambuco[3]; São Paulo State University[4]; National Institute of Space Research[5]; Rondônia Federal Institute[6]

The Amazon rainforest is the largest tropical biome in the world and develops strategic environmental services on the planet. However, for more than two decades, deforestation in Amazon has driven global GHG emissions, reducing soil carbon storage with changes in microbial populations dynamics and in biogeochemical cycles due to land use change. The objective of this study was to evaluate the temporal alterations of soil chemical attributes, quantify CO_2, CH_4 and N_2O emissions and verify changes in soil bacterial structure, due to the slash and burn of the native vegetation in Amazon. The study was developed in an area of native vegetation in the north of Rondônia

state, southern region of Amazon in Brazil. The study area consisted of 4 hectares, where it was cut and burned in 2.25 hectares. Samples were collected to evaluate soil fertility and carbon (C) and nitrogen (N) stocks until 100 cm. These samples were collected in native vegetation until 365 days after cutting and burning. The attributes pH, Al, H + Al, Ca, Mg, K, P, C, N were determined and the values of base sum, CEC, base saturation and aluminum saturation were calculated. The samples to quantify GHG emissions were carried out simultaneously in the native vegetation area and in the central hectare of the cutting and burning area until 350 days after burning. The microbiological attributes of the soil were evaluated by T-RFLP technique with simultaneous samplings in the two areas until 360 days after plant biomass burning. A rapid increase in soil fertility and a decrease in acidity and Al^{+3} contents after burning were verified, however this effect was not persistent, returning to the initial soil status after one year. There was a 30 % reduction in soil C and N stocks at the end of the study, evidencing the deleterious effects of land use change on soil chemical attributes. Also, a 50 % reduction in CO_2 emissions after cutting, compared to native vegetation and, a 35 % reduction in GHG emissions after one year of study, were observed. We verified in the surface layer, significant alterations in the soil bacteria structure due to the fire impact and the changes in the chemical attributes, such as surface deposition of ashes. However, we did not verified significant changes in the layers lower than 5 cm. Our study provided important information for understanding the impacts and changes of the tropical forest conversion process by slash and burning native vegetation in Amazon

Keywords: Land use change; Soil fertility; Greenhouse gases; Bacterial soil; Tropical deforestation
Financial support: FAPESP 2008/04490-4

(5089 - 652) Spatial distribution of roots in "patched" sodic soil

Bonadeo Elena[1]; Milán Cecilia[2]; Bauk Lucrecia[3]; Salvatierra Paola[2]
Universidad Nacional de Río Cuarto, Ruta Nac. 36 - Km. 601 - Río Cuarto, Córdoba. Argentina. Universidad Nacional de Villa María. Arturo Jauretche 1555, Villa María, Córdoba. Argentina.[1]; Universidad Nacional de Villa María. Arturo Jauretche 1555, Villa María, Córdoba. Argentina[2]; Universidad Nacional de Río Cuarto, Ruta Nac. 36 - Km. 601 - Río Cuarto, Córdoba. Argentina.[3]

The sodic soils occupy 2,800,000 ha in the province of Córdoba, Argentina. In these soils the crops show uneven growth, a phenomenon known as "patched". It is hypothesized that in the lower growth sectors of the crop, the soil presents morphological alterations and unfavorable physico-chemical properties that alter the normal pattern of root distribution. The objective of the work is to compare the morphological and physical chemical properties of the soil where the crop has less development (LD) than the soil where the crop has the highest development (HD), as well as to compare spatial distribution of alfalfa (*Medicago sativa L.)* roots of both situations. In a paddock with alfalfa located near San Basilio town, province of Córdoba, (33 ° 29'13 "S, 64 ° 21'21" W) on a typical Natrustol, situations LD and HD were selected. The morphology of the soils was described, physico-chemical properties were evaluated and spatial distribution patterns of root length density (RLD) were determined considering 4 replications for each situations. To study the spatial distribution of the roots, mixed linear models were adjusted and the structure of spatial correlation was determined. The results show that the prisms of the Btn horizon of LD have greater cohesion and the clay skins are darker in color with respect to the same horizon in HD. The carbonate concretion in LD were found closer to the surface of the soil. The pH (1:2,5 soil: water suspension) in both situations increased with depth but was always higher in LD. On the Btn horizon it was 7.47 and 9.27 for HD and LD respectively. The sodium adsorption ratio of the saturation extract (SARe) of the Btn horizon was 27 and 50 for HD and LD respectively. The spatial distribution of RLD was adjusted to a spherical model in all the replicates of HD although variations between the values of the parameters were observed. Regarding the condition of LD, spatial distributions were different in each repetition, indicating the high variability of RLD in this situation. In all the analyzes carried out, a better estimation of RLD was always shown when considering its spatial dependence. It is concluded that the spatial distribution of roots of HD with respect to LD are different, related to differences between morphological and physical-chemical properties.

Keywords: Natrustol, *Medicago sativa*, root length density
Financial support: Universidad Nacional de Río Cuarto and Universidad Nacional de Villa María

(5811 - 1380) Surface energy characterization of an Andisol from souther Chile treated with biosolid.

Itilier Salazar[1]; Karin González[1]; Alejandra A. Jara[1]
Universidad de La Frontera[1]

A common practice in many countries is to apply biosolids from sewage treatment plants on soils to improve physical properties - increasing the level of organic matter- and improve their fertility. The biosolids contain a high level of organic matter and macronutrients, be these, N, P, K and microelements at trace level. The surface properties of soil particles are dependent on their composition, and this can change when adding other materials, such as contaminants, biocides, biosolids or others. In this work, we study the effect of the biosolid application on the surface properties of a volcanic soil of southern Chile through its chemical characterization, contact angle, adhesion work to determine the magnitude of the surface interactions with the biosolid. The biosolid and the soil were characterized, the contact angle was determined as the average of five measurements using a probe water by sessile drop method, to a reference soil (TA), chemical fertilizer soil (TF) and soil plus the equivalent to 30, 60 and 90 tons/ha of biosolid (T30, T60 and T90). The value of the contact angle, Θ, was determined for each system, and calculated the solid-liquid adhesion work, Wadh. Adhesion work is the result of two types of intermolecular forces, van der Waals dispersive and non-dispersive or polar forces. The experimental results showed that the contact angle values followed the sequence, TF <TA <T30 <T60 <T90 and the Wadh, T90 <T60 <T30 <TT <TF indicating that there is a strong effect of the treatment on the surface properties of the soil particles, so the soil to be fertilized acquires greater polarity and therefore a greater interfacial interaction solid-water, ie. wettability. From TA to T90 the contact angle increased indicating that the polarity decreases due to the addition of biosolids, doing the surface more hydrophobic. This phenomenon is confirmed with the Wadh values that follow the sequence, T90 <T60 <T30 <TT <TF. The magnitude of dispersive forces exponentially increase as TF<TA<T30<T60<T90, y=7.9994e0.4202x, r2= 0.9298. This growth is attributable to the fact that the non-dispersive forces decrease as consequence of the organic matter increased contributed by the biosolids. The total surface free energy of the system exponentially decreased from TF to T90, y= 132.7e-0.649x, r2= 0.9101. In addition, the total surface free energy decreased yielding a surface on soil particles with higher hydrophobic character.

Keywords: contact angle; surface free energy; biosolid; soil
Financial support: Facultad de Ingeniería y Ciencias, Universidad de La Frontera

(3948 - 1778) The role of iron nanominerals in the preservation of soil organic matter under long-term fertilization

Ping Wang[1]; Jidong Wang[1]; Hui Zhang[1]; Yongchun Zhang[1]; Yuchun Ai[1]
Agricultural Resources and Environment Institute, Jiangsu Academy of Agricultural Sciences/Scientific Observation and Experimental Station of Farmland Conversation and Cultivation in Jiangsu[1]

The organo-mineral associations play a significant role in soil organic carbon accumulation. However, little attention has been paid to the role of highly reactive Fe minerals in soil organic carbon (SOC) preservation in soil aggregates. In this study, the effects of four long-term (37-year) fertilization regimes (NPK, chemical fertilization; NPKM, chemical fertilization + cattle manure; M, cattle manure; CK, non-fertilization control) on OC stability, soil iron fractions in bulk soil and soil aggregates were studied to characterize the capacity and mechanism of Fe minerals to preserve SOM in soil. The results showed that long-term fertilization significantly (p <0.05) altered the Fe fractions in soil and soil aggregates. The two applications with manure (NPKM and M) increased the non-crystalline Fe content, while the chemical fertilizer (NPK) increased the crystalline Fe content. The non-crystalline Fe was positively correlated to the SOC content in both soil and soil aggregates. Meanwhile, the long-term fertilization treatments greatly changed the mass distribution and OC content of soil aggregates. Silt and clay were found to be the dominant particles in soil aggregates among all treatments. In conclusion, long-term manure fertilization promoted the formation of non-crystalline Fe fractions, which bounds to SOC to form soil macro-aggregates. Thus, the formation of SOC-Fe association in soil and soil aggregates plays a crucial role in SOC preservation.

Keywords: Organo-mineral associations, Non-crystalline Fe , Soil aggregates, Soil organic carbon

Financial support: National Natural Science Foundation of China (grant No. 41201278), the National Department Public Benefit Research Foundation of China (grant No. 201203030) and the Fundamental Research Funds of Jiangsu Academy of Agricultural Sciences

(8944 - 991) The role of organic amendment and cropping system on improving physical and biological properties of a soil poor in quality for sustainable agro-ecosystem

Ardeshir Adeli[1]; John Brooks[1]; Gary Feng[1]

USDA-ARS[1]

Erosion changes soil properties, especially physical properties, mainly because it removes surface soil rich in organic materials and exposes lower soil layers. This study was conducted on an eroded Loring silt loam soil with 1-3% slope to determine the effects of broiler litter and cropping systems on improving soil quality and crop production under both conventional tillage and no-till systems. A randomized complete block design with three replications and split-plot arrangement of treatments was used. The main plots were tillage and no-till and the sub-plots were broiler litter at 9 Mg ha^{-1} , inorganic fertilizer at 220 kg N ha^{-1} as urea ammonium nitrate (UAN solution) applied in split, 75 kg ha^{-1} at planting and 145 kg ha^{-1} as side-dress at knee high and unfertilized control. The cropping system was corn-wheat rotation. Broiler litter was applied only to corn before planting. Winter wheat was planted after corn in the fall and harvested for grain in June. Corn grain yield, grain N and P uptake were significantly increased as compared to inorganic fertilizer at approximately equivalent rate. Corn grain yield and N uptake were greater with conventional tillage (4014 and 63 kg ha^{-1}) than no-till corn (2608 and 42kg ha-^{1}), respectively. Residual effect of broiler litter significantly increased wheat grain yield and grain N uptake (1778 and 26 kg ha^{-1}) as compared to the control (901 and 14 kg ha^{-1}), respectively. Broiler litter application improved soil chemical, physical and biological properties. Averaged across years, Soil P, total N, and total C increased from the base line of 0.033, 0.45, and 10.1 g kg-1 to 0.120, 0.74, and 13.4 g kg-1, respectively, at the 0-15 cm depth. Dehydrogenase levels were greatest in broiler litter treated soils. At 0-15 cm depth, broiler litter application significantly reduced bulk density and soil penetration resistance by 6 and 26%, respectively, while soil water stable aggregate increased by 22% . No differences in soil physical indicators was obtained between inorganic fertilizer and unfertilized control. Results of this study indicated that long-term use of organic amendments along with soil and crop management systems soil restore soil quality and improve crop productivity of an eroded soil

Keywords: eroded soil, , poultry litter, crop rotation, soil management

Financial support: USDA-ARS

(4754 - 1739) Tolerance to and Accumulation of Cadmium, Copper, and Zinc by *Cupriavidus necator*

Rayssa Pereira Vicentin[1]; Jessé Valentim dos Santos[1]; Cláudia Regina Gontijo Labory[1]; Amanda Monique da Costa[1]; Fatima Maria de Souza Moreira[1]; Eduardo Alves[1]

UFLA[1]

Preliminary results of *in vitro* experiments with multicontaminated soils and solid media indicated that nodulating diazotrophic bacteria of the genus *Cupriavidus* are promising for the remediation of contaminated environments due to their symbiosis with legumes and metal tolerance. Thus, strains of *Cupriavidus* spp. (LMG 19424T, UFLA 01-659, UFLA 01-663, and UFLA 02-71) were tested for their ability to tolerate and bioaccumulate cadmium (Cd), copper (Cu), and zinc (Zn) in Luria-Bertani broth. Changes in the growth pattern of *Cupriavidus* strains in the presence or absence of heavy metals were analyzed by scanning electron microscopy and metal allocation by transmission electron microscopy, to clarify the mechanisms of bioremediation. Highest tolerance was detected for strain UFLA 01-659 (minimum inhibitory concentration of 5, 4.95, and 14.66 mmol L-1 of Cd, Cu, and Zn, respectively). Among the removal rates of the metals tested (9.0, 4.6, and 3.2 mg L-1 of Cd, Cu, and Zn, respectively), the bacterial activity was clearly highest for Cd. The efficiency of strain UFLA 01-659 in removing the heavy metals is associated with its high biomass production and/or higher contents of heavy metals adsorbed and absorbed in the biomass. In response to the presence of heavy metals in the liquid culture medium, the bacteria produced exopolysaccharides and small and aggregated cells. However, these responses varied according to the strains and heavy metals. Regarding allocation, all heavy metals were adsorbed on the cell wall and membrane, whereas complexation was observed intracellularly and only for Cu and Zn. These results indicate the possibility of using *C. necator* UFLA 01-659 for remediation in areas with very high Cd, Cu, and Zn contents.

Keywords: heavy metals; electron microscopy; diazotrophic bacteria; bioremediation; tolerance mechanisms.

Financial support: Finep, Fapemig, CNPq, Capes.

(8589 - 2020) Transmission X-ray Microscopy (TXM) Reveals the Nonionic Surfactant Adsorption on Bentonite

Ya-Ting Chan[1]; Yu-Min Tzou[1]

National Chung Hsing University[1]

Macroscopic properties of bentonite are controlled by the structural arrangement of the clay and by the morphology of its finest fraction. The structural properties of clays or foreign ions-modified clays are commonly examined in a dried condition that may interfere the direct observations of the structural changes upon interactions with ions in solutions. For instance, the intercalations of organics, such as surfactants, would lead to clay swelling based on the changes in the interlayer space using a powder X-ray diffraction (PXRD) technique. However, the de-watering process prior to PXRD analyses can lead to an unreal scenario of the reactions in the interlayer spaces of clay minerals where is full of water molecules. A new technique, transmission X-ray microscopy (TXM), makes it possible to investigate the internal structures of the clay aggregates in an aqueous environment. In the study, adsorption/desorption of nonionic surfactants of Brij 30 and Igepal CO890, followed by spectroscopic

analyses was conducted to observe the tomographic reconstruction of bentonite upon its interaction with nonionic surfactants. The adsorptions of Brij 30 (entitled as BB) and Igepal CO890 (entitled as BI) on bentonite were up to 260.5 and 122.1 mg C g^{-1}, respectively, depending on the initial concentrations of surfactants. Based on the results of desorption experiments associated with the changed in the PXRD patterns, both intercalations and physical adsorption of surfactants on the clays occurred. The thermogravimetric analysis (TGA) and PXRD results showed that the surfactants were layered in the interlayers of the bentonite. The TXM micrographs indicated that morphology of the pristine bentonite looked like a cell, and the central of internal space of bentonite could be expanded to 965 nm in an aqueous environment. Upon the addition of surfactants, the interlayer space of bentonite would be narrowed down to ca. 439-455 nm. In addition, the interlayers of bentonite would be further shrunk to 314-316 nm when more surfactants were intercalated. Compared with PXRD results, TXM results might reveal to how the swelling phenomenon of surfactant adsorption/ desorption in bentonite caused by a combination of hydration and electrostatic forces.

Keywords: bentonite, nonionic surfactant, transmission X-ray microscopy (TXM)
Financial support: Ministry of Science and Technology (Taiwan, ROC) under the project number of MOST 104-2313-B-005-014-MY3

(5003 - 813) Using DRIFTs to investigate the dynamic effect of organic matter input on soil carbon functional groups

Zhaolong Zhu[1]; Budiman Minasny[2]; Damien J. Field[2]; Mario Fajardo Pedraza[2]
State Key Laboratory of Soil Erosion and Dryland Farming on the Loess Plateau, Northwest A&F University[1]; Faculty of Agriculture and Environment, the University of Sydney[2]

Soil organic matter (SOM) is an important indicator of soil quality, and diffuse reflectance Fourier transform mid-infrared spectroscopy (DRIFTs) has been widely used to investigate the composition of soil organic matter. While certain organic functional groups can be found in the MIR spectra, its quantification is still unclear. The choice of peak and valley areas at certain wavelength was arbitrary, and thus the effect of different soil organic matter inputs to the carbon functional groups is still ambiguous. A study was undertaken to investigate this problem by incubating a clay soil dominated by kaolinite amended with two different sources of organic matter (alfalfa, C: N=16.7 and barley straw, C: N=95.6) at different levels (0, 10, 20, 30 g kg^{-1} soil). The incubation was conducted for a period of 3 months under a control condition of constant room temperature (20±1 ℃) and soil moisture (70% of field capacity). Specific DRIFTs wavelengths (3010-2800, 2060-1930, 1930-1840, 1735-1650, 1660-1580, 1546-1520 cm^{-1}) and their peak/valley areas were quantified using continuum removal to represent different soil carbon functional groups (aliphatic and aromatic). The results showed that: (1) Direct abiotic effects of organic matter are immediate following inputs; (2) The specific DRIFTs valley/peak areas changed according to the quality and quantity of OM applied, e.g., for 1650-1580 cm^{-1} (aromatic functional group), the peak area increased with C levels applied, and decreased for soils with barley straw amendment; (3) The valley/peak area generally changed with incubation time, i.e. decrease with time; (4) Functional groups at 3010-2800 cm^{-1} and 1930-1840 cm^{-1} have a significant relationship with aggregate stability as measured using wet sieving techniques (R^2 = 0.93). It is concluded that specific functional groups as measured by DRIFTS can be used to quantify organic matter functional groups which are related to soil aggregation function.

Keywords: Carbon functional group, DRIFTs, infrared, organic matter
Financial support: NSFC project, 41771317

(3192 - 2590) Lithological influence on K, Al concentrations and guano density of Streptoprocane species in quartzitic karst landscape

André Luiz Miranda Reis[1]; Nicoló Clemente[2]; André Luiz Lopes de Faria[1]; Liovando Marciano da Costa[1]
Federal University of Viçosa[1]; Federal University Rural of Rio de Janeiro[2]

The Natural Heritage Private Reserve (RPPN) of the Serra do Caraça is located in the municipalities of Catas Altas and Santa Bárbara in the state of Minas Gerais, Brazil. The RPPN is located in the geological province of the Quadrilátero Ferrífero and is lithologically defined by quartzites of the Super Group Minas. In this region there was an intense process of metamorphism and rocks weathering. The weathering action in the fractures allowed the formation of caves, which house swifts of the species Streptoprocne zonaris and biscutata. These birds are responsible for the accumulation of guano on the floor of the cave, phosphate and nitrogen-rich substances that constitute the largest energy source available in the cave environment. Therefore, the objective of this work is to analyze and discuss the dynamics of K, Al and their relationship with density, in different deposits of guanos located in the caves of the RPPN. A transect was collected from the entrance of the cave to the deepest part, with the objective of identifying and collecting the guano deposits. The layers were identified by evaluating the degree of decomposition and humification from the most superficial to the deepest, and thus collected, with a metal shovel in 21 layers of guanos organized in seven deposits. The samples were conditioned in plastic bags and analyzed in the laboratory with soil methods, in the determination of K, Al and density. The results showed a significant increase in the contents of K, Al and density in the deeper layers of the deposits. This is explained considering that the quartzite, submitted to the physical, chemical and biological processes, alters and disintegrates the structure itself and the minerals present, such as feldspar-K and sericite, that rich in K and Al, released these elements to the deeper layers of guano. Therefore, the guano in direct contact with the rock, accelerates the process of weathering, due to the organic acids produced, a fact that contributes in the increase of these elements and density of the guano. It can be considered that the guano, in the layers below 30 cm is influenced by the lithology, being the rock a factor of formation of this material in depth.

Keywords: weathering, geochemical dynamics, caves, bird droppings.
Financial support: Fapemig

C3.1 - Soil Use and Management

C3.1.1 - Recent advances in terroir zoning, functioning and sustainability

(9707 - 372) Advance in automatic measuring tool of soil losses using water environment research equipment ISCO 6712 Model

Tae-young Kim[1]; Yeong-Gyu Lee[1]; Gye-Ryeong Bak[1]; Sam-Nyeo Ji[1]; Dong-Shig Oh[1]; Gye-Jun Lee[1]

Rural development administration[1]

In soil loss research work in-situ timely correct measurement for loss quantities is a hard task. The rain is suddenly coming on and its intensity is changeable every moment. On-time automatic measurement of soil losses accordingly with such a raining occurrence is really laborious and complicated. In environment-friendly agriculture research laboratory of Korea Highland Agriculture Research Institute, the automatic measuring technology of soil losses was developed using compositive water environment research equipment ISCO 6712 Model(made in USA) over the year of 2015 and 2017. Soil losses are automatically measured as follows; Site Area; 1 × 5 ㎡, Planting Crop; Maize(planted density, 60×25 ㎠), Site Soil; Saprolite(Loamy Sand), Rainfall and Run-off Water Level Measurement; Rain Gauge and Bubbler Hose attached to Model No. 6712 Equipment, Automatical Suspended Water Sampling; Automatic Catching of Suspended Water by a Sampling Bottle connected to each horizon of Water Reservoir. The expectable accuracy for soil losses quantification measures up to the goodness of 75% and 95% in the ratio of estimate to occurrence quantity in a storm of rain 201.3㎜ and 82.6㎜, respectively.

Keywords: soil loss, ISCO 6712, maize

Financial support:

(1038 - 603) African soil partnership implementation plan for addressing the challenges of sustainable soil management in the sub saharan africa

Victor Okechukwu Chude[1]

Chairman, African Soil Partnership Steering Committee National Program for Food Security Federal Ministry of Agriculture and Rural Development. Abuja, Nigeria[1]

Land is the main resource base for many people in Sub-Saharan Africa. Even with an estimated 65% of arable lands, 30% of grazing land and 20% of forests already degraded in Africa, the region still has the potential to position itself as champion in food production. Sustainable soil management is vital to achieving this goal and, for this reason, is one of the cornerstones of the Global Soil Partnership (GSP). The African Soil Partnership has identified six main areas of action as priority in sub-Saharan Africa which include: a)Addressing soil degradation as a major factor in food insecurity and making country and region-wide efforts to rehabilitate degraded lands and change them to productive assets through community participation; b) Guiding and enabling the implementation of sound and sustainable soil management practices and the restoration of soil health at all levels towards food security; c) Developing, updating and disseminating updated and harmonized national and regional soil resource information addressing all user needs including soil fertility information and making the best use of science available to increase soil productivity; d) Addressing climate change and developing resilience towards climate change adaptation; e) Developing and implementing training and capacity building programmes in all soil applications for existing and new generations of experts in soil science and land management, taking into account the gender balance; f) Establishing linkages and networks with other national, regional and global initiatives that impact soil health. This paper discusses all the identified challenges associated with Sustainable Soil Management in Africa and Regional implementation plans for addressing the challenges. The Implementation Plan sets out the road map for the next 5 years to achieve SSM over the longer term and includes a large number of outputs and activities which are considered priority in this first phase of establishing the AFSP. It is envisaged that funding for these activities will be secured by capitalizing on existing in-country initiatives and activities, as well as by actively sourcing additional external funding. Since the GSP is a voluntary initiative, it calls for the strong support of national governments, as well as national and regional entities involved in natural resource management to contribute to achieving the common goal of improved and sustainable soil management.

Keywords: African Soil Partnership, Sustainable Soil Management

Financial support: Africa Regional Office of FAO/UNO in Accra Ghana

(8699 - 2558) Agricultural potential for Crop-Livestock-Forestry integration system in the Matopiba region, Brazil

José Francisco Lumbreras[1]; Amaury de Carvalho Filho[1]; Paulo Emilio Ferreira da Motta[1]; Pedro Luiz de Freitas[1]; Alexandre Hugo Cezar Barros[1]; Mario Luiz Diamante Aglio[1]; Ricardo de Oliveira Dart[1]; Hilton Luis Ferraz da Silveira[1]; Carlos Fernando Quartaroli[2]; Rodrigo Estevam Munhoz Almeida[3]

Embrapa Solos[1]; Embrapa Territorial[2]; Embrapa Pesca e Aquicultura[3]

In this paper, it is presented the agricultural potential for integrated production systems for the Matopiba region, which covers approximately 73 million hectares and represents an important frontier for the expansion of agricultural production in Brazil. In soil and climate studies, the main limitations to agricultural land use have been identified, complemented by field campaigns to validate interpretations. The agricultural potential of the land for the adoption of Crop-Livestock-Forest integration systems (CLFi) considered the high technological level for crops, and medium and high for silviculture and planted pasture. The evaluation is presented in map compatible with the 1:500,000 scale. Mixed systems of agricultural production, based on the spatial and temporal integration of agricultural components (annual and perennial crops), forestry (silviculture) and livestock (pasture) were considered. The systems used for sustainable intensification of land include: crop-livestock-forest system or CLntegrating agricultural, livestock and forestry components in rotation, consortium or succession in the same area. They include the forest-agriculture systems or crop-forest integration with emphasis on crop-forestry systems; crop-livestock systems or Crop-Livestock integration (CLi): integrating agricultural components (annual crops) and livestock in rotation, consortium or succession, in the same area and in the same agricultural year or for multiple years. They include inadequate areas for the implantation of forest species; forest-livestock systems or Livestock-Forest integration (LFi): integrating livestock (pasture and animal) and forestry components into a consortium. They include areas that are unsuitable for planting; and, pastoral systems - exclusively for livestock component in areas not suitable for crops or forestry. They include the recovery of degraded pastures and management techniques that guarantee high productivity and pasture support capacity. A wide range of soils occur under varying climatic conditions, reflecting distinct qualities and vulnerabilities for agricultural land use. Soils with great potential for agriculture, such as Argissolos and Latossolos, are noticed. On the other hand, soils with a high vulnerability to degradation, with high sand content (Neossolos Quartzarênicos), gravel (Plintossolos Pétricos) and strong drainage restrictions (Plintossolos Argilúvicos and Háplicos, Gleissolos and Planossolos) are frequent.

Keywords: soil, agricultural suitability, environmental planning, integrated production systems

Financial support: Work executed with Embrapa resources (SEG / IDEARE Project 05.13.25.009.00.00).

(3555 - 2167) Arbuscular mycorrhizal fungi and phosphate

fertilization in production of araucaria seedlings

Carlos Vilcatoma Medina[1]; Marcos Antonio Dolinski[1]; Glaciela Kaschuk[1]; Flávio Zanette[1]

Universidade Federal do Paraná[1]

Araucaria or Paraná-pine [*Araucaria angustifolia*] is a slow-grower endangered tree species of the Mixed Ombrophylous Forest in South America that makes symbiotic association with arbuscular mycorrhizal fungi (AMF). This work was performed with the objective of verifying the effects of AMF and single superphosphate (P) fertilization on the production of araucaria seedlings. An experiment was settled with five treatments [(1) inoculation with *Rizophagus intraradices* (AMF1), (2) with *Acaulospora colombiana* (AMF2) and (3) with forest soil, (4) fertilization with simple superphosphate (SP) and (5) control (C)], under entirely random design, and five replicates. Seedlings were produced with local seeds sown in the Mecplant® substrate mixtured with washed sand in the proportion 1:1. AMF inoculation was done with 100 g of a soil-root AMF inoculant containing either, spores of *Rizophagus intraradices*, or *Acaulospora colombina*, or litter from a 50 years-old araucaria forest. Fertilization was achieved with application of 100 mg of SP. The control was the treatment in which seedlings grew without any amendment. Seedlings were let to grow for 75 days and, then, AMF root colonization, seedling height, stem diameter, fresh and dry shoot and root matter were measured. All measured variables were not affected by treatments at the 75th day of seedling growth. On average, inoculation with any strain of AMF resulted in a colonization rate of 48% while soil forest, SP and control had 44, 42 e 35 %, respectively. Seedlings measured on average 23.7 cm of height, 4.0 mm of stem diameter, 15.4 g of fresh shoot matter, 4.6 g of fresh root matter, 3.8 g dry shoot matter and 1.0 g of fresh root matter. This experiment is being continued and a new harvest happen at 180 days.

Keywords: Seedlings; symbiosis; substrate; nursery.

Financial support: Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES)

(7537 - 2597) Background and Reference Values of Heavy Metals in soils of the Brazilian Amazon

Luiz Henrique Vieira Lima[1]; Franklone Lima da Silva[1]; Clístenes Williams Araújo do Nascimento[1]; Fernando Bruno Vieira da Silva[1]

Universidade Federal Rural de Pernambuco[1]

The Amazon is considered the biome with greatest biodiversity in the world and of great socio-environmental and economic importance for Brazil. The sustainability of this environment is threatened by increasing soil contamination by heavy metals which are added by anthropogenic activities. Quality Reference Values (QRVs) reflect the natural concentrations of heavy metals in soils without anthropic interference and the initial step for environmental management of contaminated areas. In this sense, the study aimed determine the background and quality reference values for Ba, Cd, Cr, Cu, Fe, Mn, Ni, Pb, Sb e Zn in soils of a sedimentary basin located in southwest of the Brazilian Amazon. 114 soil samples were collected at a depth 0.0 – 0.2 m at sites with minimal anthropogenic interference. The samples were air-dried, ground in agate mortar and passed through a stainless steel 0.15 mm mesh sieve. 1 g of the samples were digested in a microwave at 175ºC with HNO_3 + HCl according to methodology 3051A of US Environmental Protection Agency. As quality control for the analyzes were used blank samples and the reference material SRM 2709a (*San Joaquin Soil*), with the contents of metals certified by National Institute of Standards and Technology. All analyses were performed in duplicate. The heavy metals contents were determined in ICP-OES (Perkin Elmer 7000 DV). From the data set, were calculated the mean, median, minimum, maximum and standard deviation; the QVRs for metals were defined based on the 75th percentile of the data set, eliminating the anomalous values as recommended in the Brazilian legislation. The recoveries of the metals in reference sample ranged from 90 – 114%. The average natural contents were 15462.0; 19.3; 15.1; 8.7; 6.3; 4.5; 3.3; 2.5; 1.0 e 0.1 mg kg^{-1} for Fe, Ba, Mn, Cr, Zn, Pb, Cu, Ni, Sb e Cd, respectively. When comparing the results obtained with other records in the country, it was observed that the contents of the metals in the present study were inferior due to the sedimentary origin predominant in the region. Based on the natural contents the QVRs were defined and the following decreasing order was observed (in mg kg^{-1}) Fe (15462.0) > Ba (16.5) > Mn (13.4) > Cr (6.9) > Zn (5.7) > P (4.4) > Cu (2.8) > Ni (1.7) > Sb (0.9) > Cd (0.1). The results of the present study will serve as a basis for the definition of public policies in order to investigate the environment impacts resulting from the change of land use in legal Amazon territory.

Keywords: anthropogenic activities; contamination; trace elements; quality of soil.

Financial support:

(6433 - 211) Chemical attributes variability of a quartzipisamment cultivated with eucalyptus in response to limestone application

Elizeu de Souza Lima[1]; Lenon Henrique Lovera[1]; Diego Alexander Aguilera Esteban1[1]; Zigomar Menezes de Souza[1]; Rafael Montanari[2]; Ingrid Nehmi Oliveira[1]; Henrique Barbosa Sandoval[1]; Angela Nunes Wendt Lima[3]

State University of Campinas (Unicamp), Agricultural Engineering (Feagri)[1]; State University Paulista (UNESP)[2]; [3]

Eucalyptus has been cultivated in Cerrado regions predominantly for highly weathered soils, possibly causing lower productivity, whose prevention involves soil correcting and fertilization as well as the use of monitoring and assessment methods to determine the variables mostly affecting eucalyptus growth. We aimed at analyzing the spatial variability of Eucalyptus urograndis as function of the chemical attributes of a Typic Quartzipisamment. We collected plant samples at Bom Retiro Farm, county of Três Lagoas-MS, in 2014, regarding the following attributes: height (HEI) and soil at layers 0.00-0.20 m and 0.20-0.40 m, for determination (hydrogenic potential) pH, organic matter (OM), calcium (Ca), magnesium (Mg), and aluminum (Al). Data were analyzed through descriptive statistics with SAS while the semivariogram spatial dependence was verified using GS+ software. By analyzing average contents of OM (11.14 and 9.98 g dm^{-3}), pH (4.53 and 4.31), Ca (11.74 and 6.06 mmol$_c$ dm^{-3}), Mg (9, 46 and 4.94 mmol$_c$ dm^{-3}), and Al (6.26 and 8.52 mmolc dm^{-3}) at the layers assessed and comparing with contents from before the limestone application, we found an increase in Ca in Mg. These are ideal contents to clonal eucalyptus crop because of their low nutrient values; however, it is necessary to constantly correct soil fertility upon critical levels of nutrients below the adequate content to the species. The semivariograms presented spatial dependence for ALT and OM at layer 0.00-0.20 m, Al and pH layer of 0.20-0,40 m. In relation to kriging maps, it was possible to identify homogeneous and soil specific zones for most of the attributes studied. High spatial similarity for practical soil management effect occurred for the maps of HEI, OM and Al at layer 0.00-0.20 m. Heterogeneously similar spatial distribution occurred in the northwest and southeast regions of the kriging maps, concentrating the highest eucalyptus heights (3.6-4.0 m), highest OM contents (11.3-12.5 mg dm^{-3}) and consequently the lowest Al content (3.5-5.5 mmol$_c$ dm^{-3}). We concluded that plant height, organic matter content, and pH were the attributes which presented spatial dependence between 55.8 and 89.9% as well as reaching from 11.7 to 20.6 m, thus determining specific management areas.

Keywords: Geostatistics, management zones, liming.

Financial support:

(6341 - 645) Comparation between diagnostic metodology cda versus methodology cda innovated aiming to transform degraded areas into conservation agriculture areas

Oswaldo Julio Vischi Filho[1]; Oscar Yoshikatsu Kanno[1]; Raul Barros Penteado[1]; Roberto Mikio Arabori[1]; João Flávio Bernardoni Caldas[1]; Fabrício Sales Massafera Tristão[1]; Roberto Ciciliato[1]; Jorge Aparecido Quiessi[1]; Antonio Celso Alves Vilella[1]; Edna A. Menegucci Scachetti[1]
Coordenadoria de Defesa Agropecuária[1]

Coordenadoria de Defesa Agropecuária has developed the inspection activity of agricultural soil use and conservation in the state of São Paulo for 18 years. The area of the state occupied with agriculture, has 18 million ha, with 330 thousands farms. For applying the conservation law of agricultural soil a diagnostic is done which consists on watershed delimitation, as well visit to all properties belonged to this watershed. The inspection consist on preliminary survey stage, on the visits on the properties, on conservationist projects presentation and finishes at the agri-environment rehabilitation. The inspection methodology CDA was developed from 1999, was improved in 2017, named Diagnosis Methodology CDA Innovated. The pilot project of methodologies Innovated was done in watershed of Rio do Peixe, on the of 59000ha, located in Marília region. The beginning of activities, using the old methodology, was in 2007, and finished in 2011 where it was evaluated 14076ha and, from 2011 to 2015, evaluated 8175ha totalizing 22251ha, 216ha per month, being done by a team of four Agronomist Engineer, during 103 months. Many technological innovation options were tested, the using of model airplane, helicopter and drone, however the results were only favorable when it was developed a new work method. With the new methodology it was diagnosed from 01/2017 to 09/2017, 27586ha, that is, 3065ha per month. The methodology using data base of Rural Environment Registration, of Animal and Vegetal Defense System and Aerial Images of Google Earth Pro, doing the diagnose and the inspection by remote sensing. After this stage the obtained date base work done on GE, were checked on the field and the inspection and agri-environment rehabilitation consequent are completed. This methodology allows the evaluating, with details, an area that by the old methodology would take 103 months to be done, in only 9 months, a save in time and cost, that is, a performance of 1418% favorable to the methodology CDA Innovated.
Keywords: Aerial image; Rural Environment Registration; Drone; Soil degradation; Agri-environment Rehabilitation.
Financial support: CDA, Agrisus, FEAGRI/UNICAMP

(9783 - 2136) Definition of soil management specific units at farm level

Juan Carlos Rey[1]; Gustavo Martínez[2]; Jorge Marquina[2]
1Instituto Nacional de Investigaciones Agrícolas, Av. Universidad, Maracay 2105, Venezuela. (jcrey67@gmail.com)[1]; Instituto Nacional de Investigaciones Agrícolas[2]

Soil management at the farm level is commonly uniform, at least for each land use type, without considering the soil variability. The elimination of subsidies and shortages of fertilizers, promotes a more efficient use of inputs every day. In this sense, the definition of soil management specific units (SMSU) is proposed from the description of soil augers, soil laboratory analysis and statistical analysis involving the data exploratory analysis, principal components analysis and a conglomerate analysis. The variables considered in the description of the augers were the horizons thickness (HT), soil color (SC) and depth of mottles (DM); as well as the drainage classification (D) and tha land capability use (LCU). The variables considered from the laboratory analyzes were the contents of sand, silt and clay, nutrient content (phosphorus - P, potassium - K, calcium - Ca, magnesium - Mg and microelements - Mic), pH, organic matter contents (MO) and electrical conductivity (CE). In Los Catires farm (15 hectares), located in the south of the Zulia State, four SMSU were determined, where important differences were found in the depth to mottles, pH, MO, soil granulometry and P, K and Mg contents. At El Diamante farm (54 hectares), located in Trujillo State, six SMSU were determined; these six SMSU showed important differences in the depth of mottles, MO, granulometry and contents of P, K, Ca and Mg. For both banana producing farms, the aptitude of each SMSU was determined, and fertilization management programs were designed by lot, according to the localization of SSMU, demonstrating the utility of these methodology for the farmers planning.
Keywords: soil management, farm, soil variability
Financial support: ASOBANAPTRU (Asociación de Productores de Banano y Papaya de Trujillo)

(9425 - 952) Delineating homogeneous zones in a watershed with respect of the susceptibility of lands to degradation by agricultural use

Michender Werison Motta Pereira[1]; Mara de Andrade Marinho[1]; Antonio Paz-González[2]
UNICAMP[1]; University of Corunna[2]

Land degradation has been a recurrent aspect concerning soil conservation and management. The association between intensive agricultural use and soil degradation, mainly due to the compaction and soil erosion, is widely known and studied. The history of soil degradation in the Ceveiro watershed (SP, Brazil) has motivated the present work, once the current main use is still with sugarcane, considered an overuse according to the agricultural land suitability. The goal of this work was to delineate homogeneous zones according the susceptibility of lands to degradation by agricultural use as a tool to guide the sustainable use and management. To reach our purpose we made use of concepts from Pedometrics and approaches concerning the continuous in-depth modelling of soil attributes (by using the *spline equal area function*) and digital soil mapping. To define and map the homogeneous zones according to their susceptibility to degradation we elected the following conditioning factors: the *solum* depth (A+B); particularly for *Alfisols (Argissolos)* and *Ultisols (Luvissolos)*, the depth of the top of the argillic horizon (B textural); the content of soil organic carbon; the (global) soil density; the soil macroporosity; the soil texture; and, the inclination of the terrain (slope angle). Maps representing the spatial variability at different depths (up to 1.0 m) were generated for each conditioning factor. Then, these maps were reclassified according to five levels of limitation grade to degradation, null, slight, moderate, severe, extreme, by assigning a weight for each level as suggested by Lal (1999). These maps were combined (by addition) by pairs in a GIS. At the end of this step, according to the final summation of each identified polygon, the image was reclassified to generate the map of homogeneous zones, by distinguishing the zones of very low, low, medium, high, and very high susceptibility to degradation. The more restrictive conditioning factors of land degradation in Ceveiro were identified as being the depth of the top of the argillic horizon, the content or soil organic carbon, the soil macroporosity and the terrain inclination. The percentages of distribution of the homogeneous zones in Ceveiro according to their susceptibility to degradation are as follow: very high (56%), high (28%), medium (12%), and low (4%). We conclude that is mandatory the conversion for less intensive and more conservative uses in keeping with the agricultural land suitability.
Keywords: land use planning; digital soil mapping; site-specific land management
Financial support: Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq), 142092/2014-2.

(4835 - 2274) Distribution of the radical system of capim mombaça mixed with legumes with nitrogen fertilization management

Flavia Alessandra Mignacca[1]; Tassiane Sanchez Calles[1]; Marcelo

Augusto Statello[1]; Carlos Henrique dos Santos[1]
UNOESTE[1]

Sandy soils are sensitive to intensive management, with essential use of the no-tillage system, with improvements in the chemical, physical and biological properties of the soil. Objective of this work was to evaluate root development in an Argisol under no - tillage system cultivated with mombaça grass mixed with legumes. The experiment was carried out at the experimental farm of University of Western São Paulo. The experimental design was a randomized complete block design with four treatments and four replications: single unmanned mombaça grass;Single mombaça grass with nitrogen fertilization (250 kg ha^{-1} of N); Mombaça grass mixed with horse gram without nitrogen; mombaça grass mixed with pigeonpea without nitrogen. The roots were collected with 10 x 10 x 10 cm iron monoliths at the following depths: 0-10, 10-20, 20-30, 30-40, 40-50, 50-60, 60-70, 70-80, 80-90 and 90-100 cm, in the center of the face of each trench. After being collected, the roots were washed with tap water and stored in vials containing 70% deionized water and 30% absolute alcohol, under refrigeration (± 10 ° C).To obtain the biometric parameters as volume (mm^3 cm^{-3}), surface area (mm^2 cm^{-3}) and length (mm cm^{-3}) the roots were submitted to SAFIRA.After the readings, they were oven dried at 65ºC for quantification of dry biomass (g cm^{-3}).The soil resistance to penetration with the IAAPLANALSUCAR / STOLF penetrometer was evaluated and four points were randomly sampled in each experimental plot and the resistance was measured at depths of 10, 20 and 40 cm. There was no statistical difference between the evaluated parameters of the roots, and all the managements presented higher volume and area of roots in surface with gradual decrease in depth. However, the volume, surface area and biomass values of the roots of the mombaça grass intercropped with the horse gram tended to show numerical superiority in the majority of the evaluated depths, whereas the single mombaça grass with nitrogen showed inferior in all the depths. In relation to the lenght parameter of the roots, the mombaça grass mixed with horse gram and the mixed with pigeonpea tended to larger values, and the single mombaça grass without nitrogen obtained a smaller root lenght, mainly in the superficial layers. There was no statistical difference in soil resistance to penetration, but they followed the same tendency of the roots, that is, they decreased in depth (3.1, 2.7, 2.2 MPa respectively from 0-10, 10-20, 20-40 cm)

Keywords: horse gram, pigeonpea, forage, compaction
Financial support: FAPESP - São Paulo Research Foundation [grant number 2015/50305-8], BBRSC/Newton Fund [grant BB/N013201/1] and UNOESTE - University of Western São Paulo

(5760 - 2886) Effects of sugarcane removal straw on carbon and nitrogen from soil microbial biomass

Paul Lineker Amaral de Melo[1]
Centro de Energia Nuclear na Agricultura/Universidade de São Paulo[1]

Recently the search for energy sources capable of replacing non-renewable sources has become a global effort to reduce greenhouse gas emissions. The straw from the sugarcane harvest is considered to be an important raw material in energy generation and in reducing the impact on the environment. It is believed that the maintenance of these residues on the soil will promote the occurrence of microbial communities, often associated with variations in the physical or chemical properties of the soil. The non-removal of these residues on the soil for the industry would promote soil pH increase, reduction of aluminum content in the soil and a higher soil moisture, it is believed that this management will favor the biological activity of the soil. The experiment was developed in 2016 an Oxisoil with clay texture, an area belonging to the Usina Bom Retiro in the city of Capivari. The xperimental design was a randomized block with 4 treatments and 4 replicates. The treatments consisted of the maintenance of 0, 25, 50 and 100% of the straw on the soil, which resulted in 0, 4,2; 8.7; and 18.9 Mg ha-1 of straw on the soil, respectively. The soil samples were drawn 0.90 m inter-row with 0.10 m depth, stored in plastic bags with breathing apparatus and taken to the laboratory for immediate extraction. The microbial biomass of the soil was estimated using the Fumigation-Extraction method of Vance et al. (1987). The concentration of microbial C in extract of 0.5 mol L-1 of potassium sulfate (K2SO4), as well as the C-labile extract was determined in Shimadzu® TOC-VCPN® equipment (Tokyo, Japan). No significant difference was observed between treatments for C and N-microbial values and CBM / NBM ratio (p> 0.05). In spite of this, the highest values of CBM were found when 18.9 Mg ha-1 of straw was kept on the soil (without removal), which may be justified due to the greater amount of residue available to the microbiota. For this treatment, an average value of 376 mg C / g Dry Soil (C-BM) was observed. Lower C-BM levels were observed for treatments with 8.7 and 0 Mg ha-1 with 256 and 264 mg C / g dry soil, respectively. For N-BM, the highest observed values were for treatments with 0 and 18.9 Mg ha-1, with a mean of 25 and 24 mg N / g dry soil (N-BM), respectively. In fact, the straw deposition did not reflect on the analyzed variables, a fact that may have been provided by adequate water sufficiency beyond the short straw deposition period (1 year) for evaluation.

Keywords: Bioenergy Crop residue management Microbial Biomass
Financial support: BNDES

(9125 - 2421) Energy balance in corn culture, cultivated in different soil conservational preparation systems

Gabrielle Passos[1]; Michael Mazurana[1]
UFRGS[1]

The need to produce food on a large scale, to meet the growing demand of the population, is becoming a bigger problem every day. That is why the search for new sources of energy and the reformulation of production systems dependent on fossil fuels are vital. In this sense, one of the most appropriate ways to evaluate the level of production /consumption of agriculture in a stable region is the analysis of its energy flows associated with the various activities carried out in the systems. The determination of the best management strategy for an ideal agricultural system will depend not only on the analysis of the endemic environmental conditions and the economic data of the activity, but also on the definition of the energy balance, a basic instrument capable of maximizing energy gains through better knowledge of the energy input/output relationships in agricultural production. Therefore, the objective of this research was to analyze and evaluate the energy efficiency of corn (Zea mays) production for grain, cultivated in different conservational tillage, in order to establish the energy flows through the identification of total demand and efficiency, reflected by the net gain and the output-input ratio, quantifying all the inputs used (fertilizers, pesticides, machines and equipment) and produced products that are transformed into energy units for final accounting. This experiment was installed at the Experimental Agronomic Station of UFRGS, located in the municipality of Eldorado do Sul, on a typical Argissolo Vermelho Distrófico under Cfa climate, according to Köppen. Four methods of soil preparation (treatments) with two replications, in a completely randomized design, were tested: no – tillage (NT), no - tillage with chiseling every 9 years (NT+Ch 9), chiseling using an equipment with a clod-breaking roller (ChR), and chiseling followed by disking (ChD). Due to meteorological adversities in the corn crop harvest period, the results cannot be fully compiled, analyzed and discussed to date. With the data, we can understand the cause-effect relationship of soil conservation treatments in the energy balance and search, each time more, the balance between sustainability and agricultural productivity.

Keywords: Energy balance, Tillage, Sustainable food production, Energy efficiency
Financial support: UFRGS and CNPq

(4696 - 3153) Eucalyptus harvest residues decomposition as affected by nitrogen fertilization and residue incorporation

Thaís Corrêa Sales[1]; Gustavo Conforti Ventura Mayrink[1]; Helen Carla Santana Amorim[1]

Universidade Federal de Viçosa[1]

Eucalypt plantations have been established in areas with predominantly low- fertility soils, in which nutrient cycling is critical for forest sustainability. However, despite continuous research on harvest residues management, the extent by which its decomposition rate is affected by management practices, such as N fertilization and residue incorporation still need to be better understood. Thus, the main goal of this study was to assess the decomposition dynamics of combined residue (leaf + twig + plant litter) of eucalyptus as affected by N fertilization and residue incorporation. The experiment was conducted in Três Lagoas, MS, Brazil, and consisted on four treatments mounted in a complete 2x2 factorial scheme. The treatments were: N fertilization + residue incorporation, N fertilization + without residue incorporation, without N fertilization + residue incorporation, and without N fertilization + without residue incorporation. The amount of N applied in the fertilized treatments was 200 kg ha^{-1}. The residue decomposition was evaluated in each experimental unit at the beginning of the experiment (0), and after 3, 6, 12 and 36 months of the experiment installation. The experimental units consisted on PVC pipes of 15 cm in length and 15 cm in diameter, installed up to 10 cm deep in the soil. The highest decomposition rate was verified upon residue incorporation in soil, despite of the N fertilization. This might be justified by the increased contact of the residues with soil, which favors the action of microorganisms. On the other hand, the lowest decomposition rate occurred in the surface residue when N was applied. This may be due to N immobilization in the surface residue. Therefore, the incorporation of residues in soil provides rapid residue decomposition. N fertilization is not determinative to residue decomposition when the residue is incorporated in soil; however, it affects positively the decomposition of the surface residue.

Keywords: planted forests, cycling, nitrogen fertilization.
Financial support: CAPES, CNPq

(4383 - 446) Evaluating Heavy Metal Distributions in Agricultural lands near Industrial complexes in Jeon-Buk Regions in Korea

K.I. Kim[1]; K. K. Lee[1]; J.H. Han[1]; S.W. You[1]; S. Sorakon[1]

Mokpo National University[1]

Evaluating hevy metal distributions in agricultural lands near industrial complexes are very important issues in Korea. Especially, in southwestern part of Korea, heavy metal distributions such as cadmium (Cd), chromium (Cr), nickel (Ni), lead (Pb), mercury (Hg), and zinc (Zn) have not evaluated yet precisely. The obejctives of this study were to investiage heavy metal contaminations and to provide heavy metal concentrations in agricultural lands near industrial complexes in Jeon-Buk Province in Korea. Fifteen industral complexes in Jeon-Buk province in Korea were chosen. 300 Soils with a depth of 0-15 and 15-30 cm within 0.5 and 1 km radius at each industrial comples were sampled at 10 agricultural fields randomly with four directions (east, west, south, and North) in 2017. Soils were analyzed for As, Cd, Cr, Cu, Ni, Pb, Zn, and Cr^{+6}. Research results showed that soil samples did not exceed the levels of Soil Contamination Warning Standard (SCWS) for cultivated lands (Region 1), which is regulated by Soil Environment Conservation La (SECL), Ministry of Environment (MOE) in Korea. All of heavy metal concentrations were lower than their warning levels. The warning levels are 25, 4, 100, 200, and 200 mg/kg for As, Cd, Ni, Pb, and Zn, respectively.

Keywords: heavy metal, agricultural lands, soil contamination
Financial support: "Monitoring projec on agri-environmental quality in Korea" by RDA in Korea

(2644 - 1967) Evaluation of the accuracy of maps of apparent soil electrical conductivity (ECa) in different sample densities

Kaynara Fabíola Lima Kavasaki[1]; Valdeir Moraes Soares[1]; Ricardo Santos Silva Amorim[1]; Oscarlina Lúcia dos Santos Weber[1]; Eduardo Guimarães Couto[1]; Gilmar Nunes Torres[1]

University of Mato Grosso[1]

The measurement of apparent soil electrical conductivity (ECa) is among the most common tools used in research in precision agriculture, due to the spatio-temporal characterization of soil properties that influence crop yield, thus presenting potential for determination of soil management zones. This study was conducted to evaluate the accuracy of ECa maps in different spacing schemes. Four areas of about 30 ha were cultivated with sugar cane and subjected to different times of applications of vinasse. The treatments comprised: A1 - Latosol of clay texture fertigated with vinasse for more than 10 years; A2 - Latosol of medium texture fertigated with vinasse more than 10 years; A3 - sandy texture neosol without fertigation with vinasse; A4 - Latosol of clayey texture without fertigation with vinasse. For each area the following ECa read spacing schemes were created: 12.5 m; 25 m; 37.5; 50 m; 75 m and 100 m. To evaluate the accuracy of the ECa maps obtained for the different spacing schemes was performed using the correlation coefficient, Willmott concordance index and confidence index. Results showed that the increase in the distance between lines of reading of the apparent electrical conductivity of the soil reduced the confidence index. However, spacing of 25 and 37.5m gave rise to maps that maintained the same patterns of variability of the map produced from the spacing of 12.5m.

Keywords: Agroindustrial Wastes, Precision Agriculture, Soil Management, Spatial Variability.
Financial support: Fundação de Amparo a Pesquisa de Mato Grosso – FAPEMAT

(9410 - 965) Geological and magnetic susceptibility of land use support capability managment in watersheds.

Renata Cristina Araújo Costa[1]; Gener Tadeu Pereira[1]; Teresa Cristina Tarlé Pissarra[1]; Diego Silva Siqueira[1]; Fernando António Leal Pacheco[2]

São Paulo State University, School of Agricultural and Veterinary Studies (FCAV), Campus Jaboticabal, São Paulo State, Brazil.[1]; Trás-os-Montes and Alto Douro University, Ap 1013, Vila Real, Portugal[2]

Evolution is a standard indicator of spatial variability of soil attributes, including the magnetic susceptibility, and it can be used as a criterion for planning land use and occupation. This study intended to improve knowledge about the physical and gemorphological behavior of soil associated with pedogenesis, confirming the representative of the Tiete River Basin with the Occidental Plateau of São Paulo State (*Plantalto Ocidental Paulista* - POP), inserted on the sedimentary basin of Paraná, to define the analyzes of land use capability maps using Tietê watershed subbasin. The comparative analysis at this moment has been made on the geological map of 1: 700.000, dissection map and kriging map of magnetic susceptibility. As result of the comparative analysis of the geologies, two main formations were identified Serra Geral (POP - 18.9% of area) and (Tietê River - 11.7% of area), formation of the Vale do Rio do Peixe (POP - 53.4% of area) and (Tietê River 58.0 area). The dissection map analysis also found similarity of occupation high dissection (POP - 16%) and (Tiete River 21%), intermediate (POP - 69%) and (Tiete - 68%) and less intense (POP - 15%) and (Tietê River - 11%). For the analysis of magnetic susceptibility with mean ± sd (standard deviation), POP 9.79 ± 2.02% and Tietê River 8.60 ± 1.77%. We can conclude that Tietê River Basin

can be used as a representative study basin to detail the problematic and for a better understanding of the geological conformation of the terrain as for the development of land use support capacity indicators aiming to minimize the impact of agricultural production.
Keywords: Land use policy; Geographic Information System - GIS, pedo-environmental indicators, soil conservation
Financial support: São Paulo Research Foundation (FAPESP), Project Number 2016/ 19.215-5.

(4440 - 3130) Influence of the crop-livestock farming integration system on the accumulation of organic matter in the Cerrado of Mato Grosso.

Bianca Nathiele Favetti Chagas[1]; Michael Ortigara Goulart[1]; Roberto Antonio Savelli Martinez[1]
Universidade do Estado de Mato Grosso[1]

One of the main difficulties for the agriculture in the Brazilian Cerrado is the increase of organic matter, being this a determinant factor for arise of productivity of the agricultural crops. As an alternative of improving the scenario the process of establishment of technologies such as the non-tillage system, the use of cover crops and a crop-livestock integration began. The use of forage plants in cropping areas guarantees an improvement on the chemical, physical and biological properties of the soil, due to the presence of soil straws and improvement of the soil conditions as aeration, as well as the water infiltration capacity. In this context, the aim of this work was to evaluate the influence of the crop-livestock farming integration system on the increase of organic matter content of the soil, on the Cerrado of Mato Grosso – Brazil, during four consecutive crops. Thus, the organic matter content in two different cropping systems in a rural property in Campo Novo do Parecis– Mt were evaluated.The areas consisted of a succession of soybean-corn and another with crop-livestock farming integration system. The cropping periods analyzedwere: 2014/2015, 2015/2016, 2016/2017 and 2017/2018. In all the cropping periods, the forage used in the integration area was the *Urochloa ruziziensis* with the cattle placed on the area between the months of June and September and average-stocking rate of 12 animals per hectare. The area with soybean-corn succession and the area with crop-livestock integration had250 and 242.9 ha respectively.Several soil samples were taken being one sample every 20 ha and a composite unit was made in order to perform a soil chemical analysis. According those analyzes carried out, the organic matter content in the with succession area soybean-corn were 3.68%, 3.21%, 3.07% and 3.47% in the cropping years 14/15, 15/16, 16/17 and 17/18, respectively, while in the area of crop-livestock integration system, the levels were 3.30%, 3.30%, 3.21% and 3.99%. As a result, there was a trend of organic matter increase in areas with crop-livestock integration. Thus, the crop-livestock integration system, which is a sustainable practice, tends to improve the organic matter content on soils and improve the exploitation of agriculture areas, thus being an important option to obtain high productivity in the edaphic-climatic conditions of Mato Grosso.
Keywords: agricultural system; Urochloa ruziziensis; sustainable production
Financial support: UNEMAT

(6818 - 2225) Magnetic soil susceptibility in the "Cerrado" of Piauí, Brazil

Sammy Sidney Rocha Matias[1]; Gasparino Batista de Sousa[1]; Maria Iolanda Leal Lustosa[1]; Cinthya Herley Kochhann Ribeiro[1]; Ronny Sobreira Barbos[2]; Rafael Felippe Ratke[2]; Júlio César Azevedo Nóbrega[3]; Tarcisa Fé da Silva[1]; Maysa Danielly de Sousa Ferreira[1]; Inária Vogado Borges[1]
Universidade Estadual do Piauí[1]; Universidade Federal do Piauí[2]; Universidade Federal do Recôncavo da Bahia[3]

Magnetic susceptibility (MS) is a non-destructive attribute that can serve as a parameter forassessment of soil management. The present work had as objective to verify the variation of the magnetic susceptibility of the soil in an area of tropical savannah (Cerrado) of Pauí, Brazil. The work was conducted in the municipality of Barreiras - Piauí, whose geographic coordinates are 10º03 'south latitude and 45º68' longitude west, with an average elevation of 400 m. The climate of the region is type AW', average temperature of 27 ° C. The average annual precipitation is around 1200 mm, with concentrated rainfall from November to April. The soil was classified as ENTISOLS. The area under study was delimited and georeferenced, being selected an area of 1 (one) hectare with dimensions of 100 x 100 m. In this area a regular mesh of 10 x 10 m was assembled, totaling 121 sample points, being collected soil samples in the depth of 0,0-0,20 and 0,20-0,40 m. The parameter evaluated in the work was the magnetic susceptibility of the soil (MS), being analyzed by means of an analytical balance. Soil characterization was performed by means of a soil profile. Data were evaluated through semivariograms using the GS + program, and the models were adjusted in spherical, exponential and gaussian. By means of these models, we predicted each attribute in areas not sampled by kriging, represented in contour maps, using the surfer program. The choice of the theoretical models was performed, taking into account the sum of the square of the residuals, the coefficient of determination and, later, the correlation coefficient obtained by the cross-validation technique. The classification of the degree of spatial dependence was performed based on the ratio between the nugget effect and the level ($C_0/C_0 + C_1$), being considered strong, higher than 75%, moderate between 25% and 75%, and lower of 25%. The magnetic susceptibility was adjusted at both depths to the exponential model. The degree of spatial dependence was classified as weak (less than 25%). The range reached for both depth (0.0-0.10 and 0.20-0.40 m) distances of 18 and 32 m, respectively. The spatial determination coefficients (R2) for both depths were above 0.60. The cross-validation regression correlation confirmed the result of R2, by obtaining values close to 1 (b) and 0 (a). Magnetic susceptibility identified spatial variability in soil. The depth of 0.20-0.40 m was better for identification of the magnetic susceptibility.
Keywords: Soil management, magnetization, spatial variability.
Financial support: Secretary of State for Economic and Technological Development of Piauí – SEDET.

(8878 - 719) Morphological characterization and yield of bean and corn crops in different soil classes of a toposequence from Unaí, Minas Gerais

Alceu Linares Pádua Junior[1]; Iago de Oliveira Bastos[1]; Laura de Lima Rodrigues[1]; Rannery Camargos dos Santos[1]
Universidade Federal dos Vales do Jequitinhonha e Mucuri[1]

The classification of soils is essential so that the knowledge acquired by research and agricultural practice can be scientifically organized. A plant develops vigorously in one location, while in another, it produces less (considering the same climate and management conditions), so it is important to know the soils of both locations. Soil chemical and morphological conditions associated with climate can influence the development of crops in different production environments. The objective of this work was to evaluate the morphological characteristics and chemical attributes of soils of a topossequence from Unaí, state of Minas Gerais, cultivated with the crop of bean in the year of 2015/2016 and of corn in the year of 2016/2017. The following parameters were evaluated in the bean crop: yield (Mg ha^{-1}), sieving, color, and *fusarium* infestation. In the corn crop, the evaluated parameters were: yield (Mg ha^{-1}), length cob, and number of grains per cob. All the variables were compared by the 5% t-test. In the landscape, the soils were distributed as follows: in the upper

position was the Petroferric Eutrustox (FFe) phase, in the middle position was the Petroferric Haplustox (LVAd-petroferric) phase, and in the lower position was the Plinthaquic Haplustox (LVA-plinthaquic) phase, being all the phases with clayey texture. In the bean crop, the highest values of yield, sieving and color, and the lowest *fusarium* infestation were recorded for the FFe, probably due to the lower accumulation of water in this phase when compared to the LVAd-petroferric and LVAd-plinthaquic phases in function of the soil position in the landscape and the presence of impediment in the subsurface. In the corn crop, the parameters evaluated were higher for the LVAd-plinthaquic phase, followed by the LVAd-petroferric phase and less expressive in the FFe phase, probably due to the greater effective depth and accumulation of water during the cycle of the crop imposed by the presence of petroplintite at 70 cm depth in the LVAd-petroferric phase, to the presence of mottled and plintite at 120 cm in the LVAd-plinthaquic phase and to the lowest effective depth in the FFe phase. Therefore, the presence of the evaluated morphological attributes had a distinct influence on the development of the bean and corn crops, regardless of the chemical condition of the soils.

Keywords: petroplinthite, plinthite, production environments
Financial support: Fundação de Amparo à Pesquisa de Minas Gerais – FAPEMIG

(7977 - 1744) Physical structure of an obstacle quartzarenic neosol in different systems of use in the brazilian pantanal region

Jeferson da Silva Muniz[1]; Victor Barros damacena[1]; Giovana Fornaciari Moreira[1]; thalia Inês Aleixo barbosa[1]
Instituto Federal do mato grosso - campus Caceres/ professor Olegário baldo[1]

The sustainable use of the wetland soils should follow the principles of agroecology, where the interrelations between the different elements of the agroecosystem are considered. Soil management is an art that requires a lot of care and common sense, since its use in the wrong way leads to inexpressible losses in its biodiversity, maintenance and recovery. In view of the above, this study aimed to investigate the physical structures of a quartzenetic orthotic neosol in different systems of use in the Pantanal. The study was conducted in the Pantanal area located at Bom Sucesso site, Cáceres - MT (Brazil). The experimental area is at latitude 15º47'41.3 "S, longitude 57º53'54" W and latitude 110 m. Three treatments with different uses were considered: T1- preserved area, T2- area under pasture and T3- cultivated area. For each treatment, six replicates were collected for the analysis of soil physical attributes. Samples were taken at depths of 0 to 15 cm and sent to the laboratory. In the laboratory the samples were weighed and placed in an oven at 105ºC and after 24 and 48 hours, and after cooling were weighed again. Subsequently, 20 g of soil, weighed in an aluminum container of known weight, were weighed, left for 6 to 12 hours, and then weighed again to obtain the weight of the dried sample at 105ºC. The samples were removed to a volumetric flask of 50 mL, filled with ethyl alcohol and stirred until all the air bubbles had been eliminated and the volume of the flask was complete. The following calculation was performed: Particle density (g cm3) = a / 50 - b where a = weight of sample dried at 105 ° C and b = volume of alcohol spent. Finally, the Total Poros Volume was calculated by the formula: Total porosity = 100 (a - b) / a where a = actual density and b = apparent density. The analysis of variance of the data and the comparison of the averages (Tukey to 5%) was performed using software R. According to the results, it was verified that T3 presented higher density and lower porosity value. In T1, there was lower value of soil density and higher value of porosity.

Keywords: Pantanal, Neosol, biodiversity.
Financial support:

(3648 - 450) Predicting and evaluating spatial soil information's using soil profile data and soil maps - Examples prediction soil carbon stock in Germany and potential benefits from biochar application in Ethiopia

Andreas Möller[1]; Tegbaru Belete[2]; Selamyihun Kidanu[2]; Konen Lars[1]; Andreas Richter[1]; Tobias Seitz[3]; Steffen Schulz[4]
Federal Institute for Geosciences and Natural Resources (BGR), Hannover, Germany[1]; Agricultural Transformation Agency (ATA), Addis Ababa, Ethiopia[2]; Biochar Europe UG, Halle, Germany[3]; Gesellschaft für Internationale Zusammenarbeit (GIZ), Eschborn, Germany[4]

Predicting spatial soil information is still a challenge, although worldwide many open questions in geosciences, like carbon sequestration in soil, can only be answered with precise soil information. Therefore, enormous efforts are done globally to overcome these knowledge gaps. Two examples are given here for different approaches. The first example is the evaluation of back ground values of soil carbon stocks in German soils, by combining available soil profile information's within the soil information system (FisBO BGR) and the soil map of Germany the BÜK 200 (scale of 1:200 000). The BÜK 200 includes not only spatial soil data, but also involves standardized soil profiles with estimated soil data for every soil polygon. Otherwise huge amounts of soil point data are available within the FisBO BGR and from the federal states of Germany. Coupling the two datasets with a soil carbon model based on the differentiation criteria, soil type, horizon, sample depth and land use revealed very precise soil carbon stocks in German soils. The results confirm that pedogenesis and land use are the main factors determining soil organic carbon stocks in Germany. The second example is the predictions of potential benefits from the application of biochar substrates to agricultural soils in Ethiopia. The evaluation was done in cooperation with the Ethiopian Soil Information System (EthioSIS) project. It is based on their enormous dataset of soil samples collected and analyzed from current crop lands and potential agricultural lands. Using this dataset and predictive satellite imageries in the ensemble modelling of three machine learning algorithms (MLA) Ethiopian wide spatial distributions of soil parameters were determined. Based on an evaluation matrix including these soil parameters (pH, SOM available phosphorous and CEC) benefits from biochar application were calculated. The results indicate that there is a significant area of soils which would benefit greatly from the application of biochar substrates.

Keywords: Soil information systems, spatial soil data; carbon stocks, biochar substrates
Financial support: BMZ

(5944 - 2640) Productivity and quality of Tempranillo grapes cultivated on three different soils in the Sao Francisco Valley, Brazil

Mayame de Brito Santana[1]; Mateus Rosas Ribeiro Filho[1]; Brivaldo Gomes de Almeida[1]; Giuliano Elias Pereira[2]; Tony Jarbas Ferreira Cunha[3]; Antonio Mendes de Souza Nascimento[3]; Kaline Gomes da Costa[3]; Joyce Fagundes de Souza[3]; Jamilla Fiama Maia Silva[3]
Federal Rural University of Pernambuco, Recife-PE, Brazil[1]; Embrapa Grape & Wine/Tropical Semiarid, Petrolina-PE, Brazil[2]; Embrapa Semiarid, Petrolina-PE, Brazil.[3]

Brazilian viticulture ocupies an area of 81 thousand hectares, with vineyards planted from extreme south until regions nearby equator line. At northeast of Brazil, especially at the San Francisco Valley, occured an expansion of grapevine culture, due to ideal conditions of soil and climate, obtaining more than one harvest per year. Studies aiming the grapevine zoning of the region indicates the potential of several cultivars adapted to local conditions and suitable to contribute for the typicality of the wines, as for example, using grapes from Tempranillo cultivar. The objective of this work was to evaluate the

productivity of Tempranillo cultivar grapevines on three different soil types and how these soils interfere on fruit quality. The study took place at Santa Maria farm, with Tempranillo cultivar, producing 2 harvests in 2017 (May and November) in an eight year stablished vineyard, growed in spalier, at the county of Lagoa Grande-Pernambuco State, Brazil. Three soil profiles were described and sampled, identified as: Argissolo Vermelho-Amarelo Eutrófico abrúptico plintossólico (Ultisol), Argissolo Amarelo Eutrófico abrúptico (Ultisol), with medium texture and Argissolo Amarelo Eutrófico abrúptico (Ultisol), with coarse texture, abunding with gravel and pebbles. The area of each soil was delimited, and in these areas were harvested grapes, counted, weighed, and measured the pH, total soluble solids (ºBrix), total titratable acidity (TTA) of the must and the mass and volume of 100 berries. The Yellow Argisol with medium texture presented average yield aproximately 20% higher than the Red-Yellow Argisol on both harvest, while the Red-Yellow Argisol presented lower productivity in comparison to the two other types of soil on both harvest. However, this lower productivity can promote concentration levels of phenolic and aromatic compounds, wich have great importance in enology, since they are related directly or indirectly to wine quality, being responsable for its color, body and astringency. The number and weight of bunches per plant also presented higher values on the area of the Yellow Argisol with medium texture, differing statistically from the other areas on the winter harvest. The pH, ºBrix, TTA, mass and volume of bunches did not differ statistically on both harvests. Also, differences can be noticed between the values that can lead to wine production with different quality, so that can aggregate value to the product.

Keywords: grapewine culture; tropical soils; tropical wines
Financial support: FACEPE (APQ-0686-5.01/15), CNPq (Process: 403438/2013-6), EMBRAPA, UFRPE, CAPES

(8274 - 399) Soil Permeability for Geotechnical Mapping Purposes Applied to Planning

Alan Silveira[1]; Cenira Maria Lupinacci[2]; Patrícia Borges Silveira[3]
Federal University of Uberlândia (UFU), Geography Institute (IG), Campus Monte Carmelo, MG, Brazil[1]; Territorial Planning and Geoprocessing Departament (Deplan) of São Paulo State University (UNESP), Campus Rio Claro, SP, Brazil[2]; Geographer and PhD Student in the Graduate Program in Geography (PPGG) of São Paulo State University (UNESP), Campus Rio Claro, SP, Brazil[3]

The surface permeability is an important data for the characterization of the unconsolidated materials, as it directly interferes with the infiltration and flow of rainwater. The identification of the areas of greater and lower permeability also contributes to an evaluation of the materials that are more resistant and more susceptible to the erosive processes. Therefore, this work aims to present the results of the permeability of surface horizons acquired for the organization of the chart of Unconsolidated Materials of the Córrego das Ondas Basin, located in the urban expansion area of Piracicaba (state of São Paulo, Brazil), established between latitudes 22º38'30''and 22º41''30'' S and longitudes 47º41'15'' and 47º43'30'' W. The document was adapted to the proposals of Zuquette et al. (1994) and Pejon and Zuquette (1997). In the field, with the use of cups to collect undisturbed samples, were collected 21 samples distributed in toposequences in the basin under study. Afterwards, these samples were sent to the Surface Formation Analysis Laboratory (SFAL) of Deplan/IGCE/UNESP *Campus* of Rio Claro for the experiments procedures of calculation of permeability coefficients (cm/s, factor K), through the Permeameter of Variable Load, using method B of NBR 14545. We found the following results: (1) Homogeneous material of intermediate thickness derived from the Serra Geral Formation with low to medium permeability (3,2 x 10^{-4} a 1,6 x 10^{-3} cm/s; (2) Thick homogeneous material derived from the Corumbataí Formation (reddish facie) with medium permeability (1,4 x 10^{-3} a 5,0 x 10^{-3} cm/s); (3) Thick heterogeneous material derived from the Corumbataí Formation (reddish facie) with low to medium permeability (5,2 x 10^{-4} a 1,4 x 10^{-3} cm/s); (4) Thick homogeneous material derived from the Corumbataí Formation (reddish facie) with low permeability (1,4 x 10^{-4} a 7,0 x 10^{-4} cm/s); (5) Homogeneous material of low thickness derived from Corumbataí Formation (reddish facie) with very low to medium permeability (3,7 x 10^{-5} a 1,0 x 10^{-3} cm/s); (6) Homogeneous material of low thickness derived from Corumbataí Formation (grayish facie) with medium to high permeability (4,2 x 10^{-3} a 1,1 x 10^{-2} cm/s); (7) Unconsolidated material derived from river dynamics.

Keywords: Permeability of soils; geotechnical mapping; planning.
Financial support: CNPq, Universal 14/2011, 472550 / 2011-0

(8690 - 724) Spatial and temporal analysis of synergy and trade-offs between Agroecosystem services in the Dry farming areas of northeast China in nearly a decade

Huang Yuanfang[1]; Zhuo Zhiqing[1]; Xin An[1]; Sun Zhongxiang[1]; Zhang Shiwen[2]; Cao Meng[1]; li Zhen[1]
China Agricultural University[1]; Anhui University of Science and Technology[2]

In the process of transition from traditional agriculture to modern agriculture, the role of agriculture is changing from a single production function to a multi-functional one. Comprehensive evaluation on the synergetic degree of agroecosystem has guidance for the area sustainable development. In this research, taking 85 counties located in the Dry farming areas as a case study, the synergy and trade-offs between Agroecosystem services from 2005 to 2015 were analyzed based on the synergetic model and root mean square error (RMSE). This research aims at revealing the temporal and spatial evolution characteristics of three agroecosystem services. The results showed that (1) the synergy degree of agroecosystem service was at low level in the dry-farming areas of northeast China, it has decreased 0.12 in the last decade. The synergy degree of production function and ecological function decreased 0.03 and 0.45, respectively, but the synergy degree of living function increased slightly. Except for the Drying farming areas in Liaoning province, the synergy degree of agroecosystem services decreased seriously in Jilin province and Heilongjiang province. (2) There were spatial-temporal trade-off relationships among the various functions of agroecosystem. From 2005 to 2010, the trade-offs between production-ecological function and living-ecological function benefited from ecological function. However, from 2010 to 2015, the trade-offs benefited from the production function and living function. Moreover, the root mean square error among the functions were declining with the changing of benefit direction. (3) The main reasons causing the fluctuation of synergy degree were the trade-off relationships among three functions and the changes of their benefit direction. Furthermore, the changes of RMSE can be taken as an effective indicator to evaluate the synergy degree of agroecosystem services in Dry farming areas of northeast China.

Keywords: Dry farming areas; Agroecosystem services; Synergetic development
Financial support: National Key Research and Development Program of China (2016YFD0300801)

(2080 - 953) Water infiltration in soils subjected to direct and conventional planting systems.

Maria Caroline Garcia Paschoal[1]; Camila Pereira Cagna[1]; Bruna Camila Lameira[1]; Maycon Diego Ribeiro[1]
Universidade Federal do Paraná[1]

The water infiltration in soil is a process in which occurs water penetration in the soil profile, depends on its texture and varies

according to the use and management that it is subjected to. The objective of this work was to determine the Basics Infiltration Velocity (BIV), the estimation equations of Accumulated Infiltration (AI) and the Infiltration Velocity (IV) throughout the Kotiaskov's potential model in a clay-textured latosol subjected to different management systems. The experiment was conducted in a property located in the city of Borrazópolis, state of Paraná. The infiltration tests were performed with a ring infiltrometer, composed by a 25 cm and a 50 cm diameter rings, both 25 cm height, from which 15 cm were buried and installed concentrically. During the experiment realization, water was simultaneously added in both rings and, every 2 cm of water blade height decrease, the infiltration time was measured with a chronometer, repeating this process until three sequences of equal measurements in time and height could be observed. The experimental design was made in two distinct areas, one with conventional planting system implanted 3 years ago and another with a direct planting system implanted 20 years ago. The calculated BIV for the soil with direct planting system was 2,25 cm h^{-1}, classified as high BIV, whereas the calculated BIV for the soil with conventional planting system was 4,56 cm h^{-1}, classified as very high BIV. The accumulated infiltration equation for the soil subjected to direct planting system was AI = $0,429T^{0,620}$ and for the soil subjected to conventional planting system was AI = $0,405T^{0,752}$. The conventionally prepared soil presented higher infiltration velocity concerning to the direct prepared soil, fact that can be explained due to the conventional system, during the soil preparation, promote great movements on it, causing its collapse and favoring the process of water infiltration. On the other hand, in the direct planting system, where there's a reduction or elimination of soil preparation, the haulm decreases the superficial rain water flow and increases the infiltration capacity of this soil. Therefore, the conventional planting system exhibited BIV and AI values higher than the direct planting system due to the vast soil movements during its preparation for planting.

Keywords: Infiltration velocity; texture; soil preparing and management.
Financial support:

(9008 - 538) Zoning Edaphic for grapevines in the Municipality of Santa Maria of Boa Vista-PE.

Tony Jarbas Ferreira Cunha[1]; Mateus Rosas Ribeiro Filho[2]; Iedo Bezerra de Sá[3]; Mayame Brito[2]; Vanderlise Giongo[3]; Tatiana Yaco Taura[3]

Embrapa Semiário[1]; UFRPE[2]; Embrapa Semiárido[3]

Variety, grapevines composition and vines development are directly related to the soil, which, together with the climatic conditions, determine grape sensorial qualities as well as the quality of the wines. The soil, in turn, through its attributes, is of great importance due to its influence on the wines qualities. The goal of this edaphic zoning was to identify the areas with the greatest potential for grapevine growing, in the municipality of Santa Maria da Boa Vista, PE, and thus contribute with the geographical indication of origin for the wines produced in the mentioned municipality. In this zoning, an semi-detailed survey in the 1: 25,000 scale was used as the basic material. The edaphic requirements of the vine were systematized, each of the variables being classified into four categories. Four classes of suitability for grapevine growing (1-Preferential, 2-Recommended, 3-little Recommended and 4-Not Recommended) were defined. In the municipality of Santa Maria da Boa Vista it is verified that there is no Preferential class. Most of the area falls into class 4 (not recommended), making a total of 20,857.61 ha and corresponding to 40.4% of the mapped area. The first and only limiting factor for this class was character. The second largest area was the Recommended Class, which represents a total of 20,151.87 ha corresponding to 38.3% of the mapped area and having as a first limiting factor the texture of the B-horizon. The class little recommended has as first limiting factor the soil class, corresponding to an area of 11,650.78 ha or 22.1% of the mapped area. In the little recommended or Non-Recommendable area, it is suggested a greater mapping detail in the soil studies, since in the legend appear only components with better potential than the one evaluated for the first component of the legend. The municipality of Santa Maria da Boa Vista presents a large area with potential for grapevine growing. In the areas little recommendable or not recommendable, it is suggested a greater detail in the studies of soil survey because, in the legend appear only components with better potential than the evaluated one for the first component of the legend.

Keywords: edaphology, semiarid, viticulture
Financial support: Financial support: CNPq

C3.1.2 - Multi-scale and multi-domain approaches to develop smart farming

(3493 - 1948) Arbuscular mycorrhizae in agroforestry systems with oil palm in the Amazon

Rodrigo da Silva Maia[1]; Steel Silva Vasconcelos[2]; Danielle do Socorro Silva Batista Melo[3]

UFPA[1]; Embrapa[2]; UFRA[3]

In tropical agroecosystems Arbuscular Mycorrhizae (AM) has the role of increasing the soil volume explored by host plants in the water and nutrient uptake. The oil palms (Elaeis guineensis) produce few root hairs and possibly need the mycorrhizal symbiosis in the field. In the Amazon region, conventional palm oil cultivation (monoculture) has been widely used, however an alternative and sustainable model inserting the oil palm in Agroforestry Systems (AS) was proposed for the municipality of Tomé-Açú, state of Pará. This study evaluated the AM in oil palms of approximately 10 years grown in two AS types, one composed by species with the function of producing biomass for the soil (ASfertilizer) and the other composed by diverse species (ASbiodiverse) and also in oil palms conventionally grown (monoculture) in the municipality of Tomé-Açú. In September 2017, six simple samples composed of five subsamples of soils (0-10 cm) and fine roots of oil palm (diameter ≤ 2 mm) were collected in four plots (30m x 30 m) in these treatments. Spores were extracted by the wet sieving method and the roots were cleared in 10% KOH solution and stained with 0.05% Trypan blue. Analysis of variance of repeated measures was used to test the differences between treatments and the results compared by the Turkey test at the 5% probability level. The results showed a significant difference in the spore density, ASfertilizer and ASbiodiverse presented a mean of 1.67 and 1.05 spores/g, respectively, while the mean monoculture of 2.61 spores/g. The mean of mycorrhizal colonization in the ASfertilizer and ASbiodiverse were respectively 40.81% and 45.12%, while in the monoculture the average was 14.5%, with a significant difference. The higher density of spores in monoculture compared to AS can be explained by processes related to the history of the area and random patterns of mycorrhizal dispersion. On the other hand, the higher mycorrhizal colonization in AS indicate that soil management through a system of low inputs and addition of organic matter may increase colonization. Therefore, oil palm cultivation in AS may favor mycorrhizal colonization, improve root capacity and provide a more sustainable palm oil management for the Amazon region.

Keywords: Mycorrhizae, oil palm, Agroforestry system
Financial support: USAID, Embrapa, Natura e CAMTA

(8904 - 1493) Characterization of soil properties effects on apple production in South Uruguay

Alliaume, Florencia[1]; Severino, Vivian[1]; Alvares, José Luis[1]; García, Marcia[1]; De Iacovo, Matías[1]; Tachini, Ramiro[1]; Arias, Mercedes[1]

Facultad de Agronomía, UDELAR[1]

Soil properties that may influence on apple production are being evaluated on 24 fields cropped with the two varieties most exported of Uruguay: Gala Baigent and Cripps Pink, on farms located in the south of the country. The yield of apple in Uruguay in relation to the neighbor countries are: 30% of the Chile and 45% of the Argentina and Brazil, according to FAOSTAT database for 2016. The causes of such a low productivity, in spite of using technologies as plant density higher than 2000 pl/ha, dwarf- inducing rootstocks, changes on conduction system and irrigation, needs to be depicted. Soil properties and their current management are hypothesized to be an important limiting factor that explain the low yields of export quality apples. The aim of this study is to assess soil characteristics of apple orchards to identify their main limitations for achieving larger yields of two highly productive varieties and discuss best management practices to increase the yields. Accordingly, potentials and limitations of topography and soils are being assessed using field survey to support the evaluation, together with climatic and management variables. The topographic characteristics to be assessed include slope and surface drainage class. A soil profile pit was opened and described in each field, and soil samples from each horizon were obtained. Soil properties to be analyzed are: soil texture, soil pH, soil organic carbon, $CaCO_3$, electroconductivity, cation exchange capacity, available phosphorous, drainage class, water retention properties, soil root depth, soil morphology, depth to a water table, and soil resistance with a penetrometer at field capacity. All these variables will be analyzed together with apple yields of three years using clustering analysis. The soil properties that explain most of the yield variation will be used to build a capability index and limits will be proposed for each of the soil characteristics. It is expected that resulted soil capability index will provide a reasonable prediction of potential apple yield for mature apple orchards of var Gala Baigent and Cripps Pink. Results will be discussed taking into account-predefined optimal growth requirements. Soil management strategies to lift soil constraints will be discussed with local stakeholder, and results will be taken into account in future research.

Keywords: Land suitability, land characteristics, orchard soils, limiting factors, reduced yields
Financial support: CSIC, UDELAR

(6835 - 1694) Conventional and ecological crop management systems affect bacterial diversity on the phyllosphere

Carolinne Rosa de Carvalho[1]; Elke Jurandy Bran Nogueira Cardoso[1]
ESALQ/USP[1]

Crop management affects physical, chemical and biological properties of the agroecosystem, and may have a significant impact on soil fertility, crop quality and ecosystem diversity. Conventional agriculture has been well established over the years and uses efficient but environmentally aggressive methods to optimize food production and to yield high profit. Controversely, agroecological alternatives apply long-term approaches that stimulate and explore ecological services provided by the environment and the organisms interacting in the field. Microbial communities can provide relevant benefits to plant health and fitness, which can therefore reflect on crop quality and productivity. In this study, we proposed to evaluate the effect of conventional and ecological management on the bacterial diversity of *Citrus* phyllosphere, identifying possible divergences in microbial structure and composition. Leaves were sampled in January/2017 in Mogi Guaçu, SP, sampling about 40 leaves of 20 trees from each treatment area. The bacterial community of the phyllosphere was analysed by Illumina sequencing of the 16S gene, allowing to determine the bacterial diversity and to compare them between treatments. The obtained amplicons were clustered and analysed using the software QIIME 1.9.1, and identified according to the database Silva. We found the phyla Proteobacteria, Bacteroidetes, Actinobacteria and Firmicutes to be the dominant groups in both treatments, thus suggesting them as phyllospheric residents, which means that they compose this microenvironment independently of the management. However, the treatments applied to the plant may affect the abundance and distribution of those bacterial phyla. A rarefaction curve of the data allowed us to compare the alpha diversity in order to overlook the influence of management on the bacteria. We obtained a higher bacterial diversity in the ecological management, which can benefit the plant by decreasing its susceptibility to colonization by pathogens. Higher and more complex bacterial communities on the phyllosphere normally implies in better crop quality and productivity. The structure of the bacterial community also presented some divergence between the managements, demonstrating a significant dissimilarity when evaluated by a PCoA. This dissimilarity can indicate the modulation of the bacterial community structure by the kind of agricultural management, inferring that it is an important microbial driver of the phyllosphere.

Keywords: Agricultural management; Bacteria; Citrus; Agroecology; New Generation Sequencing
Financial support: CNPq

(4428 - 3202) Evaluation of Soil Nutrients in Drip Irrigation Based on PCA and BP Neural Network

Shuqing Yang[1]
China Inner Mongolia Agricultural University[1]

This reserch is aimed at achieving the comprehensive evaluation of soil nutrient under drip irrigation.By using descriptive statistical analysis, Principal Component Analysis (PCA) and BP neural network, the soil nutrient with drip irrigation under mulch was evaluated in Kezuo Zhongqi,Tongliao which were combined with single factor evaluation and compared with the most widely used fuzzy mathematics comprehensive evaluation results in traditional methods.According to the second national soil nutrient grading standard and verified by measured data,the results show that the comprehensive evaluation level of soil nutrient with drip irrigation under mulch in Kezuo Zhongqi in 2015 and 2016 is grade 3,and we can get more objective results which are more suitable for the actual situation by connecting PCA and BP neural network in the aspect of evaluating level of soil nutrient.It's feasible and reliable to solve the soil science problem by connecting PCA and BP neural network according to the comprehensive study of many experts' achievements.The evaluation method of combining PCA with BP artificial neural network model is suitable for the samples with many factors and high complexity and high precision.Combining PCA with BP neural network can not only solve the problem of too much information and difficulty in analyzing but also reduce the fuzziness and the precision declining.It link the respective advantages effectively. Compared with the traditional method it can be more scientific and reasonable, accurate and effective to comprehensive evaluate the soil nutrients,and the results are more reliable.

Keywords: Principal Component Analysis (PCA);BP neural network;soil nutrients evaluation;Drip Irrigation Under Mulch
Financial support: The National Natural Science Key Foundation of China (No. 51539005);The National Science and Technology Support of China（No.2014BAD12B03)

(4159 - 559) Goana

Rokhaya Daba Fall[1]; Ibrahima Deme[2]; Abdoulaya Dia[3]
Governing African Development[1]; Post Doctorate[2]; Green Wall[3]

GOANA was the Senegalese initiative to respond to face food crisis and rise in basic food prices. The impact on hungry population leading to riots in several part of the world, in particular in Africa, was the light that led to this initiative. GOANA is a well-known acronym in Senegal and all over the region, as some introduced vegetables and fruits are

so called since 2008. GOANA is the French acronym of « Grande Offensive Agricole pour la Nourriture et l'Abondance », that can be translate in English « Global Agricultural Offensive for Food and Abundance ». This study was an answer of a query: do Senegal have enough agricultural land to sustainably produce more, in order to allow people to feed themself. The study conclusions led to a Global Return to Food Production and to a never reached investment on soil for food production and water management. Two methods and way of calculation led to the same results: than 64% of the territory has been identified as potentially good for agricultural activities. Tools for each method are the Soil and Terrain database (SOTER) and the existing morphopedological maps as well as rainfall and geographical maps and Google earth images. Few terrain verifications were needed. With consideration of regional specificities and adequate definition of "Land aptitude for Agricultural activities", methods used design best farm agrotechnologies and farming systems for each land aptitude category. Critical need for sufficient Food and Fuel have led us to identify and analyze key limiting soil pedoclimatic functions that determine agricultural type and biological crop, trees or animal yield as well as level of investment profitability. Regarding Land Capability there is Will and trust than investment beyond food and fuel.

Keywords: Food, Water, Crisis, Land, Investment
Financial support: SELF SUPPORT

(9073 - 343) Impact of landuse planning and management on land degradation in Kadawa Irrigation scheme, Kano, Nigeria

Bashiru A. Raji[1]

University of Ilorin, Ilorin, Nigeria[1]

Soil is the basic natural resources that support life on earth hence maintenance of this valuable resource in a state of high productivity, through appropriate sustainable land use planning is a primary necessity. Data from NigeriaSat-1 and ILWIS; a geographic information system (GIS) were used to assess the current and potential landuse on degradation in the Kadawa sub-sector of the Kano River Irrigation Project. Existing soil map of Kadawa at 1:25,000 and topographic map at 1:50,000 were digitized and used to obtain the land suitability/potential landuse map. Supervised algorithm was employed in the classification of the December 2003 NigeriaSat-1 image of Kadawa area. Overall, rainfed agriculture remained the predominant landuse, accounting for close to 50 percent of the total land area. The different land utilization types within the irrigated areas could not be discriminated at the scale of the study. As a whole, irrigated agriculture accounted for only 5 percent of the total land area. Some problems encountered included the misclassification of rivers as settlement and also some irrigated fields were placed as forest/woodland. The most comparative advantage of the NigeriaSat-1 is the provision of the most recent source of image for the country at affordable cost in local currency (Naira). Assessment of the adequacy of current landuse management shows that only 36 percent of the total land area is properly managed while 41 percent of the land area is categorized as over-utilized. About 23 percent of the land area is under-utilized. These are areas of high suitability being utilized for moderate and extensive intensity-use, and also areas of moderate suitability being allocated to extensive-use. Within this land, most severe environmental problems are envisaged to be caused by intensive-use established on soils of moderate and marginal suitability. In all, irrigated cropping and rainfed agriculture are located on about 35,000 ha of land with either severe or moderate soil limitations of depth and poor drainage. In the study area, this has caused rising groundwater table thereby limiting the effective soil depth and increasing salinity. Salinization is evident by the occurrence of black salt patches observable on irrigated fields. Conservation measures must urgently be taken to stem increasing soil erosion and avoid permanent land degradation.

Keywords: Landuse, management, degradation, irrigation
Financial support:

(5446 - 2534) Land use changes in Poland in the years 2004-2014

Piotr Skłodowski[1]; Anna Bielska[1]

Warsaw University of Technology, Faculty of Geodesy and Cartography[1]

The purpose of the research was the analysis of land use changes in Poland, taking into account the exclusion of arable and forest lands from production. The research was based on statistical data on quantity and quality of lands excluded from agricultural and forest production, as well as on changes in land use. The data were analysed for the whole territory of Poland, taking into consideration the administrative division into voivodships, and for two time periods - i.e. 2004-2008 and 2009-2014, in order to identify the changes that may result from the amendments to the Act on the Protection of Arable and Forest Lands that were enacted in 2009 and which repealed the legal protection of arable and forest lands located within the administrative boundaries of cities and towns. The most important problem is the decrease in the total area of arable lands that has been accelerating over the last 25 years. At present there is 0.49 ha of arable lands per one citizen of Poland, while 30 years ago there was 0.53 ha. This problem is aggravated by the constant decrease in the total area of best quality soils, which are protected under the Act on the Protection of Arable and Forest Lands. In the years 2004-2014 lands of the total area of 44,609 ha were excluded from agricultural and forest production in Poland. In order to demonstrate the scale of this problem it should be noted that the total area of lands excluded from production during 10 years equals the area of approximately 3-4 Polish communes. From the perspective of the amendments to the Act on the Protection of Arable and Forest Lands that were enacted in 2009 (repeal of the legal protection of arable and forest lands located within the administrative boundaries of cities and towns) it can be noted that the total area of lands formally excluded from production in the years 2009-2014 (19,201 ha) was smaller than in the years 2004-2008 (25,408 ha). However, this did not follow from any decrease in the area of lands designated for development. On the contrary, in the years 2009-2014 the total area of lands subject to development increased by 55% compared to the years 2004-2008. The decrease in the total area of lands formally excluded from production results solely from the fact that lands located within the administrative boundaries of cities and towns can now be developed without any administrative proceedings on their exclusion from agricultural or forest production.

Keywords: functional and spatial structure, soil conservation
Financial support:

(9528 - 886) Origin and Properties of Deep Sands of South-Eastern Cambodia

Richard W Bell[1]; Sarith Hin[2]; Veng Seng[2]

Murdoch University[1]; CARDI[2]

Deep sand profiles are a feature of many landscapes in Southeast Asia but explanations for their origin are contested. Deep sand and sand on clay profiles cover a large proportion of the landscape of Cambodia. Our aim was to determine the likely origin of these sands in relation to sand profiles elsewhere in Southeast Asia. The sands in Cambodia are commonly used for rainfed rice production but increasingly attention is turning to their potential for crop diversification in uplands of Cambodia. The current study examined the origin and properties of 19 sand profiles along four toposequences (Kampot, Tramkak, Ponhea Krek, and Rolea Bíer/Tuek Phos districts) in south-eastern Cambodia particularly to recognize those properties that will pose constraints for management of upland crops. From particle size analysis of 19 profiles, sand fractions ranging from 63 to 200 µm and 200 to 600 µm were predominant in most profiles, except for Kampot 4, where the fraction was dominated by sand grains from 200 to 600 µm and five profiles from Kampong Chhnang province, where the three sand fractions (63-200, 200-600 and 600-2000 µm) were equally

prevalent. Clay content was generally < 100 g/kg within 0-80 cm depth but generally increased from 80 to 100 cm depth. Sub-angular and sub-rounded grains were the major shapes of sand grains in most profiles (20-80%). Sub-angular shapes of sand grains in Tramkak and Kampong Chhnang generally decreased from the site at the base of mountain to the lower part of the toposequence. In contrast, percentages of sub-rounded grains were higher in the profile in the lower part of the toposequence. Moderately spherical sand grains were the major class in all profiles, ranging from 40-75% of grains. Based on the above analysis and their proximity to the mountains, the sand profiles sampled along the four toposequences in south-east Cambodia showed the major influence of in situ weathering of siliceous parent materials and to a lesser extent colluvial transport of sands. There was no evidence of long range transport of the sand grains or of any aeolian processes in re-working of the sands.

Keywords: colluvial, granite, particle size analysis, sand grain analysis, sandstone

Financial support: ACIAR

(3878 - 2979) Predicting potassium availability for eucalyptus in tropical soils

Filipe Bruno de Oliveira[1]; Sergio Henrique Carneiro[1]; Naiara Fernanda de Souza[1]; Cecília Fatima Carlos Ferreira[1]; Ivo Ribeiro da Silva[1]; Samuel Vasconcelos Valadares[1]

Universidade Federal de Viçosa[1]

Mehlich 1 (M1) is the official extractant for P, K and some micronutrients in several states of Brazil. Problems with M1 are frequently reported for P. Another issue is the use of M1 as a K index for plants able to use higher quantities of nonexchangeable K (NE-K) forms (e.g.: eucalypt). We assessed the extractants M1, Mehlich 3 (M3) and Hot Nitric Acid - 2 mol L^{-1} (HNA) as available K indexes for eucalypt. The HNA was included in this work because of the better correlations of this extractant with plant K in previous studies with eucalypt. The experiment was carried out in a greenhouse between 3/12/2017 and 07/04/2017. The treatments were five soils of different textures and mineralogy. The randomized blocks design was used, with four replicates. The experimental units were pots with 2 dm^3 of soil. One seedling of eucalypt (*Eucalyptus urophylla x Eucalyptus grandis* – clone AEC I44) was planted in each experimental unit. Soil samples were collected 2 days before planting. The other nutrients than K were applied equally in all experimental units. The plants were grown for 114 days when they were cut at the soil level. The K accumulation in the plant shoots (plant-K) was measured. A two-way ANOVA and the Tukey test were used to assess if differences in soils had effect on the soil K indexes (M1-K, M3-K, and HNA-K). The Pearson correlation test was used to assess the relationships of the soil tests with plant-K. The soil tests were sensitive to differences among soils. The HNA-K provided a lower discrimination of soils compared to M1-K and M3-K. The extractants M1 and M3 had high correlations with plant K ($r = 0.90$ with $P < 0.05$ and $r = 0.92$ with $P < 0.05$, respectively). We did not find significant correlations of HNA and plant K. The higher importance of exchangeable K pools for short-term K supply to plants explain why M1 and M3 correlated better with plant K. The HNA had a good performance in previous long-term studies for which a higher contribution of NE-K pools is expected. The main practical applications of our work are: M3 is good extractant to predict short-term K availability for eucalypt; considering previous studies that report HNC as a better long-term K index for eucalypt, the combination of M3 or M1 with HNC may be better to indicate both immediate (i.e. K availability during the initial development of the stand) and long-term K supply for eucalypt plantations.

Keywords: Mehlich 3, Mehlich 1, hot nitric acid, K-supply

Financial support: Klabin, FAPEMIG

(2576 - 664) Root growth of cover crops cultivated under compacted pasture in Rolim de Moura Rondônia

Fábio Lucas de Mattia[1]; Marcelo Henrique Gomes[1]; Emerson Oliveira Souza[1]; Diogo Arthur Valiati Dantas[1]; Anderson Cristian Bergamin[1]; Wesley Santana Ferreira[1]; Renan Marré Bizatti[1]; Fábio Régis de Souza[1]

Fundação Universidade Federal de Rondônia[1]

The physical limitation caused by compaction can infer in the productive potential of the agricultural crops, then becomes necessary search effective solutions for this problem. The principal methods of decompaction are realized by mechanical operation and has higher costs and low efficiency, with this, be necessary the search for alternative methods for this problem, like biological decompaction. On this way the work has as objective evaluate the root development of cover crops in a compacted soil. The experiment was installed in an Oxisol soil (Typic Haplustox) dystrophic in the experimental farm of UNIR at Rolim de Moura (RO). The experiment delineation was in randomized blocks with three repetitions, assessing the root development of four treatments: *Brachiaria brizantha, Crotalaria grahamiana, Crotalaria spectabilis* and mechanical scarification (soil cover with *B. brizantha*), in five induced states o compaction: 0, 1, 2, 4 and 8 passes of an agricultural tractor. When the cultures were find in flourishing was open trenches cross-cutting in the cultivation lines, exposing the roots of the plants, the profile was divided in layers with the aid of a mesh put on the soil, next, photographs was taken and the picture was segmented with the threshold technical. The determination of the root system was taken by a computer program SAFIRA v1.1. For the root length in the 0,0-0,05 m, 0,05-0,10 m layers, the brachiaria with or without mechanical scarification in all tractor passes presented higher values for root length highlighting a good performance of this specie explored even with physical limitation. With eight passes of an agricultural tractor reduced 42,9%, 66,3%, 54,6% e 30,9% the root length of the brachiaria *C. grahamiana, C. spectabilis* and mechanical scarification, respectively, in compare where not was compacted. The root surface was reduced too with the compaction rise of the soil, where the brachiaria presents higher values in compare with species of crotalaria. The soil compaction promote a reduced of the root system of the crops, and the brachiaria can be an alternative to explore better the soil and create greater amount of biopores left by you root system more vigorous.

Keywords: Decompaction of soil, root system, *Brachiaria brizantha*.

Financial support: CNPq e FAPERO

(4540 - 1518) Soybean (Glycine max) development in three tropical soil classes: the principle to determining production environments

Rannery Camargos dos Santos[1]; Thyara Ferreira da Silva[1]; Ingrid Horák-Terra[1]; Igor Alexandre Souza[1]; Alceu Linares Pádua Junior[1]

Federal University of the Jequitinhonha and Mucuri Valleys[1]

Nowadays agriculture has increasingly demanded ways of increasing crop productivity, not just the choice of area and cropping system, but also knowledge of all factors that condition the environment. Although there are large crops areas in Brazil, the more apropriete cultivar cultivation environment, or the adequate plant material, has not always been sought, in particular over the Cerrado biome, considering the Brazilian savanna, where soils profile are predominant deeps, well-drained, low fertility, and acidic. This research investigated how soil properties effect on soybean yield, grain weight, and plant morphology, as well as the number of pods per plant and the number of grains per pod were analyzed in Rhodic Haplustox, Rhodic Kandiustox and Rhodic Kanhaplustalf with mollic epipedon in a central Brazilian Cerrado during the 2014/2015 harvest season. The higher yields were obtained in Rhodic Kandiustox and Rhodic Kanhaplustalf, which can be explained by the morphology and

chemical condition of these soils, due to the greater exchangeable bases content and the presence of block and prism structure can increase the available water, unlike Rhodic Haplustox, with a granular structure and a lower content of exchangeable bases and probably less water availability. The chemical attributes had a great influence on productivity and grain weight, especially Rhodic Kanhaplustalf, due to the higher organic matter content, due to the soil location in a small basin of the landscape, associated to the presence of calcareous rock 150 cm depth, contributing to increase pH and calcium and magnesium content and low levels of toxic aluminum in the soil profile. Even though the three classes are considered highly weathered soils, this characteristic mainly affected the Rhodic Haplustox, in which the lower yields of grain weight can be explained by the low capacity of nutrient retention and increase in the content of toxic aluminum. In the test of comparison of means there were no statistical differences in the number of pods and number of grains per pod in the soybean crop at the three types of soil. Thus, soil descriptions at more detailed levels allow verifying the morphological and chemical differences of the soil at the landscape and can be used as alternatives tools for the planning of land use for agricultural purposes.

Keywords: Mollic epipedon, production environments, soil morphology

Financial support: Fundação de Amparo à Pesquisa de Minas Gerais – FAPEMIG

(4129 - 3078) Soybean crop expansion versus slope and soil in the Brazilian Pampa Biome through a GIS

Gabriel da Silva Lemos[1]; Aline Warnke Hipólito[1]; Rodrigo Rizzi[1]

Universidade Federal de Pelotas – UFPel[1]

In recently years, soybean cropped area has rapidly increased over the Brazilian Pampa Biome, located in the South portion of Rio Grande do Sul State, Brazil (RS). This region has been traditionally used to extensive livestock and cropped with irrigated rice over plain areas and hydromorphic soils. Soybean fields are been planted mainly in native grassland but also over low drainage lands in rotation with irrigated rice. This new scenario can greatly impact crop grain yield, soil conservation as well as the environment and its services. Thus, the objective of this work was to assess the occurrence of soybean fields regarding to slope and soil classes in the municipality of Hulha Negra-RS by using a Geographic Information System. Study area is mainly characterized by hydromorphic soils and increased the soybean area around 570% from 2012 to 2016, according to the Brazilian official data. In order to assess soybean fields along with to their slope and soil classes we used a soybean map previously performed by a meticulous and time-consuming visual interpretation over a set of five Landsat images (30-m spatial resolution) throughout the 20013/14 crop season. A slope map from the TOPODATA project which derives from the Shuttle Radar Topographic Mission with a 30-m spatial resolution and a Brazilian soil map at scale of 1: 750 000 were use as slope and soil data. Results showed that the majority of soybean area (84.6%) was above 5% slope and 14.6% between >3 and 5% slope. We also observed that soybean areas were mainly cropped over VERTISSOLO EBÂNICO (49.5%), ARGISSOLO VERMELHO (22.2%), LUVISSOLO ÁPLICO (12.9%) and CHERNOSSOLO ARGILÚVICO (10.2%), that is, soybean fields were mainly cropped above 5% slope and over low drainage soils. Since the soil erosion increases as the slope increases, especially over hydromorphic soils and conventional tillage system, soybean plantation over the Pampa Biome in Hulha Negra-RS requires carefully management techniques in order to achieve the best environment and soil conservation. Is it important to point out that since both soybean and slope maps are at 30-m spatial resolution, more detailed results can be retrieved by using a finer scaled soil map.

Keywords: Landsat Mapping; soil conservation; geotechnology.

Financial support: Post Graduation Program in Soil and Water Management and Conservation of Federal University of Pelotas – UFPel, Fundação de Amparo à Pesquisa do Rio Grande do Sul (FAPERGS) and Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES).

(2611 - 2198) Spatial dependence of the soil mechanical resistance to penetration in areas of sugarcane under mechanized harvesting with controlled traffic at mata paraibana mesorregion of Paraiba State, Brazil

Josévaldo Ribeiro Silva[1]; Flávio Pereira de Oliveira[1]; Carlos Henrique de Azevedo Farias[2]; Maíra Cunha de Souza[1]; Danillo Dutra Tavares[1]; Raphael Moreira Beirigo[1]

UFPB[1]; ProjetAgro[2]

The controlled traffic is established as a method to mitigate risks such as compaction. Spatial variability emerges as an evaluating tool for applied methods in the field. This study was to evaluate the spatial dependence of an area of sugarcane under harvesting with controlled mechanized traffic. The study was carried out in an area that belongs to Santa Emília II farm, municipality of Rio Tinto, state Paraíba - Brazil. Two areas were selected in a Alfisol, from a first (PC) and third (TC) mechanized cuts. The resistance penetration (RP) was determined using the IAA / Planausucar-Stolf impact penetrometer. It was established a sampling grid contemplating wheel tracks (EL) and planting row (LI), all georeferenced. The variability was initially analyzed with the classic statistic, generating mean, median, variance, coefficient of variation, asymmetry, kurtosis and the Shapiro-Wilk test. The spatial dependence was evaluated throug had justed semivariograms generated by the GS + program, making possible the production of isolines maps by the software surfer 14. The mean and median values were very similar, indicating normality of the data, fact end orsed by the Shapiro-Wilktest, as well as asymmetry close to zero, these data imply that the data are suitable for geostatistic alanalysis. The RP presented effect only in PC, in the depths of 0.0-0.10 and 0.20-0.30 m in the interlines, and 0.30-0.40 m in the line, in the others conditions and positions the nugget effect observed was null. A Gaussian model was observed only in TC, specifically at 0.0-0.10 and 0.30-0.40 m of the EL, and 0.0-0.40 m of the LI, the spherical model was presented in 0.10-0.20 m of the EL and 0.0-0.10 and 0.40-0.50 m in the PC LI, the same at 0.10-0.20 and 0.50-0.60 m of the EL and 0.50-0.60 m of the TCLI, the presence of the exponential model occurred in 0.30-0.60 m of the EL and 0.10-0.20 m, and 0.50-0.60 m of the PC LI, as well as between 0.20-0.30 and 0.40-0.50 m of the EL and 0.40-0.50 m of the TCLI. The ADE, in the evaluated conditions with nugget null effect, was classified as very high, with an average range of 27 m for PC and 49 m for TC, a condition that can be explained by the fact that the trafficability can generate homogenization of some soil attributes. The controlled traffic was efficient, present inglower resistance in the plantingrow in both area sand the spatial dependence was classified as verys trongand with large aches in the third leaf area.

Keywords: Sugarcane; Semivariograms; Spatial variability; Alfisol.

Financial support: Usina Miriri Alimentos e Bioenergia S/A; CAPES; CNPq.

(7396 - 706) Spatial variability of organic matter content in a Red Nitosol under an *Eucalyptus benthamii* plantation

Laura Camila de Godoy Goergen[1]; David José Miquelutti[1]; Scott X. Chang[2]

Universidade do Estado de Santa Catarina[1]; University of Alberta[2]

Organic matter is an important indicator of soil quality, since it plays a fundamental role in maintaining nutrient supply, providing cation exchange capacity, and the formation of soil structure. The objective of this work was to analyze the spatial variability of organic matter content in a clonal plantation of *Eucalyptus benthamii* Maiden et Cambage, located in the municipality of Ponte Alta do Norte, SC, Brazil, in a Dystrophic Red Nitosol. Soil samples were collected from

the 0-20 cm layer from an 8 ha area. The sampling points were distributed in a 70 x 70 m grid, totaling 16 samples. The organic matter content was quantified by the wet digestion method and later, the data were submitted to the exploratory analysis and to the spatial dependence analysis through a semivariogram. After verifying spatial dependence, the kriging map was developed to interpolate values in non-sampled areas. A strong spatial dependence for the organic matter content was found and the best semivariogram adjustment was obtained with an exponential model, with a range of 122,80 m. The map generated from kriging allowed us to identify regions with different levels of organic matter content. The results showed that the geostatistical techniques are useful to understand the spatial variation of organic matter, evidencing the need to manage the soil in a site-specific way.

Keywords: precision forestry, kriging, geostatistic.
Financial support: FAPESC (Foundation for Research and Innovation Support of the State of Santa Catarina - Brazil), CAPES (Coordination and Improvement of Higher Level or Education Personnel).

(4221 - 2005) The influence of biological preparations and humus content on soil biological activity

Zita Kriauciuniene[1]; Rita Mockeviciene[1]; Ausra Marcinkeviciene[1]; Rimantas Velicka[1]; Robertas Kosteckas[1]; Lina Marija Butkeviciene[1]; Sigitas Cekanauskas[1]

Aleksandras Stulginskis University[1]

Soil biological activity has been shown to be closely related to agricultural activities, various soil factors and climate. Scientists and farmers are looking for the methods to sustain and increase soil fertility for high and good quality agricultural production. The application of sustainable technologies and bio-preparations in agriculture could increase biological activity of the soil, which has been proved to be powerful indicator of soil quality. Field experiments were carried out in 2014–2016 at the Experimental Station of Aleksandras Stulginskis University (54°53' N, 23°50' E), Kaunas District, Lithuania. The aim of the research was to estimate the effects of bio-preparations and humus content on the soil biological activity using non-chemical weed control methods (thermal, mechanical and self-regulation) in organic spring rapeseed crop (*Brassica napus* L. spp. *oleifera annua* Metzg.) cultivated in soil with regular and thickened humus layers. Experiments showed, that the activity of soil enzymes urease and saccharase, number and mass of earthworms, CO_2 emission from the soil depended on the meteorological conditions. In the soil of both humus layer types, the highest average number and mass of earthworms and the strongest activity of saccharase and urease were identified in the plots of self-regulation, compared with thermal and mechanical weed control. Positive effect of the bio-preparations on the abundance of earthworms and the activity of soil enzymes was established in the droughty year of 2015. The application of mechanical and thermal weed control methods without bio-preparations decreased CO_2 emission from the soil, while their combination with bio-preparations increased it. In 2014 and 2015 experimental years, in the soil with a regular humus layer there were established strong correlations between the number of earthworms and oilseed rape root length (in 2014 – r = 0.94, P<0.05; in 2015 – r=0.85, P<0.05), between the number of earthworms and root area (in 2014 – r=0.86, P<0.05; in 2015 – r=0.85, P<0.05). In 2014–2016, strong and very strong correlations were established between the number and mass of earthworms (in 2014– r=0.94, P<0.01; in 2015 – r=0.91, P<0.05, in 2016 – r=0.89, P<0.05). In the soil with a thickened humus layer, there were established strong and very strong correlations between saccharase activity and organic carbon content in the soil (in 2015 –r=0.97, P<0.01; in 2016 – r=0.87, P<0.05).

Keywords: bio-preparations; humus; soil enzymes; CO_2 emission; earthworms
Financial support: This research was funded by a grant (No. SIT-8/2015) from the Research Council of Lithuania.

(8729 - 3095) Variation in soil properties, moisture, and botanical composition across catenas in northwest Arkansas, USA

Jenny Richter[1]; Christine Nieman[1]; Kabindra Adhikari[2]; Phillip Owens[3]

ORISE[1]; University of Arkansas[2]; USDA-ARS[3]

Differences in soil properties result in functional variations that affect botanical growth and composition, hydrology, and nutrient distribution across the landscape. This spatial variation makes it difficult for producers to manage fields for uniform productivity. The landscape of northwest Arkansas, USA presents pasture management challenges for livestock producers, where the natural topography creates environments favorable to certain forage species. This is generally characterized by bermudagrass [Cynodon dactylon (L.) Pers.] dominating upper hillslopes and tall fescue (Festuca arundinacea Schreb.) thriving in swales. We hypothesize that botanical distribution is driven by differences in soil properties and plant available moisture across catenas. Three catenas within continuously grazed pastures were examined to determine the variation in soil properties across the hillslopes as well as corresponding botanical composition at the summit, backslope, and footslope positions. Soil pits were mechanically excavated at each of the three hillslope positions, whereupon a soil profile description was completed and soil samples were taken from each horizon in the upper 60 cm of the profile. The soil samples were then analyzed for P, K, and organic C, as well as plant available water holding capacity, particle size, and pH. Areas at each hillslope position were fenced off to exclude grazing cattle during the study. Within the enclosures, tensiometers were placed at 30 and 60 cm depths in the three hillslope locations at each catena to monitor matric potential in the soil. Tensiometer readings were taken each month, coinciding with herbage sampling. Herbage mass was taken every month from two 1-m^2 areas within the enclosures. Herbage samples were separated by species to determine botanical composition at each site. Samples were dried and weighed to determine biomass production and biomass contribution from botanical constituents. Subsamples of all botanical contributors were analyzed for NDF, ADF, CP, P, and K. Understanding the soil distribution driving botanical composition across catenas is important for management, particularly for producers deciding whether or not to invest in cultivation and management of improved and more expensive varieties of tall fescue and bermudagrass. Knowledge of soil properties across catenas can aid producers in precision management decisions and help determine whether or not it is feasible to strive for a monoculture.

Keywords: toposequence, hillslope, pastures, grazed
Financial support: USDA-ARS

C3.2 - Soil and Water Conservation

C3.2.1 - Managing and remediating floodplain and wetland soils

(3325 - 879) Baseline concentration of vanadium in different types of soils from TaiwanBaseline concentration of vanadium in different types of soils from Taiwan

Cho-Yin Wu[1]; Zeng-Yei Hseu[1]

Department of Agricultural Chemistry, National Taiwan University[1]

Baseline concentration of vanadium in different types of soils from Taiwan Cho-Yin Wu and Zeng-Yei Hseu* Department of Agricultural Chemistry, National Taiwan University No. 1, Sec. 4, Roosevelt Rd., Taipei 10617, Taiwan *E-mail: zyhseu@ntu.edu.tw The global vanadium (V) demand in industry increased 8% from 2006 to 2014, which will become 3.45% higher in next decade. This increase of V requirment may lead to more potential risk to the environment quality and human health than before. However, only 5 countries

currently regulate the guideline of soil vanadium (42-180 mg/kg) excluding Taiwan. Geochemical fractionation is crucial to the solubility of V in soils, this study attempted to explore the fractions of soil V for the baseline of vanadium based on 17 pedons with 94 horizon samples throughout Taiwan. These pedons were selected from different soil parent materials comprising slate, sandstone and shale, andesite, serpentine, and basalt. The potential mobility of V was assessed by using the BCR sequential extraction technique to divide total V into 4 fractions: acid-exchangeable (F1), Fe-Mn oxide bounded (F2), oxidation (F3) and residual (F4). The total V concentration was analyzed by using portable x-ray fluorescence (PXRF) in situ and ICP-AES followed with HF-digestion in the lab. The total V concentration by ICP in the soils from Taiwan ranged from 35.4 to 475 mg/kg and the average level was 182 mg/kg. Moreover, the total V concentration in the basalt-derived soils was much higher than sandstone-derived soils. Nevertheless, the weathering degree of soil did not clearly affect the V level between pedons. Furthermore, V concentration obtained by PXRF was significantly and positively correlated with that by ICP, demonstrating PXRF was feasible alternative to determine V in the field for rapid screening of V. The results of BCR sequential extraction indicated the residual V accounted 94.01% of total V indicating a low mobility of V in the soils. Keywords: mobility; sequential extraction; PXRF; soil contamination; vanadium

Keywords: mobility; sequential extraction; PXRF; soil contamination; vanadium
Financial support:

(6863 - 220) Can earthworms' activity affect water transport and storage in soils?

Jamal Hallam[1]; Mark E. Hodson[2]; David Robinson[3]; Joseph Holden[4]
University of York, Environment Department, York, United Kingdom (jh2066@york.ac.uk), National Institute of Agricultural Research of Morocco (jamal.hallam@gmail.com)[1]; University of York, Environment Department, York, United Kingdom (mark.hodson@york.ac.uk)[2]; Environment Centre Wales, Centre for Ecology and Hydrology, Bangor, United Kingdom (davi2@ceh.ac.uk)[3]; University of Leeds, School of Geography, Leeds, United Kingdom (J.Holden@leeds.ac.uk)[4]

We studied the combined effect of earthworms and plant roots on soil physical and hydraulic properties. Two different groups of earthworms, *L terrestris* and *A chlorotica* which produce vertical and lateral burrows respectively, were studied for 16 weeks in columns under three different soil types. We used a factorial design with presence and absence of both winter wheat and either *L terrestris* or *A chlorotica*. Overall, in the *L terrestris* experiment water flow under field saturated and unsaturated conditions was mainly controlled by plant roots in all the soil types. The addition of *L terrestris* to the planted and bare columns led to an increase of the hydraulic conductivities in all soils. However, the increase was only significant in the sandy loam soil. The soil water release curves showed the same behaviour between treatments at high matric potential (up to 10kPa). At lower matric potential (10–500kPa) the wheat+*L terrestris* treatment held water less tightly than the other treatments. The presence of *L terrestris* also resulted in a slight, but not significant, increase in water holding capacity. The percentage of water stable aggregates increased and were significantly influenced by plant roots rather than earthworms. Earthworm-present caused a significant increase of shoot dry matter biomass in silt loam soils. *A chlorotica* had a significantly greater influence on soil hydraulic and physical properties compared to *L terrestris*, particularly for the plant+earthworm treatments. Compared to the other treatments, the field saturated hydraulic conductivity increased more rapidly across time in wheat+*A chlorotica* treatment. After 16 weeks the field saturated hydraulic conductivity was 12, 34 and 39-fold more than the control in loam, silt loam and sandy loam soils respectively. In all the soil types, wheat+*A chlorotica* treatment resulted in a significant increase of water holding capacity, % stable aggregates and dry shoot biomass compared to other treatments. These results suggest that the combined effect of earthworms and plant roots can significantly increase both soil water flow and retention. However, there are species effects due to the different ecological niches occupied by earthworms. In conditions where earthworm burrows are disconnected from drainage system, lateral burrowing earthworms have more of an impact on soil water flow than vertical burrowing species. The results are of special interest for wet areas of high flooding and waterlogging risks.

Keywords: *Lumbricus terrestris, Allolobophora chlorotica*, hydraulic conductivity, Soil physical properties.
Financial support:

(7377 - 456) Comparison of soil quality using comparative diagrams in riparian areas, Brazil

Piero Iori[1]; Reginaldo Barboza da Silva[2]; Moacir de Souza Dias Junior[3]; Ricardo Nakamura[2]; Luis Carlos Ferreira de Almeida[2]
Universidade Federal de Goiás[1]; Universidade Estadual Paulista "Júlio de Mesquita Filho"[2]; Federal University of Lavras[3]

Land areas adjoining watercourses and water bodies are considered conservation areas and are extremely important for a variety of environmental services, including sediment filtration, bank stabilization and aquifer recharging. Cultivating these areas can cause serious changes in the physical, mechanical and chemical properties of soil, promoting negative environmental processes such as siltation of water sources, which is caused by erosion. The consequences of these changing conditions are felt directly by populations living in riparian areas. Consequently, soil quality assessments can be used to evaluate and monitor sustainable land management practices in agroecosystems. The aim of this study was to compare soil quality using comparative diagrams in response to land use in riparian areas in the Sub-basin of the Ribeira Iguape River, Brazil. The physical, mechanical and chemical properties of soil were determined in land used for banana cultivation, degraded pastures, silvopastoral land and native forest, as a reference area, along the Ribeira River in Brazil. The impacts of different agricultural land uses different showed a close and inverse relationship between soil quality and land use intensity. Based on the obtained data, comparative diagrams (radar graph type) were drawn and analyzed to compare the soil quality and the area in the graph for each type of land use. Agricultural land use alongside rivers (riparian areas) has caused negative changes to the main physical, mechanical and chemical properties of soil. The polygons formed in the radar graphs, which were used to compare the reference areas to the areas for the three different agricultural land uses, differed in shape and area compared to reference values, proving that these comparative diagrams are a useful tool in the assessment of soil quality in riparian areas. Comparing diagram areas, land under banana cultivation, degraded pastures and silvopastoral land had values that were 40%, 36% and 29%, respectively, of diagram areas for native forest. The adoption of comparative diagrams for soil assessment helped to elucidate the relationships between agricultural land uses and the physical, mechanical and chemical aspects of soil quality in riparian areas.

Keywords: Agricultural land use; banana cultivated-land; Soil degradation.
Financial support: Capes and CNPq.

(6434 - 2776) Effect of former topography on insufficient growth caused by excess soil water in upland crops cultivated on paddy field

Yuta Shimizu[1]; Kenji Matsumori[1]; Hidetoshi Mochizuki[1]; Shinsuke Mori[1]
Western Region Agricultural Research Center, National Agriculture and Food Research Organization[1]

Existence of excess soil water at root depth is one of the largest potential threat to plant growth. In hilly and mountainous area in western Japan, farmers face to the above-mentioned problem when they conduct farming with the crop rotation mixed with rice paddy, soybean, and winter wheat on terraced paddy field which is recently introduced as a farming program. The source of the excess soil water is possibly due to high groundwater level based on several monitoring experiences. Current terraced paddy fields were re-developed by farmland consolidation which enlarged through gathering each small field. The farmland consolidation significantly changed the topography because it has buried and leveled most of hills and small valleys in a village-scaled area to obtain large flattened paddy fields. We thought the higher groundwater level relates to former topography before the farmland consolidation based on the assumptions that groundwater flows alongside with former river channels which is buried under the current field. The objective of this study was to confirm the spatial relationship between excess soil water and topographic changing. Former river channels and amount of soil volumes disturbed by farmland consolidation were estimated based on comparison of elevation maps between before and after the construction using GIS technique. Spatial distribution of insufficient growth of the crops were confirmed using aerial photos taken by an unmanned aerial vehicle. Water potential at root depth, and groundwater level were monitored during cultivation period. Results show that there is a clear relationship between land reclamation and plant growth; inefficient growth of crop was found on the land filled small valley while well-grown crop was found on the land leveled hills. The reason of insufficient growth is considered that the crop was damaged by excess soil water based on observed water potential trend. Moreover, the groundwater level monitored in the land filled small valley was always higher than the land leveled hills throughout the monitoring period. Consequently, former topography could be a crucial factor to predict the field influenced by excess soil water. To identify the zone is important for the farmers because the zoning is eventually related to judgement that crop can growth or not.

Keywords: excess soil water; topography; crop rotation; rice paddy field

Financial support:

(9955 - 1470) Effects of anthropization in veredas from Central Brazil

Adrieny Kerollen Alves Lopes[1]; Maria Emanuelly Ramires[2]; Rafaella Loryane Alves Cardoso[3]; Fabrício da Silva Terra[4]; Leonardo Barros Dobbss[3]; Igor Alexandre de Souza[3]; Alceu Linares Pádua Junior[3]; Alexandre Christófaro Silva[1]; Ingrid Horák-Terra[1]

Federal University of Jequitinhonha and Mucuri Valleys (UFVJM), Unaí, Brazil.[1]; Federal University of Jequitinhonha and Mucuri Valleys (UFVJM), Unaí, Brazil (emanuellyinter@hotmail.com).[2]; Federal University of Jequitinhonha and Mucuri Valleys (UFVJM), Unaí, Brazil .[3]; Federal University of Pelotas (UFPel), Pelotas, Brazil.[4]

Veredas are ecosystems that occur in the Cerrado biome characterized by the presence of Buritis-palm trees in poorly drained environments. In general, their soils have high organic matter content and allow to function as water reservoirs taking part in the hydrological cycle by regulating water discharge. In Minas Gerais state, veredas are protected by law, and the most of them hold heads of the São Francisco river's main tributaries. However, with increasing of agricultural activities in central Brazil, veredas have been often used without any specific management because there is scarce information about the characteristics of these environments. Here, we presented a characterization based on morphological and physical properties of two soil profiles, each one representing one part of the same vereda (northwestern MG state) under different conditions: anthropized (AP) in downstream and preserved (PP) in upstream of the catchment (2.5 km apart from each other). The anthropization was due to a construction of an artificial drainage channel. The AP (81 cm depth) was sampled by horizons (9 samples) in an exposed profile in this channel, and the PP (160 cm depth) was sampled each 20 cm in a borehole (8 samples). The analyzed properties were: organic carbon (C_{org}), unrubbed (URF) and rubbed fibres (RF), bulk density (BD), bulk density of the organic matter (BDO), gravimetric moisture (GM), minimum residue (MR), and mineral material content (MM). The AP was classified as Terric Haplosaprists with maximum C_{org} (25%) in the first horizon and decreasing up to the base (~ 7%) with almost absence of fibers and very decomposed. Its GM also decreased from 34 to 21%, while MM and BD increased in depth up to 89% and 1.4 Mg m^{-3}, respectively. The PP was classified as Hydric Haplofibrists with C_{org} higher than AP, from 34% to 59% in depth, and higher URF, RF, and GM increasing in depth up to 76, 68 and 90%, respectively. Its MM and BD were decreasing up to 4% and 0.09 Mg m^{-3}, respectively. Values of BDO and MR for AP ranged between 0.14-0.20 Mg m^{-3} and 0.18-0.90 m m^{-1}, respectively, and for PP between 0.08-0.18 Mg m^{-3} and 0.003-0.09 m m^{-1}. Variations among these properties reflect the conservation states of these both profiles. AP is more degraded with high stage of material subsidence losing thickness and reducing soil porosity and, consequently, its water storage capacity. PP is more preserved with more organic matter and able to storage more water.

Keywords: Tropical wetlands; water reservoirs; wetland management; physical and morphological properties; Buritis-palm trees.

Financial support: Institutional Program for Scientific Initiation (PIBIC/UFVJM - CICT 006/2017).

(2244 - 2783) Soil carbon pools in temperate saltmarsh and mangrove environments

Cecelia Chan[1]; Vanessa Wong[1]

Monash University[1]

Intertidal sediments sequester significant amounts of C globally. C sources can be categorised into organic C inputs from within the estuary (autochthonous) and inputs trapped within the estuary derived from external sources (allochthonous). SOC can be divided into three C pools, particulate organic carbon (POC), humus carbon (HC) and recalcitrant carbon (RC). Belowground organic carbon stocks in mangrove and saltmarsh environments have been quantified in a number of environments globally, identifying the potential to store substantial amounts of C. In this study, we quantified the SOC stocks in temperate saltmarsh and floodplain environments and identified the contribution from the three C pools. We found that saltmarsh sites had a higher potential to accumulate SOC compared to mangrove areas, which was related to increasing distance from the creek network and higher elevations. The mangrove sites had a higher proportion which have be related to deposition of both allochthonous and autochthonous materials. The saltmarsh sites had higher potential for C sequestration due to higher proportions of HC. These results highlight the importance of protecting these environments, not only as they provide a transitional environment between the coastal and terrestrial zone, but also as important stores of more stable organic carbon

Keywords: soil carbon, wetlands, mangrove, saltmarsh

Financial support:

C3.2.2 - Soil management in organic production and agroecology

(2435 - 1176) Comparison between the effects of sun-coral (*Tubastraea spp.*) and limestone as soil amendments in cultivated corn (*Zea mays*)

Julia Barra Netto Ferreira[1]; Thuany da Costa Janête[1]; Marlon Henrique deOliveira[1]; Rafael Thales da Silva Magalhães[1]; Ricardo de

Castro Dias[1]; Joel Christopher Creed[2]; Everaldo Zonta[1]
Universidade Federal Rural do Rio de Janeiro[1]; Universidade Estadual do Rio de Janeiro[2]

In the 1980s the accidental introduction of an exotic marine invasive species called sun-coral (Tubastraea spp.) caused an environmental and social imbalance through the coastal region of Brazil. This work is aimed to investigate whether the sun-coral can be employed as a source of soil corrective either for family or organic agriculture. The experiment was conducted with corn(Zea mays) plants grown in pots with soil from a *Planossolo háplico* (Typic fragiaquult), at initial pH of 5.1. An addition of 50 g of AlCl3 was made to raise the aluminum content to 1.0 cmol dm^{-3} in order to analyze the potential of sun-coral in neutralizing the soil acidity. The doses used were 0; 2.0; 4.0 and 8.0 ton ha-1 for both the sun-coral and commercial limestone. The plants were collected at 60 DAS, when the height, diameter and shoot dry matter were evaluated. The contents of P, K, Ca, Mg and Na on the aerial part of the plants were also determined by sulfuric digestion (Tedesco et al., 1995). The treatments were compared by analysis of variance and means were compared by the Tukey's test within the confidence limit of 95% of probability. Diameter and total content of K were the parameters which presented statistical difference. The average of plant diameter was 19.30 mm for the control; 17.98, 17.69 and 17.70 mm for doses of 2.0; 4.0 and 8.0 ton ha-1 limestone, respectively; and 18.52, 19.48 and 18.86 mm for doses of 2.0; 4.0 and 8.0 sun-coral, respectively. The average of total K content was 6.9 g.kg-1 for control; 9.2, 10.5 and 9.3 g.kg-1 for doses of 2.0; 4.0 and 8.0 ton ha-1 limestone, respectively; and 9.3, 11.1 and 11.3 g.kg-1 for doses of 2.0; 4.0 and 8.0 ton ha-1 sun-coral, respectively. The final plant diameter was lower than control in almost all treatments. The pH analysis at the end of the experiment showed an average value of 6.3, different from the initial pH, causing the precipitation of the Al added at the beginning of the experiment. This may have been due to the fact that the soil collected for the experiment was corrected without any record keeping. Therefore, comparing the averages of diameter in limestone treatments with those of sun-coral, those with coral were higher, which may be related to the total nutrients content in the composition of sun-coral structure, which increased the availability of nutrients. For the K content, only the 8 ton.ha-1 dose was significantly higher in the sun-coral than in the limestone (Tukey's test, 5% probability).

Keywords: alternative amendments, organic agriculture, residues usage
Financial support: FAPERJ

(7763 - 3183) Content of organic matter and calcium in soil cohesive treated with gypsum and leguminous residues

Jéssica de Freitas Nunes[1]; Thales Pereira Pires[2]; Virley Gardeny Lima Sena[3]; Vinícius Ribamar Macedo[2]; Lorena Silva Campos[2]; Emanoel Gomes de Moura[2]
Universidade Estadual do Maranhão[1]; UEMA[2]; USP[3]

The use of gypsum ($CaSO_4 .2H_2O$) in addition to the availability of Ca^{2+} can increase the stability of the aggregates and improve root performance in deeper layers and as a result, increase the efficiency of water and nutrient use. The use of limy ($CaCO_3$) is also an alternative to provide calcium to the soil and raise the pH which are correlated with the decomposition of organic matter. This work aims to evaluate the effect of gypsum, limy and leguminous residues on calcium and organic carbon levels in sandy soil prone to cohesion. The experiment was conducted in a greenhouse located in the Technological Center of Rural Engineering of the Agronomy Course belonging to the State University of Maranhão. The soil collected with cohesive characteristics belongs to an area of capoeira with secondary vegetation. The soil and legume milled and dried were mixed in the proportions of 50% *Gliricidia sepium* and 50% *Leucaena leucocephala*. The experimental design was a randomized complete block design, using the 3x3x2 triple factorial system (organic matter, gypsum and limy) with four replications and 18 treatments. The data were analyzed with a variance analysis (ANOVA) and were compared using Tukey's test at the 5% probability level in the 3x3x2 triple factorial system. These analyzes were performed using RStudio software. In the 10-20 cm layer the limy always increased the calcium content in the soil, but with the plaster combination the calcium contents increased significantly. In the 10-20 cm layer, the limy decreased the organic matter content in the combination of (0 t.ha-1 of gypsum / 2 t.ha-1 of limy) and in the other combinations of doses of gypsum and limy there was no significant difference. The pH values in the 10-20 cm layer were always remained low in the 0 t.ha-1 limy combinations for the three gypsum dosages. The addition of calcium in the soil from the gypsum delayed the decomposition of the products derived from the leguminous biomass applied to the soil. The addition of limy increased the pH and therefore the decomposition of the organic matter, therefore, the dosage of 2 t.ha-1 of limy decreased the organic matter content of the soil. The addition of calcium in the soil from the gypsum delayed the decomposition of the products derived from the biomass of leguminous applied to the soil increasing the M.O. content. The addition of limy increased the pH and, consequently, the decomposition of organic matter.

Keywords: pH, limy, leguminous
Financial support: FAPEMA

(4298 - 1760) Effect of organic amendments and inorganic fertilization in the yield and quality of jalapeño pepper (*Capsicum annuum* L.)

Ana Alejandra Valenzuela-García[1]; Juan José Martínez-Ríos[1]; Uriel Figueroa-Viramontes[2]; Enrique Troyo-Dieguez[3]; Ignacio Orona-Castillo[1]; Miguel Ángel Gallegos-Robles[1]; Enrique Salazar-Sosa[4]
Universidad Juárez del Estado de Durango, Facultad de Agricultura y Zootecnia[1]; Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias[2]; Centro de Investigaciones Biológicas del Noroeste[3]; Instituto Tecnológico de Torreón[4]

In this work, the effect of different doses of organic fertilizers on a jalapeno pepper crop (*Caspsicum annuum* L.) and the effect on the content of nitrogen (N), phosphorus (P), electrical conductivity (EC), pH and organic matter (OM) in soil was evaluated. The study was carried out in the Experimental Field of FAZ-UJED, located in Venecia, Durango, Mexico (coordinates 25.75º N, 103.3º W). The fertilizers used were vermicompost (VC) with doses of 0 and 3 Mg ha^{-1}, in factorial combination with solarized manure (ES), in doses of 0, 40, 80, and 120 Mg ha^{-1}, and a treatment with inorganic fertilization, 150-100-00 Mg ha^{-1} of N-P-K. Microbiological analyzes were carried out to evaluate the innocuousness of the fruit, mainly about the presence of *Salmonella* spp. The obtained results suggest that the applied dose of VC had a non-significant effect on the yield and in the evaluated soil variables. ES had a significant effect on yield, the highest value was obtained with the dose of 120 Mg ha^{-1} (56.2 Mg ha^{-1}), although it was statistically equal to the doses of 40 and 80 Mg ha^{-1}. The highest values of P (70.7 mg kg^{-1}) and OM (3.7%) occurred at dosage of 120 Mg ha^{-1}. The lowest value of OM (1.1%) was found in the inorganic fertilization treatment. The nutrients provided by ES are sufficient to satisfy the needs of the crop. The values of pH, EC and N were not affected by the manure dosage and its quality was not affected by the application of organic fertilizers. The fruits of second quality were the most frequent (60% of the total fruits), followed by the first quality (25%). The microbiological analyzes resulted negative for *Salmonella*

spp., this could indicate that the solarization process is an effective process for its elimination.
Keywords: manure, vermicompost, food safety, macro-nutrients
Financial support: None

(4889 - 1310) Influence of a afilsol's microbial activity under incorporation of ryegrass, white clover or poultry litter.

CAROLINE JERKE[1]; Adriana Cancian[1]; Cristhian Hernandez Gamboa[1]; Juan Cubillos Hinojosa[1]; Lucas Zulpo[1]; Mariana Fernandes Ramos[1]; Tiago Stumpf da Silva[1]; Victor Lucas Bassani[1]; Enilson Luiz Saccol de Sá[1]; Flávio Anastácio de Oliveira Camargo[1]
UFRGS[1]

The incorporation of residues and waste in the soil, practice widely used in conservationist agriculture, impacts on the physical, chemical and biological properties of the soil. Microbial respiration is a suitable parameter to be used as an indicator of soil microbial activity and determine effects caused by different soil management. We evaluate the microbial activity during 30 days of incubation of ryegrass, white clover or poultry litter, determining carbon evolution, at the 2nd, 3rd, 4th, 7th, 9th, 11th, 14th, 18th, 21st, 24th, 28th and 30th days of incubation experiment. Each treatment showed different behavior of microbial activity throughout the experiment. This Afilsol had low content of Soil Organic Matter and therefore was very sensitive to the applied management practices. The behavior of CO2 release in the treatments with cover crops was very similar, presenting a peak on the 4th day of incubation, however, the incorporation of poultry litter showed a different behavior, increasing rates of CO2 release and overcoming the microbial activity comparing the other treatments after the 18th day of incubation. The CO2 evolution was used to adjust equations to evaluate patterns of all treatments. The linear model was the best choice all treatments except the treatment of soil with ryegrass, which the logarithm model was the best fit. This suggests that the time of this experiment wasn't enough to observe microbial activity at the stage where the microbial community uses recalcitrant fractions of organic matter, however, the adjusted equations allowed to calculate the time to consume 50% of C available which showed that the mineralization of poultry litter regarded was twice times slow comparing to the ryegrass addition. The highest rates of mineralization were ryegrass, white clover, control, and poultry litter.
Keywords: Respirometry, Cover Crops, Soil management
Financial support: CAPES and CNPq

(9605 - 2840) Nepheline syenite rock powder as source of potassium to corn

Luis Valério C. Carvalho[1]; Julio Cesar Raposo de Almeida[1]; Ana Aparecida da Silva Almeida[1]; João Luis GAdioli[1]; Omar Vieira Vilella[2]; Hélio Minoru Takada[2]; Aluisio Ramos Ferreira[3]
UNITAU[1]; APTA[2]; Mineração Rio do Braço[3]

This work aimed to measure the supply of potassium (K) by nepheline syenite rock powder to dry matter of corn cultivated in dystrophic oxisol and to calculate its efficiency against the potassium chloride (KCl). Nepheline syenite is a plutonic rock characterized by 7.3% of K_2O, supplied by a mining company located at Lavrinhas, Sao Paulo state in Brazil. The application of rock powder to soil presents itself as an alternative to synthetic sources, taking advantage of its slow chemical dissolution what makes it less susceptible to lixiviation and a source of multiple minerals. The rock powder was applied raw (R) to the soil and after heating (H) in calcination oven mixed with calcium chloride (55%-45%) at 900 °C for 30 minutes. A 3x2+2 factorial experiment desing was set fractionating the rock powder into the granulometric ranges small (s) or below 0.053 mm, medium (m) or between 0.053 and 0.149 mm and large (l) or above 0.149 mm. A positive control treated with KCl and a negative control without any K source were set. The soil was incubated for 94 days and wet with distilled water up to 70% of its field capacity. Corn was cultivated thrice, 33 days each time. The dry matter masses, the K levels in soil and the K concentration in the plants were determined per treatment. The K contents were determined by the multiplication of the dry matter mass by its K concentration. The data obtained were submitted to analysis of variance and Tukey test at a confidence level of 5%. The agronomic efficiency was estimated comparing to the KCl treatment. The heating treatments Hs, Hm and Hl showed significant effects on the K levels in soil ($P < 0.01$) and on the concentration of K in the dry matter of the first cultivate ($P < 0.01$). The treatment Hs showed a significant effect on the total content of K in the dry matter ($P < 0.01$). Has been concluded that after heating the nepheline syenite rock powder acted closer to KCl as a fast dissolution fertilizer while the raw rock powder did not or did not have enough time to dissolve and supply potassium to the corn.
Keywords: rock for crops, calcination, oxisol
Financial support: Mineração Rio do Braço

(4326 - 1047) Nitrogen mineralization and nitrous oxide emissions in a sandy soil amended with low-phosphorus broiler litter.

Ariel Szogi[1]; Paul D. Shumaker[1]; Kyoung S. Ro[1]; Gilbert S. Sigua[1]
USDA-ARS Coastal Plains Soil, Water, and Plant research Center[1]

Recurrent land application of broiler litter in regions with a high concentration of poultry farms result in soils with phosphorus (P) far beyond the agronomic requirement of crops. A new waste treatment technology developed by USDA-ARS, called "Quick Wash", chemically extracts and recovers P from broiler litter while leaving most of the nitrogen (N) and carbon (C) in the low-P treated litter. The low-P treated litter can then be either safely land applied at agronomic N rates. A laboratory test was performed to evaluate the N mineralization and nitrous oxide (N_2O) emissions in a Norfolk soil (Fine-loamy, kaolinitic, thermic Typic Kandiudults) amended with low-P litter. Two sets of undisturbed soil cores (15 cm x 5 cm diameter) received the following treatments applied onto the soil surface in triplicate: un-amended soil (control), untreated litter, pelletized untreated litter, loose low-P litter, and pelletized low-P litter. All cores were adjusted to 60 % water-filled porosity and incubated at 25°C for 68 days. Soil from one set of cores was sampled on a weekly basis. Soil samples were extracted with 2 molar potassium chloride and analyzed for ammonium (NH_4) and nitrate (NO_3) to estimate the net N mineralization (Nm) rate of each poultry litter amendment. Another set of cores were enclosed in plastic jars having a gas sampling port for periodic N_2O emission measurements by gas chromatography. The Nm rates were in the range of 4.0 to 5.7 mg/kg of soil/day for untreated litter, pelletized untreated litter, and loose low-P litter while pelletized low P-litter and the unamended soil control were significantly lower, in the range of 1.7 to 2.0 mg/kg soil/day. The cumulative N_2O production from the pelletized raw, loose raw, loose low-P, pelletized low-P litter, and un-amended soil were 1261, 894, 407, 287, and 80 µg N_2O-N/kg soil, respectively. Therefore, percent of N_2O losses from the total applied N were 1.4%, 1.0%, 0.5%, and 0.3% for pelletized untreated litter, untreated litter, loose low-P litter, and pelletized low-P litter, respectively. Since the treated pelletized low-P litter also had the lowest nitrification rates, it appears as an efficient solution to conserve N and mitigate losses by N_2O emissions or NO_3 leaching after soil application.
Keywords: organic nitrogen, nitrification, manure, mineralization, sustainability
Financial support: USDA-ARS Project 6082-12630-001-00D

(5325 - 657) Organic Matter and Physical Attributes of the Soil with Underground Barrage in Agroecological Transition

Wanderson Benerval De Lucena[1]; Gizelia Barbosa Ferreira[1]; Maria

Sonia Lopes Da Silva[2]; Hugo Isaac Da Silva[1]; Maria José Sipriano Da Silva[1]; Igor Alberto Cabral Da Rocha[1]; Elisiane Martins De Lima[1]; Maria José De Freitas[1]; Ricardo Torres Da Silva[1]
Federal Institute of Pernambuco[1]; Brazilian Agricultural Research Corporation - Soils[2]

Underground barrage consist of a technique for capturing and storing rainwater to ensure agricultural production during the dry season. The accumulation of water in the catchment area of the barrage has demonstrated positive and negative aspects in the chemical, physical and biological attributes of soils. The difficulties of underground barrage are the result of several factors, including the use of conventional management techniques that can lead to soil erosion. The objective of this work was to evaluate the physical attributes and the organic matter of the soils with underground barrage in the brazilian semiarid, comparing with areas of conventional system and native forest. The study was carried out in two properties of the State of Bahia, both under semiarid climate. Property 01, which is located in the city of Serrolândia (latitude 11° 25' 7" S, longitude 40° 17' 40" W, at 447 meters altitude), property 02 is located in the city of Canudos (latitude 09° 53' 48" S, longitude 39° 01' 35" W, at 402 meters altitude). Sampling for the physical analysis was performed at the beginning of the rainy season, and obtained through a sample composed of each environment, collected in ten points in the zigzag direction, and in three depths, 0-10 cm, 10-20 cm and 20 -40 cm. It's verified that of all studied areas the organic matter was higher in the environment of native forest, when compared to the other environments. The removal of the caatinga, together with the long periods of drought, causes marked physical, chemical and biological degradation in these environments, in relation to the soils, these characteristics can be more accentuated, because it leaves them totally discovered and exposed to the climatic factors. Soil density in agroecosystem 01 was higher when compared to agroecosystem 02, due to soil particle density related to high sand content (in agroecosystem 01) and clay (in agroecossystem 02). These relationships in the formation of macro and micro pores of the soil can be observed in the porosity, which was higher in the agroecosystem 02 due to the clay and organic matter contents. It's concluded that both properties are still slowly moving towards a more sustainable agroecosystem, overcoming the environmental limitations of the brazilian semiarid region, placing the underground barrage as a technology with potential to perfect and balance the productive process, promoting greater stability of agroecosystems.

Keywords: Ecological management of the soil; Sustainable agriculture; Captation and storage of water in the semiarid.
Financial support: CNPq, BNB, IFPE

(4882 - 776) Soil microbial groups responses to application of garlic broth, essential oils and *Trichoderma spp.* used to control *Sclerotium cepivorum* Berk

Ezequiel D. Bigatton[1]; Boris X. Camiletti[1]; Matias Bonetto[1]; Martha Y. Conles[1]; Isabel Serdiuk[1]; Aylen Ocampo[1]; Leandro Carbelo[1]; Enrique I. Lucini[1]
Universidad Nacional de Córdoba[1]

Argentina is the second largest country in garlic (*Allium sativum* L.) production which is highly affected by the white rot caused by *Sclerotium cepivorum* Berk. This pathogen produce sclerotia that can survive in soil as the inoculum source. We previously demonstrated that applications of garlic broth (GB) obtained by hydrodistillation inducedearly sclerotial germination reducing the amount of final viable sclerotia. Essential oils (EOs) and *Trichodermaspp.* applications control *S. cepivorum*. The goal of this work was to study the effect of GB, oregano *(Origanum* spp. *vulgare*) EO, suico (*Tagetesminuta* L.) EO, *T. atroviride* (TA) and *T. harzianum* (TH) applications on final viable sclerotia and soil microbial groups. Assay was carried out inplots (45 x 45 cm) inoculated with 21 g of sclerotia at 5 cm depth (day 0). The treatments were: no applications (control); GB (80 mL) applied after 20 and 40 days; GB+ EOs of oregano and suico applied separately (1500 ppmapplied on the soil surface) after 60 days; GB + individual and combined applications of TA and TH ($4x10^8$ spores) after 90 days. Total heterotrophic and nitrogen-fixing microorganisms were determined by colony-forming unit. The most probable number method was used to quantify nitrifying, ammonia-oxidizing and cellulolytic microorganisms. All the groups were quantified after 7 days of each application. At the end of the assay, sclerotia were collected by sifting and quantify the soil samples (100g) using astereo-microscope. Viability of sclerotia was determined on agar-water (2%). Means were obtained by ANOVA and significant differences were detected using Fisher´s LSD test ($P< 0.05$). The number of nitrifying microorganism significantly decreased (9%) after GB applications. Similar results were obtained between GB + suico EO and GB + TA, reducing both the number of nitrifying (83 and 67%, respectively) and ammonia-oxidizing (7 and 12%, respectively). Ammonia-oxidizing microorganisms were also affected by GB+TA+TH (11%). GB+Oregano EO decreased the number of nitrifying and nitrogen-fixing (94 and 5%, respectively). The application of GB+TH had no significant effect on the soil microbial groups. The number of viable sclerotia was increased in control (40%) and reduced with the applications (40%). The greatest reduction was observed in GB + TA + TH (73%). Combined application of TA and TH provide additional control to GB treatment affecting ammonia-oxidizing microorganisms.

Keywords: natural control, integrated pest management, soil microbiology.
Financial support: SECyT, CONICET

(7165 - 3086) Sustainable production of strawberry in Alfisols from coastal rainfed Chile

Alonso Matamoros[1]; Oscar Seguel[1]; Verónica Diaz[1]; Rodrigo Callejas[1]; Helen Osorio[1]; Gonzalo Arancibia[1]
Universidad de Chile[1]

The soils of the coastal range of Chile present clay textures and low organic matter contents. This condition leads the soil compaction as a common constraint to establish the strawberries, very important crop for small farmers. In the present study, different organic amendments were applied in two essays (Litueche: Alto Colorado Association, Typic Rhodoxeralf, Paredones: Asociación Curanipe, Typic Kandiustalf) to evaluate their effects on soil physical properties and strawberry yield. The treatments consider a control (T0, no amendment), compost (C, 20 Mg ha^{-1}); humic substance 1 (HS1, 100 L ha^{-1}) and humic substance 2 (HS2, 30 kg ha^{-1}), evaluating after 3 and 6 months of the start of the trial: bulk density, pore size distribution, aggregate stability, mechanical resistance and the yield components of the strawberry. The bulk density was not modified by the treatments, although in Paredones tends to decrease by the use of compost. In both essays the coarse porosity increased by the use of organic amendments, but the available water did not change consistently in the time. The aggregate stability increased in Paredones site in C and HS2 treatments, and the mechanical strength remained low in all treatments, but with densified subsoil. The treatment HS1 increased the average weight of the fruit and all amendments increase the °Brix concentrations compared to T0. Finally, the number of fruit per plant, the large and diameter were not affected by the use of organic amendments, but the use of external inputs (fertilizers, agrochemicals, irrigation) decrease with the proposed managements.

Keywords: Compost, humic substances, soil physical properties, *Fragaria x ananasa* Duch.
Financial support: Project: "Cultivo de la frutilla con identidad Regional". FIC, O'Higgins, Chile

(4989 - 999) Swine slurry effect in the soil organic carbon at no tillage system

Ranier Vieira Ferreira[1]; Romulo Fuchs Brunetta[1]; Isabela Cristina Sousa Moura[1]; Sandrielle Furquim Medeiros[1]; Rose Luiza Moraes Tavares[1]

Universidade de Rio Verde[1]

The Rio Verde city is one of the largest producers of swine in the central-western region, generating around 21% of the total swine slurry (SS) produced in the Goiás state / Brazil. Due to the chemical benefits of swine slurry, rich in organic compounds besides macro and micronutrients, one of the possible destinations of this residue its use as soil fertilizer, being able to bring benefits to the agricultural crops by the addition of nutrients and mainly increase the soil organic matter. The objective of this work was to evaluate the soil organic carbon in no-tillage system with historic of swine slurry application for 16 years. For this, the soil sampling was made in the 2016/2017 harvest in a long-term experiment located in Rio Verde / Goiás / Brazil, which consists of an area under no-tillage system (soy/corn rotation)divided into experimental plots with SS applicated in different doses (0, 25, 50, 75 and 100 m^{-3} ha^{-1}). The soil sampling was made in six soil depth (0-10,10-20,20-40,40-60,60-90,90-120 cm). The determination of the soil organic carbon followed the Walkley and Black methodology - wet oxidation with dichromate and acid. The results showed that the dose effect of swine slurry did not increase the organic carbon content of the soil, possibly due to the low dry matter content of the SS, doing it more homogeneous in relation to the quantity to be applied. However, as the soil depth increases, the organic carbon is reduced, which can be concluded that the swine slurry application has the potential to increase the soil organic carbon in the arable soil depth.

Keywords: Soil management in organic production and agroecology
Financial support: Pós graduação produção vegetal

(3835 - 1829) The effects of mix-seeding of barley and hairy vetch on increasing biomass and nutrient contents

Lee, Cho Rong[1]; Park, Kwang Lai[1]; Hong, Seung Gil[1]; Kim, Jin Ho[1]

National Institute of Agricultural Sciences(NIAS)[1]

Green manure crops have been widely used in organic farming. Grass-legume mixture or mixed seeding of legumes and non-legumes can complement shortcomings of the other type (i.e. the former low in biomass and the latter low in the provision of nitrogen). This study was conducted to identify the optimum seed mixture ratio of barley (B) and hairy vetch (H) in organic upland soils of South Korea. From November 2016 to March 2017, barely and hairy vetch as single crops (B: 160kg/ha, H: 90kg/ha) and mixtures of both seeds at different seed mixture ratios (B2:H1, B1:H2) were sown and the results are shown as below. The amount of biomass and nutrient productivity shows higher in grass-legume mixture. As the proportion of hairy vetch increases, nitrogen and phosphorus concentrations of barley become greater. Yet those of hairy vetch are not affected by the increased proportion of barley. The amount of biomass and total phosphorus content are greater in mixed seeding by 78~132% and 200% respectively than in single seeding of hairy vetch. Total nitrogen content is higher in mixed seeding by 44% than in single seeding of barely. The amount of biomass (5.60Mg/ha) and nutrient contents (87.7 kg N/ha, 23kg P_2O_5/ha) are found highest in the case of seed mixture ratio of B2:H1. Accordingly, this study concludes that the optimum seed mixture ratio of barely and hairy vetch is 2 : 1 (B2:H1) considering the amount biomass and nutrient productivity, which seems highly useful for organic farming.

Keywords: Organic farming, green manure, hairy vetch, barley
Financial support:

(1628 - 1030) Variation of chemical attributes of the soil between two years of application of residue water of swine in agrofloresty system.

Adriane de Andrade Silva[1]; Regina Maria Quintão Lana[1]; Beno Wendling[1]; Alini Bossolani Rossino[2]; Mark Andrew Alves Pereira Andrada Silva[2]

UFU[1]; PPGMQ -UFU[2]

The use of wastewater reduces the amount of effluent discharged into water systems or improperly in soils and also establishes an additional source of water and nutrients for the productive systems, making it an economically viable alternative for reducing the use of fertilization mineral. Thus, the objective of this study was to evaluate the effect of swine wastewater (ARS) on an agroforestry system as a source of soil nutrient cycling. The agroforestry system was implanted under in soil dystrophic Red Latosol. Three experiments were studied: single *Urochoa decumbens* pasture; *Corymbia citriodora* in single line, spacing 2 meters between plants and 15 meters between *corymbia* lines; *Corymbia citriodora* in double line, spacing 2 meters between plants on the line + 3 meters between rows and 15 meters between double rows of *corymbia.* For the evaluation of soil chemical attributes, soil samples were determined: sum of bases(SB); and then calculated the potential CTC and base saturation (V%). Differences were observed between the experiments and between the applied doses. The area with *Urochoa decumbens* single showed a smaller increase in soil attributes evaluated after application with ARS. In relation to the sum of bases, it was observed that in the single *Urocloa* there was no effect of the increase of the dose of ARS in the two years of evaluation, indicating that this species is an excellent extractor of bases. This same behavior was observed in the system with double-line *corymbia*, but in these treatments it was observed an increase of the contents in relation to the experiment with *urocloa* pasture. In the system with single line, average increase in the doses of 400, 600 and 800 m^3 ha^{-1} was observed. These same changes observed in the SB contents influenced the potential CTC. At base saturation, it was observed that in the double line, mean values above 50% were maintained regardless of the dose in the two-year evaluation. While in the simple line the increase in saturation occurred due to the increase of doses, being higher in the first year than in the second year of evaluation. In the pasture experiment the base saturation was not influenced by the doses and on average did not exceed 35%. It is concluded that the application of ARS influences the base contents of the system, but that the agroforestry systems due to the greater exploitation of the soil profile, have a better use than the pasture.

Keywords: Sustentable Systeams; sum of bases(SB); base saturation (V%);
Financial support: UFU; Cnpq; FAPEMIG; ICIAG-UFU

(2326 - 327) Visual evaluation of soil structural quality in organic strawberry production

Camila Pereira Cagna[1]; Osvaldo Guedes Filho[1]; Maria Caroline Garcia Paschoal[1]; Lucas de Oliveira Neves[2]; Daiane de Fatima da Silva Haubert[2]; Nádia da Silva Salatta[2]

Universidade Federal do Paraná[1]; Univesidade Federal do Paraná[2]

Organic agriculture is characterized by the absence of pesticides, mineral fertilizers, and the frequent addition of organic matter to maintain fertility and improve the soil physical structure. Strawberry is a culture that has aroused interest in organic farmers because of its high yield and economic value. However, it is necessary to improve the conditions of soil management, through the adoption of a conservation management as the no-tillage. To evaluate changes that occur in the soil physical structure because of the adopted management, laboratory methods are used, although they are quite accurate and often have a high cost. The visual assessment of soil structural quality may be, in a fast, reliable and inexpensive way, an

important tool to identify management practices. The objective of this work was to evaluate the soil structural quality through visual analysis in organic strawberry production under no-tillage and conventional tillage systems. The experiment was carried out in Sítio rochedo, 17-years cultivated for organic strawberry production in the conventional tillage system, which has three production areas, following a 3-year crop rotation system. For the planting of the strawberry seedlings were made holes. The experimental area was splited in two treatments: organic strawberry cultivation under conventional tillage and –organic strawberry cultivation under no-tillage system. Three samples were taken from each experimental area with 0.15 m width by 0.20 m depth and 0.10 m thickness. For the visual analysis of the soil structural quality , a soil evaluation chart (VESS) was used. Then, visual scores were assigned for each treatment. The organic strawberry treatment in conventional tillage showed a significantly lower score (Qe = 1.3) than organic strawberry in no-tillage system (Qe = 2.1). The visual score in the conventional tillage system demonstrates a soil with excellent structural quality when compared to no-tillage. However, the lower value found for the conventional tillage reflects the soil disturbance in the surface layer, and not necessarily better structural quality. Thus, the higher value of visual score for the no-tillage system reflects a more structured soil condition when compared to conventional tillage. The method of visual analysis of soil structural quality is a practical and sensitive tool for management changes, capable of evaluating soil quality.

Keywords: Conservation Management, Organic Agriculture, VESS.
Financial support:

(4977 - 1442) Water availability in organic and conventional citrus orchard

Marcelo Raul Schmidt[1]; Michael Mazurana[1]; Victor Hugo da Silveira[1]; Renato Levien[1]

Universidade Federal do Rio Grande do Sul[1]

Brazil is the largest producer of citrus in the world with about 19,217,000 tons per year. Periods with water lack associated with strong sunshine affect fruit growth that influence on yield and quality. Soil provide water to plants growth and their management allow greater storage of water in to profile, reducing and mitigating these problems. The objective was evaluate the impact of soil management systems (conventional – CM and organic – OM) and machine traffic on water storage in entire 0-0.4 m soil layer in orchard citrus cultivated in Ultisol (80 g kg-1 clay) in South Brazil. The orchards have been conducted in these two systems for 10 years and those are the main treatments. The subplots are the traffic conditions (with tractor runs over – TR – and without traffic, i. g. plants line – PL). Soil samples were collected in to five layers until 0.4 m deep, subjected in a Richards chamber between 10 and 1,000 matric potential point, to quantify the amount of available water, after subjected the Van Genuchten model (1980). Ours results show more water volume stored in 0-0.2 m layer, in OM (compared CM) and in TR (independently of soil management). In PL, the available water (m^3 ha^{-1}) in both layers (0-0.2 and 0.2-0.4 m) was 208 and 170 in CM, and 255 and 160 in OM. On the TR treatment for same layers, the available water (m^3 ha^{-1}) was 223 and 185 in CM and 305 and 180 in OM. Our data show that OM provided 9.5 L m^{-3} of water more than CM in the PL, and 19 L m^{-3} more in the TR. Thereby, considering about 33% receives machine traffic and 67% do not, we estimated approximately 50,870 L ha^{-1} of water more in OM than CM. We concluded that organic management systems could increase the availability of water after 10 years, mitigating dry periods seasons. Further studies are need to know if this factor can increase the productivity, quality of fruits.

Keywords: Citrus; organic management; matric potential.
Financial support: CAPES

(4775 - 1180) Yield of rocket under different amounts and *Sena uniflora* L.

José Denis Lopes Diniz[1]; Marcos Antonio Vieira Batista[1]; Sherida Rayanne Cristovão Fernandes[1]; Gilbenes Bezerra Rosal[1]; Luiz Romário Uchoa[1]; Raysse Cristóvão Fernandes[1]

Instituto Federal de Educação, Ciência e Tecnologia do Ceará[1]

Rocket (*Eruca sativa* L.) is a leafy vegetable widely used in salads, rich in vitamin C, potassium, sulfur and iron. It also has anti-inflammatory and detoxifying effect. The growing consumer demand for quality and food safety has increased the need to adopt alternative production techniques that aim to minimize or eliminate the use of mineral fertilizers. An alternative is the use of green manure. The use of plants of the Caatinga as green manure is an alternative technique of management to vegetable production in Brazilian Northeast. One of these plants is *Sena uniflora*, however there is a need to evaluate it in cultivation with vegetables. The present work was carried out to evaluate the effect of *Sena uniflora* as green manure in yield of rocket. The experiment was conducted in horticulture sector the Federal Institute of Education, Science and Technology of Ceará, campus Iguatu in the period from October to December of 2017. The rocket was fertilized with *Sena uniflora* and the treatments were the different amounts incorporated in the soil (6.0, 12.0, 18.0 and 24.0 t ha -1 , on dry basis), plus the witness (bare soil). The samples were collected and used for chemical analyzes of nutrients of the *Sena uniflora* with the following results: N=1,41 %; P= 0,50 %; K=2,55 %; Ca = 1,78%; Mg= 0,26%; S= 0,21%; Fe = 443 mg kg^{-1}; Zn = 52 mg kg^{-1}; Cu = 4 mg kg^{-1}; Mn = 34 mg kg^{-1}; B = 22 mg kg^{-1}; C/N = 33:1; humidity= 7,5%. The green manure was incorporated into the soil ten days before planting. The experimental design was used in randomized complete blocks, with four replications. The evaluated characteristics in the rocket were: plant height, fresh mass of the aerial part, dry mass of the aerial part and number of leaves per plant. There was no significant difference for leaf number, plant height and fresh mass. There were significant differences for dry mass, with increasing linear response. The larger dry mass was 5,69 g $plant^{-1}$, 51% higher than zero amount that was 3,77 g $plant^{-1}$. Similar results were observed in other studies. It can be concluded that it is viable produce rocket using *Sena uniflora* as green manure.

Keywords: *Eruca sativa; Sena uniflora*, green manure.
Financial support: IFCE

(6337 - 2015) Soil physical quality and root development of citrus under a biodynamic production system in a Ultisol Dystrophic Hapludalf in Rio Grande do Sul

Caroline Valverde dos Santos[1]; Renato Levin[2]; Lucas Zulpo[2]; Joelma Divina Murliki[2]

UESB[1]; UFRGS[2]

The need to increase world food production leads to an intensification of the use of agricultural machinery and implements. Intensive use of this equipment in perennial plants promotes heterogeneous changes in the physical quality of the soil, resulting in the reduction of pore space responsible for root development. The objective of this work was to evaluate soil physical quality indicators and their relationship with root development of perennial plants. They were analyzed between lines of 'Montenegrina' bergamots (*Citrus deliciosa* Tenore) grafted on *Poncirus trifoliata*, managed with harrowing, logs in "V", mowing and knife roller, cultivated in Ultisol Dystrophic Hapludalf, located in the municipality of Montenegro, central region of Rio Grande do Sul, Brazil. Soil evaluations were performed at wheel tracks of the tractor (WT), between the wheel tracks (BWT), and in the area under the line projection of the canopy (CLP), at depths of 0.0-0.15, 0.15-0.30, 0.30-0.45 and 0.45-0.60 m layers, in four replicates. The soil physical quality indicators evaluated were soil density, macro and microporosity and total porosity, as well as the mechanical resistance of the soil to the penetration of a conical stem. The density and root

length of the rootstock were analyzed, with diameter <1.0 mm, 1.0-2.0 mm and >2.0 mm, by volume of soil. The results were submitted to analysis of variance, according to the design in subdivided plots, arranged in bands and comparison of means by Tukey's test ($p < 0.05$). The soil density ranged from 1.11 to 1.64 Mg m^{-3} with higher values found in WT, followed by BWT and CLP, in which the planting line managed with the use of the grid and trimmer showed higher values in relation to the others, as a consequence, in the reverse order, changes occurred in the pore space of the soil with a reduction of macroporosity, which presented values between 0.06 and 0.19 m^3 m^{-3}. Soil compaction was accentuated between 15 and 30 cm, evidenced by higher values of PR at this depth. CLP presented lower resistance to penetration, whereas BWT and WT presented moderate to high values, regardless of the type of implement used. The rootstock of the bergamots presented a higher density of roots at the site of the crown projection line, in all the depths, concentrated in the class of diameter <1.0 mm. The promoted soil movement promoted a reduction in the volume of soil explored by the bergamot root system, as evidenced by the use of the harrow in the orchard.

Keywords: controlled traffic, physical attributes, bergamots.
Financial support: Conselho Nacional de Desenvolvimento Científico e Tecnológico – CNPq

C3.2.3 - Artificial drainage systems: maintaining soil functions and protecting water resources

(4253 - 1793) Colloids control the transport and the fractionation of REEs in a river impacted by ion-adsorption rare earth mining

Wen-Shen Liu[1]; Meng-Yuan Zheng[1]; Le-Lan Wu[1]; Keng-Bo Ding[1]; Xi Zhong[1]; Chun-Mei Zhao[1]; Yuan-Qing Chao[1]; Hermine Huot[1]; Ye-Tao Tang[1]; Rong-Liang Qiu[1]
School of Environmental Science and Engineering, Sun Yat-sen University, Guangzhou, China; Guangdong Provincial Key Laboratory of Environmental Pollution Control and Remediation Technology, Guangzhou, China[1]

Middle rare earth elements (MREEs) and heavy REEs (HREEs) enrichment have been observed in most of the natural waters, while the reasons are still incongruent. In ion-adsorption rare earth deposits, REEs occur at trivalent cationic state (60%-95% of the total REEs) and are adsorbed onto clays and readily extractable by a simple leaching technique with an aqueous ammonium sulfate solution via an ion-exchange process. The objective of this work was to study the contribution of the colloids and the complexation by ligands to REE fractionation in a river impacted by ion-adsorption REE mining activities. In particular, the complexation of REEs by SO_4^{2-}, present in high concentrations at the upstream and by natural organic matter (NOM) at the downstream of the river were investigated. We sampled thirteen sites (3 parallels of each) along with a river influenced by ion-adsorption rare earth mining and one site of control at Dingnan, Southern China. REEs (<0.45 and <0.22μm), anions and cations (<0.45 and <0.22μm), pH, NOM (<0.7μm) were tested. Results showed a high REEs concentration in the water samples (<0.45 μm), which had a significant positive correlation with SO_4^{2-} and nitrogen concentrations, indicating mining activities sources. There was a transfer from MREEs to HREEs enrichment (normalized with Post-Archean Australian Shale (PAAS)) from upstream to downstream. At the downstream REEs were predominantly concentrated in 0.22-0.45-μm colloid fraction (59-94% of the <0.45 μm water). The proportion of REEs in the 0.22-0.45-μm colloids increased with the content of TOC in <0.45 μm water. In addition, the REEs in 0.22-0.45 colloids enriched HREEs at downstream, indicating a possible REE-NOR composition of 0.22-0.45 colloids in the downstream. These results were congruent with the results of the modelling by WHAM, which showed that NOR-REE colloids induced an enrichment in HREEs and were the dominant form of REEs (87-96% of the <0.45μm water) at the downstream. The results modeled by WHAM also showed that the major speciation of REEs was present in REE^{3+} (12-44% of the <0.45 μm water) and $REE(SO_4)^+$ (16-66% of the <0.45μm water) at the upstream water. In all, our results support that NOR-REEs colloids control the transport and fractionation of REEs in the river impacted by ion-adsorption rare earth mining activities. This stresses the need of ecotoxicological evaluation of REE-NOR colloids in such water bodies.

Keywords: Ion-adsorption rare earth mine; rare earth elements (REEs); natural organic matter (NOM); colloid; fraction
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(7984 - 2361) Diagnosis of the conflict of use and occupation of soil in hydrical quality: a study in the córrego da olaria watershed – Pindorama, São Paulo, Brazil

Maria Conceição Lopes[1]; Antonio Lucio Mello Martins[2]; Mariana Bárbara Lopes Simedo[1]; Teresa Cristina Tarlé Pissarra[1]; Renato Farias do Valle Junior[3]; Renata Cristina Araújo Costa[1]
São Paulo State University (UNESP), Faculty of Agrarian and Veterinary Sciences, Jaboticabal Campus[1]; Polo Regional Centro Norte of São Paulo Agribusiness Technology Agency (APTA)[2]; Federal Institute of the Triangulo Mineiro – IFTM, Uberaba Campus[3]

The analysis of the ecosystem in the watershed, with respect to the use and suitability of the soil and the physical characteristics, of a given region should be managed in order to improve the knowledge to the quality of the water resources. The objective of this work was to identify the areas of conflict of land use, monitoring the physical-chemical parameters of the water, differentiating the variables in the area of environmental conflict according to the methodology of the roughness coefficient, which together with the mapping of the current use allowed to identify areas of conflict regarding the use and occupation and suitability of the soil in Córrego da Olaria watershed, Pindorama, São Paulo State, Brazil. Geographic Information System were used, and information integration was performed with overlapping information plans, identifying conflicts of use that correspond to 40.02% of the area of forests and agriculture, occupied by agricultural activities. The physical-chemical parameters: Temperature, Electrical Conductivity, Turbidity and Dissolved Total Solids differed according to the areas of environmental conflict of use and soil suitability.

Keywords: water resource, environmental monitoring, potential land use.
Financial support: FAPESP, Project Number. 2013/11932-1

(1457 - 3134) Forest litter evaporation on Cerrado woodland

Lívia M. P. Rosalem[1]; Edson Wendland[1]
University of Sao Paulo[1]

Understanding hydrological and erosive processes are crucial to improve the efficiency of agricultural production. In many countries efforts have been done to better comprehend the processes and impacts related to the erosion process. Studies present that the forest litter helps the maintenance of moisture on soil and can affect the availability of water for runoff and soil infiltration. Regardless the impact of the forest litter, few studies evaluated the water evaporated from forest litter. For directly measurements of forest litter evaporation, an equipment called LID (Litter Interception Device) was installed in a Cerrado woodland area. From 1st June to 20th December

the total rainfall and the forest litter evaporation were recorded each 10 minutes. The collected data were separated into intervals of 3 hours and only the intervals without rainfall record were analyzed. It was observed lower values of total forest litter evaporation (2.3 and 3.7 mm) in June and September, respectively. The total forest litter evaporation was 71.0 mm that corresponds to 16.7% of the total rainfall (423.9 mm) for the period. Although the monitoring was just along 6 months, the results pointed that the evaporation of forest litter may be considered a significant hydrological process to the total evaporation in forests of Cerrado woodland. Thus, if the forest litter does not intercept this significant quantity, it would affect some processes as infiltration or runoff. Therefore, the forest litter interception should not be neglected. The monitoring must be carried out for more periods to achieve better analysis of variation of this interception along the year.

Keywords: Evaporation; Forest litter interception; Unsaturated zone; Available water.

Financial support:

(6828 - 1082) Monitoring of available water content variation on different upland soils using undisturbed weighable lysimeters

Junghun Ok[1]; Kyunghwa Han[1]; Yongseon Zhang[1]; Heerae Cho[1]; Kangho Jung[1]; Dongjin Kim[1]

Soil and Fertilizer Division, National Institute of Agricultural Sciences[1]

The droughts can be assessed based on soil moisture by monitoring of available water content (AWC) change in upland soil. The AWC is the range of available water that can be stored in soil and be available for growing crops. However, the AWC in the soil varies greatly depending on soil texture and bulk density. Therefore, the monitoring of AWC is difficult to know precise exact change value continuously in upland field. The aim of this study was to evaluate the effect of AWC change on crop growth using weighable lysimeters. The experiment was conducted at NAS lysimeter station (35°49'29.0"N, 127°02'46.4"E) with 18 weighable lysimeters (diameter 1 m, depth 1.5 m) with upland soil monoliths. The each 6 weighable lysimeters filled upland soils for silty clay loam, loam, and sandy loam, respectively. The tensiometers and soil moisture sensors (UMP-1) were installed at 10 ㎝, 30 ㎝, 55 ㎝, 85 ㎝ and 125 ㎝ soil depth from the surface, respectively. And the weight sensors were installed on the bottom of the lysimeter vessel to measure changes in water content in real times. The target crop was selected soybean because a large cultivation area and relatively high water consumption in Korea. The water management was treated irrigation at 50 kPa and no irrigation. In 2016, it showed low precipitation and high solar radiation compared to the last 30 years average. The yield of soybeans was reduced to 30% when the AWC for 10 days was continuously maintained at 15-45% without precipitation compared to the appropriate irrigation treatment. In addition, the whole leaf of the soybean was stunted when AWC was maintained lower than 15% for more than 7 days continuously. Therefore, the prediction of available water content variations in advance is considered necessary for appropriate water management.

Keywords: available water content, weighable lysimeter, soil texture, upland

Financial support:

(4256 - 1772) Spatial variability of soil attributes in a cultivated area of underground dam in the State of the Paraíba, Brazil

Maria Sonia Lopes da Silva[1]; Alexandre Ferreira do Nascimento[2]; Hilton Luís Ferraz da Silveira[3]

Embrapa Solos UEP Recife. Rua Antônio Falcão, 402. Boa Viagem. Recife, PE. 51020-230. E-mail: sonia.lopes@embrapa.br[1]; Embrapa Agrossilvipastoril. Rodovia MT, 222, Km 2,5, s/n. Zona Rural, Caixa Postal 343. Sinop, MT. CEP: 78550-970. E-mail: alexandre.nascimento@embrapa.br[2]; Embrapa Solos UEP Recife. Rua Antônio Falcão, 402. Boa Viagem. Recife, PE. 51020-230. E-mail: hilton.ferraz@embrapa.br[3]

The implementation of several municipal, state, and federal government programs aiming to facing the water scarcity has substantially improved the number of underground dams in the semiarid region of Brazil. That technology consists in the building of a waterproof wall transversal to drainage water preventing the lateral flow of water in and on the soil, stream bed, and River. So, the water is stored into the soil pores and may be used to crops "in situ" or to irrigate areas "ex situ", as well as to animal watering. Among the advantages in adopting the underground dams we highlight the functionality, low cost to building, low risk of contamination, low water loss by evapotranspiration, moreover it is possible to use the land around to crops. The areas of the underground dams are disturbed environments once it changes the natural water flow and its dynamic. Knowing the spatial variability of soil attributes in this colluvial/alluvial areas would aid to choose the better soil management that should be adopted to guarantee the sustainable food production in this environment. Geostatistic is a powerful tool for this purpose, allowing showing the special variability of soil attributes. This work aimed to assess the spatial variability of chemical and physical soil attributes of an underground dam located in Solânea county, Curimataú region, state of the Paraíba, semiarid area in northeast Brazil. Disturbed soil samples were collected from depth of 0-0.2 m and 0.2-0.4 m of 16 points distributed in a grid of 25 m x 30 m within the area of the underground dam. Soil attributes assessed were: pH, Ca^{2+}, Mg^{2+}, K^{+}, Na^{+}, Al^{3+}, H^{+}, P_2O_5, Organic Carbon, clay, silt, sand, and bulk density. The model applied to elaborate the maps to show the spatial variability was the Spline. The whole maps elaborated for each soil attribute did not show spatial dependence, indicating that even changing the environment by building a wall into the soil, there were no significantly disturbs in the soil attributes. Actually, the soil of the underground dam showed high fertility, high organic matter content, low acidity and Al^{3+} exchangeable, and with texture suitable to store water and to cropping. Therefore, underground dams did not trigger soil processes that can lead to soil degradation, as ions accumulation, acidity, low level of exchangeable bases, and high bulk density, however, we have realized just the opposite, very good condition to plants growing.

Keywords: soil and water management; technology to coexist with the semiarid; family farming.

Financial support: Mandacaru-I Awards; Spanish Agency for International Development Coorporation (AECID); Brazilian Ministry for social development and fight agaist hunger; and Environmental institute sustanable Brazil (IABS).

(1641 - 3104) Standardized difference vegetation index in the relationship of productivity and nitrogen content in corn cultivated in ilpf system

Hugo Miranda Faria[1]; Vinícius Marchioro[1]; Henildo De Sousa Pereira[1]; José Eduardo Corá[1]

UNESP Jaboticabal[1]

Knowledge about the possible interactions of components of the crop-livestock-forest integration system (ILPF) can help in the selection of management techniques that optimize the production system. In this way the objective of the work was to evaluate if there are synergic, null or antagonistic effects of the forest component in the productivity and nitrogen content in corn plants. The study was developed at the Teaching, Research and Extension Farm of UNESP, Campus de Jaboticabal. The experiment was composed of two areas, cultivated with maize in the intercropping, intercropped with Brachiaria, in the ILPF system, being the first area cultivated with Eucalyptus clone Urograndis I144, and the second, with the species Corymbia citriodora, in a double row system, spaced of 20 m. Nitrogen content

and yield of maize plants were evaluated. The normalized difference vegetation index (NDVI), obtained by means of an RGB optical sensor, drone board, was used for correlation with the nitrogen contents of corn plants and yield. In the maize plants closest to the eucalyptus renques, a higher concentration of nitrogen was observed, due to their development being affected by the shading caused by eucalyptus, with nutrient accumulation in the plant. It was also observed, in the plants near the roots, lower productivity. In the area with Urograndis, there was a greater antagonistic effect of the forest component, observing a reduction in the development of corn plants. The NDVI showed efficiency in determining the relationship of nitrogen contents with maize crop yield.
Keywords: remote sensing; *Zea mays*; NDVI.
Financial support: FAPESP

(7264 - 1900) Environmental assessment of the Romão dos Reis basin, Viçosa, MG: case study

Saulo Henrique Barroso[1]; Agnaldo Roberto de Jesus Freitas[1]; Danilo Cesar Mello[2]; João Luiz Lani[1]
Universidade Federal de Viçosa[1]; Universidade de São Paulo[2]

The use of natural resources beyond the capacity of support causes negative impacts to the environment. As a result, several evidences reflect: water scarcity, reduction of water quality of streams, soil compaction, loss of fertility and fertile soil layers, erosion, salinization and loss of native vegetation in certain environments. Land use planning is a alternative measure of prevention that aims to the rational use of natural resources within the capacity of support of each environment and with a personalized management, taking a watershed micro-basin as a management unit, with a view to sustainability of the agroecosystem. From these principles, the environmental conditions of the Romão dos Reis sub-basin were evaluated with a view to better planning of land use, to provide better use and occupation of the soil, mitigating environmental impacts, and enabling the socioeconomic development of the population included in it. The sub-basin Romão dos Reis is located in the municipality of Viçosa, MG. It has an approximate area of 229 hectares and is inserted in the São Bartolomeu basins. For the preparation of the project was made field evaluations and as a mapping tool was used the software ArcGis 10.1. With the use of this software, the areas occupied by native vegetation (25.28% of the total area, 57 hectares) and other uses were delimited. It was found that there is a need to expand the area of PPAs(Permanent Preservation Area), as there are evident erosive processes at the edges of the streams. The predominant relief in the sub basin is from wavy to strong wavy (average slope of 29.33%). Given this, a differentiated use and occupation of slopes is suggested, according to their respective slope classes. In addition, the presence of an area favorable to the construction of dams was identified in places with bottlenecks in the stream channel, by means of level curve analysis (2-meter elevation). Finally, it is concluded that the planning of land use and occupation in watersheds is fundamental for a better balance of environmental conditions with this, it is proposed the implementation of small earth dams with the objective of acting as reserve of the supply system of water from Viçosa city, and to promote a physical barrier, retaining part of the sediments that are carried to the dams of the São Bartolomeu stream located in the Campus of the Federal University of Viçosa, thus reducing the silting process present in the dams.
Keywords: natural resources; personalized management; environment
Financial support: NEPUT/UFV (Núcleo de Estudos de Planejamento e Uso da Terra) and FAPEMIG

C3.2.4 - Nutrient and contaminant transport in drained soils

(1622 - 1247) Agricultural land uses and their effects on water quality in Navarre (Spain)

I. Hernández-García[1]; D. Merchán[1]; E. Luquin[1]; M.A. Campo-Bescos[1]; R. Giménez[1]; J. Del Valle de Lersundi[2]; J. Casalí[1]
Department of Projects and Rural Engineering, IS-FOOD Institute (Innovation & Sustainable Development in Food Chain). Public University of Navarre[1]; Department of Rural Development, Environment and Local Administration, Government of Navarre[2]

Nitrate and phosphate leaching from agricultural areas is considered an important problem. The surplus of nitrogen (N) or phosphorus (P) applied in fertilization, often over the crop necessities, contributes to an increase in the soil emissions to the hydrosphere. Soil management, land use and, to a lesser extent, soil properties (texture, organic matter content, pH…) are recognized as factors that affect the leaching of nutrients and, therefore, water quality in receiving water bodies. N and P affect the water quality for human consumption or contribute to its eutrophication. On the other hand, an intensive management of agricultural soils not only affects nutrient leaching, but also implies an increment in soil erosion. Suspended sediment generated in erosion has several impacts in water bodies (reservoir siltation, vector of pollutants…). In agricultural areas of Navarre (Spain), soil erosion and nutrient export is a relevant problem. For that reason, the former Department of Agriculture, Livestock and Food (Government of Navarre) implemented a network of experimental watersheds in order to provide data for assessing the effect of agricultural activity on erosion and water quality. These watersheds are under typical management practices of the region and cover the most representative agricultural land uses in Navarre. The network is composed of four watersheds: Oskotz (grazed pastures and forests), La Tejeria and Latxaga (rainfed winter cereal) and Landazuria (pressurized irrigation). In these watersheds, a gradient of nitrate export has been observed, with irrigated areas exporting more nitrate than any other land use due to a higher N surplus whereas pastures and forests exported the lowest amounts. Differences in phosphate exports were explained by differences in soil pH and higher P inputs from livestock excrements in the pastures. Sediment export was greater in arable lands than in permanently covered soils (pastures and forests) or than in flat irrigated areas. Differences were found in the two rainfed winter cereal watersheds regarding sediment and nitrate exports, which were probably due to differences in drainage conditions, presence of riparian buffers and other site-specific characteristics. In this context the aim of this contribution is to summarize the knowledge generated so far on the effects of agricultural management and soil properties in the concentration and exported mass of nitrate, phosphate and suspended sediments in Navarre.
Keywords: watershed, nitrate, phosphate, suspended sediment
Financial support: Project CGL2015-64284-C2-1-R (MINECO)

(3391 - 2133) Boron leaching according to source and soil texture

Filipe Belluco Guerrini[1]; Breno Adriano Nyssen[1]; Gabrieli de Camargo Rolim[2]; Lílian Angélica Moreira[3]; Edson Pereira da Mota[4]; Rafael Otto[5]
Universidade de São Paulo, Escola Superior de Agricultura “Luiz de Queiroz”, Curso de Agronomia, Piracicaba, São Paulo, Brasil[1]; Faculdade de Ensino Superior e Formação Integral, Garça, São Paulo, Brasil[2]; Universidade de São Paulo, Escola Superior de Agricultura “Luiz de Queiroz”, Departamento de Ciência do Solo, Programa de Pós-graduação em Solos e Nutição de Plantas, Piracicaba, São Paulo, Brasil[3]; Doutor em Solos e Nutrição de Plantas, Piracicaba, São Paulo, Brasil[4]; Universidade de São Paulo, Escola Superior de Agricultura “Luiz de Queiroz”, Departamento de Ciência do Solo, Piracicaba, São Paulo, Brasil.[5]

The boron leaching is the main factor that leads to the lack of this

nutrient, which affects the development of plants. It's necessary to understand the dynamics of this element in soils in order to obtain a better efficience of borated fertilizations. The objective was to evaluate the loss of boron by leaching, when this element is applied on the soil. The experiment was conducted in a completely random desing whose scheme was 6 x 2 factorial. For this study it was used 6 sources (fertilizers) of boron (boric acid, borax, boron monoethanolamine, sodium octaborate, ulexite and control treatment without addition of boron) which were applied in 2 different soil textures (médium and clayey), with 4 replicates. The dose of boron applied was 2 mg per dm^3 of soil, which represented 6.28 mg per column. Each experimental unit was prepared with a leaching column of 40 cm lenght (tubes of PVC) and these columns received irrigation in a period of 4 days, simulating a 20 mm – rain. The experimental lasted 64 days and after this period the loss of this nutrient was measured by ICP-OES. The interection of factors among the different sources was significative ($F < 0,05$).In general, the quantity of leached boron, for each applied fertilizer, was two more times for soils with medium texture when compared to clayey soils. However, the sources control and boron monoethanolamine showed similar results for the different kinds of soil (Turkey, $p < 0,05$). The higher clay in the soil, the higher adsorption of boron in the form of iron, aluminium oxids and kaolimite, which decreased the loss of this nutrient by leaching. The control source presented, in average, a loss of 6 % of boron in the two different soils, probably beacuse of boron which was in the soil and in the water during the irrigation period. The caly soil which received borax (fertilizer) showed a leaching superior to 24 % when compared to ulexite, octaborate and control sources. Besides, it showed the double of leaching when compared to boron acid (14%). In the soil with medium texture the fertilizer borax showed the biggest leaching, in avarege a loss of 18% more when compared to the sources of monoethanolamine, boric acid, ulexite and octaborate. The dynamic of boron in the soil depends on solubility of the added source and on pH; it also depends on the charges of adsortion of the nutrient in the soil. However, regardless of the texture of the soil, borax promoted the biggest losses of boron in the system.

Keywords: Boron sources ; Solubility of fertilizer; Loss of nutrient; Determination of boron

Financial support: Conselho Nacional de Desenvolvimento Científico e Tecnológico - CNPq

(4813 - 2464) Contamination risks by potentially toxic elements into Oxisol irrigated with treated sewage effluent

Aline Michelle da Silva Barbosa[1]; Rogério Teixeira de Faria[2]; Luciana Maria Saran[2]; Yane de Freitas da Silva[2]; João Alberto Fischer Filho[1]; Anderson Prates Coelho[1]; Alexia Morello da Silva Cascaldi[1]

São Paulo State University (UNESP), School of Agricultural and Veterinarian Sciences, Jaboticabal, São Paulo, Brazil[1]; São Paulo State University (UNESP), School of Agricultural and Veterinarian Sciences, Jaboticabal, São Paulo, Brazil.[2]

The treated sewage reuse is promising to precision agriculture due to high water demand of irrigation and nutritional crops. In addition, to reduces environmental impact negative by avoiding discharge of effluent into bodies of water. However, in the long term, sewage treatment season effluent application (EETE) can cause chemical, physical and biological soil degradation. The aim of this study was to evaluate the impact the application of EETE, via fertirrigation, on the soil of an experimental area cultivated with Brachiaria crop at Jaboticabal, SP, Brazil. The EETE was applied during 4 years (2013 to 2017) in experiments using a triple sprinkler system, with delineated tracks, with four replicates. Five treatments were established by uniform application, but gradual irrigation blade of EETE, with following fractions of effluent in water: E5 = 100% effluent; E4 = 87%; E3 = 60%; E2 = 31%, E1 = 11% and E0 = 0. The treatment E0 were used only water and received fertilization with urea, triple superphosphate and potassium chloride, equivalent to what was applied to E3 treatment via effluent. In efluente the contents of As, Cd, Cu, Hg, Mo, Ni, Pb, Se, Zn. In soil, after 4 years of application of EETE concentrations of Ca, Mg, Na, K, Mn, Zn, Cd, Fe, Cd, Cr, Cu, Ni, As, Hg, Se and Mo. The application of EETE in soil cultivated with Brachiaria for 4 years resulted in a risk of soil contamination by Cu, Cd, Hg and Mo. However, it should be emphasized that the contents of these elements may be due to the soil characteristics of the region or due to the application of fertilizers. The concentration of Mo found in the soil, mainly in the treatment E5 (5.9 mg kg^{-1}), may be due to the content of this element in the effluent (4.38 mg L^{-1}), which was higher than the limiting concentration for Mo (0.001 mg L^{-1}) established in Resolution N. 430/2011 of the National Environment Council (CONAMA). Thus, it was concluded that the application of EETE of Jaboticabal, SP, Brazil, has low risk of contamination of the soil by these potentially toxic elements.

Keywords: water reuse; soil chemical analysis; environmental sustainability

Financial support: Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES)

(4016 - 2817) Dissolved organic carbon and nitrate flow in surface waters of two mini watershed of the rio das mortes river watershed

Tulio Gonçalves dos Santos[1]; Ricardo Santos Silva Amorim[1]; Rodolfo Luiz Bezerra Nóbrega[2]; Edwaldo Dias Bocuti[1]; Luiz Augusto Di Loreto Di Raimo[1]

UFMT - PPGAT[1]; University of Reading - Department of Geography and Environmental Science[2]

The present study was carried out in Campo Verde - MT to evaluate the anthropic interference on dissolved organic carbon (DOC) and nitrate (NO3) flows in the surface waters of two mini watersheds. Water samples were collected in two mini watersheds with different soil use (regenerated savanna and an agricultural area) from January 2014 to April 2015. In the rainy season, the samples were collected every 15 days and in the dry period every month. The composite samples were collected by an automatic sampler in the stream. The water flow monitoring was performed with a sensor that measured the hydraulic load on the sill of the triangular spillway installed in each of the mini watershed. Three rain gauges were also installed in each of the mini watersheds to quantify the mean precipitation. The DOC and NO3 contents were analyzed in a UV-Vis spectrophotometer. The flow was estimated with the values of flow and concentrations of DOC and NO3. The mini watershed under cerrado has a higher average flow than the agricultural mini watershed. The increment in the values of specific flow in the days with rainfall is greater in the mini watershed under cerrado. The nitrate concentrations in the two mini watersheds are the same for rainy and dry days. The mini watershed under cerrado has the highest concentrations of dissolved organic carbon, regardless of rainfall. In both watersheds there is a significant increase in the concentration of nitrate and organic carbon dissolved in rainy days. The flows of dissolved organic carbon and nitrate are higher in the Cerrado microbasin, independent of the occurrence of rainfall.

Keywords: Soil use and occupation, Hydrological monitoring, Nutrient flow, Riparian vegetation.

Financial support: 1. Carbiocial CNPq

(6867 - 2344) Exportation of chemical elements in particulate and soluble forms during rainfall events in a small rural catchment in southern Brazil.

Cláudia Alessandra Peixoto de Barros[1]; Tales Tiecher[1]; Rafael Ramon[1]; Jean Paolo Gomes Minella[2]; Marcos Antônio Bender[3]

Federal University of Rio Grande do Sul[1]; Federal University of Santa

Maria[2]; Emater, RS-ASCAR[3]

One of the major off-site consequences from soil water erosion is the contamination of waterbodies, by manure, chemical fertilizers and agrochemicals. Chemicals in the streamflow may be natural (e.g.: weathering), but the magnitude of erosive process can intensify the transference process of elements to the waterbodies. However, this process of chemical elements to waterbodies is still few explored. This study aims to investigate the relationship between the magnitude of erosive process and the transfer of chemical elements in their preferential form, soluble or particulate. The study was carried out in Lajeado Ferreira Creek catchment (1.23 km²) in Arvorezinha, RS, Br. The water and sediment flows were automatically monitored at 10 min-intervals. Manual samples for chemical analysis of the *water + sediment* mixture collected from 2011 to 2013, in the catchment outlet. An aliquot of the sample was filtered at 0.22 µm to characterize the soluble fraction. Another aliquot containing *water + sediment* was digested using aqua regia (HCl + H_2NO_4) assisted by microwave characterizing the total of elements. By the difference in the total and soluble element concentration, the particulate form was estimated. The chemicals exportation in each form was calculated from the element concentration multiplied by solid and/or liquid discharge data. Al, B, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, K, La, Mg, Mn, Na, Ni, P, Pb, Sb, Se, Si, Sr, Ti, V and Zn concentration were determined by ICP-OES. The samples were collected during eight rainfall events with peak flow that varied between 36 and 3399 L s^{-1} and sediment yield between 0.01 and 70.6 t. Observing the average of the events, Be, Ca, K, Na, Se, and Sr were the main elements carried out in the soluble form (>50%) whereas other elements had greater transference in the particulate form. It was observed that two events occurring in September and October of 2013 presented the largest sediment mobilizations, of which 91 and 92% of transference occurred in the particulate form, respectively. These months are when farmers carry out the tobacco transplantation, generating low soil covering and matching with the period of greater rainfall erosivity. Moreover, when analyzing them separately, it is verified that the chemical elements did not present similar behavior among the events. Therefore, the magnitude of the event and the availability of sediments have a large impact on the predominant fraction of chemical elements transference.

Keywords: surface runoff, water resources, contamination, sediments.
Financial support: CAPES, CNPq, FAPERGS, SINDITABACO

(8455 - 270) Improvement of a simplified model for Phosphorus Thresholds in soils receiving pig slurry in Santa Catarina State, Brazil

Luciano Colpo Gatiboni[1]; Daniel João Dal'Orsoletta[1]; Djalma Eugênio Schmidt[1]; Thomas Jot Smyth[2]; Rodrigo da Silveira Nicoloso[3]
Santa Catarina State University[1]; North Carolina State University[2]; Embrapa Swine and Poultry[3]

The state of Santa Catarina is the largest pork producer in Brazil. This activity is usually carried out on small farms (< 20 ha) in regions with steep slopes (20-40%), where pig slurry is applied to the soil surface as fertilizer for plants. Until 2014, the States' environmental legislation allowed the application of a maximum rate of 50 m^3 ha^{-1} $year^{-1}$ of pig slurry. However, this rule did not consider important factors such as the concentration of phosphorus (P) in the waste, the P sorption capacity of the soil, the removal of P by harvested crops and the use of other nutrient sources. After 2014 the legislation was improved, establishing a P-threshold, which is the maximum environmentally safe P concentration in the soil, beyond which the soil is a source of P to the environment and P fertilization should be stopped. The model was adjusted from studies using soils from the state and considered that soils with higher clay content sorb more P, so they could receive larger rates of manure. The model established was P-threshold = 40+Clay% (where *P-threshold* is the maximum content of P by the Mehlich-1, in mg dm^{-3}, in the 0-10 cm soil layer, and *clay%* is the clay content of the soil in percentage). This method has been used since then, and if a soil has a P content above the P-threshold, no inorganic or organic P application to the soil is allowed. However, the developed method infers only about the soil sorption capacity and does not consider the transport factors contributing to P loss by runoff. Thus, two field experiments were carried out using soils with contrasting textures (22 and 64% clay), three land slopes (10-15%, 20-25%, and 30-35%) and four rates of pig slurry (0, 110, 220 and 440 kg ha^{-1} $year^{-1}$ P_2O_5) in bermudagrass pastures. In these experiments water and sediments from the runoff were collected during 18 months and analyzed. In the sandy loam soil, the amount of P lost by runoff is less dependent on the slope due to the higher water infiltration rate of the soil. In this soil, increasing the slope from 15 to 35% increased by 37% the P lost into runoff. Conversely, in the clayey soil, increasing the slope from 10 to 30% increased by 95% the P lost into runoff. Thus, we are proposing to change the previous model, including the land slope as a factor for P-threshold reduction in soils susceptible to runoff. The adjusted model proposed is *P-threshold = (55+Clay%) - (0.03*Clay%*Slope%)*, where *Slope%* is the land slope in percentage, with R^2=0.96.

Keywords: Phosphorus, eutrophication, P-threshold, animal wastes
Financial support:

(7129 - 2251) Influence of land use and management on the quality of the water resource

Mariana Bárbara Lopes Simedo[1]; Teresa Cristina Tarlé Pissarra[1]; Antonio Lúcio Mello Martins[2]; Maria Conceição Lopes[1]; Renata Cristina Araújo Costa[1]
São Paulo State University (UNESP-FCAV)[1]; Polo Regional Centro Norte of São Paulo Agribusiness Technology Agency (APTA)[2]

The anthropic actions developed in the agricultural production system have threatened water resources. The watershed is a territorial unit of work that develop the anthropic activities, being essential the understanding of this productive space of occupation. The according to National Agency of Sanitary Surveillance, Brazil is the largest consumer of pesticides, and studies indicate that in the coming years there will be a high risk in water quality, due to the excess of substances used in agriculture. The National Environmental Council (CONAMA), through Resolution 357/2005 establishes a classification for water bodies and provides environmental guidelines for its framework. The objective of this study was to evaluate the quality of the water bodies in the Córrego da Olaria subbasin, correlating with the land use. This subbasin presents an extension of 9.18 km² and is located in the Polo Regional Centro Norte of the Agência Paulista de Tecnologia dos Agronegócios (APTA), Pindorama County, São Paulo State, Brazil. The surface water samples were collected at four points of the watershed (Cacau; Onça; Usina; Voçoroca). Soil uses include native forest, annual crop, pasture and reforestation. The physical-chemical parameters of water: nitrate (mg L^{-1} NO_3- – N), total nitrogen (mg L^{-1}), total phosphorus (mg L^{-1}), were analyzed at Laboratory of the International Institute of Ecology, Brazil. The data analysis was submitted to descriptive statistics, and in analysis of variance in a 5% of significance level. Total nitrogen is present with high values in all subbasins: Cacau 1.30; Onça 1.72; Usina 1.72 and Voçoroca 1.72, being the limit value allowed by CONAMA of 1.27 mg L^{-1}. Nutrients such as nitrogen and phosphorus are essential for plant growth, but excess in water can cause adverse ecological effects. Total phosphorus was high in the subbasins Cacau 0.105 and Usina 0.076. The maximum allowed value is 0.020 mg L^{-1}. The nitrate presented higher value in Cacau 12,29, with the limit value allowed of 10.00 mg

L^{-1} NO_3- – N. In the surroundings of these subbasins there is a large planting of sugar cane, which during the rainy season occurred the rupture of the crop level curves, collaborating for the surface runoff and deposition of sediments and nutrients in the water resource. It was concluded that the use and management of the soil influence the quality of the water resource, demonstrating the need for a set of conservationist practices in the agricultural system.
Keywords: watershed, conservation practices, agronomic research
Financial support:

(5419 - 1544) Water, soil and phosphorus losses in no-tillage under long-term application of liquid dairy manure and simulated rainfall

Jair Augusto Zanon[1]; Nerilde Favaretto[1]; Gabriel Democh Goularte[1]
Federal University of Paraná[1]

Liquid dairy manure (LDM) has been worldwide applied as source of nutrients in agricultural production, however, the excessive application may generate environmental problems, such as pollutants associated with surface runoff. The aim of this work was to evaluate the effect of long-term application of LDM (12 years) in no-tillage in water, soil and phosphorus losses by surface runoff under simulated rainfall. The experiment was installed in 2005 at the ABC Foundation Experimental Station in Ponta Grossa, Paraná, Brazil, in a dystrophic red-yellow oxisol; sandy clay loam texture with 13% slope. The treatments consisted of four rates of LDM (0, 60, 120 and 180 m^3 ha^{-1} $year^{-1}$) with three replicates, totaling 12 experimental units. The simulated rainfall with intensity of 60 mm h^{-1} was applied in 1 m^2 with corn straw as plant residue; 120 days after the last application of LDM, which was carried out in the corn seedling. The surface runoff was measured at different time intervals until constant rate, with at least 90 minutes of sampling period. The analyses of water quality were performed in composed samples (10, 20, 30, 60 and 90 minutes). The following parameters were determined: pH, turbidity, sediments, electrical conductivity and phosphorus (soluble, particulate, total and bioavailable fractions). The results show similar trends for water and soil losses; 120 m^3 ha^{-1} $year^{-1}$ of LDM had the highest water loss and consequently the highest s oil loss. In general, the accumulated losses of water and soil were low compared to the applied rainfall which may be associated to higher soil aggregation and stability in no-tillage system. The concentration and losses of phosphorus in all fractions increased with application of LDM. These results indicated that intensive rainfall (60 mm h^{-1}) even in long-term application of LDM, which improves the soil structure, represents a potential for water contamination if the surface runoff reaches the water bodies. So, it is recommended best management practices to keep the generated runoff in the field, as for example the terraces, even in no-tillage system.
Keywords: Surface runoff, manure, water quality, phosphorus
Financial support: DSEA-UFPR, Departament of Soil Science and Agricultural Engineering, Federal University of Paraná

C3.2.5 - Soil erosion modelling: Global Alliance

(9945 - 520) Assessment of water erosion dynamics by connectivity indices in an agricultural watershed

María Guadalupe Ares[1]; Luisa Fernanda Fajardo[2]; Celio Chagas[3]; Marceo Varni[4]; Joaquín Mozo[5]
Consejo Nacional de Investigaciones Científicas y Técnicas; Instituto de Hidrología de Llanuras; UNCPBA, Facultad de Ingeniería[1]; Comisión de Investigaciones Científicas; Instituto de Hidrología de Llanuras; UNCPBA, Facultad de Ingeniería[2]; UBA, Facultad de Agronomía[3]; Instituto de Hidrología de Llanuras[4]; Agencia Nacional de Promoción Científica y Tecnológica; Instituto de Hidrología de Llanuras[5]

Water erosion is a global issue which affects soil quality and nutrients availability, and threatens agricultural productivity. The hydrological and sedimentological connectivity approach to study this process is being developed to understand its spatial heterogeneity and complexity and the dynamics of connections between hillslopes and drainage networks which redistribute the eroded soil. In this context, connectivity indices constitute important tools for erosion modelling. The objective of this work is to assess the sedimentological connectivity during three rainfall-runoff-soil loss events registered in a small basin (560 ha) under no-tillage agriculture by two indices. The first index, the index of sediment connectivity (IC), evaluates the structural connectivity, and is a measure of potential connectivity. It is calculated by geographical information system, using data derived from a digital elevation model (slope, flow direction, flow accumulation) and a map of factor C from Universal Soil Loss equation to consider the resistance to water and sediment fluxes by vegetation during each event. The second index corresponds to the index for physically connected compartments (Cpc), which considers aspects of structural and functional connectivity: the area physically connected, expressed as the area of the drainage network, and the rate of transported sediment during the events. This index complements IC, because it takes into account the variability of each storm and its hydro-sedimentological response. The IC index showed values of 1.35, 1.85 and 1.63 for event 1, 2 and 3, respectively, while Cpc values were 7.9, 16.4 and 175.9 for event 1, 2 and 3, respectively. The indices evidenced the low connectivity induced by the sheet erosion and the good vegetation cover conditions during event 1. Comparatively, during events 2 and 3 the indexes showed discrepancies: high potential connectivity (IC) for fallow period, but medium Cpc in relation with the connected area and the erosivity of the storm event. In contrast, the IC was medium for case 3, with good land cover condition, but Cpc was the highest related to the high erosivity of the rainfall which generated rills in the area. The results indicate that low vegetation cover and rill formation are two key factors which induce connectivity in the area. The adjustment of these indexes and their incorporation in erosion models may improve the understanding of the temporal dynamics of the erosion process.
Keywords: connectivity indices; land cover; sheet and rill erosion
Financial support: UBA, Project UBACYT 20020130100709BA, Agencia Nacional de Promoción Científica y Tecnológica, Project PICT 2015-2012 and Consejo Nacional de Investigaciones Científicas y Técnicas.

(4104 - 2801) Different scale rainfall simulation methods and their applicability for erosion modelling

Boglárka Keller[1]; Judit Szabó[2]; Csaba Centeri[3]; Zoltán Szalai[2]; Gergely Jakab[2]
National Agricultural and Research and Innovation Centre[1]; MTA Research Centre for Astronomy and Earth Sciences[2]; Szent István University[3]

Rainfall simulation is widely applied instrument in soil erosion modelling within soil conservation planning since it is fast and more cost-effective than other soil erosion measurement methods. In the same time there are many criticisms due to the non-standardized circumstances and the difference between simulated and natural environment. Besides many studies emphasize that the results coming from different scale rainfall simulations aren't comparable and the resulted values aren't suitable for long term erosion modelling just for event-based modelling which reflects on soil erosion dynamic and hydrology. In our experiments Cambisol was investigated under two different scale rainfall simulation, in situ and ex situ circumstances. The comparative measurement was carried out in a laboratory on 0,5 m^2, and in field (Shower Power-02) on 6 m^2 plot size. The main idea was to examine and compare the results and its applicability in

different type soil erosion models concerning for long term and event-based methods. The mean compared parameters were the soil loss and soil erodibility. The applied model calculations originated from the USLE, USLE MM, GUEST and PESERA. The given results show high variability between the different rainfall experiments and calculation methods. The question is that: Which is the most suitable estimation method for event-based soil erosion modelling.

Keywords: rainfall simulation, event based, different scale, soil erosion modelling

Financial support:

(9479 - 3148) Erodibility of a Yellow Latosol (LA) under pasture and SAF in the southern region of Amazonas, Brazil by two Indirect Methods

Tatiana Acácio da Silva[1]; Miqueias Lima Duarte[2]; Heron Salazar Costa[3]

Universidade Federal do Amazonas - Grupo de Pesquisa Agricultura & Ambiente, 786, Centro, Humaitá, 69800-000, Brasil (tatianaacacio1909@gmail.com)[1]; Universidade Federal do Amazonas - Grupo de Pesquisa Agricultura & Ambiente, 786, Centro, Humaitá, 69800-000, Brasil (miqueiaseng@hotmail.com)[2]; Universidade Federal do Amazonas - Grupo de Pesquisa Agricultura & Ambiente, 786, Centro, Humaitá, 69800-000, Brasil (hescosta@ufam.ed.br[3]

Despite the technological advancement of agriculture, soil erosion is still one of the most troubling economic and environmental problems, because, according to data from FAAO (2015), the global cereal production losses due to erosion here estimated at 7.6 mi t/year. The K factor, which corresponds to the inherent susceptibility of each soil to erosion, is a variable of the Universal Soil Loss Equation (USLE), a tool of great value in land use planning. It has been little used, either by lack of data or by ignorance of your practical value. This study aimed to evaluate the erodibility of a Yellow Latosol (LA), in the municipality of Apuí, southern of Amazonas State, using two methods: (I) Wischmeier & Smith (1978) and (II) Denardin (1990). , Ten samples deformed were collected randomly at the depth of 0-0.2 m of a LA, being five from an area under from pasture, and five from an area under Agroforestry System (SAF). The structure and permeability of the soil were determined directly in field as method proposed by Wischmeier et al. (1971). Particle size was determined by the total dispersion method with NaOH solution to 1.0 mol L^{-1} as chemical dispersant. For determining the dimensions of the solid particles (DMP) was held the screening of solid mineral fractions using a sieve Shaker. Organic exist when the issue has been estimated based on total organic carbon according to Yoemans & Bremner (1988). Considering the 0.20 m from the soil analyzed, LA studied presented predominantly silty texture franco silty (24.13% sand, 74.80% 2.19% silt, clay), and 0.268 mm average DMP structure predominantly moderate, small to medium granular. Moderate to rapid permeability can be observed is associated to the presence, on average of 63.23 $g.kg^{-1}$ of organic matter. The maximum and minimum values of soil erodibilidade, by method I, were: 0, $t.ha^{-1}.MJ^{-1}.mm^{-1}$ and 0.0065 $t.ha^{-1}.MJ^{-1}.mm^{-1}$, respectively, with average of 0.0012 $t.ha^{-1}.MJ^{-1}.mm^{-1}$. By method II: 0, 0224 $t.ha^{-1}.MJ^{-1}.mm^{-1}$ and 0 1.mm, 0045 $t.ha^{-1}.MJ^{-1}.mm^{-1}$, also respectively to the maximum and minimum, and average of 0.93 0143 $t.ha^{-1}.MJ^{-1}.mm^{-1}$. No significant difference was observed between the averages of the K values calculated for the area under pasture and under SAF. Considering the values observed in the literature, the soil was evaluated high erodibility. The data will be used to draw up a map of vulnerability to erosion associated with the distribution of rains in the region.

Keywords: Soil conservation, USLE, Yellow Latosol, Agroforestry System.

Financial support: Fundação de Amparo à Pesquisa do Estado do Amazonas - FAPEAM.

(7871 - 3185) Erodibility of soils in southern Amazonas State for two Indirect Methods

Larissa Carvalho Gato[1]; Heron Salazar Costa[2]; Miqueias Lima Duarte[3]

Universidade Federal do Amazonas - Grupo de Pesquisa Agricultura & Ambiente, 786, Centro, Humaitá, 69800-000, Brasil (larissambiental@gmail.com)[1]; Universidade Federal do Amazonas - Grupo de Pesquisa Agricultura & Ambiente, 786, Centro, Humaitá, 69800-000, Brasil (hecosta@ufam.edu.br)[2]; Universidade Federal do Amazonas - Grupo de Pesquisa Agricultura & Ambiente, 786, Centro, Humaitá, 69800-000, Brasil (miqueiaseng@hotmail.com)[3]

The erodibility of the soil is represented by the factor K in the Universal Soil Loss Equation (USLE). It expressed the susceptibility of soil to the erosive process. Such geological process causes degradation of agricultural soils, generating losses. According to data from FAAO (2015), the global cereal production losses due to erosion were estimated at 7.6 million tons per year. Such losses can be avoided with management techniques indicated for each condition of erodibility of each soil. The aim of this study was to estimate the erodibility of different classes of soils in southern Amazonas State through two indirect methods. We used published data of the attributes necessary for the application of the method proposed by Dernadin (1990) and the proposed by Mannigel et al. (2002). The study area is located in southern Amazonas State, where collections were carried out in a toposequences (four sampling points), as well as in Black Land sites in depth Archaeological 0-22 cm (seven sampling points). For application of the proposed methods, has evaluated the structure, permeability, texture, organic matter and weighted average particle diameter (DMP). By the Mannigel et al. (2002) method, were found the following maximum, medium and minimum values of the index K for each soil, expressed in $t.ha.h.ha^{-1}MJ^{-1}.mm^{-1}$: Gleysols: 0.0271; 0.0239 and 0.0207; Cambisols: 0.0354, 0.0329 and 0.0313; Acrisol: 0.0364; 0.028925 and 0.0219 and Neossolo: 0.0972; 0.07645 and 0.0557. By the Denardin (1990) method, the maximum values of K were equal in all soils (0.0134 $t.ha.h.ha^{-1}MJ^{-1}.mm^{-1}$). However, Gleysols presented maximum, medium and minimum only (0.0134 $t.ha.h.ha^{-1}MJ^{-1}.mm^{-1}$). Cambisols, Acrisol and Neossolo presented the same minimum value (0.0089 $t.ha.h.ha^{-1}MJ^{-1}.mm^{-1}$), while the average value differentiated for classes Cambisols (0.0104 $t.ha.h.ha^{-1}MJ^{-1}.mm^{-1}$), Acrisol (0.010025 $t.ha.h.ha^{-1}MJ^{-1}.mm^{-1}$) and Neossolo (0.01115 $t.ha.h.ha^{-1}MJ^{-1}.mm^{-1}$). Relating the values obtained by different methods, it was observed that those found by the method of Denardin proved to be lower than the values observed by the method of Mannigel, contrary to results observed in the literature. Considering the lack of information on the topic for the region, emphasized the importance of this work to obtain data that will enable the construction of maps of vulnerability to rain erosion of soils of the region studied.

Keywords: Amazonian Soils, USLE, Erodibility, Indirect Methods.

Financial support: Fundação de Amparo à Pesquisa do Estado do Amazonas - FAPEAM.

(7993 - 2120) Estimation of erosion and proposal of soil conservation practices in Florencia and El Llano in Zamorano, Honduras

Mariana Gómez Botero[1]; Gloria E. Arévalo[1]; Carlos A. Gauggel[1]

Escuela Agrícola Panamericana, Zamorano[1]

Erosion is a process of disintegration, transport and deposition of soil materials by wind and water, resulting in the loss of about 40 billion tons per year. The objectives were: i. Calculate soil loss by erosion

under current management conditions and by changing the sowing direction in Florencia and El Llano in Zamorano, Honduras, ii. Design conservation practices under current management conditions and by changing the sowing direction. The universal soil loss equation USLE was used. The precipitation pattern, soil properties, length and degree of the slope, cover, land management and soil conservation practices were analyzed. These are loamy soils, slopes between 0 and 30% and length of the slope between 37 and 506 m. Currently, it is lost between 6 and 31 $t \cdot ha^{-1}$ $year^{-1}$. By changing the sowing direction, soil erosion varies between 3 and 16 $t \cdot ha^{-1} year^{-1}$. The proposal is to construct broad-base terraces of variable widths of 20, 50 and 100 m, separated by channels of 1 m width and maximum 30 cm depth, which allows the passage of machinery and does not interrupt the sowing lines, or change the sowing direction perpendicular to the slope. Elaborate collecting drains at distances varying between 50 and 575 m. Also, put water energy dissipators in the channels and sowing in covered beds and furrows to prevent erosion on slopes <5%.

Keywords: Broad-base terraces, collector drains, USLE, water energy dissipators.
Financial support: Escuela Agrícola Panamericana, Zamorano

(1417 - 2653) Estimation of water erosion by Erosion Potential Method in a watershed of southern Minas Gerais.

Natanael Rodolfo Ribeiro Sakuno[1]; Augusto César Guiçardi[1]; André Silva Tavares[1]; Lucas Emanuel Servidoni[1]; Diogo Olivetti[2]; Ronaldo Luiz Mincato[1]
Federal University of Alfenas[1]; University of Brasília[2]

Water erosion is the phenomenon that most affects tropical soils with losses of arable areas and support to ecosystems. Thus, studies estimating rates of water erosion are essential for assessing the impacts of soil degradation and consequent production and loss of sediment. The aim of this study was to estimate the potential soil losses due to water erosion in a Hydrographic Basin in the south of the State of Minas Gerais, by the Erosion Potential Method. For this, geological, topographic, pedological and climatic data were obtained from a database based on soil analysis and land use and occupation using geoprocessing techniques. Besides the occupation, the digital mapping of the soils of the area was also carried out, being found Red Latosols in flat relief to soft, wavy, undulating and strongly undulated. Data were compared with those obtained and by the Revised Universal Equation of Soil Loss. The coefficient of erosion intensity, Z, was 0.325, which is indicative of low erosion intensity. Potential mean losses for the basin were 49 Mg ha-1 year-1 by the Erosion Potential Method and 40 Mg ha-1 year-1 by the Revised Universal Soil Loss Equation. The application of this methodology demonstrated the potential of both soil loss prediction models for tropical regions. Erosion Potential Method estimated higher loss rates in pasture areas, which occupy a larger area, while the Revised Universal Soil Loss Equation estimated the greatest losses for exposed soil areas. Values of the soil losses indicate the presence of management and occupation of the sustainable soils in the basin. Anthropic actions do not have a deleterious bias and the high permeability rates indicate conservationist management, which means that the average slope does not prevent the agricultural occupation, provided that with sustainable management practices. The lack of data obtained from experimental plots of data validation indicates that soil losses are potential. Pearson correlation coefficient was 0.96 between the two models and indicates that the Erosion Potential Method is effective and can be applied in the estimation of soil losses in tropical regions.

Keywords: Modeling of water erosion; Erosion Potential Method; Revised Universal Equation of Soil Losses; Tropical Soils.
Financial support: CNPq, FAPEMIG

(4620 - 1730) Hidrossedimentological Simulation using the WATERSED Model

Ana Letícia Sbitkowski Chamma[1]; Jean Paolo Gomes Minella[1]
Federal University of Santa Maria[1]

The objective of this study is to verify the modeling efficiency of surface runoff and sediment yield with a physics based model found in rainfall events and with high potential for applying to soil and water conservation programs at catchment scale. The erosive processes that occur at catchment scale are, in many cases, difficult to describe, with hydrological monitoring associated with modeling, which is indispensable for the hydrological and environmental degradation behavior to be predicted and understood. Considering the existing diversity of hydrological and erosive models, it is crucial to choose/develop those that are representative of local hydrological processes and sensitive (parameters) to conservation practices to be defined in the catchment. In this study, the WATERSED model is used in the Arvorezinha experimental catchment, which is located in the Municipality of Arvorezinha, Rio Grande do Sul State. The WATERSED model is a relatively simple hydrological and erosive model that considers the dominant factors of the erosive process in the catchment through the formulation of decision tables, which require a smaller amount of input data. The evaluation of the model in the description of the processes is performed in twenty pluviometric events with significant surface runoff and sediment production. The results obtained by the simulation of the WATERSED model were compared to the data of the monitored events.

Keywords: Hydrological Modeling. Catchment Scale. Erosive Processes. Physics-based models.
Financial support: Sinditabaco, CNPq CAPES FINEP

(4328 - 2996) Hydrosedimentological dynamics in a hydrographic basin covered by Red Oxisols in Southeast of Brazil

Joaquim Ernesto Bernardes Ayer[1]; Lucas Emanuel Servidoni[2]; Marx Leandro Naves Silva[3]; Sueli Yoshinaga Pereira[1]; Ronaldo Luiz Mincato[2]
UNICAMP / IGE[1]; UNIFAL-MG / ICN[2]; UFLA / DCS[3]

Sixteen samples of deformed and undeformed soil of Red Oxisols were collected from 0.0 to 0.2m depth to evaluate the hydrosedimentological dynamic in the Pedra Branca River Basin (PBB), southern Minas Gerais, Brazil. The distribution of the attributes of soil pH, aluminum toxicity, organic matter, cation exchange capacity (effective and potential), soil texture, clay flocculation, aggregate stability, soil permeability, and data from the literature, were used to evaluate the hydrosedimentological dynamic. Physical and chemical attributes of Red Oxisols were spatialized by geostatistical and geoprocessing techniques. Several maps of this basin were generated by GIS, as digital terrain model, trend surfaces and interpolations of soil attributes, vegetation index (NDVI), flow direction and susceptibility to erosion. These results make it possible to show the inputs and outputs in the hydrosedimentological system. The basin studied has 2.642 ha of area and the climate of the region is Tropical Mesothermic (CwA-Köppen), with mean precipitation of 1,500 mm/year. The region is characterized by the transition between Atlantic Forest and Savanna biomes but with only 10% of native forest remnants. The geological substrate is dating from Proterozoic with gneissic and granulitic rocks, and have relief slightly undulated to undulated where slopes between 2 to 20% prevail and Red Oxisols dominate. Sampling points in the floodplain areas with indiscriminate tropical soils and in low slopes, when compared to areas with higher slope and altimetry elevation, have more acidic pH, increase in cation exchange capacity, increase of small grains and reduction of permeability, indicating changes in soil attributes, when compared to previous studies. The high slope areas have more organic matter, because of difficulty of mechanization by the agriculture while in the slopes with low and middles declivity present higher rates of erosion, carrying to the river sediments and many agrochemicals, since the

region is the world's largest coffee producer and makes extensive use of these products. As shown by the maps of flow direction and NDVI, the erosion channels are completely degraded, and most of the sediments are carried into the river. Therefore, the characterization of and spatialization of the bio-physiographical attributes of the landscape, had shown changes of soils by wrong soil practices management, resulting in soil erosion and silting in rivers.
Keywords: Landscape; Watershed; Soil Modeling; Water Erosion
Financial support: CAPES and FAPEMIG

(5256 - 234) Hydrosedimentological modeling with a high level of detail in an urban basin with a high slope

DaríoTomas Rodriguez[1]; Gerardo Adrián Riccardi[2]; Pedro Abel Basile[2]; Sergio Daniel Vera[1]; José Javier Fernandez[1]; Juan Antonio Sanchez[1]
FI-UNaM[1]; FCEIA-UNR[2]

Changes in the land uses of the basins triggered by the urbanization processes cause an increase in surface volumes and higher runoff velocities, processes that directly affect the generation and transfer of sediments by water erosion. Particularly, the basins of the mountain range of Misiones, Argentina have rugged topography and are subject to severe pluviographic events of convective fronts, which increase the erosion potential of the fine soils that cover the region. Product of previous investigations is counted on a hydrological-hydraulic model with a high level detail, built in the SWMM, in the Mbotaby basin of the city of Oberá, which has allowed the characterization the runoff of one of the most densely populated urban basins of the Central Sierra` Misiones. The present work details the coupling of the hydrological-hydraulic model available with algorithms of production and transfer of sediments of the Mbotaby basin. The model implemented allowed us to disaggregate the sediment production of both permeable and impermeable areas, as well as to simulate the accumulation of sediments during the dry periods prior to the storms. For the calibration process hydrosedimentological measurements were made in 10 events and were contrasted with results calculated in terms of levels, flows and TSS, reaching a satisfactory level of approximation. In the modeling carried out, the net precipitation range varied between 30.4 and 177.5mm, producing sediments between 0.28 and 1.77T/ha. The results indicate that the sediment discharges have values of TSS closer to values determined by the methodologies that predict higher volumes of sediments, 6.44 [T/(ha year)]. A subsequent sensitivity analysis indicated that the model shows a greater sensitivity to the C11 coefficient (drag exponent of the permeable areas), followed by C10 (drag coefficient of permeable areas), while the coefficient of lower sensitivity is C8 (coefficient of dragging of impervious areas). It is concluded that the technological tool achieved is suitable for future exploitations where it is expected to evaluate the performance of structural and non-structural measures tending to control the processes of erosion-sedimentation in this type of basins before different design events and hypothetical future scenarios.
Keywords: Hydrosedimentological modeling; urban basin; high slope
Financial support:

(9934 - 3039) Mapping of rain erosivity in mato grosso state

Luis Augusto Di Loreto Di Raimo[1]; Ricardo Santos Silva Amorim[2]; Eduardo Guimarães Couto[2]; Edwaldo Dias Bocuti[1]; Wellington de Azambuja Magalhães[1]; Rodolfo Luiz Bezerra Nóbrega[3]
Federal University of Mato Grosso, Postgraduate Program in Tropical Agriculture, , Cuiabá, MT, Brazil[1]; Department of Soil and Agricultural Engineering, Federal University of Mato Grosso, Cuiabá, MT, Brazil[2]; Department of Geography and Environmental Science, University of Reading, Reading, United Kingdom[3]

The rainfall capacity to cause erosion on unprotected soils is denominated rainfall erosivity. Due to the oscillations of soil coverage, agricultural lands present variable susceptibility throughout the year and, depending on the erosive characteristics of the local rains, can stimulate the erosive processes. Mato Grosso state, the largest national grains producer, it has wide farming areas that, along year, they stay through long exposure periods. In that way, this study aimed to predict and to map the spatial and temporal variability of rain erosivity for Mato Grosso state. To estimate the rainfall erosivity, it was used regression equations, taking as an independent variable rain coefficient (Rc), which was obtained from rainfall data. Therefore, monthly (EI_{30}) and annual (R) rainfall erosivity were calculated for 158 stations, distributed over the Mato Grosso territory and with a minimum historical series with ten years of data. Sequentially, to obtain the maps, the EI_{30} and R values were spatialized from kriging method. The R values, in MJ mm ha^{-1} h^{-1} $year^{-1}$, were classified as low (less than 2452), average (2452 to 4905), medium high (4905,1 to 7357), high (7357,1 to 9810) and very high (greater than 9810). The EI_{30} values, in MJ mm ha^{-1} h^{-1}, were classified as very low (less than 250), low (from 250 to 500), average (from 500,1 to 750), high (from 750,1 to 1000) and very high (greater than 1000). The R values were correlated with latitude, longitude and height, aiming to a better understanding of spatial variation of erosivity in Mato Grosso state. To discuss the peculiarities of each region, the EI_{30} and R maps were subdivided into macroregions (northwest, north, northeast, middle north, west, south center and southeast). At the northwest, north, west and middle north macroregions of Mato Grosso state occur the highest values of the R. The R values in the very high class predominate in the north and, classes high and medium high, in the south. The average value of R for Mato Grosso state is equal to 8835 MJ mm ha^{-1} $year^{-1}$ (classified as high). Between October and April, related with the rainy season, occur 91% of R, being October, January and February the most critical months, due the high erosivity values (responsible for 41% of R) in planting and harvesting season, when the soil surface is exposed. The variations of latitude and height, up to 300 meters, are the factors that best explain the spatial variations of R in Mato Grosso state.
Keywords: erosion, USLE, spatial variability, kriging, geostatistics
Financial support: UFMT, CAPES, FAPEMAT

(6442 - 1425) Modeling Ephemeral Gully Erosion in Agricultural Fields of Southern Ontario, Canada

Prasad Daggupati[1]; Swapan Roy[1]; Kevin McKague[2]; Cliff Patterson[3]; Asim Biswas[1]; Ramesh Rudra[1]
University of Guelph[1]; Ontario Ministry of Agriculture and Rural Affairs[2]; Kettle Creek Conservation Authority[3]

Erosion of agricultural fields due to climatic and land use changes is very severe on many unprotected farmlands around the world. Ephemeral gully (EG) erosion significantly contributes to total soil losses from upland area to stream channels and is a serious environmental and productivity problem. In the last couple of decades, a few physical and semi-empirical based prediction models have been developed to estimate EG erosion so that appropriate conservation measures can be implemented. In this study, the Annualized Agricultural Non-Point Source (AnnAGNPS) model will be used to investigate the mechanics of EGs and quantify EG erosion and also overland erosion in selected fields across several watersheds in southern Ontario. In the selected fields, inputs of Digital Elevation Model (DEM) is being generated from Unmanned Aerial Vehicles (UAVs) equipped with high resolution camera, soil characteristics are being manually measured. Other inputs such as implemented management practices and available daily climate data are also being collected. Inputs collected in selected fields will be incorporated in AnnAGNPS model in which overland erosion is simulated using

Revised Universal Soil Loss Equation (RUSLE) and EGs are simulated using Revised Ephemeral Gully Erosion Model (REGEM). Simulated results of overland and EG erosion will be used to understand the mechanics of EGs and their contribution to total erosion in Ontario. In addition, economic impact analysis of EG and overland erosion will be performed.

Keywords: Annualized Agricultural Non-Point Source (AnnAGNPS) model, Watersheds of Southern Ontario, Runoff and Sediment Simulation, Ephemeral Gully Erosion, Soil Erosion

Financial support: Natural Sciences and Engineering Research Council of Canada

(7123 - 3173) Monitoring of accelerated erosion in recovered slope using Bioengineering of soils in the state of Alagoas, Brazil

Diego Medeiros1[1]; Jonas Olímpio de Lima Silva[2]; Erivaldo James Rocha do Rego[1]; Luiggi Canário Cabral e Sousa[1]; Claudia Lins[3]; Regla Toujaguez La Rosa Massahud[1]

CECA-UFAL[1]; CECAUFAL[2]; IGDEMA-UFAL[3]

At the Northeast of Brazil, the state of Alagoas, followed by the state of Pernambuco are the most affected places for the intense rainfall and flooding according to the Nacional Center of Monitoring and Warnings of Natural Disasters (*Centro Nacional de Monitoramento e Alertas de Desastres Naturais*). Into the state of Alagoas the town called Rio Largo, located at the region of Zona da Mata, is one of the most affected as acknowledge by the historical disasters registers especially due to occurrence of strong rainfalls between 2010 and 2017, presenting accelerated erosion registers in excavated slopes uncovered by vegetation with over 60º rise. Therefore, the aim of this research was apply the Bioengineering of Soils associating the grass Vetiver (*Chrysopogon zizanioides*) to the biodegradable geotextiles (BG) made of fibers of banana tree bark to counter the accelerated erosion in three experimental areas (controlling area without BG and Vetiver, an area with BG and Vetiver applied and an area with only Vetiver applied) of a degraded slope (84 m² - 14 m x 6 m) at the Center of Agricultural Science (Centro de Ciências Agrárias) of the Federal University of Alagoas. Also, monitoring the efficiency of this method using date collected by land surveying techniques and computational modeling by the software AutoCad Civil 3D between February and August of 2017. The growth of the part above of the ground of the Vetiver was noticed all over the areas where it was applied. However, the efficiency of BG could not be quantified by the method applied; the vegetation cover could be clearly noticed over the land surveys the area BG and Vetiver presented the smallest ground loss. By the models generated from the areas a increasing of the ground loss was noticed all over the experiment between the first and third (and last) land surveys, increasing from 0,14 m³ to 0,89 m³ of volume. Associated to a uncommon volume of rain on th town during April and May of 2017. In conclusion, the use of land surveying techniques and computational modeling at hard access areas required appropriateness in the method and instrument used to data collecting to achieve more reliable results. Increase the point's density to represent the natural ground and use others algorithms to refine the models. The use of Vetiver associated to BG made of banana tree bark showed itself a low cost technique useful to recover slopes affected by accelerated erosion.

Keywords: risk; monitoring; vetiver

Financial support: UFAL

(8905 - 2821) Natural potential of water erosion for Mato Grosso state, Brazil

Luis Augusto Di Loreto Di Raimo[1]; Ricardo Santos Silva Amorim[1]; Eduardo Guimarães Couto[1]; Edwaldo Dias Bocuti[1]; Tulio Gonçalves dos Santos[1]; Rafael Vinicius Rodrigues[2]

Postgraduate Program in Tropical Agriculture, Federal University of Mato Grosso[1]; Postgraduate Program in Water Resources, Federal University of Mato Grosso[2]

Currently, Mato Grosso state has a prominent position in the Brazilian agricultural production, it is responsible for 25% and 13% of the production of grain and the national cattle herd, respectively. Clearly, such high rate of agricultural production requires wide areas of Mato Grosso. However, it is known that unduly exploited areas, without regarding the land use capacity, can be severely eroded, becoming quickly unusable. Therefore, the spatial characterization of soil susceptibility to erosion is a decisive tool for future land use planning, allowing the identification of critical areas, which should be studied and explored with greater attention. Thus, the aim of this study was to estimate the spatial variability of natural potential erosion (NPE) along the Mato Grosso territory. In order to obtain NPE, the universal soil loss equation (USLE) was used, considering the erosivity (R), erodibility (K) and topographic factor (LS) values. The R values were obtained for 158 points by means of regression equations that use rainfall data as independent variable. Values of K were estimated from equations proposed by Wischmeier and Smith, in 1978, and Denardin, in 1990, to 427 points distributed by the state. The spatialization of R and K values were achieved by using geostatistics and kriging methods. The LS map was obtained by applying the LS factor equation, proposed by Bertoni and Lombardi Neto in 1985, on a slope map, got from the union and processing of SRTM images. The NPE values, in t ha^{-1} $year^{-1}$, were classified as low (less than 100), average (from 100 to 200), high (from 200.01 to 600) and very high (greater than 600.01). Aiming a better visualization of critical regions, the Mato Grosso state was subdivided into macroregions of agroeconomic similarity (northwest, north, northeast, middle north, west, south center and southeast). In Mato Grosso state predominate PNE values in the average, low and high classes, that covers 59%, 20% and 22% of its territory, respectively. The areas of low NPE are situated mainly in the flat regions of state, showing relief as a preponderant factor for attribution of such NPE class. The regions with high NPE, considered critical, cover greater proportions in the northwest (46.69%), north (32.70%) and west (30.06%) macroregions. The wide extensions of high NPE used with agriculture, on north of west macroregion, illustrate a problematic region, which might be monitored according to annual rates of soil loss.

Keywords: NPE, soil conservation, erosivity, erodibility, USLE

Financial support:

(9845 - 2033) Organic matter content under coverage plants

Dione Pereira Cardoso[1]; Lucas Rodrigues Nicole[2]; Fábio Ribeiro Pires[2]; Kerwin Araujo Costa[2]; Vinícius Soares de Oliveira[2]; Alessandra Ferreira Belo[2]; Raquel Cristina Ramos[2]; Benedicto Barbosa Netto[2]; Gabriel Marcarini de Aguiar Sousa[2]

Federal University of Lavras[1]; North University Center of Espírito Santo – Federal University of Espírito Santo[2]

The content of organic matter is of utmost importance for the construction of soil fertility. However, the increase of this content is difficult, mainly in sandy soils. In this context, the objective was to evaluate the organic matter content provided by the cultivation of coverage plants in sand dystrophic yellow agrisol, submitted to two additional irrigation regimes. The randomized blocks design has been used, in split plots, in a 2 x 6 scheme, with four replicates (48 experimental units). The plots were two additional irrigation schemes, water regime 1 (I_1) and with 50% of the water volume, the water regime 2 (I_2). The subplots were six covering plants, four cultivars of *Pennisetum glaucum* L. - Millet (ADR 300, ADR500, ADRf 6010 and BRS 1501), *Canavalia ensiformis* DC. (Jack bean) and - *Brachiaria ruziziensis* (Brachiaria), evaluated at depths of 0-0.20 m and 0.20-0.40 m. The determination of the organic matter has been achieved by humid

carbon oxidation with potassium dichromate in acidic medium. The values were submitted to analysis of variance anf the Tukey mean test was performed, at a significance level of 0.05, using the Sisvar software. The highest organic matter content in the soil was observed in the I2 regime, that is, the reduction in availability has favored the increase in soil. There was no difference in the organic matter content between the cover crops evaluated. The values differed from 1.43 dag kg^{-1} for brachiaria to 1.61 dag kg^{-1} for pork. In relation to the depths, the superficial layer (0-0.10 m) provided the largest contribution of organic matter (1.87 dag kg^{-1}) in relation to the depth of 0.20-0.40 m (1.20 dag kg^{-1}). This is due to the deposition of the vegetable remains on the surface of the soil. Therefore, it is economically viable to grow these cover crops under reduced irrigation. With successive experiments, it is possible that there will be a differentiation in the organic matter content between these cover plants.

Keywords: *Pennisetum glaucum* L.; *Canavalia ensiformis* DC.; *Brachiaria ruziziensis*

Financial support: Capes, Fapes

(3820 - 2076) Probable causes of the return of erosion in areas with no-tillage system

Claudia Maria do Prado Furquim[1]; Adriana Pereira da Silva[1]; Lucas Augusto de Assis Moraes[1]; Eliane Araújo[1]; João Tavares Filho[1]

Universidade Estadual de Londrina[1]

The State of Parana, Brazil, has in its agribusiness main economic activity with more than 30 million hectares for the production of grain under no-tillage system (NTS). However, this technology, until then considered effective in erosion control, has increased gradually in the soil loss. The objective was to understand the likely causes of the return of erosion in areas under NTS, in rural properties in the North of Parana. The municipalities which were analyzed were Lerroville, Tamarana and Ortigueira, being the predominant soil class were Oxisols. The methodology used was a questionnaire for the survey of information pertaining to soil management and use of agricultural terrace, with 145 farmers which were selected through information obtained by the rural extension and agricultural cooperatives. Of the 145 questionnaires answered, 41% got elementary school, 53% high school and 6% higher school. Of this total, 37% properties ≤ 30 ha, 38% properties between 30-100 ha and 25% properties ≥ 100 ha. 100% of respondents stated that the NTS held the property comprises permanent soil cover, crop rotation and the minimum tillage exclusively on sowing line. However, when the questions were more specific, 70% declared low residual straw when they observe the sowing of a new culture and 97% are sown annually the same crops, such as soybeans, corn and wheat because has such influence the market value of the grain. Still, 88% declared using every 3 years some kind of equipment with the goal of breaking the surface layer more compact the soil. The use of implements on the ground soon after the winter culture seems to be a common practice. However, the effect of the tickler is short term with little or no modification is preserved in the soil structure after this period. The issues relating to the use of agricultural terrace showed that 74% consider that only the NTS is enough in erosion control, eliminating the use of terraces in the fields. In addition, 81% considered that the removal of the terraces facilitates soil management and the application of pesticides in the direction of the slope, without cause problems to the soil, thus increasing, according to 72% of respondents, the efficiency in the use of machines. It was concluded that the erosion has as causes the lack of crop rotation for a repeatability of same year species; The tickler to decompression of the surface layer; the removal of agricultural terraces and consequent slope planting.

Keywords: soil degradation, soil management, agricultural production, soil cover, agricultural terrace

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(9891 - 1516) Ratio between rare earth element fluxes in suspended sediments and bedload under watershed-scale

Yuri Jacques Agra Bezerra da Silva[1]; Fábio Farias Amorim[2]; Clístenes Williams Araújo do Nascimento[2]; Ygor Jacques Agra Bezerra da Silva[2]; Vijay P. Singh[2]; José Ramon Barros Cantalice[2]

Federal University of Piaui[1]; Federal Rural University of Pernambuco[2]

Rare earth elements (REEs) have been recently recognized as potentially emergent pollutants in rivers. However, data regarding REE fluxes in suspended sediments and bedload are scarce. Aiming to fill this gap, we determined the concentration and flux of La, Ce, Pr, Nd, Sm, Eu, Gd, Yb, Lu, Dy, Er, Ho, Tb and Tm in bedload and suspended sediments of a representative and polluted Brazilian River. Suspended and bedload sediments were collected from upstream and downstream cross sections, using the US DH–48 and BLH-84 sampler, respectively. The REE concentration in suspended sediments and bedload were determined using inductively coupled plasma optical emission spectroscopy. Light rare earth elements (LREEs) comprised more than 94% of the total REE associated with suspended sediments and bedload. Suspended sediments accounted for more than 95% of the REE flux. Thus, suspended sediments controlled REE flux to the ocean. The Ce and Nd fluxes of about 7 t $year^{-1}$ were higher than those reported for Cd, Cr, Cu, Hg and As. On the other hand, bedload often transported less than 0.0007 t $year^{-1}$ for each element and did not play an important role for the REE flux. It draws attention to the importance of including REEs in future estimation of global element flux carried by suspended sediments. Bedload does not play an important role in transporting REEs in Ipojuca River; however, it might have some influence at short distances.

Keywords: Lanthanides; Environmental quality; Sediment transport

Financial support:

(7742 - 910) Resistance of acrisols to erosion in soils in brazilian semi-arid environment

Rennan Cabral Nascimento[1]; José Ramon Barros Cantalice[1]; Wagner Luis da Silva Souza[2]; Douglas Monteiro Cavalcanti[1]; Elves Obede dos Santos Nunes[1]; Sergio Monthezuma Santoianni Guerra[1]; Fábio Farias Amorim[1]

Universidade Federal Rural de Pernambuco[1]; Instituto Federal de Pernambuco[2]

In the Brazilian Semi-Arid, many areas under exposed soil conditions, potentiate the erosive actions of rain, and the consequent desertification process. The objective of this work was to determine the erodibility in pre-formed rills on acrisols in the semi-arid environment of Brazil, through field experimentation. The study was carried in the Exu Riacho watershed, sub-basin of the Pajeú River, of the state of Pernambuco (Brazil). The soil was classified as Acrisol red-yellow. The region has a hot semi-arid climate, with annual mean precipitation around 647 mm. For the determination of erodibility (Kr) and critical shear stress (τc) experimental erosion procedures were performed on preformed rills with concentrated runoff simulations. The rills were preformed with 3m in length and 0.15m in depth. The experimental design was completely randomized, with four flow rates (treatment) and four replications: 20.66; 40.22; 60.2 and 79.3 L min^{-1}, totaling sixteen flow simulations. The samples liquid and solid samples were collected at the bottom of each channel for four minute intervals, being the first one after the initiation of the flow. The total time for each simulation was 12 minutes. the results were submitted to analysis of variance ($p>0.05$) and tukey test. For the determination

of the Kr and τc, linear regression analysis was performed between the shear stress values of the concentrated surface runoff and the soil detachment rates. The Kr was considered equal to the angular coefficient of the line, and τc was determined by the intercept value of the shear stress when the soil detachment rate is zero. The angular coefficient of the line, which determines the Kr of the soil, was 0.0176kg$N^{-1}s^{-1}$. In addition, the τc, which represents the intercept between the straight and the abscissa, was 4.72 Pa. The Kr and τc in preformed rills obtained here are greater than other results obtained on acrisols, from experimentation, as in Braida and Cassol (1996) (Kr = 0.0104 kg$N^{-1}s^{-1}$), Schäfer et al. (2001) (Kr=0.012 kg$N^{-1}s^{-1}$/τc = 2.61 Pa) and, Cantalice et al. (Kr = 0.0024 kg $N^{-1}s^{-1}$/τc = 2.75 Pa). The lower content of the clay fraction, may have minimized the cohesive forces between the particles, increasing the susceptibility to detachment and consequent transport. Therefore, the acrisol presented erodibilid attributes and critical stress of steepness indicated that this class of soil in the semiarid environment presents greater susceptibility to erosion in rills.

Keywords: erodibility, critical shear stress, concentrated runoff.
Financial support: Universidade Federal Rural de Pernambuco (UFRPE) - Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES)

(9878 - 2285) Sediment fingerprinting using geochemical tracers: a global meta-analysis

Rafael Ramon[1]; Tales Tiecher[2]
Graduate Program in Soil Science, Federal University of Rio Grande do Sul, 7712, Bento Gonçalves Avenue, 91540-000, Porto Alegre, RS, Brazil[1]; Department of Soil Science, Federal University of Rio Grande do Sul, 7712, Bento Gonçalves Avenue, 91540-000, Porto Alegre, RS, Brazil[2]

Fingerprinting approach has been recently widely used to trace the sources of sediments in catchment scale. This method is based on the fact that the chemical characteristics of eroded sediments are related to the characteristics of the potential sediment sources. Two of the main prerequisites for the use of physic-chemical characteristics as tracers of sediment origin are: (i) to be conservative during the process of erosion and transport and (ii) to show differences in the concentration among the potential sources. Tracer selection for this purpose is a key step of the fingerprinting procedure, but the tracers selected are often very site-specific. Therefore, a review of the main procedure and the tracers most successfully used in these studies could be helpful to guide applications of this methodology. This study aims to review scientific publications that have used geochemical composition as a tracer of sediment sources in order to provide information regarding (i) the conservativeness behaviour of geochemical tracers and (ii) the tracers most frequently selected to use in apportionment models. We reviewed 112 scientific papers published from 1988 to 2018 that used the geochemical composition as potential tracers, involving a total of 319 different modelling approaches. Of these tracers, 26 papers and 73 approaches were removed from the analysis because of limited information provided about statistical procedure used. Altogether, 75 geochemical tracers were tested as the potential ones. We focused our analysis on the 30 most frequently tracers used (Al, As, Ba, C, Ca, Cd, Ce, Co, Cr, Cu, Fe, Ga, K, La, Mg, Mn, Mo, N, Na, Ni, P, Pb, Rb, Sb, Sr, Ti, Tl, V, Y and Zn). Only 42% of these papers applied a conservative test. Ba (n=100, 55%), Y (n=74, 55%) and Rb (n=61, 54%) were considered as the most conservative. On the other hand, elements that are part of the biogeochemical cycle, such as C (n=51, 81%), N (n=34, 81%) and P (n=83, 78%), were considered as non-conservative. Al (n=107, 46%), Ti (n=140, 36%) Sr (n=145, 30%), K (n=208, 29%) and Ba (n=151, 28%) were the most frequently selected elements in the final set of tracers to model sediment sources contribution, while N (n=126, 15%), Na (n=198, 14%), As (n=170, 14%), Sb (n=114, 14%) and Tl (n=81, 11%) were the less selected elements. Studies are needed to optimize and make feasible the application of the fingerprinting approach, giving directions to the choice of tracers and their evaluation methods.

Keywords: Soil erosion, suspended sediment, catchment scale, fingerprinting review.
Financial support: CNPq

(4849 - 2161) Sediment production by different intensity and duration of simulated rainfall

Wilk Sampaio de Almeida[1]; Fernandes Antônio Costa Pereira[2]; Daniel Fonseca de Carvalho[2]
Federal Institute of Education, Science and Technology of Rondônia / Federal Rural University of Rio de Janeiro[1]; Federal Rural University of Rio de Janeiro[2]

Erosivity is the main meteorological parameter studied to know the erosive potential of rainfall. However, the physical characteristics of rainfall provide completely different levels of soil erosion, even when the total erosivity of these rainfall is equal. We studied the effect of the intensity and duration of rainfall with the same total erosivity on soil particles detachment. For this, two types of rain were applied with five repetitions each using a portable rotating disk simulator, with constant intensities of 44.5 mm h^{-1} and duration of 106 min and rains of 75 mm h^{-1} and duration of 38 min. After the soil tillage (two plowing scales and a leveling harrow) the plots (1.0 m x 0.70 m) were fixed in the experimental area. Before the application of rainfall in the field plots, the soil was moistened to standardize soil water content prior to rainfall application. When was observeted the runoff beginning, at every minute the runoff was quantified and every five minutes, a sample of the runoff was collected to determine the sediment production. The total rainfall erosivity was 871,404 MJ mm ha^{-1} h^{-1} ± 0,139 MJ mm ha^{-1} h^{-1}. The accumulated sediment production varied from 3.33 g m^{-2} (rain of 75 mm h^{-1} and 38 min of duration) to 6.23 g m^{-2} (rainfall of 44.5 mm h^{-1} and 106 min of duration). The sediment yield rate ranged from 0.011 g m^{-2} min^{-1} to 0.092 g m^{-2} min^{-1} for a greater intensity of 0.059 g m^{-2} min^{-1} to 0.065 g m^{-2} min^{-1} to the lowest intensity of rain. The pattern of rainfall occurrence due to its physical characteristics influence in the total erosivity and, consequently, on precipitated volume, on surface runoff and on detachment of the soil particles. However, the rainfall with the shortest duration and the high intensity also have high potential to produce soil particles detachment (in our study 53.45% of sediments in relation to rainfall of 44,5 mm h^{-1}). Thus, the potential of rainfall to erode the soil is not only related to its total rainfall erosivity, but also to the form of precipitation.

Keywords: Soil erosion; Rainfall physical characteristics; Rainfall erosivity
Financial support: National Council for Scientific and Technological Development of Brazil (CNPq), AGEVAP

(8572 - 2134) Soil loss by water erosion in the Oxisols of a hydrographic sub-basin, affluent of a hydroelectric power plant reservoir, Brazilian southeast

Augusto César Ferreira Guiçardi[1]; Natanael Rodolfo Ribeiro Sakuno[1]; André SIlva Tavares[1]; Joaquim Ernesto Bernardes Ayer[2]; Lucas Emanuel Servidoni[1]; Marx Leandro Naves Silva[3]; Ronaldo Luiz Mincato[1]
Universidade Federal de Alfenas - UNIFAL-MG[1]; Universidade Estadual de Campinas - UNICAMP[2]; Universidade Federal de Lavras - UFLA[3]

In natural conditions the surface's erosion is compensated by the continuous alteration of the rocks. However, the lack of adequate soil management increases erosion, which causes socio-economic and environmental havocs. The study was conducted between November 2016 and October 2017 in the Pedra Branca Stream Hydrographic Sub-basin, located in the city of Alfenas, affluent of the Furnas Hydroelectric Power Plant reservoir, an important hydric resource in the Brazilian southeast. The aim was to apply the Revised Universal Soil Loss Equation using a geographic information system for the spatialization of soil losses considering potential and current erosions. In the potential erosion mapping, which considers the topographic, soil erodibility and rainfall erosivity factors, it was observed that of the total area, 51.14% presented losses up to 100 Mg ha^{-1} $year^{-1}$, 32.67% losses ranging from 100 to 200 Mg ha^{-1} $year^{-1}$ and 16.19% losses above 200 Mg ha^{-1} $year^{-1}$, mainly conditioned by relief. In the current erosion mapping, obtained by the incorporation of the vegetation coverage, land use and management, and soil conservation practices factors regarding the potential erosion, the highest losses were 98.78 Mg ha^{-1} $year^{-1}$, occurring in bare soil areas, followed by the eucalyptus, maize, pasture, sugarcane and coffee crops representing 14.25, 14.19, 10.98, 6.99 and 4.62 Mg ha^{-1} $year^{-1}$, respectively. On the other hand, the areas that suffered least losses of soil due to hydric erosion, with 1.63 Mg ha^{-1} $year^{-1}$, were native forest areas, reiterating their protective role in the sediment detachment and sediment transport processes. 33.65% of the area presented losses above the tolerance limit of soil losses, calculated in 9.52, 9.99 and 8.94 Mg ha^{-1} $year^{-1}$ for the Red Oxisols with slope up to 8%, from 8% to 20%, and higher than 20%, respectively. However, simulating a scenario with all crops associated with conservation techniques such as no-tillage, contour farming, increased crop densities in the case of coffee, no burning in the harvest in the case of sugarcane and adequate pasture management, the average losses would fall from 8.00 to 2.20 Mg ha^{-1} $year^{-1}$, and only 2.04% of the area would be above the soil loss tolerance limits, showing that conservationist management should be widely spread among agricultural producers, hence drastically reducing the erosive potential of tropical regions.

Keywords: RUSLE, Modelling, Conservationist approach

Financial support: Fundação de Amparo à Pesquisa do Estado de Minas Gerais - FAPEMIG, Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – CAPES

(4846 - 1561) Space distribution of rainfall erosivity in climate change scenarios for the state of Tocantins, Brazil

Wharley Pereira dos Santos[1]; Junior Cesar Avanzi[1]; Marcelo Ribeiro Viola[2]; Nilton Curi[1]

Department of Soil Science, Federal University of Lavras, Brazil[1]; Department of Engineering, Federal University of Lavras, Brazil[2]

Improper soil management and land use can lead to degradation of available natural resources. This is a fact that tends to worsen with the climatic changes that are taking place on Earth. Among the aggravating factors, water erosion due to rainfall potential is a relevant factor in studies involving climatic variables. Thus, modeling rainfall erosivity (R-factor) to locations where rainfall data in series are scarce is imperative. The objective of this work was to predict rainfall erosivity by the middle of the 21st century in two scenarios of future climate change of the IPCC's Fifth Assessment Report (AR5) ("representative concentration pathways") for the state of Tocantins, located on the last Brazilian agricultural frontier. The two RCPs span a range of year 2100 radiative forcing values from 4.5 to 8.5 W/m², RCP 4.5 and RCP 8.5, respectively. For this, daily precipitation data were obtained from downscaling performed through the regional climate model (RCM) Eta-MIROC5. After correction of the precipitation biases found in the simulated model in relation to the observed climate (1985 to 2005) from rain gauge stations, an overlap on baseline period of the regional climate model, and the statistical validation of the model, we proceeded to use equations available in the surroundings of the state considering as an independent variable the mean monthly precipitation or the modified Fournier index for calculating the R-factor. Lower annual mean erosivity values were found in the future climate simulation compared to the historical period of climate events, with a mean reduction of 12.4% for RCP 4.5 and 12.5% for RCP 8.5. The mean annual erosivity presented values between 5,181.05 and 14,499.93 MJ mm ha^{-1} h^{-1} yr^{-1} for RCP 4.5 and between 4,724.72 and 14,927.90 MJ mm ha^{-1} h^{-1} yr^{-1} for RCP 8.5. The lowest reductions in the erosivity factor occurred in the north, west and southeast regions of the state for both scenarios. The results provide a future overview for soil and water conservation planning on Tocantins state with higher-skill of RCM-based climate-change impact studies.

Keywords: Soil erosion; R-factor; Climate change; North of Brazilian territory.

Financial support: CAPES; CNPq; FAPEMIG.

(6231 - 267) Surface soil erosion assessment in a Protected Area on Paraty Municipality coast, Rio de Janeiro State, Brazil

Luana de Almeida Rangel[1]; Antonio Jose Teixeira Guerra[2]

D.Sc in Geography at Federal University of Rio de Janeiro – Geography Department, Federal University of Rio de Janeiro - Athos da Silveira Ramos Avenue, 274, Rio de Janeiro State, 21940- 590, Brazil (luarangel24@gmail.com)[1]; PhD in Soil Erosion at London University - Geography Department, Federal University of Rio de Janeiro - Athos da Silveira Ramos Avenue, 274, Rio de Janeiro State, 21940- 590, Brazil[2]

In humid tropical areas, water erosion is a major cause of soil loss. An analysis of the microtopography, soil compaction and soil quality allows inferring areas that are suffering with erosive processes. The use of trails in Protected Areas, can cause impacts when there is no planning and management suitable for their implementation and use. This research work aims at analyzing soil quality on a trail located on the coast of Serra da Bocaina National Park (PNSB), in Paraty Municipality, Rio de Janeiro State. To reach this target, soil microtopography was monitored using the erosion bridge method (EB), between 2016 and 2017. Soil compaction, through penetrometry (PN) was also assessed at two sites, on the trail. In addition, physical and chemical quality of the soils was assesed in three sites of the trail (PT), at 0-10 cm depth. Soil aggregates stability was performed according to the Yoder method (1936), texture and organic matter analysis were carried out following the methods of EMBRAPA-Brazil (2013). The trail is suffering with the effect of trampling, mainly in PN2, where the resistance to penetration was 29.12 kgf/cm², and with the removal of sediments by water erosion, mainly in EB 2, where the eroded area was approximately 0.21m². Regarding aggregate stability, PT3 was less stable (88.34%), while PT2 presented greater stability (97.73%). Organic matter contents corroborate the values found in the analysis of aggregate stability, PT3 presented the lowest values (3.43%) and PT2 presented the highest values (6.55%). Soil texture varied between Clay Loam (PT1), Sandy Clay Loam (PT 2) and Loam (PT 3). The highest concentrations of silt + fine sand, fine particles more susceptible to erosion were found in PT1 (45.07%) and PT3 (40.88%). In conclusion, the trail is suffering from intense trampling of the users, which is negatively affecting soil quality and influencing the occurrence of erosive processes, associated with runoff, such as the occurrence of microrills and rills.

Keywords: Soil compaction, soil microtopography, soil penetration resistance, soil quality.

Financial support: Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES), Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) e Fundação de Amparo à Pesquisa do Estado do Rio de Janeiro (FAPERJ).

(4596 - 2912) Use of tracer and digital filters for runoff separation: an aid to modeling soil erosion in catchments

Felipe Bernardi[1]; Jean Paolo Gomes Minella[1]; Claudia Alessandra Peixoto de Barros[2]; Daniel Allasia[1]; Alexandre Schlesner[1]
Federal University of Santa Maria,[1]; Federal University of Rio Grande do Sul[2]

Modeling sediment production requires precise hydrological control to quantify erosion processes. Erosion processes occur mainly due to the high kinetic energy of surface hydrological processes. In catchments, the water outlet is recorded in a hydrograph and composed of surface and subsurface flows. Thus, a valuable strategy for hydrological control and understanding of the erosive processes by modeling is the separation of these components in relation to their trajectory. For this, the use of conservative elements or properties of the hydrological system have been widely used. Tracers are elements that are conserved in specific phases of the hydrological process, thus allowing, through mass balance, to quantify different components. Another widely used method for separating flow is recursive digital filters (RDF), which are computational routines applied over the flow that remove the large amplitudes of the hydrograph associated to surface flow. Recursive digital filters are empirical models and numerous studies have shown positive correlation between RDF and tracers. Additionally, the responses of RDF are calibrated and validated by tracer observations, which enables the separation of the entire series. The Lajeado Ferreira catchment area, which is located in the municipality of Arvorezinha-RS in southern Brazil, was the subject of different sediment modeling studies. In order to verify the participation of the different flows, sample collection of the dissolved silica (DSi) tracer was performed to verify the behavior of the plot of each component in the hydrograph. With the use of these observations, the parameterization of the RDF model, which is called the Eckhardt filter, allowed flow separation of the river catchment, in addition to being coupled to erosion prediction models. Separation of the flow facilitates interpretation by the model of hydrological processes, such as infiltration, resulting in greater quantitative control over the superficial processes responsible for the production of sediments.

Keywords: Superficial flow, Hydrology, Sediment Yeld.
Financial support: CAPES and CNPq

C3.2.6 - Agricultural management to protect soil resource to support a growing population

(4809 - 2742) Abundance of microarthropods in conventional tillage and direct systems in areas under cultivation of *Nicotiana tabacum*

Vanessa Aparecida dos Santos Silva[1]; Gleidson Gimenes Rieff[1]; Victor Lucas Bassani[1]; Enilson Luiz Saccol de Sá[1]
Universidade Federal do Rio Grande do Sul – UFRGS, Laboratório de Microbiologia do Solo, 91540-000 - Porto Alegre - RS – Brasil.[1]

Management practices such as soil rotation in the conventional tillage system and the maintenance of straw in the no-tillage system and the use of monocultures can affect the diversity of mites and collembolans. The aim of this study was to verify the population dynamics of mites and collembolans and to monitor the degree of influence of soil management systems in areas under tobacco cultivation and to evaluate the potential use of these organisms as bioindicators.This work was conducted in Arvorezinha (Rio Grande do Sul state) watershed in two areas under tobacco cultivation, one under no - tillage system and another under conventional tillage system. Samplings were also made in native forest areas as a reference of the site. Soil samples were collected during the period of one crop cycle. The soil samples were removed with a metal cylinder (0 - 7.5 cm). Subsequently, the extraction of mites and collembolans has been performed by the Berlese-Tullgren Funnel method and the captured micro-arthropods were cataloged and identified. A total of 4744 individuals were captured, 2599 mites and 2145 collembolans,the lowest abundance was in the area under conventional tobacco cultivation. The native forest area located below the crop was also affected by the conventional cropping system. This cropping system had a greater impact on edaphic diversity than the no - tillage system.The same occurred also in the native forest area located below conventional cultivation, with a reduction in the abundance of Oribatidae families. From these results it is possible to observe the potential bio-indicator of the mites and collembolans. Tobacco cultivation systems have an impact on the diversity of microarthropods. However, we can see that in no-tillage there is less impact.

Keywords: Agro-ecosystem, Soil quality, Bio-indicators, Farming systems
Financial support: CNPq - Ministério da Ciência, SINDITABACO-Sindicato Interestadual da Indústria do Tabaco

(7858 - 656) Aggregate tensile strength in sugarcane areas with different cover crops and soil tillage system

Lenon Henrique Lovera[1]; Camila Viana Vieira Farhate[1]; Ingrid Nehmi de Oliveira[1]; Zigomar Menezes de Souza[1]; Elizeu de Souza Lima[1]; Diego Alexander Aguilera Esteban[1]; Fabio Henrique Barbosa Sandoval[1]; Euriana Guimarães[1]; Felipe Freitas Barbosa[1]
Unicamp/Feagri[1]

Aggregate tensile strength, defined as the force per unit area required to cause aggregate disruption, is a measure sensitive to the effects of land use and management systems on soil structure. Our aim was to assess aggregate tensile strength by applying different cover crops and soil tillage systems to sugarcane cultivation. We carried out the study at Santa Fe Mill experimental field, located in the municipality of Ibitinga-SP covering an area of typic Ultisol. The experiment implementation occurred in blocks in a subdivided-plots scheme containing four cover plants (sum hemp, millet, peanut and high biomass sorghum) and four soil tillage systems (no-tillage, minimum tillage, deep subsoiling, and conventional tillage), with three replicates. To establish the aggregate tensile strength, we collected deformed soil samples on the layers of 0.00-0.05, 0.05-0.10, 0.10-0.20, 0.20-0.30, and 0.30-0.70 m, while dry aggregates were obtained by a dry sieving in the size classes of 19.0 to 12.5 mm for carrying out the tests using a dynamometer. The aggregate tensile strength variability occurred mainly in depth, where the soil surface layers presented the formation of aggregates with lower tensile strength than the surface layers. Such results were probably influenced by the presence of the textural B horizon, peculiar to the Ultisol soil. As for the treatment effect, the use of legumes as cover plants (sum hemp and peanut) associated with deep subsoil system provided the formation of aggregates with higher tensile strength, 79 and 62 kPa, respectively. In contrast, the treatment with no-tillage for the millet presented the formation of aggregates with higher tensile strength, 71 kPa, 30% above the remaining treatments. The treatment with high biomass sorghum indicated no differences because of different soil preparation systems. Therefore, our results point out that each cover plan requires the use of a specific soil tillage system during sugarcane planting, aiming at the formation of more resistant aggregates to adverse management conditions.

Keywords: Soil structure, deep subsoil, no-tillage
Financial support: AGRISUS Foundation - Sustainable Agriculture (PA: 1439/15).

(9420 - 1226) Application of hydrogel and organic residue and their effects on soil chemical and biological attributes

Mirian Cristina Gomes Costa[1]; Mário Rógeson de Abreu Vasconcelos[1]; Paulo Furtado Mendes Filho[1]

Universidade Federal do Ceará[1]

Reforestation is a conservation practice needed to combat soil degradation in the Brazilian semi-arid region. Nevertheless, due to water deficit and low fertility of degraded soils, alternatives are necessary to enable reforestation in the region. Polyacrylamide hydrogels and the organic residue from carnauba palm, bagana (leaf fibers, byproduct of wax production), have been proposed for reforestation in the semi-arid region because, besides retaining water, these materials are believed to release nutrients and improve biological attributes in the soil. The present study evaluated soil chemical attributes and the presence of arbuscular mycorrhizal fungi (AMF) in response to hydrogel doses, with and without the addition of bagana. In February 2014, an experiment was installed in a degraded Haplic Planosol, using a randomized block design, in 2 x 4 factorial arrangement, with five replicates. Treatments consisted of four hydrogel doses (0.0, 4.0, 5.0 and 6.0 g L^{-1}), with and without the addition of bagana as top-dressing. Hydrogel was applied in the holes to which *Enterolobium contortisiliquum* (Vell.) Morong. seedlings were transplanted. In October 2015, soil samples were collected in the 0-20 cm layer to determine the contents of phosphorus (P), calcium (Ca), magnesium (Mg), potassium (K), sodium (Na), copper (Cu), iron (Fe), manganese (Mn) and zinc (Zn) in the soil, and to evaluate AMF colonization. The data were subjected to analysis of variance; regression analysis for the quantitative factor and means comparison for the qualitative factor. The highest hydrogel dose (6 g L^{-1}) reduced soil Ca and K contents in the treatments with and without bagana, which may result from the greater growth and higher absorption of nutrients by plants in this treatment. Without hydrogel (zero dose), soil Ca content was higher (1.6 $cmol_c$ kg^{-1}) without addition of bagana. With the hydrogel doses, soil Ca contents increased in the treatment with bagana. At the hydrogel dose 0.0 g L^{-1}, soil K contents were similar in the treatments with and without bagana (0.25 $cmol_c$ kg^{-1}), but from the hydrogel dose 4 g L^{-1} on, soil K contents increased in the treatment with bagana and decreased in the treatment without bagana. Zn contents linearly decreased in the soil that did not receive bagana. Mycorrhization was 54.4% under bagana application and 30.6% without the organic residue. Hydrogel doses also contributed to the increase of mycorrhization.

Keywords: Soil conditioner; nutrients; mycorrhizae.
Financial support: CAPES/Ministry of National Integration (Pró-Integration nº 55/2013), Embrapa, Brazilian Confederation of Agriculture and Livestock – CNA (Bioma Project).

(2819 - 2774) Assessment of crop combinations in small farms for local adaptation to rainfall variability and soil types in the semi-arid tropics

Yenumula Gerard Prasad*[1]; Ashok Kumar Singh[2]
ICAR-ATARI, HYDERABAD[1]; Indian Council of Agricultural Research[2]

Small farmers in the semi-arid tropics face increasing rainfall uncertainty during the crucial South-West monsoon cropping season (June-September). Crop performance is adversely affected due to late onset of monsoon leading to early season drought or prolonged dry spells after normal onset leading to mid season drought and sometimes early withdrawal of monsoon leading to terminal moisture stress. Soil type is a also crucial factor in responding to contingency situations in rainfed areas with low rainfall. Productivity and profitability of soybean is low when planted after the normal cut-off planting date (mid July). On-farm assessment of intercropping in soybean with pulse crop (pigeonpea) over four seasons gave higher grain equivalent yield and net returns over sole soybean especially when planting was delayed. Foxtail millet intercropped with pigeonpea (5:1) gave significantly higher average grain equivalent yields and net returns across the years compared to sole cropping. In case of cotton, intercropping with short duration pulse crops was particularly beneficial during deficit rainfall seasons. Intercropping of pearlmillet with short duration pigeonpea ensured higher grain equivalent yield along with fodder for livestock and enhanced profitability. Choice of crop cultivars of sorghum (*Sorghum vulgare*) and soil management practices depending on rainfall and soil type enhanced productivity and profitability for farmers in the semi-arid tracts. The evidences from on-farm assessment of appropriate crop choices and their combinations are being incorporated in local adaptation plans at the district level to combat changes in rainfall and enhanced the resilience of small farmers.

Keywords: Small farmers, semi-arid tropics, drought, soil type, intercropping, crop combinations, resilience
Financial support: Indian Council of Agricultural Research

(8094 - 2442) Assessment the efficient management indicators of irrigation in the production of avocado Hass (*Persea americana* Mill) in Colombia

Grajales Guzmán Luis Carlos[1]; Dorado Guerra Diana[1]; Rebolledo Roa Alexander[1]; Tafur Hermann Harold[2]
Corporación colombiana de investigación agropecuaria-Corpoica[1]; Universidad Nacional de Colombia sede Palmira[2]

The objective of this study was to evaluate environmental sustainability indicators to assess the efficiency of water supply and productivity in Hass avocado (Persea americana) in commercial orchards of three regions with the highest production in Colombia (Morales-Cauca, Rionegro-Antioquia and Herveo -Tolima). Edaphic variables (texture, usable water sheet and movement of water in the soil) and climatic variables (precipitation, temperature, relative humidity, wind speed and solar radiation) were considered in relation to the indicators evaluated. The indicators were Relative Water Supply (RWS), Relative Irrigation Supply (RIS), Relative Supply of Rainwater (RRS) and Water Use Efficiency (WUE), evaluated in two cycles of production, for three irrigation treatments based on the evapotranspiration of reference-ETo calculated by the FAO Penman-Monteith method (0.5ETo, 0.75ETo, 1.0ETo). The values of RWS were between 3.05 and 1.97, higher values 1.5, suggested as a minimum limit to establish that the water resource is being used efficiently and there is no overexploitation of the resource. The RRS allowed to establish that the irrigation satisfied the water needs of the crop in the deficit periods. The RIS indicator showed values between 2.46 and 0.91, indicating that the irrigation treatments supply the water requirements of the crop, with the treatment T2 (0.75ETo) being the most adequate. The highest WUE values were obtained with treatment T1 (0.5ETo) for the three localities, Herveo 9.55 kg / m^3, Morales 4.4 kg / m^3 and Rionegro 11.26 kg / m^3.

Keywords: Keywords: water use efficiency, water productivity, relative water supply, relative irrigation supply
Financial support: Corporación colombiana de investigación agropecuaria-CORPOICA

(6361 - 1354) Availability of land for sustainable sugarcane production: Case study for Colombia

Felipe Haenel Gomes[1]; Marcelo Melo Ramalho Moreira[2]; Mariane Romeiro[2]; Rafael Aldighieri Moraes[3]
UEM[1]; Agroícone[2]; Unicamp[3]

Modern and sustainable bioenergy production may be an effective way to substitute substantial portions of energy demand for transportation in the future. Since the overall scale of bioenergy production will in part depend on the availability of fertile land with good climatic conditions, it's clear that the world will consider the Latin America, the Caribbean and Africa for future expansion of bioenergy. The objective of this work is to provide a database of

potential areas for sustainable expansion of biofuels in Colombia, focusing on sugarcane for ethanol production, and is part of a bigger Project (LACAf/GSB – Latin American, Caribbean and African Countries/ GSB – Global Sustainable Bioenergy) with the objective to create a robust and updated perspective for sustainable bioenergy development in these regions. A logical sequence of updating, elaboration, overlapping and interpretation of satellites images, maps and databases with different characteristics to identify geographies with good potential for sustainable sugarcane ethanol production was proceeded. Land use and land cover map was updated using satellite images and deforestation data. Then, an edaphoclimatic map was obtained through a sequence of data crossing, including temperature, water deficit and soils. Areas with strong restrictions were excluded, generating a map of the edaphoclimatic potential for the sugarcane expansion. Finally, areas with moderate constraints were excluded, obtaining the map of soil and climatic potential for the sustainable sugarcane expansion. The results shown about 84.000 km² of suitable areas to expansion of sugarcane crops, and most of these areas are concentrated in the departments of Meta and Vichada, in the "Llanos Orientales", considering moderate and strong restrictions simultaneously. Although the area is suitable, soils do not present high potential, being limited by their chemical conditions, with low CEC and base saturation and often with the presence of exchangeable aluminum, but which can be easily corrected. They are, however, mostly fine textured, with good water storage capacity. It should be emphasized that in the Llanos Orientales it is possible that the expansion of sugarcane culture occurs in the extensive areas of underutilized pasture. And projects such as the use of hydrolyzed bagasse combined or not with the intensification of agriculture with integrated systems can, in the end, even increase the production of meat considering the same area.

Keywords: Bioenergy, biofuels, ethanol
Financial support: FAPESP

(6382 - 1925) Can terracing in no-till systems of South Brazil be a strategy to mitigate the water deficit in soybean cultivation?

Tiago Hörbe[1]; Jean Minella[1]; Paulo Gubiani[1]; Dinis Deuschle[1]; Ana Londero[1]; Alenxandre Schlessner[1]; Fábio Schneider[1]
UFSM[1]

Strategies to mitigate food and water safety are recurrent issues in agricultural research. The aim of this study was to evaluate terracing in no-tillage systems of South Brazil as a strategy to optimize soybean yield through the increase of moisture in the rooting layer of the crop. The study was conducted in the municipality of Júlio de Castilhos, in the middle plateau region of Rio Grande do Sul State during the agricultural year of 2016/17. The soil of the experimental area is classified as Nitisols, well drained and with low natural fertility. To conduct the experiment, two slopes, which are called zero-order catchments, with similar hydrological characteristics were chosen with the purpose of comparing them in terms of management. The management adopted in the experimental area of both catchments represents the most usual production system in the region, which is soybean cultivation in the summer and wheat/oats in the winter using no-tillage systems. Thus, the main difference between the paired catchments is the complementary practice of controlling surface flow (5 infiltration terraces) in one of them. The size of the study units is approximately 2.3 hectares each. The strategy of the study was to evaluate soybean yield through 5 paired transects between the catchments, totaling 47 georeferenced sampling points, with a sampled area to estimate the crop production of $2m^2$ per point. Four points were installed to monitor the available water refilling (R_{aw}) in eight layers in a profile of (0.0-1.5 m). One at the base and another at the top of each catchment. Sensors CS616 were used for soil water content measurement (Θ_i). Soil samples were taken to determine field capacity (Θ_{fc}) and the permanent wilting point (Θ_{pwp}) in order to estimate the maximum available water storage (S_{maw}, cm). With the summation in the monitored profile of (Θ_i-Θ_{pwp}), the current available water storage (S_{caw}, cm) was estimated. Hence, it was possible to calculate R_{aw} through the relation $R_{aw}= S_{caw}/S_{maw}$. Soybean yield differed between the monitored catchments, and the final mean for the catchments with and without terrace was 4.531 and 4.032 kg ha^{-1}, respectively. Similarly, the R_{aw} was higher in the terraced catchment, with an the average increase of 13%. In this way, the use of terracing optimized soybean yield and increased water productivity (kg/mm) by 12.4% even in a scenario of 667 mm accumulated and well distributed rainfall in the crop cycle.

Keywords: managing water, rainfed agriculture, conservation agriculture, water productivity
Financial support: CAPES

(4418 - 551) Carbon stock of physical fractions of organic soil matter in different management systems

Jean Sérgio Rosset[1]; Diego Henrique de Oliveira Morais[2]; Carla Aparecida da Silva[2]; Thais Melissa Dias dos Santos[2]; Leandro Marciano Marra[2]; Selene Cristina de Pierri Castilho[2]; Jefferson Matheus Barros Ozório[2]
State University of Mato Grosso do Sul, UEMS E-mail: jsrosset@hotmail.com[1]; State University of Mato Grosso do Sul, UEMS[2]

The present work had as objective to quantify the carbon stocks of the particulate organic matter (EstPOM) and mineral (EstMOM) of the soil under the influence of the different management systems in the municipality of Eldorado, MS. Four areas with different management systems were evaluated: permanent pasture area with *Brachiaria brizantha*, 12 years old (PP); area of no-till system in succession soybean/corn and cassava with 15 years of cultivation (NT); area of sugarcane cultivation for 11 years (SC) and an area of native forest (NF). Four areas of 400 m^2 were demarcated in the areas and the deformed and undisturbed samples were collected in the 0-0.05, 0.05-0.1 and 0.1-0.2 m layers. Soil density analysis was carried out to calculate the carbon stock of the soil organic matter (SOM) fractions, and the physical fractionation (sorption) separating the SOM in particulate organic matter (POM) and organic matter associated with minerals (MOM). C-POM contents were determined via wet, C-MOM obtained by difference between total organic carbon (TOC) and C-POM. From the results obtained from C-POM and C-MOM, the organic carbon stocks of each of these fractions were calculated according to the equivalent mass method. For the EstPOM, in the 0-0.05 m layer, the MN area presented the highest value, 6.12 Mg ha^{-1} and the SC area the lowest value, 2.68 Mg ha^{-1}. For the remaining layers, again the lowest values were found in the SC area. The smaller soil rotation in the NT and PP areas contributed to the fact that these areas did not have low EstPOMs such as the SC area. Observing the EstMOM in the most superficial layers of 0-0.05 and 0.05-0.1 m, the four areas studied were considered similar. MOM is not always considered a good indicator of the effect of soil management, as its cycling is slower and consequently takes longer to modify the inventory standards. For the 0.1-0.2 m layer, the MN and NT areas had the lowest values when compared to the PP area. The contribution of organic materials associated to the lower rate of soil rotation are the reasons for the higher carbon stocks of particulate organic matter that occurred in the PP, NT and MN areas in relation to the SC area. Particulate organic matter stocks were more efficient in detecting differentiated patterns of carbon accumulation in relation to mineral organic matter stocks.

Keywords: Soil quality, particulate organic matter, mineral organic matter.
Financial support: State University of Mato Grosso do Sul, UEMS

(5695 - 1447) Characterization of chemical attributes on soil management function

Elaine Araújo[1]; Katiaíres Evangelista Delpin Malvezi[1]; Luiz Gustavo Garbelini[1]; Gislaine Silva Pereira[1]; Igor Matheus Oliveira dos Santos[1]; Lucas Augusto de Assis Moraes[1]; Paula Pinheiro Sanches[1]; Laura Feuser Acco[1]; Adriana Pereira da Silva[1]
Universidade Estadual de Londrina[1]

The sustainability of agroecosystems is directly influenced by the effect of agricultural practices on soil structure. The aim of this study was to evaluate chemical attributes, in a dystroferric Red Latosol, with 24 years under no-tillage (NT) and conventional tillage (CT), in succession of cultures. The experimental area consisted of plots with 7.5 m wide by 30.0 m in length (225 m^2), with four repetitions per treatment, distributed with experimental design in randomized blocks, with two systems of soil management in succession soybean (summer) /corn (winter). The soil samples were collected in the winter of 2017, at the depth of 0-10 cm. The total organic carbon (TOC), total nitrogen (TN), C:N ratio, pH in $CaCl_2$, potential acidity (H+Al) and available phosphorus (Pavb.) have been evaluated. Only the TOC have showed significant difference between the managements, and superior content has been found in the NT (34.32 g dm^{-3}) compared to the CT (23.40 g dm^{-3}). On average, the increase of TOC in the NT has been 31.82% superior to the CT. This difference can be attributed to minor and maintenance of tickler plant residues on the soil surface that preserves its structure and contributes, through aggregation, for protection and stabilization of organic matter in that system. The value of the NT was 1.15 and 1.01 g dm^{-3}, respectively, to the NT and CT, whilst the C:N relationship was 30.05 and 23.62, respectively, for the same management. That result, possibly could be associated to the time of soil sampling, which corresponded with the dry and low temperatures, contributing to the maintenance of the N. The dynamics of this element in the soil is directly related to the content of organic matter, type of crop, especially its C:N relationship predecessor and soil type, the process of immobilization/mineralization regulated by weather conditions. For the H+Al attribute value was 5.97 and 6.33 cmolc dm^{-3}, respectively, to the NT and CT, while the pH in $CaCl_2$ was 5.15 and 5.09, respectively, for the same management. The absence of differences in these attributes coincided with the application of limestone (2 tons ha^{-1}) in all the plots before the summer harvest 2016/2017. For the Pavb, also there was no difference between NT (23.43 mg dm^{-3}) and CT (23.86 mg dm^{-3}), assigned to lower microbial activity at the time of collection, since microorganisms play a key role in the biogeochemical cycle of P and its availability in the soil.

Keywords: tillage, potential acidity, organic carbon, total nitrogen, phosphorus
Financial support: Financial support: CAPES (Coordination for the Improvement of Higher Education Personnel) and CNPq (National Council for Scientific and Technological Development).

(2893 - 754) Chemical P recovery from dairy manure using the Quick Wash process and use of low-P washed manure solids as soil amendments

Virginia Takata[1]; Ariel Szogi[2]; Paul Shumaker[2]
Facultad de Agronomía – Universidad de la República Oriental del Uruguay, Av. Garzón 780, 12900, Uruguay[1]; USDA-ARS Coastal Plains Soil, Water, and Plant Research Center, 2611 W. Lucas Street, 29501, Florence-SC, United States of America[2]

Large volumes of manure generated by intensive dairy production and their final land disposal is a significant environmental problem. Due to the imbalance of N and P (4;1), emendation of soils with dairy manure entails a raise in available soil P levels beyond the crops' capacity to absorb P. When emendations are applied to the soil at an agronomic N dose, there is an unnecessary P accumulation in the soils. In order to improve the N and P balance in animal waste prior to soil application, USDA-ARS, Florence, SC researchers developed a process for extracting P from manure solids using mineral or organic acid solutions, and recovery of P from the extract by adding lime and an organic polymer forming a calcium-containing P precipitate. The quick wash process has two products: 1) a washed manure solid with a N:P ratio optimal for use in crop production; and 2) a concentrated solid P material that can be used as an effective P fertilizer. This method can recover P in concentrated solid Ca phosphate. An experiment was made in order to evaluate P removal from dairy manure using the Quick Wash process. The experiment had two treatments (T1 and T2) and a control, with two replicates. In T1, the manure was acidified prior to being passed through a coarse sieve (12-mm). In T2, the manure was first passed through the 12-mm sieve before acid addition. The acid dose used in both treatments was 25 mmol L^{-1} of H_2SO_4. Thereafter, solids and liquid in the control, T1 and T2 were separated, and the acid extract was used to recover P by precipitation with lime at 2.2 g L^{-1} of 10 % $Ca(OH)_2$. Results for the control, T1 and T2 showed recoveries of 35, 44 and 58 % of P in the precipitate with respect to the initial P manure content. XRD analysis revealed that precipitated P was amorphous calcium phosphate with contents of 4, 7 and 8 % P_2O_5 for control, T1 and T2. We concluded that these precipitates can be used in a comparable way as fertilizer. Thereafter, the N:P ratios of the washed solids in control, T1 and T2 were 6.5, 8.8 and 11.3. Since the majority of C and N remained in washed solids, soil emendations with wash solids were further evaluated with respect to raw dairy manure application for their rate of C and N mineralization in a 70-day soil incubation. Further detailed discussion of the potential use of low-P manure emendations for soil C and N recycling will be included in our presentation.

Keywords: Uruguay; dairy effluent; pollution; soil
Financial support: Agencia Nacional de Investigación e Innovación (ANII), Uruguay

(9902 - 3004) Comparing point assessments of soil loss rates with RUSLE estimates in Fogo Island, Cape Verde, Africa

Tomás de Figueiredo[1]; Maria Clotilde Carré Chagas[2]; Zulimar Hernández[3]; Felicia Fonseca[4]
Instituto Politécnico de Bragança (IPB), Portugal[1]; Universidade Federal de Pelotas, Brasil/ Instituto Politécnico de Bragança, Portugal[2]; Universidade Autonoma de Madrid[3]; CIMO/ESA/Instituto Politécnico de Bragança, Portugal[4]

Soils developed on volcanic ash in dry climates, in general, are poorly structured and have a low bulk density, which are relevant factors when appraising their erodibility. In dry climates, intense rainfalls (in the short wet season) and scarce vegetation cover combine with high soil erodibility to export off-site large sediment volumes from eroded hill-slopes. Hence, soil conservation measures are required to reduce soil loss and improve food security. The volcanic Fogo Island, Cape Verde, depicts impressive erosional features all over the strong relief landscape. Conservation structures were built along the country's history and stone walled check dams are common in thalwegs, however, not always coupled with hillslope soil protection measures. Severe soil loss rates during erosive rainfalls lead to a quick decline in check dams performance. The study aimed at mapping soil erosion rates using the RUSLE equation in volcanic Island, and comparing model estimates with field assessments of sediment volume trapped in check dams. Data for mapping erosion rates consisted in: a detailed topographic map (5x5m resolution) to derive LS factor; 10-year daily

rainfall records from 12 stations to estimate R factor; field data from soil profiles description to calculate K factor; Landsat satellite images to identify vegetation index and estimate C factor. A published agroecological map supported map validation. Spatial data treatment, model run and map generation were performed in GIS environment. On check dams, built for erosion control in dry thalwegs, field measurements were taken on wall size, slope gradients of soil surface upstream, of thalweg and of contributing hillslopes. Enquiries to local farmers helped retrieving dates of check dam construction and infilling. Volume of sediment trapped was estimated from field measurements, referred to contributing area and to time of infilling, resulting in an erosion rate when converted to mass with soil bulk density determined from samples collected in the check dam infill. The erosion map generated matches with the main erosion-borne geomorphological features observed in the field, where higher erosion rates are mapped. Estimates from sediment trapped averaged 100 ton ha-1 year-1 in a 2 years infilling period. Model output in checkdam sites approaches this rate. Results confirm the need of combined hillslope and thalweg soil conservation measures to increase checkdams performant life-time.

Keywords: soil erosion; check dams; sediment trap; agriculture
Financial support: Work supported by SEMACA Project (UE MAC Interreg Program, 2007-2013), complemented with funds by IPB (2017).

(6966 - 2921) Conservationist use potential of the Manso river watershed, Minas Gerais - Brazil

Adriana Monteiro da Costa[1]; Hugo Henrique Cardosos de Salis[1]; Antônio Henrique Noronha Ribeiro[1]; Dayane Caroline Freitas Carvalho[1]; João Herbert Moreira Viana[2]
Federal University of Minas Gerais, 6627 Antônio Carlos Ave, 1st floor, room 108, Belo Horizonte – MG, 31270-901, Brazil, nucleoisza@gmail.com[1]; Embrapa Milho e Sorgo, MG 424 Highway Km 45, Rural Area, Sete Lagoas - MG, 35701-970, Brazil, João.herbert@embrapa.br[2]

The growing demand and the human pressure on the water resources are causing scarcity in many places in Brazil. The Environmental Productive Zoning System is the method used in Minas Gerais State for the environmental and socioeconomic characterization of the watersheds, and aims to guide the conservationist use of the resources, to simplify and to straight forward the management and the monitoring of the soil and water uses. It has three steps, the land use mapping, the conservationist use zoning and the water demand diagnostic. This work presents the conservationist use potential zoning, applied in the Manso river watershed, in the metropolitan region near Belo Horizonte, in Minas Gerais State (Brazil). For this purpose, the following materials were used: the Minas Gerais State soil map (1:650.000), the Minas Gerais State geological map (1:1.000.000) and the ALOS PALSAR digital elevation model (12.5 m resolution). The data were processed with the software SPRING v. 5.4.3, Quantum GIS v. 2.18.13 and Google Earth Pro ® 7.1.8.3036. Five potential classes were identified. The broader one is the average potential class, occupying 64% of the area. It presents Ultisols and Inceptisols in a hilly topography, overlying orthogneiss, mafic, ultramafic and meta-ultramafic rocks. The second broader one is the low potential class, with 26% of the area, presenting mainly Inceptisols in a very hilly topography. The regions with the high and the very high potential classes sum 8.5% of the area, and present Ultisols and Inceptisols. The former presents smooth rolling topography and the later a flat one, located in the depressed areas, with lowland Inceptisols. The region with the very low potential class is about 1% of the area, and presents Entisols in a mountainous topography, in the crests over itabirite rocks. The topography and the soils were the main determinant factors for the conservationist use potential in the watershed, and adequate soil use practices are recommended to warrant the sustainability of the watershed.

Keywords: Environmental Productive Zoning System, hydrographic basin, watershed management
Financial support: FAPEMIG; CNPQ, Universidade Federal de Minas Gerais, Fundação Agrisus

(7494 - 269) Corn consortium with *BRACHIARIA CV PIATÃ* submitted to soil management and phosphorus doses in the crop-livestock integration system on western Amazônia.

Gabriel Ferreira soares[1]; Fabio Regis de Souza[1]; Anderson Cristian Bergamin[1]; Ramom Antônio de Souza[1]; Melissa da Silva Pereira[1]; Luciana Sônia da Silva[1]; Weder Vinicius de Oliveira SilvaWeder Vinicius de Oliveira Silva[1]; Ana Claudia Scheer Willers[1]
Federal University of Rondônia Foundation[1]

The systems of crop-livestock integration arise to be an alternative for recuperate the pastures degraded and promoting a greater contributing with the vegetables waste, that improve the physics, quimical and biological quality of the soil. The work have as objective value the agronomic characteristics in consortium with corn (*Zea mays*) and *Brachiaria brizantha* cv. Piatã in the crop-livestock integration system submitted an a management of the soil with phosphorus doses in degraded pasture area at Zona da Mata Rondoniense. The work was carried in the municipality of Pimenta Bueno-RO at Fazenda Alto Alegre located at RO 010 Km 30, in area of degraded pasture in a Red-Yellow Latosols. The experimental delineation was completely randomized blocks in arrangement of subdivide parcels. The principal parcel consist in two treatments of soil management, limestone harrowing incorporated, limestone harrowing incorporated with subsoiling, limestone applied in surface, preparation just with harrowing, prepare with harrowing and subsoiling and parcel with no management. The sub-plots received phosphorus doses, which are: 133, 247, 362 476 e 591 kg de P_2O_5 ha^{-1}. The variables of the corn evaluated was: diameter of stem, the insertion height of cob, plant height, cob length, cob diameter, number of grains in each row, number of row in each cob and productivity. The variables of forage evaluated were: leaf blade, stem + sheath and total dry mass. Data collect was submitted an analyses of variance with 5% of probability, and when significant in the F test, was applied a Tukey test with 5% for qualitative factor, and a regression analyses for the quantitative, using a computer program ASSISTAT – STATISTICAL ASSISTANCE. The soil management with limestone incorporated increase the dry mass of leaf blade and the total of *Brachiaria brizantha* cv. Piatã cultivated in consortium with corn. The dose of 342,2 kg of P_2O_5 ha-1 presents an increase of 133,05% in relation of the witness, provide a dry mass of 1139,6 $kg.ha^{-1}$ result in a greater production of dry mass in the leaf blade for *Brachiaria brizantha* cv. Piatã. The production of corn is linearly respond the phosphate fertilization.

Keywords: *Brachiaria brizantha*. Pasture degraded. Phosphate fertilization.
Financial support: Fundação Agrisus

(6806 - 799) Dynamics of Carbon´s handling indices in management systems in the Conesul´s region of Mato Grosso do Sul

Camila Beatriz da Silva Souza[1]; Jean Sérgio Rosset[1]; Paulo Guilherme da Silva Farias[1]; Elias Faria[1]; Luan Soares Bispo[1]; Thais Melissa Dias dos Santos[1]; Leandro Marciano Marra[1]; Selene Cristina de Pierri Castilho[1]; Jefferson Matheus Barros Ozório[1]
UEMS[1]

Fractionation techniques of soil organic matter (SOM) provides detailed and conclusive results on the dynamics of SOM under

different forms of soil use. The objective of this work was to evaluate the dynamics of carbon management indices from the physical fractions of SOM in different management systems over time in the municipality of Mundo Novo, in the Conesul´s region of the state of Mato Grosso do Sul. Between 2016 and 2017 in Sandy-red Argissolo of sandy texture in three study areas: degraded pasture area with coast-cross (*Cynodon dactylon*) (pasture area - PA), degraded pasture area that was isolated and native tree species (reforestation) for recovery (area in recovery - AR) were planted, as well as a reference area of native forest (NF). Soil samples were collected in four replicates in each area, in the 0-0.05, 0.05-0.1 and 0.1-0.2 m layers at time zero month (March / 2016), after six months (September / 2016), and after 12 months (March / 2017) (time counted from the isolation and planting of native species in AR). After the sampling, the samples were processed in the laboratory, after which physical fractionation of the SOM was performed, particulate organic matter (POM) and mineral organic matter (MOM), with subsequent calculations of the following indexes: carbon stock index (CSI), lability of SOM (Lab), lability index (ILab) and carbon management index (CMI). AR had an increase in CSI values over time (0, 6 and 12 months). This results expresses the potential of increase of the organic carbon due to the adoption practices of recovery areas. The highest values of Lab were found in the MN area in layers of 0.05-0.1 and 0.1-0.2 m, both in the first collection, reaching 2.32 for the 0.05-0 layer, 1 m. Only the ILab was not efficient in detecting the main changes in the quality of the organic material. The BMI values of the AR were numerically higher than 100 (reference value), showing improvement in soil quality, being this characteristic more evident in the 0-0.05 m layer, where the values were 87.69, 106.92 and 134.52, in the first, second and third collection, respectively. The isolation and planting of native tree species in the recovering area significantly improved carbon management indices, especially in the 0-0.05 m layer, after 12 months.

Keywords: Soil organic matter, physical fractionation, soil quality.
Financial support: State University of Mato Grosso do Sul, UEMS - PIBIC and City Hall of Mundo Novo, MS.

(4789 - 820) Effect of inoculation with arbuscular mycorrhizal fungi and blanching on heavy metals chemical forms in edible parts of water spinach (*Ipomoea aquatic* Forsk)

Chun-Ming Lam[1]; Hung-Yu Lai[2]

Department of Post-Modern Agriculture, MingDao University[1]; Department of soil and Environmental Sciences, National Chung Hsing University[2]

The tolerance and detoxification mechanisms of plants for heavy metals are associated with chemical forms. In this study, water spinach (*Ipomoea aquatic* Forsk) was planted in the heavy metals-contaminated soils and inoculated with arbuscular mycorrhizal fungi. The objective is to assess the effect of changing the phosphorus concentration in the water spinach on the chemical forms of heavy metals in the edible parts. Blanching's effect on the concentration of trophically available heavy metals was also assessed. Experimental result showed that inoculation of arbuscular mycorrhizal fungi could improve the plant growth. It also decreased the accumulation of nickel but was opposite for cadmium. Inorganic form of cadmium and nickel are the major proportion in the water spinach. Blanching could decrease concentration of cadmium and nickel.

Keywords: arbuscular mycorrhizal fungi; chemical form; trophically available
Financial support: MOST 105-2313-B-005-044

(8815 - 1463) Effect of nitrogen doses on absorption, distribution and accumulation of sulfur in banana williams variety

Wilson Iván Torres Díaz[1]; Brayan Manuel Zabaleta Gonzalez[1]; Jaime Torres Bazurto[1]

Universidad Nacional de Colombia[1]

In the process of adjusting fertilization in banana for export, one of the elements that has been worked is nitrogen (N), whose effect on the absorption dynamics of other nutrients such as sulfur (S) is being studied. The objective of this investigation was to evaluate the effect of different doses of N on the absorption, distribution and accumulation of S in Williams variety banana in two production cycles, in a sixth generation crop. The S was quantified in plant tissue of all organs of the plant and in soil during five development stages per cycle. Five treatments were used, replicated four times taking into account the soil variability, namely; absolute control, 0 kg ha^{-1} of N, 161 kg ha^{-1}, 321.8 kg ha^{-1} and 483 kg ha^{-1} of N, using urea as a source. For data processing, the multivariate approach was used for the analysis of variance of the design in repeated measurements. The univariate and multivariate statistical analysis for plant accumulation and soil content showed significant differences between development stages and cycles, but not between treatments. The descriptive analysis for S content in soil, showed to harvest for the second cycle, values lower than 16 mg kg^{-1} in all treatments except in the 161 kg ha^{-1} of N, its behavior for the remaining development stages differs in the two cycles, this effect is associated with the changes in precipitation that occurred during the development of the investigation. Regarding the analyzes in vegetal tissue, the dose of 483 kg ha^{-1} of nitrogen stood out for obtaining the highest content of S in leaves. The values of S found and evaluated by organ, plant and soil, for each stage of development, allowed to select the doses of 161 and 483 kg ha^{-1} of N as the highest concentration.

Keywords: Musa AAA, sulfate anion, mineralization, dry matter, extraction.
Financial support: Cenibanano, Yara Colombia, Universidad Nacional de Colombia.

(3731 - 1855) Effect of severe fire disturbance on soil mites community assembly in greater xing'an mountain,china

Lin Yinghua[1]; Wang Jing[1]; Liu Dandan[1]; Jin Yusong[2]; Li Huiren[3]; Liu Fangrui[3]; Liu Xueshuang[3]; Wei Changlei[3]; Wang Lizhong[3]

Institute of Wetland Research, Chinese Academy of Forestry, Beijing 100091,P.R China.[1]; School of Forestry, Northeast University of Forestry, Harbin, Heilongjiang, 150040 ,P.R. China[2]; Research Institute of Agriculture and Forestry, Daxing'anling Forestry Group, Jiagedaqi, Heilongjiang,165000, ,P.R. China[3]

Fire disturbance is an important disturbed factor in the forestry ecology, which s often lead to changes in environmental conditions, soil animal species diversity and ecosystem function, while the effect of servere fire disturbance on soil animal community assembly is poorly understand in Coniferous broad-leaved mixed forest at Great Xing'an Mountain, China. To understand how ground dwelling soil mite community assembled after severe fire disturbance, we studied ground dwelling soil mite community assembled under servere burned Coniferous broad-leaved mixed forest with a history of more than 10 years of servere fire disturbance area at Nan wenghe National Nature Reserve, Great Xing'an Mountain, Northeast of China. Using a spatially delimited sampling design, 81 samples were collected by pitfall traps in a 20m×20m area, and soil samples were taken to quantify several soil properties (soil organic carbon, soil total nitrogen, soil total phosphorus, pH, soil moisture). Results of variation partitioning showed that 10 years after servere fire,soil mites community composition was controlled by space of independent of environment (10.71%) at scale of quadrate (20m×20m). The contribution of environmental filtering was relatively low and only soil moisture had significant effect on soil mites assembly based on RDA analysis($p < 0.01$). The null model revealed soil mite community was non-random co-occurrence pattern, and a weak function of biotic

interaction based on body size ration and environment niche overlap. Our result indicate that dispersal limitation is a important regulators in soil mite community composition at Coniferous broad-leaved mixed forest with a history of more than 10 years of the servere fire disturbance.This study was supported by National Natural Science Foundation of China (No.31570603)

Keywords: disperal limitation, biotic interaction, environment factor,Coniferous broad-leaved mixed forest

Financial support: This study was supported by National Natural Science Foundation of China (No.31570603)

(8387 - 1513) Effect of the application of copper on the communities of mites and collembolans edaphic in an area under grape cultivation

Gleidson Gimenes Rieff[1]; Vanessa Aparecida dos Santos Silva[1]; Naihana Schaffer[1]; Victor Lucas Bassani[1]; Lucas da Ressurreição Garrido[2]; Enilson Luiz Saccol de Sá[3]

Universidade Federal do Rio Grande do Sul – UFRGS, Laboratório de Microbiologia do Solo, 91540-000 - Porto Alegre - RS – Brasil[1]; Embrapa Uva e Vinho, Laboratório de Fitopatologia, 95700-000 - Bento Gonçalves, RS – Brasil[2]; Universidade Federal do Rio Grande do Sul – UFRGS, Laboratório de Microbiologia do Solo, 91540-000 - Porto Alegre - RS – Brasil.[3]

The use of monitoring of mites and collembolans diversity can contribute to the study of changes in soil biological quality. The edaphic mesofauna responds to many environmental variables, with variations in the densities and alterations of the community structures and, therefore, may indicate environmental stresses. In the vines the application of Bordeaux ($CuSO_4$) was used as a fungicide for the control of mildew caused by *Plasmopara vitícola*. However, according to Normative Instruction 46/2011 of the "*Ministério da Agricultura Pecuária e Abastecimento*" limits the maximum amount of copper 6 kg ha^{-1} ano^{-1}. However, toxic amounts are being observed in grape growing area in the RS State, above 100 mg $CuSO_4$ kg^{-1} soil. Over time, copper can accumulate in the soil causing changes in edaphic biodiversity. Changes in the soil contribute to the reduction of biodiversity, impacts on the biogeochemical cycles, problems in the cycling of nutrients, etc. The objective of this study was to monitor the mites and collembolans population in areas under grape cultivation with a long history of $CuSO_4$ application. Soil samples were collected during the years 2016 and 2017 in three areas, two under grape cultivation with over 100 years of $CuSO_4$ application and one native forest area (reference). From each point a sample was withdrawn by inserting a metal cylinder (7.5 cm high by 7.0 in diameter). The samples were wrapped in plastic wrap and packed in polystyrene boxes to be transported to the Laboratory of Soil Microbiology - UFRGS. The methodology used for extraction, capture and identification of the groups of micro-arthropods was that of the Berlese-Tullgren funnel. The specimens of mites and collembolans were visualized in a stereoscopic microscope, with an increase of 40x and fixed in microscopic slides. The identification of the families was performed under a phase contrast microscope. Areas under cultivation of vines with high copper content affected the specimens of mites and collembolans. This shows the potential bioindicator of these edaphic mesofauna to diagnose changes in soil biological quality caused by the excessive use of $CuSO_4$ applications above the pre-established limit.

Keywords: Agro-ecosystem; Soil quality; Bio-indicators Farming systems

Financial support: Capes - Coordenação de Aperfeiçoamento de Pessoal de Nível Superior; CNPq - Ministério da Ciência, Tecnologia, Inovações e Comunicações; Renovitis – Embrapa Uva e Vinho

(5887 - 329) Evaluation of physical soil attributes of subirrigated lowland in the Araguaia Valley

Marcio Nikkel[1]; Saulo de Oliveira Lima[1]; Danilo Pereira Ramos[1]; Guillermo Arturo Herrera Chan[1]

Universidade Federal do Tocantins[1]

The evaluation of soil physical attributes is important for soil behavioral prediction. Physical attributes help to evaluate the situation of an agricultural soil and once compared to a nearby native area, it can be interpreted if the management in the area is maintaining its natural attributes or promoting degradation. The northern region of the Araguaia Valley, in Tocantins, Brazil, has been shown to be a region of strong agricultural ability, with soybean, common beans and cucurbit under subirrigation system. Therefore, the objective of this work was to evaluate soil physical attributes of two subirrigated areas in the south of Tocantins and to compare them with soil from an adjacent native area. The work was carried out in the municipality of Lagoa da Confusão in October 2016. The soil, classified as PLINTHOSOL, was covered with the cultural remains of the previous crop (soybean), awaiting the sowing of rice, 2016/2017 season. In the agricultural areas as well as in the adjacent native area, undisturbed soil samples were collected from 0 to 0,10 m; 0,10 – 0,20 m and 0,20 – 0,30 m for total porosity, macro and microporosity and density. PR were obtained with an impact penetrometer. The comparison of the means was done by the Scott-Knott test, at 5% probability. Macroporosity had a statistical difference between the areas and depths, with relatively higher values in the native area. One of the agricultural areas had lower value while the other area and native area presented higher values. At the superficial layer one of the areas presented greater value when compared to the other area and forest area. There was a statistical difference on soil density between the evaluated areas, with higher values in the agricultural land compared to the native area. Regarding PR, there was a statistical difference in the mean of the areas, however, the depths did not present statistical difference. The comparison between the three areas showed values above 2.5 MPa, considered restrictive. In general the values ranged from 2.36 to 4.16 MPa. The conclusion was that soil physical attributes such as macroporosity and density were altered by soil management. Soil compaction was observed in one of two areas analyzed, with values considered restrictive to root development. However, when comparing with values of the native forest, the soil management has been conducted in a satisfactory way, not promoting soil deterioration in a large scale.

Keywords: soil management, porosity, tropical lowland

Financial support: Capes (National Council for the Improvement of Higher Education)

(3728 - 2718) Evaluation of the biometric characteristics of eucalyptus clones at different degrees of soil compaction

Jéssica Conceição Nunes Silva[1]; Júlio César Lima Neves[1]; Teógenes Senna de Oliveira[1]

University Federal of Viçosa[1]

The increase of the operations with machines on and in the soil are modifying their physical condition, favoring the reduction of the porous space, with repercussions in several properties of the soil and also in the development of plants. In view of the above, the objective of this work was to evaluate the growth in height, diameter, leaf area and mass production of shoot dry matter (MMSPA) of eucalyptus seedlings when submitted to three levels of soil compaction under controlled conditions. The experiment was conducted in a greenhouse, using material from a Red Yellow Latosol (LVA) collected in the 20-40 cm layer of the area, in Viçosa-MG. Eucalyptus seedlings of 16 clones from the (Eucalyptus grandis Hill ex Maiden x Eucalyptus urophylla ST Blake) crossing of the company Celulose Nipo-Brasileira S / A (Cenibra) were used in a three-compaction structure: 80% of the soil) (GC1); 87% (GC2) and (92%). Humidity was maintained at field

capacity, soil chemically corrected for requirements and plants conducted for 60 days. The cultivation of the seedlings was carried out in pots formed by PVC pipes of 0,25 m of height and diameter of 0,10 m, totaling a volume of 0.0020 m³ of soil per pot. The evaluations involved the biometry of the aerial part (height, dry mass and leaf area) with the aid of a ruler and digital caliper for the measurements of the aerial part and the meter of leaf area Liquor model LI-3100. The experimental design was a completely randomized design, in a 3 x 16 factorial scheme, with three degrees of compaction and 16 clones, using four replications, totaling 192 sample units. The data were submitted to analysis of variance, the means being compared by the Tukey test at 5% of probability, using SPSS software. Significant differences were observed among clones evaluated for growth in height and diameter ($p < 0.000$), especially clones C7, C9 and C2, which obtained the highest growth in density of 1.20 kg / dm³ (GC2). The clones that obtained the largest increases in diameter were C7, C1 and C5, being the diameter significantly influencing by the degree of soil compaction. The specific leaf area was higher in GC2 (195.48 cm² / g). There were significant differences in the evaluation of MMSPA as a function of the evaluated densities and clones ($p < 0.01$) with 19.95 g in GC2 and 16.67 g in GC3 showing the influence of the increase in density on the dry mass clones.

Keywords: degree of compaction cloning growth
Financial support: CAPES and FAPEMIG

(4664 - 2975) Historical overview patterns of agricultural areas and natural vegetation cover in São Paulo state

Paulo André Tavares[1]; Gerd Sparovek[1]

Escola Superior de Agricultura Luiz de Queiroz[1]

Compensation is one of the ways to comply with the liablities provided from the Brazilian Law as a counterbalancing mechanism for non-mitigable environmental impacts, which allows owners or holders of rural properties not to comply with their Legal Reserve (LR) compensante in another propreties with surpluses of native vegetation. Non-fulfliment to with liabilities leads to the owners punishment with administrative sanctions. However, according to article 68 of New Forest Act (NFA - 12.651/2012), rural owners that made a supression before 2008 july 22, area required to coply wih the liability in accordance with the legislation in frce at the time, withtout adaministrative sanctions. The complexy of the article's understanding in function of, for example, the different conceptualizationson vegetation contained in the previous laws, added to the difficulty of historical supression verification in relation to the legal framework, maskes the processes of deficit cover vegetation analisys anda consequently the signing of a "Term of Commitment" foreseen in the Environmental Regularization Program (ERP) a weak process. This project aims to analyze an interpretation of the rules for demarcation of areas conserved in rural properties in laws prior to Federal Law 12.651/2012, to generate models of potencial areas of native vegetation cover and agricultural operations in the 1920's, for understand the evolution of agriculture, providing the public authority a tool for effective implemetation of the ERP in São Paulo State

Keywords: Agricultural Suitability, Native Vegetation, GIS, New Forest Act
Financial support: FAPESP

(2099 - 1167) Hydrological monitoring in small rural catchments as a tool in adopting soil and water conservation practices

Danrlei de Menezes[1]; Jean Paolo Gomes Minella[1]

Universidade Federal de Santa Maria[1]

The hydrological monitoring of small catchments makes it possible to understand soil and water degradation mechanisms and, consequently, can help in planning conservationist practices at landscape scale. However, hydrological data, such as runnoff and its associated processes, in small catchments are rare, consequently making it difficult to define the most efficient practices at this scale, since most studies are focused on plots or large catchments. The interpretation of the temporal pattern of the characteristic variables (precipitation, streamflow and sediment concentration) and their relationships contribute to: a) the description of degradation control mechanisms, b) the parameterization of hydrological and erosive processes, and c) aiding in choosing soil and water management measures. The objective of this work is to demonstrate, from a case study, how the hydrological monitoring of a small catchment can be used to infer about soil and water degradation processes, in addition to contribute to the recommendation of conservation practices. The study site is an experimental catchment with 120 ha, which is located in Arvorezinha (RS). Rugged relief, shallow soils and intensive farming system with high sediment production rate are typical characteristics of the experimental area. Monitoring is mainly based on obtaining data of precipitation, streamflow and sediment concentration at high frequency (10 min intervals), as well as monitoring variations in land use and management over time. Analysis of the processes occurs through the interpretation of the hydrographs and sedimentgraphs as a response to the rainfall events (hietograms) and different conditions of use and soil management. The main analyzes involved: a) determination of the magnitude of water and sediment losses in each event, b) variation of the relationship between streamflow and sediment production in response to climate influence, and c) determination of typical hydrological and erosive parameters of the study site The results express the influence of climate and use and management of water and soil losses along the events during the years, which enabled the selection and design of the best conservation practices in the catchment. The results also express how techniques of hydrological monitoring of small rural catchments can serve as a tool to support planning public policies aimed at soil and water conservation.

Keywords: Hydrological monitoring Erosion Soil and water conservation.
Financial support: CNPq – PIBIC

(5692 - 2345) Identification of soil use and occupation on the performance of center pivot

João Alberto Fischer Filho[1]; Yane de Freitas da Silva[1]; Katherine Viana Batista[1]; Aline Michelle da Silva Barbosa[1]; Anderson Prates Coelho[1]; Alexia Morello da Silva Cascaldi[1]; José Renato Zanini[1]; Alexandre Barcellos Dalri[1]

UNESP - Jaboticabal[1]

It is of great importance the preservation and recovery of natural resources in view of the high degree of environmental degradation, both in the urban and in the agricultural area. The use and the occupation of the soils exert influence in the superficial runoff and transport of sediments, being able to alter the quality and the availability of the water. The use of irrigation has the objective of increasing profitability, with increased production and quality, besides allowing cultivation in areas with a scarcity of rain, in which it would not be possible to cultivate without the application of water through irrigation. The study of irrigation systems with the appropriate use of the soil is of fundamental importance for the rational management of the water resources and contributes directly to avoid wastes and to promote an increase of the productivity of the cultures. The current study aimed to analyze the land use with the central pivot areas in the Northeast region of the state of São Paulo, Brazil. It was observed that 20% of the area is formed by forest region and 5% by urban area and that sugarcane is cultivated in more than 50% of the studied area, being of great importance for the development of the region. It should be noted that in several properties, the limits of permanents preservation area and the amount of water granted are not respected, causing influences to water resources. Center pivot irrigation is

present in approximately 10% of the area, corresponding to a total of 358 hectares, mainly irrigating annual crops such as beans, corn, and soybeans. The center pivots are installed in areas with an average slope of 1.8%, is considered ideal for maintenance, as well as future irrigation projects. The literature shows that center pivot systems are capable of operating on land with up to 30% slope. Nevertheless, very intense precipitations can be produced, favoring the erosive process; therefore, it is recommended that the terrain slope does not exceed 15%. It is concluded that the slope conditions in which the center pivots are present are favorable to this irrigation system, because they provide correct application of the amount of water, saving in electricity and an adequate use of the soil, avoiding losses due to erosion and leaching.

Keywords: irrigation, protect soil, water saving
Financial support: CAPES

(6768 - 1320) Impact of Rice production on soil health parameters: a study of two contrasting rice-growing Regions of Mozambique

David Fangueiro[1]; Obinna Ezeokoli[2]; Rasheed Adeleke[2]; Belo Afonso Muetanene[3]; Ana Ribeiro-Barros[1]; Ana M. P. Melo[1]; Irene Fraga[4]; Joao Coutinho[4]; Alexis Ndayiragije[5]

Instituto Superior de Agronomia, Portugal[1]; Agricultural Research Council, South Africa[2]; Lúrio University-Mozambique[3]; Universidade de Trás-os-Montes e Alto Douro, Portugal[4]; International Rice Research Institute[5]

Most of the rice (*Oryza sativa* L.) produced in Mozambique is cultivated in rainfed systems on clayey and hydromorphic soils with poor soil management. Rice yields vary significantly between geographical regions and indications are that it is due to differences in soil management practices which impact in soil quality. But, Information regarding the impact of rice cultivation on soil health parameters in Mozambique are lacking. Our study undertaken to investigate impacts of rice cultivation on soil health properties and identify some soil characteristics that potentially limit rice production. Soil samples were collected in Chokwe and Umbeluzi districts, where Makassane rice variety was grown. In each region, virgin areas (10 years fallow) were sampled as reference soils. Soil samples were collected at 10-cm depths for analyses of physical-chemical properties, enzymatic activity (urease, β-glucosidase, acid and alkaline phosphatases) and metagenomic analysis of soil bacterial (16S rRNA gene) communities using high-throughput sequencing. A significant decrease ($P < 0.05$) of organic matter content was observed in Chokwe region with rice cultivation. In both regions, a significant decrease of electrical conductivity was observed with rice growth compared to virgin areas, while soil pH followed the opposite trend. Rice production had a significant impact on acid and alkaline phosphatase but no clear effect was observed in other enzymes. Bacterial communities of rice-field soils significantly differed (PERMANOVA $P < 0.001$) between reference soils and rice-cultivated fields in both regions with up to 20.1% and 35.8% variations in the bacterial community in Chokwe and Umbeluzi, respectively. Taxonomic analysis revealed that the phylum Proteobacteria was most abundant in both locations. However, the relative abundance of Actinobacteria reduced with rice cultivation in Umbeluzi but not in Chokwe. A species indicator analysis further revealed that the relative abundance of certain plant-growth promoting bacteria like *Desulfobulus, Dechloromonas*, *Azospira*, or *Massilia* statistically differed between reference sites and rice-field soils. Over all, these preliminary results indicate that rice cultivation impacts the physico-chemical properties of soil and microbial communities. We also showed that physico-chemical properties might not be enough to identify soil alteration, highlighting the need to explore functional diversity and quantity of soil microbes.

Keywords: Rice, Tropical soils, Metagenomic, soil productivity
Financial support: Agricultural research for development in Portuguese speaking Africa: Enhancing Local Research Capacity, Contributing to Address Local Challenges IRRI (IRRI Ref. No. A-2014-98)

(6305 - 3213) Impact of the underground dam on soil chemical characteristics in of Arara the municipality, Paraiba State

Roseli Freire de Melo[1]; Anderson Ramos de Oliveira[1]; Jose Barbosa dos Anjos[1]; Tony Jarbas F. Cunha[1]

Embrapa Semiárido[1]

Study of the impact of the underground dam on soil chemical characteristics is of paramount importance for crop planning. For this environment to be closed there is a tendency of accumulation of sediments, and can contribute to the improvement of soil fertility. The aim of this study was to evaluate the impact of the underground dam on soil chemical characteristics in the cultivation or rainwater harvesting area. Composite soil samples were collected after the rainy season in three depths and in four environments; three environments in the dam area and one environment in a reference area (outside the dam in a cultivated area).The three environments, in the dam area, were divided in the beginning (area closest to the spillway), middle (approximately the middle of the dam) and end (considered the farthest part of the spillway). In its turn, each environment was separated into three positions: right side, left side and middle. The study was carried out in an underground dam located in the Arara municipality, Paraiba State, in 2016, approximately seven years after its construction The chemical analyzes of the soil samples were carried out in the soil laboratory of Embrapa Semiárido. The experiment was analyzed using a completely randomized design in a 12 x 3 factorial scheme, (12 environments and 3 depth), with three replications. According to the results, it was possible to verify that the soil chemical characteristics of the dam varied according to the location. The highest values of P, K, Ca, Mg, CEC and BS were found in the environment near the spillway and in the middle position, in the 0-20cm layer, decreasing in depth. These values are statistically higher than those found in the reference area, thus showing the contribution of the subterranean dam construction to the improvement of soil fertility. Additionally, the dam does not present soil salinity risks, presenting EC values varying from 0.12; 0.18 and 0.22 dS m-1 at depths of 0-20; 20-40 and 40-60cm, respectively. It was observed that the highest levels of organic matter were found in the surface of 0-20 cm, varying in the different environments and in depth, but in all dam environments presented higher values than the reference area. It was observed that the underground dam contributed to a positive change in the chemical characteristics of the soil, with greater evidence in the area near the spillway and in the superficial layer.

Keywords: soil fertility, rainwater harvesting technology, sedimentation
Financial support: Embrapa Semiárido

(2251 - 2772) *In vitro* dissolution of a remineralizer as an estimate of its performance in soil

Roseclênia Alves Santos[1]; Renata Alcarde Sermarini[1]; Rafael Cipriano da Silva[1]; Antonio Carlos de Azevedo[1]

ESALQ - USP[1]

Remineralizers (RM) are powdered rocks applied to soil to improve its quality and crop quantity and/or quality, and had their use regulated by the Brazilian Agriculture Ministry in 2016. Because the dissolution rate of RMs in soil are usually small, there is a necessity of a simple method to provide a rough and fast estimate of RM performance in soil. We tested the shaking of RM particles into centrifuge tubes. The results will be contrasted to an ongoing field experiment with the same RM. Here, the objective is to investigate if, among the three variables tested, there is a dominance of any of these factors on the RM dissolution. The RM particles were dry sieved, and three particle

sizes were chosen, Coarse Sand (CS = 1.0 to 0.5 mm); Fine Sand (FS = 0.25 to 0.125 mm), and Filler (FL = smaller than 0.05 mm) to be shaken in 50 mL Falcon tubes suspended into three solvents, deionized water (W), 0.01 mol L^{-1} citric acid solution (C), and 0.01 mol L^{-1} oxalic acid solution (O). The particle mass and solvent volume ratio was 1:4 (5.0000 g of particles into 20 mL of solvent) The RM grains were shaken for 14 hours (end-over-end shaker (120 cycles per minute), centrifuged and the supernatant removed and replaced by fresh solvents. Each run of 14 hours was one extraction (E). The experiment had 5 extractions. Electrical Conductivity and pH were taken immediately after the supernatants were obtained. Treatments were the combination of particle size and solvent, therefore there was nine combinations plus the control (only solvent), summing up 12 treatments, and five extractions. Each treatment had 4 replications. Group analysis were calculated using the results of pH and CE as response variables by the Ward method and the Euclidean distance, considering the average of the response variables for the combinations of factors: particle size (CS, FS, FL), solvent (W,C,O) and extraction (E1 to E5). The three sets generated grouped the results exactly according to the solvents, disregarding the other factors. The two first components of the principal components analysis represent 98.07% of the total variability. The results suggest that the performance of a RM may be strongly influenced by the type and concentration of organic acids produced by the local plant and soil microbe communities.

Keywords: Rock powder; Weathering; Soil resource; Solubilization
Financial support: ESALQ - USP; CNPq project 406600/2013-9

(9835 - 2697) Land recover and soil management by Agroforestry system

Marques, Maria Aparecida[1,2][1]; Delgado, Angel Ramon Sanchez[1][2]; Dunay Anna[2][3]
[1]Federal Rural University of Rio de Janeiro, Rodovia BR 465, Km 07 - Zona Rural, Seropédica - RJ, 23890-000, Brazil (mariamarquesadm@gmail.com)[1]; [1]Federal Rural University of Rio de Janeiro, Rodovia BR 465, Km 07 - Zona Rural, Seropédica - RJ, 23890-000, Brazil[2]; [2]Szent István University, Gödöllő, Páter Károly u. 1, 2100, Hungary[3]

Besides the many environmental functions and ecosystem service, the soil is the base resource to food production. Currently is pointed by FAO that approximately one-third of arable lands have degradation process. Most part of the degradation factors in the soil are erosion, low soil nutrition, soil salinization, soil compaction and soil contamination. Brazil is not different, soil degradation is present, mostly by inappropriate land management. Strategic policies are in developed aiming to mitigate this problem. The sustainable agriculture, as Agroforestry, is pointed as a possible path to mitigate and even recovery degraded areas. Beyond the technics, the knowledge must reach the farmers, due to the complexity of the systems. The aim of this study was to analyze the experiences with Agroforestry, applied in Australia and Africa, and to compare with Brazilian cases, to find the similarities in the application of the methods in these complex systems. By the compilation of the Agroforestry system methods, each degradation factor presented a specificity in the method that promotes a decreasing in the environmental degradation, such desertification, also the recovering the soil physical and chemical quality, restoration the water cycle, among others.

Keywords: Soil resource; soil recover; sustainable development; food security
Financial support: Federal Rural University of Rio de Janeiro; Tempus Foundation

(2599 - 2902) Leguminous mulch and nitrogen influences on soil penetration resistance and mayze growth in Arenic Hapludult soil

Lorena Silva Campos[1]; Jessica de Freitas Nunes[1]; Vinicius Ribamar Alencar Macedo[1]; Emanoel Gomes de Moura[1]
UEMA[1]

In tropical sandy loam soils, both available water capacity and nutrient availability are often limited. Furthermore the small content of free iron, organic carbon jointly with a large amounts of sandy particles tend to harden during drying which adversely affects root development. One of the feasible alternatives for increasing productivity is the use of mulch on the soil surface with leaves and branches of leguminous trees in order to increase crops productivity. This work is based on the hypothesis that the use of legume biomass in cohesion-prone soils may decrease water stress days, increase nitrogen efficiency. Therefore, the objective was to evaluate the effects of leguminous biomass on soil penetration resistance (SPR) and mayze growth. The experiment was conducted on State University of Maranhão field which had a hot, semi-humid, equatorial climate with two well-defined seasons and soil classified as Arenic Hapludults. The experiment was conducted under no-tillage conditions, with eight different treatments: 6-day irrigation intervals in bare soil (6S) or covered (6C), 6-day irrigation intervals with soil covered and nitrogen (6CN) or nitrogen in bare soil (6N), 9-day irrigation intervals in bare soil (9S) or covered (9C), 9-day irrigation intervals with soil covered and nitrogen (9CN), or bare soil and nitrogen (9N). The SPR was measured with 5-cm gradations until 20 cm using a digital penetrometer. In the 0- to 5-cm treatment, comparing the the 9C and 9S measurements, there was no significant difference in SPR. In the layer of 6-10 cm, mulching decreased the resistance only when added nitrogen. In the range of 11-15 cm the SPR was lower in all treatments with coverage. From 16 to 20 cm the resistance was lower in 9CN than 9N. The results show that mulching can reduce three days of water stress in the presence of nitrogen. The use of the 9-day irrigation interval with plant cover (9 CN) compared to 6 days without mulch (6 N), both in the presence of N, developed the same rate of growth for the crop, which means greater efficiency in use of nitrogen and water. Therefore, the usage of mulch with nitrogen have demonstrated to be a good solution in order to increase maize productivity.

Keywords: Mulching; nitrogen; mayze.
Financial support: FAPEMA

(4378 - 1486) Long-term application of liquid dairy manure in no-tillage: effects on water, soil, and phosphorus loss by runoff under natural rainfall

Nerilde Favaretto[1]; Verediana F. Cherobim[1]; Gabriel Barth[2]; Volnei Pauletti[1]; Jeferson Dieckow[1]; Fabiane M. Vezzani[1]
Department of Soil Science and Agricultural Engineering - Federal University of Paraná, Curitiba, Paraná, Brazil[1]; Foundation for Agricultural Assistance and Technical Divulgation, Curitiba, Paraná Brazil[2]

Milk production generates a large amount of waste, which is disposed on agricultural fields, improving soil quality and crop yields. On the other hand, manure application without criteria can cause environmental problems. The objective of this study was to report the effects of long-term (10 years) application of liquid dairy manure (LDM) on runoff, soil and phosphorus losses in no-tillage under natural rainfall. The study was conducted at two research sites of the ABC Foundation, Paraná state, Brazil: 1) located in Ponta Grossa, started in November 2005 in a dystrophic red-yellow oxisol (sandy clay loam texture with 13% slope); 2) located in Castro, started in May 2006 in a dystrophic oxisol (clayey texture with 10% slope). Treatments consisted of four LDM (0, 60, 120, 180 m^3 ha^{-1} $year^{-1}$) displayed in a randomized complete block design with four replications. The manure was applied on soil surface in the winter and summer crops in 29.75

m² plot bounded by metal strip. The no-tillage had been practiced at the two research sites prior to the first application of LDM for more than 15 years, then, no-tillage practices continued to be applied along with annual applications of liquid dairy manure for the next 10 years in a crop rotation with black oat and wheat in the winter and soybean and maize in the summer. The surface runoff was sampled and analysed after each rainfall event for 10 years. Application of LDM reduced losses of water, soil and dissolved reactive phosphorus with lowest values, in general, at 120 m^3 ha^{-1} $year^{-1}$, in both oxisols (sandy clay loam and clayey soil textures). However, the weighted mean concentration of dissolved reactive phosphorus increased with LDM application. Overall, the losses of water, soil and phosphorus were low compared to intensive agricultural system, even in the treatment with no LDM application, indicating the efficiency of no-tillage on soil and water conservation. In practical terms, considering the potential risk of water pollution, it is recommended best management practices to avoid the surface runoff to reach the aquatic system providing agronomic benefits and minimizing environmental problems

Keywords: Conservation tillage; organic fertilization; water quality; eutrophication.

Financial support: National Council for Scientific and Technological Development (CNPq); Coordination for the Improvement of Higher Education Personnel (CAPES); Foundation for Agricultural Assistance and Technical Divulgation (ABC Foundation)

(2995 - 2031) Mechanical resistance to the penetration of a Red Oxisol under different forest systems in the Cerrado.

Diego dos Santos Pereira[1]; Christtiane Fernandes Oliveira[1]; Rafael Montanari[1]; Alan Rodrigo Panosso[1]; Leandro Alves Freitas[2]; Eduardo de Lima Felix[1]; Joel Francisco dos Santos[1]; Jaqueline Bonfim de Carvalho[1]; Jean Carlos de Almeida Ramos[1]

São Paulo State University (UNESP)[1]; Federal University of Technology Paraná (UTFPR)[2]

The expansion of pine and eucalyptus forests has occupied large areas in the Brazilian Cerrado. However, there are few studies on the impacts these forests can have on the soil. The mechanical resistance to penetration (RP) has been used as an indicator of soil compaction, as it is a parameter of easy determination and is directly related to the root growth of the plants. Monitoring and periodically evaluating this attribute becomes important as a subsidy for the adoption of rational soil management systems. In this sense, the objective of the work was to evaluate the RP of a dystrophic Red Oxisol, reforested with Pinus, Eucalyptus and a Ciliary forest. The experiment was conducted in three areas of the Teaching and Research Treasury, Faculty of Engineering of Ilha Solteira (UNESP), located in the municipality of Selvíria-MS, the soil is classified as a dystrophic Red Oxisol, and is being used as a reforestation with Pinus (*Pinus caribeae* var. *Hondurensis*), Eucalyptus (*Eucalyptus camaldulensis*) and a Ciliary forest reforested with native species over 30 years old. The RP was evaluated in 25 points per area, obtained by means of an impact penetrometer, in the 0.00-0.10 layers; 0.10-0.20; 0.20-0.30 and 0.30-0.40 m. The values obtained in each area were compared using the Tukey test at 5% probability. The values of RP in the area under Ciliary forest, RP1 (2.575 MPa) and RP2 (4.377 MPa), and in the area under Pinus, RP1 (2,020 MPa) and RP2 (4,349 MPa), were statistically the same, and both treatments presented the same values, lower values of RP1 and RP2, when compared to the Eucalyptus area, with RP1 (4,694 MPa) and RP2 (6,200 MPa). The soil of the Ciliary forest presented higher values of soil moisture due to shading and the accumulation of organic matter from litter from the trees, contributing to the lower values of RP1 and RP2. The RP4 (5.264 MPa) area was statistically equal to the values obtained in the areas of Pinus RP4 (6,010 MPa) and Eucalyptus (4,323 MPa), and the area under Pinus culture presented the highest value of RP4. It is probable that the low water content in the deepest layer evaluated in the Pinus area has caused an increase of the cohesion between the mineral particles of the soil, making them more difficult to be separated by external forces, resulting in the increase of RP4. The values of RP1 and RP2 were higher in the Eucalyptus area, while RP4 was higher in the Pinus area.

Keywords: Eucalyptus, Pinus, Ciliary forest, mechanical resistance to penetration.

Financial support: CAPES, FAPESP

(4501 - 1614) Microbiological attributes as indicators of soil quality in agricultural management

Elaine Araújo[1]; Luiz Gustavo Garbelini[1]; Gislaine Silva Pereira[2]; Igor Matheus Oliveira dos Santos[1]; Lucas Augusto de Assis Moraes[1]; Paula Pinheiro Sanches[1]; Laura Feuser Acco[1]; César Yoshio Muraoka[1]; Amanda Letícia Pit Nunes[1]; Adriana Pereira da Silva[1]

Universidade Estadual de Londrina[1]; Universidade Estadual e Londrina[2]

Microorganisms have gained prominence due to their role in the operation and soil quality, being considered critical components agro ecosystems, regulate the decomposition of the organic material and biogeochemical cycles, with effect on fertility and nutrition of plants. The aim of this study was to evaluate microbial attributes, in a dystroferric Red Latosol, with 24 years under no-tillage (NT) and conventional tillage (CT), in succession of cultures. The experimental area consisted of plots with 7.5 m wide by 30.0 m in length, with four repetitions (four servings) per treatment, distributed with experimental design in randomized blocks, with two systems of soil management (NT and CT) in succession soybean (summer)/ corn (winter). The soil samples were collected in the winter of 2017, at the depth of 0-10 cm. Carbon and nitrogen of microbial biomass were evaluated (MB-C and MB-N), by fumigation-extraction method, basal respiration (BR), total organic carbon (TOC), metabolic (*q*Met) and microbial (*q*MIC) quotients. The contents of MB-C and MB-N were significantly higher in the NT compared to CT. For the MB-C, the contents found in the NT (136.97 mg kg^{-1} of dry soil) were 45% higher than that obtained in the CT (75.19 mg kg^{-1} of dry soil). In the case of the MB-N, the CT presented only 41% of the biomass observed in NT. The NT system benefits the formation and stabilization of macro-aggregates, which combined with ongoing coverage maintenance, provides an environment with greater availability of organic matter, moisture retention and lower thermal oscillations and hydropower. These factors improve the structural quality of the soil, protect the habitat of the microorganisms, leading to higher levels of microbial biomass in that system. For the BR there was no significant difference, possibly due to soil sampling have been carried out in the winter. The 50% higher qCO_2 was on CT (1.09 mg CO_2-C g^{-1} h^{-1} CBM) compared to the NT (0.55 mg CO_2-C g^{-1} h^{-1} CBM), indicating less efficiency in nutrient mineralization and immobilization by soil microorganisms. The TOC was 32% higher in NT (34.32 mg kg^{-1}) compared to the CT (23.40 mg kg^{-1}). The increment of TOC in the NT surface is due to the continuous supply of organic matter added to the soil via cultural waste. For the *q*MIC, there wasn't observed difference between treatments, however variation in this attribute suggest changes in the conversation efficiency from organic-C to microbial-C, C losses and stabilization.

Keywords: microbial biomass, basal respiration, metabolic quotient (qCO_2), microbial quotient (*q*MIC).

Financial support: CAPES e CNPq

(5148 - 222) Nutrient activation of different coverage plants in sugarcane areas

Euriana Maria Guimarães[1]; Camila Viana Vieira Farhate[1]; Zigomar

Menezes de Souza[1]; José Luiz Rodrigues Torres[2]; Lenon Herique Lovera[1]; Ingrid Nehmi de Oliveira[1]
State University of Campinas (Unicamp), Agricultural Engineering (Feagri)[1]; Federal Institute of Triângulo Mineiro Campus Uberaba[2]

Significant increase in planted areas for sugarcane production has been supported on new technologies and high crop mechanization index. Such scenario has led to mechanized harvesting of most of the cultivated areas in the country, which is considered a world-class technology with recognized environmental and economic benefits. However, intensive sugarcane cultivation characterized by monoculture, intense soil revolt and machine traffic are all factors which caused an accelerated process of soil degradation. Therefore, more comprehensive research on the optimum use for cover crops along the sugarcane off-season planting is required. In this context, our aim was to quantify the accumulation of macro and micronutrients in different hedge plants used as green fertilizers in sugarcane areas production. We carried out our study under field conditions at Santa Fe Mill, an experimental area in the municipality of Ibitinga, São Paulo, Brazil. Our experimental design was a randomized block with three replications and four crops as cover plants: i) sum hemp (IAC KR1), ii) Millet (BRS 1501), iii) Peanut (Runner IAC 886), and iv) High biomass sorghum (BD 7607). Each experimental unit was 90 m long and 10 m wide, covering an area of 900 m^2. At the point of maximum flowering, the plants were sampled for analysis of dry biomass as well as accumulation of macro and micronutrients. The use of high biomass sorghum provided the highest values of dry biomass, having reached a production of 21 Mg ha^{-1}, followed by sum hemp and millet, which produced 11 and 10 Mg ha^{-1}, respectively. Peanut was the cover plant which provided the lowest biomass production, only 5 Mg ha^{-1}. Regarding the accumulation of macronutrients, we observed that sum hemp and sorghum provided higher accumulations of nitrogen (N), potassium (K), and calcium (Ca). However, sorghum is highlighted with higher accumulations of magnesium (Mg) and sulfur (S). As for the accumulation of micronutrients, in general, sum hemp and sorghum presented higher values than the remaining treatments. Therefore, the use of high biomass sorghum provides good soil cover and allows higher accumulation of both macro and micronutrients, with the cover plant with the highest potential to supply the nutritional need of the sugarcane crop.

Keywords: High biomass sorghum, macronutrients, micronutrients
Financial support: AGRISUS Foundation - Sustainable Agriculture (PA: 1439/15)

(1015 - 1406) Participative Quality Index for the No-Till System (IQP) and Soil Structure Rapid Diagnosis (DRES)

Amanda Letícia Pit Nunes[1]; Ana Carolina Polinarski Coqueiro[1]; Adriana Pereira da Silva[1]; Jeankleber Bortoluzzi[2]; Cassio Wandscheer[3]; Hudson Carlos Lissoni Leonardo[2]; George Gardner Brown[4]; Marie Luise Caroline Bartz[5]; Ricardo Ralisch[1]
Universidade Estadual de Londrina[1]; Federação Brasileira de Plantio Direto e Irrigação[2]; Itaipu Binacional[3]; Embrapa Floresta[4]; Universidade Positivo[5]

The Participative Quality Index for the No-Till System (IQP) is a management tool that qualifies and monitors the quality of the No Till-System (NTS) in Brazilian conditions, by a participative methodology, which involved farmers to decide about the 8 indicators used to give a note between 0 to 10. The Brazilian Federation of No-Till System and Irrigation (FEBRAPDP) developed the tool in partnership with Itaipu Binacional based in scientific data, to promote the best ways to adopt the NTS. The soil structure is a fundamental characteristic of its fertility, being directly altered by the management, mainly its topsoil. Therefore, soil quality and management can be evaluated and monitored by the quality of topsoil structure. A new methodology for rapid assessment of topsoil structure (Soil Structure Rapid Diagnosis – DRES) was proposed by Londrina State University (UEL), FEBRAPDP, Embrapa Soils, Embrapa Soybean, Embrapa Wheat and Embrapa Western Agriculture, with the support of Itaipu Binational. The sample, taken as a monolith from 0 to 0.25 m, is separated into layers (when visually differentiated) and identified as to size of clods, signs of compaction and presence of roots. The aim of this study was to correlate the IQP data and the history of the management with soil structure quality. Samples were collected in the Paraná Watershed 3; located in the western region of Paraná State, Brazil. It was assessed 40 areas cultivated under different systems, including NTS and Conventional System, and six native forests to compare as their references. In each of these areas were sampled five points, in a transect. The structural quality of soil was evaluated by DRES methodology, from 0 to 0.25 m. The IQP information, which results in one note per area, qualifying the NTS, allowed the separation of the areas into distinct groups of management quality. Based on the effects resulting management observed in the topsoil structure, associated with the IQP score, it was possible to establish recommendations for the farmers to obtain improvements in the management adopted. Crop rotation and the non-disturbance of the soil allowed the maintenance of soil organic matter contents, as well as better topsoil structure quality. The soil quality evaluated by DRES methodology agreed with the IQP methodology and allowed the understanding of the quality of the management adopted.

Keywords: soil management, zero-tillage, soil quality indicators, soil analysis
Financial support: Financial Support: CAPES (Coordination for the Improvement of Higher Education Personnel), Londrina State University, FEBRAPDP, Itaipu Binacional and Embrapa Solo Vivo Project.

(7388 - 1562) Physical and Chemical Attributes of Red Oxisols in Southern Minas Gerais, Brazil

André Silva Tavares[1]; Augusto César Ferreira Guiçardi[1]; Natanael Rodolfo Ribeiro Sakuno[1]; Lucas Emanuel Servidoni[1]; Joaquim Ernesto Bernardes Ayer[2]; Ronaldo Luiz Mincato[1]
University of Alfenas[1]; University of Campinas[2]

Inadequate agricultural management reduces environmental services and changes the ecological balance. Thus, soil conservation is essential for agricultural production. This study evaluated the soil management from the spatial variation of the physical and chemical attributes of a watershed, in the South of Minas Gerais, Brazil. On average, the precipitation is 1,500 mm $year^{-1}$ and the temperature is 22 ° C. The region belongs to the Proterozoic metamorphic polydeformates Varginha - Guaxupé Unit. Soil uses are coffee in level, maize/bean in succession with direct planting, native forest, eucalyptus with planting slope downhill, exposed soil, constructions and alluvial areas. Deformed and undeformed soils were collected at 0-20 and 20-60 cm, considering the relief and land use. Red Oxisols were classified in relief plan to wavy, wavy and strong wavy. The values of pH, base saturation (V%), cation exchange capacity (CEC) effective and potential, silt-clay ratio, geometric mean diameter (GMD), soil density (Ds), soil penetration resistance and soil permeability to water, that were obtained by impact penetrometer and by mini infiltrometer, respectively. Geoprocessing techniques allowed to interpolate points in each attribute, generating linear regression indices. The pH ranged from 4.68 in native forest, to 6.92 in coffee, which illustrates the natural acidity of the soils, which require correction for agricultural production, which is confirmed in the coffee cultivation with higher values of V% (<50%) and CEC, which illustrate the importance of the fertility improvement. The permeability was 0.63 and 87.03 mm h-1,

with lower values of infiltration in the exposed soils in steep reliefs, which has greater soil mechanical resistance to penetration due to compaction and reduction of macro porosity by agricultural machines, which resulted in higher Ds (1.24 g cm^{-3}). DMG and silt-clay ratio showed higher values in coffee plantations and lower in native forest, with a texture varying from clayey to very clayey, which reflects the loss of fine grains in coffee plantations. Thus, definition of areas for the adoption of conservation management techniques that combat erosion, based on spatial assessment of soil attributes, is an efficient method for the planning and management of sustainable agricultural production. Geoprocessing techniques are effective in identifying priority areas for improvement of management practices.

Keywords: Soil Conservation - Soil Attributes - Geoprocessing
Financial support: FAPEMIG; CNPq

(1193 - 2868) Physiological responses of *Theobroma cacao* L. genotypes to drought stress

Paúl Lama Isminio[1]; Jose Olimpio de Sousa Junior[2]; Julio Lima Neves[3]; Raphael Bragança Alves Fernandes[3]
National University Toribio Rodriguez of Mendoza[1]; State University of Santa Cruz[2]; Federal University of Viçosa[3]

Irregular rainfall and soil-water stress in the cocoa producing regions affect the growth and development of the plants, especially in the first years of cultivation. The objective of this study was to evaluate the physiological alterations and tolerance to soil water deficit of four cocoa genotypes (CCN-51, PS-13.19, CEPEC-2002, and PH-16). After a period of acclimatization, seedlings of cocoa genotypes were subjected to two soil water regimes (control and drought) during a period of 12 days under greenhouse conditions. In the control, soil moisture was maintained near field capacity with the leaf water potential of -0.1 to -0.3 MPa. During and after the cultivation period were evaluated leaf water potential (Ψw), stomatal conductance (gs), rate of assimilation of CO_2 (A), and transpiration (E). The values of Ψw recorded after 12 days after the suspension of the irrigation were -2.30 MPa (CEPEC-2002), -2.09 MPa (PS-13.19), -1.86 MPa (PH-16), and -1.45 MPa (CCN-51), providing a reduction of the total leaf area and total dry mass of CCN-51 and PH-16 genotypes. Reductions of *gs* and *E* values were verified in all the genotypes starting from -0.5 MPa, whereas reduction of A values started close to -1.0 MPa. The results indicate that the genotypes CCN-51 and PH-16 present mechanisms that allow them to maintain high values of Ψw during more days in soil water depletion conditions, in relation to the PS-13.19 and CEPEC-2002 genotypes.

Keywords: soil-water deficit, tolerance, stomatal conductance, leaf water potential
Financial support: Coordination for the Improvement of Higher Level Education-CAPES

(6980 - 1041) Soil aggregate stability in an Ultisol under increasing cattle trampling pressure

Mastrangello Enivar Lanzanova[1]; Rodrigo Da Silveira Nicoloso[2]; Thomé Lovato[3]; Vitor Girardello[4]; Jardes Bragagnolo[4]
UERGS[1]; EMBRAPA[2]; UFSM[3]; URI[4]

One of the main problems found in crop-livestock integration systems is soil compaction due to both machinery traffic and animal trampling. Among the soil attributes used to evaluate soil compaction, the aggregate stability is usually considered a good indicator of soil physical quality. The present work was conducted in an Ultisol from Southern Brazil. The climate of the region is classified as Cfa. The experiment was established in random blocks with four replications of increasing intensities of winter forage grazing: 14 days (G14); 28 days (G28) and no grazing (NG). The winter forage consisted of a forage consortium of black oats (*Avena strigosa* L.) and ryegrass (*Lolium multiflorum* L.) under no-tillage. Cattle with 350 kg live weight were used for grazing. In the G14 treatment, grazing occurred at 50, 64, 78, 92 and 106 days after forage emergence, while for G28 grazing occurred at days 50, 78 and 106. Thus, a total of three and five grazing events occurred during one winter forage cycle. Soil was sampled and winter forages were then terminated at day 131 with the application of glyphosate for establishment of summer crops. The analysis of the distribution of water-stable aggregates followed Kemper & Chepil (1965). Briefly, soil was passed through a 8 mm sieve and the soil retained on the top of 4.76 mm sieve were air dried. Samples were placed on a set of sieves of 4.76, 2.00, 1.00 and 0.21 mm, and wet-sieved with vertical oscillation (3.8 cm) during 10 minutes at 0.5 Hz. The mean geometric diameter (MGD) of soil aggregates did not differed among treatments for the 0-5 cm depth. The MGD of soil aggregates from the 5-10 cm layer were slightly lower than the surface layer. The MGD of soil aggregates (5-15 cm) were 4.41, 4.83 and 4.56 mm, for NG, G28 and G14, respectively. Thus, no significant effect of cattle trampling on soil structure was noticed. Nonetheless, soil bulk density was higher in the soil with increased cattle trampling intensity (G14). Higher root density and aboveground biomass production by winter forages under no-tillage was shown to increase SOC stocks, thus alleviating the negative impacts of animal trampling and soil compaction on soil structure.

Keywords: Soil Compaction; Soil Quality; No-Till
Financial support: Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – CAPES

(4327 - 2723) Soil chemical, physical and microbiological properties under Integrated Crop-Livestock System in Araguaia Valley Region, Mato Grosso State, Brazil

Silvio Yoshiharu Ushiwata[1]; Cesar Crispim Vilar[1]; Ândria Alves de Souza[1]; Luis Paulo Leme dos Santos[1]; Franciele Kelly Mendes Soares[1]; Kálita Souza Silva[1]; Potiguara Marques Pizarro[1]; Vandoir Holtz[1]; Marcelo Alessandro Araújo[2]
Universidade do Estado de Mato Grosso[1]; Universidade Estadual de Maringá[2]

The Integrated Crop-Livestock System (ICLS) comes as option for the recovery of large areas with degraded pastures. However, information is missing to expand and consolidate the use of the system in the region. The aim of this work was to evaluate the influence of the ICLS on soil chemical, physical and microbiological properties. The study was fulfilled in the São Luiz Farm, in the Araguaia Valley region, Mato Grosso, Brazil, in the year 2017. Five areas were evaluated: two, three and four years of ICLS (ICLS2, ICLS3 and ICLS4), native vegetation (NV) and degraded pasture (DP). Each area was subdivided in five pseudo-repetitions. The soil was sampled in different depths: 1) 0 to 5; 5 to 10; 10 to 20 and 20 to 40 cm for analysis of soil organic matter (SOM), base saturation (%BS) and pH; 2) intervals of 10 in 10 cm to the depth of 60 cm to determine the soil penetration resistance (SPR); and 3) 0 to 5 and 5 to 10 cm to analyze the acid phosphatase activity (APA) and beta glycosidase activity (BGA). The data were analyzed by the confidence interval of averages to 95 % ($p<0,05$) of probability. Therefore, the SOM content in NV were higher in all depths, ranging from 12.6 (20 to 40 cm) to 32.8 (0 to 5 cm) g dm^3. Though in other areas there was no significant difference. On the other hand, the %BS and the pH were higher in ICLS in relation to DP and NV. While the SPR in the depths of 0 to 10 cm and 10 to 20 cm were lower in ICLS (ranging from 1.8 to 2.32 and from 2.6 to 3.2 MPa) when comparing to DP (7.9 and 5.7 MPa). To depths of 20 to 30 cm, the SPR ranged from 2.66 to 3.44 MPa in ICLS and the values decreased under 30 cm. In relation to APA, a higher value in ICLS4 (503 mg of p-nitrophenol kg^{-1} of soil h^{-1}) was found when compared to DP (265) and no significant difference was found to NV (588) in the depth of 0 to 5 cm. While at 5 to 10 cm the APA was higher in ICLS3 (44) in relation to DP (28), but lower in relation to NV (108). The values of BGA were higher in NV and there

were no differences among the other areas. The results show that the system of ICLS was not enough yet to raise the SOM, but the practices of soil correction favored the reduction of the soil acidity and raised the %BS. In ICLS, the higher values of SPR between 10 and 30 cm show a tendency of compaction by the traffic of agricultural machines. At the same time, the higher values of APA in ICLS indicate that the system is benefiting the soil microbial activity.

Keywords: No-tillage; Soil Quality; Pasture; Soil Organic Matter; Soil Enzymes Activity

Financial support: Fundação Agrisus - Agricultura Sustentável

(5829 - 774) Soil density dynamics and physical fractions of organic matter in management systems in the Conesul´s region of Mato Grosso do Sul

Paulo Guilherme da Silva Farias[1]; Jean Sérgio Rosset[1]; Camila Beatriz da Silva Souza[1]; Elias Faria[1]; Luan Soares Bispo[1]; Thais Melissa Dias dos Santos[1]; Leandro Marciano Marra[1]; Selene Cristina de Pierri Castilho[1]; Jefferson Matheus Barros Ozório[1]

UEMS[1]

Physical fractionation of soil organic matter (SOM) is one of the techniques used to identify the dynamics of SOM in relation to different forms of soil use. The objective of this work was to evaluate the dynamics of soil density (SD), total organic carbon (TOC) and physical fractions of SOM in different management systems over time in the Conesul´s region of Mato Grosso do Sul. areas managed in addition to a reference area (native forest - NF) in the municipality of Mundo Novo, MS. The two areas managed included: permanent coast-cross pasture (*Cynodon dactylon*), with visible signs of degradation (pasture - PA) and an area that was under the same conditions as the PA area, but in March 2016 it was isolated , where native tree species were planted for recovery (area in recovery - AR), making three different systems analyzed as a function of driving time. Three samples of soil were taken in the 0-0.05, 0.05-0.1 and 0.1-0.2 m layers at zero month (March / 2016), after six months (September / 2016), and after 12 months (March / 2017) (time counted from the isolation and planting of native species in AR). For the three soil samples, the SD, TOC contents and the physical-granulometric fractions of SOM were evaluated: particulate organic matter - POM and mineral organic matter - MOM. For the SD, the AP area presented the highest value in the 0-0.05 m layer, 1.72 Mg m^{-3}, a value considered critical for crop development. In addition, there were no changes in SD in RA over 12 months. When the TOC dynamics were evaluated, the AR in the 0-0.05 m layer presented a 31% increase between time zero and after 1 year of evaluation, going from 17.31 to 22.67 g kg^{-1}, demonstrating potential for TOC accumulation after 12 months. The same dynamics observed in AR for TOC was also observed for the POP and MOM fractions, especially the POM, reaching 10.61 g kg^{-1} in the 0-0.05 m layer, the layer is more sensitive to changes caused by the management systems. The isolation and planting of native tree species in the recovering area was shown to be beneficial for the improvement of soil quality in this area, mainly in relation to the organic fraction of the soil, with increase in the total organic carbon, particulate organic matter associated with sand fraction and mineral organic matter, associated with silt and clay fractions.

Keywords: Soil quality, Sustainability, Recovery.

Financial support: State University of Mato Grosso do Sul, UEMS - PIBIC and City Hall of Mundo Novo, MS.

(3972 - 3126) Soil losses in different soil management under pasture

Fabiano Oliveira Machado[1]; Marlete Littig[1]; Paulo Roberto da Rocha Junior[1]; Felipe Vaz Andrade[1]

Federal University of Espírito Santo[1]

Soil loss on pasture lands is caused by several biotic and abiotic factors, including inadequate management practices and, especially, failure during the pasture formation. The objective of this work was to evaluate soil loss on pasture lands under different soil management and natural rainfall during the dry and rainy season and indicate, focused on soil conservation view, sustainable management practices. The experiment was carried out in the city of Alegre, ES, on the Federal University of Espírito Santo Research Farm. Control pasture (CP), scarified pasture (SP), fertilized pasture (FP), burned pasture (BP), crop, livestock, and forest integration pasture (CLFI) and plowed and harrowed pasture (PHP). The plots were set up in the direction of the slope, with dimensions of 11 x 3.5 m. A collecting system was installed on the lower part of the plot to direct the surface runoff soil to sediment collection boxes for later further analysis. Soil loss data were evaluated during the dry and rainy period, starting in April 2015 until March 2017. Soil losses were quantified after each rain event, and data were grouped for each month. Coarse sediment was obtained was retained in the 0,250mm mesh sieve installed at the water box entrance of each plot, and then dried using an oven at 40º C for 72 h for subsequent mass quantification of the bulk sediment. The fine sediment was obtained from the total volume of the suspension (water + fine sediment) that passed through the 0,250mm mesh sieve of the collection boxes. Summarizing, BP was the management that presented the highest loss of soil in the dry (107 kg ha^{-1} per year) and rainy period (3,600kg ha^{-1} per year). For the dry period, the lowest values of soil loss were found in PHP (2 kg ha^{-1} per year) and FP (11 kg ha^{-1} per year), and CLFI (83.57 kg ha^{-1} per year), PHP (4.77 kg ha^{-1} per year) and FP (80.83 kg ha^{-1} per year) for the rainy season. The management that showed highest coarse sediment loss was BP in the rainy season (5724.58 kg ha^{-1} per year) and the lowest was PHP for the dry period (1,573 kg ha^{-1} per year). The results proved that using edaphic practices to manage soil erosion contributes to increase water infiltration into the soil, and consequently, reduce soil loss by erosion, however, there was a soil mass displacement in the treatment, reducing coarse and fine sediment compared to the other treatments.

Keywords: Soil loss; sediment; soil management.

Financial support: Acknowledgments: UFES, FAPES.

(8813 - 1898) Soil mechanical resistance to penetration of maize no-tillage system in succession with cover crops and chiseling systems

Márcia Luciane Kochem[1]; Paulo Cesar Conceição[1]; Lizete Stumpf[1]; Vitor Cauduro Girardello[2]; Maiara Karini Haskel[1]; Weslei Sbalcheiro[1]

UTFPR[1]; URI[2]

The adoption the non-soil turnover combined with machine traffic has promoted the compaction of subsurface layers in the no-till areas, becoming the main problem to the sustainability of this system, between four and six years of establishment. In this sense, many farmers have adopted chiseling as an additional cultural treatment before planting, aiming at increasing the physical soil quality and guaranteeing the productivity of crops. Therefore, the objective of the study was to evaluate the soil mechanical resistance to penetration of an Oxisol under maize no-tillage in succession with winter cover crops and two chiseling systems. The five soil prepare systems evaluated were: a) No-tillage; b) No-tillage chiseling only in the start of experiment (2015) with Jumbo equipment; c) No-tillage chiseling only in the start of experiment (2015) with Terrus equipment; d) No-tillage chiseling annually (2015 and 2016) with Jumbo equipment; e) No-tillage chiseling annually (2015 and 2016) with Terrus equipment. The winter cover crops evaluated were: a) vetch; b) radish; c) Oats. In April 2017, after the maize harvest, the soil mechanical resistance to penetration was evaluated in the different treatments and the data presentation of 0.00-0.05 m, 0.05-0.10 m, 0.10-0.20 m and 0.20-0.40

m layers. The maize no-tillage in succession with different cover plants did not present mechanical resistance to penetration restrictive to root development, providing the same grain yield in relation to chiseling treatments. The succession maize/oat and maize/radish promoted the permanence of the chiseling soil effect for 24 months, therefore there is no need to carry out the scarification annually

Keywords: Chiseling; Oats; Radish; Vetch; compactation
Financial support: UTFPR, CNPQ, Fundação Araucária, CAPES

(9179 - 1726) Soil organic matter and macronutrients dynamics of a long-term conservation tillage experiment in a brazilian Ultisol

Fernanda Cristina Caparelli de Oliveira[1]; Alceu Pedrotti[1]; Sara Julliane Ribeiro Assunção[1]; João Lucas Souza Santos[1]; Matheus Emmanuel Oliveira Vieira[1]
Universidade Federal de Sergipe[1]

Low natural fertility and sandy texture in the shallow depth of Ultisols, and climatic conditions of Northeast Brazil stimulate soil degradation in case of inappropriate agricultural management adoption. Conservation tillage (CT) usually has positive impact in soil chemical attributes (SCA), however there is a lack of dataset to support CT establishment in Northeast Brazil. Thus, the overarching goal of this work is to evaluate the dynamics of soil organic matter (SOM) and macronutrients in a long-term maize experiment. The experiment was established in 2001 at UFS Campus Rural (10°55'24"S; 37°11'57"W) and repeated annually throughout 16 yr. Soil is classified as Ultisols and the climate described as tropical with dry summer. Treatments consisted of three tillage operations (conventional, minimum and no-tillage) and four cover crops (sunn hemp, Pigeous bean, millet, cowpea). Tillage operations were laid out as whole plot (830 m²), and the cover crops randomly distributed through three plots (60 cm² each). Soil sampling (0-10 cm) occurred after maize harvesting at 5, 9, 11, and 14 yr of the experiment beginning. A principal component analysis (PCA) was performed to investigate the soil chemical attributes dynamics throughout agricultural management. The first two principal components (PC) accounted for 74.9 % of the dataset variation. The PCA shows that SCA were first separated by the duration of the management adoption: the SCA at 5 and 9 yr were more similar than at 11 and 14 yr. Phosphorus (P) and potassium contents increased with time of management adoption, conversely to Ca and Mg content. SOM content tend to stabilize after 9 yr and presented lower values in conventional tillage. P and SOM contents separated minimum tillage and no-tillage from conventional tillage. There was no clear pattern of cover crops effects on SCA. Our results indicate that either minimum or no-tillage have great potential of increasing natural fertility of maize cultivated Ultisols in Northeast Brazil.

Keywords: no-tillage, minimum-tillage, cover crops, soil nutrients
Financial support: FAPITEC, CAPES

(1411 - 2300) Soil physical attributes under integrated agricultural production systems at Agreste mesoregion of Paraiba State, Brazil

Pedro Luan Ferreira da Silva[1]; Flávio Pereira de Oliveira[1]; Danillo Dutra Tavares[1]; Mylena Costa Da Silva[1]; Alisson José Da Silva[1]; André Julio Do Amaral[2]; Camila Costa da Nóbrega[1]; Victor Ferreira Brandão[1]
Universidade Federal da Paraíba[1]; Embrapa Solos[2]

The objective of this study was to evaluate the soil quality by means of physical attributes under a crop-livestock-forest integration system with two years of implantation. The experiment was conducted at the experimental station of the EMEPA, in Alagoinha City (PB) in a Eutric Planosol. A randomized complete block design (DBC) was used, with five treatments and three repetitions, as: 1) *Brachiaria decumbens* + *Gliricidia sepium* (ILFG); 2) *Brachiaria decumbens* + *Mimosa caesalpiniifolia* (ILFS); 3) *Brachiaria decumbens* + *Tabebuia alba* (ILFI); 4) *Brachiaria decumbens* + *Zea mays* (ILCm); 5) *Brachiaria decumbens* (P), in plots with dimensions of 38 x 20 m. Forest species were planted in triple rows, at spacing 3 x 2 m, with 20 m between triple row and another. Undisturbed samples were collected at depths of 0.0 - 0.10 m and 0.10 - 0.20 m, totalizing 120 samples. Granulometry, flocculation degree (GF), soil density (Ds), total porosity (Pt), macroporosity (Ma), microporosity (Mi), saturated hydraulic conductivity (Kθ), resistance to penetration (Rp), aggregate stability index (IEA), total organic carbon (TOC), field capacity (θCC), permanent wilting point (θPMP) and available water (θAD) had the variances evaluated. The analyzes were carried out at the Soil Physics Laboratory of the Agricultural Sciences Center of the Federal University of Paraíba. The analysis of variance and its medias were compared by the Tukey test at the 5% probability level. The soil was classified as sandy-loam and the sand contents ranged from 650 to 703 g kg^{-1}. At depth of 0 - 0.10 m the soil Ds was lower in T3 - 1.24 kg dm^{-3} and higher in T5 - 1.27 kg dm^{-3}. There was an increase of Ds in depth and the soil Pt ranged from 0.45 to 0.49 m^3 m^{-3}. The Kθ was larger on the surface, with 13.37 cm h^{-1} at T2 and 4.32 cm h^{-1} at the control treatment. The Rp was below the critical limit in all evaluated treatments, and the highest average was 0.30 MPa in T1 in the 0.10 - 0.20 m layer. The COT content decreased in depth, as did the IEA values. The content of θAD did not differ between treatments and depths evaluated. The highest volume of θAD (0.463 m^3 m^{-3}) was verified in T4 at a depth of 0.10 - 0.20 m. Soil density was the attribute that presented the greatest variation between the collection distances and the evaluated treatments. The adoption of ICLF contributed to the improvement of the physical attributes of the soil in comparison to the areas occupied with isolated cultivation.

Keywords: soil management; agricultural practices; semiarid.
Financial support:

(7979 - 1577) soil physical quality of an ultisol under crop-livestock-forest integration system in Amazonia, Brazil

Diego Lima de Souza Cruz[1]; José Frutuoso do Vale Júnior[2]; Edmilson Evangelista da Silva[3]; Anna Bárbara de Souza Cruz[4]
Instituto Federal de Roraima - IFRR[1]; Universidade Federal de Roraima - UFRR[2]; Embrapa RR[3]; Universidade de São Paulo - USP[4]

The Crop-Livestock-Forest Integration System (ILPF) is considered one of the most suitable conservationist systems for the recovery of degraded pastures, because it increases the efficiency of the area utilization. In Brazil, this system have a wide use, mostly because of governamental incentive. In this context, the present work was elaborated with the objective of comparing the management systems with a natural forest with the physical and chemical characteristics of Ultisol in the state of Roraima. The study was carried out in a private property with ILPF experiment installed in partnership with Embrapa-RR. There were 4 main treatments (Areas): T1 = Rotated Pasture; T2 = Natural Forest (NF); T3 = Crop-Livestock Integration (CLI); T4 = Livestock-Forest Integration (LFI); The secondary treatments were 6 depths: P1 = 0 to 10 cm; P2 = 10 to 20 cm; P3 = 20 to 40 cm; P4 = 40 to 60 cm; P5 = 60 to 80 cm; P6 = 80 to 100 cm in a completely randomized design in the spli-plot scheme. The evaluated properties were: Soil Penetration Resistance (PR), Texture, Soil Density (SD) and Soil Particle Density (PD), Total Porosity (TOP), Dispersed Clay in Water (DCW), Clay Flocculation Degree (CFD) , Soil Organic Matter (SOM), Soil Carbon Stock (SCS) and Soil Physic Quality Index (SPQI). Analyzing the set of all the properties and comparing the managed environments with the natural forest, considered as a parameter of physical soil quality, it was verified that there is no physical degradation of the soil in the management systems studied, being able to be indicated to be used as a recovery system for degraded areas. Some properties showed values that indicate soil low quality (SD, TOP and PR), but the natural áreas had the same characteristics.

Therefore, comparing the crop area with the natural area, there where no loss of soil phisical quality, even though that values where considered critical by the literature. The higher SD values in the CLI and LFI was a signal to the importance of implementing a physical soil quality monitoring program in the property, besides the control in the activities of machines and animals in those systems.
Keywords: Soil Compaction; Soil Management; Pastagem; Roraima;
Financial support: Embrapa RR; CNPq, CAPES

(5623 - 266) Soil quality indicators of a Planosol under integrated Crop/livestock/Forest system at Agreste Mesoregion of Paraiba State, Brazil

André Julio do Amaral[1]; José Carlos Pereira dos Santos[1]; Luís de França da Silva Neto[1]; Roberto da Boa Viagem Parahyba[1]; Giliane Aparecida da Silva Souza[2]; Flávio Pereira de Oliveira[2]; Djail Santos[2]; Valdemir Ribeiro Cavalcanti[3]

Embrapa Solos[1]; Universidade Federal da Paraíba[2]; Empresa Estadual de Pesquisa Agropecuária da Paraíba[3]

Crop, livestock, and forestry integrated systems (CLFIS) are strategies that promote soil quality. This work aimed to determine some soil quality indicators attributes, after short time use of CLFI systems at Agreste of Paraiba State, Brazil. The soil is an Eutric Planosol, moderate A horizon, sandy loam texture, light towaved slope, sub-deciduous forest of semi-arid climate. Intercropping was implemented at June 2015: a) B*rachiaria decumbens sole pasture* (Livestock system); b) *B. decumbens* + Gliricidia (*Gliricidia sepium* (Jacq.) Steud.) (Livestock/Gliricidia Forest integration system LGFIS); c) *B. decumbens* + Sabiá (*Mimosa caesalpiniifolia*) (Livestock/Sabia Forest integration system LSFIS); d) B. decumbens+ Yellow Ipê (*Tabebuia alba* (chamiso) sandwith) (Livestock Ipê Forest integration system LIFIS); e) B. decumbens+ maize (*Zea mays* L.) (Crop/Livestock integration system CLIS) at last crop in april 2016, in no-tillage. The trial was carried out in a randomized block experimental design, with four replicates. Forest species were planted in triple rows, at regular spacing 3 m x 2 m, with 20 m between triple rows. Plots (rectangular format) have 20 m x 38 m. In April 2016, 15 days after maize seeding, soil samples (5 subsamples) was collected, inside the plots (triple rows) at center plots, at 0-0.10m; 0.10-0.20 m and 0.20-0.40 m depths. Physical attributes of: gravimetric soil moisture (Ug), soil bulk density (Ds) and index cone by electronic device (RP) and chemical attributes of: soil reaction (pH-H_2O); potassium (K^+), phosphorus (P) and organic matter (OM) were evaluated. In general, no significant difference was found in both physical (without indicating additional soil compaction) and chemical attributes. Probably the short time of systems was the reason. The pH-H_2O mean values ranged from 4.7 to 5.2 ($p > 0.05$). From the results it was concluded that it is necessary to raise pH-H_2O to increase availability of the replacement of nutrients, mainly Ca^{2+}, Mg^{2+} and P and K^+. OM levels increased at 0-0.10 m depth this shown important role of CLFI systems for the recovering of degraded pastures by higher soil cover, increasing nutrient cycling, promoting income diversification and increasing productivity in farmlands at the local of this study.
Keywords: soil management; soil attributes; sustainable production systems.
Financial support: EMBRAPA Project number: 0413110010604, Brazilian development network ICLF

(8315 - 2270) Soil temperature measurements by newly developed soil probes in Hungary

Zsófia Dobó[1]; Csaba Centeri[1]; Izabella Oláh[1]

Szent István University[1]

According to the state of science today, we have different ways available to measure soil paramteres, including in situ and remote sensing methods. In agricultural production the effect of soil temperature on germination is well known. Besides that soil temperature has impact on other biology, chemical and physical processes. This research was carried out on measuring soil temperature by newly developed soil probes in Hungary. The soil puffer capacity and its temperature dinamics does not belong to the main research themes. We have selected a few arable land throughout Hungary which have characterized by different soil type. The common point is the cultivated plant grown on them. By the examination we get answer about puffer capacity, resistance of each soil types againt athomosperic effects. Each type of soil has different characters, whereupon each soil type has different response againts external influences. We would like to use the results to help developing landscape management.
Keywords: soil temperature, temperature dynamics, soil probe
Financial support:

(5563 - 2978) Soil water dynamics in a Cerrado fragment and clonal *Eucalyptus* plantation fertilized with K sources

Fábio Henrique Silva Floriano de Toledo[1]; Eric Victor de Oliveira Ferreira[2]; Alexandre de Vicente Ferraz[3]; Yesid Alejandro Mariño Macana[4]; Gabriela Gonçalves Moreira[5]; José Leonardo de Moraes Gonçalves[4]

Universidade Federal de Lavras[1]; Universidade Federal Rural da Amazônia[2]; Instituto de Pesquisas e Estudos Florestais[3]; Universidade de São Paulo[4]; International Paper[5]

Among the Brazilian tropical soils most used for *Eucalyptus* plantation are oxisols (48%) and ultisols (26%). Often these soils present low natural chemical fertility and, those with lower clay content, low water retention capacity. Considering that potassium (K) presents physiological functions related to plant water regulation and frequently provides positive responses in tree growth, the objective of this research was to evaluate the potassium fertilization effect in a clonal *Eucalyptus* plantation in a Red Yellow Oxisol with low clay content (185 g kg^{-1}; 0-60 cm soil layer) and exchangeable K (0.3 $mmol_c\ dm^{-3}$), and compare the soil water content dynamics under *Eucalyptus* plantation, using a Cerrado fragment as reference, original phytophysiognomy of the study area. The experiment was carried out in the municipality of Luiz Antônio, SP, Brazil, between April 2014 and December 2016. Three treatments were evaluated: (CER) Cerrado fragment; (POT) *Eucalyptus* plantation fertilized with 180 kg ha^{-1} K_2O, using KCl; and (FO) *Eucalyptus* plantation fertilized with 180 kg ha^{-1} K_2O, using phonolite rock powder. Soil water content was measured monthly at 1.6 m depth with a capacitive probe (Diviner model) between the 16th and 41st months after *Eucalyptus* planting. The measurements were performed in a 120 m² plot using three probe access tubes, which were considered repetitions. To assess tree growth, the circumference at the breast height (CBH; 1.3 m above ground level) of the trees of the two treatments with *Eucalyptus* at the 13th and 42nd months after planting were measured. CBH averages were generated from the measurement of four plots with 16 trees/treatment. During the 16 months of evaluation, the CER treatment presented the highest soil water content (154 mm), followed by FO treatment (131 mm) and POT treatment (111 mm). The growth in CBH of the FO treatment was 5 and 0.7% higher than POT at the 13th and 42nd months after planting, respectively. The substitution of KCl fertilizer by phonolite rock powder decrease soil water consumption, maintaining the same CBH growth in eucalyptus trees.
Keywords: KCl; Phonolite; Rock powder; Soil water content; Forestry
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(7994 - 1896) Sources, manners application and translocation of sulfur in the initial development of corn.

Rafael de Paiva Andrade[1]; Moniki Campos Janegitz[1]
Faculdades Gammon[1]

Due to the low concentration of S in the soil, corn can present a high probability of response to this nutrient, visa that this is an essential element and participates in the synthesis of various proteins. The objective of this study is to evaluate different sources and methods of sulfur in the initial development of the corn in soil with low content of this nutrient. The experiment was conducted in a greenhouse conditions with three sources of sulfur: 2,5 l ha^{-1} do Sulformax 50% S, 30 kg ha^{-1} of granular elementary sulfur (99% S) and 530 kg ha^{-1} of gypsum (17%SO_4) and different modes of application, being composed of six treatments with five replicates each one. The treatments was: Control without addition of sulfur; Sulfur via leaf; Elementary sulfur via soil; Gypsum; Elemental sulfur via soil + Sulfur via leaf and Gypsum + Sulfur via leaf. Thirty-two days after plant emergence height of plants, shoot dry matter, root dry matter and S content in shoot and root was determined. There was statistical difference for all variables, except for the S content in the shoot and plants height. The highest sulfur concentration independent of the application form was in the root when compared to the shoot. Elementary sulfur application in the soil was statistically equal to the control treatment. The treatments that received soil + foliar and / or gypsum fertilizer increased the S content in plants. However the gypsum and leaf application of sulfur increased the S content in root of corn plants.

Keywords: Sulfate; sulfur efficiency use; foliar fertilizer.
Financial support:

(4800 - 365) Soybean yield and physical soil properties in succession to cover crops.

Katiely Aline Anschau[1]; Edleusa Pereira Seidel[1]; Jean Sérgio Rosset[2]; Marcos Cesar Motin[1]; João Henrique Silva Caetano[3]
West Paraná State University, 1170 Pernambuco St., Marechal Cândido Rondon - PR, 85960-000, Brazil[1]; State University of Mato Grosso do Sul - UEMS, Unidade Universitária de Mundo Novo, BR 163, km 20,2, 79980000 - Mundo Novo, MS - Brazil[2]; West Paraná State University, 1170 Pernambuco St., Marechal Cândido Rondon - PR, 85960-000, Brazil (jhscaetano@bol.com.br)[3]

The soybean (Glycine max (L.) Merrill) is the main crop growing in Brazilian commercial fields and its production is mainly focused on exporting. However, in the last years, the economic pressures and the farmers' lack of care had lead to the loss of quality of the soils. It includes problems in soil physical properties, leading increase erosion, compaction and consequently crop yield loss. The crop coverage use, in No-Tillage system, is an useful tool to increase ambiental quality and avoid physical problems in the fields, enhancing biological diversity, the carbon and nitrogen input and, by this way, leading to the production sustainability. The aim of this work was to evaluate the physical properties (macroporosity, microporosity, total porosity, bulk density) and aggregates stability (aggregates stability index, weighted average diameter and geometric mean diameter) after soybean crop cultivation. The experimental design was a completely randomized block design, with six treatments and four replications. The treatments consisted of the soybean crop sown on different coverage plants straw (No-Tillage): black oats, black oats + forage turnip, forage turnip, black oat + forage pea, forage pea and control (fallow). Among the evaluations carried out , the use of cover plants did not alter the total porosity and microporosity. On the other hand, the use of coverage crops enhanced qualities, showing significant positive differences in macroporosity and bulk density in almost all observations. For the depth of 0.10 m, only treatments of soybean seeded on turnip and oat + pea did not obtain macroporosity higher than control; for the other depths all treatments were superior to the control's. Regarding the aggregates stability, only the weighted average diameter, in the peas covered treatment (0,10 m layer) was different of the control, reflecting the small time frame on the evaluations carried out.

Keywords: Green fertilizers, *Glycine max*, soil aggregates, soil physical properties.
Financial support: Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – CAPES

(3956 - 1758) Spatio-temporal heterogeneity of water table level under cranberry production

Jonathan A. Lafond[1]; Silvio José Gumiere[1]; Guillaume Létourneau[1]; Jacques Gallichand[1]
Laval University[1]

In North America, cranberry production is rising. Since 2005, land area dedicated to cranberry doubled, principally in Canada. Recent studies have shown that subirrigation could lead to improvements in yield, water use efficiency and pumping energy requirements compared to conventional sprinkler irrigation. Knowledge of spatiotemporal structure and evolution of the water table and soil properties is primordial to establish new and more intelligent water management methodology in cranberry production. The objective of this work is to characterise the spatiotemporal heterogeneity at the farm scale. Water table level measurements over more than 60 observation wells, including weekly and automatic at 15-minutes time step, during the 2016 and 2017 growing seasons were used to performed multi-frequential periodogram analyses and coregionalization analyses with a drift (CRAD). Preliminary results will be presented showing distribution patterns of water table maintained in time and over years. The structure revealed by this spatio-temporal analysis will be integrated to an irrigation app developed for integrated irrigation management.

Keywords: irrigation, geostatistics, frequency analysis
Financial support: Collaborative Research and Development Grant from Natural Sciences and Engineering Research Council of Canada (NSERC) and cranberry growers

(7392 - 2162) Stability of soil aggregates on over crop cultivation in *Piper nigrum* in northern Espírito Santo state

Ivoney Gontijo[1]; Juan Ricardo Rocha[1]; Ivne Franco Pires[1]; João Vitor Furlan[1]; Alan Mendes de Araújo Lima[1]; Yan Vinturini Vieira Dantas[1]; João Victor Fioroti Cescon[1]; Hugo Calegari Bonini[1]
UFES[1]

In the north of Espírito Santo state, conditions of exposed soil are frequently observed, which predisposes them to water erosion and decrease of the organic matter content, being influenced by the stability of soil surface aggregates. One of the most used conservation practices is the green manuring in the line of perennial crops, and has proved to be efficient in achieving sustainability in the agricultural system. The organic matter is one of the conditioners of soil that has greater influence under the structure and aggregation, due to its cementing action, giving the soil greater stability. The objective of this work was to study the potential of different species used as cover crops in *Piper nigrum*, under soil and climate conditions in the northern region of Espírito Santo state. The study was carried out in a commercial crop, with localized irrigation, on a dystrophic Yellow Latosol of franco-clayey texture and particle density of 2.65 g cm^{-3}. The experimental design was a randomized complete block design with four species of cover plants (*Crotalaria spectabilis, Cajanus cajan,*

Pennisetum glaucum and *Brachiaria*) and one control, with four replicates, the samples being taken at two depths, 0.0-0.10 and 0.10-0.20 meters. Cover plants were harvested during the flowering period, and after 45 days soil samples were collected. In each experimental plot, a deformed sample was collected for determination of the stability analysis of aggregates, in the interweaving of *Piper nigrum* planting, in the line of traffic of implements. The aggregate analysis was performed by the wet screening method according to the methodology recommended by Embrapa (1997), using a Yoder apparatus (1936). Analysis of variance was performed by the GENES software. Under the conditions under which the experiment was conducted, no significant statistical differences were observed between the species of plants used, as well as between the depths studied, since there was not sufficient accumulation of organic matter in the soil surface in the studied time, being insufficient for the physical improvements of the soil.

Keywords: conservation practices, stability of aggregates, organic matter

Financial support: FAPES-Fundação de Amparo à Pesquisa e Inovação do Espírito Santo

(1281 - 892) Stability of soil aggregates under distinct management systems of cauliflower at hillslope areas

Nivaldo Schultz[1]; Carlos Roberto Pinheiro Junior[1]; Gustavo Candido da Silva Rodrigues[1]; Luiz Alberto da Silva Rodrigues Pinto[1]

UFRRJ[1]

Adequate maintenance of the mineral, organic and porous on soil is a basic principle to meet the nutritional demands of plants, providing infiltration and reducing the runoff of rainwater and irrigation. The objective of this study was to evaluate the stability of soil aggregates before and after three crop cycles (2 years) of cauliflower (*Brassica oleraceae var. botrytis*) in different management systems. The experiment was developed in a Cambisol, under hillslope relief, located in Barracão dos Mendes, Nova Friburgo, Rio de Janeiro State. The design was randomized blocks, with 3 treatments and 4 replications and two evaluation periods - March 2015 and April 2017. The treatments were: conventional tillage with the soil preparation using rotating hoe without presence of cover plants - CT; conventional planting with incorporation of hedge plants using rotary spindle - CPIHP; and no-till (NT). The straw was formed by black oats (*Avena strigosa*) and weeds, in the proportion of approximately 50% of black oats and 50% of weeds. The accumulation of straw was 8.1, 10.3 and 5.1 Mg ha^{-1} for the first, second and third cycle, respectively. Soil samples were collected between the lines of cauliflower, at 0.0-0.10 m and 0.10-0.20 m depth. A sample per plot was collected to evaluate the stability of aggregates, through the index weighted mean diameter (WMD). Data were analyzed for variance and the means were compared by *T* test at 5% probability, using the Sisvar 4.3 software. The stability of the aggregates was altered in function of management. In March of 2015 the soil WMD values of the plots under CT, CPIHP and NT treatments were still to be implanted were 4.68, 4.85 and 4.63 mm in the 0.0-0.10 m and 4.81, 4.78 and 4.73 mm in the 0.10-0.20 m layer, respectively. No differences were observed in the values, as expected to the initial analysis. In April 2017, after the third cycle of cauliflower production, the WMD values of CT, CPIHP and NT were 3.52, 4.04 and 3.94 mm in the 0.0-0.10 m, respectively, and 3.43, 4.13 and 4.00 mm in the 0.10-0.20 m layer, respectively, with CT differing from CPIHP, and NT with the lowest value. This result shows the beneficial effect of no-tillage system on soil physical attributes. Based on these results, it can be inferred that soil management in no-tillage system provide the infiltration of water into the soil and reduces the runoff minimizing problems from water erosion.

Keywords: *Brassica oleraceae;* soil structure; mountain farming

Financial support: Fundação Agrisus – Agricultura Sustentável

(5994 - 2860) Subsurface erosion formation and triggering: pedological controlling factors

Renata Cristina Bovi[1]; Gabriela Pereira da Silva Souza[1]; Matheus Ortega Gomes[2]; Miguel Cooper[1]

Luiz de Queiroz School of Agriculture, University of São Paulo[1]; University of São Carlos[2]

Soil erosion studies are mainly focused on the soil particles release and their subsequent transport into surface flows, while subsurface flows are considered as a process of importance limited only to certain materials. Piping is an erosive process that involves the removal of particles from the subsurface of the soil, causing the formation of underground tunnels. The study area is located in the county of Piracicaba (state of São Paulo, Brazil), which presents several erosive features, among them the piping, object of the present study. Six pits were opened and described, in which the soil was classified as Hapludults (Argissolo Amarelo distrófico típico). The occurrence level of the pipes lies between the horizons E and Bt. With the objective of detecting contrasts between these horizons that could trigger the subsurface erosive process, based on the stagnation of water at the top of the Bt horizon, disturbed and undisturbed samples were collected in the E and Bt horizon and the following analyzes were performed: morphological, particle size distribution, bulk density (Ds), particles density and mapping of the Bt horizon microtopography (performed in successive points with an auger). In general, a gradient of pedological factors between the E and Bt horizon was observed. They are: a) textural gradient with increment of clay in subsurface, changing from sandy texture to medium texture, b) low flocculation degree in surface and high in subsurface, c) simple grains structure in the superficial horizons, in contrast to the subsurface horizons, which presented a better structuring, with medium to large subangular blocks, moderate degree, d) higher Ds in the subsurface horizons, together with a lower total porosity, in contrast to the superficial horizons with low Ds and higher total porosity. Also, it was observed that the top of the Bt horizon presented a slight inclination and a non-homogeneous microtopography. It was concluded that the contrasts in the pedological factors between horizons E and Bt may favor the accumulation of water at the top of the Bt horizon due to changes in the hydraulic conductivity between the two horizons, altering the fluxes in subsurface, in order to favor lateral flow instead of vertical. On the other hand, the microrelief and slope of the top of the Bt horizon may be responsible for inducing sufficient erosive velocity to the water flow.

Keywords: piping; soil morphology; soil erosion

Financial support: ESALQ (USP) and CNPq

(5863 - 1285) ***Theoretical and methodological contributions of the Integrated Management of Watersheds and Coastal Areas (IWCAM), for the improvement of the Sustainable Land Management (SLM) in the province of Cienfuegos.***

Yamila Vigo Cuza[1]; Yodani López Fonseca[2]; Clara Elisa Miranda Vega[3]

Provincial Department of Soils.Ministry of Agriculture[1]; Provincial Department of Soils. Ministry of Agriculture[2]; Center for Environmental Studies of Cienfuegos[3]

With the aim of demonstrating how from the approach of Integrated Management of Watersheds and Coastal Areas (IWCAM) approach contributes to the improvement of the Sustainable Land Management (SLM), a review is made of the studies carried out on sustainable land management in the province of Cienfuegos. 15 of the 98 studies were taken for the analysis, as they are the most representative of the subject in question. The analysis of the results obtained in these studies allowed identifying the need to incorporate the IWCAM approach to the SLM studies. The points of convergence that allowed establishing the complementation relationship between SLM and

IWCAM are also identified. It is concluded that the SLM and the IWCAM, pursue common objectives so promoting the SLM with IWCAM approach is to approach the response of a search for a solution to the environmental problems caused by agricultural activity in the basins. The points of convergence found in the theoretical review of the object of study allow establishing the articulation between SLM and the IWCAM. The analysis of the Environmental Totality, contributed to the theoretical foundation of the relationship that coexists between both approaches. The contributions of the previous studies in the basin constitute a strong contribution in the elaboration of the current proposal. The articulation of the SLM and the IWCAM in the province will contribute to the improvement of the management plans of their tributary basins.
Keywords: Keywords: Basin, management, land, environmental
Financial support: Financial Support: Proyect GEF-IWECO

(8693 - 3082) Variation of water storage in mobilized soil by deep tilling equipment in the Northwest of Paraná

Gislaine Silva Pereira[1]; Rayane Vendrame da Silva[1]; Emily Carolina Bacon[1]; Caroline Honorato[2]
UEM[1]; UNOESTE[2]

It is essential knowledge to relation between the water-soil-plant system for the proper management of soil parameters and irrigation. The objective of the present work is to evaluate the variation of the water storage in a dystrophic red Oxisol managed with the use of deep tilling in the northwest of Paraná. The study was conducted at the State University of Maringá, Campus do Arenito, in Cidade Gaúcha, Paraná. According to Koppen, the region has subtropical climate, with minimum annual temperature of 18 ° C and maximum of 22 ° C. The evaluation was execute in the year 2015 in a dystrophic red Oxisol with sandy texture, under area cultivated with cassava, evaluations at intervals of three days between the period from 20 to 30 July 2015. The soil mobilization was execute using equipment of deep tilling, denominated "penta". Deformed and undisturbed sample were collected with the use of auger and equipment called “castelo” in the layers between 0.00-0.20 m; 0.20-0.40 m and 0.40-0.60 m. Soil density and gravimetric moisture were obtained according to Embrapa (1997). Volume moisture was measured through the relationship between gravimetric moisture and soil density. Soil water storage was estimated according to Libardi (2012). There was an increase in water storage (120 to 207 mm) in the period between 20 and 23/07, under the influence of rainfall occurred on July 21. In the other periods, the values obtained from water storage were lower. The variation of water storage decreased over time and may be related to the type of soil management execute in the area. The deep tilling equipment made the mobilization of the soil layer to the depth of 0.60 m, causing the breakage of the same, and the rotary hoe coupled to the penta, broke the superficial layers of the soil until the layer of 0.30 m. The decrease in water storage was related to the management adopted and due to soil texture. Sandy soils have a greater amount of macropores, which favors water storage, however, they have a low retention capacity of stored water, which causes this water to be lost rapidly by infiltration to the deeper layers. The use of deep tilling equipment favored the loss of water from the system.
Keywords: Penta; Red Latosol; Water content.
Financial support:

(5509 - 1429) Water and sediment losses in paired zero-order catchments under no-till with and without terraces.

Ana Lúcia Londero[1],[1]; Jean Paolo Gomes Minella[1],[2]; Fabio José Andres Schneider[1][3]; Dinis Deuschle[2]; Tiago de Andrade Neves Hörbe[3]
Federal University of Santa Maria, Roraima Avenida n.1000, Santa Maria, RS Postal Code 97105-900, Brazil.E-mail: londeroanalucia@gmail.com[1]; Federal University of Santa Maria, Roraima Avenida n.1000, Santa Maria, RS Postal Code 97105-900, Brazil.[2]; Federal University of Santa Maria, Roraima Avenida n.1000, Santa Maria, RS Postal Code 97105-900, Brazil[3]

The no-till system is a conservation technique for soil management whose principles are little or no soil disturbance, maintenance of surface straw and crop rotation. Currently, negligence in its use leads to situations of soil degradation. Despite this, little is known about the hydrological and erosive dynamics in hillslopes and zero-order catchments under this kind of land use and soil management. The present study monitored water and soil losses in these mishandled tillage systems in the scope of paired catchment of zero order with and without mechanical practices for runoff control. The areas are located within the Seed Research Center, which is located in the County of Julio de Castilhos in central Rio Grande do Sul State, Brazil. The catchments have an area of approximately 2.4 hectares. The main variables measured in each event rain/flow were: rainfall, water flow, surface runoff volume, peak flow, surface runoff coefficient, suspended sediment concentration and sediment yield in the period of 2015/2017 in different soil cover conditions, rainfall magnitude and antecedent moisture. The events were compared in terms of total water and sediment losses, and the comparison of the hydrograph and sedimentograph was performed in order to better comprehend the dynamics of runoff formation and erosive processes. The results demonstrate that the catchments are highly responsive to precipitation and that runoff is highly significant in the catchment without terraces. The no-till system without mechanical practice was unable to contain the superficial runoff whereas in the catchment where mechanical practices were used such losses were greatly reduced. For rainfall of larger magnitudes, flow rates were heightened, which indicates high sediment yield capacity. Soil losses were significant for larger events in areas with little ground cover. For a better parameterization of the WaterSed model, used in this work to simulate catchment scale, input data of the parameters of the simulated events were obtained from hydrological and sediment monitoring variables in this scale. On grounds of the above, the no-till system cannot contain runoff, and adoption of complementary practices, such as terracing, are necessary to reduce soil and water losses.
Keywords: No-till, paired catchment, monitored
Financial support: FINEP, Projeto Mais Àgua, CNPq, SEAPI.

(3589 - 1428) Wood ashes as an alternative source of potassium in the biomass production of *Pennisetum purpureum* cv. Cameroon, for energy purposes.

Gabriel Barros Pinto[1]; Jean Felix Loubak[1]; Márcio dos Reis Martins[1]; Bruno Jose Rodrigues Alves[2]; Robert Michael Boddey[2]; Cláudia Pozzi Jantalia[2]; Segundo Urquiaga[2]
UFRRJ[1]; Embrapa Agrobiologia[2]

In the same manner as sugar cane, energy cane (*Saccharum* spp.), *Miscanthus* spp. and switch grass (*Panicum virgatum)*, elephant grass (*Pennisetum purpureum*) accumulates very large quantities of potassium, a fertilizer nutrient with severely limited world resources. The use of ash derived from the combustion of plant biomass, may help to minimize the necessity for K fertilizer and act as an alternative source of K for biomass production. The objective of this study was to evaluate the response of elephant grass to the application of ash as an alternative source of potassium fertilization in a long-term study planted in a Planosol on the field station of Embrapa Agrobiologia - RJ. The research was carried out from September 2013 to July 2017, in which the treatments were evaluated, T1, control, without potassium, T2 that received KCl, and T3 where applied vegetable ash as a source of potassium. The ash was derived from plant biomass burnt at 900 °C in the ovens of a brick factory. The potassium dose applied was 100 to 150 kg $K_2O.ha^{-1}$. The elephant grass genotype studied was cv.

Cameroon Piracicaba planted in plots of 5 rows of 5 m length with 0.8 m between rows, with 4 replications, in an experimental arrangement of randomized complete blocks. A total of seven cuts were performed every six months between the years of 2013 and 2017. The experimental results of biomass production demonstrated that the ash was only as effective as the KCl fertilizer from the second year onwards. Subsequently biomass production was approximately 26 $Mg.ha^{-1}$ with yields being very similar to those receiving K fertilizer, a much higher yield than that of the control treatment (10.3 $Mg.ha^{-1}.year^{-1}$), which each year decreased its production. Similar behavior was observed in the accumulation of K by plants. According to the results presented, the use of plant ash as an alternative source of potassium for elephant grass fertilization proved to be a promising long-term alternative to the same rate of K applies as KCl.

Keywords: Elephant grass, nitrogen, energy biomass
Financial support: Embrapa Agrobiologia, CNPq

(5186 - 2647) Pig slurry application methods: Implications for soil quality parameters and productivity of maize and soybean crops (Córdoba, Argentina)

Pegoraro, Vanesa Romina[1]; Cazorla, Cristian Román[1]; Bachmeier, Omar Antonio[2]; Hang, Susana[2]; Ortiz, Jimena[1]; Briacchi, Martina Betiana[3]; Maury, Mariana[1]; Baigorria, Tomás[1]; Boccolini, Mónica Fabiola[1]; Zubillaga, Marta Susana[4]
Instituto Nacional de Tecnología Agropecuaria, Marcos Juárez, Córdoba, Argentina[1]; Universidad Nacional de Córdoba, Córdoba Capital, Argentina[2]; Universidad Nacional de Rosario, Zavalla, Santa Fé, Argentina[3]; Universidad Nacional de Buenos Aires, Buenos Aires Capital, Argentina[4]

Surface application of pig slurry (PS) is characterized by a high risk of ammonia losses. Different methods to decrease these emissions are available, but there is poor information about its impacts on the soil-plant system. The aim of this investigation was to evaluate PS application methods on indicators of soil quality and grain production, in maize-soybean crop sequence. Field testing was carried out for two years and five treatments were evaluated: acidified PS (AS), incorporated PS (IS), surface PS (SS), mineral N fertilization (MF) and control (C). Chemical parameters (0-20 cm depth) were determined during crops growth, and microbiological parameters (0-10 cm depth) were determined at physiological maturity, as soil quality indicators. Organic C, organic N, ammonium, nitrate (NO_3^-), extractable P (Pe), pH, electrical conductivity (EC), anaerobic N (AN), particulate organic matter, microbial biomass C, microbial respiration (MR), metabolic coefficient and acid phosphatase were evaluated. Also, grain yields were measured. Incorporate slurry inputs caused increases in AN and MR after two successive applications of PS on soybean crop. Treatments with PS and/or FM showed significant lower values in pH than C in both crops, and higher EC only in maize crop. PS treatments showed higher Pe on soybean crop, with respect to MF and C, due P contribution of PS. The concentration of NO_3^- increased with MF in both crops. In maize, MF presented similar concentrations to AS and SS, while the applications methods did not differ among them. For other soil quality indicators were not observed differences between treatments. Grain yields were affected by application method, depending of the crop evaluated. IS increased yields of maize crop by 16 %, whereas SS and AS increased yields of soybean crop by 112% and 79%, respectively, compared to C. Therefore, the different methods of application of PS produced changes in soil quality and modified the crops response. The surface application could indicate lower efficiency in retention of N within the system, being more evident in cereal crops. On the other hand, the soybean crop yield could be more related to the P contribution of PS.

Keywords: acidified pig slurry, incorporated pig slurry, surface pig slurry, anaerobic nitrogen, microbial respiration
Financial support: Instituto Nacional de Tecnología Agropecuaria

C3.3 - Soils and land use Change

C3.3.1 - Nitrogen use efficiency (NUE) in tropical soils

(5902 - 742) ^{15}N recovery in depth by flooded rice in Southern Brazil

Gerson Laerson Drescher[1]; Qamar Sarfaraz[1]; Cesar Cella[1]; Allan Kokkonen[1]; Natalia Tobin Aita[1]; Gustavo Dal Molin[1]; Leandro Souza da Silva[1]
Federal University of Santa Maria, 1000 Roraima Ave, Santa Maria-RS, 97105-900, Brazil[1]

Nitrogen (N) fertilization for rice in Southern Brazil is based on soil organic matter (SOM) content (analyzed on a 0-0.2m layer) as a soil index. Recent studies have shown alkaline hydrolysable nitrogen (AH-N) as a better N availability index than SOM. SOM content is higher at soil surface and decreases with depth, while some soils have large amount of AH-N in depths bellow 0.2m, which can contribute to rice nutrition and affect AH-N calibration. This study aims to investigate the soil depth that rice plants are actively using N in Southern Brazil paddies. Stratified soil samples were collected up to 0.6m depth in three rice paddies (PSM, GSM, and GA) and selected chemical and physical properties were analyzed. The study was carried out in greenhouse, and rice was grown in undisturbed soil samples collected with a polyvinyl chloride tube (0.2 x 0.65m). ^{15}N-labeled $(NH_4)_2SO_4$ was injected at 0, 0.1, 0.2, 0.3 and 0.45m deep. Rice shoot part was collected at flowering, and dry mass, total N, and ^{15}N content and recovery was evaluated. Anova was conducted in factorial arrangement, and means were compared with Fisher`s LSD ($\alpha \leq 0.05$). Highest ^{15}N recovery was observed when fertilizer was injected at 0.1, 0.2, and 0.3m deep for all soils, which can be related to ammonium (NH_4^+) adsorption to cation exchange sites, and protection against loss. Thus, NH_4^+ was protected and available when rice roots reached deeper layers, which apparently occurred when plants where in a phenological stage of higher N demand, resulting in high ^{15}N recovery even when fertilizer was applied at 0.45m. The GA soil had higher ^{15}N recovery (52%) when ^{15}N was applied at 0.1m, with constant decrease with depth. PSM and GSM soils kept similar recovery when ^{15}N was applied at 0.2 (54% and 61%, respectively) and 0.3m (54% and 59%, respectively), and only decreased ^{15}N recovery at 0.45m (22% and 36%, respectively). Overall, GSM had the highest ^{15}N recovery, while also presented highest hydraulic conductivity (HC), which indicates HC is an important soil property that dictates N absorption, considering that N is predominantly absorbed through mass flux. These findings indicate rice plants are actively using N from depths up to 0.45m, and the intensity of N recovery is also related to soil physical properties. N located bellow 0.2m contributes to plant nutrition, therefore it should be considered in future studies with calibration of soil-based N tests such as AH-N for rice in Southern Brazil.

Keywords: Fertilization; isotope; organic nitrogen; *Oryza sativa* L.; soil analysis.
Financial support: National Council for Scientific and Technological Development – CNPq

(7964 - 1960) Addition of gypsum with leguminous residue to reduce cohesion and increase maize grain yield.

Stéfanny Barros Portela[1]; Virley Sena[2]; Vinícius Macedo[1]; Francielle Silva[3]; Luis Adriano Almeida[1]; Carlos César Sousa[1]

Universidade Estadual do Maranhão[1]; Universidade Estadual de São Paulo[2]; Universidade Estadual do Norte Fluminense[3]

In the humid tropics region, the accumulation of humified organic matter, which could attenuate the negative effects of cohesion and reduced soil rootability, is prevented by the availability of water, oxygen and high temperatures favoring the rapid biomass decomposition. We hypothesized that the use of gypsum with the leguminous biomass applied to the soil surface can contribute to the permanence of Ca and organic matter in profile, increase the thickness of rooting layer and increase the water and nitrogen use efficiency in cohesive soils. This work began in January 2016 and ended in June 2017, following a randomized block design with four replications of the following treatments: control (C); 4 Mg ha^{-1} of gypsum (G); 200 kg ha^{-1} of N from urea (U); 12 Mg ha^{-1} of dry matter legumes residue (L); 12 Mg ha^{-1} of dry matter legumes residue + 4 Mg ha^{-1} of gypsum (LG); 200 kg ha^{-1} of N from urea + 4 Mg ha^{-1} of gypsum (UG); 12 Mg ha^{-1} of dry matter legumes residue, 200 kg ha^{-1} of N from urea + 4 Mg ha^{-1} of gypsum (LUG). In 2016 gypsum application decreased maize grain yield and the N use efficiency due to Ca excess in the surface layer and leaching of K and Mg to depths not intercepted by the root zone. P deficiency was also observed. Ca has a preference in the lyophilic sequence of the soil, competing for the same active site as K and Mg, which decreases the availability of these nutrients in the superficial layer. In 2017, the levels of Ca in the soil reduced due to leaching and export through the crop. This year, it was noticed an improvement in soil ephemeral structure, which increased the absorption of water and nutrients by the maize crop due to the direct and indirect improvements provided by Ca. Directly because Ca contribution stimulating maize root development and indirectly because Ca in soil does strong binding with c-organic. These factors improved maize rooting, which reflected higher N uptake, 75 kg ha^{-1} in the control treatment and 195 kg ha^{-1} in GLU treatment, and higher maize grain yield, 3.10 Mg ha^{-1} in Control and 6.17 Mg ha^{-1} in GLU. In humid tropics the contribution of organic matter and gypsum application are alternatives that allow to improve the soil ephemeral structure, to increase c-organic levels and base saturation in the rooting layer from the second year of cultivation.

Keywords: Calcium, maize grain yield, nitrogen uptake, sandy loam soil

Financial support: This work was undertaken as part of NUCLEUS, Funded in Maranhão by FAPEMA and in the United Kingdom by BBSRC.

(4436 - 3115) Agronomic characteristics of sunflower cultivars (*Helianthus annuus* L.) BRS 122 and BRS 324 under nitrogen fertilization in the brazilian semiarid region.

Amanda Michele Santos de Lima[1]; Francisca Maria da Silva Correia[1]; Emídio Cantídio Almeida de Oliveira[1]; Abraão Cícero da Silva[1]; Magda Aline da Silva[1]

Universidade Federal Rural de Pernambuco[1]

The Brazilian semiarid is a region that shows peculiar and limiting conditions of soil and climate to the majority of plant species. The restrictions imposed by these peculiarities, especially the local irregular rainfall distribution, give to the soil some specific characteristics such as low organic matter content, the main source of Nitrogen to the soil. Therefore, the nitrogen requirement of the agricultural crops at this location is almost exclusively supplied by the nitrogen fertilization. That being said, identifying crops that present high efficiency in the use of nitrogen fertilizers has become crucial in the management of the crops cultivated in this region. In this perspective, this paper aims to evaluate the growth and yield of two sunflower cultivars under different levels of nitrogen grown in the semiarid region. The experiment occured in a field with two sunflower cultivars (BRS 122 and BRS 324) and four levels of nitrogen (0, 40, 80 e 120 kg ha^{-1}) distributed in randomized blocks with six repetitions in a 2x4 factorial design. Growth parameters (height, diameter, amount of leaves, diameter of the capitulum, and dry biomass produced) were evaluated at 45, 53, 60, 67, 70, 81, 90 and 104 days after sowing (DAS). Production parameters were also evaluated (aerial dry mass, root dry mass, mass of 1000 achenes, achene yield, yield, and oil content) at the end of the cycle. There was a significant interaction between the level of nitrogen applied and the cultivar regarding height, diameter of the capitulum, and amount of leaves. The achene yield, oil content, and the total dry mass differed according to the level of nitrogen applied, presenting better results with the amount of 100kg ha^{-1}. At the end of cycle, the BRS 122 cultivar presented higher efficiency of nitrogen fertilizer use and higher increases in growth variables, while the BRS 324 cultivar showed to be more demanding in nitrogen, and presented better performance in the amount of achenes and oil content in response to nitrogen fertilization. For both cultivars, with the increase of the nitrogen level, there was an increase in oil productivity and reduction in oil contents.

Keywords: Keywords: Fertilizer efficiency; biofuels; oilseeds.

Financial support:

(9360 - 1357) Agronomic variables and silage production of maize plant intercropped with forage plants under different nitrogen topdressing rates.

Clarice Backes[1]; Stephanie Vicente de Bessa[1]; Lucas Matheus Rodrigues[1]; Arthur Gabriel Teodoro[1]; Alessandro José Marques Santos[1]; Lorrayne Lais Ferreira Leite[1]

State University of Goiás[1]

The maize silage is an important food in dairy and cattle production during dry season thus is fundamental improve productivity. To improve yield and silage production it can be use intercropping maize with forage plants and nitrogen fertilization. The objective of this study was to evaluate the effect of nitrogen topdressing rates applied to an intercrop of maize (M) with paiaguás grass (G) and pigeonpea (P) on silage production and on agronomic variables of shoots of maize plant. Treatments consisted of two intercropping systems (M+G; and M+G+P) and four N topdressing rates (0, 80, 160, and 240 kg ha^{-1}). In the maize dent reproduction stage, the plants were harvested for silage production. On that occasion, was measured agronomic traits of maize such as plant height, height of ear insertion, stem diameter, final stand, and ear index. The growth of maize plants was not influenced by the introduction of pigeonpea into the system, although the legume was sown simultaneously in the maize inter-row. The N rates influenced only the stem diameter and the estimated N rate of 198 kg ha^{-1} provided maximum value. Silage dry matter yield was affected by the interaction between intercrops and N rates. The highest yields were obtained when the pigeonpea was introduced in the system, with increase of 43% based on the means of the M+G+P intercrop in relation to M+G. With respect to the N rates, for the M+G intercrop, yields increased linearly, reaching 13.9 t ha^{-1} at the N rate of 240 kg ha^{-1}. For the M+G+P intercrop, the response was quadratic, with maximum yield (18.1 t ha^{-1}) obtained at the estimated N rate of 120 kg ha^{-1}. The introduction of pigeonpea contributed to increase the silage dry matter and reducing the N rate in the system as a function of the produced mass.

Keywords: maize morphology; crop-livestock integration system; legumes.

Financial support:

(7308 - 2973) Ammonia volatilization from liquid nitrogen fertilizers

treated with urease and nitrification inhibitors

Mateus de Paula Gomes[1]; Chaenzy Specimille Hamer[1]; Ariana Mota Pereira[1]; Reinaldo Bertola Cantarutti[1]

Universidade Federal de Viçosa[1]

UAN is a liquid fertilizer composed of urea and ammonium nitrate, with 32% N. It can have its efficiency compromised through N losses by ammonia volatilization and nitrate leaching. The objective of this study was to evaluate the efficiency of the urease inhibitor N-(n-butyl) thiophosphoric triamide (NBPT) and the nitrification inhibitor dicyanodiamide (DCD) to control UAN volatilization. The experiment was carried out on a soil cultivated with maize (Red Latosol, clay-sandy loam) collected in Patos de Minas and a soil under pasture (Cambic Red-Yellow Argisol, very clayey) collected in Viçosa, Minas Gerais, Brazil. The fertilizers evaluated were UAN+NBPT+DCD (UANnbpt.dcd), UAN+NBPT (UANnbpt), UAN+DCD (UANdcd), UAN and Urea (U). NH_3 volatilization were measured 20 times. Thus, the treatments consisted of a factorial design (2 × (5 + 1)) × 20. The experiment was arranged in a completely randomized design with measurements repeated over time, with three replicates. The soils previously received limestone application sufficient to raise the base saturation to 70%. The experiment was conducted in a system of an incubator containing 200 g of soil connected to a NH_3 collector containing H_3BO_3 solution (20 g L^{-1}). Fertilizer amounts equivalent to 100 mg of N were applied on the soils. The system was closed and immediately subjected to a flow of NH_3-free air to carry the NH_3 produced. The 20 measurements of volatilized NH_3 were performed between 3 and 312 h from the fertilizer applications. At each measurement, the collecting units were changed and the NH_3 captured by the H_3BO_3 solution was determined by potentiometric titration. The fertilizer urea showed the highest ammonia volatilization, with losses of 291 and 286 mg/g of N for the soils with the maize crop and the pasture area, respectively. The peak of volatilization occurred after 48 h and 24 h for the soils with maize and pasture, respectively. The application of DCD to UAN had no influence on the N loss by ammonia volatilization in both soils. However, the application of NBPT to UAN reduced the ammonia volatilization accumulated in the soil from the maize area by 55% at UANnbpt.dcd and 50% at UANnbpt. While in the pasture soil, the NBPT delayed the volatilization peak, which occurred after 60 hours for UAN and after 120 hours for UANnbpt and UANnbpt.dcd.

Keywords: NBPT; DCD; UAN

Financial support: Conselho Nacional de Desenvolvimento Científico e Tecnológico - (CNPq); Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - (CAPES); Fundação de Amparo à Pesquisa do Estado de Minas Gerais - (FAPEMIG)

(3176 - 959) Ammonia volatilization from nitrogen fertilizer formulated with biochar

Aline Peregrina Puga[1]; Cristina Silva Carvalho[2]; Marcos Antônio Vieira Ligo[1]; Adriana Marlene Moreno Pires[1]; Braulio Garcia Pereira Neto[3]; Cristiano Alberto de Andrade[1]

Embrapa Meio Ambiente[1]; UEMA[2]; Carbosolo Desenvolvimento Agrícola[3]

Ammonia (NH_3) volatilization results in low N use efficiency by crops. The aim of this study were to evaluate NH_3 volatilization from nitrogen fertilizer formulated (F) with biochar (BC). In a incubation experiment the fertilizers were applied to soil surface. NH_3 volatilized was captured by H_2SO_4 solution. BC used in the production of fertilizers is from eucalyptus (charcoal fines). Two types of formulated fertilizers were tested: granulated (F6 and F8; mixture of BC, urea and additives) and coated granulated fertilizers (F17 and F19; coating of urea granule with BC, acidified or not, and additives). Treatments tested were: 1) blank; 2) control; 3) soil + urea; 4) soil + F6 (10% N, 51% BC); 5) soil + F8 (20% N, 29% BC); 6) soil + F17 (20% N, 29% BC) and 7) soil + F19 (32% N, 20% BC). Granulated fertilizers (F6 and F8) and F17 coated fertilizer volatilized lower amounts of NH_3 than urea, indicating greater efficiency when applied to the surface. In the case of F17, where the BC was previously acidified prior covering urea granule, acidification must have influenced the reduction of NH_3 losses. In total urea volatilized 71% of N applied while F6 and F8 showed losses of 60% and 66%, respectively. F8 was produced with 20% N and 29% BC, while F6 with the lowest NH_3 loss had 10% N and 51% BC. Proportion of BC in the fertilizer and the BC/N ratio appear as important in reducing N loss by NH3 volatilization. F19 showed worse performance than urea, volatilizing 80% of the applied N. However, F17 which was coated with previously acidified BC, presented lower volatilization (64%) compared to F19 and urea. In the equations of first-order chemical kinetics model describing the urea NH_3 volatilization process of BC granulated and BC-coated fertilizers, it was found that the lowest N_0 values (indicates the stabilization value of the volatilization process) belong to F6 and F8 (@64%), 12% lower than urea (N_0=73%). It was observed that the highest value of N_0 was of F19 (84%), confirming the BC alkalinity effect (pH@ 7.7) favoring N losses when fertilizer production technology was the coating of urea granule with BC without prior acidification. F6 and F8 tested in this study demonstrated potential to be applied in top dressing fertilization, due to lower volatilization rates, providing lower risk of N losses due to volatilization of NH_3. Granulated F6 and coated F17 provided reductions between 10 and 15% for NH_3 losses compared to urea.

Keywords: N losses, increased efficiency, NH_3, mitigation

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(2061 - 1197) Ammonia volatilization in oxisol cultivated with maize and irrigated with swine wastewater treated anaerobically

Sarah Mello Leite Moretti[1]; Edna Ivani Bertoncini[2]; André Cesar Vitti[2]; Cassio Hamilton Abreu-Junior[1]

University of São Paulo, Center for Nuclear Energy in Agriculture[1]; São Paulo's Agency for Agribusiness Technology, Secretariat of Agriculture and Food Supply of São Paulo[2]

Swine effluent presents significant nitrogen (N) amounts in forms easily available by crops and its agricultural use can represent mineral fertilizers savings and nutrient cycling. However, its potential fertilizer can be reduced due to N atmospheric losses, which is preferably in ammoniacal form in effluent. Under tropical and subtropical conditions, there is little information about N volatilization from organic wastes applied to soils. This study was carried out in field conditions, in randomized blocks with three replicates. Summer and winter corn crops were cultivated in a clayey Oxisol, evaluating the following treatments: T1- control, without fertilizer and irrigation; T2- mineral fertilization without irrigation, T3- irrigation with swine wastewater SWB, T4-irrigation with SWBD, T5-mineral fertilization with irrigation with water. Irrigation needs were controlled by crop water requirement and soil matric potential measured by tensiometers installed in each plot. Next to maize central line of each plot, it was installed semi-open chambers containing foams soaked in 0.01 mol L^{-1} phosphoric acid and glycerin to capture volatilized N-NH_3. Periodically, the saturated foams were exchanged, washed with deionized water, and N-NH_4^+ contents were determined in extracts, quantifying the N losses. The average N-NH_4^+content in treated effluents was 1423.2 mg L^{-1}, representing 80% of N-total. The pH value at the soil surface was 4.7, which could facilitate N losses by

volatilization. Higher N losses occurred 2 and 3 days after first application of SWB (33.3 mm) in T3 and T4 treatments, equals to 4 kg ha^{-1} and 3.8 kg ha^{-1} of N, respectively for winter and summer cultivation. However, highest lost nitrogen percentage was obtained for soil irrigated with SWBD during winter cultivation, equal to 6.4% of total N applied when compared to SWB irrigation, in which the losses were equal to 3.3% of total N. Higher rainfall indices observed during summer cultivation promoted the incorporation of effluents and nitrogen fertilizer to soil, reducing the N atmospheric losses. Despite a small increase in losses observed at 22^{nd} day of evaluation in treatments with mineral fertilizer application, as function to temperature (29ºC). Thus, N volatilization was influenced by amount and characteristics of swine effluents, application time and soil characteristics. These factors should be considered for predict nitrogen losses by volatilization in soils treated with swine wastes.

Keywords: swine manure, anaerobic digestion, gas emission, nitrogen losses

Financial support:

(3055 - 1326) Ammonia volatilization of nitrogen sources applied in maize in no tillage

Bruno Paulo Moschini[1]; Nicole Colombari Cheng[1]; Pedro Lopes Garcia[2]; Paulo Cesar Ocheuze Trivelin[2]

ESALQ/USP[1]; CENA/USP[2]

The maize (*Zea mays* L.) is one of the most studied crops due to its economic importance. Despite the high yield potential in maize, what can be observed in practice is a low and irregular grain yield due to management problems such as the incorrect use of nitrogen fertilizers which provide nitrogen (N) losses in the soil-plant-atmosphere system. A manner to increase fertilizers use efficiency can be using enhanced efficiency fertilizers. The objective of this study was to evaluate the effect of N rates and sources on volatilization of ammonia (NH_3-N). The experimental area was located in Iracemápolis, São Paulo, Brazil, in a Rhodic Eutrustox site with clayey texture. The treatments were arranged in randomized blocks with four replications and consisted of the application of urea, ammonium nitrate, and blends of NBPT-treated urea with polymer-sulfur coated urea with the following rates: 75, 150, 225 and 300 kg N ha^{-1}. The treatments were applied at maize sowing at top dressing in no tillage. A control treatment (without urea-N) was also included. A static open collector (14 x 14 x 7 cm) manufactured with PVC with an exchangeable circular foam (diameter: 15 cm; thickness: 2 cm; density: 0.02 g cm^{-3}) soaked in 25 mL of phosphoric acid solution (5 mol L^{-1} with 5% of glycerin (v/v)) was used to quantify the ammonia losses. The flow injection analysis (FIA) was utilized to determine NH_3-N retained in the foam after extraction by deionized water. The results were submitted to analysis of variance, the means were compared by the Fischer test, both at 0.1 of probability, using the R statistical software. The ammonia losses were measured during 61 days, having low losses until the fourth day of evaluation, maximum losses in the fifth day after fertilization, and decreasing losses until the last evaluation. The maximum volatilization losses was similar in the treatments. The urea (225 and 300 kg de N ha-1) had higher total volatilization losses than other treatments.

Keywords: nitrogen fertilizer, coated urea, static collection open, Zea mays L.

Financial support: CAPES, CNPq, CENA/USP, Produquímica

(8413 - 2369) Analysis of initial growth of pepper pout submitted at nitrogen levels

Jéssica Patrícia Paula Lima[1]; Márcio Koetz[1]; Edna Maria Bonfim-Silva[1]; Juliane de Souza Beltrão[1]; Francielly Gonçalves Barbosa-Oliveira[1]

Universidade Federal do Mato Grosso[1]

The production of peppers in Brazil has shown growth in the last years, being worth mentioning the pepper pout of the genus Capsicum chinense, considered the most domesticated Brazilian species. Its cultivation in Brazil is maintained by the small and medium farmers, mainly of the Southeast region. Because it is a crop that does not require excessive labor, especially when it comes to its harvest, its cultivation is a good option for obtaining income. However, research is still necessary for its efficient cultivation in the Cerrado. The objective of this study was to evaluate the diameter of the stem of the pepper pout in protected crop under nitrogen doses. The experiment was conducted in a greenhouse in pots of 5 dm^{-3} with Oxisol from native Cerrado. The experimental design was completely randomized, with 5 nitrogen doses (0, 60, 120, 180 and 240 mg dm^{-3}) and 5 replicates, totaling 25 experimental units. According to the soil chemical analysis, the base saturation was corrected to 80% and fertilized with 600 mg dm^{-3} of phosphorus, 180 mg dm^{-3} of potassium and nitrogen, divided in 3 times according to the treatments. It was fertilized with micronutrients via solution, applying 5,72 mg dm^{-3} of boron, 3,93 mg dm^{-3} of copper, 10,95 mg dm^{-3} of manganese and 13,51 mg dm^{-3} of zinc. The cultivar BRS Moema was used to seed the seeds in expanded polystyrene bile and later transplanted to the pots, when the seedlings reached an average of 7 cm in height, 37 days after sowing. Irrigation was performed by monitoring soil moisture with tensiometers, installed at 10 cm depth in the pots, so that the soil returned to the field capacity condition whenever the read tension reached 15 kPa. The stem diameters were analyzed at 15, 30, 45 and 60 days after transplanting (DAT). A significant difference was found in the F-test at 5% probability at 30, 45 and 60 DAT, where it was fitted to the linear regression model, using the statistical software SISVAR. The stem diameters of the pepper pout cultivated with Oxisol, under protected environment were influenced by the nitrogen doses.

Keywords: Capsicum chinense, irrigation, family farming, fertilization.

Financial support: Universidade Federal do Mato Grosso

(7690 - 3128) Biological nitrogen fixation in legume crops grown in a consortium with grasses

Jéssica Rafaella de Sousa Oliveira[1]; Sueide Karina da Silva[1]; Ana Dolores Santiago de Freitas[1]; Carolina Etienne de Rosália e Silva Santos[1]; Vinicius Santos Gomes da Silva[1]; Leandro Reis Costa Santos[1]

Universidade Federal Rural de Pernambuco[1]

Biological nitrogen fixation (BNF), performed by diazotrophic microorganisms, is extremely important for agriculture, since it has the potential to reduce the indiscriminate use of nitrogen fertilizers, resulting in savings for the producer and reduction of impacts on the environment. The objective of this study was to estimate the BNF of jack bean (*Canavalia ensiformis*) and cowpea (*Vigna unguiculata*) grown in a consortium with C4 grasses (maize (*Zea mays*), sorghum (*Sorghum bicolor*) and millet (*Pennisetum glaucum*)) or sunflower (*Helianthus annus*). Samples of the superficial layer of a Planosol (0-30cm) were collected in agricultural area of the municipality of Belo Jardim, semiarid region of Pernambuco state. This soil was used for potting (6.5L). The study was conducted in a greenhouse using a randomized block design. The harvest was done 50 days after planting, cutting the aerial part, which was dried in an oven, ground and submitted to analysis of N concentrations and its isotopes. The nodules were counted and packed in silica gel to determine the biomass of dry nodules. FBN was estimated using the ^{15}N natural abundance methodology. For the biomasses, concentrations and accumulations of N, nodulation, % Ndda and N fixed in the legumes, comparisons were made considering a 2 * 4 factorial experiment (8

treatments: 2 legume species and 4 intercalary species situations) and the means were compared to the Tukey test at 5% probability. The presence of compatible rhizobial populations in the soil was demonstrated by the natural nodulation of legumes. It was verified that the grass species does not alter the nodulation, demonstrated by the similarities in the number of nodules, dry biomass and average size of legume nodules when cultivated together with maize, sorghum or millet. On average, the plants had 118 and 56 nodules, with a dry biomass of 0.84 and 0.45 g plant^{-1} and mean nodule size of 7.81 and 8.63 mg for jack bean and cowpea , respectively. For jack bean, the percentage of nitrogen derived from the atmosphere (% Ndda) varied between 67 % and 86 %, showing that in intercropped or single crops, the legume has considerable fixation capacity, which corresponds to a mean of 461 mg of nitrogen obtained by FBN. The same occurred with the cowpea, which had values between 70 and 85% and 366 mg plant^{-1} of fixed N. The sampled soil harbors a naturally established rhizobial population with the ability to nodulate the legumes, not being altered by the consortium.

Keywords: Sustainable agriculture, isotope techniques, natural nodulation, native rhizobia.
Financial support: FACEPE-Fundação de Amparo a Ciência e Tecnologia de Pernambuco- FACEPE / Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – CAPES

(1729 - 1709) Components of the efficiency of nitrogen use in culture of the inoculated corn with *Azospirillum brasilense*

Karen Alessandra Sousa Castro[1]; Marcelo Marinho Viana[1]; Lincon Matheus Araujo Silva[1]; Danilo Nunes Sodre[1]; Assistone Costa de Jesus[1]; Ester de Paiva Alves[1]; Werlen Araújo Barbosa[1]; Erivaldo Plinio da Costa Borges[1]; Cristina Silva Carvalho[1]; Heder Braun[1]
State University of Maranhão[1]

The association of nitrogen with diazotrophic bacteria of the genus Azospirilum brasilense can guarantee a greater productive capacity and efficiency of the use of N for the corn crop. The objective of this study was to evaluate the association between inoculation of Azospirillum brasilense and N rates on grain yield and efficiency of N using corn. The experiment was installed in the field at the State University of Maranhão in the year 2015 (2° 35'S and 44° 12' W). A randomized complete block design with four replications in a factorial scheme was used, the treatments consisted of the combination of four doses of N (0, 45, 90 and 180 kg ha-1) applied as a cover in the form of urea (45% of N) with three forms of inoculation of the bacteria of the genus A. brasilense (seeds, foliar and control). The seed corn was the hybrid AG-1051, with plots of four rows spaced 0.80 m and 0.20 m between plants. The relationship between the N content and the plant matter mass and the dry grains determined the content of N. With these data the following components of the NUE were calculated: N utilization efficiency (NUtE, kg kg-1), N uptake efficiency (NUpE, kg kg-1) and nitrogen use efficiency (NUE, kg kg-1). The ANOVA was performed adopting p≤0,25 for the interaction and p≤0,05 for the Tukey test. The R software was used with the RStudio interface to perform the analysis. The interaction rates of N x inoculation forms of A. brasilense influenced grain yield (p = 0.0381). The mean grain yield (GY) with seed inoculation was 8.0% higher than the GY average with foliar inoculation and 50% higher than the GY mean where it was not inoculated with A. brasilense. The interaction between the doses of N and the forms of inoculation with A. brasilense was significant on NUpE (p <0.0001) and NUE (p <0.0001). There was a 50% increase in NUE where inoculation with A. brasilense by way of seed was received in relation to treatment that was not inoculated. NUpE increased 62% when inoculated with A. brasilense by way of seed in relation to treatment that was not inoculated. There was no significant interaction for NUtE (p = 0.6683). With these results we can conclude that there was a 50% increase in GY and NUE in treatment of seed inoculant when compared to the control. In this way, the inoculation of A. brasilense in the seeds provides an increase in the productivity and greater efficiency of the use of N and its components, which proves the efficiency for the humid tropic of Maranhão.

Keywords: Zea mays L., inoculant, performance, diazotrophic bacteria, nitrogen fixation
Financial support: Maranhão Foundation for the Protection of Research and Scientific and Technological Development (FAPEMA).

(9636 - 1303) Cultivation of pout pepper under nitrogen in a greenhouse

Juliane de Souza Beltrão[1]; Márcio Koetz[1]; Edna Maria Bonfim-Silva[1]; Jéssica Patricia Paula Lima[1]; Francielly Gonçalves Barbosa-Oliveira[1]
Universidade Federal de Mato Grosso[1]

The cultivation and processing of peppers is an important economic activity for small producers. The pepper pout (*Capsicum chinense*) stands out due to its main characteristic which is the absence of pungency in the fruits, allowing its use in several product lines. However, studies are still necessary, in order to have the knowledge of the ideal techniques of its cultivation in the Cerrado. The objective of this study was to evaluate a plant height of the pepper pout submitted to different doses of nitrogen. The experiment was conducted in a greenhouse, located at the Federal University of Mato Grosso, Campus Rondonópolis. The experimental units were composed of pots of 5 dm^{-3}, filled with Red Latosol, from the Cerrado. The experimental design was completely randomized, with 5 nitrogen doses (0, 60, 120, 180 and 240 mg dm^{-3}) and 5 replicates, making 25 experimental units. From the chemical analysis, dolomitic limestone was applied to soil to raise the saturation by bases to 80% and was fertilized with macro and micronutrients, applying 600 mg dm^{-3} of phosphorus, 180 mg dm^{-3} of potassium and nitrogen, divided in 3 times according to the treatments. The micronutrients were via aqueous solution with 5.72 mg dm^{-3} of boron, 3.93 mg dm^{-3} of copper, 10.95 mg dm^{-3} of manganese and 13.51 mg dm^{-3} of zinc. The seeds of the cultivar BRS Moema were seeded in expanded polystyrene trays to be transplanted to the experimental units 37 days after sowing, when the seedlings reached an average of 7 cm in height. By means of a previous study with the soil, the water retention curve was obtained, where it was verified that the soil in the tension of 5 kPa was in the capacity condition of the field. Thus, irrigation was performed whenever the average reading of tensiometers installed at 10 cm depth in the experimental units, indicated the tension of 15 kPa, applying the volume of water required for the soil to return the field capacity. Plant height at 15, 30, 45 and 60 days after transplanting (DAT) was evaluated. A significant difference was found at 15, 30 and 45 DAT, by the F test at 5% probability, adjusting to the linear regression model at 30 DAT and quadratic at 15 and 45 DAT, using the statistical software SISVAR. The height of pepper pout plants cultivated with Red Latosol under greenhouse conditions are influenced by the nitrogen doses.

Keywords: *Capsicum chinense,* BRS Moema, family farming, irrigation, fertility.
Financial support: Universidade Federal de Mato Grosso

(9193 - 2724) Differential response of maize hybrids to inoculation with Azospirillum brasilense

Denise Pacheco Dos Reis[1]; Rafael Augusto Lima Rodrigues[1]; Christiane Abreu De Oliveira Paiva[2]; Lauro José Moreira Guimarães[2]; Ivanildo Evódio Marriel[2]
Universidade Federal De São João Del Rei[1]; Embrapa Milho E Sorgo[2]

High costs of nitrogen fertilizers from an energy and economic point of view make it important to develop technologies that increase the

nitrogen use efficiency by crops. The objective of this work was to evaluate the genetic variability and to identify maize genotypes responsive to the inoculation with diazotrophic bacteria of the genus Azospirillum, in an environment with low nitrogen availability. The study was conducted in dystrophic Red Latosol (Oxisol) soil, Cerrado phase, poor in nitrogen (<20 ppm of mineral N), in experimental area of EMBRAPA Maize and Sorghum, Sete Lagoas - MG. Seven hybrids of maize (HB1, HB3, HB3, HB4, HB5, HB6 and HB7) were evaluated in the presence and absence of an inoculant composed of three different strains of Azospirillum brasiliense, in a randomized complete block design with four replicates. At planting a uniform basal dose of 300 kg ha^{-1} of formulation 8-28-16 was applied. Coverage was not applied. For the preparation of the inoculant, cultures of bacteria enriched in defined medium for 5 days under stirring at room temperature, were centrifuged, washed and resuspended in saline. The cell suspensions were adjusted to approximately 10^8 CFU mL^{-1}, incorporated into ground charcoal (60% w/ v) as carrier and added to the seeds moistened with cassava starch gum 5%. In addition to the agronomic characteristics, grain yield (GY) at 13% moisture was evaluated. There results revealed that there were significant difference between maize genotypes ($p<0.05$), with GY ranging from 2.764 to 5.561 kg ha^{-1}, with differential response to inoculation ranging from -7(HB6) to + 82% (HB1) in uninoculated treatment. It is concluded that the technology of inoculation with Azospirillum brasilense can contribute to the gain of maize yield depending on the cultivar used.

Keywords: Diazotrophic; biotechnology; sustainability
Financial support: Embrapa, CAPES, FAPEMIG, CNPq

(3609 - 2156) Does the way of lime application change nitrogen amidic sources efficiency in mitigating N-NH_3 loses?

Marcos Renan Besen[1]; Evandro Antonio Minato[1]; Carolina Fedrigo Coneglian[1]; Éder Junior De Oliveira Zampar[1]; Bruno Maia Abdo Rahmen Cassim[1]; Lucas Simas De Oliveira Moreira[2]; Tadeu Takeyoshi Inoue[1]; Marcelo Augusto Batista[1]
UEM[1]; COAMO[2]

Higher nitrogen (N) loses in N-NH3 form can occur when urea is applied on surface, and can be enhanced by liming, due to soil pH increase changing the equilibrium between NH_3 e NH_4^+ in soil (NH_4^+ + OH↔ NH_3 + H_2O). in this way the use of enhanced efficiency fertilizers (EEF) can be an alternative in mitigation of N-NH_3 loses. The objective of this work was to evaluate the effect of lime application way in N amidic sources performance. O experimental design was a factorial randomized blocks (2x4x3 +2), where two ways of liming application: surface (SL) and incorporated (IL) application; four levels of base saturation (V%): 44, 60, 70 and 90%, which were combined to make the main plot; three N sources: conventional urea (CU); urea + N-butil tiofosfórico triamida (Ur-Nbpt); and commercial urea coated with boron and copper (Ur-CuB), which were the subplots. The additional treatments were with no N and lime in each soil management. N was applied in a rate of 80 kg N ha^{-1} in a Red Oxisoil, cultivated with wheat. The volatilization was measured to 2, 4, 7, 10, 14 e 17 days after N application. The volatilized NH3 evaluationg was carried out by semi open static chamber method with a filter paper tape submerged in a H_2SO_4 0,05 mol L^{-1} + 2% v/v de glycerin solution and determined by UV/VIS spectrophotometry. There was interaction only between N sources and ways of lime application and there was no effect from V%, possibly due the short term between lime reapplication and N application. Related to factorial versus additional treatments, only Ur-Nbpt in IL did not differ from the controls, showing higher mitigation potential. There was no effect from the Ur+CuB (20.15 kg N-NH_3 ha^{-1}) and UC (20.48 N-NH_3 ha^{-1}) in SL, however there was effect from Ur-Nbpt (15,33 kg N-NH_3), reducing in 25% the N loses compared to the others sources. When IL was used, mitigation occurred to both EEF. Emissions of 18.52, 13.60 e 8.30 kg N-NH_3 ha^{-1} were verified, resulting in N loses of 25, 17 and 10 % of the total amount of N applied from UC, Ur-CuB e Ur-Nbpt respectively. When we consider that in no-till system the urease activity is higher, we can presume that EEF efficiency in mitigate N loses is higher in less favorable conditions to volatilization, such as IL, being Ur-Nbpt source efficient in reduce N-NH3 volatilization in both soil managements.

Keywords: N-butil tiofosfórico triamida, pH, no-tillage,
Financial support: Coordenação de Aperfeiçoamento de Pessoal de Nível Superior

(5736 - 2752) Effect of natural zeolite on the nitrogen fertilizer efficiency in coffee crop, in Aserrí, Costa Rica

Karla Montero Jara[1]; Patricia Oreamuno Fonseca[1]; Wagner Peña[1]
Universidad Estatal a Distancia[1]

The objective of this work was to evaluate the effect of natural zeolite on the efficiency of nitrogen fertilizer in coffee crop. In search for sustainable alternatives to the nitrogen fertilizer of coffee crops, the proportional addition of clinoptilolite-type natural zeolite contributes to enhance the use of urea. The experiment was conducted in Vueltas de Jorco-Aserrí (Central Valley of Costa Rica). This study was established during the first vegetative stage of the coffee plants, replacing with different percentages of natural zeolite (0, 15, 25 and 35%) combined with urea. Physical, biological and chemical variables were analyzed. Most of the results were positive, but the variables related to microbial activity stand out in the treatment of 25% of natural zeolite.

Keywords: Fertilization, urea, isotope, coffee.
Financial support: Own funds.

(3608 - 750) Effect of the use of nitrification inhibitors in the reduction of nitrogen losses of nitrogenous fluid fertilizer

Ronaldo Batista Pinheiro[1]; Mauro Pinheiro Marra[1]; Karla Vilaça Martins[2]; Klaus Reichardt[3]; Adenir Antônio Martins Júnior[1]
Terrena Agronegócios Ltda[1]; University of Patos de Minas[2]; University of São Paulo[3]

Nitrogen (N) is the most used nutrient in agriculture, however, the main sources of nitrogen fertilizers present limitations due to N losses by volatilization, leaching or denitrification. One of the strategies to reduce the N losses of the nitrogen fertilizers applied to the soil is the use of urease and nitrification inhibitors. The objective of this research was to evaluate the ammonia volatilization of nitrogen fertilizers mixed with nitrification inhibitors. The study was carried out from December of 2017 to January of 2018, in a greenhouse located in the municipality of Patos de Minas, MG, Brazil. The experimental design consisted of a randomized complete block design with four treatments [T1 - Urea, T2 - Uan, T3 - Uan + DCD (dicyandiamide), T4 - Uan + DMPP (dimethylphenylpiperazinium), T5 - Uan + Nitrapirine and T6 - Uan + TA (ammonium thiosulfate)] all in 5 replicates. The experimental units consisted of plastic trays 50 cm long by 50 cm wide and 9 cm high. At the time of installation, a soil classified as Red Latosol of clay texture was sieved in each tray, sieved through 2 mm, and irrigated with 5 mm of water with the aid of a watering can. The ammonia collecting chamber was made from a transparent plastic bottle of polyethylene terephthalate (PET), with a capacity of 2 L. The ammonia losses were evaluated at 3, 7, 14 and 21 days after the application of the fertilizers (DAA). Ammonia losses were determined by titration with standardized solution of 0.005 mol L^{-1} H_2SO_4. Statistical analysis of the results was performed with the aid of the SAS® program. At 21 days after application of the fertilizers, the total

losses of N were, on average, in the T1 52% (a), T4 26% (b), T2 24% (b), T3 24% (b), T6 20% (b) and in T5 19% (b). The highest loss of N by volatilization was in the treatment with Urea application. And the smaller N losses were from treatments of uan only or mixed with nitrification inhibitors, so that we can conclude that the nitrification inhibitors do not affect ammonia volatilization when added to uan.
Keywords: Ammonia; Nitrogen; Volatilization.
Financial support: Terrena Agronegócios Ltda

(3848 - 752) Effect of urease inhibitor on a nitrogen fertilizer

Mauro Pinheiro Marra[1]; Ronaldo Batista Pinheiro[1]; Karla Vilaça Martins[2]; Klaus Reichardt[3]; Gustavo Borges Lima[1]
Terrena Agronegócios Ltda[1]; University of Patos de Minas[2]; University of São Paulo[3]

Nitrogen (N) is the most widely used nutrient in agriculture, however 20-50% of the N applied to the soil surface is lost by volatilization. Technologies have been developed to reduce losses of N by volatilization by inhibiting urease activity. The objective of this research was to evaluate the efficiency of urease inhibitors for a better use of nitrogen fertilizers. The study was carried out from October to November of 2017, in a greenhouse located in the municipality of Patos de Minas, MG, Brazil. The experimental design consisted of randomized complete blocks with 9 treatments including the inhibitors: NBPT [N- (n-butyl) thiophosphoricotriamide], AT (ammonium thiosulfate), HA (humic acid) and DCD (dicyandiamide), Treatments were: [T1 - Control, T2 - Urea, T3 - Ammonium nitrate, T4 - Uan, T5 - Uan + NBPT, T6 - Uan + TA, T7 - Uan + AH, T8 - Uan + NBPT + DCD and T9 - Uan + DCD], all with 5 replicates. The experimental units consisted of plastic trays 50 cm long by 50 cm wide and 9 cm high. At the time of installation, a soil classified as Red Latosol of clayey texture was sieved through 2 mm, placed into trays and irrigated with 5 mm of water with the aid of a watering can. The ammonia collecting chamber was made from a transparent plastic bottle of polyethylene terephthalate (PET), with a capacity of 2 L. Ammonia losses were evaluated 3, 7, 14, 21 and 28 days after fertilizer application (DAA). Ammonia was determined by titration with standardized solution of 0.005 mol L^{-1} H_2SO_4. The statistical analysis of the results was carried out with the aid of the SAS® program. At 28 DAA the total N losses were, on average, in T2 42% (a), T7 23% (b), T4, T6 and T9 20% (bc), T8 and T5 11% and, T3 6% (d). The greatest loss of N by volatilization was in the treatment with Urea application (T2). The lowest losses were observed in the treatment with Ammonium Nitrate (T3), followed by the treatment with the Uan fertilizer when the NBPT urease inhibitor was applied (T5 and T8). The DCD nitrification inhibitor did not affect ammonia volatilization when added to uan together with NPBT.
Keywords: Stabilized fertilizers; Nitrogen; Volatilization
Financial support: Terrena Agronegócios Ltda

(1684 - 1514) Efficiency of nitrogen fertilization and association with rhizobia in Vigna unguiculata in Latosol of the cerrado of Tocantins

Weslany Silva Rocha[1]; Mauro Gomes dos Santos[1]; Valéria França Brito[1]; Gilberto Coutinho Machado Filho[1]; Manoel Mota dos Santos[1]
Universidade Federal do Tocantins[1]

High doses of nitrogen can increase production costs and damage to the environment, but through symbiosis with bacteria of the genus *Bradyrhizobium*, cowpea, can obtain N by the biological fixation process of N_2 (BNF), reducing costs with nitrogen fertilizers and also environmental contamination. However, nitrogen, deficient in most cerrado soils, affects nitrogenase activity and may interfere with BNF. The objective of this study was to evaluate the efficiency of nitrogen doses with and without the use of rhizobium inoculation in *Vigna unguiculata* in the Latosol of the cerrado of Tocantins. The experiment was conducted in a greenhouse on the campus of Gurupi belonging to the Federal University of Tocantins, with the variety BRS Novaera. For the inoculation a standard strain already recommended for the cowpea culture was used. The experimental design was completely randomized, in factorial (2x5) with two variables (with and without inoculation) and five nitrogen doses, totaling 10 treatments, with three replications. To determine the aerial part dry mass (MSPA); dry mass of roots (MSR); number of nodules (NN); dry mass of the nodules (MSN) and accumulation of nitrogen in the aerial part (ANPA). There was no efficiency of both the doses and the inoculation for the dry mass of the aerial part of the cowpea. Nitrogen doses that allowed maximum root dry mass production were 60 kg ha^{-1} of N without inoculation of rhizobium and 120 kg ha^{-1} of N with inoculation of rhizobium. The application of nitrogen with or without inoculation negatively influenced the number and mass of nodules of BRS Novaera cowpea. The accumulation of nitrogen in the aerial part was only influenced by the doses of nitrogen, presenting greater accumulation in the dose of 120 kg ha^{-1} of N.
Keywords: Cowpea; Symbiosis; Urea.
Financial support: Federal University of Tocantins.

(6511 - 2480) Efficiency of nitrogen use due to the application of phosphorus and nitrogen doses inoculated with N_2-fixing bacteria in cowpea bean

Ester de Paiva Alves Barbosa[1]; Werlen Araújo Barbosa[1]; Marcelo Marinho Viana[1]; Assistone Costa de Jesus[1]; Danilo Nunes Sodré[1]; Erivaldo Plínio Borges da Costa Junior[1]; Karen Alessandra Sousa Castro[1]; Lincon Matheus Araujo Silva[1]; Márcia Masson Mendes[1]; Cristina Silva Carvalho[1]; Heder Braun[1]
Universidade Estadual do Maranhão[1]

In Brazil, nutrient deficiency in soils, especially nitrogen (N), has been considered a preponderant factor to obtain low yields by the beans. The cowpea has the capacity to symbiosis with bacteria of the genus *Bradyrhizobium*, to perform the biological fixation process of N_2 (BNF). Phosphate fertilizer (P) added to the soil, besides the immediate effect on the crop following fertilization, may have a residual effect on the subsequent crops. The objective of this study was to quantify the efficiency components of the use of N due to the form of application of phosphorus and nitrogen doses associated to the use of inoculated N2 fixing bacteria. The experiment was carried in the field, located in São Luis, MA, Brazil (2°30'S and 44°18'W). The treatments were a factorial arrangement (4x3) + 2 of four doses of N (0, 20, 60 and 120 kg ha^{-1}) and three ways of applying P (in the total area - TA, planting furrow - PF and split in the furrow - SF), plus two additional treatments (N_2-fixing bacteria and control without N, P, and bacteria) in total 56 plots. Treatments were replicated four times and randomized complete block design was used. The cultivar used was "BRS Guariba", with plots of four rows spaced 0.50 m and 0.25 m between plants. As sources of N and P, urea (45% N) and simple superphosphate (20% P_2O_5) were used. The content of dry matter in the grains, N harvest index, crude protein and yield were determined. The ANOVA for the qualitative factor (forms of P application) were compared by the Turkey's test ($p \leq 0.05$) and for regression analysis the quantitative factor (N doses) was applied. There was a significant interaction between the treatments on the average dry matter content in the grains ($p=0.05$) and productivity ($p=0.01$). There was no significant interaction between treatments for crude protein averages ($p>0.05$) and harvest index of N ($p>0.05$). There was a significant difference between the two treatments (bacteria and control) on all variables studied. The plots that received only the bacteria showed higher means in relation to the control treatment. The application of P_2O_5 (SF) presented higher averages for the crude protein, harvest

index of N for wet tropic conditions. Thus, our results suggest that the dose of 60 kg ha^{-1} of N when associated with the application of P (SF) and inoculated with *Bradyrhizobium* in the seeds provides an increase in yield and dry matter content in the grains for cowpea bean cultivation.
Keywords: *Bradyrhizobium*; BRS Guariba; protein.
Financial support: National Council for Scientific and Technological Development (CNPq)

(8039 - 441) Influence of N source on nutrient uptake and cabbage growth.

Ivan Carlos Carreiro Almeida[1]; Talita Gabriela Gentil[2]; Leonardo Angelo De Aquino[2]
IFNMG - TEÓFILO OTONI[1]; UFV - RIO PARANAÍBA[2]

The cabbage has a high potential for nutrient extraction. High fertilization is required to allow the achievement of high yields and crop quality. Among the nutrients, nitrogen (N) is the second most accumulated and exported by the crop. The objective of this study was to evaluate the influence of sources and rates of N on the cabbage yield. The experiment was carried out at UFV - Rio Paranaíba, Brasil. Pots with a capacity of 250 dm^3 were used, filled with sifted soil, which is classified as Red-Yellow Latosol very clayey texture with the following chemical characteristics: pH (H_2O) = 5.7; Ca^{2+} = 5.8; Mg^{2+} = 1.2; Al^{3+} = 0, expressed in $cmol_c$ dm^{-3}, P = 13.4; Prem = 14.1; S = 14.7; K = 46.2 expressed as mg dm^{-3}, organic matter = 3.1 kg kg^{-1} and V = 63%. The treatments consisted of four sources: urea (U), ammonium nitrate (AN), ammonium sulfate (AS) and calcium nitrate (CN) and four doses (50, 100, 150 and 300 mg dm^{-3}) of N and a further control treatment, without application of N. Doses of 50 and 100 mg dm^{-3} of N were applied incorporated before transplanting the seedlings. The doses of 150 and 300 mg dm^{-3} were split-fertigated two and three times, respectively. The first on the day of transplanting the seedlings, the second at 15 days after transplant (DAT), and the last at 40 DAT. At 40 DAT, 50 mg dm^{-3} of K was applied to all treatments. The cultivar used was Astrus Plus, F1 hybrid, and cultivated four plants per pot. The seedlings were transplanted 35 days after sowing. In the transplantation, 5.4 g of P (SSP), 0.4 of Cu, 0.5 of B and 100 mg dm^{-3} of K was applied. The dry matter of cabbage-head and accumulations of N were determined in each part of the plant. The best doses were defined as those that allowed the reach of 95% of the maximum productivity estimated by the adjusted models. N sources did not influence productivity. The accumulation of dry matter in the whole plant (head, outer leaves, stem and root) with an application of the N dose to obtain 95% of the maximum estimated cabbage-head production was 242.1; 255.1; 240.0 and 257.2 g/plant with a N uptake of 4.72; 4.40; 4.10 and 4.23 g/cabbage-head, and in the whole plant was 7.40; 7.80; 6.90 and 7.21 g/plant in the sources U, AS, AN and CN, respectively. The uptake and partition of N were similar between N sources. Urea is generally the lowest cost source and in its use measures to avoid N volatilization should be employed, making it the best option for nitrogen fertilization in cabbage.
Keywords: *Brassica oleracea* var. capitata; urea; fertilizers
Financial support: CNPq and FAPEMIG

(3224 - 2477) Influence of the nitrogen fertilizer coverage administration in the quantity and nodule number of common bean in no-tillage system

Amanda Magalhães Bueno[1]; Rilner Alves Flores[1]; Enderson Petronio de Brito Ferreira[2]; Aline Franciel de Andrade[1]; Frederico Simões Raimundo de Lima[1]
Universidade Federal de Goiás[1]; EMBRAPA[2]
[1]Programa de Pós-Graduação em Agronomia/UFG – e-mail: amanda.mabu@gmail.com. alineandrade418@gmail.com. fredlimaufg@yahoo.com.br; [2]Departamento de solos/UFG – e-mail: rilner1@hotmail.com. Universidade Federal de Goiás; [3]Departamento de Microbiologia do Solo, Embrapa Arroz e Feijão – e-mail: enderson.ferreira@embrapa.com.br.

Common bean (*Phaseolus vulgaris* L.) is able to benefit from the biological nitrogen fixation when associated with rhizobacteria. The addition of nitrogen fertilizers in bean cultivation may help increase grain yield. Despite the beneficial effect of nitrogen fertilization, the addition of fertilizer may disrupt the association and nodules formation by diazotrophic bacteria. The objective of this work was to evaluate the effect of nitrogen fertilization on the number and weight of nodules formed by symbiotic association of rhizobacteria in common bean. The study was performed in the EA / UFG with the BRS Pérola cultivar using a randomized block design, 2x2 factorial scheme, with four replications. The first factor was the presence or absence of seed inoculation. The second factor used was nitrogen fertilization (120 kg of N ha^{-1}), 80 kg ha^{-1} at 20 days after germination (DAG) and 40 kg ha^{-1} at 40 DAG or 60 and 60 kg ha^{-1} of N at 20 and 40 DAG. The inoculation was carried out using peaty inoculant, containing the strains SEMIA 4077 and SEMIA 4080 of *Rhizobium tropici* and the strain SEMIA 4088 of R. *freirei*, using 10% sugar solution as an adhesive agent. The sowing occurred in the winter cropping season, under no-tillage system, under a central pivot irrigation system. The number of nodules per plant was obtained by extracting 3 plants with their conserved roots. Nodules were removed from the roots, counted and, subsequently dried (65 ºC; 72 h) to determine the nodules dry weight (NDW). Plants not inoculated with the highest N supply in the first days showed an average of 36.64 nodules per plant and the ones with less supply had 20.39 nodules. Beans inoculated with 60 kg of N ha^{-1} at 20 DAG obtained an average of 30.84 nodules and those with 80 and 40 kg of N ha^{-1} in the 20 DAG presented an average of 42.94 nodules per plant. Also, plants fertilized with 80 kg ha^{-1} of N at 20 DAG showed higher NDW, for which inoculated plants presented NDW of 24 g and for the non-inoculated plants the NDW was 0.9 g. No significant differences were found for the weight of nodules of the bean fertilized with the 60 and 60 kg N ha^{-1} plots at 20 and 40 DAG.
Keywords: Phaseolus vulgaris L. Symbiotic efficiency. Inoculant.
Financial support: CNPQ (Conselho Nacional de Desenvolvimento Científico e Tecnológico)

(1897 - 1683) Maize crop inoculed with *Azospirillum brasilense* and nitrogen top-dressing increase grain yield and nitrogen use efficiency

Marcelo Marinho Viana[1]; Lincon Matheus Araujo Silva[1]; Karen Alessandra Sousa Castro[1]; Ester de Paiva Alves[1]; Danilo Nunes Sodre[1]; Assistone Costa de Jesus[1]; Werlen Araújo Barbosa[1]; Erivaldo Plinio da Costa Borges[1]; Cristina Silva Carvalho[1]; Heder Braun[1]
State University of Maranhão[1]

Nitrogen (N) management is essential to maximize nitrogen use efficiency (NUE) and sustain agricultural production as well as reduce environmental impacts. We hypothesized that the combination of N and inoculants containing plant growth promoting bacteria (*Azospirilum brasilense*) can increase grain yield and NUE for the maize crop. The present study aimed evaluate the relationship between inoculation way of application of *A. brasilense* and N fertilization rates on grain yield and NUE on maize crop. The experiment carried out in the field at 2016 (2°35' S and 44°12' W), in a randomized complete block design, with four replications. The treatments were performed in factorial arrangement 4 x 3: four N fertilization rates (0, 45, 90 and 180 kg ha^{-1}), applied as top-dressing with three inoculation way

(seeds, leaf and control). Urea (45% of N) was N source. Nitro 1000 Gramíneas® was the inoculant used in the treatments. It was performed with 100 mL ha^{-1} of the commercial product in seed-inoculant before planting and 200 mL ha^{-1} in leaf-inoculant spraying application. The N fertilization rates and *A. brasilense* leaf-inoculant spray were applied at the corn growth stage V4. The variable evaluated were: grain yield (GY, Mg ha^{-1}), N utilization efficiency (NUtE, kg kg^{-1}), N uptake efficiency (NUpE, kg kg^{-1}) and nitrogen use efficiency (NUE, kg kg^{-1}). The ANOVA was performed adopting p≤0,25 for the interaction and p≤0,05 for the Tukey test. The R software was used with the RStudio interface to perform the analyzes. There was no significant interaction between the doses of N x forms of inoculation of *A. brasilense* (p=0,5444) for grain yield (GY). The interaction between the doses of N x forms of inoculation with A. brasilense significantly influenced NUE (p=0,0003), but did not significantly influence NUtE (p=0,7955) and NUpE (p=0,6396). With these results, we can conclude that there was increase of 20% in GY and 42% in NUE in seed-inoculant treatment when compared with control. N fertilization rates affect positively the GY and reduce NUE and its components. In view of the results, there should not be a total substitution of nitrogen fertilization by inoculation with *A. brasilense,* but it is necessary to perfect the N partition, which can result in increased productivity, even at low levels of N. Responses depend on the concentrations of bacteria, soil, climate of each ecosystem and inoculation technology.

Keywords: *Zea Mays* L, inoculant, production, diazotrophic bacteria, nitrogen fixation.

Financial support: Maranhão Foundation for the Protection of Research and Scientific and Technological Development (FAPEMA).

(7582 - 1963) Mulching of leguminous trees to improve nitrogen use efficiency in tropical cohesive soil

Virley Gardeny Lima Sena[1]; Vinicius Ribamar Alencar Macedo[2]; Stéfanny Barros Portela[2]; Ivana de Sousa Diniz[2]; Juliano Carlos Calonego[1]

UNESP[1]; UEMA[2]

The reduced efficiency of nitrogen use (EUN) is one of the problems that weaken the productivity and profitability of crops under the conditions of family agriculture. Mainly, in soils that present very low levels of organic matter, as occurs in the humid tropic region. Under these circumstances, reduced availability and low efficiency of applied nitrogen can make agricultural crops unviable and decrease farmers interest in making continuous use of the same area every year. This process ends up forcing farmers to constantly change the area of planting, a disadvantage for agriculture and the environment that ends up losing natural reserve area. In order to increase the efficiency of nitrogen use, the legume *Gliricidia sepium* (4% N) was used as a cover crop in cohesive soils with low natural fertility. This study started in January 2016, after a randomized block design with four replicates of the following treatments: T1: gliricidia + nitrogen, T2: gliricidia + potassium, T3: gliricidia, T4: gliricidia + potassium + nitrogen, T5: soil exposed + nitrogen T6: uncovered soil + potassium, T7: uncovered soil, T8: uncovered soil + potassium + nitrogen. The corn cultivar AG 7088 (*Zea mays* L.) was sown between the legume lines, spaced 80 cm apart. In 2016, the area received P fertilization of 120 kg ha^{-1} P in the form of triple superphosphate, 60 kg ha^{-1} K as KCl, 60 kg ha^{-1} N as urea and 200 kg N organic / ha in the form of *Gliricidia Sepium* gliricidia for certain treatments to be received. It could be observed in two years of cultivation of maize that this legume gave rise to considered increases in the efficiency of N use compared to treatment that received only chemical fertilization (T4> EUN T8). In addition, when it was associated with chemical nitrogen fertilization (T1), it was more advantageous when confronted with an area that received only mineral fertilization (T5). These results evidenced the possibility of using gliricidia to increase the EUN in cohesive soils. In addition to contributing to a decrease in the pressure for natural resources, once higher productivity is achieved even with the continuous use of the area.

Keywords: Management; cover soil; maize

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(2850 - 1315) Nitrogen (^{15}N) use efficiency in maize as affected by urea treated with boric acid and copper sulfate

Nicole Colombari Cheng[1]; Bruno Paulo Moschini[1]; Pedro Lopes Garcia[2]; Beatriz Nastaro Boschiero[3]; Eduardo Mariano[4]; Paulo Cesar Ocheuze Trivelin[2]

ESALQ/USP[1]; CENA/USP[2]; CNPEM[3]; UNESP/Botucatu[4]

Urea (U) is the most used nitrogen fertilizer in maize (*Zea mays* L.). It is highly prone to ammonia (NH_3) volatilization losses when applied on soil surface. The use of urease inhibitors is one of the most promising and least expensive technologies on the market among the strategies that aim to circumvent the environmental impact and increase the nitrogen use efficiency (NUE). In this context, the objective of this study was to evaluate the NUE in maize at VT growth stage applying ^{15}N-urea treated with boric acid (H_3BO_3) and copper sulfate ($CuSO_4$) under controlled conditions. The study was conducted in greenhouse conditions in a randomized block design with three replications. The treatments consisted of a single rate of 180 mg N kg^{-1} soil applied in a band on soil surface with the following nitrogen fertilizers (N-fertilizers): (a) Conventional urea (U); (b) Urea treated with 0.40% boric acid (U+0.40% B); (c) Urea treated with 0.52% boric acid (U+0.52% B); (d) Urea treated with 0.64% boric acid (U+0.64% B); (e) Urea treated with 0.88% boric acid (U+0.88% B); (f) Urea treated with 0.40% boric acid and 0.15% copper sulfate (U + CuB); (g) Urea treated with thiophosphoric N-(n-butyl) triamide (U + NBPT). N-fertilizers were ^{15}N enriched (0.85 atom % of ^{15}N excess) and applied at V4 growth stage in granular form. Total N and isotopic abundance (^{15}N) analysis was performed in a mass spectrometer coupled with an automatic N analyzer. ^{15}N in the plant derived from fertilizer (NPDF), ^{15}N fertilizer use efficiency (NUE-F) and ^{15}N balance in the soil-plant system were calculated and then submitted to mean comparisons adopting the LSD test ($p \leq 0.05$). As the concentration of H_3BO_3 in the urea treatment increased, the NUE-F increased (10% on average). U+NBPT had higher NUE-F than untreated U (almost 20%) and did not differ from U+0.88% B. There were low ^{15}N recovered in the soil that suggests the occurrence of high N losses from the system. The treatments with urease inhibitors (H_3BO_3 and NBPT) increased the recovery of ^{15}N-urea in the soil-plant system from 7 to 10%. U+0.40% B did not differ from U+CuB for NUE-F and ^{15}N balance, it shows that there isn't effect for the addition of $CuSO_4$ in the coating of U granules. Therefore, the $CuSO_4$ is a component that can be reduced or dispensed from the U coating when in association with H_3BO_3 once it didn't influence the NUE-F.

Keywords: *Zea mays* L., urease inhibitors, stabilized fertilizers, enhanced efficiency fertilizers, NBPT

Financial support: National Council for Scientific and Technological Development (CNPq), Center for Nuclear Energy in Agriculture (CENA/USP) and Fertilizantes Heringer S.A.

(2034 - 442) Nitrogen and potassium fertilization in the productive characteristics of BRS 394 wheat in the Cerrado of Mato Grosso

Ronaldo Aparecido de Oliveira[1]; Edna Maria Bonfim-Silva[1]; Thiago Henrique Ferreira Matos Castañon[1]; Tonny José Araújo Silva[1]
Universidade Federal de Mato Grosso[1]

Wheat (Triticum aestivum L.) is one of the most cultivated crops around the world, standing out as the base of many food products for its nutritional value. Thus, the objective was to evaluate the productive characteristics of wheat irrigated in the Cerrado of Mato Grosso, fertilized with nitrogen and potassium. The experiment was carried out in the experimental area of the Federal University of Mato Grosso, in the municipality of Rondonópolis-MT, Brazil, located an altitude of 284 meters. The soil was classified as Oxisol. The experimental design was a randomized complete block design, with factorial scheme 5², fractionated with four replicates. Nitrogen doses were: 0, 70, 140, 210 and 280 kg ha^{-1} and potassium 0, 50, 100, 150 and 200 kg ha^{-1}. Nitrogen fertilization was applied in two periods, the first one in the seeding using 30% of the doses of each treatment and the remaining 70% at the beginning of the tillering, which occurred 15 days after the emergence of the plants using urea as source. The fertilization with potassium was applied at the time of seeding and the source used was potassium chloride. The irrigation of the experiment was performed by a system of irrigation bars coupled to a self-propelled roll system. The variables analyzed were number of spike per m² and dry mass of spikes. The analyzed variables did not present interaction between the nutrients, only isolated effect for the nitrogen. The number of spikes set to the quadratic regression model with the highest value of 408 spikes per m² in the nitrogen dose of 243.53 kg ha^{-1}. The dry mass of the spikes set to the linear regression model, with an increase of 34.92% when compared to the higher dose with the absence of fertilization. Nitrogen fertilization increases the number and dry mass of wheat spikes. Potassium does not influence the number and mass of wheat spikes.

Keywords: *Triticum aestivum* L., Oxisol, Irrigated wheat
Financial support: Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq)

(4489 - 949) Nitrogen and potassium in the production of braquiaria grass and organic matter of soil in the western Amazon

Edinelia Roos[1]; Andressa Gregolin Moreira[1]; Bianca Souza Selhorst[1]; Adriele Laurindo Sobreira[2]; Vanessa Rodrigues de Brito[2]; Fábio Régis de Souza[1]; Jairo André Schlindwein[1]; Elaine Cosma Fiorelli-Pereira[1]
Federal University of Rondonia, Av. Norte Sul, 7300, Nova Morada, Rolim de Moura - RO, CEP 76940-000, Brasil[1]; Federal University of Rondonia, Av. Pres. Dutra, 2965 - Centro, Porto Velho - RO, CEP 76801-974, Brasil[2]

The low fertility of the soil in the Amazon region associated with the poor pasture formation, with low adoption of technical management, in addition to the higher rates of capacity and a continuous grazing system, have contribute for the fast and rising degradation process, compromising the productive process. Reconstruction the fertility of the soil it is one of the ways to recuperate the productive capacity of the degraded pasture. The experimental design was in randomized blocks, in a factorial scheme 5x5, corresponding of five doses of nitrogen 0, 50, 100, 200 e 400 kg ha^{-1} de N) and five doses of potassium (0, 100, 200, 400 e 800 kg ha^{-1} de K2O) with four repetitions totaling 200 parcels, in a established pasture more than 10 years, in process of degradation, at a property in the municipally of Rolim de Moura, Rondonia, Brasil. Was evaluated the production of fodder dry mass, index of green color in leaves (SPAD) and organic matter of the soil. The nitrogen fertilization changed the production of dry mass on a quadratic form, being the major production observed in 41 kg ha^{-1} of N doses with 5212,9 kg ha^{-1} of dry mass. There was only influence in nitrogen doses in index of green color in leaves of brachiaria, where the major dose (400 kg ha^{-1} of N) provide the greater concentrations (47,57), so that, the index of green color is straightly related with the fertilization that the plant receive. The nitrogen influenced on the organic matter of the soil in a linearly way, being that at the dose of 0 kg ha -1 of N, had the major production of organic matter of the soil, with 33,18 mg kg^{-1}, fertilization with potassium do not have any effect in the variables studied.

Keywords: Nitrogen fertilization, chlorophyll index, nutritional status.
Financial support: Universidade Federal de Rondônia, CAPES.

(2613 - 459) Nitrogen and sulphur fertilization in the tillering of BRS 394 wheat cultivar irrigated in Brazilian Cerrado

Thiago Henrique Ferreira Matos Castañon[1]; Edna Maria Bonfim-Silva[2]; Tonny José Araújo da Silva[2]; William Fenner[3]
Federal University of Mato Grosso, Cuiabá – Mato Grosso, Zip-code 78070-900, Brazil (thiagocastanon@live.com)[1]; Federal University of Mato Grosso, Rondonópolis – Mato Grosso, Zip-code 78735-001, Brazil[2]; Federal University of Mato Grosso, Cuiabá – Mato Grosso, Zip-code 78070-900, Brazil[3]

Wheat has the characteristic of forming tillers and this structure is much important to occupy empty spaces between plants, improving soil cover and increasing the number of spikes, thus increasing grain yield. Many factors may influence wheat tillering, such as genotype, luminosity, soil moisture, temperature and nutritional status. Thus, the aim of this study was to evaluate the tillering of wheat submitted to combinations of nitrogen and sulphur in the Brazilian Cerrado. The research was carried out in the field in 2017, in the experimental area of the Federal University of Mato Grosso, Campus of Rondonópolis-MT, Brazil. The soil was classified as Oxisol. The geographical coordinates are 16º27'54.98"south latitude and 54º34'41.75" longitude west, altitude of 284 m. The experimental design was randomized block in factorial scheme 5², fractionated with four replicates. The treatments were five nitrogen doses (0, 70, 140, 210 and 280 kg ha^{-1}) combined with five doses of sulphur (0, 25, 50, 75 and 100 kg ha^{-1}). It was sown to wheat cultivar BRS 394, classified as an early cycle and indicated for irrigated systems. The irrigation was by sprinkling, with an adapted irrigation bar. The number of tillers + main stem was evaluated at 15, 30 and 45 days after emergence of the plants. It was quantified in 1m linear, divided into three samples of 0.33m in the useful area of each experimental unit, counting together tillers and main stems. The significant variables were number of tillers at 30 and 45 days after emergence (DAE) for nitrogen only. At 30 days the number of tillers was adjusted to the linear regression model, with a 19.47% increase when compared to the higher nitrogen dose with the absence of fertilization with this nutrient. However, at 45 days the number of tillers was adjusted to the quadratic regression model, with the highest number (104 tiller m^{-1}) at the nitrogen dose of 199 kg ha^{-1}. Nitrogen fertilization increases the number of tillers in wheat plants. Sulphur does not influence tiller formation of wheat plants when cultivated in Cerrado Oxisol.

Keywords: *Triticum aestivum L.*; tillers; nitrogen fertilizer.
Financial support: National Council of Scientific and Technologic Development (CNPq)

(2816 - 1362) Nitrogen concentration in signal grass fertilized with nitrogen doses and sources

Guilherme Constantino Meirelles[1]; Reges Heinrichs[1]; Maikon Vinicius da Silva Lira[1]; Igor Virgílio Ribeiro[1]; Thiago Bergamini Ibañez[1]
São Paulo State University, FCAT/UNESP[1]

The amount and quality of forage produced is directly related to the nitrogen amount that is associated with the production system. For

sustainable agricultural production, techniques that minimize losses and support the use of nutrients during the crop cycle are necessary. The experiment was conducted in the experimental field of the College of Agricultural and Technological Sciences, Campus Dracena, SP, Brazil. The objective of this study was to evaluate the conventional nitrogen fertilizer and the nitrogen sources with increased efficiency in the nitrogen concentration in aerial part of the signal grass pasture (*Urochloa decumbens*; syn. *Brachiaria decumbens*). The soil of the area was classified as Ultisol. The experimental design was in ranged blocks with four replicates, in a factorial scheme 4x2+1. The plots were composed of 4 nitrogen sources (urea, ammonium nitrate, urea with NBPT inhibitor and urea coated with B and Cu), with two doses of nitrogen (100 and 200 kg ha^{-1}), plus a treatment without nitrogen fertilization (control). The nitrogen doses were divided in 5 equal applications (20 e 40 kg ha^{-1}), the first one after the cut of uniformization and the others after the immediately subsequent cuts. The N concentration in the aerial part of the forage varied as a function of the doses in the summer (water period) and winter (dry period), but did not present a difference between the nitrogen sources. The response in the nitrogen concentration in the forage in the winter season cut evidences the residual effect of the nitrogen fertilization performed during the period of the waters, providing the production of animal feed of better quality. The amplitude of response in nitrogen utilization due to the use of sources with increased efficiency can vary greatly with climatic conditions during the study. According to the interpretation ranges for plant nutrition, the levels of nitrogen in signal grass produced during the water period, in the treatments without nitrogen fertilization and in the dose of 100 kg ha^{-1} of nitrogen are slightly below the critical level, while at the dose of 200 kg ha^{-1} of N, the contents are within the range considered adequate.

Keywords: Pasture, slow-release fertilizer, urease inhibitor, *Urochloa decumbens*
Financial support: Fundação Agrisus; Koch Industries Inc.

(4469 - 1344) Nitrogen fertilization and crop management in the agricultural production system in sandy soil

Ana Carolina Mônico Moreira[1]; Carlos Henrique dos Santos[1]; Luciana Boulhosa Fabris[1]; Juliano Carlos Calonego[2]; Pedro Francisco da Silveira Reis[1]

Universidade do Oeste Paulista[1]; Universidade Estadual Paulista Júlio de Mesquita Filho[2]

Nitrogen is an essential element for the growth of plants, being constituent of molecules important for its development as proteins, nucleic acids, hormones and chlorophyll. The no-tillage system has as main objective the production of straw on the soil surface, and in this same system the use of legumes helps in this production besides performing the green fertilization providing N to the system. The aim of this research was to evaluate the N content made available by the soybean crop in a no tillage system. The experiment was carried out at the College of Agricultural Sciences, at University of Western São Paulo, in Presidente Prudente, São Paulo State, in soil classified as Ultisol. Soil samples were collected in the representative layers of the depths of 0-5, 5-10, 10-20, 20-40 and 40-60 cm for characterization of the granulometry and chemical parameters of the soil and, later, the experiment was installed following the randomized block design, with four replications, in a subdivided plot scheme. The plots were constituted by three crop rotations in no-tillage system: 1) Maize (Ma) / Lupine (Lu) / Fallow field (Fa) / Soybean (So); 2) Maize (Ma) + *Urochloa brizantha* cv. MG-5 (Uro) / *Urochloa brizantha* cv. MG-5 (Uro) / Soybean (So); 3) *Urochloa brizantha* cv. MG-5 (Uro) / Soybean (So) and the subplots were formed by four rates of N applied annually (50, 100, 150 and 200 kg ha^{-1}). The determination of the total N contents present in the straw collected from the soil surface was performed 30 days before the soybean harvest and the day after the harvest (residual straw). The results were submitted to analysis of variance and the effects compared by the Tukey test at the 5% probability level. There was a significant difference in the total N contents of the straw before soybean harvest as a function of the rotations and N rates applied, while in the residual straw after harvest there was no significant difference. The available N in this biomass returns to the soil after its decomposition, being able to be used by the successor culture. Crop management with the presence of both lupine legumes and soybean provided higher N contents, and after soybean cultivation these were even higher. In a no-tillage system, and especially in sandy soils, rotation of legume crops brings benefits to successor crops as well as improvement in soil biological quality.

Keywords: Keywords: nitrogen use efficiency; leguminous species; pasture
Financial support: Financial support: University of Western São Paulo

(9004 - 2773) Nitrogen Fertilization at Different Stages in Soybean Culture

Felipe de Abreu Soldatelli[1]; Elaine Damiani Conte[2]; Taísa Dal Magro[1]; Joséli Schwambach[1]

University of Caxias do Sul, Vacaria, RS 95200-000, Brazil.[1]; University of Caxias do Sul, Vacaria, RS 95200-000, Brazil. E-mail: edconte@ucs.br[2]

Nitrogen fertilization in soybean crop (sowing and cover) is a subject that has been gaining importance among professionals and producers in Brazil in the search for increased productivity, being adopted as field practice by many of them. However, there is still no consensus regarding the efficiency of this practice, especially in soils with high levels of organic matter. This study sought to evaluate the efficiency of the use of top-dressing fertilization with nitrogen (N) at different stages of development of the soybean crop. The experiment was carried out in a no-tillage system during the 2016/17 crop with soybean cultivar BRASMAX Raio IPRO®, at Campus II of the University of Caxias do Sul, Vacaria, RS, Brazil (28º 30'S and 50º 56 'W). The soil at the experiment site is classified as typical Distroferric Bruno Latosol and presents 7.0% organic matter and 65% clay, with corrected acidity and fertility. A randomized blocks design with five treatments and five replicates was used. The treatments consisted of N application in different moments, being: a control (without external source of N) (T1); at sowing (T2); at complete development of the third tripartite leaf (T3); at flowering (T4); and, at grain filling (T5). The dose used was 120 kg / ha, with urea (45% N) as the source. The variables evaluated were: plant height; chlorophyll content in leaves; final plant stand / m²; number of vegetables and grains / vegetables; grain yield, expressed in kg / ha at 13% moisture; and, mass of 1000 grains, expressed in grams. The results of the evaluations were submitted to analysis of variance ($p \leq 0.05$); and, in case of significance, compared by Tukey test ($p \leq 0.05$). The results obtained showed only difference for the chlorophyll content, indicating a higher N uptake according to the period of application. However, this difference in chlorophyll content did not affect the other parameters evaluated, with an average yield of 4,123 kg / ha (Coefficient of Variation = 6.18%). Therefore, considering the edaphoclimatic conditions and the genetic potential of the cultivar evaluated, the application of N does not alter the productivity of the soybean crop.

Keywords: *Glycine max;* Nitrogen top-dressing; productivity.
Financial support: University of Caxias do Sul

(5560 - 1680) Nitrogen fertilization in *Brachiaria brizantha* cv. BRS Piatã in the end of the rainy season in the state of Rondônia

Cauandrey Deyverson Fagundes[1]; Fábio Régis de Souza[1]; Simone Assumpção De Almeida[1]; Iracy Soares de Aguia[1]; Anderson Cristian Bergamin[1]; Wesley Santana Ferreira[1]; Rodrigo Maciel Nunes[1]; Júnior

Antônio Rodrigues Mello[1]; Deisiane Lima Almeida[1]; Luciana Sônia da Silva[1]

Fundação Universidade Federal de Rondônia[1]

Currently almost 70% of formed pastures in Rondônia present in degradation state. The degradations process appears when the productivity of forage comes down in gradually, because of many factors. Like low natural fertility of the soil, inappropriate management of the pastures and no maintenance of fertility. The degradation reduces the index of organic matter and consequently the availability of nitrogen for the forages, being pointed such as low forage offer, this condition can be increased with nitrogen fertilizer with ammonium sulphate or urea. The objective was evaluate the agronomic characteristics of Piatã grass (*Brachiariabrizantha*cv. BRS Piatã) submitted to doses of nitrogen font in the end of the rainy season. The experiment was conducted in the experimental campus of Federal University of Rondônia Foundation, in the municipally of Rolim de Moura- Rondônia located at 11° 34' 57" south latitude and 61° 46' 21" of longitude. The design adopted was randomized blocks, in a factorial scheme, being the treatments nitrogen fonts (urea and ammonium sulphate) and the doses (0, 25, 50, 100, 150, kg of N ha^{-1}).Thework was conducted between April to December of 2016.The planting of Piatã grass was realized on April 5, 2016. The variables analyzed in the five cuts were: height of the plant; number of leafs, number of tiller, stem diameter, chlorophyll index, green matter and dry mass. Was obtained significates results for plant height in the third and fourth cut with the 80kg ha^{-1} (1,29 m) dose and 75 kg ha^{-1} (1,25 m) respectively. For the numbers of leaf was observed significance in relation to doses of nitrogen, presenting a linear behavior in the third and fourth cut. From the third cut has a linear increase of the tiller with the nitrogen increase. The chlorophyll index present larger values in the 75 kg ha^{-1} – dose in the third cut. Diameter and stem in the first cut and the green matter of the stem and leafs in the fourth cut, were observed higher results when the fertilizer font was urea.

Keywords: Urea; Chlorophyll; Period of fertilization.
Financial support: Fundação Universidade Federal de Rondônia

(1522 - 2962) Nitrogen fertilization with urease inhibitor and nitrification in capim-tifton 85

Edimar Rodrigues Soares[1]; Esmeralda Ochoa Martínez[2]; Márcio Silveira Da Silva[3]; Fabio Tiraboschi Leal[3]; Edson Luiz Mendes Coutinho[3]

Faculdade de Educação e Meio Ambiente - FAEMA[1]; Instituto Nacional de Investigaciones Forestales, Agrícolas e Pecuarias - INIFAP[2]; Universidade Estadual Paulista - Faculdades de Ciências Agrárias e Veterinárias - UNESP/FCAV[3]

Nitrogen is a highly dynamic and mobile nutrient that may undergo losses through different processes, such as volatilization, leaching and denitrification. Urease or nitrification inhibitors are technologies that may improve nitrogen fertilization efficiency; however, usage of these products is little studied in tropical regions. The present essay evaluates growth and production of tifton 85 grass on field conditions according to nitrogen doses with urea containing urease and nitrification inhibitor for two agricultural years (2013/14 and 2014/15), from November through March, each year with four cycles of growth. Treatments in experiment were build up on a 3 x 5 factorial scheme with urea; urea + urease inhibitor [NBPT: N-(N-Butyl) thiophosphoric triamide] and urea + nitrification inhibitor (DMPP: 3,4-dimethyl pyrazole phosphate) and doses of N (0, 40, 80, 120 and 160 kg ha^{-1}, in each growth). N doses increased leaf area, leaf area indexes and height, but there was no effect due to the type of fertilizer in this scenario. On the tenth day of the first growth, it was verified that nitrogen fertilization increased tillers linearly. On the 20th day, there was tiller death due to greater doses of N applied, with linear reduction of tiller on the 30th day. The usage of urea + NBPT and urea + DMPP did not influence the production of tifton 85 grass in the two agricultural years. On the first year, an actual effect from doses of N was not observed, neither from the type of fertilizer on the apparent N recovering. The usage of urea with urease or nitrification inhibitor does not interfere in the production and growth of tifton 85 grass.

Keywords: Nitrogen; stabilized fertilizers; Cynodon spp
Financial support: CAPES-Coordenação de Aperfeiçoamento de Pessoal de Nível Superior

(7457 - 2265) Nitrogen fertilization in wheat

Gleize Leviski de Brito[1]; Dirceu Maximino Fernandes[1]; Aline Cássia da Fonseca[1]

Universidade Estadual Paulista "Júlio de Mesquita Filho"[1]

The nitrogen is one of the nutrients most required by the wheat crop, and the moment of application of this nutrient can directly influence its utilization by the plants The objective of this study was to evaluate the influence of the application of different nitrogen sources on sowing and tillering of wheat in medium texture soil. The experiment was conducted in Botucatu-SP, in a randomized blocks design with 4 replications, in a 3 x 2 factorial. The treatments consisted of 3 nitrogen sources (ammonium nitrate, ammonium sulfate and urea) applied at two times, the total dose incorporated in the soil in the week prior to sowing and 25% at sowing and the remainder in the tillering phase of wheat. The N dose was 80 Mg ha^{-1} and the spacing was 0.2 m. There wasn't interaction between the sources and the N application times. The N sources differed only when the number of tillers was evaluated, with the ammonium nitrate being responsible for the largest number of tillers, as for the yield components, all sources under study were similar. Although the application in cover provided a greater number of tillers in relation to the nitrogen applied at the time of sowing, the weight of 1000 grains, the number of spikes per spikelet and the number of grains per spike was higher when applied the total N at sowing.

Keywords: Tillering, nitrogen, Triticum aestivum
Financial support: CAPES

(7415 - 711) Nitrogen on dry biomass production and calorific power of elephant grass grown in Cerrado biome

Rilner Alves Flores[1]; Silas Ferreira de Queirós[1]; Virgínia Damin[1]; Mellissa Ananias Soler da Silva[2]; Gustavo Castoldi[3]; Carlos Ribeiro Rodrigues[3]

UFG[1]; Embrapa[2]; IF Goiano[3]

The Brazilian energy matrix has sought new alternatives for the gradual replacement of oil and its derivatives. In the last decade, studies with alternative sources of energy from biomass have gained prominence, since these represent 31.1% of the energy matrix in force in the country. In this scenario, elephant grass (*Pennisetum purpureum*) presents great potential for biomass production per unit of time, due to a short growth cycle (between 5 and 7 months), with rapid leaf expansion, high percentage of fibers, lignin, in addition to high calorific value. The objective of this work was to evaluate the effect of nitrogen fertilization on leaf contents and dry biomass production of elephant grass grown under the edaphoclimatic conditions of the Cerrado biome. The study was carried out in the 2016/17 harvest, in a clayey dystrophic Red Latosol, with the genotype 'Roxo'. The experimental design was in randomized blocks with five doses of nitrogen fertilizer (0, 50, 100, 150 and 200 kg ha^{-1}, applied in the planting furrow as urea). Forage cutting was performed 180 days after regrowth of the first ratoon. Leaf nitrogen levels, relative

chlorophyll index, biomass production and the upper calorific value of elephant grass biomass were evaluated. The results were submitted to analysis of variance by F-test, and when significant, polynomial regression analysis was performed to determine the maximum points of the variables evaluated. Nitrogen application did not affect leaf nitrogen content, which presented a mean value of 19.95 g kg^{-1}. Regarding stem production, there was a quadratic adjustment by F-test at 10% probability, with the maximum yield of 47.4 t ha^{-1} obtained with the use of 105 kg ha^{-1} N. The upper calorific value of elephant grass biomass was not altered due to nitrogen fertilization, presenting a mean value of 3952 kcal kg^{-1}. The results observed in this study are promising, since the crop is very responsive to nitrogen fertilization, with significant gains in biomass production. The results obtained for the calorific value of elephant grass biomass are very close to those observed in eucalyptus (~ 4500 kcal kg^{-1}), one of the main crops used for direct burning. Thus, nitrogen fertilization of elephant grass for the production of briquettes should aim at the maximum gain in biomass production when grown under the same conditions of the present study.

Keywords: *Pennisetum purpureum*, briquetes, soil fertility, plant nutrition

Financial support: FAPEG, UFG, EMBRAPA

(4238 - 1296) Nitrogen use efficiency in maize-forage rotations

Letusa Momesso[1]; Carlos Antonio Costa do Nascimento[1]; Katiuça Sueko Tanaka[1]; Isabela Garcia Cocatto[1]; Ciro Antonio Rosolem[1]; Carlos Alexandre Costa Crusciol[1]

São Paulo State University (UNESP)[1]

Forage grasses of *Urochloa* genus are adapted to low fertility soils due to its vigorous and deep root system and its ability in taking up poorly available nutrients. *Urochloa* species introduced in a cropping system as cover crops can maintain or increase maize yields, but it depends on nitrogen (N) supply and management. Thus, an alternative for N fertilization in this cropping system would be to apply N to the cover crop, before desiccation, which can avoid N loss by leaching or NH_3 volatilization, improving N use efficiency. The objective of this study was to assess the feasibility of N application to forage grasses to supply N to maize. Palisade grass (*Urochloa brizantha*) and ruzigrass (*Urochloa ruziziensis*) were grown in the maize of-season, and 160 kg ha^{-1} of N was applied 5 days before grass desiccation and at maize planting + sidedressing), plus one control for each forage grass (no N added). Both dry matter and N accumulation by forage grasses were about 63% higher in palisade grass than in ruzigras. Nitrogen applied before desiccation increased forage dry matter and N accumulation by 17 and 30% , respectively. There was no difference between forage grasses on soil mineral N content. At desiccation, the soil mineral N was higher where fertilizer was applied to forage grasses. Palisade grass straw had released 222 kg ha^{-1} of N whilst 167 kg ha^{-1} of N were washed out from ruzigrass 90 days after disiccation, however, all treatments resulted in similar amounts of soil mineral N at this time. Nitrogen application at planting + sidedressing increased N in maize leaves and grain yield, and eventualy resulted in higher NUE than when N was applied to the forages. Maize yield was higher after palisade gras than ruzigrass, reaching 70% in the absence of N fertilization. Our results suggest that while both palisade grass and ruzigrass produce high biomass and N release N, applying all N to forage grasses is not a feasible alternative, probably because there is no synchrony between N release and maize demand. Thus, applying N at seeding + sidedressing is still the best alternative for N management in maize, irrespective of the cropping system.

Keywords: Brizantha; cropping system; *Urochloa* spp.

Financial support: FAPESP [grant 2015/50305-8, 2016/12317/7] BBRSC/Newton Fund [grant BB/N013201/1]

(9139 - 1407) Number of wheat leaves cultivar brs 394 irrigated and fertilized with nitrogen and sulfur combinations in Cerrado mato grossense

Kellyane Pereira dos Santos[1]; Edna Maria Bonfim-Silva[1]; Thiago Henrique Ferreira Matos Castañon[1]; Tonny José Araujo da Silva[1]

UFMT[1]

The leaves are plant structures that, with their tissues, assist mainly in photosynthesis, respiration and transpiration processes, functioning as a reserve structure, characteristics that are linked to the vegetative development promoted by nitrogen, and consequently improves crop productivity. The objective was to evaluate the number of leaves of wheat plants submitted to different combinations of nitrogen and sulfur. The experiment was carried out in the experimental area of the Federal University of Mato Grosso, in the municipality of Rondonópolis - MT, Brazil, in a Oxisol. The experimental design was a randomized complete block design with factorial scheme 5^2, fractionated with four replications. The nitrogen doses were: 0, 70, 140, 210 and 280 kg ha^{-1} and sulfur 0, 25, 50, 75 and 100 kg ha^{-1}. The wheat cultivar used was the BRS 394. The nitrogen source used was urea (45% N). The sulfur fertilization was carried out in the sowing line in single application with elemental sulfur powder (97% S). The irrigation of the experiment was carried out by means of a sprinkler irrigation system. The number of leaves at 15, 30 and 45 days after plant emergence were evaluated. It was considered in the linear 1 m evaluation divided into three samples of 0.33 m. The number of leaves was significant at 30 and 45 DAE, presenting an isolated effect only for nitrogen. At 30 days after plant emergence, the number of leaves was adjusted to the quadratic regression model, with the highest number (387.05 leaves m^{-1}) at the nitrogen dose of 198.67 kg ha^{-1}. At 45 days after plant emergence, the number of leaves was adjusted to the linear regression model, with an increase of 18.36% between the highest nitrogen dose and the absence of fertilization. Nitrogen fertilization increases the number of leaves of wheat plants. Sulfur fertilization does not influence the number of wheat leaves.

Keywords: Nitrogen fertilization, sulfated fertilization, *Triticum aestivum* L.

Financial support: National Council of Scientific and Technologic Development (CNPq)

(8317 - 1637) Paiaguas grass yield in two crop-livestock integration system under nitrogen topdressing rates applied

Alessandro José Marques Santos[1]; Stephanie Vicente de Bessa[1]; Lucas Matheus Rodrigues[1]; Arthur Gabriel Teodoro[1]; Clarice Backes[1]; Danilo Augusto Tomazello[1]

State University of Goiás[1]

Integrated crops provide economic and environmental improvements in addition to increasing production efficiency. In the crop-livestock integration system after silage production the grass remains in the area it is that making possible to supply feed to grazing animals during the offseason in addition to serving as roughage material in the system. The objective of this study was to evaluate the effect of nitrogen topdressing rates applied to an intercrop of maize (M) with paiaguás grass (G) and pigeonpea (P) on yield and number of tillers of paiaguás grass after silage process. Treatments consisted of two simultaneous intercropping systems (M+G; and M+G+P) and four N topdressing rates (0, 80, 160, and 240 kg ha^{-1}). The collection times was at harvest of maize, after 72 and 245 days after the harvest of maize (DAH). The number of tillers and dry matter of the grass yield responded to the interactions at the three collection times. At the harvest of maize, the M+G intercrop provided the highest number of tillers only with zero N. After 72 days of harvest, at the N rate of 0 kg

ha^{-1}, the intercrops showed no significant differences; however, they did at the other rates, with the M+G intercrop resulting in the highest means. At 245 DAH, the intercrops differed from each other at all rates, with M+G providing higher means when compared with M+G+P. The N rates promoted increase on number of tillers in both intercrops at harvest of maize, at 72 DAG and at 245 DAH. On the dry matter yield at harvest, with the N rates of 0 and 80 kg ha^{-1}, M+G resulted in the highest dry matter yield of paiaguás grass, but the other rates did not lead to differences between the intercrops and at the other evaluated times, at 72 and days after harvest the highest means were obtained in the M+G intercrop as compared with M+G+P in all N rates and at 245 days after harvest with zero N the yield was similar, but in other rates the M+G intercrop provided the highest means. The N rates, at harvest and at 72 DAH, both intercropping systems tested here had a linear increase in grass dry matter. At 242 DAH, these variables responded quadratically, with 3,868 kg ha^{-1} for M+G and 3,086 kg ha^{-1} for M+G+P at the respective estimated N rates of 164 and 163 kg ha^{-1}. In these crop-livestock integrated systems M+G intercrop get highest means of number or tillers and dry matter yield of paiaguás grass comparing with M+G+P intercrop.

Keywords: *Urochloa brizantha*; crop-livestock integration system; legumes.
Financial support:

(7239 - 1347) Persistence and release of nitrogen from the straw of cover crops under no-till

Hugo Mota Ferreira Leite[1]; Juliano Carlos Calonego[2]; Ciro Antonio Rosolem[2]; Letícia Azal frare[2]; Carlos Antonio Costa do Nascimento[2]
UNESP/UFAC[1]; UNESP[2]

In crop rotation systems the amount, quality and persistence of straw depend on the types of cover crops. Moreover, the amount of N accumulated in the straw and its release rate during the following soybean cycle, are important factors in the crop rotation in tropical regions, due to the high straw decomposition rates. The objective of this study was to evaluate the persistence of millet, sorghum and sunn hemp straw and its nitrogen release under no-till, as well a and the rotations effect on soybean yield. The work was carried out under field conditions in Botucatu, state of São Paulo, Brazil. The crop rotations in a 15-years no-till system, with no nitrogen application. Triticale (*X Triticosecale* Wittmack) and sunflower (*Helianthus annuus*) were cultivated in plots through fall-winter; in subplots, millet (*Pennisetum glaucum*), sunn hemp (*Crotalaria juncea*), forage sorghum (*Sorghum bicolor*) and fallow were cultivated through spring: and soybean (*Glycine max*) was cultivated in the summer. Sunn hemp, sorghum and millet were desiccated 50 days after the emergence. The persistence, nitrogen release, and C/N ratio of the cover crop residues were evaluated at 0, 30, 60 and 90 days after desiccation. The dry matter accumulation was 6.3, 5.8, and 4.6 Mg ha^{-1} for sorghum, sunn hemp, and millet, respectively. Sunn hemp straw showed lower persistence among the studied species, it lost the most of its biomass within 30 days, while for millet and sorghum this occured within 60 days. After 90 days, only 24% of the sunn hemp dry matter remained, and it was approximately half of the values observed in millet and sorghum. The C/N ratio of the cover crops increased with time. The highest initial C/N ratio was found in sorghum (26/1) and lowest in sunn hemp (10/1). The amount of N released was higher for sunn hemp (0.14 Mg ha^{-1}) than for millet and sorghum (0.02 Mg ha^{-1}) until 30 days of desiccation. Lower yield of soybean was observed with sunn hemp, even with higher N input, while higher yield was observed after millet, where straw dry matter and N accumulation was lower, but the persistence was higher, protecting the soil and avoiding water losses, which probably resulted in a greater benefit to yield than the contribution of N input by sunn hemp.

Keywords: Sorghum, millet, sunn hemp, crop rotation, plant residue.
Financial support: FAPESP (grant 2015/50305-8), BBRSC/Newton Fund (grant BB/N013201/1) and UFAC.

(7225 - 1693) Photosynthetic efficiency in the use of nitrogen in the culture of the inoculated corn with *Azospirillum brasilense*

Lincon Matheus Araujo Silva[1]; Marcelo Marinho Viana[1]; Karen Alessandra Sousa Castro[1]; Ester de Paiva Alves[1]; Danilo Nunes Sodre[1]; Assistone Costa de Jesus[1]; Werlen Araújo Barbosa[1]; Erivaldo Plinio da Costa Borges[1]; Cristina Silva Carvalho[1]; Heder Braun[1]
State University of Maranhão[1]

The nitrogen fertilization in maize culture assumes a potential effect on agricultural production, because nitrogen is considered to be one of the most important factors in increasing grain production. Therefore, measures should be taken to maximize the efficiency of the constant use of this nutrient. In this study, the aim to quantify the photosynthetic efficiency of nitrogen use (PNUE) in corn culture inoculated with *Azospirillum brasilense* and nitrogen applied in coverage. The experiment carried out in the field at 2016 (2°35' S and 44°12' W), in a randomized complete block design, with four replications. The treatments were performed in factorial arrangement 3 x 3: three N fertilization rates (45, 90 and 180 kg ha^{-1}), applied as top-dressing with three inoculation way (seeds, leaf and control). Nitro 1000 Gramíneas® was the inoculant used in the treatments. It was performed with 100 mL ha^{-1} of the commercial product in seed-inoculant before planting and 200 mL ha^{-1} in leaf-inoculant spraying application. The variable evaluated were: to 20, 40 and 60 days after the fertilization of the photosynthetic CO_2 assimilation (*A*) was obtained with the aid of infrared gas Analyzer (Li 6400XT, LiCor, Lincoln, USA). Was quantified specific leaf area (LA, cm^2/g) and the N content per unit leaf area (TNT_A, g/m^2). The photosynthetic efficiency of N use (PNUE) was obtained by the ratio A/TNT_A. The analysis of variance (ANOVA) was performed with the goal of deploying the sum of squares of treatments for each factor and to the interaction between the factors. Was adopted $p \leq 0.25$ for the interaction between the factors and $p \leq 0.05$ to the Tukey test. For statistical analysis we used the Software R with the interface RStudio. There was significant interaction for doses of N x forms of inoculation of *A. brasilense* just for photosynthetic assimilation of CO_2 (μmol m^{-2}, s^{-1}) ($p < 0.05$) to 20 days after fertilization (DAF), for other times and evaluated variables there was no interaction. The forms of inoculation did not make the necessary income to lift the photosynthetic efficiency of N use in evaluated. The doses of N influenced so backwards specific leaf area and photosynthetic efficiency of the use of the N. The doses of N increasingly influenced the content of N per unit leaf area and total N content.

Keywords: *Zea mays*, nitrogen, biological fixation, gas exchange.
Financial support: Maranhão Foundation for the Protection of Research and Scientific and Technological Development (FAPEMA)

(1037 - 1457) Plant height of herbaceous cotton drip fertigated under nitrogen fertilization and water depth

Daniele Job Alves[1]; Tonny Jose Araújo da Silva[1]; Paula Caroline Lima Silva[1]; Edna Maria Bonfim-Silva[1]; Thiago Franco Duarte[1]
Universidade Federal do Mato Grosso[1]

Cotton (*Gossypium hirsutum* L.) is of great importance in agriculture in Mato Grosso State, being the largest producer in Brazil. This great importance is due to the different forms of use of this culture, where both fibers and seeds are used. With the fibers are produced the fabrics, mattresses, among others. Already the seeds are used in the manufacture of oil, biodiesel and derivatives. The objective of this

study was to analyze the influence of drip fertigation on herbaceous cotton cultivated in Cerrado Oxisol, as a function of nitrogen doses and water depths. The study was carried out in the field at the Federal University of Mato Grosso, University Campus of Rondonópolis, from June to December 2017. The experiment utilized a 3 x 3 factorial arranged in a randomized complete block with four replications. The treatments consisted in three water depths of 50, 100 and 150% of ETc and three levels of nitrogen fertilization of 20, 110 and 200 kg ha^{-1} by drip fertigation, contemplating 40 experimental units. The total area of the experiment was 1,440 m², with each plot experimental area of 30 m² (6x5m). The plant height variable was obtained from 67 days after emergence with 15-day intervals, performed with the aid of a graduated scale measuring from the neck to the apex of the plant in nine plants per experimental unit. For the statistical analysis, the Sisvar software was used, at a level of 5% error probability. Nitrogen fertilization showed a significant difference at 97 days after emergence for plant height, showing an increasing linear behavior for the highest height of 74.04 cm at the dose of 200 kg ha^{-1}. Nitrogen fertilization positively interfered the plant height variable in all evaluations with an isolated effect. The plant height of cotton was influenced by nitrogen fertilization and water depth.

Keywords: *Gossypium hirsutum* L., Cotton in the Cerrado, Vegetative development.
Financial support:

(1764 - 1257) Productive development of herbaceous cotton fertigated by dripping under nitrogen doses and water slides

Paula Caroline Lima Silva[1]; Tonny José Araújo da Silva[1]; Thiago Franco Duarte[1]

Universidade Federal de Mato Grosso[1]

Cotton is the most important natural fiber produced in the world. In Brazil, the Mato Grosso State has great representativity in the culture production. In the 2016/2017 harvest, the State produced 66.1% of the national amount. Due to the crop importance in the Brazilian and Mato Grosso production, it is necessary to invest in research and technologies to ensure sustainability in the cultivation of cotton. The objective of this study was to evaluate the performance of the herbaceous cotton cultivated in Dystrophic Oxisol fertigated by drip irrigation, as a function of nitrogen doses and water slides. The experiment was carried out in the field, at the Federal University of Mato Grosso, University Campus of Rondonópolis, from June to December 2017. The experimental design was a randomized complete block with four replications, in a factorial scheme, with nine treatments, three nitrogen doses (20, 90 and 200 kg ha-1) and three water slides (50, 100, 150% ETc), totalizing 40 experimental units. The experimental units had dimensions of 6 x 5 m (30 m²), with total área of 1440 m². Before the harvest, the number of beaks per plant was obtained by means of a general average, after manual counting of the beetles in nine plants per experimental unit. The data were submitted to statistical analysis on the response surface using the Sisvar software at the 5% probability level in all statistical tests. Nitrogen doses had an isolated effect with increasing linear behavior for the variable number of beaks per plant, reaching a maximum value of 4.67 beaks. The water depth was significant for the variable number of beaks per plant, where the water blade of 108.48% of ETc provided the maximum value of 3.77 beaks per plant. Nitrogen fertilization and water depth influenced the number of pods per herbaceous plant.

Keywords: Gossypium hirsutum L., nitrogen fertilization, irrigation.
Financial support:

(5221 - 948) Reduction of nitrogen fertilization in corn crop due to combinations of plant growth promoting bacteria

Marcelo Carvalho Minhoto Teixeira Filho[1]; Jeferson Silva de Souza[1]; Rafaela Neris Gaspareto[1]; Fernando Shintate Galindo[1]; Íngrid Torres Pereira[1]; Salatiér Buzetti[1]; Laura Britto Garcia de Oliveira[1]; Antonio Leonardo Campos Biagini[1]

Universidade Estadual Paulista (UNESP), Ilha Solteira Câmpus[1]

Recent researches have shown that inoculation with plant growth promoting bacteria, such as *Azospirillum brasilense*, can increase the efficiency of nitrogen fertilization in grasses, such as corn. Other bacteria such as *Bacillus subtilis* and *Pseudomonas fluorescenses* have several plant benefits, such as phytohormonal effect and induction of resistance to pathogens. Therefore, as there are few studies with the interaction of these bacteria, the objective was to evaluate the influence of combinations of seed inoculations with plant growth promoting bacteria (*A. brasilense*, *B. subtilis* and *P. fluorescens*), associated to the reduction of N fertilization, in the N concentrations in leaf diagnosis, grains and straw, and corn grain yield. The experiment was conducted in second corn crop, under no-tillage system with supplementary irrigation, in Selvíria - MS, Brazilian Cerrado region. The experimental design was a randomized block, with four replications and eight treatments, being: 1) Control (without inoculation and without N fertilization); 2) Without inoculation and with 75% of the recommended N dose (112.5 kg ha^{-1} of N, in the form of urea applied in V4 stage); 3) Without inoculation and application of the recommended N dose (150 kg ha^{-1} of N); 4) Inoculation with *A. brasilense* + 75% of the N dose; 5) Inoculation with *A. brasilense* + *B. subtilis* + 75% of N dose; 6) Inoculation with *A. brasilense* + *P. fluorescens* + 75% of N dose; 7) Inoculation with *B. subtilis* + *P. fluorescens* + 75% of N dose; and 8) Inoculation with *A. brasilense* + *B. subtilis* + *P. fluorescens* + 75% of N dose. The results were analyzed by analysis of variance and Scott-Knott's test at 5% probability for comparison of treatments means. N concentrations in the diagnostic leaf, grains and straw of corn were higher with fertilization at the recommended N dose and when was used 75% of the N dose associated with inoculation with *A. brasilense*, *A. brasilense* + *B. subtilis*, and *A. brasilense* + *P. fluorescens*. However, the highest grain yields were obtained in the treatments with the inoculations + 75% of the N dose, all of which were significantly higher than the control and the application of 75 and 100% of the recommended N dose. This is due in part to the fact that these bacteria induce systemic resistance of the plant to pathogens, which caused less damage of the corn stunt. Therefore, with the inoculation of these bacteria, was possible to reduce in 25% the N dose applied in the corn crop.

Keywords: Nitrogen; grain yield; *Azospirillum brasilense*; *Bacillus subtilis*; *Pseudomonas fluorescens.*
Financial support:

(5670 - 2041) Response of Marandu grass (Brachiaria brizantha) to mineral and organic fertilization

Andréia Lopes de Morais[1]; Jéssica Rodrigues Dalazen[1]; Renan Garcia Malikouski[1]; Kamila Cabral Mielke[1]; Janderson Rodrigues Dalazen[2]; Karem Caroline V. do Nascimento[3]; Anderson Cristian Bergamin[3]

UFES[1]; EMATER - RO[2]; UNIR[3]

Marandu grass (Brachiaria brizantha), is considered one of the most used forages in Brazil, this preference is due to its high tolerance index in conditions of low soil fertility, resistance to pests, and high productivity in properly managed soils. Fertilization, along with other management strategies, is fundamental for pursuing economic, social and sustainable exploitation, without causing damage to the environment. The present study aimed to evaluate the behavior and productivity of Brachiaria Brizantha cv. Marandu under the use of mineral fertilization (MF) using Urea as source and organic fertilization (OF) using bovine manure as the source. The study was carried out in pots with a volume of 5 dm³, conducted in a greenhouse at the Experimental Campus of the Federal University of Rondônia (UNIR), from October to December 2014. With a completely randomized

experimental design, with five treatments and five replications, in the following combinations 0% OF / 100% MF; 25% OF / 75% MF; 75% OF / 25% MF; 100% OF / 0% MF and one control (0% of nitrogen fertilization and 0% of organic fertilization), totaling 25 experimental units. For the study of the morphogenic and structural variables, the dry mass weight (Air Part) was analyzed; leaf appearance rate; leaf elongation rate; leaf senescence rate; number of leaves per tiller during its establishment phase. For Marandu grass, no response was observed for leaf elongation rate and leaf appearance rate, with no difference between treatments. The treatment that obtained the best response for wet mass and dry mass was 0% OF and 100% MF better, the control obtained the worst yield. Treatment with a dose of 75% OF; 25% MF showed better results to the chlorophyll content and with the dose 100% OF and 0% MF the result was not satisfactory. For the best management of the plant, the use of mineral nitrogen and organic nitrogen is recommended, because of this, to an interaction with different times of nitrogen reaction in the plant, so that maximum production can be obtained.

Keywords: Brachiaria grass, leaf area, plant nutrition.
Financial support: Universidade Federal de Rondônia – UNIR

(7947 - 2759) Root growth and expression *OsNRT2.4* gene in rice lines under low nitrate supply

Andressa Fabiane Faria de Souza[1]; Laura Carine Candido Diniz Cruz[1]; Leilson Novaes Arruda[1]; Carlos Alberto Bucher[1]; Sonia Regina de Souza[1]

Universidade Federal Rural do Rio de Janeiro[1]

Nitrogen (N) is one of the factors that most limits plant growth and productivity, being the nitrate (NO_3^-) a major source of N for most higher plants in cultivated (well aerated) soils (Glass, 2009). Nitrate uptake by plants is mediated by two different transport systems, a low (NPF) and other high-affinity (NTR2), in which the high-affinity transport system operates at low nitrate concentration in the external medium. Thus, the present study aimed to evaluate a relative expression of the OsNRT2.4 gene in transformed rice lines obtained by gene silencing technique using the artificial micro RNA (amiRNA), under low N supply. The experiment was performed in a growth chamber at $28^oC/24^oC$ day/night temperature with a 14/10 h light/dark regime, with a light intensity of 318 µmols $m^{-2}.s^{-1}$. The relative humidity was kept at 70%, at the Soil Department of the Federal Rural University of Rio de Janeiro (UFRRJ). The rice seeds (wild type (WT) and lines) of the variety Nipponbare (*Oryza sativa* L. subsp. Japonica) were surface-sterilized with sodium hypochlorite (2,5%) for 15 min and germinated in deionized water. Three days after germination (DAG), plants were transferred to modified Hoagland solution (Hoagland and Arnon, 1950) with different N regimes. The solutions were changed every 3 days, and the pH was maintained at 5.5. At 15 DAG the treatment was started, with the ½ ionic strength of 0.2mM N-NO_3^-. The plants were harvest at 21 DAG, four hours after the change of the nutrient solution. A fresh weight of the plants and root length were measured, and root samples were stored at -80°C for subsequent use. Total RNA was extracted, and gene expression was analyzed by real-time semi-quantitative RT-PCR through the comparative Ct method 2^(-delta delta Ct) using gene-specific primers. It was used as the housekeeping genes UBC, eEF-1α. The results indicated that the transformed lines used as study object had a reduction in the expression of the *OsNRT2.4* gene up to 80% compared to WT plants. And even under the effect of gene silencing, when growth in a solution containing 0.2mM N-NO_3^- (low N), the silencing lines the *OsNRT2.4* gene presented values of root length close to the wild type. It was also observed that the silencing lines the OsNRT2.4 gene showed a lower root dry matter compared to the WT plants. These results reinforce the performance of the OsNRT2.4 transporter in rice roots under low N supply.

Keywords: Nitrate transporter; *OsNRT2.4*; low nitrate; RT-PCR; *Oryza sativa*
Financial support: CNPq (Conselho Nacional de Desenvolvimento Científico e Tecnológico), CAPES (Coordenadoria de Aperfeiçoamento de Pessoal de Nível Superior) e PPGA-CS (Programa de Pós-Graduação em Agronomia-Ciência do Solo)

(4944 - 1675) Secondary macronutrients concentration in signal grass (*Urochloa decumbens*) fertilized with nitrogen doses and sources

Guilherme Constantino Meirelles[1]; Reges Heinrichs[2]; Maikon Vinicius da Silva Lira[2]; Filipe Virgílio Ribeiro[2]; Luiz Felipe de Melo Santos[2]

São Paulo State University (UNESP), FCAT[1]; São Paulo State University, FCAT/UNESP[2]

The interaction between nutrients can substantially affect the mineral nutrition of plants. The effects of nitrogen fertilization on sulfur contents are well known, especially due to the joint action in the production of amino acids. However, with the use of nitrogen sources efficiently increases can also affect in a distinct way the use of other nutrients. The experiment was conducted in the experimental field of the College of Agricultural and Technological Sciences, UNESP, Campus de Dracena, SP, Brazil. The objective of this study was to evaluate the conventional nitrogen fertilizer and the nitrogen sources with increased efficiency in the secondary macronutrients concentration in aerial part of the signal grass pasture (*Urochloa decumbens*; syn. *Brachiaria decumbens*). The soil of the area was classified as Ultisol. The experimental design was in ranged blocks with four replicates, in a factorial scheme 4x2+1. The plots were composed of four nitrogen sources (urea, ammonium nitrate, urea with NBPT inhibitor and urea coated with B and Cu), with two doses of nitrogen (100 and 200 kg ha^{-1}), plus a treatment without nitrogen fertilization (control). The nitrogen doses were divided in five equal applications (20 e 40 kg ha^{-1}), the first one after the uniformization cut and the others after the immediately subsequent cuts. The results presented lower sulfur concentration with application of nitrogen doses in the summer (water period) and winter (dry period), but did not differ among the sources. These results can be attributed to the dilution effect, due to the higher production of dry mass with nitrogen fertilization. A similar result was verified with the Mg concentration in the winter period. The Ca concentration at the two season and the Mg during the water period were not affected by nitrogen fertilization. The Mg and S contents in the aerial part of the signal grass are within the range considered adequate. On the other hand, the Ca presented values below the critical level for the forage.

Keywords: *Brachiaria decumbens*, Calcium, magnesium, pasture, slow-release fertilizer, sulfur, urease inhibitor
Financial support:

(5402 - 978) Soil Inorganic nitrogen content in a system of legume intercropping with pasture in the Brazilian Savannah

Carlos Henrique dos Santos[1]; Ana Carolina Mônico Moreira[2]; Amarildo Francisquini Júnior[2]; Juliano Carlos Calonego[3]; João Pedro de Pádua Dutra[2]; Jean Marcos Pereira da Silva[2]; Willian Lucas Mativi[2]; Lucas Rodrigues da Silva[2]

University of Western São Paulo, College of Agricultural Sciences, Campus II, 19067-175, Presidente Prudente, State of São Paulo, Brazil (chenrique@unoeste.br)[1]; University of Western São Paulo, College of Agricultural Sciences, Campus II, 19067-175, Presidente Prudente, State of São Paulo, Brazil[2]; São Paulo State University, College of Agricultural Sciences, PO Box 237, 18610-307, Botucatu, State of São Paulo, Brazil[3]

Nitrogen is an essential element for the development and growth of plants, but difficult to manage due to its high mobility in the soil, which leads to higher losses due to leaching, volatilization and denitrification. These losses may be more intense in sandy soils due to the low clay content and organic matter. The major challenge from this is to implement systems such as no-tillage, crop-livestock integration, crop rotation and intercropping to increase the accumulation of organic matter in soils and improve the conditions of the production system. The purpose of this research was to evaluate the levels of N-inorganic in soil (NH_4^+ and NO_3^-) in a system of crop-livestock integration, with N supply through composting or intercropping with legumes in pasture areas. The experiment was carried out at the experimental farm of University of Western São Paulo, in Presidente Bernardes, State of São Paulo, Brazil, in a soil classified as Ultisol. The experimental design was defined as a randomized complete block design with four replicates and de treatments were described as: 1) Single mombaça grass with N cover fertilization, 2) Mombaça grass intercropped with dwarf pigeon pea without N fertilization, 3) Single mombaça grass with absence of N fertilization, 4) Mombaça grass intercropped with *Macrotyloma axillare* cv. Java without N fertilization. Soil samples were collected at depths of 0-5, 5-10, 10-20, 20-40, 40-60 and 60-80 cm and the data were submitted to analysis of variance and compared by Tukey test ($p<0.05$). The legumes influenced positively the NH_4^+ and NO_3^- contents in the system, promoting a significant increase of inorganic N in the soil. The intercropping between mombaça and the legumes increased the contents of N-inorganic in the soil, with a predominance of NH_4^+ in relation to NO_3^-. There was a statistical difference for the NH_4^+ levels between the treatments only in the depth of 40-60 cm, whereas the NO_3^- contents were significantly different in the same ones in all the depths sampled. Legumes influenced positively the NH_4^+ and NO_3^- contents in the system, promoting a significant increase of inorganic N in the soil.

Keywords: Nitrogen use efficiency; sandy soil; leaching;
Financial support: Financial Support: FAPESP - São Paulo Research Foundation [grant number 2015/50305-8] and UNOESTE - University of Western São Paulo

(1490 - 743) Urease inhibitor use in nitrogenous fluid fertilizers in mixture with vinasse

Karla Vilaça Martins[1]; Ronaldo Batista Pinheiro[2]; Mauro Pinheiro Marra[2]; Klaus Reichardt[3]; Maicon Henrique Martins[2]
University of Patos de Minas[1]; Terrena Agronegócios Ltda[2]; University of São Paulo[3]

The use of fluid nitrogen fertilizers mixed with vinasse is an alternative for fertilization of the sugar cane crop. However, there is a lack of information regarding nitrogen (N) losses that can occur by volatilization when the fertilizer is applied on the straw. The objective of this research was to evaluate N losses of nitrogenous fertilizers in mixture with vinasse applied on sugarcane straw. The study was carried out in a greenhouse situated in the municipality of Patos de Minas, MG, Brazil. The experimental design consited of randomized blocks with 8 treatments [T1 - Control, T2 - Uan, T3 - Liquid urea, T4 - Uan + inhibitor NBPT (N-(n-butil) tiofosfóricotriamida), T5 - Vinasse, T6 - Uan + Vinasse, T7 - Liquid urea + Vinasse and T8 - Uan + NBPT + Vinasse] and 5 replicates. The experimental units consisted of plastic trays 50 cm long by 50 cm wide and 9 cm high. At installation time, the soil classified as Red Latosol of clayey texture, was sieved through 2 mm, covered with 1 cm of sugar cane straw and irrigated with 5 mm of water on each tray using a watering can. An ammonia collecting chamber was used, made from a transparent polyethylene terephthalate (PET) plastic bottle with a capacity of 2 L. Ammonia losses were evaluated 3, 7, 10 and 14 days after fertilizer application (DAA). Ammonia was determined by titration with standardized solution of 0.005 mol L^{-1} H_2SO_4. The statistical analysis of the results was carried out with the aid of the SAS® program. At 14 DAA the total N losses were, on average, for T3 84% (a), T2 33% (b), T4 11% (c), T7 8% (cd), T6 5% (e), T8 3% (ef), T5 1% (ef) and in T1 0.3% (f). The highest loss of N by volatilization was in the treatment with application of Liquid urea (T3). The mixture of vinasse with fluid fertilizers significantly reduced the losses of N (T6 and T7), especially when the urease inhibitor (NBPT) was added (T8).

Keywords: Sugarcane; Nitrogen; Volatilization
Financial support: Terrena Agronegócios Ltda

(8796 - 1381) Use of gypsum and leguminous residue to improvement of soil rootability and increase of nitrogen use efficiency in a cohesive tropical soil.

Emanoel Moura[1]; Stefanny Portela[1]; Karina Vieira[1]; Jessica Nunes[1]
State University of Maranhão[1]

In cohesive soils, crops are able to exploit only a thin surface layer to sustain development due to an increase of fine particles and decreased organic carbon at lower depths, which can limit crop growth when the stock of water and nutrients is not sufficient in this soil volume. We hypothesized that the use of gypsum combined with leguminous residue may extend the soil rootability, and consequently enhance nitrogen uptake, increase growth and maize grain yield. The aim of this work was to evaluate the combined effects of gypsum and leguminous residue on soil rootability nitrogen uptake and maize grain yield in a sandy loam cohesive soil. This study began in January 2011, following a randomized block design with four replications of the following treatments: control; 12 Mg ha^{-1} of dry matter legumes residue; 12 Mg ha^{-1} of dry matter legumes residue + 6 Mg ha^{-1} of gypsum; 90 kg ha^{-1} of N from urea + 6 Mg ha^{-1} of gypsum; 12 Mg ha^{-1} of dry matter legumes residue, 90 kg ha^{-1} of N from urea + 6 Mg ha^{-1} of gypsum; 12 Mg ha^{-1} of dry matter legumes residue, 90 kg ha^{-1} of N from urea, 12 Mg ha^{-1} of gypsum. In the year 2015, the plots of the control treatment were divided into two treatments: C (Control) and U (100 kg ha^{-1} of N from urea). The treatment Urea was created to provide comparative data in N contents and yields components of maize. The results showed that the combination of gypsum with leguminous residue modified the root zone by increasing the calcium and organic matter levels and by reducing the soil penetration strength. For the maize, these changes increased the leaf area index and the remobilization of nitrogen to grains due to greater uptake before and after tasselling stage. This positive effect on the physiological process also produced variations in maize grain yield. For example, the difference in weight of grains between the treatments U, and LG6 (4.33 Mg ha^{-1} to 6.33 Mg ha^{-1}) suggests that, rather than increasing mineral fertilization alone, the gypsum and leguminous residue combination is a more suitable strategy to improve agrosystems in cohesive soils of the humid tropics.

Keywords: Keywords: calcium; organic-carbon; penetration strength.
Financial support: This work was undertaken as part of NUCLEUS, Funded in Maranhão by FAPEMA and in the United Kingdom by BBSRC.

(6983 - 1510) Vegetative development of cotton in drip fertigation under nitrogen fertilizer and water depths

Joyce de Oliveira Rodrigues[1]; Tonny José Araújo da Silva[1]; Paula Caroline Lima Silva[1]; Thiago Franco Duarte[1]; Edna Maria Bonfim-Silva[1]

Universidade Federal de Mato Grosso - UFMT[1]

The Brazil is a major producer of cotton (*Gossypium hirsutum L.*), currently one of the five largest producers of fiber in the world. In relation to national level the Mato Grosso State stands out as the biggest producer of the plume. The objective of this study was to evaluate the performance of the drip fertigated cotton cultivated in Cerrado Oxisol under doses of nitrogen and water depths. The experiment was carried out at the Federal University of Mato Grosso, University Campus de Rondonópolis, in the city of Rondonópolis-MT, from June to December 2017. The treatments were three nitrogen doses (20, 110 and 200 Kg ha^{-1}) via fertigation and three water depths (50, 100 and 150% of ETc) via drip irrigation. The experiment utilized a 3x3 factorial arranged in a randomized complete block with four replications. The experimental unit had dimensions of 6x5 m with total area of 30 m^2. The number of cotton leaves was evaluated at 15 - day intervals, by means of manual counting in nine plants per experimental unit. For the statistical analysis of the variable, the Sisvar software was used, at 5% probability. The number of leaves was significant for nitrogen and water levels at 112 days after emergence (DAE). For nitrogen doses, it is possible to observe increasing linear behavior, with the highest number of leaves (30.61) at the dose of 200 kg ha^{-1} of nitrogen. The water depth corresponding to 116.7% of ETc presented a greater number of leaves of 28.63 per cotton plant. The number of cotton leaves is influenced by nitrogen fertilization and water depths.

Keywords: *Gossypium hirsutum L.*; water depths; nitrogen.
Financial support:

(7626 - 2367) Vegetative performance of pepper pout under nitrogen doses

Francielly Gonçalves Barbosa-Oliveira[1]; Márcio Koetz[1]; Edna Maria Bonfim-Silva[1]; Juliane de Souza Beltrão[1]; Jessica Patricia Paula Lima[1]
Universidade Federal do Mato Grosso[1]

The cultivation of peppers in Brazil has great importance for its profitability for family agriculture, which is influenced in the market by regional food habits. The lack of pungency of the pepper pout fruits and their organoleptic characteristics impels the acceptance and preference for several types of consumers, increasing the interest for scientific research. The objective of this study was to evaluate the number of leaves of pepper pout submitted to nitrogen doses. The experiment was conducted in a greenhouse with the experimental units constituted by pots of 5 dm^{-3} with Oxisol, from Cerrado. The experimental design was completely randomized with 5 doses of nitrogen (0, 60, 120, 180 and 240 mg dm^{-3}) and 5 replicates, making 25 experimental units. According to the soil chemical analysis, the base saturation was corrected to 80% and fertilized with 600 mg dm^{-3} of phosphorus, 180 mg dm^{-3} of potassium and nitrogen, divided in 3 times according to the treatments. It was fertilized with micronutrients via solution, applying 5,72 mg dm^{-3} of boron, 3,93 mg dm^{-3} of copper, 10,95 mg dm^{-3} of manganese and 13,51 mg dm^{-3} of zinc. The seeds of the cultivar BRS Moema were seeded in expanded polystyrene trays to be transplanted to the pots, when the seedlings reached an average of 7 cm in height, with 37 days after sowing. Irrigation was performed so that the soil returned to the condition of field capacity, by monitoring the humidity with tensiometers, installed at 10 cm depth in the experimental unit, applying water whenever the water tension in the soil reached 15 kPa. The number of leaves at 15, 30, 45 and 60 days after transplanting (DAT) was evaluated. A significant difference was found in the F-test at 5% significance for 30, 45 and 60 DAT, adjusting to the quadratic regression model using the SISVAR statistical software at 30, 45 and 60 DAT, where it was observed, respectively, that the best nitrogen doses were 32,75, 130,25 and 120,82 mg dm^{-3}. The number of leaves of pepper pout cultivated with Oxisol under greenhouse conditions were influenced by the nitrogen doses.

Keywords: Capsicum chinense, BRS Moema, family agriculture, irrigation, fertility.
Financial support: Universidade Federal do Mato Grosso

(5543 - 2351) Volatilization of Ammonia ($N\text{-}NH_3$) in Corn (*Zea mays* L.) in Function of the Application of Urea, Ammonium Sulphate and Polymer Coated Urea

Bruno Maia Abdo Rahmen Cassim[1]; Evandro Antonio Minato[1]; Fabrício Linares Mazzi[1]; Marcos Renan Besen[1]; Éder Junior de Oliveira Zampar[1]; Rodrigo Sakurada Lima[1]; Tadeu Takeyoshi Inoue[1]; Marcelo Augusto Batista[1]
Universidade Estadual de Maringá (UEM)[1]

The urea is the main nitrogen fertilizer used in agriculture. In some situations when applied on the soil, it can present low efficiency because of losses by volatilization, denitrification and leaching. Due to this, the urea coated by materials as resins, waxes and polymers, seeks to diminish the losses by volatilization and to increase the use efficiency by a gradual nutrient release mechanism. The objective of this work was to evaluate the accumulated losses of ammonia (NH_3) of different nitrogen sources over time in corn (*Zea mays* L.) cultivation. The field experiment was conducted in Maringá city, Paraná state, in a Dystrophic Red Acrisol (Ultisol) and Cfa climate. The experimental design was randomized blocks with 6 treatments (T1: control; T2: urea; T3: ammonium sulfate, T4: Agrocoat polymer, T5: FortBlen polymer and T6: polymer kincoat) and 6 replicates. For all treatments the dose used was 60 kg N ha^{-1}. The samplings were made at the 3 °, 5 °, 9º, 13°, 18 °, 23 ° and 27 ° days after fertilizer application. The method used to quantifying the ammonia volatilization was the semi-opened static chamber made of a plastic bottle (PET) with a filter paper strip soaked by a H_2SO_4 0.05 mol L^{-1} + 2% v / v glycerol solution. The determination was made by the colorimetrich method of salicylate, described by Miyazawa (2007). The results were submitted to no-linear regression analysis using logistic model $Y=\alpha/1+\exp[-\gamma(time-\beta)]$. According to the adjusted model, the maximum accumulated losses were 26.4; 26.1; 20.1; 16.8; 1.9; 0.2 kg ha^{-1} of $N\text{-}NH_3$ for urea, Kincoat, Agrocoat FortBlen, ammonium sulfate and control, respectively. It showed the efficiency of the FortBlen polymer, which had a loss reduction of 36.37% of the N applied, when compared to the urea. Among the nitrogen sources, the ammonium sulfate showed the lowest loss by volatilization, because it is an ammoniacal source. According to the adjusted model, the peak of $N\text{-}NH_3$ volatilization was observed at 4.23; 4.49; 4.87; 4.86 and 4.33 days after application of urea, Kincoat, Agrocoat, FortBlen and ammonium sulfate respectively. These peaks represented losses of 3.91; 3.94; 3.12; 2.39; 0.38 kg ha^{-1} d^{-1} of $N\text{-}NH_3$, respectively. The conclusion is that there is a difference among the coated fertilizers, analysed in the work, and some of them have the potential to minimize the losses of $N\text{-}NH_3$.

Keywords: nitrogen sources; fertilizer and logistic model.
Financial support: State University of Maringá-UEM

(8600 - 1685) Volatilization of NH_3 in nitrogen fertilizers applied on coffee crop with and without straw

Pedro Rocha Santos[1]; Maila Adriely Silva[2]; Mateus Gonçalves de Borba[1]; Leticia Gonçalves Pinheiro[1]; Victor Gustavo Soares Ribeiro[1]; Vanessa Júnia Machado[1]
Centro Universitário de Patos de Minas[1]; Universidade Federal de

Lavras[2]

The nitrogen (N) is the element most exported by the coffee trees, thus it has used higher doses on the fertilization, being the efficiency of this practice responsible to reach the high productive ceiling. Due the dynamic, the nitrogen is transformed easily in compounds that are easily lost, among these losses stands out the volatilization of NH_3 the process that can lead to extremely high losses in urea-based fertilizers. Thus, the present study has the objective quantify the nitrogen losses by NH_3 volatilization in function of the different application of nitrogen fertilizers on coffee crop soil with and without straw. The experiment was conducted in the plantation of coffee Arábica at Fazenda Santiago, Patos de Minas, Minas Gerais State, Brazil. The design used was randomized complete block with Split-plot temporal and factorial 2 x 5 x 6 with 3 repetitions, being two application methods (on the straw and without the straw), four fertilizers sources: F1 = Ammonium Nitrate (32% of N), F2 = Urea (45% of N), F3 = Urea-NBPT (44% of N) and F4 = Polymer-coated urea (45% of N) and the control; and the split plot with eight collections to 3, 6, 10, 17, 24, 38 and 53 days after the fertilizer application. The plots were constituted of chambers made of plastic bottles, following the SALE model proposed by Araújo with area of 0,008 m^2, using a sponge soaked with H_2SO_4 1 mol L^{-1}, that were collected and destilled by method Semimicro Kjeldhal. It was verified that the both application methods the urea showed higher volatilization average per day, respectively with and without straw, 2,44 and 3,53 $Kg.ha^{-1}$ of N, with close average was found respectively, 1,45 and 2,99 $Kg.ha^{-1}$ of N, at the polymer-coated urea, followed by urea NBPT with the average 1,42 and 2,15 $Kg.ha^{-1}$ of N, the best results were found in the ammonium nitrate source, with 0,94 and 0,76 $Kg.ha^{-1}$ of N, and the average close of the control with 0,83 and 0,42 $Kg.ha^{-1}$ of N. The volatilization peaks were found on the days 3 and 6 at the ammonium nitrate and urea sources, and at the polymer-coated urea and urea NBPT was found on the days 6 and 10, showing a delay on that peaks related with the associated technology on these fertilizers.The urease inhibitor and polymer proved to be efficient in the delay of the volatilization peak, while the ammonium nitrate was the source with the lowest loss per volatilization.

Keywords: Nitrogen fertilization, efficiency, losses.
Financial support: Centro Universitário de Patos de Minas

(4091 - 3136) Volatilization, Leaching and Nitrogen Runoff according to dose, sources and soil moisture in rice cultivation.

Luis Armando Castilla Lozano[1]
FEDEARROZ[1]

N is one of the most important macronutrients in rice crop, there is a direct correlation between nitrogen fertilization and yields. The soils of the rice areas of Colombia have lost organic matter and this affects the availability of N, which is why the application of significant amounts of nitrogen fertilizers, decreasing the efficiency of fertilization, increasing losses due to runoff, leaching and volatilization. As a strategy to improve efficiency, this study was carried out in a *Typic Haplustalf* soil of the Ibagué Colombia, under a complete random blocks design (CRB), with four replications. Two experiments were carried out: in one, doses of 250 and 125 kg of N ha^{-1} (urea) were evaluated with three levels of soil humidity (50% CC, CC and saturated). Experiment 2 evaluated the effect of different sources of nitrogen fertilizers (urea, ammonium sulfate, urea with urease inhibitors, urea with nitrification inhibitors, physical mixture urea + ammonium sulfate and a control) and irrigation applied immediately and 24 hours after fertilization. In experiment 1, it was found that the volatilization of N was greater at higher doses and in soils at 50% CC (10-12 kg N ha^{-1}) and less at lower doses and in soils at saturation (6 -7 kg N ha^{-1}). Leaching and runoff were higher in saturated soils (25 mg l^{-1}) and at higher doses, than in soils at 50% CC (20 mg l^{-1}) and with lower doses. In experiment 2 it was found that urea and ammonium sulfate are greater loss by volatilization (29.93 and 21.13 kg N ha^{-1}, respectively) contrasting urea with urease inhibitors (10.69 kg N ha^{-1}). The same tendency was found in runoff and leaching. There were no differences in N loss, between applying the irrigation immediately and 24 hours later.

Keywords: losses of N, Oryza sativa, Colombia
Financial support: The author express their thanks Fedearroz, for funding of this research.

C3.3.2 - Nutrient budgets in agricultural soils

(3626 - 2201) A sequential extraction procedure to study phosphorus binding forms in arable soils

Kristof Dorau[1]; Nina Gerlach[1]; Tim Mansfeldt[1]; Marcel Bucher[1]
University of Cologne[1]

Phosphorus (P) as a major nutrient is of special concern in order to investigate the study plant *Zea mays*. Within the project RECONSTRUCT, we investigated five genotypes of *Zea mays* at the DOK trial in Therwil and at the DEMO trial in Reckenholz (both Switzerland). The farming systems at the trials are managed differently and consist of an organic system (BIODYN) and a conventional system with mineral fertilizer exclusively (CONMIN) at DOK. At the DEMO trial, a fully fertilized soil (by nitrogen (N), potassium (K) and P (NPK)) and a plot with N and K fertilization but without P (NK) were investigated to study the effects of maize growth. Even when P levels exceed plant requirements, it might be possible that symptoms of P starvation occur, because soils can retain P very strongly depending on their mineralogical composition. Therefore, a differentiation into mobile and immobile P fractions is important. We employed the Hedley fractionation procedure and quantified P availability in a stepwise extraction to quantify labile P (resin P and $NaHCO_3$-P), moderately labile P (NaOH-P), and stable P (HCl-P, HCl_{conc} P and residual P). This poster summarizes first results about different P binding forms in soils and their impact on biomass production for a consortium of maize genotypes under variable agricultural management practices.

Keywords: Hedley fractionation, phosphorus, long-term fertilization, cropping systems
Financial support: Bundesministerium für Bildung und Forschung, Project Number 031B0200D

(5761 - 1917) Application of an Electric Potential to Retain Plant Nutrients Around the Root Zone in Rice (*Oryza sativa* L.)

Gayathree I. Senevirathne[1]; J. A. Surani Chathurika[1]; Manju Gunawardene[1]; Asitha Siriwardena[1]; Kosala Purasinhala[1]; Gehan Amaratunga[2]
Sri Lanka Institute of Nanotechnology, Mahenwata, Pitipana, Homagama, Sri Lanka.[1]; Sri Lanka Institute of Nanotechnology, Mahenwata, Pitipana, Homagama, Sri Lanka. Department of Engineering, University of Cambridge, Trumpington Street, Cambridge, CB2 1PZ, United Kingdom.[2]

Nutrient leaching is one of the major concerns that affect crop production as well as environmental health and human health. Specially, retention of plant nutrients in waterlogged rice cultivation is a challenging task. Therefore this study aims to evaluate the effect of direct electric potential (EP) in retaining soil nutrient around the root zone. This study was conducted in a greenhouse at Sri Lanka

Institute of Nanotechnology, *Homagama*, Sri Lanka. The soil selected for the study was Tipic Tropofluvents. Treatments were arranged according to complete randomized design with four replicates. Treatments were; control (plants without EP around the root zone), treatment 1 (plants with EP around the root zone). A local rice variety (*Oryza sativa* L.) BW 367 was selected as the test crop. Five rice seedlings were planted in pots containing inner and outer cylindrical pots made of iron mesh. Electric potential of 5.0 V was supplied with the minimum direct current of 0.1 A for 8 hours continuously per day until the end of the growing season. Iron mesh was purposely selected to provide excess iron (Fe) to the root zone as rice shows visible symptoms in growth and yield when subjected to Fe toxicity. Inner pot was given positive end (anode) while outer pot was considered as negative end (cathode). Plant height was measured weekly and soil total and available Fe content in three zones (near to the rice plant, near to the anode and near to the cathode) were determined at the time of panicle initiation and at the end of the experiment. Above and below ground biomass, paddy yield, number of seeds per panicle and unfilled grains per panicle were measured at the end of the growing season. Soil total and available Fe content was higher around the cathode zone than the anode zone. Plant height, above ground biomass, and paddy yield were significantly lower in treated plants than the control plants. Treated plants showed 45% reduction in paddy yield compared to the control plants. Below ground biomass and number of seeds per panicle were lower in treated plants compared to the control. Iron uptake in rice grain was higher in treated plants than the control treatment. This confirms that provided excess iron with an electric potential increases the iron concentration around the root zone and enhances the Fe absorption. This study suggest that application of EP around the root zone and rhizosphere can be solution to mitigate nutrient leaching in waterlogged rice soils.

Keywords: Electric potential, Nutrient leaching
Financial support:

(4752 - 342) Calibrations of phosphorus and potassium modules for an integrated crop macro-nutrients model

Kefeng Zhang[1]
Ningbo Institute of Technology, Zhejiang University, Ningbo 315100, China[1]

Production of quality crops depends on the provision of an optimal supply of essential macro-nutrients of nitrogen (N), phosphorus (P) and potassium (K). With the advances in knowledge of soil and plant sciences, key processes controlling water and nutrients cycles in the soil-crop system could mechanistically be understood, and as a result numerous agro-hydrological models have been proposed for optimising fertiliser application in crop production. In this study, attempts have been made for calibrating P and K modules in the integrated NPK model. The modules were constructed based on the previous PHOSMOD and POTAS models and strong correlations between the percentage content of P (%P) and N (%N) and between the percentage content of K (%K) and N (%N) which were observed experimentally for measurements made on 19 crops grown under the conditions of various combinations of N, P and K fertilisers. Two parameters, the ratios of %N:%P and %N:%K, were introduced for determining critical %P and %K based on critical %N in the integrated model for crop growth. An effective root diameter, which could be obtained by calibration against the results of field experiments, was used for describing the differences in roots ability to absorb P and K. Forty separate experiments each containing 6 different levels of P or K treatments were used for calibrating root radii of 17 crops. The measured dry weights and the calculated dry weights from the calibrated P and K modules under various P and K treatments were then compared. Good agreement between simulated and measured dry weights for different P treatments was achieved (y=0.979x+0.187, R2=0.932, n=221). The correlation for different K treatments was satisfactory (y=0.892x+0.287, R2=0.941, n=222) for most crops, except for few crops including onion that required more attention. Overall the calibrations for P and K modules were successful, and the calibrated modules had the potential to be used for optimal fertiliser application in a range of crop production.

Keywords: Crop P and K models; fertiliser application; sustainable agriculture.
Financial support: UK Department for Environment, Food and Rural Affairs (DEFRA), Project Number HH3507SFV

(9010 - 1485) Changes in nutrients reserves of agricultural soils of the eastern lowlands of Georgia

Giorgi Ghambashidze[1]; Giorgi Ormotsadze[2]; Aleksandre Megrelidze[2]; Naira Kentchiachvili[2]; Maia Tarkhnishvili[2]; Giorgi Gventsadze[2]; Tamar Jolokhava[2]; Tea Meskhi[2]
Scientific-Research Centre of Agriculture, 6 Marshal Gelovani Avenue, Tbilisi, 0159, Georgia (giorgi.ghambashidze@srca.gov.ge)[1]; Scientific-Research Centre of Agriculture, 6 Marshal Gelovani Avenue, Tbilisi, 0159, Georgia[2]

Georgia is a mountainous country and has the limited area of arable lands accounting only 15.8% of its whole territory. Therefore, it is essential to maintain the fertility of soils on those lands, the most of which are concentrated in lowland areas. The current study was aimed to evaluate actual content of total and plant available pool of macro- (N, P, K, Ca, Mg) and micronutrients (Fe, Cu, Zn, B, Mn, Mo, Co) in top 30 cm of soil of agricultural lands covering 20 000 ha in the eastern lowlands of Georgia. Alongside with abovementioned elements soil pH, soil organic carbon, particle size distribution and calcium carbonate contents were also measured. The results were compared to the historical datasets to assess the basic trends in soil management practice. The data comparison has shown that main changes were associated with changes in land use affecting total nitrogen, plant-available phosphorus and potassium concentrations. Positive changes in soil organic carbon content were observed in arable lands, which are abandoned and cannot be used as pastures due to their locations.

Keywords: soil fertility, nutrient reserve, macro and micronutrients
Financial support: The study was funded by the Scientific-Research Centre of Agriculture and the Ministry of Agriculture of Georgia

(9458 - 3239) Changes in soil phosphorus balance and phosphorus use efficiency in long-term fertilizer application experiment conducted on agriculturally-used Chernozem soils in Germany.

Dirk Freese[1]; Tania Medinski[1]; Thomas Reitz[2]
Chair of Soil Protection and Recultivation, Brandenburg University of Technology Cottbus– Senftenberg[1]; Department of Soil Ecology, Helmholtz Centre for Environmental Research – UFZ[2]

Efficient phosphorus (P) fertilization systems which ensure high yield production and effective usage of expensive and limited P fertilizer are of great focus nowadays. This study investigates changes in soil P in different fertilization treatments applied since 1902 on Chernozem soil at a “Static Fertilization Experiment” in Germany. Total and plant-available soil P, and soil P balances were assessed at 0-30, 30-60, and 60-90 cm soil depth layers in unfertilized “Zero”, mineral “NK” and “NPK”, and combined mineral and organic “FYM+NK” (farmyard manure + NK) and “FYM+NPK” fertilization treatments. Composition of P fractions at different fertilization treatments was assessed using sequential chemical fractionation procedure. P use efficiencies for each crop in the crop rotation (sugar beet, spring barley, potato, and winter wheat) were determined. The 110 years of P fertilization at rates between 22 and 55 t ha^{-1} $year^{-1}$ resulted in significant increase in soil P stocks up to 60 cm depth. The total P accumulation comprised 1.3 t ha^{-1} for NPK, 1.1 t ha^{-1} for FYM+NK, and 3.1 t ha^{-1} for FYM+NPK. The increase in total P was mainly associated with the increase of inorganic phosphorus (Pi) fraction. An increase in organic phosphorus (Po) was only observed in FYM+NPK (0-30cm). The available P

contents also significantly increased to above recommended values in P fertilized treatments. Soil P was mostly presented by Ca- as well as Fe- and Al-bound fractions. Cultivation of crops without P fertilization in Zero and NK treatments resulted in a negative P balances and in a reduction of total and available soil P below recommended levels. Between 1903 and 1981, average P use efficiency of different crops varied between 31 and 70 %. After 1981, a reduction of mineral P application rates, along with crop variety-dependent yield increases, resulted in an improved P use efficiency for all crops, with the highest P use efficiency for winter wheat. Our results revealed, that for the Chernozem soil, an organic fertilization combined with additional supply of N and K mineral fertilizers (FYM+NK) resulted in the highest P use efficiency. P in this treatment is exclusively added in manure form, which reduces fertilization costs, and in addition, manure application may increase soil organic matter, and positively affect soil fertility.

Keywords: phosphorus fertilizer treatments_organic manure_phosphorus use efficiency_phosphorus fractions_Chernozem fertility
Financial support:

(8293 - 2116) Chemical atributes and the specific surface area of Oxisol under different uses

Antônia Finkler Dias Fernandes[1]; Tatiele Fruett Santos[2]; Alberto Vasconcelos Inda[3]
Graduation student of the agronomy course, Federal University of Rio Grande do Sul / UFRGS, 7712 avenue Bento Gonçalves, Porto Alegre, zipe code 91540000, RS, Brazil, antonia_finkler02@hotmail.com[1]; PhD student, Federal University of Rio Grande do Sul / UFRGS, 7712 avenue Bento Gonçalves, Porto Alegre, zipe code 91540000, RS, Brazil, tatielefruett@yahoo.com.br[2]; Professor, Federal University of Rio Grande do Sul / UFRGS, 7712 avenue Bento Gonçalves, Porto Alegre, zipe code 91540000, RS, Brazil, alberto.inda@ufrgs.br[3]

Soil conversion under field in farming or planted forests alters the dynamic balance of the system and can induce chemical and physical changes. The study was accomplished in a farm in the city of Júlio de Castilhos in the region of plateau of Rio Grande do Sul, Brazil. The objective was to evaluate soil use with soybean farming (FAR) and eucalyptus forest (EUC) on chemical and physical characteristics of a Oxisol, in relation to the same soil under native pasture (NP). The planting of eucalyptus and soybean under no-tillage system began 30 years ago. In the three treatments, the soil was sampled in triplicate at depths 0-5, 5-10, 10-20, 20-40 and 40-60 cm. In the ADFS fraction (Æ<2 mm) was analyzed the particles sizes and the specific surface area (SSA), and chemical characteristics of assorted complex. The particle size analysis was performed by the pipette method. The specific surface area (SSA) was estimated by the water adsorption method. The chemical analyzes were realized in the ADFS for the following components: pH in H2O, Ca, Mg, K, H+Al and P. Were calculated the base sum (BS) and the cation exchange capacity (CEC). The total organic carbon (TOC) fraction in ADFS was determined by dry combustion in a TOC analyzer. The fractions of the particle size analysis didn't differ between treatments. The SSA values were also similar, except in the 0-5 cm layer of the EUC, where SSA increades in relation to the NP. This result is related to the increse of TOC verified in the 0-5 layer of the EUC and corroborates with the positive effect of organic matter on soil SSA values. In the others layers, there were no changes in TOC levels between treatments. The EUC and FAR increased the sum of bases, mainly Ca and Mg, in the depths of 20 and 40 cm, respectively; and the contents of P to the depth of 10 cm. In the EUC, where no correctives and fertilizers were applied, these increases elapsed by biocycling while in FAR they were the result of the addition of limestone and fertilizers containing NPK. The addition of limestone in the FAR reduced the active acidity of the soil up to 40 cm of profundity. Just as the SSA, the CEC differed between treatments only in the 0-5 layer of the EUC, due to the increases in TOC. The results indicated a maintenance of the chemical quality of the Oxisol after thirty years of reforestation with eucalyptus and soybean culture under no-tillage, such as the importance of the organic matter to the SSA and the CEC of the soil.

Keywords: Soil use, Eucalyptus spp., organic carbon
Financial support: CNPq

(6988 - 2305) Chemical fractionation of copper and zinc in some Mollisols of Córdoba (Argentina), in conditions of waterlogging

Eduardo Buffa[1]; Silvia Ratto[2]
Universidad Nacional de Córdoba, Argentina[1]; Universidad de Buenos Aires, Argentina[2]

Excess water in soils of the Pampa plain of Córdoba, Argentina, is frequent and there are no studies that show its effect on the availability of micronutrients. Zinc is regularly applied in crops with variable responses. Cu is less important, poorly applied in crops and more in pastures. The objective of the work was to analyze the effect of waterlogging on the Cu and Zn pools by the following sequential fractionation method: Step 1 to 4: Labile pools extractable with DTPA (reaction time of 30, 30, 60 and 1000 min, respectively). Step 5: Pool in easily reducibles Mn oxides. Step 6: Pool in amorphous Fe oxides. Step 7: Pool in humified OM. Step 8: Residual pool. The soils were entic Haplustol, typical Haplustol and typical Argiustol. The soils were conditioned in 50 ml plastic pots in triplicate, saturated with destilled water during 0, 15, 30 and 60 days. Subsequently, they were air dried and fractionated with the method described above. The following hypotheses were proposed: H1: Waterlogging affects the metal-matrix interaction, modifying the bonds energy with a decrease in stability. H2: Reduction of the ligand energy favors more labile structures. H3: The increment of the labile structures of the element, increases the extractable quantities by complexation. Copper results: The sum of DTPA, steps 1 to 4, increased from 0.5 to 2 mg kg^{-1} with 30 days of waterlogging in the three soils. The residual fraction of Cu (step 8) was the only one favored by the waterlogging, increasing from 0 to 0.5 mg kg^{-1} in the three soils. The total extracted Cu for the fractionation was 9 and 12 mg kg^{-1}, in Haplustols and Argiustol, respectively. Zinc results: Step DTPA 1 increased from 1 to 2 mg kg^{-1} with waterlogging of 30 days in the three soils, without effect in the DTPA 2 to 4 extracts. The most favored Zn bound fraction due to waterlogging was amorphous oxides of Fe that increased from 1.5 to more than 3 mg kg^{-1} in all soils. The total extracted Zn by the fractionation was 9 and 14 mg kg^{-1} in Haplustols and Argiustol, respectively. Conclusions: Waterlogging favored the release of both metals. This results can explain the symptoms of Zn deficiency diagnosed in times of drought and its disappearance with the rewetting of the soil. The hypotheses can be accepted with caution but should be considered in regional experiments with fertilizers because the increments of Zn and Cu extracted due to waterlogging were important.

Keywords: Mollisols; waterlogging; fractionation; zinc; copper
Financial support: Proyecto SECyT-UNC

(3222 - 1548) Chemical properties of a Red Latosol cultivated under a no-till system and under native semi-deciduous dry forest in the Cerrado.

Diogo Barbosa Silva[1]; Sara Aparecida Guimarães de Souza[1]; Cláudia Fabiana Alves Rezende[1]
UniEVANGÉLICA[1]

The effect of vegetation on the soil can be perceived by comparing the soil properties between areas planted to no-till and forest areas. The objective of this work is to investigate the characteristics that increase

the soil fertility of the Cerrado, evaluating conservationist systems and without anthropic action. Samples were collected in a Red Latosol, clayey texture (44%), in two contiguous areas, 00-0,2 and 0,2-0,4 m, in an area of agricultural experimentation and semi-deciduous dry forest area, both located in UniEVANGÉLICA, Experimental Unit (Latitude 16º19"36' S and Longitude 48º27"10' W). Physical and chemical analyses of both samples were performed to evaluate the fertility of the areas. The introduction of the agricultural system caused a nutritional imbalance modifying the chemical properties of the soil. Conservation management leads to improved soil fertility, but not yet matched fertility in native forest area. At the two observed depths there is a statistical difference for K, Ca, Mg and H+Al. There is a discrepancy of values for MO and P, but no statistical differences were observed. There is a greater accumulation of MO, K, Ca and Mg in the native forest area, which is directly linked to the nutrient cycling promoted by the constant deposition of organic residues on the soil surface. The nutrient that dissociates the observation in the superficial and subsurface layer analysis is the P, in greater concentrations in the agricultural area. This difference may be associated with fertilizer residue. It is observed that MO, in higher concentration in the native forest area, provides higher CTC for the soil. The high base saturation observed indicates that most of the soil CTC is occupied with essential cations (Ca, Mg and K), noting that both native forest soil and agricultural soil are suitable for the correct nutrition of the plants. Soil cultivation with frequent MO additions is the most rational and ecological way of increasing soil fertility, which occurs in conservationist management such as no-tillage system. Soil cultivation under tropical conditions managed in a conservationist way shows an improvement in the chemical conditions, making the fertility of these agricultural areas equip themselves with native forest areas.

Keywords: Soil fertility; conservationist systems; organic matter.
Financial support: UniEVANGÉLICA.

(6362 - 1420) Control of potential acidity in soil with variable load after surface application of micronized correctives

Jasmine Jurich Pillati[1]; Bruna Simone Siqueira[1]; Adriel Ferreira da Fonseca[1]; Jessica Alves dos Santos[1]
State University of Ponta Grossa[1]

Acidity is one of the main constraints to food production in the world. Limestone material is the most commonplace used product to correct soil acidity, but, requiring a long time for adequate control in the soil layer 0-20 cm, in no till system (NT). Consequently, there is a need to search for more efficient alternatives to control soil acidity. Micronized correctives, which has smaller particle size and higher specific surface area when compared to dolomitic limestone (DL), and can react faster in the soil. The objective of this study was to evaluate the pH values over 48 months after the superficial application of liming materials: granulated micronized calcite (CMG), granulated micronized dolomite (DMG) and carbonated suspension (SC) and compare them with the DL. The experiment was installed in Palmeira -PR, on Inceptisol, under NT for more than 15 years. The experimental design was complete randomized blocks in split-plot desing with four replications. Four liming materials were studied in the plots: DL, GMC, DMG and CS. In the subplots, doses were studied aiming to increase the soil base saturation (V) to 50, 70 and 90%, besides to the control treatment. In June 2012 were applied in the soil surface, without incorporation. At 6, 12, 24, 36 and 48 months after superficial application, soil samples from the 0-5, 5-10, 10-20, 20-40, and 40-60 cm layer were collected and taken to the laboratory for determination of pH values. Data were submitted to univariate and multivariate statistical analyzes. The DL was the least corrective to increase pH values at 6 and 12 months. GMC and CS increased pH over 48 months. The special liming materials were more efficient than the DL in reducing the acidity in the superficial layers of the soil until 24 months after they were applied. Micronized correctives can increaase productivity by the need for exploration of new areas.

Keywords: Inceptisol; liming; micronized liming material
Financial support: National Council for Scientific and Technological Development (CNPq); State University of Ponta Grossa (UEPG).

(4894 - 2512) Effect of base fertilization with fertilizers with or without sulfur on the soil and the sugarcane

Marcelo de Almeida Silva[1]; Lucas Almeida de Holanda[2]; Gabriel Henrique Germino[1]; Marcela Cristina Brunelli-Nascentes[1]; Vinicius Ribeiro Arantes[1]; Mariana Peduti Vicentini Sab[1]
Sao Paulo State University - School of Agricultural Sciences[1]; IFMT[2]

The objective of this research was to evaluate the soil chemical and nutritional attributes of sugarcane after base fertilization with different fertilizers enriched or not with sulfur. The experiment was conducted in a commercial area, located in Lençóis Paulista, SP, Brazil, in the 2013/2014 season, in production environment C. A randomized blocks experimental design was used, with six treatments, (1) (07-33-18 + 9% S) + 298 kg ha-1 KCl; (2) (06-25-24 + 9% S) + 100 kg ha^{-1} triple superphosphate + 397 kg ha^{-1} KCl; (3) 09-25-25 + 490 kg ha^{-1} of MAP + 87 kg ha^{-1} of urea + 423 kg ha^{-1} of KCl; (4) 04-20-30 + 320 kg ha^{-1} of MAP + 180 kg ha^{-1} of single superphosphate + 500 kg ha^{-1} of KCl; (5) 05-25-25 + 410 kg ha^{-1} of MAP + 173 kg ha^{-1} of single superphosphate + 417 kg ha^{-1} of KCl and (6) (90-23-18 + 15% S) + 300 kg ha^{-1} KCl, with 4 replicates. All treatments received 58.5 kg ha^{-1} of N, 150 kg ha^{-1} of P_2O_5 and 225 kg ha^{-1} of K_2O. The variety used was RB966928. At the time of harvesting, macro and micronutrient contents were evaluated on leaf, stalk and sheath. In addition, leaf analysis was performed 180 days after sprouting and also soil analysis at the end of the crop cycle. Data were submitted to analysis of variance, complemented with the Tukey test, considered significant when $p < 0.05$. Regarding the soil, treatment 1 differed positively from the others as to CTC, sum of bases and calcium content. The highest values of sulfur and boron content were observed in treatments 1 and 6. Regarding foliar analysis at harvest, there was a higher accumulation of nitrogen in treatments 1 and 6. Higher levels of phosphorus, calcium and copper were observed in the treatment 1. The fertilizer with higher concentration of sulfur provided greater accumulation in the leaves of the nutrients sulfur and manganese. The analysis of the sheath indicated that treatment 1 resulted in higher values of nitrogen, phosphorus and potassium, and treatment 6 in the higher sulfur content. Treatment 2 provided the highest nitrogen content exported by the stalk. Treatments 2 and 6 resulted in higher sulfur and copper contents. Treatments 1 and 6 accumulated higher amounts of iron. The highest amount of zinc was accumulated under the treatment 3. Sulfur-enriched fertilizers provided nutritional gains for the sugarcane crop, maintaining the sum of bases and CTC.

Keywords: *Saccharum* spp., macronutrient, nutrition
Financial support:

(6505 - 1719) Effect of co-inoculation on grain production in Wheat / Soybean succession.

Carolina Fedrigo Coneglian[1]; Marcelo Augusto Batista[1]; Renan de Oliveira Camparoto[1]; Fabricio Linares Mazzi[1]; Bruno Maia Abdo Rahmen Cassim[1]; Rodrigo Sakurada Lima[1]; Marcos Renan Besen[1]; Jessica Caroline Coppo[2]
UEM[1]; [2]

Plant residues left on the soil in succession of crops contribute to the increase of organic matter content, microbiological activity, nutrient availability and grain production. Allied to this, nitrogen fixing bacteria are used for better efficiency in the use of fertilizers. Currently in Brazil

has been used inoculants with Bradyrhizobium japonicum, Azospirillum brasilense and co-noculation with both. In this sense, the objective of this study was to study the effect of co-inoculation on grain production in wheat and soybean succession. The experiment was carried out in Campo Mourão - Paraná - Brazil, in a dystroferric Red Latosol with a very clayey texture. The study was conducted in a randomized complete block design, with 4 treatments, with 5 blocks and 2 replicates, making 40 experimental units of 36.0 m^2 each. The treatments were tested in two production systems, beginning in the wheat harvest and ending in the soybean crop. The inoculants used were the Masterfix L. soybean inoculant (MS) 200 mL/50 kg seed dose in soybean, co-inoculant with Bradyrhizobium japonicum + Azospirillum brasilense (BA) 200 mL ha^{-1} dose in wheat and 200 mL/50 kg seed in soybean and without inoculant (SI). It was sown Tbio Toruk wheat with base fertilization 150 kg ha^{-1} of 16-16-16 and covering 70 kg ha-1 of nitrogen and sowed soybean NA5909 with base fertilization 200 kg ha^{-1} of 02-20-18. The treatments consisted of T1: SI in wheat and MS in soybean, T2: BA in wheat and MS in soybean, T3: SI in wheat and BA in soybean and T4: BA in wheat and BA in soybean. For the statistical analysis were added the average yields of grains and mass of one thousand grains. The collected data were summed and submitted to analysis of variance by the Scott-Knott test (α = 5%) using the statistical program SISVAR (1996). For the sum of the production of grains produced in the wheat and soybean system, no significant statistical differences were observed, with average grain yield for T2 = 9,715,46; T1 = 9,539.91; T3 = 9,526.85 and T4 = 9,333.08 kg ha^{-1}. For the mass sum of a thousand grains no significant statistical differences were also observed, with mean weight for T3 = 183.73; T4 = 183.19; T1 = 183.09 and T2 = 182.09 grams. It was concluded that the co-inoculation in the succession of wheat and soybean did not alter the production of grains and mass of thousand grains produced.
Keywords: Inoculation; Diazotrophic bacteria; Biological fixation of nitrogen.
Financial support: CNPq

(6106 - 3042) Effect of land use change on soil nitrogen availability in northeastern Amazon

Sílvia Fernanda Mardegan[1]; Arianne Flexa de Castro[1]; Manoela Sena Avelar[1]; Richardson Sandro dos Santos Freitas[1]; Fabio Alexandre Oliveira Teixeira Filho[1]
Federal University of Pará[1]

Nitrogen is known as one of the elements that most limit plant productivity in natural ecosystems. Tropical forests are characterized by high nitrogen (N) inputs and cycling, enabling these systems to accumulate and recycle large amounts of N. With their conversion to croplands, a range of effects on soil physical-chemical properties are likely to be expected, reflecting into changes in ecosystem productivity and nutrient availability. Land-use changes may lead to lower soil N cycling rates, which in turn can increase N gaseous losses, increasing the concentration of greenhouse gases in the atmosphere. Here we assessed how land use change affects soil N availability in northeast Amazon. The study was carried out at Agropalma agroindustry complex, Tailândia – PA, Brazil. Soils sampled are typic dystrophic Yellow Argisol, with sandy texture (around 60%), high acidity (pH around 4), and low fertility (cation exchange capacity around 2 $cmol_c\ dm^3$; sum of bases around 19%). We sampled soils (0-10, 10-20, and 20-30 cm), from organic and conventional oil palm (*Elaeis guineensis* Jacq., Araceae) plantation, under palm rows, frond piles, and inter rows. Additionally, we sampled soil at a terra firme forest nearby, which were used as reference. Whether organic or conventional, oil palm plantation had higher soil N content (0.76 ± 0.03 and 0,67 ± 0,02 g kg^{-1}, respectively) than terra firme forest (0.55 ± 0.33 g kg^{-1}). Soil C:N ratios were similar among land use types (around 14). Soil N stocks at both oil palm plantations were around 1 Mg N ha^{-1}, being almost 30% higher than at terra firme forest. When comparing organic and conventional plantations, we observed a rise in soil N stock from superficial layer (0-10 cm) under frond pile at organic plantation. Evidences suggest a similar trend at palm rows and between them. These early findings suggest the importance of organic plantations to increase nitrogen storage in Amazon systems.
Keywords: agroecosystems; nitrogen stock; palm oil plantation; tropical forest
Financial support: Conservation International; Agropalma agroindustry complex

(2513 - 1390) Effect of potassium fertilization different cassava cultivars under tropical conditions

Claudio Hideo Martins da Costa[1]; Rogério Borges de O. Paz[1]; Álvaro Guilherme Oliveira de Melo[1]; Bárbara de Fátima Silva Moura[1]; Letusa Momesso Marques[2]
Universidade Federal de Goiás[1]; Universidade Estadual Paulista[2]

The cassava crop is considered rustic, mainly because it expresses reasonable root production under adverse soil fertility conditions, although the potential of root production and quality of cassava varieties may have better responses in well - managed crop. Thus, potassium is one of the most important nutrients for the growth of cassava plants, by enhancing the development of shoots, carbohydrate and proteins content, as well as improving the use of water. Therefore, with the realease of new materials in the market beyond the study of adaptability, it is necessary to know the potassium requirements for each of them. In this sense, the objective was to evaluate the performance of two new cultivars under different levels of potassium fertilization. The experiment was carried out in Jataí, GO, in a clayey Rhodic Ferralsol. The chemical attributes of the topsoil were: pH 4.6, K of 0.09 $mmol_c\ dm^{-3}$ and base saturation of 37%. The experimental design was a randomized complete block design in a 2x4 factorial scheme, with four replications. The treatments were composed of two cultivars (BRS 396 and BRS 397) and four K rates (0, 30, 60 and 120 kg ha^{-1} K_2O). The cassava was planted in October 2016, using a spacing of 1.00 x 0.80 m at a depth of 0.10 m. The fertilizer used was 20 kg ha^{-1} of N and 50 kg ha^{-1} of P_2O_5, respectively, and for K_2O were used the pre-established rates. The management was performed according to the needs. The harvest was carried out in July 2017. At the time of harvesting, the following variables were evaluated: Fresh and dry shoot production, root yield components, root fresh and dry matter production and partition of assimilates. The cultivars presented similar shoot dry and fresh matter production, differing only in the dry and fresh mass of roots, with higher productivity for the BRS 397 cultivar, about 12% higher, which is associated with higher root production per plant. Potassium fertilization, independently of the cultivar, increased the production of fresh and dry matter of shoots, which provided a linear increase in the number of roots per plant, directly reflecting the root productivity. However, the assimilate partition was not altered by the treatments. Therefore, it is evident that the producers of cassava have not reached all crop potential, since it is a culture considered traditionally rustic, but that is shown highly responsive to potassic fertilization.
Keywords: *Manihot esculenta* Crantz; BRS 396; BRS 397; Fertilization of systems
Financial support:

(4660 - 629) Eucalyptus productivity at 44 months in a coppice system according to the number of shoots per strain and mineral fertilization

Natasha Mirella Inhã Godoi[1]; Marcelo Carvalho Minhoto Teixeira Filho[1]; Salatiér Buzetti[1]; Thiago de Souza Celestrino[1]; Rodolfo de Niro

Gazola[1]; Willian Lima Rodrigues[1]; Jeferson Silva de Souza[1]
Faculdade de Engenharia de Ilha Solteira - Universidade Estadual Paulista[1]

Forest management through shallow cutting and regeneration by sprouting of the strains characterizes the coppice system, presenting the advantage of a high initial growth rate of shoots when compared to the first production cycle. However, despite the apparent advantage, there is a decrease in productivity between the production cycles, attributed to nutrients removal due to the eucalyptus harvest. The objective of this study was to evaluate the eucalyptus productivity as a function of the number of sprouts per strain and doses of mineral fertilizer. The experiment was conducted in Três Lagoas - MS, Brazil, being in an Entisol (orthosic Quartzarenic Neosol), with the definition of shoots in April 2013. The experimental design was a randomized block with 8 treatments and 4 replicates, arranged in a 2x4 factorial scheme, with: one or two shoots per strain in the second cycle; and four doses of mineral fertilizer (0, 50, 100 or 200% of the recommended, equal to 200 kg ha^{-1} of the formula 06-30-06 + 1% Ca + 3% S + 1% Mg + 1.5% Cu + 1% Zn). The planted eucalyptus clone was I-144, spaced 3 x 2.5 m. Each useful plot contained 49 plants and the evaluations of plant height, diameter at breast height (DBH), estimated volume of bark and average annual increment (AAI) of eucalyptus were performed at 44 months after the definition of shoots. The analysis of variance and Tukey test at 5% probability were used to compare mean number of shoots and adjusted to regression equations to analyze the effect of fertilization doses. Eucalyptus with one sprout per strain showed higher plant height and DBH in relation to two sprouts per strain, evidencing the competition among sprouts of the same strain by water, light and nutrients, in relation to the estimated volume of bark there was no difference in the number of shoots per strain. These eucalyptus evaluations were not influenced by the increment of the mineral fertilizer doses, however, it is worth noting that there was an increase of approximately 14% in the estimated volume of wood in the application of the dose of 100% of the fertilization used. The IAA of eucalyptus was 112.3 m^3 ha^{-1} year, and there was no difference in the conduction of one or two shoots per strain, or effect of the increase in mineral fertilizer doses for IMA, even in sandy soil with low fertility. This is due to the nutrients cycling of litter from both the first eucalyptus production cycle and this second productive cycle.

Keywords: Eucalyptus urograndis, average annual incremente, volume of wood, sandy texture soil
Financial support: FAPESP (process number: 2016/11613-1)

(1604 - 2976) Evaluation of calcium absorption by 'yellow' melon with green manure use in the Brazilian semiarid

Acacio Figueiredo Neto[1]; Antonio Pereira Filho[1]; Jose Teixeira Filho[2]; Vanderlise Giongo[3]
Universidade Federal do Vale do São Francisco[1]; Universidade Estadual de Campinas[2]; Empresa Brasileira de Pesquisa Agropecuária - Embrapa Semiárido[3]

In Brazil, melon production is mainly concentrated in Northeast region, where about 95% of the melon is produced. The absorption of large amounts of nutrients in short periods of time is a nutritional characteristic of melon. However, the nutrients extraction by a crop depends on factors related to the growing environment, such as soil type, climate and water management, and internal or plant-related factors, among which we can cite its age and genetic potential. The objective was to evaluate the absorption curve and the calcium contribution by green manure in the development of 'yellow' melon produced in the Brazilian semiarid region. A randomized blocks design, in a split-plot scheme, with four replications, is being used. Plots will be composed by three green manure : natural vegetation, composition 1 (25 % grass / oilseed + 75 % legume) and composition 2 (25 % legume + 75 % grass/oilseed) and two tillage systems with and without plowing. The sampling of melon plants were carried out weekly at 11, 18, 25, 32, 39, 46, 53 and 59 days after transplantation, in a total of 8 samplings. The patterns of nutrient accumulation during the plant growth period followed the time course of dry matter production. The accumulation of nutrients was reduced in the first 18 days after transplantation, with mean values of 4.7 kg ha^{-1} Ca, increased markedly in the following week (25 days after transplantation), flowering period, with mean values of 27.9 kg ha^{-1} Ca and intensifying continuously until the end of life cycle. Composition 1 contributed with the highest amount of Ca to the crop, releasing 139.3 kg ha^{-1} Ca during the melon cycle. The organic residues with a higher proportion of legumes, can meet the demand of Ca for melon up to 39 days after transplantation.

Keywords: cover crop,*Cucumis melo* L.,soil fertility, macronutrient
Financial support: Embrapa Semiárido, CNPq

(1435 - 512) Fate of phosphorus under long-term grazed pasture in New Zealand Leo Condron Lincoln University, Christchurch, 7647, New Zealand (leo.condron@lincoln.ac.nz)

Leo Condron[1]
Lincoln University[1]

The fate of fertilizer phosphorus in intensively managed agroecosytems remains poorly understood. Using a combination of new and historic data, a mass balance approach was used to assess and quantify the impact of over 60 years of different phosphorus fertilizer and irrigation regimen on the spatial distribution and dynamics of phosphorus under grazed pasture. Replicated field plots had received different inputs of superphosphate fertilizer (nil (Control), 188 kg ha^{-1} $year^{-1}$ (188PA), and 376 kg ha^{-1} $year^{-1}$ (376PA)) and irrigation (nil (base average rainfall of 740 mm $year^{-1}$; control), together with flood irrigation applied when gravimetric moisture in the topsoil dropped below 10 or 20% (i.e. rainfall + 260 mm $year^{-1}$ of supplemental irrigation [$irrigation_{10\%GM}$] and rainfall + 770 mm $year^{-1}$ [$irrigation_{20\%GM}$], respectively). Substantial increases in pasture production and animal grazing capacity occurred in response to fertilizer and irrigation inputs, which in turn resulted in increased phosphorus removal and transfer in animal products, animal excreta (stock camp transfer and irrigation outwash) and by leaching. Accumulation of phosphorus in the soil profile to 100 cm was 5.3 kg P ha^{-1} $year^{-1}$ (31% of applied phosphorus) for the 188PA treatment, compared with 21.7 kg P ha^{-1} $year^{-1}$ (64% of applied phosphorus) for the 376PA treatment, while transfer to stock camps and losses by irrigation outwash were estimated as 3.8-4.6 kg P ha^{-1} $year^{-1}$, which represented 19-22% of applied phosphorus. Combined annual phosphorus removal in animal products, internal dung transfer, and loss in irrigation outwash were also directly related to irrigation frequency and increased from 8 to 18.6 kg P ha^{-1} for the $irrigation_{10\%GM}$ and $irrigation_{20\%GM}$ treatments, respectively. These findings emphasize the need to develop strategies to increase utilization of accumulated legacy phosphorus in soil and reduce phosphorus losses in order to improve fertilizer use efficiency in intensive pastoral agroecosystems.

Keywords: phosphorus; fertilizer; grassland; mass balance.
Financial support: Not Applicable

(6426 - 2157) Influence of biofertilizer in the soybean response to phosphorus and potassium fertilization

Adilson Pelá[1]; Lucas Brennon Romão Crispim[1]; Luiz Henrique Barros Cirino[1]; Rafael Umbelino Bento[1]; Ivan Carneiro Custódio[1]

Universidade Estadual de Goiás, Câmpus Ipameri[1]

The soybean (*Glycine max* (L.) Merrill) is one of the main agricultural crops produced in the world. Currently, large amounts of nutrients are applied to soils, with phosphorus and potassium being key elements for increasing or limiting the production of soybeans and other crops. The use of biofertilizers can stimulate the development of the root system, favor the biodiversity of microorganisms and improve the absorption of nutrients from the soil. The objective of this work was to evaluate the influence of biofertilizer on the response to fertilizations with P and K by the soybean crop. The study was carried out in a field in the municipality of Ipameri - GO (17º43'20 "S and 48º09'44" W) and an altitude of 800 m, in Oxisol (Red-Yellow Latosol). The experimental design was a randomized complete block design, in a 2x5 factorial scheme with four replications. The first factor was the presence or absence of the application of the biofertilizer (Bacsol + Orgasol), containing strains of rhizospheric microorganisms; the second factor was the variations in the doses of phosphorus and potassium in the base fertilization, as follows: complete base fertilization T1 - 100% of the doses of P and K; T2 - 0% P + 100% K; T3 – 100% P + 0% K; T4 – 50% P + 50% K; e T5 - Control (0% of P and K). Based on the soil analysis, the full doses (100%) of phosphorus and potassium were 100 kg ha^{-1} of P_2O_5 and 80 kg ha^{-1} of K_2O, using triple superphosphate and potassium chloride as sources. The plot consisted of eight planting lines with 5 m in length, spaced at 0.42 m. The plot area was the four central lines, discarding 0.5 m at each end. In the treatments that were used the biofertilizer (Bacsol + Orgasol) the application was done via seed treatment. Seeding occurred on November 4, 2015 by mechanical means (Precision Seeder) in order to obtain a population density of 260,000 plants ha^{-1} of the variety Monsoy 7739 IPRO. Plant height and number of pods per plant were not influenced by treatments. The mass of a thousand grains was higher with the biofertilizer only when the fertilization with P and K was integral. Without fertilization with P and K or with only half of the adequate doses of these nutrients, better results were verified when the biofertilizer was used. Phosphorus was the nutrient that most limited soybean yield. The use of the biofertilizer allowed good yields even when no sowing fertilization was used, or when only 50% of the P and K were used.

Keywords: *Glycine max*; nutrients; rhizospheric microorganisms.
Financial support:

(9682 - 2518) Influence of proportion and source of potassium fertilizers on soybean yield

Marcelo de Almeida Silva[1]; Marcela Cristina Brunelli-Nascentes[1]; Vinicius Ribeiro Arantes[1]; Mariana Peduti Vicentini Sab[1]; Renan Fonseca Nascentes[1]; Mirela Mayumi Nagaoka[1]
Sao Paulo State University - School of Agricultural Sciences, 1780 Jose Barbosa de Barros St, Botucatu, 18.610-307, Brazil[1]

The objective of this research was to evaluate the influence of the proportion and the source of potassic fertilizers, double magnesium and potassium sulfate ($KMgSO_4$) and potassium chloride (KCl), in soybean production components and yield. The experiment was developed at the School of Agricultural Sciences (FCA/UNESP), in Botucatu, SP, Brazil, in the 2014-2015 and 2015-2016 seasons, in a red dystroferric nitosol. A randomized blocks experimental design was used, with five treatments, which received 200 kg ha^{-1} of the formulated 09-46-00 in the base fertilization: (1) 100% KCl; (2) 75% KCl + 25% $KMgSO_4$; (3) 50% KCl + 50% $KMgSO_4$; (4) 25% KCl + 75% $KMgSO_4$ and (5) 100% $KMgSO_4$, all applied after sowing, before the germination, with 4 replicates. The cultivar used was BMX TURBO RR with density of 18 plants m^{-1}. The evaluations of chlorophyll content, SPAD index and GreenSeeker were performed in the V3, V5 and R3 stages at the first season. In the season 2015-2016 the chlorophyll content and the leaf area index were evaluated in the V4, V5 and V7 stages. Plant height, first pod insertion height, number of branches, number of pods in the branches, number of pods in the main branch, main branch diameter, weight of 100 grains and productivity were evaluated at harvest time. Data were submitted to analysis of variance, complemented with the Tukey test, considered significant when $p < 0.05$. In the experiment of the 2014-2015 season, the highest SPAD index in the V3 stage was verified in the treatment 75% KCl + 25% $KMgSO_4$, whereas in the 100% KCl treatment the lowest one was observed. In the V5 stage, the 100% KCl treatment caused the lowest SPAD index and GreenSeeker, while the lowest values of chlorophyll *a* and *a + b* were verified in the 50% KCl + 50% $KMgSO_4$ treatment. Also, the 100% KCl treatment provided the lowest leaf area and leaf area index, while the highest averages were in the treatment 75% KCl + 25% $KMgSO_4$. The first pod insertion height was higher in the 100% KCl treatment. The highest yields were verified in the treatments 75% KCl + 25% $KMgSO_4$ and 100% $KMgSO_4$, a result that was repeated in the second season with a 14% increase over the 100% KCl treatment. The treatments with $KMgSO_4$ provided higher grain yield, which was influenced by some variables, such as the SPAD index and GreenSeeker in the vegetative stages.

Keywords: *Glycine max* L.; potassium chloride; double magnesium and potassium sulfate
Financial support: Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – CAPES

(9944 - 1201) Influence of soil management and depth on pH, Al and organic matter

Patricia Rojas Nerhot[1]; Daisy Leticia Ramirez Monzon[1]; Arnulfo Encina Rojas[1]; Jimmy Walter Rasche Alvarez[2]
Facultad de Ingenieria Agronomica. Universidad Nacional del Este.Paraguay[1]; Facultad de Ingenieria Agronomica. Universidad Nacional del Este. Paraguay[2]

Alto Paraná soils are formed from basaltic igneous rocks, having as main characteristics the high content of clays, iron oxide and aluminum, has a fertility classified between medium to high, pH acid to slightly acidic and high aluminum contents causing a chemical degradation, this last factor being considered as a problem for the farmers of the region, since they have variations according to the soil depths and management, considering this, the research goal was to observe and analyze the relationships between Al^{+3}, pH; organic matter, clays in different ways and depths. The sampling was carried out in the Minga Guazú-Paraguay District, with an area of 489.5 km^2 in four managements; forest, direct seeding, conventional system and pastures, each one at six depths of 0-5, 5-15, 15-30, 30-60, 60-100 and 100-150cm, totaling 216 samples, of a stratified random sampling. The samples were analyzed in the Soil Laboratory of the Facultad de Ingeniería Agronómica in the Universidad Nacional del Este. In the results was observed that the forests pH appeared low, with Al^{+3} in toxic form and high content of organic matter. Al^{+3} levels increased from 30cm depth. On the surface (0-5 cm) the organic matter appeared high, with a low pH. The correlation data were negative between Al^{+3} and organic matter, inversely proportional relationships were also found between pH and Al^{+3}; however, a positive relationship between clay and Al^{+3} was observed according to the *Spearman* analysis. Clay soils such as Oxisols have high Al^{+3} content related to soil formation. Management that involve less soil removal and higher organic matter content can reduce the toxic effect of exchangeable acidity.

Keywords: Oxisols, Minga Guazú, clay

Financial support: Facultad de Ingenieria Agronomica. Universidad Nacional del Este. Paraguay

(5489 - 736) Investigating polyhalite nutrient movement through soil profiles

Timothy D Lewis[1]; Paul D. Hallett[2]; Graeme I Paton[2]; Luke Harrold[2]
Sirius Minerals[1]; University of Aberdeen[2]

Polyhalite ($K_2SO_4.MgSO_4.2CaSO_4.2H_2O$) is increasingly becoming of interest as a fertiliser with the discovery of the world's largest resource of over 2.5 billion tonnes in North Yorkshire, UK. Important to understanding the agronomic performance of polyhalite is the movement of nutrient through the soil profile over several years. This study uses leaching columns to investigate how the equivalent of several years of leaching affects the movement of nutrients (K, Ca, Mg and S) through an arable, sandy loam soil. The treatments evaluated were: (1) 0 kg ha^{-1} polyhalite, (2) 711 kg ha^{-1} polyhalite powder, (3) 711 kg ha^{-1} polyhalite granules and (4) and 166 kg ha^{-1} potassium chloride. Treatments 2 – 4 represent an application of 100 kg K_2O ha^{-1}. Columns were saturated and a flow rate of 100 mm hr^{-1} was maintained until 4500 mm had been leached through the sample (equivalent to five years UK average rainfall). Leachate analysis showed polyhalite granules yielded greater release of potassium, calcium, magnesium and sulphur than polyhalite powder and potassium chloride over the five-year period. Differences between treatments are likely due to the availability of nutrients from the fertiliser and the subsequent ionic interactions with soil clays. The results suggest that polyhalite provides a viable alternative K fertiliser, with potential added benefits of Ca and Mg.

Keywords: polyhalite, nutrient movement, fertilizer
Financial support:

(3706 - 306) K management strategies to achieve K balance in sandy soils of South central coastal Vietnam

Hoang Thi Thai Hoa[1]; Do Thanh Nhan[2]; Surender Mann[3]; Richard W. Bell[3]
University of Agriculture and Forestry, Hue University, Hue city, Vietnam[1]; Agricultural Science Institute for SCC Vietnam, Quy Nhon, Vietnam[2]; Murdoch University, Perth, Western Australia[3]

Sands are common in Southeast Asia where intense wet season rainfall and irrigation increase the risk of nutrient leaching. Irrigated peanut productivity on the sands in south-central coastal Vietnam can be increased by K fertilizer but the optimum rate for sustainable production has not been determined. The aim of this study, conducted from 2015 – 2016 on two sands in Phu Cat district, Binh Dinh province, Vietnam, was to determine the effects of different K management practices on soil K balance under irrigated peanut crops and to propose the best management practice for K management to increase peanut yield and optimize soil K balance. Peanut yields were the highest at 100 kg K/ha with 19 – 22% increase compared to control. In all three experiments, K outputs always exceeded K inputs resulting in negative soil K balance (from -33 to -110 kg K/ha) even at the highest K rate applied (75 - 100 kg K/ha). At 100 kg K/ha fertilizer application, soil K balance were less negative than the control from -13 to 6 kg K/ha (with added KCl) and -24 to 1 kg K/ha (with added K_2SO_4). Both 8 tons of farm yard manure and 10 tons of rice husk biochar/ha, decreased the negative soil K balance with 50 kg K as fertilizer/ha but did not eliminate it. In the peanut cropping system, K losses occur out of the fields mainly due to removal of crop residues (for animal feed) and leaching. Negative balances at field level in the long term will limit crop yields on deep sands. On-farm recycling of nutrients, especially from organic sources and using slow release K fertilizer are proposed for sustainable farming systems on deep sands. Further work is examining S balance in these cropping systems also.

Keywords: K balance, management practices, peanut, sandy soil
Financial support: ACIAR, Project Number: SMCN/2012/069

(2982 - 3233) Making fertilizer practices efficient using polyhalite

Robert Meakin[1]; Kiran Pavuluri[1]; Kwadjo Ahodo Timothy D Lewis[1]; Lino Furia[1]
Sirius Mineral[1]

Inappropriate application of nitrogen has resulted environmental impacts that has led to strict environmental regulation in Europe and elsewhere. Similarly, phosphorus impacts the environment by entering waterways, as a result of soil erosion, causing eutrophication. In England alone, 60% of nitrates and 25% of phosphates originate from agricultural land. At the same time, farmers need to increase yields to be able to feed a world population of 9.8 billion by 2050 whilst being environmentally responsible. Therefore, farmers need to explore new efficient fertilizer practices to adopt. The recent discovery of the world's largest deposit of polyhalite ($K_2SO_4.MgSO_4.2CaSO_4.2H_2O$) has raised interest in the mineral being used as a multi-nutrient fertilizer. Validation of polyhalite as an efficient fertilizer source required an extensive research programme to be commissioned that consists of over 260 trials on 32 crops in 17 different countries. This presentation will focus on presenting global findings from this extensive research programme on globally important crops. Trial results have shown that inclusion of polyhalite into fertilizer plans can increase yields and improve post-harvest soil fertility compared to current practices. The research also highlights that fertilizer plans using polyhalite can be more efficient with improved nutrient uptake for nitrogen, phosphorus, potassium, calcium, magnesium and sulphur.

Keywords: polyhalite, fertilizer use efficiency
Financial support:

(1648 - 2455) Management of the phosphate fertilization of soils with different textures under continuous cultivation of sugarcane in Brazil

Daniela Batista da Costa[1]; Fernando José Freire[2]; Suellen Roberta Vasconcelos da Silva[2]; Janyelle de Oliveira Lemos[2]; Nathalia Sobral Bezerra[2]
UFPB[1]; UFRPE[2]

Phosphate fertilization has been the main management responsible for increasing the productivity of sugarcane in tropical soils, because of the low levels of P in these soils and predominance of clay minerals that intensify P adsorption process. Thus, this research aimed to evaluate P availability in soils with different texture after phosphate fertilization in two crop cycles of the sugarcane and its effects in agricultural productivity. The research was developed in Northeast of Brazil in ultisols of texture clayey ($PVAd_2$), loamy sand (PADx) and sandy ($PVAd_1$). The experimental design was a randomized complete block with four replications, applying the following doses in first crop cycle (plant cane): 0; 40; 80; 120; 160 and 200 kg ha^{-1} of P_2O_5 and 0 and 40 kg ha^{-1} of P_2O_5 in second crop cycle (ratoon), using triple superphosphate as source of P. Its availability was estimated by melich-1 (M1) and anion exchange resin (AER). P contents extracted increased for both solutions, however the extracted rate depended of the soil characteristics, especially with regard to mineralogy, when the solutions was M1. There were evidences that increasing P doses was benefic to sugarcane productivity in both crop cycles for all soils, above all to PDAx in the ratoon, because of its initial higher P content and its lower P fixation capacity, suggesting that the soil has a longer residual effect. Thus, P availability depended of the chemical, physical and mineralogical properties of the soils, but P absorption by plants

might be optimized with the phosphate fertilization also in ratoon, especially on lower buffer capacity soils.
Keywords: Phosphorus availability; sugarcane; productivity.
Financial support: CNPq, FACEPE and CAPES.

(7399 - 1538) Mineral footprint of extensive agriculture in Buenos Aires province in the processes of soil acidification

Miriam E. Presutti[1]; Mirta G. García[1]
FCAyF-UNLP[1]

In Buenos Aires, the area allocated to extensive agriculture has been increasing in recent decades to the detriment of mixed systems. Grasses have been replaced with others crops of greater economic attractiveness, like the soybean, that combines its cycle with the wheat, allowing two harvests in the year. This causes a high extraction of nutrients that are not replaced in the same magnitude, generating soil degradation, such as acidification. In this work, two indicators were applied, Mineral Footprint (MF) and Mineral Exports Efficiency Index (MEEI) of the base cations. The MF accounts for the export levels of minerals, the amounts of nutrients contained in the grains produced. The MEEI relates the level of export of nutrients and the physical production of the set of crops in a region, is a measure of efficiency of production processes, the higher the value the lower the efficiency because more minerals are used to produce it. Data on harvested area (ha), production (t) and yield (kg ha^{-1}) per municipality were analyzed for 47 agricultural seasons from 1969/70 to 2015/16, for the main crops: wheat, corn, soybean and sunflower. The data were split into 5 decades, calculating the mean yield of each crop by summing the production divided by the sum of the harvested area in the same period. The MF/ha was determined, that is, the quantities extracted by the harvested grains of the basic cations Ca, Mg and K, expressed in kg ha^{-1}. Maps were generated to determine the spatial distributions of those extractions and therefore the vulnerability to acidification. The extractions in t for each decade of each nutrient were calculated multiplying the MF/ha by the harvested area. Summing all the municipalities the total MF for each crop and for each decade were obtained. The results indicate that 9.36 million tons of basic nutrients were extracted, in the 47 seasons for the 4 crops, corresponding 10% for Ca, 21% for Mg and 69% for K. Similar proportion is observed in all decades, although they are exponentially increasing. The soybean, in all periods, except the first one, was the crop with the highest total MF, leading to the extraction of 80% of Ca and K and 64% of Mg. Regarding the MEEI, they remained constant in all the periods for each crop; soy being the one that shows higher values: 0.26, 0.3 and 1.64 for Ca, Mg and K respectively; corn is the crop that showed the minimum values, being the most efficient; the values were 0.02, 0.14 and 0.34 for Ca, Mg and K.
Keywords: degradation, base cations, agriculture, sustainability
Financial support:

(9370 - 1613) Nitrogen use efficiency associated with molybdenum

Lílian Angélica Moreira[1]; Geovânia Morais de Rezende[1]; Italo Kaye Pinho de Faria[1]; Edson Pereira da Mota[1]; Rafael Otto[1]
ESALQ/USP[1]

Maize is the most produced cereal in the world exceeding 1 billion tons. Nitrogen (N), among other nutrients, is the one that can more easily result in significant increases in yield. Among the micronutrients, molybdenum (Mo) is responsibility for nitrate reductase and consequently influence N use efficiency. In this way, a synergistic effect between Mo and N is observed, due to the Mo attend in N metabolism. The aim of this author was to evaluate the foliar Mo application in the efficiency of N fertilization and yield of second season maize. An experiment in an agricultural area located in the city of Uberlândia - MG (latitude 19º11'16,60" S, longitude 48º0'16,64"' W and altitude of 700 m). The climate of the region is classified as Cwa. The experiment was installed on February 23, 2017, after soybean crop harvesting, following the "out of season" maize (second season). The hybrid used was AS1633, VT PRO 3 technology. The plant population adopted was 56,000 plants ha^{-1}, spacing 0.5 m between rows. It was adopted a randomized block experimental design, with four replications, in a 4 x 2 factorial scheme, represented by four N rates (check plot, 60, 90 and 120 kg ha^{-1}), and two treatments of Mo supply (without Mo supply and foliar application of 55 g ha^{-1}). Treatments were applied at the V6 phenological stage of the crop. The maize harvest was performed on July 24, 2017. Analyzing the set of variables, it was found statistical differentiation for leaf Mo content regardless of the N rates applied (LSD, $P < 0.01$). The N rates influenced protein content (LSD, $P = 0.086$) and yield (LSD, $P = 0.067$) regardless of the Mo supply. The absence for interaction between Mo and N is explained by the N content in leaf, which evidenced this not to be a limiting factor; also the Mo dose applied may have been low. Although the Mo content has increased this was not responsible for increasing N use efficiency due the absence of yield gain under Mo application. The protein content in the grain had linear increase with yield gain, possibly because N rates. Second season maize showed response to N fertilization regardless of foliar Mo supply. Foliar Mo application at the V6 stage increased Mo foliar content to all N rates. However, under the conditions of this study, foliar Mo application was not useful in increasing N use efficiency.
Keywords: Maize; Urea; Foliar application; Mo leaf content; Zea mays
Financial support: CAPES

(8821 - 1084) Nutritional characteristics of commercial organic fertilizers circulated in Korea

Seok-Cheol Kim[1]; Myung-Sook Kim[1]; Seong-Jin Park[1]; Chang-Hoon Lee[1]
NIAS[1]

The total content of nitrogen, phosphate, potash are important factors to determine the application amount of the organic fertilizers for agricultural lands. The concentration of nutrient, organic matter, salt, water, heavy metal in mixed perilla cakes and mixed organic fertilizers in circulation were investigated with 141 and 179, respectively. The mean contents of total nitrogen, total phosphate, and total potash in organic fertilizers of 2015~2017 years were 4.9%, 2.8%, 1.7%, respectively. The mean concentration of total potash was increased more 1.3 times than that of 2009~2010 years. The average contents of organic matter, salt, and water were 77%, 11.5%, and 0.26%, in mixed perilla cakes, and 72.2%, 11.7%, 0.49% in mixed organic fertilizer, respectively. The maximum concentrations of Cr, Cu, Ni, and Zn were found to be in accordance with the official standard of commercial fertilizer. On the other hand, in order to promote balanced nutrient absorption of crops, it is necessary to increase the content of the organic fertilizers having the lowest concentration of total potash
Keywords: Organic fertilizers, Mixed oil cake, Mixed organic fertilizer, Nutrient content, Official standard of commercial fertilizer
Financial support: This study was conducted by support of NAS research and development project(PJ01262303)

(6936 - 1699) Perspectives of using Infrared and X-ray fluorescence sensor technology in a Hungarian soil testing and in nutrient management services

Viktória Vona[1]; Csaba Centeri[2]; Renátó Kalocsai[1]; Attila József Kovács[1]; Márton Vona[3]; Peter van Erp[4]
Széchenyi István University Hungary, Faculty of Agricultural and Food Sciences, Department of Biosystems and Food Engineering[1]; Szent István Ubiversity, Faculty of Agricultural and Environmental Sciences, Institute if Nature Conservation and Landscape Management[2];

Csernozjom Lp.[3]; Soil Cares[4]

The soil fertility status of agricultural land in Hungary is under pressure and there is a need for proper soil nutrient management strategies. Such strategies should be based on information of the actual soil fertility status. Since traditional soil testing is time consuming and expensive, there is a need for techniques and instruments that allow rapid, affordable and precise routine soil testing. Five years ago SoilCares Research started a research program focusing on the development and implementation of a quick, precise and affordable soil quality testing method using Infrared and X-ray fluorescence (XRF) sensor technology. One of the major challenges of such a concept is the derivation of reliable prediction models linking sensor spectra to traditional wet chemistry data. Together with SoilCares a calibration and validation study has been started in Hungary in 2017. In total 550 soil samples have been taken representing Hungarian agricultural lands. These samples have been analysed at the calibration laboratory of SoilCares to determine the MIR and XRF spectra and about 90 soil parameters. Moreover 100 samples have been analysed at a local Hungarian laboratory to find relationships between results of Hungarian soil testing methods and SoilCares testing methods. In this paper the first results will be presented of the calibration and conversion study and the perspectives of the SoilCares concept of using MIR/XRF for routine soil testing will be discussed. There are certain soil parameters that correlate very well between soluble based and MIR/XRF based measurements and there are parameters from the Hungarian soils that tremendously reduce the similarity if the old and new methods, reducing the goodness of correlation tremendously. We can conclude that the XRF technology is a very good alternative of the old, soluble based technology, however the reginal validation is a must.

Keywords: soil fertility, advanced soil analyses, remotely sensed data
Financial support:

(9350 - 3151) Potassium, calcium and magnesium contents as a function of rotation crops and cover crops under no-tillage system in Cerrado soil

Hugo Henrique Andrade Meneghette[1]; Raul Sobrinho Pivetta[1]; Edson Lazarini[1]; João Willian Bossolani[1]; Izabela Rodrigues Sanches[1]
Faculdade de Engenharia/UNESP – Campus de Ilha Solteira[1]

The Direct Planting System (DPS) is a rational way of cultivating, by attenuating problems of nutrient losses and recommending the maintenance of straw on the soil and crop rotation is one of the basic conditions for the sustainability of the system. The objective of this work was to verify the effects of no - tillage 15 years after its establishment and rotational or single crop in succession to cover crops (CC), on Ca, Mg and K contents in the soil, in Cerrado region. The experiment started in October 1999. The experimental design was a randomized block, with treatments arranged in subdivided plots. The treatments were constituted by monoculture of corn or rotated with soybean. The plots were subdivided with the CC, sown in the spring (*Crotalaria spectabilis*, *Pennisetum glaucum*, *C. juncea* and *Panicum miliaceum*), in addition to a fallow area. The levels of calcium (Ca), magnesium (Mg) and potassium (K) of the soil in the 0-0.10 m and 0.10-0.20 m layers were evaluated. Statistical analyzes of the data were performed by SISVAR software. Soil management in DPS, associated with crop rotation, provided significant changes in the attributes of the arable layer of the soil. There was a significant interaction between management and CC for the attributes under study. Note the contribution of corn crop management, after the establishment of the DPS, where straw residues on the soil as well as the straw contribution conferred by the CC, exerted a great influence on the evaluated attributes. The areas managed with either corn rotated with soybean or monoculture, presented higher levels of K in the soil when *C. spectabilis* was used. The Ca contents of the studied strains were positively influenced by CC cultivation only in the area under monoculture. The same behavior was not observed for the area with rotated corn, where the Ca content of the fallow area did not differ from the CC areas. In the treatment with *Pennisetum glaucum*, the contents of Ca were the lowest among the CCs, being higher in the monoculture. For Mg, CCs in the area submitted to monoculture had higher values in relation to the fallow area, differing only for *C. spectabilis*. The contents found are between medium (5 to 8 $mmol_c$ dm^{-3}) to high (> 8 $mmol_c$ dm^{-3}). Crop rotation between corn and soybean, with CC sown in spring, promoted a better balance of soil chemical attributes studied.

Keywords: Soil fertility, *Glycine max,* Covering plants, *Zea mays.*
Financial support: Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES)

(3643 - 1464) Poultry litter applications and cropping sequences drive dynamic soil properties and soil diversity under no-tillage

Amanda Ashworth[1]; Fred Allen[2]; Phillip Owens[3]; Jennifer DeBruyn[4]; Carl Sams[2]
USDA-ARS, Poultry Production and Product Safety Research Unit[1]; University of Tennessee, Plant Sciences Department[2]; USDA-ARS, Dale Bumpers Small Farms Research Center[3]; University of Tennessee, Department of Biosystems Engineering and Soil Science[4]

Dynamic soil physiochemical interactions with conservation agricultural practices and soil biota are largely unknown. Therefore, this study aims to quantify long-term (12-yr) impacts of cover crops, poultry litter, crop rotations, and conservation tillage and their interactions on soil physiochemical properties, and determine their relationships with nutrient cycling, crop yield, and soil biodiversity (soil microbial and earthworm communities). Main effects were 13 different cropping sequences of soybean (*Glycine max*), corn (*Zea mays*), and cotton (*Gossypium hirsutum*) at the Research and Education Center at Milan, TN, and 8 sequences of corn and soybean at the Middle Tennessee Research and Education Center, Spring Hill, TN. Sequences were repeated in 4-yr phases from 2002 to 2014. Split-block cover crop treatments consisted of winter wheat (*Triticum aestivum*), hairy vetch (*Vicia villosa*), poultry litter, and a fallow control. Soil carbon and nutrient fluxes were calculated at surface (0-5 cm) and sub-surface (5-15 cm) during years 0, 2, 4, 8 and 12. After 12 years of cropping systems, weighted means (0-15 cm) of soil pH, P, K, Ca, Mg, total N and C were greatest under poultry litter amended soils compared to cover crops (P<0.05). In addition, continuous corn sequences resulted in greatest soil K, N, and C concentrations, compared to soybean-soybean-corn-corn rotations (P<0.05). Poultry litter treatments were positively correlated to greater soil physiochemical levels, as well as higher crop yield and soil biodiversity. These results underscore linkages between manure additions and cropping sequences, within the nutrient cycling, soil health, and crop health and production continuum.

Keywords: manure amendments; cover crops; cropping sequence; no-tillage; soil biodiversity; One Health Initiative.
Financial support:

(4484 - 3015) Response of corn hybrids genotypes to two different levels of soil fertility

Anna Carla Lima Villela[1]; Adilson de Oliveira Junior[2]
Agronomic Institute of Parana, Km 375, Celso Garcia Road, Londrina, 86057-902, Brazil (anna.carla.villela@gmail.com)[1]; Embrapa Soybean, Carlos Joao Strass Road, Londrina, 86001-970, Brazil[2]

Parana is one of the greatest producers of second corn crop in Brazil, which is grown after soybean crop and is commonly cultivated under minor fertilization conditions than the main crop. For this reason, in order to evaluate corn hybrids genotypes response to soil acidity and

fertilization management, eight genotypes were grown in two different levels of soil fertility divided into a limed and an acidic area. The corn hybrids used in this study were DKB 330 PRO2, Biomatrix 709 VT PRO 2, 2B 655 PW, SYN 7205, AG 7098, Syngenta Impacto, P30F35 and 30A91PW. The experiment was sowed in March 2017, at Embrapa Soybean experimental farm, in Londrina, Parana in an eutrophic Red Latosol. The high fertility plots were fertilized at the base of 20 Kg de N.ha^{-1}, 50 Kg de P_2O_5.ha $^{-1}$, 50 Kg.ha $^{-1}$ de K_2O at the sowing while the low fertility area was not fertilized. At the vegetative stage V4, both areas were top dressing fertilized with 50 kg of N.ha^{-1} in the high fertility plot and 70 kg of N.ha^{-1} in the acid plot. The corn hybrids were classidied by their efficiency and responsiveness to soil correction and fertilization, using the quadrants defined from the average yields of corn hybrids genotypes in low and high fertility areas. In conclusion among the genotypes, the hybrid 30A91PW was classified as responsible and efficient, due to the average yield was higher in low and high fertility areas; the hybrids, Biomatrix 709 VT PRO 2, Syngenta Impacto, P30F35 were classified as responsive and the genotypes 2B 655 PW and AG 7098 were classified as efficient. Due to lower average yield among the genotypes used in this study, the hybrids DKB 330 PRO2 and SYN 7205 were inefficient and not responsive.

Keywords: Efficient use of fertilizers; *Zea mays*
Financial support: The authors would like acknowledge CAPES for the financial support.

(3951 - 3143) Response of sugarcane (*Saccharum officinarum* L.) RB92579 under increasing levels of manganese cultivated in sandy soil of the Coastal Tablelands of the Brazilian Northeastern.

Antonio Eduardo Freire Damasceno[1]; Wildson de Morais Silva[1]; Emídio Cantídio Almeida de Oliveira[1]; Amanda Michele Santos de Lima[1]
Universidade Federal Rural de Pernambuco[1]

Sandy soils are limited soils regarding nutrient availability due to its low cation exchange capacity and high loss of added elements via leaching. Manganese is a limiting micronutrient in the sugarcane production areas of the northeastern region, where the crop has presented symptoms of nutritional deficiency. The application of humic substances to chelate the nutrients is a management option to reduce leaching losses. Thus, this work aims to evaluate the effect of increasing levels of manganese in the soil and in the nutrition of sugarcane plants. The experiment took place in a sugarcane field with the RB92579 (a sugarcane variety) under five levels of manganese (0; 2,5; 5; 7; 9 kg ha^{-1}), with and without humic substances distributed in a statistical arrangement of randomized blocks, with four replications, in a 2x5 factorial design. Soil samples were collected before and 30 days after applying the fertilizers in order to quantify the levels of micronutrients recovered by the soil. A biometric analysis (height, stem diameter, number of tillers and plant biomass) as well as an indirect measurement of chlorophyll content by using a chlorophyll meter on the leave 3+ (SPAD index) were made 120 days after applying the fertilizers. The increase of the manganese dose showed a positive linear correlation with the levels recovered by the soil, the biometric parameters and the chlorophyll content. The use of humic substances was more efficient in soil nutrient recovery and resulted in higher SPAD indices. For the biometric parameters the increasing levels reflected in an increase of biomass for the treatments without humic substances. In the treatments with humic substances it was possible to obtain the maximum agronomic efficiency dose of 5 kg ha-1.

Keywords: SPAD index, Quelatization; Fertilizer efficiency.
Financial support: Fertilizantes Heringer

(5567 - 2502) Rock dust as part of the world's fertilizer mix

David Manning[1]; Suzi Theodoro[2]
Newcastle University[1]; Universidade de Brasília[2]

Crushed and milled silicate rocks have a long history as potential sources of nutrients required for plant nutrition. Their effectiveness depends essentially on the mineralogical composition of the soil. In the north, with soils dominated by glacial till parent materials, it can be difficult to show their value. In deeply leached tropical soils, dominated by oxide and hydroxide minerals, both theory and practice demonstrate that addition of silicate rocks provides an alternative to conventional chemical fertilizers, especially where these are inaccessible on the grounds of cost or poor infrastructure for import and internal distribution. Through the Rochagem movement, Brazil has led the way in bringing the use of rock dust into practice, with recent changes in federal law and regulations (Law No. 12,890/2013; Decree No. 8,384/2014 and Normative Instruction No. 05/2016). There is now a clear definition of rock dust, and NI 05/2016 sets out standards that materials should meet. Thus these materials can now be used within a strong regulatory framework to provide crop nutrients. It is vital that this approach is extended to other countries with deeply leached tropical soils, especially in Africa. According to FAO figures, current use of conventional fertilisers in Africa is a tenth of what would be expected if nutrient balance was achieved, for the current population of 1 billion people. In these circumstances it is very difficult to see how African soils will feed 2 billion people by 2050. Amongst other innovations, the development of polyhalite as a multi-nutrient crushed rock fertiliser, especially in the UK, is an example of a major change in the fertilizer industry. Delivering K, Ca, Mg and S, polyhalite will be produced from two deep mines, one of which is designed to have a capacity equivalent to Canada's current potash production. Parallel innovation in Brazil involves planning for the large scale exploitation of potassium feldspar, in the form of syenite, on a scale sufficient to significantly reduce dependency on imports. These developments reinforce the need for a thorough understanding of the fundamental processes which allow silicate and other minerals to decompose in soils of different types, so that appropriate fertilizer choice can be based on sound science.

Keywords: rockdust, rochagem, fertilizer, syenite
Financial support: Newcastle University

(1131 - 268) Selenium bioavailabiliy in soils from Jequitinhonha Valley

Vico Mendes Pereira Lima[1]; Roberta Pereira Matos[1]; Ricardo de Matos Silva[1]; Matheus Gobira Lacerda[1]
IFNMG[1]

Selenium (Se) is a micronutrient of great interest due to the narrow range between the essential and toxic levels. Most of the selenium ingested by animals and humans is from the soil, where plants and vegetables absorb this element. In this study, 12 class of soils were collected (horizons A and B) from the Jequitinhonha Valley, Minas Gerais state, Brazil. Total Se concentration in these soils was determined by hydride generation atomic absorption spectrometry (HG AAS). Physicochemical characteristics of soils, such as sand, silt, clay, pH, organic matter and oxides of Al, Fe and Si were determined. Se concentration ranged from <0.30 ± 0.03 to 5.97 ± 0.2 mg kg^{-1}. The average Se concentration in the A horizon was 1.09 ± 0.72 mg kg-1, while in the B horizon the average was 1.63 ± 1.63 mg kg^{-1}. For most soils, no significant differences in the concentration of Se between the horizons of the same class were observed. The physicochemical characteristics were correlated with the Se content in the soils using Pearson's correlation coefficient and principal component analysis (PCA). The natural concentrations of selenium total in the soil samples studied are in agreement with data reported in the literature for Brazilian soils. Among the soils, Spodosol showed highest content, but selenium was found in a very deep layer, meaning it is not readily

available. In Latosols (both red and red-yellow), significant quantities were found in the surface layers, which may be available to the plants. However, weathered soils with high concentrations of Fe and Al oxides in the clay fraction can adsorb selenite, reducing its availability to plants. For most soils, we observed a significant difference in Se concentration between the two horizons of the same profile. In general, selenium is associated with the clay fraction, which is more related to oxides of Al than iron oxides. Furthermore, the organic matter content may have influenced the characteristics of some soils. Although pH does not appear to be a correlation factor, we believe that low pH of the soil may have contributed to adsorption of selenium anions in some soils. The integrated assessment of characteristics of a group of heterogeneous samples with use of chemometric techniques such as PCA and HCA enabled a better understanding of the correlation between the concentration of Se and the physicochemical characteristics of the soil samples, as well as the correlation between soils.

Keywords: Selenium, soils, HG AAS, PCA
Financial support: IFNMG, CNPq and FAPEMIG

(7887 - 2546) Sugar cane yield by crop removal of nutrients from the field

Eduardo Renato Moreto[1]; José Marcos Garrido Beraldo[1]
Instituto Federal de São Paulo[1]

The choice sugarcane variety is one of the most important steps in the productive process, which sustains the permanence of the plant in the field reducing the cost of production and and influences the renewal of sugarcane. The variety RB 928064 stands out due to its lower retention of water, favoring regions that present water deficit at some times of the year. Despite being cultivated in production environments with high fertility and water availability, to obtain a yield response is the need availability soil nutrient and acidity. In conditions of low fertility, a low response in yield crops is expected, which can cause the farmer proceed with the renewal of the sugarcane early, raising the cost of production. The objective of this work was to evaluate the yield sugarcane of the variety RB 928064, cultivated in soil under no nutritional replacement. The research was conducted in an experimental area under Oxissol. The experimental plot consisted of four rows of 12.0 m in length with spacing of 1.5 m. The seedlings already sprouted of the variety RB 928064 have been used. No correction of soil and fertilization of plan was carried out. The harvest was taken manually in November 2015 and March 2016, where the dry matter production was evaluated. From the dry matter production, sugar cane yield was calculated. It was observed an extraction of the nutrient contents of the soil, due to non-replenishment by liming and fertilization. Soil organic matter contents did not change throughout the crop. Phosphorus and potassium content in the soil decreased. The calcium and magnesium contents decreased during the cultivation, but no nutritional deficiencies were observed. The dry matter production ranged from 589.68 kg in the 2015 harvest to 286.15 kg in the 2016 harvest. The Sugar cane yield ranged from 81.90 Mg ha^{-1} to 39.74 Mg ha^{-1}. These results indicate a half reduction in Sugar cane yield. The correction of soil and fertilization is limiting for the longevity of the sugar cane field. These results have a direct impact on the development of the plant and confirm the need for renewal of the sugarcane, causing losses to the farmer due to the costs for implantation.

Keywords: crop yield; yield by soil type; fertilizing
Financial support: Instituto Federal de São Paulo

(4995 - 1524) Total carbon, nitrogen and phosphorus stocks in agroecosystems of the Chiloé island, Chile

Silvia Cano[1]; Mauricio Galleguillos[2]; Bruce Osborne[3]; Jorge F. Perez-Quezada[2]
Programa de Magíster en Manejo de Suelos y Aguas, Universidad de Chile, Casilla 1004, Santiago, Chile[1]; Departamento de Ciencias Ambientales y Recursos Naturales, Facultad de Ciencias Agronómicas, Universidad de Chile, Casilla 1004, Santiago, Chile[2]; School of Biology and Environmental Science, University College Dublin, Belfield, Dublin 4, Irlanda[3]

In recent years the island of Chiloé, located in southern Chile, has undergone several processes of transformation in the use of soil, moving from native forests to peatlands and other anthropogenic uses. Therefore, soils with natural vegetation have been transformed into intervened and modified soils, in which agricultural practices have been intensified in order to increase the yields of species of agricultural interest. It is presumed that these changes alter the carbon (C) stocks and the balance of greenhouse gases, so it is necessary to quantify this change, since the soil is the component of the biosphere that that stores more C. The main objective of the study was to quantify the total stocks of C, nitrogen (N) and phosphorus (P) in the agroecosystems of the island of Chiloé, comparing the effect of different types of land use in agroecosystems. The agroecosystems to study are grasslands, shrubalands invaded by espinillo (*Ulex europaeus*) and retamo (*Cytisus striatus*), natural shrubland and potato croplands. The sampling will be carried out in three plots, defined in each type of agroecosystem, with which a composite sample will be formed. In each plot, soil samples will be collected in three depth intervals (0-10, 10-30, >30 cm); In the same way in each plot the biomass will be harvested and the total C, N and P stocks will be estimated, both for the aboveground and belowground components. The results obtained are compared with previous studies conducted in the same area, where the total stock of C was determined in a native forest and a peatland. Finally, the effect of land use change on the C, N and P stocks in the soil is analyzed.

Keywords: Agricultural systems; Land use change; Nutrient pools.
Financial support: Fondecyt Regular 2017, Project Number 1171239

(6418 - 3154) Yield of vine under protected environment using fertirrigation with different nutrient doses

Katiúscia Fonseca dos Santos Strassburger[1]; Leonardo Meggiolaro[1]; Andre Samuel Strassburger[2]
Universidade de Caxias do Sul[1]; Universidade Federal do Rio Grande do Sul[2]

Niagara Rosada grapes cultivar (Vitis labrusca L.) is very importance to the agricultural economy of the Serra Gaúcha (RS). The protected cultivation associated with fertigation has shown advantages over conventional farming, as: better quality of grapes, reducing the use of agrochemicals and labor-intensive and more efficient fertilizer application. The aim of this study was evaluate the quality and production of grape in covered area and chemical changes in the soil and plant by different doses of nutrient applications. The treatments studied were T1: control (irrigation only), T2: 100%, T3: 50% T4: 200% of the recommended dose for the grapevine applied by fertigation. The experimental design was completely randomized, with four replications; each experimental plot consisted of 40 plants and 5 units of observation. The evaluation of the effects of fertigation on vine was based on production and size of harvested bunches, chemical analysis of soil and leaf analysis. Through the experiment it could be seen that the variables, the bunch size, the acidity, the brix degree and the phosphorus levels were not significantly different, since the other variables, nitrogen and boron showed interaction (dose - time). In this context, it is concluded that increasing of the dose of nutrients applied by fertigation improve the productivity. Reviews with greater and longer concentrations periods should be performed to assess residual effects and possible improvement the yield.

Keywords: *Vitis labrusca* L., nutritional efficiency, table grape.
Financial support:

C3.3.3 - Advancement of plant nutrition studies for sustainable agriculture

(7795 - 3156) Accumulation of N forms in 'Pérola' pineapple as a function of N and P doses

Anne Carolline Maia Linhares[1]; Alexandre Paiva da Silva[1]; Sonaria de Sousa Silva[1]; Josinaldo Lopes de Araújo[2]; Alessandra Alves Rodrigues[1]; Fernando Julião de Medeiros Junior[1]
Universidade Federal da Paraíba[1]; Universidade Federal de Campina Grande[2]

Although the pineapple is well studied in nutritional terms, information on the effects of mineral fertilization on the nitrogen metabolism of the crop is still scarce. The objective of this work was to evaluate the effect of nitrogen (N) and phosphorus (P) doses on the accumulation of different N forms in 'Pérola' pineapple. The experiment was carried out in a Red Yellow Argisol (pH in water = 4.8, organic matter = 18.3 g kg^{-1}, P = 25.6 mg dm^{-3}, K^{+} = 52.4 mg dm^{-3}, clay = 163 g kg^{-1}) of the municipality of Itapororoca, in Paraiba State, Brazil. The experimental design was the randomized blocks with the treatments arranged in a factorial scheme 6 × 5, with three replications. (N1P2 = 1.2 g plant-1 of N and 2.8 g plant-1 of P2O5; N2P1 = 7.2 g plant -1 of N and 0.48 g plant-1 of P2O5; N2P2 = 7.8 g plant-1 of N and 2.8 g plant-1 of P2O5; N2P3 = 7.2 g plant-1 of N and 6,7 g plant-1 of P2O5; N3P2 = 16 g plant-1 of N and 2.8 g plant-1 of P2O5; N3P3 = 16 g plant-1 of N and 6.7 g plant-1 of P2O5) and five morphological parts of the pineapple: [root, stem, new leaves (A, B and C), leaf 'D' and old leaves (E and F)]. Before planting (60 days) 1.0 t ha-1 of dolomitic limestone (PRNT 62%, depth of 0.20 m, total area) was applied. Slip seedlings were planted in double rows at a spacing of 0.80 × 0.40 × 0.40 m. At 180 days after planting, total nitrogen (N-total) and inorganic (N-NO3-) and ammonium (N-NH4 +) accumulations were determined in the different morphological parts of the plant. The N and P doses did not influence (P> 0.05) the accumulations of N-total, N-NO3- and N-NH4 +. However, a higher accumulation of N-total (330.73 mg kg-1) in the N2P1 treatment (7.2 g plant-1 of N and 0.48 g plant-1 of P2O5) was observed, and a tendency of accumulation of N-NO3- and increased accumulation of N-NH4 + with the increase of N and P doses. A higher accumulation of N-total was observed in 'D' leaves (443.81 mg kg -1). In relation to nitrate and ammonium, there were larger accumulations in the stem (1.77 and 4.32 mg kg-1, respectively). It was concluded that at 180 dap N and P doses do not influence the accumulation of N-total and N-inorganic forms of 'Pérola' pineapple; however, there is greater accumulation of N-total in leaf 'D' and of ammonium and nitrate in the stem

Keywords: nitrate, ammonium, assimilation of N.
Financial support:

(4420 - 3171) Accumulation of P forms in 'Pérola' pineapple as a function of N and P doses

Sonaria de Sousa Silva[1]; Alexandre Paiva da Silva[1]; Anne Carolline Maia Linhares[1]; Josinaldo Lopes de Araújo[2]; Alessandra Alves Rodrigues[1]; Fernando Julião de Medeiros Junior[1]
Universidade Federal da Paraíba[1]; Universidade Federal de Campina Grande[2]

Although the pineapple is well studied in nutritional terms, information on the effects of mineral fertilization on the partition of the different forms of P in the tissues of the crop is still scarce. The objective of this work was to evaluate the effect of the application of nitrogen (N) and phosphorus (P) doses on the accumulation of different P forms in 'Pérola' pineapple. The experiment was carried out in a Red Yellow Argisol (pH in water = 4.8, organic matter = 18.3 g kg-1, P = 25.6 mg dm-3, K + = 52.4 mg dm-3, clay = 163 g kg-1) of the municipality of Itapororoca, region of Coastal Tablelands, in Paraiba State, Brazil. The experimental design was the randomized blocks with the treatments arranged in a factorial scheme 6 × 5, with three replications. (N1P2 = 1.2 g plant-1 of N and 2.8 g plant-1 of P2O5; N2P1 = 7.2 g plant -1 of N and 0.48 g plant-1 of P2O5, N2P2 = 7.8 g plant-1 of N and 2.8 g plant-1 of P2O5, N2P3 = 7.2 g plant-1 of N and 6 , 7 g plant-1 of P2O5, N3P2 = 16 g of plant-1 of N and 2.8 g of plant-1 of P2O5, N3P3 = 16 g of plant-1 of N and 6.7 g of plant-1 of P2O5) and five morphological parts of the pineapple: [root, stem, new leaves (A, B and C), leaf 'D' and old leaves (E and F)]. Before planting (60 days) 1.0 t ha-1 of dolomitic limestone (PRNT 62%, depth of 0.20 m, total area) was applied. Slips seedlings were planted in double rows at a spacing of 0.80 × 0.40 × 0.40 m. The accumulation of total phosphorus (P-total), inorganic (Pi) and organic (Po) in the different morphological parts of the plant was determined 180 days after planting. The doses of N and P significantly influenced (P ≤ 0.05) the accumulations of P-total and Po, but did not affect the contents of Pi. The highest accumulations of P-total (17.5 g kg-1) and Po (16.5 g kg-1) were obtained with the combination of the doses of 7.2 g plant N and 6.7 g P plant. It was observed that the highest accumulations of P-total (21.7 mg), Po (19.4 mg) and Pi (2.3 mg) were obtained in the stem, while the lowest accumulations were recorded in the root (2.80, 2.43 and 0.30 mg, respectively). It was concluded that, at 180 dap, N and P doses influence only the accumulations of P-total and Po forms of 'Pérola' pineapple; and that the stem presents the largest and the roots the smallest accumulations of all fractions evaluated.
Keywords: organic P, inorganic P, efficiency of utilization P
Financial support:

(9872 - 2929) Activity of the nitrate reductase enzyme and nitrate and ammonium concentrations in brachiaria palisadegrass as a function of fertilization with nitrogen sources and rates

Marcio Mahmoud Megda[1]; Michele Xavier Vieira Megda[1]; Marcelo Andreotti[2]; Paulo César Ocheuze Trivelin[3]; Salatiér Buzetti[2]
UNIMONTES[1]; UNESP/Ilha Solteira[2]; CENA/USP[3]

The activity of nitrate reductase (At.RNO_3) is the main limitation of nitrogen (N) assimilation by the plant and this activity is dependent on the N form and the continuous nitrate transport by the xylem. The objective of this study was to evaluate the At.RNO_3 and nitrate and ammonium concentrations in the leaf blades (LR) of brachiaria grass, as a function of the application of N doses and sources. The experiment was conducted in a degraded pasture area with the brachiaria palisadegrass (Brachiaria decumbens). The experimental treatments were five annual rates of N: 0, 150, 300, 450 and 600 kg ha^{-1} with three sources of ammonium sulfate, ammonium nitrate and urea, in a 5x3 factorial. The design was in randomized complete blocks and three replications, totaling 45 experimental units. At.$RNO_3$was determined in the LRs. The spectrophotometer was read at 540 nm. To determine the concentration of nitrate and ammonium, extraction was carried out by stirring with potassium chloride and distillation using Devard's alloy and calcined magnesium oxide. The results were submitted to analysis of variance for the sources and rates of N and, with significance at the 5% level, the unfolding was performed. Otherwise, the ANOVA procedure was applied with the Tukey test for N sources and the first and second degree regression study for the rates effects of N. The interaction rates of N x sources of N was not significant for the concentration nitrate, ammonium and At.RNO_3. In the case of nitrate, for urea, ammonium sulfate and ammonium nitrate, maximum concentrations of nitrate were observed of 587, 603 and 693 mg kg^{-1} at the N rates of 454; 448 and 475 kg ha^{-1} $year^{-1}$, respectively. Ammonium concentrations, for urea, ammonium sulfate and ammonium nitrate, presented linear adjustments varying

from 538; 590 and 607 mg kg^{-1} for non-application of N to 704; 746 and 818 mg kg^{-1} for application of the maximum N dose of 600 kg ha^{-1} year-1, respectively. For the sources of N urea, ammonium sulphate and ammonium nitrate the point of maximum At.RNO_3 of 0.0327; 0.0333 and 0.0329 µmol g^{-1} h^{-1} NO_2^- were at N rates of 444; 424 and 397 kg ha^{-1} $year^{-1}$, respectively. The At.RNO_3 and the nitrate and ammonium concentrations were altered by the supply of N rates. For the maintenance of the At.RNO_3, adequate nitrate levels were required. The concentration of ammonium in the LRs was higher than that of nitrate in the brachiaria palisagrass.

Keywords: Nitrogen fertilization; Brachiaria decumbens and degraded pasture area

Financial support: São Paulo Research Foundation (FAPESP)

(6714 - 567) Adjustment in the recommendation of fertilization by leaf analysis in banana "Prata" fertigated

José Aridiano Lima de Deus[1]; Júlio César Lima Neves[2]; Ismail Soares[3]; Víctor Hugo Alvarez V.[4]; Fabrício Martinazzo Regis de Albuquerque[4]; Lauana Lopes dos Santos[4]; Lucas Carvalho Gomes[4]; William Natale[3]

Federal University of Ceará, 2977 Mister Hull Ave, Fortaleza, Ceará, 60440-554, Brazil[1]; Federal University of Viçosa, Campus Universitário, Peter Henry Rolfs Ave, Viçosa, Minas Gerais, 36570-900, Brazil[2]; Federal University of Ceará[3]; Federal University of Viçosa[4]

Fertilization recommendations are made almost exclusively on the basis of soil chemical analysis, without considering the leaf analysis and the expected yield, which may aid in the adjustment in fertilization programs. The objective of this study was to develop a method for the recommendation of macronutrient doses that integrates information of leaf analysis, soil chemical analysis and yield. The chemical analyzes of soil and leaves and yield were carried out in the first and second semester from 2010 to 2015, in fertigated banana 'Prata' commercial crops. Yield was related to the values of organic matter (OM) and macronutrient concentrations (P, K, Ca and Mg) present in the soil to obtain the critical level (cl_Nu_i). Then, the nutrient contents in the leaf were plotted on the dispersion plot, as a function of soil concentrations, using the Plant-Soil Relationship Quadrant Diagram (DPQps) method. From the foliar analysis, the recommended doses were simulated for four plots, and compared to doses recommended by Ferticalc-banana and Recommendation Table. The values of cl_Nu_i obtained were: 13.2 g dm^{-3} for OM; 97.5 and 91.5 mg dm^{-3} for P and K; 2.71 and 0.61 $cmol_c$ dm^{-3} for Ca and Mg. The recommended doses based on leaf analysis were 16.6 kg ha^{-1} of N, 230.6 kg ha^{-1} of P_2O_5, 21.6 kg ha^{-1} of K_2O, 626.5 kg ha^{-1} of Ca and 1,0 kg ha^{-1} of SO_4, being different from the recommendations of the other methods. The proposed method presents an advantage to the evaluation of nutritional status of plants in decision making in relation to fertilization or not. In addition, the method is sensitive to nutritional and non-nutritional factors that affect productivity, recommending doses only for cases where the limitations are due to nutritional factors. Leaf analysis satisfactorily adjusts recommended doses of nutrients and brings advantages when incorporated into nutritional balance models. In addition, its use in an integrated way with soil chemical analysis and yield, increasing the precision in the recommendation of banana fertilization.

Keywords: Musa spp.; nutrient; critical level; boundary line; yield.

Financial support: Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES), Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq#141578/2014-9) and Sítio Barreiras Fruticultura Ltda.

(9442 - 1261) Agronomic biofortification of rice grain with selenium

Josimar Henrique de Lima Lessa[1]; Mateus Bilisário de Assis[1]; Jéssica Francisco Raymundo[1]; Liniker André Ferreira[1]; Gabrielly Nayara Tavares da Silva[1]; Maria Jéssica Vieira dos Santos[1]; Anderson Mendes Araujo[1]; Fábio Aurélio Dias Martins[2]; Luiz Roberto Guimarães Guilherme[1]; Guilherme Lopes[1]

Federal University of Lavras[1]; Agricultural Research Company of Minas Gerais[2]

The enrichment of plants with selenium (Se), an essential element for humans and animals, through agronomic biofortification is relevante in countries where Se contents in the soils are low, such as in Brazil. In this context, studies involving the addition of Se by foliar spray in rice plants were carried out in two experimental farms of the EPAMIG (Lambari and Patos de Minas). Both experiments were arranged in complete randomized blocks, with 2 Se sources (selenate or selenite), six Se doses (0; 5; 10; 20; 40 and 80 g ha^{-1}), and 4 replicates. Se doses were split in two applications with interval of 2 weeks between the first and the second application and were applied as foliar spray during the flowering period. Rice plants were harvested at the end of the cycle and the grain yield were quantified. Se contents in rice grains were measured by GFAAS after the digestion process, which was performed according 3051A method of the United States Environmental Protection Agency, using HNO_3. Results show that the Se contents in rice grains increased upon increasing Se doses applied as foliar spray, being found higher Se contents when the selenate was used as Se source. This fact indicates that selenate is more easily transported through the phloem compared with selenite, when applied in the rice leaves. Comparing the two location where the studies were performed, the rice grain yield was greater in Patos de Minas compared with Lambari, and this higher productivity affected negatively the biofortification of the grains due to the dilution effect. Therefore, this study provides useful information concerning agronomic biofortification of rice, showing that both Se sources (selenate and selenite) could be used as foliar spray to increase Se contents in rice grains.

Keywords: Selenate; Selenite; Foliar spray; Human health

Financial support: CNPq; CAPES; FAPEMIG; EPAMIG; UFLA.

(9921 - 728) Alfalfa production under base saturation levels in Cerrado Oxisol

Camila Thaina Rueda da Silva[1]; Edna Maria Bonfim-Silva[1]; Tonny José Araújo da Silva[1]; Antonio Rodrigues da Silva[1]

UFMT[1]

Generally, most agricultural crops express their best performance under soil conditions with about 50% base saturation. However, alfalfa, considered one of the most important forage plants in the world, requires base saturation around 90%, limiting the expansion of the crop in tropical soils. In this context, the objective of this study was to evaluate the effects of base saturation levels on dry mass production of alfalfa grown in Oxisol of the Brazilian Cerrado region. The experiment was carried out in a greenhouse at Federal University of Mato Grosso, Campus of Rondonópolis-MT. The experimental design was completely randomized with six base saturation levels (V%) (10, 30, 50, 70, 90 and 110%) with five repetitions. The soil was collected in a region under Cerrado vegetation, sieved and corrected with dolomitic limestone 30 days before sowing, raising to saturation levels by preestablished bases. Each experimental unit consisted of a 2 dm^3 vessel containing five plants. The fertilization consisted of 150 mg dm^{-3} of potassium (K_2O) using as a source the potassium chloride divided in two times, 60% at sowing and 40% after the first cut, 800

mg dm^{-3} of phosphorus (P_2O_5) in the superphosphate form and micronutrients of 15 mg dm^{-3} of FTE (9% - Zn; 1.8% - B; 0.8% - Cu; 2% - Mn; 3.5% - Fe and 0.1% - Mo) both added at the time of sowing. Irrigation management was performed by the gravimetric method, maintaining 60% of the maximum soil water retention capacity. Plant cutting at 45 days after sowing. The shoot dry mass was weighed, and oven dried at 65°C until constant weight. The results were submitted to analysis of variance by the t-test and regression analysis, both at the 5% error probability level, using the SISVAR software. The shoot dry mass of alfalfa presented a significant difference in the base saturation soil levels, adjusting to the quadratic regression model. The maximum shoot dry mass accumulation estimated was 2.02 g pot^{-1} at 61.25% of base saturation. Thus, the base saturation levels interfered significantly in the development of the crop when cultivated in Cerrado Oxisol.

Keywords: Liming, forage legume, tropical soils, *Medicago sativa* cv. crioula

Financial support:

(2264 - 2732) Biofortification: study under application of n rates by two wheat cultivars

Jana Daisy Honorato Borgo[1]; Daniel Ramos Pontoni[2]; Milton Ferreira de Moraes[3]; Volnei Pauletti[1]

Universidade Federal do Paraná[1]; Instituto Brasileiro de Geografia e Estatística[2]; Universidade Federal do Mato Grosso[3]

The use of wheat cultivars with higher capacity for protein and Zn allocation in grains is an alternative to attenuate nutritional deficiencies in humans. The objective of this work was to evaluate the application of N doses in two cultivars regarding the allocation of protein and Zn in the grains, in flag leaf and aerial biomass. The 2x7 factorial arrangement was installed in a greenhouse, combining two cultivars Quartz and BRS Parrudo with application of 12, 20, 27, 35, 42, 50, 75 mg dm^{-3} of N. During the development of the crop were evaluated the protein concentration and Zn in flag leaf, at physiological maturity, protein concentration and Zn in the grains and aerial biomass. Partitioned grains such as spikes were separated into three equal parts (proximal, medial and distal) which confer as medial, upper and inferior parts of the spike. The total nitrogen content (N) was determined by dry combustion using the VARIO EL III - Elementar®. The N% obtained was multiplied by 6.25 to obtain the protein and transformed to g kg^{-1}. The Zn was determined by means of Optical Emission Spectroscopy with induced plasma (ICP-OES), after the digestion with nitric-peroxide solution in microwave. The cultivar BRS Parrudo was distinguished by the higher concentration of protein and Zn in the grains, biomass productivity. The increase of the N supply contributed to the reduction of the protein concentration and Zn in the grains. With respect to the accumulation of protein and Zn the cultivar Quartzo was more efficient in relation to BRS Parrudo. In spike partitioning, the concentration of Zn were significantly increased in the grains of the proximal to medium part of the spike. The protein did not respond to the grain parts analyzed in the spike. The effect of the cultivar is preponderant regarding the efficient use of N in the reserve allocation of proteins in the grains. It was concluded that the cultivar Quartzo was more efficient in protein accumulation, whereas BRS Parrudo was more efficient for accumulation of Zn. The concentration of protein and Zn varied according to the site in the evaluated spike, with higher concentration in the proximal and middle parts in relation to distal.

Keywords: Zinc. Grain quality. Protein.

Financial support: CAPES

(5356 - 3117) Biomass and volume of wood in clonal stands of Tectona grandis in Mato Grosso estimated by allometric equations

Márcio Luiz dos Santos[1]; Rayanne Oliveira Teixeira[1]; Thaís Seelent[1]; Valéria Santos Cavalcante[1]; Júlio César Lima Neves[1]

Federal University of Viçosa[1]

Nutritional management is fundamental for the good growth and productivity of teak stands (Tectona grandis), especially in low fertility soils. Obtaining good estimates of volumetric production and biomass of the trees, together with the nutrient utilization efficiency, allows the definition of nutritional demand and requirements. The objective of this work was to obtain allometric equations for volumetric and biomass production in teak plantations. The study was carried out in Nova Maringá - MT in clones of 15, 51, 63 and 75 months of age. At each planting, the circumference at chest height (CCH) of all the trees in the plots was determined, the mean (x) and the standard deviation (s) of CCH were determined, and the stratification of the trees was done according to the 3 diameter classes: 1 - Inferior ($\leq x - s$), 2 - Mean ($x - s \leq x \leq x + s$) and 3 - Upper ($\geq x + s$). A tree was selected within each class, thus totaling 12 trees sampled for the set of studied stands, which were felled and separated in leaf, twig, bark and wood, weighed in the field. For the calculation of trunk volume, the Smalian formula was applied. With the fresh matter weights and humidity values, the production of dry biomass (DB) was obtained from all compartments. The wood density was obtained from the quotient of its DB and volume. For the trunk volumes (Vtr) and the wood (Vw), and for the biomasses of the aerial part (Bap), the trunk (Btr) and the wood (Bw), all per tree, allometric equations were adjusted according to the diameter breast height (Dbh) at 1.3 m, whose coefficients were tested at 0.1% probability, by the t test. The allometric equations obtained, all with statistically significant coefficients ($p < 0.001$) and R^2 values greater than 0.99, were: Log Vtr = -3.8889 + 2.4826 Log Dbh; Log Vv = -3.8892 + 2.3889 Log Dbh; Log Bap = -1.2471 + 2.4561 Log Dbh; Log Btr = -1.5285 + 2.5933 Log Dbh; Log Bw = -1.6480 + 2.6361 Log Dbh. These equations, besides having a high predictive capacity, have a high degree of universality, since they are estimated as a function of a population variable that reflects the growth of the trees and not according to the chronological age, and can therefore be used for clonal teak plantations under varying soil and climatic conditions. Allometric equations were obtained for the estimation of volumetric and biomass production in clonal teak plantations, with high predictive capacity and degree of universality.

Keywords: forest soils; nutritional management; equation adjustment.

Financial support: Fapemig, CNPq and Empresa Guavirá Industrial e Agroflorestal

(8732 - 2376) Calcium speciation in limed brazilian oxisols using ca k-edge xanes spectroscopy

Welldy Gonçalves Teixeira[1]; Dean Hesterberg[2]; Leonardus Vergütz[1]; Víctor Hugo Alvarez V.[1]

Universidade Federal de Viçosa[1]; North Carolina State University[2]

Calcium deficiency along with Al toxicity are the major chemical constraints on brazilian acidic soils. There have been a number of studies in Brazil to re-evaluate lime requirement (LR), but information regarding how Ca and Al interact on different soil components across a wide pH range following liming is required to estimate changes in pH due to alkaline imputs, and to improve LR predictions for soils high in exchangeable Al. Our primary objective was to measure trends in Ca speciation with progressive liming of Oxisols of varying soil organic matter (SOM) content. We hypothesized that SOM-bound Ca species would increase with increasing SOM content, regardless of pH. The secondary aim was to determine whether dehydration by heating at 120 °C might potentially change the molecular bonding environment of Ca on different soil matrix components. Samples of three Oxisols (10 - 27 g C kg^{-1}) were reacted in aqueous suspensions with increasing

rates of calcite to achieve pH ranging from 4.5 - 6 (native pH) to 8.2 (excess lime). Calcium K-edge XANES spectra were collected at the Brazilian Synchrotron Light Source (LNLS) on 23 soil samples and standards of SOM-complexed Ca (Ca-humic acid and Ca-peat) and organic-Ca compounds (Ca-cellulose and Ca-oxalate), mineral-adsorbed Ca (Ca-montmorillonite, Ca-kaolinite, Ca-goethite, Ca-bayerite and Ca-non-crystalline Al-hydroxide), calcite and other Ca minerals. A distinct signature of undissolved calcite appeared at pH ≥ 8.1. Our results suggest that regardless of the SOM content, Ca-Al exchange occurs on SOM, kaolinite, and Fe and Al oxides across the pH range of limed soils, in addition to production of non-crystalline Al-hydroxide. Although the fitting results showed no significant increase in organic-associated Ca with increasing pH, the results did suggest greater diversity of organic-associated Ca species for the two soil samples containing higher SOM. Heating to 120 °C changed the bonding configuration of Ca in montmorillonite, but minimal spectral changes were found for other Ca species. Although we found limited sensitivity of Ca K-edge XANES spectroscopy to different forms of adsorbed and organic-associated Ca, a distinct spectrum for calcite would make this technique particularly suitable for detecting undissolved calcite in acidic soils to assess overliming. Moreover, our results indicate that deterministic models for recommending LR should account for both SOM and mineral effects on Ca sorption.

Keywords: acid soils, aluminum toxicity, calcium, organic matter, calcite.

Financial support: Brazilian CAPES (Coordination for the Improvement of Higher Education Personnel– project CAPES-A105/2013); Brazilian Synchrotron Light Source (LNLS)

(2623 - 3102) Concentration of N, P and K in corn diagnostic leaf as a function of phosphorus doses associated with inoculation with plant growth promoting bacteria

Nathália Cristina Marchiori Pereira[1]; Marcelo Carvalho Minhoto Teixeira Filho[1]; Elisângela Dupas[2]; Salatiér Buzetti[1]; Fernando Shintate Galindo[1]; Willian Lima Rodrigues[1]; Poliana Aparecida Leonel Rosa[1]; Laura Britto Garcia de Oliveira[1]; Maikon Richer de Azambuja Pereira[1]

UNESP Ilha Solteira[1]; UFGD[2]

Phosphate fertilizers are applied in large amounts in corn, despite its low demand by plants when compared to nitrogen and potassium. Phosphorus is one of the most limiting nutrients in the development of this cereal, especially in tropical soils that generally have a low P content and a predominance of acidity. For this reason, for a more sustainable agriculture, the use of bacteria with the capacity to solubilize the unavailable phosphorus and to promote the growth of plants, especially of roots, can increase the efficiency of the phosphate fertilization, seems to be an interesting alternative to the current agriculture, lacking research. Thus, the objective of this research was to evaluate the effect of phosphorus doses associated with inoculation with *Azospirillum brasilense*, *Pseudomonas fluorescens* or *Bacillus subtilis*, in the concentration of N, P and K in corn diagnostic leaf. The experiment will be carried out in an experimental area belonging to the Faculty of Engineering of Ilha Solteira - UNESP, in Selvíria – MS (Brazilian Cerrado region), in an Oxisol with a clay texture, mean P content and pH ($CaCl_2$) of 5.3. The experimental design was in randomized blocks with four replications, arranged in a 4 x 5 factorial scheme, being: 4 types of inoculation (with *A. brasilense*, with *P. fluorescens*, with *B. subtilis* and without inoculation) and 5 doses of P_2O_5 (0; 17.5 kg ha^{-1} being 25% of the recommended dose, 35 kg ha^{-1} being 50% of the recommended dose, 70 kg ha^{-1} being the recommended dose and 105 kg ha^{-1} being 150% of the dose recommended), applied in the sowing line. At the time of flowering was collected the average third of the leaf below the spike to determine N, P and K concentrations. The analysis of variance was used for the F test and Tukey's test at 5% probability for comparison of mean values of types of inoculation, and regression equations for the effect of P_2O_5 doses. Leaf N, P and K concentrations were adequate. There was no effect of phosphorus doses and inoculation with bacteria for N leaf concentration. With the inoculation of *Azospirillum brasilense*, was observed higher concentratio of P in the leaves, but not differing from the treatment without inoculation. *Bacillus subtilis* was highlighted by potentiating the effect of phosphate fertilization on P and K uptake. The three bacteria tested associated with the increase of phosphorus doses had a positive effect on the K uptake.

Keywords: Foliar diagnosis; phosphate fertilization; *Azospirillum brasilense; Bacillus subtilis; Pseudomonas fluorescens.*

Financial support: Foundation for Research Support of the São Paulo State (FAPESP).

(1392 - 1154) Controlled release fertilizer in the first production cycle of the banana crop

Leandro José Grava de Godoy[1]; Camila Aparecida Nunes de Souza[2]; Matheus Gabriel de Borba[1]; Rafael Paulo Kabata[1]; Gabriella Dutra Bortolini[1]; Bruno Donizeti Reschini[1]

Universidade Estadual Paulista (UNESP) - Campus Registro[1]; Universidade Estadual Paulista (UNESP) - FCA/Campus Botucatu[2]

The high demand for nitrogen and potassium by the banana crop and the losses of these nutrients, mainly by leaching, justify the split application of fertilizers, which is often manual and requires a lot of labor. The use of controlled release fertilizer may be an interesting alternative for these conditions. The experiment was conducted in Sete Barras, SP, Brazil, with the cultivar Zelig (Cavendish), at 2,0 x 2,5 m spacing. The soil of the area was classified as Haplic Cambisol medium texture with the following characteristics: pH 5,2; 9,6; 87; 47 e 19 $mmol_c\ dm^{-3}$ of K, Ca, Mg and potential acidity, respectively, 299 mg dm^{-3} P (resin); 9; 1,72; 4,1; 70; 11,6 and 16 mg dm^{-3} of S, B, Cu, Fe, Mn and Zn respectively, bases saturation of 88% and 13 g dm^{-3} organic matter; 312, 299 e 389 g kg^{-1} of sand, clay and silt, respectively. The experimental design was a randomized block, with six replications and six treatments: four doses of NPK controlled release fertilizer (CRF) in five to six months (Polyblen® 13-00-34 + 8S+ 0,2Zn) - 100%, 75%, 50% and 25% of the conventional dose (250 Kg ha^{-1} N; 250 Kg ha^{-1} P_2O_5, 750 Kg ha^{-1} K_2O), supplemented with single superphosphate; treatment using conventional fertilizer (CF) NPK 10-10-30, in four applications and control treatment (without fertilization). The CRF has granules of urea and potassium chloride coated by a layer of sulfur and another layer of polymer. The treatments with CRF were applied at once time. The CF was split into four applications in the proportion of 20, 30, 30 and 20% of the total dose. The content of K in the diagnostic leaf presented a quadratic adjustment for the doses of CRF. The indirect measurement of chlorophyll (SPAD-502) increased linearly according to the doses of CRF. The CRF-100% maintained the soil K and Zn levels, greater than or equal to the CF, from 45 to 105 days after fertilization. There was a linear increase in the weight of the bunches, number of hands, diameter and fruit length as a function of the CRF dose. The treatments with CRF-100% and CRF-75% provided heavier bunches and advanced the harvest, compared to treatments with CF and control. The losses by volatilization were very small in the treatments with the CRF. The use of controlled release fertilizer in the first production cycle of the banana crop is an interesting and viable alternative.

Keywords: Fertilizing; potassium; nitrogen.

Financial support: FAPESP (2015/15633-4); Produquímica/Compass

Minerals; Wagner Magário.

(7215 - 2954) Correlation between soil fertility and nutrient accumulation in arabica coffee grains

Aymbiré Angeletti da Fonseca[1]; Renato Correa Taques[2]; Aymbiré Francisco Almeida da Fonseca[3]; Aldemar Polonini Moreli[2]; Luiz Carlos Prezotti[2]

Universidade Federal do Espírito Santo[1]; Instituto Capixaba de Pesquisa Assistência Técnica e Extensão Rural[2]; Empresa Brasileira de Pesquisa Agropecuária[3]

Brazilian Coffee Exports in 2017 total more than 30.7 million bags, of which 5.1 million were “special coffees”. Of the total exchange revenue, equivalent to US$ 5.2 billion, special coffees accounted for 19.6%. This justifies the great importance of the development of studies that allow the increase of Brazil's participation in this distinct market, whose coffees have greater added value. When evaluated the determining factors for the quality of coffee drink, many studies highlight the environmental conditions, the care in post-harvest processing and the presence of some nutrients, for example nitrogen and potassium, as the most important factors. However, there are few studies in the literature on the direct relationship between soil fertility and nutrient content in coffee grains. So that excessive application of nutrients can become an environmental problem over time. In this context, the objective of this study is to understand how soil chemical attributes correlate with nutrient contents in coffee grains. For this, 142 areas were cultivated with arabica coffee of the Catuaí Vermelho variety, being distributed in 20 municipalities of the mountain region of the state of Espírito Santo. Soil samples were collected under the plants to a depth of 0-20 cm, and subjected to chemical characterization. On the other hand, nutrient content in the grains was obtained through a sampling performed when most of fruits reached the cherry stage. The results were submitted to Pearson correlation. Copper and manganese were the only nutrients that showed a direct and significant (*p<0,01)* correlation between their soil availability and their fruit content. In general, the attributes of the soil present low correlation with the nutrient content in the fruits, mainly in the macronutrient contents. Among the nutrient contents evaluated, manganese presented the highest correlation with soil attributes. The larger positive correlation was with the availability of this nutrient in the soil and the larger negative correlation with the organic matter concentration. For most of the studied nutrientes the increase in their availability in the soil does not necessarily indicate that will present higher fruit contents. Therefore, excessive fertilization aimed at such a response should be avoided, reducing risks such as eutrophication of springs.

Keywords: Absorption of nutrients; reduction of environmental risks; special Coffee

Financial support: FAPES; Incaper; Embrapa Café, and Fapemig

(9402 - 2118) Cover crops associated with nutrient sources in the initial recovery of degraded areas in bauxite mining in the central-west region of Brazil

Atila Reis da Silva[1]; Wilson Mozena Leandro[2]; Leonardo Santos Collier[2]; Vinícius Almeida Oliveira[3]; Rilner Alves Flores[2]

Instituto Federal Goiano[1]; Universidade Federal de Goiás[2]; Faculdade Metropolitana de Anápolis-FAMA[3]

The mine bauxite Barro Alto is the first ore economically viable bauxite in the central- west region of Brazil and has peculiar characteristics. After mining, the chemical, physical and biological soil characteristics are unsuitable for replanting, making it difficult to environmental recovery. The aim of this study was to evaluate the use of green manure in organic and mineral fertilizer and their influence on the physical and chemical attributes of the area to be reclaimed. This work was developed in degraded area located at Barro Alto, Goias The study area has 5000 m^2 and is in the process of recovery since February 2012. Two cycles of planting green manure the first in March 2012 were performed, and the second. In December 2012 the treatments were: 1- pigeonpea; 2- jack bean; 3- sunn hemp; 4- velvet bean; 5- milhet intercropping with faba bean; 6 - millet intercropped with beans pork; 7 - milhet intercropped with sunn hemp; 8- milhet intercropped with velvet bean and three nutrient sources: 1- fertilization with phosphate Arad; 2- the cattle manure; 3- mineral fertilizer controlled release fertilizers. Phytotechnical the characteristics of green manures (height, chlorophyll content, biomass production and nutrient accumulation) , chemical properties (pH, macronutrients and soil organic matter) and physical soil (bulk density, macro and micropores, volume total pore, gravimetric moisture and penetration resistance). The results showed that 17.1% of the biomass originated in pearl millet indicating legumes are the main factors of increase in that variable. The use of mineral source (NPK) significantly increased the biomass of green manure, nutrient accumulation and plant height in relation to the Arad phosphate and manure. With the introduction of green manuring, the content of exchangeable soil Al, H + Al and Al saturation (m%) reduced by 55%, 18.46% and 37.47% in relation to beginning of recovery, respectively. The use of green manure increased the soil organic matter, base saturation and potassium in 156%, 41.71% and 52.41% in relation to beginning of recovery, respectively. The macro and microporosity, in addition to resistance to penetration, improved after 18 months of implementation of the recovery, demonstrating that cropping practices adopted for recovery of degraded in the study area is being active.

Keywords: Cover plants, revegetation, soil attribute, degradation

Financial support: À Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES), Ministério do Meio Ambiente e ao Fundo Clima

(8495 - 759) Crude protein in diagnostic leaves of wheat brs 394 irrigated and fertilized with nitrogen and sulfur

Luana Aparecida Menegaz Meneghetti[1]; Edna Maria Bonfim-Silva[1]; Thiago Henrique Ferreira Matos Castañon[1]; Tonny José Araújo Silva[1]

Universidade Federal de Mato Grosso[1]

There is a large demand of wheat in Brazil, whose production supplies just half of the national consumption. The Brazilian Cerrado region has huge potential for wheat in the country. The Oxisol of this region have low natural availability of nitrogen and sulfur. The objective of this study was evaluate the crude protein content in diagnostic wheat leaves BRS 394, irrigated under combinations of nitrogen and sulfur doses, in the Brazilian Cerrado region. The experiment was carried out in the field, at the Federal University of Mato Grosso, Campus of Rondonópolis, in 2017. The soil of the region was classified as a Oxisol. Five nitrogen doses were applied (0, 70, 140, 210 e 280 kg ha^{-1}) and five sulfur doses (0, 25, 50, 75 e 100 kg ha^{-1}), using randomized blocks design, in factorial scheme 5x5, with four replications. The sulfur was applied in a single rate at sowing and nitrogen in a split-plot, 30% at sowing and 70% at 15 days after plant emergence. Urea fertilizer were used for nitrogen fertilization and elemental sulfur for sulfur fertilization. The analyzed variable was crude protein content in wheat leaves at 45 days after emergence of the plants. Twenty diagnostic leaves (10 leaves +1 and 10 leaves +2) were collected from the useful area of each experimental plot. The crude protein content of the leaves at 45 days after emergence of the plants was significant in isolation for nitrogen and sulfur treatments. For the nitrogen, the protein adjusted to the linear regression model with increase of 18.73% in comparison between the highest nitrogen dose (280 kg ha^{-1}) and absence of fertilization. For sulfur, the protein content was adjusted to the linear regression model, obtaining an increase of

2.66% when compared to the higher sulfur dose (100 kg ha^{-1}) with the absence of fertilization. The crude protein content in wheat leaves BRS 394 irrigated increases with nitrogen and sulfur fertilization.
Keywords: *Triticum aestivum L.*; Nitrogen fertilization; Sulfur fertilization; Wheat in the Cerrado.
Financial support: NATIONAL COUNCIL FOR SCIENTIFIC AND TECHNOLOGICAL DEVELOPMENT (CNPq)

(6499 - 2257) Decomposition and nutrient release from cover crops residues of different species growing in peach orchards under subtropical climate

Adriele Tassinari[1]; Jovani Zalamena[2]; Raí Augusto Schwalbert[3]; George Wellington Bastos de Melo[2]; Amanda Veridiana Krug[1]; Carlos Alberto Ceretta[1]; Paulo Ademar Avelar Ferreira[4]; Rafael da Rosa Couto[5]; Rodolfo Assis de Oliveira[5]; Gustavo Brunetto[1]
Universidade Federal de Santa Maria, Av. Roraima nº 1000, Santa Maria, 97105-900, Brasil[1]; Embrapa Uva e Vinho, Rua Livramento nº 515, Bento Gonçalves, 95701-008, Brasil,[2]; Kansas State University, Throckmorton Plant Sciences Center 1712, Manhattan, KS 66502, United States of America[3]; Universidade Federal de Santa Maria, Rua Ernesto Barros nº1345, Cachoeira do Sul, 96506-322, Brasil[4]; Universidade Federal de Santa Catarina, Campus Universitário Reitor João David Ferreira Lima, Florianópolis, 88040-900, Brasil[5]

Cover crops are used in peach (*Prunus persica* (L.) Batsch) orchards to protect soil against water erosion and part of the nutrients contained in the tissue can be released into the soil and uptake by the plants. However, the decomposition and nutrient release rate is dependent on the biochemical composition of the added residue and the edaphoclimatic conditions. The objective of this study was to evaluate the decomposition and nutrient release rate of *Avena strigosa* Schreb (black oats) and *Lolium multiflorum* L. (ryegrass) aboveground section, growing in peach orchards. The experiment was carried out in Bento Gonçalves, southern Brazil, during the 2014/15 season. The peach cultivar was 'Chimarrita', grafted on the 'Capdeboscq' rootstock. Black oats and ryegrass were seeded in the total orchard area. At the cover crop flowering the total aboveground section of the plants were sampled. The first fraction one was dried at 65 °C for quantification of dry matter production and, the second one was packed in litter bags with dimensions of 40x40 cm and added on the soil surface around the canopy of the plants. 35 litter bags were added to the total and five samples were collected at each collection (0, 30, 60, 90, 120, 150, 180 days) to determine the remaining dry matter and C, N, P, K, Ca, Mg, cellulose, lignin and non-structural components concentrations. Decomposition of residues and release of nutrients rate were estimated by the variation of the initial amount of dry matter, C, N, P, K, Ca and Mg in relation to the remaining contents in litter bags in each sample time. The determination of the remaining percentage of each one of the parameters was estimated through an exponential mathematical model described by Wieder & Lang (1982), $X=Xo\ e^{(-kt)}$, where Xo is the amount of dry matter or nutrient remaining after a period of time t, in days, and K is the decomposition constant. The half-life was calculated with the value of K ($t½= 0.693/K$). The remaining percentage of black oats residues was higher over time compare to the ryegrass residues. This happened because the residues of black oats had lower content of cellulose and higher content of lignin and C/N ratio, furthermore, the highest percentages of P, Ca and Mg. The highest amounts of N and K occurred in flowering, period of higher root emission and nutrient uptake. Black oats residues promotes greater soil protection throughout the peach growing season, but releases smaller amounts of nutrients into the soil.
Keywords: Nutrient cycling, biochemical composition, *Prunus persica*
Financial support: CNPq; Fapergs; Finep; Embrapa Uva e Vinho

(4181 - 497) Determine nutrient balances of wheat (*Triticumaestivum* L) plants with CND-ilr method and their validation

Adel Reyhanitabar[1]; Abolfazl Geiklooi[1]; Nosratollah Najafi[1]
University of Tabriz[1]

Nutrition status in plants are diagnosed commonly using concentration and nutrient ratio ranges which are biased in order to neglect compositional data properties, leading to conflicting results and wrong inferences. The objective of this study was to use isometric log ratio (ilr) technique for nutrient diagnosis in cultivated wheat plants (*Triticum aestivum* L.) at Aridisols and Entisols. Foliar sample were collected at booting stage in 96 fields in Moghan agro-industrial Company of Ardabil province,NW, Iran. Resulted balances were validated by two separated field trials that were laid out in factorial form at randomized complete block design with three replication. Ten nutrients contains N, P, K, Ca, Mg, Zn, Fe, Mn, Cu and B were analyzed. The raw data of nutrient concentration were represented by unbiased balances computed as ilr. The ilr technique authorize scheming the simplex into a Euclidean space of *D*-1 non-overlapping orthogonal log contrasts. For diagnostic purposes, there is a need to split the crops into low- and high-yielding. A receiver operating characteristic (ROC) curve was used to classify tissue nutrient concentrations between balanced/misbalanced and high/low-yielders. The ROC partitioning method for data of wheat fields and field validation test respectively showed that the critical Mahalanobis distance of 4.67 and 4.02 with yield cut-off of 5304 $kgha^{-1}$ and 6559 $kgha^{-1}$ separate balanced from imbalanced specimens (area under curve = 0.83 and 0.88). Tukey test showed significant differences in nutritional balance between reference (high-yielding) and non-reference (low-yielding) group. The [Fe,Mn,Zn,Cu | B,Mg,Ca,K,P,N] and [Mn | Zn,Cu] balances were significantly higher in reference specimens and other hand the [Zn | Cu] and [Fe | Mn,Zn,Cu] balances were significantly higher in non-reference specimens. Balance dendrogram showed that the [Fe | Mn,Zn,Cu]‹ [Mn | Zn,Cu]‹[Zn | Cu]‹ [Fe,Mn,Zn,Cu | B,Mg,Ca,K,P,N] and [Ca, Mg | K] balances were found to be sources of misbalance in the studied fields. By applying fertilizer treatments in the validation test was balanced the concentration of nutrients in the wheat plants.
Keywords: Plant nutrition, Isometric log ratio technique, receiver operating characteristic, yield
Financial support: University of Tabriz

(9077 - 1085) Development of multifunctional food waste fertilizer having the capability of biocontrol, and phosphate solubility. -A new horizons of food waste recycle using microorganism-

Rio Iguchi[1]; Ahmad Mahmood[1]; Ryota Kataoka[1]
University of Yamanashi[1]

The recycling of food waste is very important for sustainable society. An increase in domestic food waste recycle is necessary in Japan, as it is still lower as compared to trade refuse. Moreover, making compost from food waste has been carried out in Japan, but nutrients of the compost are consumed as a result of microbial growth. However, if the food waste is dried instead of composting, its composition can be maintained, besides, providing the opportunity for growing certain functional microbes like biocontrol agents on the same material. In this study, we tried to isolate the functional fungi from soil, and then grew it using dried food waste to develop a functional fertilizer. About the functionality, we focused on abilities of the biocontrol, and phosphate solubilization. For biocontrol ability, the confrontation assay was performed using isolated fungal strains against *Fusarium* spp. Only one strain out of 157 isolates showed the growth inhibition of *Fusarium* spp. and was named as strain UY2015_11. The sequencing analysis of Internal transcribed spacer (ITS) region showed that strain UY2015_11 was closely related to *Aspergillus niger*. In addition, strain UY2015_11 also showed the ability to solubilize the hardly soluble

phosphates such as calcium, and iron type. Therefore, we used dried food waste to grow strain UY2015_11, and evaluated the response of vegetable growth with this strain inoculated material. Food waste was collected from the restaurant of University of Yamanashi several times, and dried using garbage dryer (HITACHI). The dried food waste was homogenized by mixing, and grounded by grinding mill followed by storage at 4°C until use. The 12.7 g of dried food waste, moisture level adjusted to 30%, was inoculated by a disk of strain UY2015_11, and incubated for 2 weeks at 25°C. Since strain UY2015_11 was capable of growing on the dried food waste, so the material was mixed with soil followed by sowing each of *Lactuca sativa* (lettuce) and *Brassica rapa* seeds. The plants were grown for 50 days, harvested, and plant growth parameters were measured. The results indicated that the dried food wastes with strain UY2015_11 inoculated dried food waste material showed same vegetable growth as chemical fertilizer and organic fertilizer (rapeseed oil cake).

Keywords: Food waste; organic fertilizer; biocontrol; phosphate solubilization; Aspergillus

Financial support: University of Yamanashi and Yanmar Resource Circulation Support Organization

(6593 - 636) Discovering spatial dependence between experimental units of a fertilization field trial in an andean blackberry crop (*Rubus glaucus benth*.) in Colombia

Joan Sebastián Gutiérrez Díaz[1]; Martha Marina Bolaños Benavides[2]; Carmen Rosa Bonilla Correa[1]; William Andrés Cardona[2]

Universidad Nacional de Colombia[1]; Corporación Colombiana de Investigación Agropecuaria[2]

The Andean blackberry crop (*Rubus glaucus* Benth.) has shown a rapid growth in production and area sown in Colombia, given its demand in the domestic market and its potential for export. Its value for small and medium farmers is highlighted as it is a source of income, as well as for the food industry. However, there is little information on the management of soil fertility for the crop in Colombia. The objective of this study was to reveal the existence of spatial dependence between experimental units and remove it, in an experimental field trial in an Andean blackberry crop in Colombia. The experimental plot was established in the municipality of Silvania, Cundinamarca, in a response surface design with 25 treatments, combinations of five different doses of each nutrient N (13.3, 22, 43, 64 and 72.7 kg ha-1), P (1.5 , 4, 10, 16 and 18.5 kg ha-1), K (71.7, 80, 100, 120 and 128.3 kg ha-1) and Ca (31.7, 40, 60, 80 and 88.3 kg ha-1); three blocks and 75 experimental units. In the productive stage, a soil sample was taken from each experimental unit georeferenced for the determination of chemical properties, and the average productivity of blackberry was recorded. The influence of the geographical location of the experimental units on the distribution of each response variable was verified. For the variables that present a distribution conditioned by the spatial location, trend surface models were adjusted to eliminate the spatial dependence between the observations and then verify the effect of the treatments. For the other variables, a non-spatial multivariate inferential analysis, ASCA (ANOVA Simultaneous Component Analysis) was used. By removing spatial dependence, the effect of treatments on crop productivity was highly significant, so the structured variability of the experimental error was not allowed to express the effect of treatments. The soil chemical properties were not affected by the application of N, P, K and Ca treatments. The most appropriate fertilization strategy for the Andean Blackberry crop, removing the spatial dependence, must consider the soil mineralogy, to adjust the quantities of N, P, K and Ca that are required. This study shows an adequate dose for the crop fertilization in productive stage and represent an important advancement of Andean Blackberry nutrition studies for sustainable agriculture in Colombia. With this technique more accurate results can be obtained in experimental field trials and can be applied in soil science.

Keywords: Sustainable agriculture, crop nutrition, spatial analysis, multivariate analysis

Financial support: Corporación Colombiana de Investigación Agropecuaria. Corpoica C. I. Tibaitatá.

(3923 - 2264) Dry mass of leaves and stems in pasture in recovery using vegetal ash

Louisy Oliveira da Silva[1]; Helon Hébano de Freitas Sousa[1]; Edna Maria Bonfim-Silva[1]; Tonny José Araújo da Silva[1]; Alessana Schlichting[1]

Federal University of Mato Grosso - University Campus of Rondonópolis[1]

The objective of this study was to evaluate the dry matter yield of leaves and stems of Brachiaria brizantha cv. Marandu in recovery, submitted to doses of vegetal ash and forms of application. The experiment was conducted, in its third year, at the experimental farm of the Institute Mato Grosso do Algodão-IMAmt, in Rondonópolis - MT, from December 2016 to April 2017. The experimental design was randomized blocks, in a factorial scheme in the range, 6x2, corresponding to six doses of plant ash (0, 3, 6, 9, 12 and 15 t-1) and two treatments of ash application (incorporated and not incorporated to the soil with light grid), with four replications. The experimental plots (8x30 m) received the doses of vegetal ash, while the subplots (8x15 m) the application management. The application of the ashes was carried out manually, and the built-in handling performed with a light grid. Four evaluations were performed with a 30-day interval. The plants for evaluation were cut at a height of 0.05 m in the internal area of a rectangle of 0.25m², randomly played twice within the limits of the useful plot. The dry mass production of leaves and tillers was evaluated. The results were submitted to analysis of variance up to 5% of probability and, when significant, to the doses of vegetal ash, regression analysis was applied and, for the application management factor, the means were compared by the Tukey test, through the statistical program SISVAR. There was no interaction between treatments in any of the evaluated sections. For plant ash doses, except for the dry mass of stalks in the first cut, the data for all cuts for the two variables were adjusted to the quadratic regression model, with maximum yields observed at doses above 9 t -1. Regarding the application management, for the dry mass of leaves, only a significant difference was observed in the 1st and 2nd cuts, and in the first cut the unincorporated treatment promoted greater production and, in the second cut, the reverse was observed. The dry mass of stalks showed only a significant difference for the handling of the application in the 3 rd and 4 th cuts, in the two cases the ash incorporated into the soil promoted higher results. Vegetable ash promoted an increase in the production of dry mass of leaves and stems, and can be used for pasture recovery, the incorporated application method damages dry mass production in the first cut, but it is more efficient in the following.

Keywords: Vegetable residue; Pasture in degradation; Marandu grass.

Financial support: Institutional Program of Scientific Initiation Grants PIBIC - CNPq/UFMT.

(8794 - 883) Dry mass production of pasture in recovery under wood ash doses and application forms

Tallys Henrique Bonfim-Silva[1]; Helon Hébano de Freitas Sousa[1]; Edna Maria Bonfim-Silva[1]; Tonny José Araújo da Silva[1]

Universidade Federal de Mato Grosso[1]

The wood ash is a residue of industries in the production of thermic energy by mean of the burning of the vegetal biomass, is an organic fertilizer alternative and soil corrective that can positively influence the recovery of degraded areas. The objective of this study was evaluate the dry mass production of the pasture in recovery under wood ash doses and two forms of application. The experiment was carried out in the field in his third year of conduction, in the municipality of Rondonópolis, Mato Grosso, at the experimental farm

of the Instituto Mato-grossense do Algodão (IMAmt). The experimental design was in randomized blocks with plot subdivided into strips, in factorial scheme 6x2, corresponding to six wood ash doses (0, 3, 6, 9, 12 and 15 Mg ha^{-1}) in the plots and two applications (incorporated with light and non-incorporated grid), in four replications. The experimental plots (8x30 m) received the wood ash doses, while the subplots (8x15 m) the application management totaling 24 plots and 48 subplots. The application of wood ash was carried out the flight, manually. The evaluations of the plants were performed in four predetermined intervals cuts of 30 days with each other. The cuts of the plants were carried out at the time of 0.15 m of the soil surface in an area bounded by a rectangle of 1.00x0.25 m (0.25 m^2) sampled in the area that best represents the treatment in the useful area of each subplot. Significant effect was observed for wood ash doses in the 1st, 2nd and 4th cuts, setting the quadratic regression model, being respectively the highest wood ash doses (15.3, 10.7 and 10 Mg ha^{-1}) and dry mass (1.6, 0.7and 0.9 Mg ha^{-1}). The 3rd cut had a significant effect only for the wood ash doses, and there was no significant difference for the application management, adjusting also to the quadratic regression model, with the highest dose 27 Mg ha^{-1} producing 1.5 Mg ha^{-1} of dry mass. The doses and fertilization management with wood ash increases the production of dry mass in pasture in recovery in the Brazilian Cerrado.

Keywords: *Brachiaria brizantha*; Alternative fertilizer; soil management; Wood ash
Financial support: National Council for Scientific and Technological Development (CNPq)

(8921 - 3011) Effect of excessive B-spraying on growth and antioxidant activity of European hazelnut cv. Tonda di Giffoni

Cristian Meriño-Gergichevich[1]; David Alarcón[2]; Elizabeth Ulloa-Inostroza[3]; Ana Luengo Escobar[3]; Marjorie Reyes-Díaz[3]
Scientific and Technological Bioresource Nucleus (BIOREN-UFRO), Universidad de La Frontera, Temuco, Chile (cristian.merino@ufrontera.cl)[1]; Laboratorio de Fisiología y Nutrición de Frutales Caducifolios, Universidad de La Frontera, Temuco, Chile.[2]; Scientific and Technological Bioresource Nucleus (BIOREN-UFRO), Universidad de La Frontera, Temuco, Chile[3]

Boron (B) is essential to the growth and development of many crops, by its role in sugar transport, cell wall structure and phenol metabolism. However, low B availability in acid soils (pH ≤ 5.5), due to its leaching by high precipitation and calcareous amendment management, affect its uptake by roots. In fruit crops, B spraying is an agronomic tool which enables optimize B use, reducing the typical symptomatology of B deficit in plants, such as stunted development, necrotic meristems, reduced fruit set and fruit abortion, among others. In Chile, European hazelnut (*Corylus avellana* L.) is an important nut fruit with high volumes of exportation. However, hazelnut production presents serious difficulties to obtain viable fruit, due to fertility problems. All this, present many problems in the production chain, limiting the volume for fruit production and hindering the post-harvest management by vain fruits. Based on the above mentioned, the knowledge of boron as foliar fertilization program can improve hazelnut productivity. Therefore, the aim of this study was to determinate the effect of B foliar-applied on antioxidant performance and productivity of European hazelnut. The experiment was carried out in the 2016-2017 season, in a commercial orchard in Cunco County, La Araucanía region, Chile (39° 29` S; 72° 23` W). Ten years old plant cv. Tonda di Giffoni grew in an Andisol (Typic Hapludands) with low B concentration (0.37 mg kg^{-1}). Doses of 0, 800 and 1600 mg L^{-1} (B0, B800, B1600 respectively) were sprayed four times (October 15th to November 30th) in a randomized design with three replications. Treatments B800 and B1600 increased ten-folds foliar B in comparison to non-treated B0 (P≤0.05). At B1600, leaf water potential (Ψ_{leaf}) showed more negative values (-1.1 MPa) and stomatal density (stomata per mm^{-2}) was significantly increased at 140 stomata mm^{-2} in lower leaf surface compared to control (97). Dry matter was a 10% higher at B800 than B0 (P≤0.05). Lipid peroxidation was reduced concomitantly with increased antioxidant activity in leaves, in comparison with control treatment. Hazelnut seems to be a species that accumulate high B concentration in leaves, whereas it is involved in an improved antioxidant activity.

Keywords: Acid soil; Boron; hazelnut; nut fruit.
Financial support: Fondecyt 11160762

(2895 - 2926) Effect of macronutrient deficiency in the development of the african mogno (Khaya ivorensis)

Mateus Gonçalves de Borba[1]; Gustavo Ferreira de Sousa[1]; Maila Adriely Silva[1]; Juliana Luíza Cagarmos da Costa[1]
Centro universitário de Patos de Minas-UNIPAM[1]

African mahogany (Khaya ivorensis) is one of the main alternatives for the recovery of deforested and degraded areas, due to its excellent climatic adaptation and high economic value, although there is little scientific knowledge about its nutritional requirements. The objective of this work was to evaluate the African mahogany development (Khaya ivorensis) when submitted to macronutrient deficiency separately. The experiment was carried out in an experimental greenhouse at the University of Patos de Minas-MG, Brazil, consisting of an experimental DBC (randomized block design) with 8 treatments and 4 replicates, using 100 day old seedlings, duly selected from certified nursery, transplanted to pots with sand washed with distilled water, submitted weekly to the application of nutrient solution specific to the appropriate treatments T1 (without application of nutrients), T2 (complete nutrient solution application), T3 (nutrient solution without Ca 2+ addition), and T4 (nutrient solution without K +), T5 (nutrient solution without N), T6 (nutrient solution without S), T7 (nutrient solution without P), T8 (nutrient solution without Mg^2 +) for 120 days, evaluating agronomic characteristics at the end, the data were submitted to analysis of variance and their means were compared by the Tukey test at 5% of error probability. There were differences in the agronomic aspect, according to the solutions, nitrogen being the nutrient that presented as main limiting factor to the development and growth of the African mahogany in comparison to the other macronutrients, this fact is related because it is the nutrient responsible for the cellular growth and by the formation of numerous enzymes present in the plant cell, its deficiency acts directly on the vegetative development throughout the whole cycle. In this context, N was the macronutrients that most limited the growth and quality of the Khaya ivorensis seedlings.

Keywords: African mahogany, Khaya ivorensis, Macronutrient deficiency
Financial support:

(7212 - 2602) Effect of silicon addition on (*Sorghum bicolor* l.) moench plant grown under iron deficiency

Márcia Masson Mendes dos Santos[1]; Alexander Calero Hurtado[1]; Diego Correia Sodré[1]; Isaias dos Santos Reis[1]; Renato de Mello Prado[1]
UNESP[1]

With de objective to study the physiologic and biochemical to changing stimulate by iron deficiency in sorghum plant (Sorghum bicolor L.) Moench and researcher the role of silicon addition in the acclimation induction of this specie under iron deficiency. The sorghum cv Dekalb 540 were cultivated plants were grown hydroponically in a complete nutrient solution with or without Si supply and sufficient and deficient Fe, with modification in the iron

source Fe-EDDHMA, keeping the pH value of solution nutritive was 5.5, adapted for the crops. The treatments were in a 2x2 factorial scheme and the first factor corresponding to sources of Si Potassium Silicate is the standard source with 128.00 g L^{-1} of Si and 126.5 g L^{-1} of K_2O in Si concentration and 0,4983g L^{-1} and the second factor, the Fe being the Fe-EDDHMA (Fe = 6%) source in the concentrations 0.2 and 4.12 g L^{-1} being in the first week the measure of the deficiency was 0.1 g L^{-1} totaling 20 experimental plots. The sowing was done in trays of styrofoam filled with vermiculite medium and irrigated 5 ml per cell with nutrient solution of Hoagland and Arnon (1950) with and without silicon being the source the potassium silicate until the transplant. After four weeks until the transplant was assessment the fallowing variables: plant height, dry matter of roots and shoots, Fe and Si accumulate in roots and shoots, lipid peroxidation in roots and shoots, chlorophyll and carotenoids. The results showed that the presence of Si in the culture media induced the acclimation of sorghum plant under iron deficiency, in conclusion in growing highest of sorghum plant. The acclimation of the sorghum plant on iron deficiency mediated by silicon see related with the increment of chlorophyll and carotenoids, major and better distribution and iron accumulate and achieve the dry matter production in roots and shoots and decrease the MDA in roots and shoots of sorghum plants.

Keywords: Sorghum bicolor, Iron deficiency, silicon
Financial support: CAPES

(8444 - 1432) Effect of urea application on soybean nodulation, CO_2 assimilation and dry matter production at early phenological stage

Nícolas Braga Casarin[1]; Maria Clara Faria Chaves[1]; Gil Miguel de Sousa Câmara[2]; José Lavres Júnior[1]
Center of Nuclear Energy in Agriculture - University of São Paulo (CENA-USP)[1]; Luiz de Queiroz College of Agriculture - University of São Paulo (ESALQ-USP)[2]

Biological nitrogen fixation (BNF) is the main source of nitrogen (N) uptake and assimilation by soybean crop. However, the application of mineral nitrogen fertilizers can affect nodulation and its efficiency and may not represent gains of grains yield and shoot biomass. This work aims to evaluate the main effect of BNF, the application of mineral nitrogen (urea) at V1 phenological stage (20 kg ha^{-1}), flowering – R2 stage (2 kg ha^{-1}), and both times, on soybean nodulation, CO_2 assimilation, shoot and roots dry matter yield. The experiment has been carried out in a greenhouse at the Center for Nuclear Energy in Agriculture (CENA-USP) in Piracicaba, São Paulo State, Brazil, since December 2017. Two plants of an indeterminate growth habit cultivar (BMX Potência RR) are being cultivated per pot, each containing 5 dm^3 of soil from a Typic Hapludox (LVAd), using the experimental design of complete blocks at random, with treatments arranged in a 4 x 5 factorial scheme (four forms of N application x five times of evaluation – plant growth stage), with five blocks. The seeds were inoculated with strains of *Bradyrhizobium elkanii* (SEMIA 5019) and *Bradyrhizobium japonicum* (SEMIA 5079). The CO_2 assimilation has been determined by using an *Infrared Gas Analyser – IRGA, LI 6400 XT*. The leaves, stem+petioles and roots were separated and oven-dried (60 °C) and later each part was weighed to obtain its dry matter. The nodules were collected at harvest of the plants. The results were submitted to analysis of variance ($p<0.05$) using a SAS statistical package. The number of nodules significantly decreased at V4 stage when urea was applied at sowing, although leaves, stem+petioles and roots dry matter did not differ among the treatments. Mineral nitrogen application has not influenced CO_2 assimilation at both V4 and flowering (R2) stages, however, there was a difference between the stages with an increase of carbon assimilation at R2 for all treatments, supporting the idea that soybean has a photosynthesis peak at flowering. Further results will be obtained, since the experiment is still being conducted.

Keywords: biological nitrogen fixation, photosynthetic rate, physiology
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(8160 - 659) Efficiency of organomineral fertilizers in the development of corn plants, cultived in a cerrado soil.

Angelica Araujo Queiroz[1]; Luiza De Freitas Nehme[1]; Gabriel Camargo De Jezus[1]
IFTM, campus Uberlandia[1]

The corn, for your productive potential, chemical composition and nutritional value, is one of the most important cereals consumed and cultivated in the world. Productivity depends on factors such as climate and adequate supply of nutrients, through fertilization. The organomineral fertilizer has potential for use in agriculture, because it comes from other productive systems, such as chicken manure. The purpose of the study was to analyze the influence of organominerals on the initial development of corn plants in a cerrado soil. The experiment was conducted at the nursery for seedling production at IFTM, campus Uberlândia – MG. Soil sampling (Oxisoil, cerrado soil) was performed for the chemical characterization. It was used dolomitic limestone to raise base saturation to 50%. The seeding occurred in nursery pots with a capacity of 5 m^3 of soil, and 15 days after sowing (DAS), a urea cover fertilization was performed. The experimental design was used in randomized blocks, with five treatments and five replications. The organomineral fertilizer used was the formulated 4-10-10 in the proportions 140% (1200 kg ha^{-1}), 120% (1000 kg ha^{-1}), 100% (800 kg ha^{-1}), 80% (600 kg ha^{-1}) e 60% (400 kg ha^{-1}) of the recommended dose of organomineral fertilizer for maize. The following parameters were evaluated: phosphorus content (P) in the soil at 60 DAS, pH value of the soil, SPAD index in the upper middle third of each plant at 30 and 60 DAS and diameter and stem height at 30 and 60 DAS. According to the results, it was verified that there was influence of the rates tested for the P levels in the soil, which increases linearly as a function of the rates tested. At the highest rate, corresponding to 140% (1200 kg ha^{-1}) of the recommended rate, a content of 10,6 mg dm^{-3} of P in soil was found, approximately 2,5 times higher than the P content in rate of 60% (400 kg ha^{-1}). Concludes that the proportions of the formulation applied in the soil influenced the P levels in the soil, but did not interfere with soil pH and SPAD index.

Keywords: Fertilization; Plant nutrition; *Zea mays* L..
Financial support: INSTITUTO FEDERAL DO TRIANGULO MINEIRO

(7946 - 887) Efficiency of Polyhalite as fertilizer to banana crop in Brazil

Renato Agnelo da Silva[1]; Fabio Vale[2]; Danilo Ramos Sério[3]
Monterra Consultoria[1]; International Potash Institute[2]; ICL Fertilizers[3]

Banana cultivation reaches a large area in Brazil, being the most consumed fruit the country, generating 4,5 billion dollars in income for the farmers in 2016. Fertilization with KCl in high rates is common in the management of crop, leaving soils with high concentration of potassium and usually with high salinity. This can influence the development of plants and their nutrition, mainly with calcium and magnesium. The aim of the research was to evaluate the efficiency of Polyhalite as fertilizer to banana crop in a high fertility soil, common in banana areas in Brazil. Polyhalite is a natural fertilizer extracted from a single crystal complex with two molecules of water of crystallization, the chemical formula of the mineral is:

$K_2Ca_2Mg(SO_4)_4.2(H_2O)$, and it contains 19.2% of sulfur (S), 14% of potash (K_2O), 12% of calcium (Ca), 3.6% of magnesium (Mg). Important characteristics of Polyhalite are the slow release and higher availability of nutrients due to its sulphate form, and the lower salinity in function of the low contents of chloride (Cl) and sodium (Na). Trial was made at Lagoinha farm, in Juquia, Sao Paulo state, Brazil. Experimental design in randomized blocks with 7 treatments and 4 replications. Treatments were blends of KCl and Polyhalite, relative to the weight of fertilizers, to provide 360 kg ha^{-1} of K_2O, except Treatment 1, Control without nutrient application. Treatments: 1- Control; 2 - 100% KCl; 3 - 80% KCl/20% Polyhalite; 4 - 60% KCl/40% Polyhalite; 5 - 40% KCl/60% Polyhalite; 6-20% KCl / 80% Polyhalite; 7 - 100% Polyhalite. There wasn't significant effect for the KCl application in relation to the control, with reduction of 1.5% in fruit yield due to the K_2O fertilization. However, the best results were observed with the fertilization with blends Polyhalite and KCl, and the best result was obtained with the 60% Polyhalite / 40% KCl ratio, which increased yield by 13.2% compared to conventional fertilization with KCl. Plants that received Polyhalite showed the bunches with greater vigor, and the plants had larger diameter of the stem. Polyhalite is a viable alternative for use in banana fertilization because it improves the nutritional balance with supply of Ca, Mg and S, besides decreasing the salinity and increasing the yield potential.

Keywords: Polyhalite, potash, sulfur, magnesium, banana
Financial support: International Potash Institute

(7938 - 1914) Enhancing micronutrient availability in different soils: Laboratory incubation study

Tapasya Babu[1]; Fabio Scudeler[1]; Daniela Vitti[1]
Produquímica - Compass Minerals[1]

Significant advances in sustainable agriculture can be attained by improving the efficiency of sources of micronutrients for crops. The EDTA (Ethylenediaminetetraacetic acid) chelates of micronutrients are known to perform better than other conventional sources. Nonetheless, most chelates of these trace elements, particularly Zn (Zinc) chelate (Disodium-Zn-EDTA) have a lower stability than the corresponding Cu (Copper) or iron (Fe) chelates that tend to replace Zn from within the complex and rapidly dominate the soil solution. The study was initiated with the goal of identifying the combination and ratio that will maintain the soil solution concentration of that micronutrient at a level significantly more than capable by other sources. Series of experiments with three micronutrients, i.e., Zn, Cu and Mn (Manganese) were conducted using two different soils, acidic (pH=4.6) and alkaline (pH=7.8). The different treatments with three replications that were included in each experiment were control (soil only), Metal (M)-sulfate, M-chloride, Disodium-M-EDTA, M-sulfate +Disodium-M-EDTA and M-chloride +Disodium-M-EDTA. Metal concentration of 10 ppm was added in the soil before shaking them for up to 4 hours on a reciprocal shaker, centrifuging, and filtering. Zinc, Cu, Fe, calcium (Ca) and Mn equilibrium concentrations in the filtrate were determined using ICP-MS. The results revealed that by adding sulfate form of the micronutrient along with the chelate form in the ratio near equal to 1:1(sulfate: chelate) in such a way that 1 part of total zinc was supplemented by the chelate and 3 parts of the total zinc were supplemented by the sulfate, more Zn or Cu ($p<0.001$) was maintained in solution than other source combinations tested with respect to Zn and Cu. This could be attributed to the decrease in exchange of micronutrient from within the Disodium-metal-EDTA complex and thereby its loss from soil solution phase by providing a temporary competitive advantage of concentration to the metal or micronutrient used in the combination over others in soil solution. This was further supported by the results of concentrations of the competing ions like calcium and Fe that were considerably lower ($p<0.001$) when Zn or Cu was added as sulfate+Disodium-M-EDTA mix rather than Metal (M)-sulfate, M-chloride, or Disodium-M-EDTA. This study generated new information for the development of high efficiency new generation soil-applied micronutrient formulations.

Keywords: Chelated Zinc, micronutrient availability, soil fertilizer, EDTA
Financial support:

(2773 - 916) Growth and carbon isotopic composition in *Eucalyptus* seedlings in function of potassium and sodium variable supplies

Nikolas de Souza Mateus[1]; Eric Victor de Oliveira Ferreira[2]; Greice Leal Pereira[3]; Alexandre de Vicente Ferraz[4]; José Lavres[1]; José Leonardo de Moraes Gonçalves[5]
Center for Nuclear Energy in Agriculture[1]; Amazon Rural Federal University[2]; Federal University of Viçosa[3]; Forest Science and Research Institute[4]; University of São Paulo[5]

Potassium (K) is the most required and taken up macronutrient by the *Eucalyptus* plant, while sodium (Na) can partially substitute some specific physiologic functions of K. Despite the positive responses of K replacement by Na, sodium supply may also be toxic for plants, hampering tree physiology. Since plants responses to salinity are very close to those of water stress, physiologic changes in salinity conditions can be measured by the carbon isotopic composition ($\delta^{13}C$ ‰). Then, specific studies for *Eucalyptus* are needed to identify the process involving Na in *Eucalyptus* physiology, as in $\delta^{13}C$ and its correlation with growth variables (e.g., dry matter yield and leaf area). The experiment was carried out in a greenhouse at the Center for Nuclear Energy in Agriculture (CENA-USP) in Piracicaba, São Paulo State, Brazil, from November 2014 to February 2015. The experiment replaced the original K rate of Clark's nutrient solution (1.80 mmol L^{-1}) by increasing percentage of Na applied (as NaCl), in *Eucalyptus* clone IPB8 (*E. urophylla* × *E. grandis* hybrid). Thus, the treatments consisted of five combinations of Na and K application rates (0/1.80, 0.45/1.35, 0.90/0.90, 1.35/0.45 and 1.80/0 mmol L^{-1} of Na/mmol L^{-1} of K). The higher Na rate (1.80 mmol L^{-1}), with no K supply (0 mmol L^{-1}), represented the stressful treatment to plants. The study was arranged in randomized blocks with four replications, accounting 20 experimental units (pots of 5 L), with one plant in each pot. The leaf area (LA) determination was taken by passing all leaves through a leaf area integrator (LI-3100). Later, the leaves, stems, branches and roots were oven-dried (65 °C) and after each part was weighed to obtain its dry matter. The $\delta^{13}C$ ‰ isotope composition of the leaves was determined using a mass spectrometer coupled to a C automatic analyzer and values of $\delta^{13}C$ (‰) were calculated as described by Cernusak et al. (2013). The results were submitted to analysis of variance ($p<0.05$) using a SAS statistical package. The LA and total dry matter decreased with increased Na rates, according to the quadratic model. The Na application did not influence the $\delta^{13}C$ value of E*ucalyptus* seedlings, while the Na rate of 1.8 mmol L^{-1} provided the trend of a higher average value of $\delta^{13}C$ (-31.65 ‰). Besides not significant at 5%, there is a trend for negative correlation among $\delta^{13}C$ and shoot dry matter.

Keywords: nutrient solution, forest nutrition, physiology.
Financial support: São Paulo Research Foundation- Fapesp (Process number 2014/16397-0)

(5288 - 2790) Influence of aluminum on emergence and root growth of *Hancornia speciosa* Gomes

Douglas Almeida Rodrigues[1]; Arthur Almeida Rodrigues[1]; Sebastião Carvalho Vasconcelos Filho[1]; Cássia Lino Rodrigues[1]; Eduardo Matheus Guimarães Teles[1]

Goiano Federal Institute of Education, Science and Technology (IFGoiano), Campus Rio Verde[1]

Hancornia speciosa, Gomes, is a species with several medicinal and nutritional applications presenting important economic potential, is typical of sandy, acid and nutrient poor soils. The study of native plants of regions with soils with presence of aluminum at levels toxic to most of the cultivated species, has been considered the best alternative in increasing the production in acid soils with high concentrations of this cation. The objective of this study was to characterize the effect of aluminum on emergence and root growth of *H. speciosa* seedlings. The effect of Al in *Hancornia speciosa* was examined via sand emergency test with calcium chloride solution (0.1 mM $CaCl_2$, pH 4.0) and culture in nutrient solution (pH 4.0) with macro and micronutrients; $(Al_2O_4)_3 \cdot 18H_2O$) and Al_2O_3 (Al_2O_3) at the end of the experiment. In the emergence, the emergence velocity index and root diameter of the seedlings were significantly reduced with Al treatment. In hydroponic cultivation, aluminum promoted greater root growth at the concentration 300 µmol L^{-1} of Al. It was concluded that the seeds of *H. speciosa*, showed greater sensitivity to Al^{3+} with negative effects on seedling emergence, in the solution culture the tolerance of the seedlings to Al^{3+} are indicative of the action of mechanisms that possibly act in the detoxification of Al in the plant allowing the species to survive in high concentrations of this cátion.

Keywords: aluminum; cerrado; root growth; mangaba; tolerance.
Financial support: Goiano Federal Institute of Education, Science and Technology, Coordination for the Improvement of Higher Education Personnel (CAPES).

(2883 - 2475) Influence of base fertilization with fertilizers with or without sulfur on sugarcane productivity

Marcelo de Almeida Silva[1]; Lucas Almeida de Holanda[2]; Gabriel Henrique Germino[1]; Marcela Cristina Brunelli-Nascentes[1]; Mariana Peduti Vicentini Sab[1]; Vinicius Ribeiro Arantes[1]
São Paulo State University - School of Agricultural Sciences[1]; IFMT - Advanced Campus Guarantã do Norte[2]

The objective of this research was to evaluate the effect of sulfur-enriched or non-enriched fertilizers applied in base fertilization on the production components and yield of sugarcane. The experiment was conducted in a commercial area, located in Lençóis Paulista, SP, Brazil, in the 2013/2014 season, in production environment C. A randomized blocks experimental design was used, with six treatments, (1) (07-33-18 + 9% S) + 298 kg ha-1 KCl; (2) (06-25-24 + 9% S) + 100 kg ha^{-1} triple superphosphate + 397 kg ha^{-1} KCl; (3) 09-25-25 + 490 kg ha^{-1} of MAP + 87 kg ha^{-1} of urea + 423 kg ha^{-1} of KCl; (4) 04-20-30 + 320 kg ha^{-1} of MAP + 180 kg ha^{-1} of single superphosphate + 500 kg ha^{-1} of KCl; (5) 05-25-25 + 410 kg ha^{-1} of MAP + 173 kg ha^{-1} of single superphosphate + 417 kg ha^{-1} of KCl and (6) (90-23-18 + 15% S) + 300 kg ha^{-1} KCl, with 4 replicates. All treatments received 58.5 kg ha^{-1} of N, 150 kg ha^{-1} of P_2O_5 and 225 kg ha^{-1} of K_2O. The variety used was RB966928. At 120 days after sprouting (DAS), faults greater than 50 cm (%) and number of tillers were evaluated, while at harvest, diameter, length and number of stalks per meter, yield of stalks (TCH) and sugar (TAH), total recoverable sugars (ATR), Pol, purity and fiber. Data were submitted to analysis of variance, complemented with the Tukey test, considered significant when $p < 0.05$. The treatments 4 and 5 presented the biggest faults in the stand while in the treatment 1, with 9% of sulfur, the lowest value was verified. The highest TCH were observed in treatments 1 and 6 and the lowest in treatment 4. Despite no difference in the number of tillers at 120 DAS, treatment 1 had the highest number of stalks harvested. The highest TAH was obtained in the treatment 07-33-18 + 9% S, due to the higher TCH, since the ATR did not differ between the treatments. These results demonstrate the beneficial influence of fertilizer sources containing both, sulfur in the form of readily available sulfate and in elemental form with gradual release, on sugarcane production. The high concentration of sulfur and the adequate ratios of this nutrient with nitrogen and phosphorus provide an increase in the efficiency of nutrient absorption and consequently higher production.

Keywords: *Saccharum* spp.; sulfur; production
Financial support:

(5709 - 1586) Influence of silicon supply on different wheat cultivars grown under phosphorus deficiency

Paula Cartes[1]; Teresa Sepúlveda[1]; Marlys Ulloa[2]; Paulina Jara[3]; Sofía Pontigo[2]
Departamento de Ciencias Químicas y Recursos Naturales, Facultad de Ingeniería y Ciencias, Universidad de La Frontera, P.O. Box 54-D, Temuco, 4811230, Chile[1]; Programa de Doctorado en Ciencias de Recursos Naturales, Universidad de La Frontera, P.O. Box 54-D, Temuco, 4811230, Chile[2]; Center of Plant-Soil Interaction and Natural Resources Biotechnology, Scientific and Technological Bioresource Nucleus (BIOREN-UFRO),Universidad de La Frontera, P.O. Box 54-D, Temuco, 4811230, Chile[3]

Phosphorus (P) is an essential nutrient for plants, but low P availability strongly limits crop production in most of soils. Current evidence has shown that silicon (Si) can ameliorate the deleterious effects derived from P deficiency in vascular plants. However, the mechanisms regarding these responses are still poorly understood. This study aimed to assess the influence of Si supply on P uptake, plant growth, and phenols production with either antioxidant or structural function in two wheat cultivars differing in their tolerance to P deficiency. Wheat (*Triticum aestivum*) cultivars (Púrpura-sensitive and Fritz-tolerant) were hydroponically grown with P (0, 0.01 or 0.1 mM; supplied as K_2HPO_4) in combination with Si (0, 1 or 2 mM; supplied as Na_2SiO_3). At harvest, plant growth, P concentration, lipid peroxidation, radical scavenging activity (DPPH) and total phenols concentration were determined in shoots. In addition, lignin distribution pattern and hydrogen peroxide (H_2O_2) production in chloroplasts were analyzed. Phosphorus concentration was steadily reduced in shoots of wheat cultivars as the level of applied P decreased from 0.1 mM P to 0 mM P. A significant increase of shoot lipid peroxidation coincided with the reduction of shoot dry weight when Purpura and Fritz were subjected to low P supply. Nevertheless, Si applied to P-stressed plants improved shoot dry matter production of Purpura and counteracted the P-induced oxidative damage by up to 39% and 22% in Purpura and Fritz, respectively. Whereas P deficiency augmented both the antioxidant activity and phenolics concentration in shoots of the P-sensitive cultivar, Si application diminished the radical scavenging activity as well as soluble phenols. By contrast, an evident enhancement of lignin deposition was detected in shoots of both cultivars as level of Si increased. Moreover, greater lignifications induced by Si was observed in Fritz, which also showed a lower intracellular H_2O_2 production when Si was applied. These findings will contribute to the understanding the impact of Si on wheat plants grown under P deficiency conditions, as well as its potential benefits on crops production.

Keywords: Silicon; phosphorus; mineral stress; wheat; phenols
Financial support: FONDECYT project 1161326, CONICYT Doctoral-Scholarships 21120704 and 21171958 and Dirección de Investigación of Universidad de La Frontera.

(7701 - 2627) Influence of Zn/Cu ratio on production components of soybean

Marcelo de Almeida Silva[1]; Amanda Mei Furuya[1]; Marcela Cristina Brunelli-Nascentes[1]; Hariane Luiz Santos[2]
Sao Paulo State University - School of Agricultural Sciences, 1780 Jose Barbosa de Barros St, Botucatu, 18.610-307, Brazil.[1]; Sao Paulo State University - School of Agricultural Sciences, 1780 Jose Barbosa de Barros St, Botucatu, 18.610-307, Brazil (harianeluiz@gmail.com).[2]

The objective of this study was to evaluate the influence of Zn/Cu ratio in the production components of BRS 133 soybean variety. This experiment was conducted at School of Agricultural Sciences – FCA/UNESP, Botucatu/SP, carried out in greenhouse with semi controlled temperature and relative humidity. The experimental design used was randomized blocks, carried out in pots filled with low Cu content soil (0,3 mg dm-³), with four treatments applied in sowing: (T1) Standart; (T2) 0,6% Zn, 0,6% Mn, 0,3% B; (T3) 0,6% Zn, 0,6% Mn, 0,1% Cu, 0,3% B; (T4) 0,6% Zn, 0,6% Mn, 0,2% Cu, 0,3% B, with five replicates. All pots received the same basic fertilization: 0,4 g pot^{-1} of Muriate of potash (MOP) (sowing + covering), 0,78 g pot^{-1} of Super Triple, 0,042 g pot^{-1} $ZnCl_2$, and were inoculated with 160 mL 100 kg^{-1} *Bradyrhizobium*. The production components were evaluated in the harvest. The data was submitted to normality test and to variance analysis, and the averages compared through Tukey test (P<0,05). Significant differences were not observed among the treatments for length of seedpods with three seeds (cm), length of seedpods with two seeds (cm), number of seedpods with a single seed, number of seedpods without seeds, number of branches, number of seedpods in the main branch, number of seedpods in the branches, total of seeds per plant, total of expected seeds, production (g $plant^{-1}$), mass of 100 seeds (g), stem dry mass (g) and root dry mass (g). However, it was observed differences regarding the number of seedpods with three seeds among treatments, that is the greater values were observed in treatments 2 and 3, while treatment 4 was similar to standart. Treatments 2 and 4 propitiated the lower values of number of seedpods of two seeds, while treatment 3 propitiated the greater value on length in seedpods with a single seed. Although most of the variables evaluated did not show differentiated effects among the treatments, there was a tendency of positive response to the application of muriate of potash with micronutrients fertilizer, however, it was possible to observe the reduction of positive effects with an increase of Cu in relation to Zn in the fertilizer formula. That tendency may indicate an antagonistic effect between Cu and Zn, that is explained through the competition of bivalent cations by bearers in plasma membrane absorption sites.

Keywords: *Glycine max*, micronutrients, muriate of potash.
Financial support:

(8447 - 1984) Interaction between lime and zinc fertilizer in plant cane

Edilson Cavalli[1]; Estêvão Vicari Mellis[1]; Cleide Aparecida de Abreu[1]; Luiz Antonio Junqueira Teixeira[1]; José Antonio Quaggio[1]; Cassiano Cavalli[1]
Campinas Agronomic Institute / IAC[1]

Although the liming is common practice, it is observed in the literature little response to sugarcane. Recent studies showed positive increases in productivity of the plant cane with the application of Zn. Thus, the low sugarcane response to liming may occur due to Zn deficiency. The objective of this study was to evaluate the interaction between liming and fertilization with Zn in plant cane in tropical soils in São Paulo State, Brazil. The experiment was conducted on two types of soil, a clayey soil and other sandy, 4x4 factorial design with 5 replications arranged in randomized blocks. Treatments consisted of 4 managements liming: Dolomitic (DO), Dolomitic+10 kg ha^{-1} Zn (DO+Zn) Zincal (correction with 0.3% Zn in composition) (ZI) and Zincal + complement reaching 10 kg ha^{-1} Zn (ZI+Zn) and 4 of limestone (clay: 0, 1, 2, and 3 and sandy: 0, 1, 1.5 and 2 Mg ha^{-1}). The liming was applied in total area and Zn-sulfate in the furrow. Were evaluated cane yield (TCH), Zn content and the carbonic anhydrase enzyme activity in leaves. The results were compared by Tukey's test and regression analysis, 10% probability. The Zn content in the leaf showed response to managing in both soils. The averages obtained in clay soil were 16,7a; 16,4ab; 15,5b and 15,4b and 14,8ab; 16,0a; 13,6b and 13,9b in mg kg^{-1} in sandy soil, respectively for DO+Zn, ZI+Zn, DO e ZI. The activity of the carbonic anhydrase presented interaction between managements and rates. The regression was not significant for the ZI+Zn treatment in the clay soil and in the treatments with application of Zn-sulphate in the sandy soil. The effect is quadratic in clay soil for treatments: DO ($y=136.16+36.61x-11.64x^2$) DO+Zn ($y=129.55+108.22x-31.36x^2$) and ZI ($y=129,25+43,18x-13,54x^2$) and treatments DO ($y=137.31+61.55x-29.82x^2$) and ZI ($y=130,47+53,62x-26,38x^2$) in sandy. The TCH increased with the application of Zn-sulfate. There was interaction between management and rates only on clay soil. The management DO, DO+Zn and ZI+Zn, showed a quadratic response ($y=170,37+4,73x-5,07x^2$; $y=166,86+24,65x-7,56x^2$ e $y=167,76-12,04x+6,2x^2$, respectively). For ZIN management, the response was linear ($y=151.7+68,59x$). On sandy soil obtained answer to managements (97.1a; 95.4ab; 93.6b 92.8b and Mg ha^{-1}, respectively for ZI+Zn, DO+Zn, ZI and DO) and rates ($y=91.57+10.02x-4.47x^2$), was not observed interaction. Soil correction together with ZN-sulfate fertilization increased TCH, regardless of the limestone used.

Keywords: bioenergy, corrective soil, micronutrients, limestone
Financial support: CAPES and FUNDAG

(2132 - 2927) Intercalation of borate ions in layered double hydroxides: matrices for source of boron for plant growth

Gustavo Franco de Castro[1]; Jader Alves Ferreira[1]; Roberto Ferreira Novais[1]; Frederico Garcia Pinto[1]; Jairo Tronto[1]
Universidade Federal de Viçosa[1]

The increase of the absorption efficiency of Boron (B) by plants is essential for increasing crop productivity. The intercalation of B in Layered Double Hydroxides (LDH) is an alternative to evaluate how these materials can provide B to plants. This work thus had following objectives: to synthesize and characterize a magnesium and aluminum LDH intercalated with borate ions (Mg_2Al-B-LDH), and to evaluate, by means of a bioassay, the potential of the material produced as a matrix for storage and sustained release of B for plants. To characterize Mg_2Al-B-LDH, the following analysis techniques were used: X-ray powder diffraction (XRD), Fourier-transform infrared absorption spectroscopy with attenuated total reflectance (FTIR/ATR), Scanning Electron Microscopy (SEM), and Ultraviolet-Visible (UV-Vis) molecular absorption spectrophotometry. The treatments a biossay were defined by the combination of 2 x 6 factorial, two sources of B (LDH-B and boric acid) and six doses of B (0.0, 0.5, 1.0, 2.0, 3.0 and 5.0 mg dm^{-3}). The experimental design was performed in randomized blocks (RBD) with four replications. Four sunflower plants (*Helianthus annuus*) were cultivated in each pot. The results were submitted to analysis of variance and regression. The diffractogram profile is characteristic of LDH. For this material, the basal spacing value calculated by the Bragg law equation was 12.0 Å. The FTIR/ATR spectrum shown bands in the region between 1600 and 500 cm^{-1}, this bands are attributed to the various modes of vibration related to the presence of borate anions. The morphology of the Mg_2Al-B-LDH analyzed by SEM presented a surface with many spherical aggregates, with diameters varying between 1 and 5 µm. The total B content in Mg_2Al-B-LDH as determined by UV-Vis was 45.23

mg g^{-1} of B per LDH. For the plants that received the treatments with Mg_2Al-B-LDH and H_3BO_3, there was an increase in the dry matter (DM) and B content in the aerial part of the plants. DM production did not differ statistically in relation to the two sources of B used. Before cultivation, the pH presented average values between 5.73 and 6.15. This pH range, chemically classifies the soil as having medium to weak acidity. This acidity provided destabilization of the lamellar structure of Mg_2Al-B-LDH and the subsequent release of B. The no statistical difference for plant yield between the two sources of B suggests no stability of the Mg_2Al-B-LDH structure under the acidic condition of the soil.

Keywords: Slow-release fertilizer; plant nutrition; LDH matrix; micronutrient; bioassay.
Financial support: FAPEMIG, CAPES, CNPq

(9304 - 1708) Maize productivity due to the use of biofertilizers in seed treatment and nitrogenous fertilization

Sandro Moreth Borges Santos[1]; Adilson Pelá[1]; João Paulo Ferreira Lopes[1]; Lucas Brennon Romão Crispim[1]; Luiz Henrique Barros Cirino[1]
State University of Goias[1]

Corn (Zea mays L.) is one of the world's most important cereals because of its versatility of use in industry, food and feed. Fertilization is the factor that presents the highest contribution to corn yield, due to its highly demanding on nutrients, especially nitrogen. For a more sustainable management, it is necessary to use alternatives that reduce the use of inputs and the cost of production, such as biofertilizers. The objective of this work was to evaluate the action of the biofertilizer Bacsol + Orgasol on the efficiency of nitrogen fertilization in corn yield. The experiment was carried out on an Oxisol (17º 43 '07 "S, 48º 08' 42" W) in the agricultural year 2016/2017. The experimental design was a randomized block design, in a 5x2 factorial scheme, with four replications. The first factor consisted in the presence or absence of the Bacsol + Orgasol biofertilizer, containing rhizospheric microorganisms; the second factor was the nitrogen fertilization rates (0, 40, 80, 120 and 160 kg ha^{-1} of N). The plot consisted of eight planting lines with 5 m in length, spaced at 0.42 m. The plot area was the four central lines, discarding 0.5 m at each end. Seeding was done manually, aiming to obtain a population of 60,000 ha^{-1} plants of the simple hybrid SYN7205 TLTG Viptera. The application of the biofertilizer was done in the seed treatment. In the sowing fertilization, 30 kg ha^{-1} of N, 100 kg ha^{-1} of P_2O_5 and 75 kg ha^{-1} of K_2O were applied. The cover fertilization was done at the phenological stage V3, the haul in the planting line, using urea (45% N) as the source. Maize was harvested manually after the physiological maturation of the grains. The number of rows per scob, grain per row, dry mass of 1,000 grains and grain yield (14% moisture) were evaluated. Greater mass of 1,000 grains was verified with the application of the biofertilizer in the treatment of seeds, while the number of grains per row and rows per scob were not influenced. Higher yields were obtained when the biofertilizer Bacsol + Orgasol, 10,022 kg ha^{-1}, 578 kg ha^{-1} was used more than the treatments without inoculation, in the average of doses of N. The maximum yield was 10,729 kg ha^{-1} at the dose of 86.7 kg ha^{-1} of N in coverage when using biofertilizers in seed treatment. Without biofertilizer, the highest productivity was obtained with the dose of 93.1 kg ha^{-1} of N in coverage, of 9,975 kg ha^{-1}.

Keywords: production, microorganisms, bacsol, orgasol.
Financial support: Yukawa e Yukawa Comércio de Produtos Agropecuarios Ltda – Me

(9133 - 328) Morphophysiological and nutritional characteristics of pineapple cv. Pérola and their influence on size and fruit quality

André Guarçoni[1]; Sara Dousseau Arantes[2]; José Aires Ventura[2]
Instituto Capixaba de Pesquisa, Assistência Técnica e Extensão Rural (INCAPER) (guarconi@incaper.es.gov.br)[1]; Instituto Capixaba de Pesquisa, Assistência Técnica e Extensão Rural (INCAPER)[2]

The morphological, physiological and nutritional characteristics of pineapples, at the time of floral induction, have a great influence on crop productivity and fruit quality. The objective of this study was to determine the relationship between the morphological characteristics of 'D' leaf, the nutritional status of the plant, at the time of artificial floral induction, and the size and fruit quality of the pineapple cv. Pérola. In a 'Pérola' pineapple plantation, 120 plants were randomly marked and 'D' leaves were removed at the floral induction time. The pineapple plants were cropped and receiving the same cultural management, being identified in the field with the same numbers of 'D' leaves sampled. The variables of 'D' leaves (length-LL and fresh matter mass -FMM) were evaluated in cm and g, respectively, and the SPAD indices in the upper third (SAF) and the middle third (SMF) were measured with a portable chlorophyllometer. Thirty groups of samples were formed with four leaves each, considering the length of 'D' leaves, that is, the 'D' leaves were classified in ascending order of length, forming groups every four leaves. Three fractions of 'D' leaves were separated: apical fraction - upper third of 'D' leaf (AF), median fraction - middle of 'D' leaf (MF) and basal fraction - basal part aclorophyll of 'D' leaf (BF). The fractions were oven-dried at 70ºC, until reaching constant weight. The leaf fractions of the 30 groups were chemically analyzed for macro and micronutrient contents. After harvested, were determined the mass of the fruits with crowns (WHCM), mass of the fruits without crowns (WTCM), fruit length (FL), fruit circumference (FC), total soluble solids (TSS) and the titratable acidity of the pulp (TAP), determining the mean per sample. Correlation analyzes were performed between the leaf and fruit variables (30 samples each). The developmental characteristics of the leaf (LL and FMM) and the SPAD indices values (SAF and SMF) showed a significant and positive linear correlation ($r > 0,70$; $p > 0,01$) with the fruit growth variables (WHCM, WTCM, FL and FC), but not with the pulp quality characteristics (TSS and TAP). The apical fraction of 'D' leaf (AF) presented the highest levels of nutrients, with the exception of K and Zn. The median fraction of 'D' leaf (MF) must be analyzed for nutritional evaluation of 'Pérola' pineapple.

Keywords: *Ananas comosus*; 'D' leaf; floral induction; yield.
Financial support: Fundação de Amparo à Pesquisa e Inovação do Espírito Santo (FAPES)

(8586 - 2260) Multivariate analysis in corn cultivars productivity submitted to fertilization and spacing between rows

Joicelene Costa de Moraes[1]; Anailson de Sousa Alves[2]; Jackson de Mesquita Alves[2]; Luana Ribeiro de Andrade[3]; Suedêmio de Lima Silva[4]; Thainara Brenda Lameira das Neves[1]
Universidade Federal Rural da Amazônia[1]; Universidade Estadual do Maranhão[2]; Universidade Estadual da Paraíba[3]; Universidade Federal Rural do Semi-Árido[4]

The maize is important in various contexts of Brazilian agricultural production, both with regard to economic factors as the social factors. This study assessed through multivariate methods, the productive performance of maize cultivars in terms of three types of fertilization and row spacings, identifying the correlation between the variables and the group throughout the experiment. The experiment was conducted at the Experimental Farm Rafael Fernandes, in Mossoro, RN, adopting a randomized complete block design in a factorial 3 x 2 x 2, with four replications, and the treatments consisted of three fertilizer (AO - Organic fertilization; AOM - organic- mineral fertilization and AM - Mineral fertilization), two corn cultivars (Bras

3010 and Potiguar) and two row spacing (80 cm and 50 cm). The highest yield was obtained with the use of organic fertilizer in Potiguar spaced 80 cm between rows. The final population, productivity and thousand-grain weight were the components that most influenced the evaluation of all the data. Each corn cultivar evaluated responded differently to fertilization and evaluated spacings. The agreement between the results of cluster analysis and principal component analysis with the analysis of variance shows the appropriateness of multivariate statistical techniques used in this study. The combined use of multivariate techniques allowed inferring more safely in groups formed between treatments and their characteristics.

Keywords: organic-mineral fertilization; spatial arrangement.
Financial support: CAPES, BNB, UFERSA

(2999 - 644) N supply strategies to young vineyards at begging of production

Lincon Oliveira Stefanello[1]; Raíssa Schwalbert[1]; Raí Augusto Schwalbert[1]; Luana Paula Garlet[1]; Simoni Weide Belles[1]; Rodrigo Knevitz Hammerschmitt[1]; Beatriz Baticini Vitto[1]; Letícia Morsch[1]; Vanessa Marques[1]; Gustavo Brunetto[1]
UFSM[1]

Sandy soils with low organic matter content usually presents low nitrogen (N) availability to the vines and therefore mineral N supply is necessary. However, it is not sufficiently known which is the best way of supplying N, allowing rapid grapevine growth, maximum yield of grape, without depreciating the quality of the must. The study aimed to establish the most appropriate way of supplying N in vines at the beginning of production. The experiment was carried in vineyard implanted in 2011, in Santana do Livramento, region of Campanha Gaúcha - Rio Grande do Sul State, southern region of Brazil. Four years data were collected for this study. The cultivar was '*Alicante Bouschet*', grafted on the 'Paulsen 1103'. The vines were grown under the cordon training method, with spacing of 1.2 m between plants and 2.8 m between rows. The weather of the region is Cfa-subtropical, humid without drought. The soil is classified as a Typic Hapludalf. The experimental design was random blocks with five repetitions, each repetition was composed for five vines. The treatments were: without N application (WN), application of 20+20 kg N ha^{-1} without irrigation (NWI), application of 20+20 kg N ha^{-1} followed by irrigation (NFI), application of 20+20 kg N ha^{-1} via fertigation (NF) and application of 20 kg N ha^{-1} via fertigation (½ NF). Urea (45% N) was used as the N source. In treatments with N application via NWI and NFI, urea was applied to the soil surface in the crown projection of the plants. In NF and ½ NF, 1 kg N day^{-1} was supplied. During the flowering and veraison, the leaves located opposite to the bunch were collected to determination of the N concentration, and stem diameter measurements. Grape yield, number of cluster per plant, average weight of cluster and mass of 100 berries were determined in the end of each season. The total soluble solids (TSS), pH, total titratable acidity (TTA) and total anthocyanins (TA) were determined in must of berries. Vines cultivated in the soil submitted to the application of NFI and NF showed larger stem diameter, higher N concentrations in the leaves, higher grape yields and, the lowest values for TSS, TTA and TA, which is not desired. Increases in N uptake conducted to increases in grape yield, but depreciated the composition of the grape, which may negatively affect the quality of the wine. Vines submitted to WN and NWI presented lower grape yield, however, must of chemical composition more suitable for winemaking.

Keywords: fertigation, nitrogen management, yield
Financial support: CNPq; Fapergs; Finep

(4290 - 195) Nitrogen concentration and SPAD value in off-season maize intercropped with ruzi grass as a function of nitrogen topdressing fertilization

Karina Batista[1]; Waldssimiler Teixeira de Mattos[1]; Alessandra Aparecida Giacomini[1]; Luciana Gerdes[1]; Ivani Pozar Otsuk[1]
Instituto de Zootecnia[1]

The study of nitrogen topdressing fertilization in the off-season maize intercropped with ruzi grass in no-tillage system is of great importance since in the first five years of the adoption of the no-tillage system the requirement of N is high due to its immobilization. Researches showed that the relationship between the chlorophyll content determined by the chlorophyll meter in SPAD value and the concentration of N in the leaves of annual plants is promising to evaluate the nutritional status in relation to the nitrogen of these plants. Thus, starting from the hypothesis that there is competition for N among intercropped plants, the objective of this study was to evaluate the responses of the off-season maize intercropped with *Brachiaria ruziziensis* cv. Common (ruzi grass) in no-tillage system for nitrogen topdressing fertilization. The experiment was carried out in an Ultisol in the period from March 11, 2015 to October 5, 2015. The treatments were four nitrogen topdressing fertilization rates (0, 30, 60 and 90 kg ha^{-1}) in the off-season maize and in the ruzi grass. A randomized complete block design was used, with four replicates. N was supplied as ammonium nitrate. The SPAD value and the N concentration in the diagnostic leaves of the off-season maize on the occasion of its flowering were evaluated. All the results received the recommended statistical treatment, through the use of SAS, adopting the level of 5% of significance. The analysis of variance was performed by the F test and then the first and second degree regression study for the effect of N rates. The study of correlation between the variables was also performed. The SPAD value and the N concentration in the diagnostic leaves of the off-season maize at the time of flowering corresponded linearly to the N topdressing fertilization rates. It was observed a positive correlation between the SPAD value and the N concentration in the diagnostic leaves of the off-season maize. It was concluded that the nitrogen topdressing fertilization for the off-season maize intercropped with ruzi grass interferes with the concentration of N in the leaves of the off-season maize, and that the SPAD value can be indicative of the nutritional status in N of the off-season maize.

Keywords: diagnostic leaves; no-tillage; sustainability.
Financial support: Fundação Agrisus, Project Number 1334/14

(4844 - 1747) Nitrogen uptake and removal in normal and short cycle common bean cultivars

Fernando Vieira Costa Guidorizzi[1]; Rogério Peres Soratto[1]; Adalton Mazetti Fernandes[2]; Lohan de Oliveira Gomes Pinto[1]; Carolina Ragoni Maniero[1]; Gustavo Felipe Andrews da Silva[1]; Tiago Aranda Catuchi[3]
São Paulo State University (UNESP)-College of Agricultural Sciences, Department of Crop Science, Rua José Barbosa de Barros, nº1780, Botucatu, 18610-307, Brazil[1]; São Paulo State University (UNESP)-Center for Tropical Roots and Starches, Rua José Barbosa de Barros, nº1780, Botucatu, 18610-307, Brazil[2]; University of Western São Paulo, Rodovia Raposo Tavares, km 572, Presidente Prudente, 19026-310, Brazil[3]

Knowledge about nutrient uptake and removal is important for the management of fertilization in agricultural crops; however, in common bean cultivars with short cycle and determined growth habit there is little information about nitrogen (N) uptake and removal. The objective of this study was to evaluate the uptake along the cycle and the removal of N in the common bean cultivars Pérola (normal cycle and indeterminate growth habit) and IPR Andorinha (short cycle and determined growth habit). The experiment was conducted during "rainy season" of the growing season 2016/17 in a dystrophic Red Nitosol. The experiment was arranged in a randomized complete block design with split plots and four replications. Plots were composed of two cultivars and the subplots for seven sampling

periods during the common bean development cycle (14, 28, 42, 56, 70, 77, and 84 days after emergency (DAE)). The cultivars Pérola and IPR Andorinha showed low N uptake up to the sampling period at 14 DAE (first trifoliate leaf), in which they reached approximately 10% of the maximum N uptake. Subsequently, there was an increase in N uptake in both common bean cultivars up to 42 DAE (flowering), when cvs. Pérola and IPR Andorinha reached approximately 80 and 90% of the maximum N accumulation, respectively. Between sampling periods at 42 and 56 DAE (flowering and pod filling) occurred maximum N uptake in cv. IPR Andorinha (107 kg of N ha^{-1}), estimated at 55 DAE (filling of pods), while between at 56 and 70 DAE (pod formation and filling of pods), occurred maximum N uptake in cv. Pérola (116 kg of N ha^{-1}), estimated at 59 DAE (filling of pods). After 56 and 70 DAE, there was a reduction of about 10% of the N uptake by both common bean cultivars. Nitrogen removal was not statistically influenced by the cultivars, which may have occurred due to the similarity in N concentration in grains and grain yield. Nitrogen removal in cvs. Pérola and IPR Andorinha were 84 and 75 kg of N ha^{-1}, respectively. Therefore, it was possible to conclude that the cultivars IPR Andorinha and Pérola did not present important differences in the N uptake and removal.

Keywords: *Phaseolus vulgaris*; nitrogen accumulation; growth habit.
Financial support: CAPES, CNPq e FAPESP (Process nº 2016/18597-1).

(7726 - 1177) Number of leaves of safflower crop under soil moisture maintenance methods

Lucas Tavares Da Silva[1]; Tonny José Araújo da Silva[1]; Julyane Vieira Fontenelli[1]; Edna Maria Bonfim-Silva[1]; William Fenner[1]
UFMT[1]

Plant growth and development are directly influenced by the soil moisture. Thus, the correct management of soil moisture throughout the cycle is fundamental, with the objective of ensuring the adequate supply and distribution of soil water to supply the physiological demand and the vegetal production. When soil fertility is not limiting, water becomes the main limiting factor to growth and development, and its impact can be measured by morphometric characteristics, such as number of leaves. Thus, the objective was test soil moisture maintenance methods, evaluating the number of leaves in safflower crop, cultivated in a protected environment. The experiment was carried out at the Federal University of Mato Grosso, Campus of Rondonópolis, in a completely randomized design, with 4 soil moisture maintenance methods (Gravimetric, Irrigas, Tensiometer and Self-irrigation) and 8 replications in a greenhouse. The safflower cultivar used was IMA 0213, sown in the experimental plots, composed of pots of 3.18 dm^3, filled with Oxisol collected in the 0 - 0.2 m layer in an area of native Cerrado vegetation. After liming to raise base saturation to 60%, the soil remained incubated for 30 days. The soil was fertilized with 150 mg dm^{-3} of P_2O_5 (superphosphate simple), 100 mg dm^{-3} of K_2O (potassium chloride) and 15 mg dm^{-3} of FTE BR 12 to provide micronutrients. Nitrogen fertilization (200 mg dm^{-3}) was divided into three urea applications at 10, 20 and 40 days after emergence (DAE). The soil water retention characteristic was used for moisture management and humidity equivalent to 80% of field capacity for all treatments except the Self-irrigation. The soil moisture in the Gravimetric method was determined by mass difference. In Irrigas replacement was performed when the tension of 20 kPa was reached. For the Tensiometer the tension of 5 kPa was considered and for the Self-irrigation 3 kPa. The readings were performed at 7 and 14 h daily. Leaves count was performed at 15, 22, 29 and 69 DAE and data submitted to ANOVA and Tukey test at 5% probability. The average leaves production was 22.41, 48.53, 59.59 and 134.38 leaves per pot at 15, 22, 29 and 69 DAE, respectively. At 69 DAE, Gravimetric differed significantly from the Irrigas, Tensiometer and Self-irrigation methods with the highest number of leaves.

Keywords: *Carthamus tinctorius* L., soil water, plant development, tensiometry, plant development
Financial support:

(5354 - 1038) Number of Safflower leaves submitted to doses of vegetal ash and soil compaction levels in Oxisol

Horácio Manfrin Mazero[1]; Edna Maria Bonfim-Silva[1]; Túlio Martinez Santos[1]; Tonny José Araújo da Silva[1]
Universidade Federal de Mato Grosso[1]

Soil compaction and poor fertility are important limiting factors for agricultural production. Besides that, there are economic and environmental requirements to apply wastes, such as vegetable ash, to fertilize the soil. In this context, the scope of this study was to evaluate the effect of vegetal ash doses coupled to levels of soil compaction in the numbering of safflower leaves. The experiment was performed in a greenhouse under randomized complete block design with five levels of soil compaction (1.0, 1.2, 1.4, 1.6 and 1.8 Mg m^{-3}) and fertilized with five vegetable ash doses (0, 8, 16, 24, 32 g dm^{-3}). The applications of the ash doses occurred immediately after the gathering of the soil according to the respective treatments. Each experimental unit was formed a PVC vase with three isometric rings attached by silver tape. The vases had 200 mm of internal diameter and 300 mm of height, with a total of 9.4 dm^3 of soil. The intermediate ring was compacted using the hydraulic press (P15ST, BOVENAU) according to the treatments, while the upper and lower rings were filled with soil with a density of 1.0 Mg m^{-3}. Because no nitrogen was expected to exist in the vegetal ash due to its loss by combustion, fertilization with nitrogen of 150 mg dm^{-3} was performed in all vessels to meet the plant's needs. This fertilization was divided in three fortnightly applications from the 15th day after emergence (DAE): 40, 55 and 55 mg dm^{-3} at 15, 30 and 45 DAE, respectively. The results (number of leaves) were submitted to analysis of variance and significance was verified to the regression analysis using the SISVAR software with significance of 5%. The number of leaves variation occurred linearly for both ash doses and soil compaction levels, being a positive correlation for the increase of the doses, and negative for the elevation of the compaction levels. On the 15th day, the best results (5.88 leaves per plant) were observed in the highest dose of vegetable ash (32 g dm^{-3}), and there was no statistical difference in the results for different compaction levels. On the 30th day, the best treatments provided 29.43 leaves, observed for 32 g dm^{-3} of dose and 1.4 Mg m^{-3} of compaction. Finally, on the 45th day, the best treatments provided 55.63 leaves per plant, observed for 24 g dm^{-3} of dose and 1.0 Mg m^{-3} of compaction. The number of leaves of the safflower cultivated in the Oxisol from Cerrado was influenced by fertilization with vegetal ash and soil compaction levels.

Keywords: Soil density; solid residue destination in agriculture; *Carthamus tinctorius* L.
Financial support:

(3162 - 638) Phosphorus forms in organs of *Cordia trichotoma* subjected the phosphate fertilization

Matheus Severo de Souza Kulmann[1]; Lincon Oliveira Stefanello[1]; Yohana Porto Calegari Alves[1]; Álvaro Luís Pasquetti Berghetti[1]; Wagner Squizani Arruda[1]; Simone Weide Belles[1]; Rodrigo Otavio Schneider Souza[1]; Jacson Hindesrmann[1]; Maristela Machado Araujo[1]; Gustavo Brunetto[1]

UFSM[1]

The Louro-Pardo (*Cordia trichotoma*) has high potential for reforestation, because it has a rapid increase in biomass and wood of density high. However, it has higher productivity and better growth when grown on fertile soils. Therefore, when the need is diagnosed, nutrients are supplied, such as phosphorus (P). However, in plants of *Cordia trichotoma* in growing, it is not known if the application of P doses and the increase of their availability in the soil, it can modify a distribution of forms of P, as P_{SI} and P_{SO} in interior of the plant, and increase the production of biomass. This study aimed to evaluate the distribution of forms of P in organs of *Cordia trichotoma* grown in Argissolo Vermelho Distrófico arênico subjected to the application of 0, 120 and 360 kg P_2O_5 ha^{-1}. After 24 months of fertilization, the plants of *Cordia trichotoma* were cut and removed. The roots, leaves, branches and stems were collected, dried, weighed and ground. The tissues of the organs were subjected to chemical forms of P, which estimates forms of total soluble P (P_{ST}), soluble inorganic P (P_{SI}), soluble organic P (P_{SO}) (difference between P_{ST} and P_{SI}). The highest production of dry matter of stem, branches and leaves for observation in plants grown with 120 kg P_2O_5 ha^{-1}, followed by plants grown with 360 kg P_2O_5 ha^{-1} and those without P. The highest production of dry matter root was observed in the plants grown with 120 kg P_2O_5 ha^{-1}, followed of plants subjected the application of 360 kg P_2O_5 ha^{-1} and those without application of P. P in the tissue of annual organs, as leaves, of *Cordia trichotoma* was preferentially accumulated in soluble inorganic (P_{SI}), in plants grown in the soil without application of P and with the addition of 120 and 360 kg P_2O_5 ha^{-1}. On the other hand, P in perennial organs, such as stems and branches, was preferentially accumulated in soluble organic (P_{SO}), in plants grown in the soil without application of P and with the addition of 120 and 360 kg P_2O_5 ha^{-1}. The application of the higher dose of P (360 kg P_2O_5 ha^{-1}) stimulated the accumulation of P preferentially in the forms soluble organic (P_{SO}) in roots, as a reserve organ. Plants of *Cordia trichotoma* grown with 120 kg P_2O_5 ha^{-1} had more efficient use of P available in the soil, using P within the plant in its metabolism, in the form P_{SI}, allowing the increase of cell membrane complexes, such as thylakoid, allowing a higher photosynthetic rate by the plant, which stimulated biomass production.

Keywords: Phosphate fertilization; Chemical fractionation of phosphorus in tissue; Plant P distribution

Financial support: Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq); Fundação de Amparo à pesquisa do Estado do RS (FAPERGS); Financiadora de Estudos e Projetos (FINEP)

(5874 - 891) Photosynthesis in young peach trees submitted to application of nitrogen sources in soil with and without presence of cover crops

Betania Vahl de Paula[1]; Álvaro Luis Pasquetti Berghetti[2]; Camila Peligrinotti Tarouco[2]; Beatriz Baticini Vitto[2]; Gabriel Alberto Sans[2]; Luana Paula Garlet[2]; Wagner Squizani de Arruda[2]; George Wellington Bastos de Melo[3]; Carlos Alberto Ceretta[2]; Gustavo Brunetto[2]
Federal University of Santa Maria, Av. Roraima nº 1000, Camobi, Santa Maria - RS, CEP: 9710500, Brazil. behdepaula@hotmail.com.[1]; Federal University of Santa Maria, Av. Roraima nº 1000, Camobi, Santa Maria - RS, CEP: 97105-900, Brazil.[2]; Embrapa Uva e Vinho, Livramento Street, 515, CEP: 95701-008 - Bento Gonçalves – RS, Brazil.[3]

The Peach Tree (*Prunus persica* L.) is the third most fruit tree species in the world, behind apple and pear trees. Nitrogen (N) is extremely important for plant nutrition, especially as it is an essential constituent of proteins and directly interferes with the photosynthetic process, being present in the chloroplasts as a constituent of the chlorophyll molecule. However, the information on the best sources of N to be applied to young Peach Trees with presence or absence of cover crops in the planting line still are scarce. The study aimed to evaluate the photosynthetic parameters in young Peach Tree with application of N sources, with and without presence of cover crops. The experiment was conducted in greenhouse from October 2016 to April 2017. Plants of the cultivar Chimarrita, grafted on the one year old Capedebosq rootstock, were transplanted in pots containing samples of Humic Cambisol soil, normally cultivated with Peach Trees in the Brazil. After 15 days of the Peach Tree transplant, six shoots of *Paspalum notatum* were transplanted into 50% of the pots. After 21 days, the following treatments were installed: Control (cultivation of Peach without fertilization and without cover crops), urea (U), urea + cover crops (UPC), organic compost (C), organic compost + cover crops (CPC) and cover crops plans (PC). The dose of urea and organic compost was equivalent to 40 kg N ha^{-1}. The experimental design was completely randomized, with 5 replicates. The photosynthetic parameters were evaluated at 120 days after the experiment was installed, using the portable infrared analyzer LI-COR (IRGA), model LI-6400 XT, we evaluated the net assimilation rate of CO_2 (μmol CO_2 m^2s^1), water use efficiency (mol CO_2 mol H_2O), and the carboxylation efficiency of Rubisco. The minimum fluorescence (F_0), maximum fluorescence (F_m) and electron transport rate (ETR) was evaluated using portable modulated light fluorometer (JUNIOR-PAM). The N sources used did not showed difference between the treatments. However, Peach plants cultivated without intercropping with cover crops presented higher rates of CO_2 net assimilation, higher water use and Rubisco carboxylation efficiency, as well as higher ETR and lower F_m. This suggests that when there are cohabiting plants with peach trees, which do not yet have a large volume of roots, there is competition for water and nutrients between the two species, causing a negative effect on the physiological parameters of the Peach plants.

Keywords: Nitrogen fertilization, Prunus persica, Paspalum notatum.
Financial support: Cnpq, Capes, Fapergs, Embrapa Uva e Vinho and Embrapa Clima Temperado.

(2480 - 242) Photosynthetic activity of upland rice plants in response to selenium applicationPhotosynthetic activity of upland rice plants in response to selenium application

Maria Luiza Nunes Palone Fauvel[1]; Eduardo Henrique Marcandalli Boleta[1]; André Rodrigues dos Reis[2]
São Paulo State University - UNESP/Ilha Solteira[1]; São Paulo State University - UNESP/Tupã[2]

Selenium (Se) is an essential element for humans and animals due to antioxidative properties. There are conclusive evidences about Se deficiency in Brazilian soils. The application of Se in low concentration can decrease the lipid peroxidation, enhance the antioxidant metabolism and photosynthesis of plants. Agronomic biofortification through fertilizer application, is a good strategy to increase the Se concentration in plants. This study aimed to evaluate the photosynthetic activity of upland rice plants in response to Se rates and application methods (foliar and soil). The experimental design used was randomized blocks containing 7 rates of Se (0; 2,5; 5; 7,5; 10; 15; 20 g ha^{-1}) via soil application and 7 rates of Se (0; 1; 2; 4; 6; 8; 10; g ha^{-1}) via foliar application. Sodium selenate was used, as Se source applied to BRS Esmeralda cultivar. After 15 days of Se application, the net photosynthesis was analyzed using a portable system of infrared

gas analyzer (LC pro-SD – ADC BioScientific Ltda., Herts, UK). The CO_2 liquid assimilation (A, µmol CO_2 m^{-2} s^{-1}) and the stomatal conductance (Gs, mol H_2O m^{-2} s^{-1}) were measured. Soil and foliar Se application increased significantly the A rates. The largest doses of soil and foliar application increased 31,89% and 63,44%, respectively, when compared to the control. The Gs increased up to 10 g ha^{-1} of Se via soil, and up to 2 g ha^{-1} via foliar application. The increase of A and Gs in response to Se application suggest the protective effect of Se to rice plants. The application of Se up to 20 g ha^{-1} via soil and 10 g ha^{-1} via foliar increased the photosynthetic activity of rice plants.

Keywords: Selenium, photosynthesis, antioxidation
Financial support: FAPESP (Process: 2016/19937-0)

(8822 - 674) Physico-Chemical Properties of Soil in Sweetpotato Cultivated Area in Korea

Kyeong-Bo Lee[1]; Sang-Sik Nam, Yong-Gu Kang, Jung-Wook Yang, Gyeong-Dan Yu, Seung-Yong Lee, Hyeong-Un Lee, Eung-Gi Je[1]
National Institute of Crop Science, RDA[1]

Sweetpotato [*Ipomoea batatas* (L) Lam.] cultivated area has grown at a rapid rate over the past several years in Korea and the area spread to 20 thousands hectares. The production per unit was 15 ton/ha which has been stable since 2000. The average production in 2016 was 341 thousand M/T which was 79% in 1990's. About 30 cultivars used for eating, processing, viewing and brewing etc. have been bred since 1990. The latest cultivars are the most popular because of their resistance against disease and their production quality. The largest cultivated area of sweetpotato in Korea is Jeonnam-province (24.9%) followed by Jeonbuk (18%), Gyeonggi (15.6%) and Chungnam (14%) province, respectively. The quality of sweetpotato is dependent on various features of cultivated soil environment. For that reason, we analyzed and evaluated the physico-chemical properties of soil of major cultivated area in order to provide baseline data for researching the quality characteristics of sweetpotato. Physico-chemical properties includes soil pH, organic matter, P_2O_5 content, T-N content, potassium, calcium and magnesium content. The regions that we chose were Icheon, Wonju, Yoeju, Ganghwa, Nonsan, Gochang, Gimje, Iksan, Muan and Haenam. The soil texture of Gimje, Iksan and Haenam were loam and the others were sandy loam. The regions which have sandy loam were consisted of sand (53~72%), silt (21~34%) and clay (6~18%). Result showed that, the pH of these areas were 5.3~7.2 and organic matter content was 3.2~16.8 g/kg which was lower than the other fields. As of the P_2O_5 content, it ranges from 72 to 221 mg/kg, Gochang (31 mg/kg) and Haenam (5 mg/kg) is tend to be lower than the other area. The T-N content varied from 0.02~0.08%. In regard of exchangeable cation, potassium content varied from 0.3~0.6 $cmol^+$/kg, where calcium and magnesium content were 1.8~8.8 $cmol^+$/kg and 1.1~8.0 $cmol^+$/kg, respectively. Icheon and Yeoju has the least content of exchange cation capacity (CEC) whose range was 7.4~8.9 $cmol^+$/kg and on the contrary, Haenam showed the most 13.1~14.5 $cmol^+$/kg.

Keywords: Sweetpotato, Soil properties, Sweetpotato cultivated area, Korea
Financial support:

(5340 - 3033) Physiological responses to differencial boron fertilization on soybean of brazilian Cerrado

Larissa Urzêdo Rodrigues[1]; Antônio Carlos Martins dos Santos[2]; Vitor de Laia Nascimento[2]; Fernando Machado Haesbaert[2]; Rubens Ribeiro da Silva[2]
Plant Production Graduate Program, Universidade Federal do Tocantins, Gurupi, Tocantins, Brazil[1]; Plant Production Graduate Program, Universidade Federal do Tocantins, Gurupi, Tocantins, Brazi[2]

Soybean is one of the main crops in Brazil and the Tocantins state comes every year increasing production and yield of this crop. A bottleneck for this increase is the management of macro and micronutrients in the Cerrado soil. Boron (B) is a micronutrient that has influence on plant physiology and growth, and one of the most demanded by the soybean. The strategies to complement the supply of B to crops are the fertilization via soil and the foliar application. Considering that soybean requires specific amounts of B for optimal yield and quality, it is necessary that ideal dose for each soil be established. The aim of this work was to use non-destructive physiological tools to evaluate the efficiency of B fertilization via soil and leaves in the soybean crop in the Tocantins Cerrado. The experiment was conducted in greenhouse with semi-automated irrigation system, plants grown in pots with 7.0 kg of soil (yellow latosol) and the experimental design was completely randomized in a 4x5 factorial scheme with four replications. The cultivar used was M8808Ipro. Treatments consisted of four doses of boric acid (the form that B is absorbed by plants) on soil (0; 2; 7; 40 kg ha^{-1}), done at the time of sowing, and five doses of boric acid on leaves (0; 0.5; 1.0; 1.5; and 2.0 kg ha^{-1}), applied during development. Here we analyzed photosynthetic pigments content (chlorophyll *a*, *b*, total, and *a*/*b* ratio, with ClorofiLOG®), as well as gas exchange (photosynthesis, transpiration, stomatal conductance, internal CO_2 concentration, and water use efficiency, with Infrared Gas Analyzer - IRGA), in two phenological stages, vegetative and reproductive. All variables presented interaction among the factors, demonstrating that these non-destructive physiological parameters are interesting tools in the study of micronutrient fertilization management. It is noteworthy that in the vegetative stage the low concentration of B via foliar application associated with low or none application of B in the soil were the best results of chlorophylls contents and photosynthetic rate demonstrating that high doses of B, even without presenting phytotoxicity, can be harmful to plant growth. Finally, for non-destructive physiological characteristics here analyzed, leaf fertilization presented better performance compared to soil fertilization. However, for the confirmation of these results it is necessary the growth and productivity analysis of the soybean at the end of the experiment.

Keywords: boron; micronutrients; non-destructive analysis; photosynthesis
Financial support: CAPES; CNPq

(5646 - 1704) Potassium doses in the cultivation of tomato (Solanum lycopersicum) for the industry

Eli Pereira Jesus[1]; Bruno Bernardes de Andrade[1]
Centro Universitário de Patos de Minas - UNIPAM[1]

The tomato is one of the most consumed vegetable products in the world, whether in natura or industrialized (extracts, sauce and ketchup) and widely cultivated in Brazil, characterized as a very demanding nutrient culture where potassium is the most demanded, followed by nitrogen and calcium. In the Patos de Minas region, the cultivation of tomatoes destined to the processing occurs not only for commercial interest, but also as an alternative for soil nutrient cycling and reduction of pest and disease pressure in the region's crops. The supply of potassium to the plants, according to the literature, varies between 50 and 250 kg ha^{-1} of K_2O, which are lower than those used in Brazilian crops, which can be considered as lagged. The objective of this work was to evaluate the productivity of tomatoes as a function of different doses of potassium (378, 428, 478, 528, 578 kg ha^{-1} K_2O) using potassium chloride as the source. The experiment was carried out in May/17, in a pivotal pivot, located in Patos de Minas - MG, Brazil, using the hybrid HMX 7885 F1, with an experimental design in

a randomized complete block design (DBC) with five treatments and four replications. The leaves were collected randomly to determine the foliar content of potassium. The mean productivity (t ha^{-1}), mean fruit weight (kg), number of fruits per plant were also evaluated. The data averages were submitted to analysis of variance with the help of Sisvar software. There was no adjustment of the regression model indicating that there was no significant statistical difference for the K_2O doses on the characteristics studied. The results show that the dose of 378 kg ha^{-1} promoted higher productivity indexes (128.28 t ha^{-1}), a higher average number of fruits per plant (103.88), and it was possible to infer that this dose should serve as a delivery ceiling of potassium to the tomato. Although the increase in the potassium dose reduced the yield of the crop, all the treatments provided an average productivity higher than the national one. The leaf contents varied between 2.858 and 3.193% for the doses of 428 and 528 kg K_2O ha^{-1} respectively. The use of new genetic materials with high productive potential reinforces, as well as the results obtained in this work support the need in the development of studies to supply not only potassium but all nutrients for the tomato crop.

Keywords: Horticulture, pant nutrition, K_2O

Financial support: Centro Universitário de Patos de Minas – UNIPAM

(9231 - 639) Potassium extracted by Ammonium acetate, Mehlich-3 and Sodium tetraphenylboron methods and their relationships with mineralogy in soils under agricultural systems in Uruguay

Marcelo G. Ferrando[1]; Mónica M. Barbazán[1]

Facultad de Agronomía, Universidad de la República[1]

Most methods of soil analysis to evaluate the supply of potassium (K) for the plants measure a proportion of the total exchangeable K of soil. The neutral 1 N ammonium acetate (NH_4OAc) is the conventional extractant, although other methods such as Mehlich-3 (M3) test, are being rapidly adopted, since they allow the simultaneous extraction of several elements in a single procedure. However, these methods do not estimate the nonexchangeable K held in the interlayers of the expandable clays minerals, which can be released to exchangeable or available forms in the medium and long term. The sodium tetraphenylboron ($NaBPh_4$) method has been proposed to improve the predictions of K available for the plants, since it estimates not only the exchangeable K, but also a proportion of that K held in the micas's interlayers. Were analyzed 412 soil samples from different agricultural soils in Uruguay, including a wide range of textural classes, different parent materials, history of K fertilization, K content and availability for plants. The K was extracted using NH_4OAc, M3 and $NaBPh_4$ (5-min extraction period). It was also analyzed the mineralogy of the clay fraction of most soils by X-ray diffraction analysis. Results showed a very strong correlation between the extraction of K with M3 and NH_4OAc (R^2=0,90), although the amounts extracted whit M3 were somewhat lower. The $NaBPh_4$ solution extracted between 1.5 and 2 times more K than the other solutions and allowed to groupe soils with different non-exchangeable K reserves, frequently associated with the presence of illite as the main clay fraction mineral.

Keywords: Soil analysis, Nonexchangeable K, illite

Financial support: IPNI-Canpotex

(7055 - 2435) Potassium increases production and reduces the oxidative stress of Tanzania guinea grass used for cadmium phytoextraction

Ellen Cristina Alves de Anicésio[1]; Francisco Antonio Monteiro[1]

Escola Superior de Agricultura "Luiz de Queiroz" - ESALQ/USP[1]

Cadmium (Cd) is considered a serious environmental problem due to its high toxicity to living organisms. This metal induces oxidative stress causing negative impacts on plant growth and development. The potassium (K) supply is one strategy to increase the tolerance of tanzania guinea grass (*Panicum maximum* Jacq. cv. Tanzania) exposed to Cd toxicity. The aim of this study was to verify the influence of K on reducing the toxic effects of Cd in tanzania guinea grass used for phytoextraction of this metal. Plants were grown in a greenhouse, in a randomized complete block design, using a 3x4 factorial, with six replications. Three rates of K (0.4, 6.0 and 11.6 mmol L^{-1}) were combined with four rates of Cd (0.0, 0.5, 1.0 and 1.5 mmol L^{-1}) in nutrient solution. Two plant growth periods were evaluated. The first harvest was done at 35 days after seedlings transplanting to the pots and the second at 27 days after the first. In the second growth, Cd was not added in the nutrient solution. At the harvest, shoots were separated in recently fully expanded leaf laminae (LR) and other parts (DP). The Cd concentration in LR in both harvests and in the roots increased with the rate of Cd. In the second harvest, in medium to high Cd rates (0.5 to 1.5 mmol L^{-1}), the higher K supply favored the highest Cd concentration in the plant tissue. The increase of the K rates provided higher Cd accumulation in shoots collected in both harvests, increasing the Cd-phytoextraction potential of tanzania guinea grass. In the first harvest, the higher availability of cadmium (1.5 mmol L^{-1}) resulted in lower shoot dry mass production due to the increase (35%) in malondialdehyde (MDA) concentration in the DP. However, the K supply in plants exposed to Cd provided a reduction of the MDA concentration of the LR. In the second harvest, the higher K availability (11.6 mmol L^{-1}) provided higher shoot growth, under conditions of moderate toxicity (residual effect of Cd), due to the 26% reduction in MDA concentration of the DP. These results indicate that the K reduces oxidative stress of plants exposed to Cd toxicity, increasing shoot dry mass production. The increase in Cd concentration in plant tissues associated with higher production of dry mass indicate that the supply of K increases the Cd-phytoextraction potential of tanzania guinea grass.

Keywords: heavy metal, nutrition of forage plants, *Panicum maximum*, phytoremediation.

Financial support: Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq); Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP).

(7956 - 758) Productive and nutritional characteristics of wheat cultivar brs 394, fertilized and irrigated with nitrogen and sulfur in the brazilian Cerrado

Edna Maria Bonfim-Silva[1]; Tonny Jose Araujo da Silva[1]; Thiago Henrique Ferreira Matos Castañon[1]; William Fenner2.[1]

UFMT[1]

Wheat (*Triticum aestivum* L.) is one of the main cereal cultivated in the world. In Brazil, wheat cultivation is concentrated in the southern region, characterized by mild temperatures and regular precipitation throughout the year. However, the Central-West region, in which the Cerrado biome is located, has great potential for wheat cultivation, in an irrigated regime during the off-season (months from April to September). Thus, the objective of this study was to evaluate the nitrogen concentration in the leaves and the number of wheat spikes cultivar BRS 394, irrigated and submitted to combinations of nitrogen and sulfur doses. The research was carried out in 2017 at the Federal University of Mato Grosso, Rondonópolis Mato Grosso, Brazil (16°27'54.98" S and 54°34'41.75" W). The soil of the area was classified as Oxisol. The experiment was in randomized block design in factorial scheme 5^2 fractionated with four replicates. The treatments were five nitrogen doses (0, 70, 140, 210 and 280 kg ha^{-1}) combined with five doses of sulfur (0, 25, 50, 75 and 100 kg ha^{-1}). The sources of fertilizers used were urea (45% N) and elemental sulfur (97% S). BRS 394 wheat cultivar is classified as early cycle. Irrigation was a self-propelled irrigation system with adapted irrigation bar. The evaluated

variables were nitrogen concentration in the diagnostic leaves (leaves +1 and +2) at 45 days after emergence of the plants and the number of spikes per m². The variables were significant only for nitrogen doses. The nitrogen concentration in the leaves was adjusted to the quadratic regression model, with the highest concentration (40 g kg^{-1}) at the nitrogen dose 280 kg ha^{-1}. The number of spikes was adjusted to the quadratic model of regression, with the largest number (387 spikes m^{-2}) in the nitrogen dose of 170 kg ha^{-1}. Nitrogen fertilization increases the nitrogen concentration in the leaf and the number of spikes of wheat. Sulfur does not influence the concentration of nitrogen in the leaves and the number of spikes when cultivated in Oxisol of the Brazilian Cerrado.

Keywords: *Triticum aestivum* L., Nitrogen fertilization; Sulphur fertilization; Wheat in the Cerrado.
Financial support: NATIONAL COUNCIL FOR SCIENTIFIC AND TECHNOLOGICAL DEVELOPMENT (CNPq)

(5565 - 319) Productive components and yield of corn with *Azospiriilum brasilense* associated with silicon and nitrogen doses

Fernando Shintate Galindo[1]; Marcelo Carvalho Minhoto Teixeira Filho[1]; Salatiér Buzetti[1]; Willian Lima Rodrigues[1]; Eduardo Henrique Marcandalli Boleta[1]; José Mateus Kondo Santini[1]; Poliana Aparecida Leonel Rosa[1]; Rafaela Neris Gaspareto[1]
FEIS/UNESP[1]

Azospirillum brasilense is a bacterium that stands out for its biological nitrogen fixation (BNF) in corn crops. However, there is a lack of more comprehensive research defining how much mineral N can be applied as regards the efficiency of BNF to attain high, economically sustainable yields. Moreover, it would be interesting to investigate the use of silicon, which exerts numerous benefits on grasses, especially when the plants are subjected to biotic and abiotic stresses. The aim of this work was to study a synergistic effect between the inoculation with *A. brasilense* and the application of silicon, thus enabling a higher efficiency of nitrogen fertilization, evaluating the productive componentes (number of grains per spike, 100 grains mass, harvest index) and grain yield of irrigated corn. The experiment was conducted in Selvíria, MS, Brazil, which had been cultivated with annual crops for over 28 years, with the last 11 years under the no-till system, and the crops prior to corn were corn and wheat, respectively, on a Latossolo Vermelho distrófico (Oxisol) in 2015/2016 crop. The experiment was set up as a randomized block design with four replications, in a 2 × 5 × 2 factorial arrangement consisting of two soil corrective sources (dolomitic limestone PRNT = 80%, CaO = 28% and MgO = 20% and silicate of Ca and Mg as Si source PRNT = 88%, Ca = 25%, Mg = 6% and Si total = 10%); five doses of N (0, 50, 100, 150 and 200 kg ha^{-1}); with and without inoculation with *A. brasilense*. N doses influenced positively 100 grain mass and harvest index, with adjustment to the linear increasing function. The interaction between doses and inoculation was significant for the number of grains per spike and grain yield. The treatments without inoculation set to the linear increasing function, and the treatments with inoculation set to the quadratic funtion until the doses of 150 and 155 kg ha^{-1} of N for grains per spike and grain yield, respectively. At the dose of 200 kg ha^{-1}, the inoculated treatments promoted higher grain yield. The interaction between doses and sources of acidity correctives was also significant, with positive linear adjustment for dolomitic limestone and quadratic adjustment for Ca and Mg silicate until the dose of 138 kg ha^{-1}. At the dose of 200 kg ha^{-1}, the utilization of dolomitc limestone promoted higher grain yield.

Keywords: *Zea mays*, biological nitrogen fixation in grasses, plant growth promoting bacteria, silicon application, grain yield
Financial support: Fundação de Amparo à Pequisa do Estado de São Paulo - FAPESP, process number: 2017/06002-6

(4677 - 2824) Productivity and nutritional status of maize grown under different dosages of nitrogen, phosphorus and potassium.

José Lucas Farias da Silva[1]; Renato Lemos dos Santos[1]; Maria José Alves de Moura[1]; Victor Hugo de Farias Guedes[1]; José de Arruda Barbosa[1]; Nayara Rose da Conceição Lopes[1]; Evaldo Barbosa de França Júnior[1]; Lyllian Brunelly dos Santos[1]; Larissa Grasiela de Arruda Ferreira Costa[1]; Diego Moura de Andrade Oliveira[1]; Wellisson José Maurício de Andrade[1]; Alisson Rodrigues Galvão da Silva[1]
IFPE[1]

The expression of the genetic potential of maize production requires adequate nutrition, which is usually favored by fertilization. However, the dosages traditionally recommended are outdated in relation to the need of the crop, and should be based on nutrient extraction. The objective of this work was to evaluate the effect of N, P and K dosages on nutritional status and biomass production of the maize. The experiment was developed at Fazenda Cipoal, in Passira-PE, from September to December 2017. The hybrid maize genotype AG 8677 VT PRO 3 was submitted to five treatments, varying dosages, in kg ha^{-1}, de N, P_2O_5 e K_2O, as follows: 200, 104 and 120, T1; 200, 104 and 240, T2; 200, 50 and 240, T3; 240, 104 and 280, T4; and 240, 50 and 280, T5. The experiment was a randomized block design, with four replications. Each plot is 39.2 m², with five plants per m². At 65 days after planting (DAP), index leaves were collected to evaluate the nutritional status of the crop, determining the N, P, K, Ca and S content. The nutritional evaluation was performed using the range of sufficiency. For the evaluation of the fresh matter production of the aerial part (MFPA), at the 70 DAP the cutting and the weighing of the plants were performed. The product of the number of plants per meter and the fresh mass of the plants estimated the production of the crop. The data were submitted to analysis of variance by the F test ($p < 0.05$), when observed significant effect, was applied or Scott-Knott's test ($p < 0.05$). When using the sufficiency range, it was observed that in all treatments maize was fed N, K and Ca, and the P content was below the sufficiency range. S levels did not present within the sufficiency range, only when T2 treatment was received. In general, T4 provided levels above the target stipulated by the sufficiency range for the crop. At 70 DAP, the highest productivity of MFPA was observed in T4, 68.87 Mg ha^{-1}, a value above the crop yield average of 45 Mg ha^{-1}. T1 presented the lowest productivity among treatments. The production of MFPA between treatments T2, T3 and T5, was intermediate to treatments T1 and T4, but similar to each other. The application of 240 kg ha^{-1} of N, 104 kg ha^{-1} of P_2O_5 and 280 kg ha^{-1} of K_2O, based on the extraction and the K/N ratio, provided the maize with better nutrition, resulting in higher productivity of aerial biomass.

Keywords: *Zea mays* L.; fertilization recommendation; K/N ratio; nutrient extraction; productivity.
Financial support: IFPE, Fazenda Cipoal.

(6655 - 2877) Productivity of the sugar cane in the second cycle, cultivated under nitrogen and molybdenum fertilization

Wellisson José Maurío De Andrade[1]; Renato Lemos Dos Santos[1]; Diego Moura De Andrade Oliveira[1]; José De Arruda Barbosa[1]; Maria José Alves De Moura[1]; Nayara Rose Da Conceição Lopes[1]; Victor Hugo De Farias Guedes[1]; Larissa Grasiela De Arruda Ferreira Costa[1]; Lyllian Brunelly Dos Santos[1]; Lluan Dos Santos Costa Ataide[1]; Monalisa Barbosa Da Costa[2]; José Lucas Farias Da Silva[1]

IFPE[1]; UFPE[2]

The production of sugarcane in Brazil stands out with most of the sugar marketed worldwide. Nitrogen (N) is one of the nutrients most absorbed by the crop. Reductions in their availability and absorption lead to loss of productivity. Molybdenum (Mo) is a micronutrient, of extreme importance for sugarcane, because it acts in the assimilation and fixation of the N, promoting greater absorption of the nutrient, raising productivity. The objective of this work was to evaluate the effect of nitrogen and molybdenum fertilization on yield of stalks and sugar in the second cycle of sugarcane. Methodology – The experiment was conducted at the Plant of the JB Group, located in rural area of the city of Vitória de Santo Antão-PE. It was started in March 2017, in the second cycle of the crop. The variety used was SP 933094. It was submitted to four doses of Mo (0, 100, 200 and 400 g ha^{-1}) and three doses of N (0, 60 and 120 kg ha^{-1}), using four repetitions, arranged casually in blocks. 300 days after the cut (DAC) was evaluated the yield of stalk (TCH), estimated by the mass of three stalks per plot and the number of plants per meter in each plot. In the stalk was determined the Pol of the corrected sugarcane (PCC), according to the methodology of CONSECANA (2006). The ton of Pol per hectare (TPH) was estimated by the equation: TPH = TCH × PCC/100, according to LIMA NETO ET AL. (2013). Data were submitted to analysis of variance (Test F, $p < 0.05$). When a significant effect of Mo was observed, regression analysis was performed. Results and discussions – At 300 DAC, the application of 120 kg ha^{-1} of N, in the absence of Mo, promoted increase in stalks, differentiating from the other N availability situations. However, when the Mo dose was maximal, the values were close, and no difference was observed. The TPH value was higher with the application of N, until approximately the dose of 200 g ha^{-1} of Mo. In the absence of molybdenum fertilization, the application of 120 kg ha^{-1} of N promoted an average increment of 8% in Pol productivity. Mo doses increased the Pol productivity. In situations of lower N availability, TPH was maximal with the dose of 200 g ha^{-1} of Mo. When 120 kg ha^{-1} of N was applied, TPH was maximal with the highest dose of Mo. Conclusions – TCH and TPH had gains with molybdenum fertilization. Therefore, it is recommended to use molybdenum fertilization, regardless of the dose of N, to promote increases in agricultural productivity.

Keywords: Saccharum officinarum; nutrition; biological fixation
Financial support: IFPE, CNPq, GRUPO JB

(4465 - 347) Quantification of carbon, phosphorus and potassium in a red nitosols under succession of cultures with different historical

Ericles Marques Ribeiro[1]; Vitor Hugo Terrenas Carvalho[1]; Felipe Gasparello Luccas[1]; Wesley Machado[1]; Thadeu Rodrigues de Melo[1]; Maria de Fátima Guimarães[1]; Pedro Vendrame Siqueira[1]
Universidade Norte do Paraná[1]

Nowadays, with the advent of no-till, we support the idea of soil and water conservation, consequently, the preservation of natural resources, through the pillars that support the technique, but this isn't the reality we are. The objective was to quantify the levels of carbono (C), phosphorus (P) and potassium (K) in crop succession areas, with different historical. Trenches were opened for pedological classification and samples collection from 0-10, 10-20 and 20-40cm. For chemical analysis, a composite sample of each deep was made. Tukey's test was performed at 5% significance. Both trenches were classified as Red Nitosol due to the presence of B-Nithic horizon, with clay accumulation and presence of cerosity. The first analyzed area (A1), was in succession of cultures 20 years ago, however, in no-tillage, being previously, destined to pasture. While the second (A2), was in succession for 42 years, being the first 20 years conventional management. The C results at all deeps of A1 were higher than A2, with emphasis on 0-10 cm layer, with 23.4 g kg^{-1} organic matter (OM), since A2 had 19.2 g kg^{-1} of OM. This is because the conservation of C stocks over the time due to non-rotation and the presence of highly productive and doesn't degrade pasture, which has been able to increase C until the succession implantation, although the absence of rotation, got to hold the stocks in relation to A2. The P contents were only higher in the 0-10cm layer of A1 when compared to A2, in the other layers the A2 stood out. The highest levels of P in the first layer are due to the positive correlation with the OM content. In the 10-20cm layer the A2 was 4.16 $mg.dm^{-3}$, while the A1 was 1.58 $mg.dm^{-3}$. In the 20-40cm layers, A2 was also higher, differing from A1 in 1.54 $mg.dm^{-3}$. This is due to the intense soil revolving, resulting in the incorporation of P in deep, since it's an immobile element. The K contents didn't differ statistically in the two studied areas, being in A1 of: 0.77; 0.38 and 0.21 $cmolc.dm^{-3}$, respectively in the deeps: 0-10,10-20 and 20-40 cm, while in A2, in the same deeps was found 0.79; 0.46 and 0.31 $cmolc.dm^{-3}$. Because K is a mobile element, it easily translocates in the soil profile, resulting in the same proportion of the element in the two areas observed. The history of the area directly influences the management to be accomplished, and the intense revolving favors only the incorporation of immobile elements, degrading the C.

Keywords: Succession of Cultures; Nutrients; Pasture
Financial support: CAPES/CNPq

(4481 - 290) Silicon fertilization is an alternative tool against the water deficit effects in sugarcane

Monica Sartori de Camargo[1]; Breno Kennedy Lima Bezerra[2]; Marcelo de Almeida Silva[2]
APTA Polo Centro Sul[1]; UNESP/FCA[2]

Sugarcane is planted in sandy soils with silicon (Si) low soluble contents and low water storage capacity, which is a problem during water deficit periods. The increased of Si uptake by Si fertilization could decrease negative effects in sugarcane, but information is scarce. This study evaluated the effects of Si fertilization on macronutrients and Si concentration in the leaves, and morphological and physiological aspects of sugarcane cultivars after water deficit. A completely randomized factorial design with four replications, two cultivars (RB86-7515 and RB85-5536), two Si rates (equivalent to 0 and 600 kg ha^{-1} Si, Si- and Si+), and without (well-watered, WW) and with water deficit (water deficit, WD) was used. Pots (100 L) were filled with samples of Quartizpsament with equal quantities of Ca and Mg, using silicate (274 g kg^{-1} Ca; 481 g kg^{-1} Mg;108 g kg^{-1} Si) in +Si treatment, and lime (343 g kg^{-1} Ca; 96 g kg^{-1} Mg), and $MgCl_2$ (12% Mg) in –Si treatment. WD (55% of field capacity of soil) was imposed in 4 months-old plants (May, 2014) and WW treatment was kept close to 100%. Evaluations were done in the top visible dewlap leaves after 30 and 60 days after stress (DAS). Treatments did not influenced macronutrients concentrations, and number of green leaves. Si concentrations increased by fertilization in both evaluations and RB85-5536 showed the highest values only after 30 DAS. WD decreased Si concentrations only after 60 DAS. Plant height was superior to RB86-7515 and WD reduced 9% it after both periods. Number of tillers per plant was reduced by Si after 60 DAS for RB85-5536, no effect was found for RB86-7515. RB86-7515 showed higher RWC in both evaluations and B85-5536 showed higher EL after 30 DAS. Si application decreased electrolyte leakage (EL) after 30 DAS and increase Ψw at pre-dawn after both periods. Si fertilization is useful to alleviate the effects of WD in sugarcane, leading to sustainable agriculture.

Keywords: silicate, soil, nutrition
Financial support: FAPESP, Project 2013/04144-7.

(1881 - 2196) Silicon foliar in development and sugarcane production

Gelza Carliane Marques Teixeira[1]; Luiz Cláudio Nascimento dos Santos[1]; Ramon César dos Santos Pinto[1]; Antonio Márcio Souza Rocha[1]; Marcilene Machado dos Santos Sarah[1]; Renato de Mello Prado[1]

Paulista State University[1]

Silicon (Si) is a beneficial element and has shown an effect on the increase in sugarcane production. The Si has low mobility in the plants, thus, the leaf silicates can be considered sources of interesting Si, to favor the use of this element by plants. The objective of this research was to discover viable Si fertilization alternatives through the use of smaller quantities that could supply Si plants or to stimulate their beneficial effects. The work was developed in a greenhouse of UNESP / FCAV, Campûs de Jaboticabal - SP. The experimental design was a randomized complete block design with four replicates, arranged in a 4 x 5 factorial scheme, four Si sources and five concentrations (0, 0.25, 0.5, 0.75 and 1.0 mmol L -1). The Si sources used were nanosilica (77 g L-1 Si), acid silicate (14 g L-1 Si), stabilized alkali silicate (107 g L-1 Si) and potassium silicate (128 g L-1 Si). Four leaf applications of Si were performed at 41, 54, 68 and 84 days after transplanting. The highest Si accumulations were obtained in the acid silicate and alkali silicate sources, with 89.8 and 87.86 mg plant, in the concentrations of 0.61 and 0.52 mmol L-1, respectively. The results for the green color index followed the same pattern of element accumulation. In the angle of insertion of the first fully expanded leaf, the plants with Si presented lower insertion angles, an important characteristic, since the smaller insertion angle can give the plant a greater photosynthetic efficiency by the improvement in the capitation of the light energy, higher plant growth, which can be observed from increases in plant height, especially in the sources of acid silicate and alkali silicate. The highest internode lengths were obtained in the sources of silicate, alkali silicate and potassium silicate, being 13.04 cm, 13.25 cm and 11.69 cm in the concentrations of 0.52; 0.58 and 0.51 mmol L-1 respectively. The shoot yield was also increased by the application of foliar Si, reaching 2.52; 2.71 and 2.58 kg of stem per pot at concentrations of 0.59; 0.81 and 0.63 mmol L -1 of Si for the acid, alkaline and potassium silicate sources, respectively.

Keywords: Plant nutrition; beneficial elemento, Saccharum officinarum

Financial support: Paulista State University

(4945 - 1870) Soil characteristics in a long-term liming abandoned agricultural land and the adjacent mixed pine plantation in central Taiwan

Chuang-Wen pai[1]; Chiu Ching-An[2]; Chiou-Pin Chen[1]

the Experimental Forest, National Taiwan University[1]; National Chung Hsing University[2]

An abandoned agricultural land next to the Formosan landlocked salmon refuge in Shei-Pa National Park, central Taiwan, had been continuously cultivated by local farmers, and the seedlings growth was found retarded after afforesting. In order to investigate the effects of cultivation on soil characteristics and the possible reasons causing plant growth retardation, soil properties and nutrient conditions in this abandoned land were determined. Except the agricultural land, soils under the adjacent mixed pine forest (Taiwanese red pine (*Pinus taiwanensis*), red cypress (*Chamaecyparis formosensis*), Formosan China-fir (*Cumminghamia konishii*)) were also determined as the reference. Comparing to the mixed pine plantation, the abandoned agricultural land showed the higher bulk density, soil pH, electrical conductivity, total phosphorus, available phosphorus, exchangeable Ca, K, Mg, Na but lower soil organic matter, cation exchangeable capacity and total nitrogen. The higher levels of soil pH (7.2-7.44) and exchangeable Ca (4208-5104 mg kg^{-1}) in the abandoned agricultural land showed the significant effects of long term liming. The lower levels of available Fe (21.4-30.71 mg kg^{-1}) and Mn (33.4-40.4 mg kg^{-1}) was suspected to contribute to plant growth retardation since the high soil pH could reduce the solubility of Fe and Mn and the large amount of Ca could also reduce the availability of Fe and Mn. However, the exact reasons for plant growth retardation still need to be investigated through plant analysis in the future.

Keywords: abandoned agricultural land; liming; mixed pine plantation

Financial support: the Experimental forest, National Taiwan University, Project Number 106-A06-1

(7998 - 467) The VIUSID agro as an alternative in the nutrition of radish (Raphanus sativus L.) and beet (Beta vulgaris L.)

Kolima Peña Calzada[1]; Juan Carlos Rodríguez[1]; Dilier Olivera Viciedo[2]; Jorge Meléndrez[3]

University of Sancti Spíritus José Martí[1]; University (Unesp), School of Agriculture and Veterinary Sciences, Jaboticabal, SP- Brazil.[2]; Universyti of Sancti spiritus José Martí[3]

To evaluate the effect of the VIUSID agro on the radish and beet culture, two randomized block experiments were designed with five treatments and three replications. The variants were: dose 0.2; 0.5; 0.7 and 1.0 L ha-1 of the growth promoter and a control. Among the evaluated indicators was the fresh and dry mass of the plant as well as its organs individually. In addition, the polar and equatorial diameter of the stem and fleshy root, the physiological growth rates, the foliar, productive efficiency and the agricultural yield were evaluated. The results showed a significant increase ($p \leq 0.05$) of the fresh mass of the plant when the VIUSID was used and the increments with respect to the control on average were 12.13 g in the radish and 65.88 g in the beet. In the final evaluation dry mass, all VIUSID treatments differed significantly from the control and exceeded it on average by 35.43% in the radish and over 40% in beet. In the fresh and dry mass of the stems, last evaluation, the 0.7 L ha-1 dose was the one with the best behavior in radish and that of 1.0 L ha-1 in beet. The net assimilation rate was significantly higher with the mentioned dose. The highest productive efficiency was achieved with the variants (0.5, 0.7 and 1.0 L ha-1) and the best performance in the performance with significant differences ($p \leq 0.05$) of the rest of the treatments was dose 0.7 and 1.0 L ha-1. For this reason, the VIUSID agro positively influenced the morphophysiological and productive indicators of the cultivation of radish and beet.

Keywords: amino acids, fertilization, vegetables, VIUSID agro, molecular activation

Financial support: Convention 1 University of Sancti Spíritus- Catalysis Spain

(1598 - 2792) Tolerance potential of *Eugenia dysenterica* DC to aluminum

Arthur Almeida Rodrigues[1]; Sebastião Carvalho Vasconcelos Filho[1]; Douglas Almeida Rodrigues[1]; Caroline Müller[1]; Cássia Lino Rodrigues[1]; Joiran Luiz Magalhães[1]

Goiano Federal Institute of Education, Science and Technology (IFGoiano), Campus Rio Verde[1]

Aluminum (Al) is highly phytotoxic for several crops in general, however, some native Cerrado species that occur on acid soils have developed or inherited strategies that allow them to survive in high concentrations of this element. The aim of this study was to evaluate the morphological and fluorescence characteristics of chlorophyll a and *Eugenia dysenterica* as indicative of species tolerance markers for Al stress. The variables were analyzed based on the evaluation of root growth and fluorescence of chlorophyll a in seedlings (0.1 mM $CaCl_2$, pH 4.0) with low ionic strength with Al at the concentrations of (0, 200,

400, 600 and 800 µmol L^{-1}) in the form of sulfate ($Al_2(SO_4)_3 \cdot 18H_2O$). The PSII (Fv / Fm) quantum yield potential of Al, which was not affected by the growth of the alloys at 400, 600 and 800 µmol L^{-1}, thermal energy dissipation efficiency in the antenna system (Fv'/Fm'), non-photochemical quenching (qN) and non-photochemical dissipation (NPQ) were not affected with increasing doses of Al. For *Eugenia dysenterica* aluminum is not toxic and can be beneficial for the better development of the plant.
Keywords: Al-tolerant; cagaita; cerrado; growth stimulus.
Financial support: Goiano Federal Institute of Education, Science and Technology, Coordination for the Improvement of Higher Education Personnel (CAPES).

(5272 - 1543) Use of inverse vulcanization for the production of multifunctional sulfur FERTILIZERs

Stella Fortuna do Valle[1]; Amanda Soares Giroto[1]; Caue Ribeiro[2]
Federal University of São Carlos[1]; Embrapa Instrumentation[2]

Sulfur (S) is an important macronutrient for vegetable development and its deficiency in soils has been a concern in several agricultural regions nowadays. Elemental sulfur (S_8) stands out amidst conventional sulfur-based fertilizers due to its higher sulfur content and lack of leaching problems. However, in order to be assimilated by plants it needs first to be biologically oxidized to sulfate (SO_4^{2-}), a slow rate process that strongly depends on the fertilizer's characteristics. The aim of this study is to develop a fertilizer in which elemental sulfur's structure is more accessible to the microorganisms that promote the element's oxidation, and thus investigate if this structural modification can increase the oxidation rate. Ring opening polymerization (ROP) of S_8 occurs when the compound is heated above 159ºC, a reversible reaction that leads to depolymerization of the product back into cyclic species when cooled down. The recently developed inverse vulcanization technique addresses this issue by stabilizing the terminal sulfur radicals with low amounts of dienes, producing materials with chemically stable polymeric sulfur chains and enhanced processability. The materials proposed in the present work were obtained by performing the inverse vulcanization method, selecting vegetable oil as a cheap, renewable alkene for the reaction. A detailed physical-chemical characterization of the products was conducted by infrared spectroscopy (FTIR), X-ray diffraction (XRD), scanning electron microscopy (SEM), thermogravimetric analysis (TGA) and differential scanning calorimetry (DSC). Sulfate release experiments were also carried out, both in soil and in cultivation under submerged fermentation (SmF). The results confirmed the successful conversion of reagents and the formation of homogeneous functional materials with great potential to be applied as a multifunctional sulfur fertilizer.
Keywords: Inverse Vulcanization; Sulfur; Fertilizer.
Financial support: Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq), Project Number 133960/2017-0.

(7656 - 1770) Vegetal cover of soil in grazing under recovery in response to wood ash doses

João Vitor Dourado Soares[1]; Jean Carlos Costa Couto[1]; Helon Hébano De Freitas Sousa[1]; Edna Maria Bonfim-Silva[1]; Tonny José Araújo Da Silva[1]
Universidade Federal De Mato Grosso[1]

Wood ash can be a way to potentiate and to recover the productivity of pastures, since it can act as fertilizer and corrective of acidity. So, the objective was to evaluate the effects on soil cover of Brachiaria brizantha cv. Marandu in response to wood ash doses and forms of application in Entisol. The experiment was carried out in the field, in its third year of execution, from December 2016 to April 2017, in the municipality of Rondonópolis, Mato Grosso, at the experimental farm of the Mato-grossense Institute of Cotton (IMAmt). The design was randomized blocks in a 6x2 factorial scheme, in bands, with four replications. Six doses of wood ash (0, 3, 6, 9, 12 and 15 t ha^{-1}) were used in the plots and two treatments of application (incorporated and not incorporated) in the subplots. The application of ash was carried out manually. Nitrogen fertilization was performed at 100 kg ha^{-1} in all subplots, using urea as source. Four evaluations were performed before the programmed cuts, with intervals of 30 days between them, using "Line Transect Method". The results were submitted to analysis of variance up to 5% probability and, when significant, the averages for the application form were compared by the Tukey test. For the wood ash dose factor, regression analysis was applied at the 5% probability level, using the SISVAR statistical program. There was a significant effect on the levels of wood ash for vegetation cover in the four evaluations. In the first, the data were adjusted to the linear regression model, with the maximum result obtained in the highest dose. In the second, third and fourth cuts, the data adjusted to the quadratic regression model, reaching the maximum coverage of 44.17, 30.07 and 39.58% for the doses of 10.8, 11.05 and 9.98 Mg ha^{-1} respectively. Regarding the form of application, there was a significant difference in the first three evaluations. The unincorporated form presented better results, with coverage percentage of 49.86, 40.51 and 36.97% against 25.52, 32.03 and 30.87% of the application of incorporated form, in the 1st, 2nd and 3rd cuts, respectively. The application of vegetal ash influences the soil cover of the soil cultivated with Brachiaria brizantha cv. Marandu, the effect can be observed from small doses, but reaches the maximum around 10 Mg ha^{-1}. The unincorporated form provides greater vegetative cover.
Keywords: Plant residue; altenative fertilization; Entisol.
Financial support: NATIONAL COUNCIL FOR SCIENTIFIC AND TECHNOLOGICAL DEVELOPMENT (CNPq)

(1511 - 641) Vegetative development of the safflower under doses of wood ash and levels of bulk density

Tulio Martinez Santos[1]; Edna Maria Bonfim-Silva[1]; Tonny José Araújo da Silva[1]; Luana Glaup de Araújo Dourado[1]
UFMT[1]

Due to the increase in mechanized areas and inadequate soil management, problems such as compaction grow exponentially in agricultural crops, as well as the generation of residues such as ash, from the processing and storage of products of agricultural origin. The objective of this study was evaluate the effect of combined ash wood doses at bulk density levels on the initial development of safflower crop cultivated in Brazilian Cerrado Oxisol. The experiment was conducted in a greenhouse under a randomized block design with five doses of wood ash (0, 8, 16, 24, 32 g dm^{-3}) combined at five levels of bulk density (1.0, 1, 2, 1.4, 1.6 and 1.8 Mg m^{-3}), with four replicates. Each experimental plot was composed of polyvinyl polychloride cylindrical vessels containing 9.4 dm^3 of soil, composed of three isometric rings of 100 mm height each, the intermediate ring being compacted, with the aid of hydraulic press model Bovenau P15ST. After the soil was collected, the ash doses were applied according to the treatments and after 30 days the pots were made. Nitrogen fertilization was performed with 150 mg dm^{-3}, divided into three applications (40, 55 and 55 mg dm^{-3}), at 15, 30 and 45 days after sowing, respectively. The soil water tension was maintained above 20 kPa with the aid of Irrigas® irrigation flag. Three heights were measured at 15, 30 and 45 days after sowing. The results were submitted to analysis of variance and regression test, both at 5% significance using the software SISVAR 5.6. The linear effect for the

ash doses applied when evaluated at 15 days. For the 30 days after the emergence of the plants a significant difference was observed only for the doses of vegetal ash, with maximum height point estimated when applied 25.08 g dm^{-3} and maximum of 42 cm. For the 45 days both sources of variation had quadratic behavior, the optimum dose estimated of ash is 24.59 g dm^{-3} and the compaction favoring the highest growth was 1.2 Mg m^{-3}. Fertilization with vegetal ash and soil compaction levels influence the growth of safflower plants cultivated in Cerrado Oxisol.

Keywords: bulk density, agricultural residues, *Carthamus tinctorius* L., Cerrado Oxisol.
Financial support:

(3430 - 873) Water use efficiency in safflower crop under soil moisture maintenance methods

Tonny José Araújo da Silva[1]; Julyane Vieira Fontenelli[2]; Edna Maria Bonfim-Silva[1]; William Fenner[1]
UFMT[1]; UNICAMP[2]

Adequate water supply is essential to ensure maximum plant growth and development, since water is the major limiting factor to plant development. However, in agricultural experimentation, especially under controlled conditions, such as greenhouses, several methods of soil moisture maintenance are used, which may constitute sources of experimental errors. Thus, the objective of this study was to test soil moisture maintenance methods in a greenhouse, evaluating the water use efficiency (WUE) in safflower crop, cultivar IMA 0213. Therefore, an experiment was carried out in a greenhouse at the Rondonópolis Campus of the Federal University of Mato Grosso, in a completely randomized design, with four moisture maintenance methods: Gravimetric; Irrigas; Tensiometer and Self-irrigation, with 8 repetitions. The experimental units were composed of plastic vessels with a capacity of 3.18 dm^3, which were filled with Oxisol from a Cerrado native vegetation area collected in the 0 - 0.2 m layer, incubated for 30 days after liming to correct the acidity and increase the base saturation at 60%. Were incorporated into the soil 150 and 100 mg dm^{-3} of P_2O_5 and K_2O, using simple superphosphate and potassium chloride, respectively. Were also applied 200 mg dm^{-3} of N in form of urea at 10, 20 and 40 days after emergence and 15 mg dm^{-3} of FTE BR 12 to meet the demand for micronutrients. To monitoring soil moisture, the soil water retention characteristic curve was used, and humidity equivalent to 80% of the field capacity was considered for water replacement in all treatments except the Self-irrigation. For the Gravimetric method the humidity was determined by mass difference, each vessel being weighed individually. In the Irrigas system replacement occurred when the ground tension reached 20 kPa. For the Tensiometer the considered value was 5 kPa and 3 kPa for the Self-irrigation. The readings were performed daily at 7 and 14 h. The plants were harvested 69 days after emergence and the WUE was determined considering the dry mass production of chapters (g $plant^{-1}$) and the water consumption (L $plant^{-1}$) expressed in g L^{-1}. Data were submitted to ANOVA and Tukey's test at 5% probability. The Gravimetric, Irrigas and Self-irrigation methods differed significantly in relation to the Tensiometer with greater WUE in the dry mass of chapters of the safflower crop

Keywords: *Carthamus tinctorius* L., soil water retention, plant development
Financial support: NATIONAL COUNCIL FOR SCIENTIFIC AND TECHNOLOGICAL DEVELOPMENT (CNPq)

C3.3.4 - Greenhouse gases emissions associated with fertilizer use

(8110 - 576) Assessment of Nitrous Oxide Emission Factors from Barley Cropland under Land Application of Biosolids

Carmen Cecilia Roman Perez[1]; Guillermo Hernandez Ramirez[1]; Germar Lohstraeter[2]; Len Kryzanowski[2]
Department of Renewable Resources, Faculty of ALES, University of Alberta[1]; Agri-Environmental Innovation Unit, Environmental Strategy and Research Section, Alberta Agriculture and Forestry[2]

Agriculture is responsible for more than 60% of anthropogenic global N_2O emissions mainly due to the application of synthetic nitrogen-based fertilizers. Biosolids (BS) are byproducts from municipal wastewater treatment plants that can have beneficial uses in agriculture, forestry and land reclamation. Canada still uses the emission factors from the IPCC 2006 (Tier 1) to estimate N_2O emissions from land application of BS, which assumes that 1% of mineral N applied to soils is lost as N_2O. The objective of this study was to estimate the N_2O emission factors from a cropland fertilized using different biosolids and placement. To determine N_2O emissions, 15 nutrient management treatments (including a control) were evaluated growing barley for silage (*Hordeum vulgare*). For organic amendments, liquid mesophilic anaerobic digested (B_{lmad}), alkaline stabilized (B_{as}) and composted (B_c) biosolid were applied, while urea was applied as mineral fertilizer. Treatments with a mix of BS and urea in a proportion of 50%-50% were also evaluated. Regarding to fertilizer placement, the treatments were evaluated under surface and incorporation methods. Treatments were arranged in a randomized complete block design with 4 replications. Aboveground biomass of barley yield was quantified at the end of the growing season in dry matter basis production. Emission factors (EF) were calculated on the basis of area and yield. Results indicated that barley biomass was typically higher in treatments that combined BS with urea and with incorporation of the nutrient sources. Incorporation also increased N_2O fluxes typically by 2-21 times compared to surface application. Treatments with B_{lmad} showed higher N_2O cumulative emissions. These findings were mirrored by the $EF_{area\text{-}based}$ values, where treatments with B_{lmad} and under incorporation exhibited the highest $EF_{area\text{-}based}$ (1.57%). This $EF_{area\text{-}based}$ was 4 to 17 times higher than treatments with other types of nutrient sources and using surface application (0.41%-urea and 0.09%-B_c). Regarding the results for $EF_{yield\text{-}based}$, a similar behavior was observed; incorporated Blmad was the highest (0.74 $gN_2O\text{-}N\ kg^{-1}$ biomass dry matter) and 8 to 37 times higher the treatments using surface application (e.g., B_c was 0.02 $gN_2O\text{-}N\ kg^{-1}$ barley dry matter). For most treatments, the $EF_{area\text{-}based}$ were below the IPCC Tier 1 (0.09 - 0.73%); only 2 treatments that used BS incorporation (B_{lmad}-1.57%, and B_{lmad} + 50% urea-1.14%) exceeded the IPCC EF of 1%.

Keywords: Nitrous oxide, emission factors, biosolids, plant dry matter productivity, soil nitrogen
Financial support: University of Alberta

(6294 - 2918) Carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) fluxes from potato production system (solanum phureja) under traditional fertilizer and k- carrageenan -coated fertilizer management

M. Camila Morales-Pulido[1]; Carmen Alicia Parrado[1]
Universidad Jorge Tadeo Lozano[1]

Environmental impact associated with greenhouse gas emissions (GHG) from agricultural soils is linked to N fertilizer overuse. A worldwide leading strategy to diminish the impact is the use of controlled release fertilizers that deploy nutrients into the soil continuously reducing time-spatial asynchrony thus reducing GHG

emissions. However, in Colombia, a country where traditional management prevails, the use of these fertilizers is not a common practice due to costs and low research in the subject. We studied the effect of a controlled release fertilizer (coated with *k-carrageenan*) on carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) fluxes and their interaction with associated microbiological processes (N-mineralization, potential denitrification rates) in a potato (*Solanum phureja*) production system in Cundinamaca, Colombia. Using a traditional N fertilizer, the average fluxes were 103.765 µg C-CO_2 m^{-2} hr^{-1}, -0.017 µg C-CH_4 m^{-2} hr^{-1} and 1.828 µg N-N_2O m^{-2} hr^{-1}, the average N-mineralization rate was 3.34 µg N-NH_4 g^{-1} h^{-1} and the potential denitrification rate was 0.3342 µg N g^{-1} hr^{-1}. Meanwhile, using a controlled release fertilizer the average fluxes were 98.530 µg C-CO_2 m^{-2} hr^{-1}, -0.019 µg C-CH_4 m^{-2} hr^{-1} and 0.872 µg N-N_2O m^{-2} hr^{-1}, the N-mineralization rate was 3.53 µg N-NH_4 g^{-1} hr^{-1} and the potential denitrification rate was 0.286 µg N g^{-1} hr^{-1}. Results showed lower GHG emissions and lower potential denitrification rate as well as higher N mineralization rate in soils managed with the *k-carrageenan* controlled release fertilizer than those managed with the traditional one. Even though fluxes were not significantly lower than traditional N fertilizer values, the CH_4, CO_2 and N_2O fluxes and N mineralization rate showed to be driven by the amount of N in the soil.
Keywords: Potential denitrification, Controlled release fertilizer, Greenhouse gases, N-mineralization and Agricultural soils.
Financial support: Colciencias, Universidad Jorge Tadeo Lozano

(5747 - 1074) Comparison of greenhouse gas emissions with application of organic fertilizers (manure, slurry and digested slurry) in a managed grassland in Southern Hokkaido, Japan

Kaho Yasuda[1]; Arata Nagatake[1]; Chiho Sugiyama[1]; Masahito Kawai[2]; Ryusuke Hatano[1]
Soil Science Lab. Hokkaido University[1]; Field Science Centre for Northern Biosphere Hokkaido University[2]

A field experiment was conducted at a managed grassland in southern Hokkaido, Japan to evaluate effects of application of organic fertilizers on greenhouse gases (CO_2, CH_4 and N_2O) emissions and carbon (C) budget. Fertilized plots (chemical fertilizer (F), manure (M), slurry (S) and digested slurry (D)) and no-fertilizer plot (NF) were established in the middle of May, 2017. Due to high concentration of potassium in the organic fertilizers, their application rates were limited to the recommended level of potassium in this region, and deficits of nitrogen (N) and phosphorus were supplied by chemical fertilizers. Soil CO_2 (RH), CH_4 and N_2O emissions, above- and below-ground net primary production (ANPP and BNPP, respectively) and harvest were measured in all plots from May 14 to Sep 20, 2017, and used to calculate EF N_2O, net biome production (NBP=NPP-RH-Harvest+C input), and global warming potential (GWP=GWPCO_2+GWPCH_4+GWPN_2O, GWPCO_2 was calculated using -NBP). Inputs of C and N in M, S and D were 797, 152, 914 kg C ha^{-1} and 28, 21, 109 kg N ha^{-1}, respectively. There was no significant difference in harvest among the treatments despite a tendency higher in fertilized plots than NF. RH was not different but lower in organic fertilizer plots than F and NF. NBP was negative in all plots, however, significantly higher in M, S and D than F and NF (-3.39, -4.40, -3.30, -5.65, -5.56 Mg C ha^{-1}, respectively). Cumulative N_2O emission was significantly higher in fertilized plots (2.97, 5.61, 4.15 and 4.50 kg N ha^{-1} in M, S, D and F, respectively) than NF (0.59 kg N ha^{-1}). The EF N_2O was 3.92% for chemical fertilizer, while it was higher for slurry (6.5%), lower for digested slurry (0.9 %) and negative for manure (-4.7 %). Cumulative CH_4 emission was very small and had no tendency among the treatments, although its flux peaked when soil was wet. GWP was significantly lower in M and D than S, F and NF (14.66, 14.95, 19.58, 24.12, 22.40 Mg CO_2eq ha^{-1}, respectively), and GWP CO_2 contributed to more than 88% of GWP, but GWP CH_4 did less than 0.2 %. GWP CO_2 significantly decreased in M and D where C input was large, and GWP N_2O also tended to be smaller in M and D than S and F. The results clearly showed that each organic fertilizer had different effects on greenhouse gas emissions and C budget, manure and digested slurry may perform better to mitigate global warming than slurry.
Keywords: greenhouse gas, emission factor, organic fertilizer, carbon budget, global warming potential
Financial support: Ministry of Agriculture, Forestry and Fisheries. Project name "Development of method to mitigate global climate change in Agriculture"

(5805 - 2535) Effect of fertilizers on CH_4 production and emission from paddy soil

Takashi Nagasawa[1]; Zanyang Wang[1]; Kazuyuki Inubushi[1]
Chiba University[1]

Over the last decade, the greenhouse gas concentration in the atmosphere has been constantly increasing because of anthropogenic activities. One of the greenhouse gases, CH_4, contributes to global warming and paddy field is one of important source as estimated to be about 18% among total CH_4 emission. The trend of atmospheric CH_4 concentration has been continued to increase, so mitigation to prevent this increase is very imperative. A steel-making slag, a by-product of the steel industry, has been used as silicate fertilizer and a possible mitigation to reduce CH_4 from paddy fields. This study aimed to show how the effects of this fertilizer and organic fertilizer (Bokashi) on CH_4 emission from paddy soil and rice growth. The soil from farmer's paddy field in Tokamachi, Niigata Prefecture, central Japan, was used for incubation experiment and pot experiment. Incubation experiment was designed with 4 treatments as; slag fertilizer, bokashi, bokashi+slag fertilizer, and the soil only as a control; all with three replications. The soil (10g) was placed in a glass bottle containing about 20 ml of distilled water to give a standing above water layer. Bottles were covered with lids and incubated at 30°C for 16 weeks to measure CH_4 production. In the pot experiment, 3 kg soil was placed into plastic pots (1/5000a), the steel-making slag was added to the pots at the rate of 2 g, equivalent to 1 ton ha^{-1}, and the other pots were treated with NPK fertilizer 1g, 0.5 ton ha^{-1} then transplanted with rice. CH_4 flux from the pot and soil Eh were measured from April to September, 2016. In the incubation experiment, CH_4 production increased 9 % by Bokashi, but decreased 2 % by slag fertilizer. In the pot experiment, the steel-making slag treatments showed higher Eh values compared with the control. CH_4 emission during the cultivation period was reduced about 38 % by steel-making slag, and the rice growth was better than the control.
Keywords: Bokashi; CH_4; paddy soil; rice; steel-making slug
Financial support:

(5714 - 1784) Emission of greenhouse gases (N_2O, CO_2 and CH_4) of sandy loam Mollisol, under maize—cover crop rotation and nitrogen fertilization

Daniela Mallitasig[1]; Jorge F. Perez-Quezada[2]; David Aguilera-Riquelme[2]; Osvaldo Salazar[3]
Programa de Magíster en Manejo de Suelos y Aguas, Universidad de

Chile, Casilla 8820808, Santiago, Chile[1]; Departamento de Ciencias Ambientales y Recursos Naturales, Facultad de Ciencias Agronómicas, Universidad de Chile, Casilla 1004, Santiago, Chile[2]; Departamento de Ingeniería y Suelos, Facultad de Ciencias Agronómicas, Universidad de Chile, Casilla 8820808, Santiago, Chile[3]

Information about the effects of greenhouse gases (GHG) (N_2O, CO_2 and CH_4) emissions from soils in Chilean crops systems is limited. It is known that cover crops (CC) reduce GHG emissions such as nitrous oxide (N_2O), carbon dioxide (CO_2), while methane (NH_4) emissions increase under anaerobic conditions with high soil moisture content. In this study, we analyzed the inclusion of cover crops (*Fabaceae and / or Poaceae*) and nitrogen (N) fertilization on maize and its effect on GHG emission in a sandy loam soil (Entic Haploxeroll) in the Mediterranean climatic region of Chile. The experiment was done at the Antumapu Experimental Station located in Santiago, Chile (33 ° 34'S, 70 ° 38'W), where 4 plots were established: i) Zea mays – $fallow_{250}$, ii) Zea mays – $fallow_{400}$, iii) *Zea mays-L. multiflorum*$_{250}$ and iv) *Zea mays-T. repens*$_{250}$ (x 3 replicates) where the two subscript indicate two different doses of N (250 or 400 kg N ha^{-1}). The first measurements (performed between 4 and 15 January 2018) confirm that the GHC emissions increase proportionally with the dose of N, but the properly control of water supply by irrigation prevent differences in N_2O emissions between treatments. In the present season, we continue studying the effect of the cover crop type (*Fabaceae* vs *Poaceae*). This information will help to understand the dynamics of N and C emissions from soils and the environmental and agronomic effects that are associated with the CC in the maize production in central Chile.

Keywords: *Zea mays*, Mediterranean climate, Soil Carbon Sequestration
Financial support: Fondecyt Regular 2015, Project Number 1150572

(8950 - 2052) Flow of Greenhouse Gases in the Summer Period in a System of Integrated Crop-Livestock with Nitrogenous System Fertilization

Jonatas Thiago Piva[1]; Priscila Grella Moretti[1]; Felipe Bratti[1]; Jorge Luiz Locatelli[1]; Guilherme Seiki Iwasaki[2]; Ricardo Henrique Ribeiro[2]; Kelen Cristina Basso[1]; Claudia Aparecida Guginski-Piva[3]; Cimélio Bayer[4]
UFSC_Curitibanos[1]; UFPR[2]; UNOESC_Campos Novos[3]; UFRGS[4]

Nitrous oxide (N_2O) and methane (CH_4) are the main greenhouse gases (GHG), a fact that is related, among other factors, to the intensification of activities carried out in the agricultural sector. When properly managed Integrated Crop-Livestock Systems (ICLS) have a great potential for mitigation in the emission of these gases. The objective of this work was to evaluate the emissions of N_2O and CH_4 due nitrogen system fertilization (summer), and residual pasture heights during the development of maize crop in ICLS. The experiment was conducted at the Federal University of Santa Catarina (UFSC), Curitibanos-SC, in a Cfb climate, with an average annual rainfall of 1500 mm, and an average temperature of 15ºC. The soil is classified as Clayey Cambissolo Háplico. The experimental design was randomized blocks, in sub-subdivided plots. The main plot corresponded to nitrogen (N) rates (0, 75, 150 kg ha^{-1}), and the subplot, in winter, as residual pasture heights (7 and 15 cm) in the *Avena strigosa* crop, in rotational grazing by calves. For the sub-subplot, N rates (0, 75, 150 Kg ha^{-1}) were applied in the summer crop (*Zea mays*). The air samples were collected during the summer period, by the static chamber method, at 0, 15 and 30 minutes and were submitted to gas chromatographic analysis. A peak in N_2O emission was observed in the treatment with 150 kg ha^{-1} and grazing intensity of 7 cm in winter, even at 0 kg of N ha^{-1} in the summer. This may be related to the higher soil bulk density in the superficial layer, caused mainly by the animal trampling, the high soil moisture and the presence of mineral N available in the soil, which are substrate for the denitrification processes, resulting in N_2O production. Treatment with 0 kg of N ha^{-1} grazing at 15 cm in winter and 75 kg N ha^{-1} in summer also showed a peak emission, mainly after nitrogen fertilization. In general, the soil presented as CH_4 absorption during the maize cycle, with a greater sink in the treatment without N in summer and winter, with a 15 cm residual pasture height. Higher GHG fluxes were observed after N application, coinciding with periods of high rainfall, favouring the anaerobic environment of the soil, which allowed higher production of N_2O and CH_4. The higher pasture management (15 cm) influenced positively the soil properties, showing that it is the best option in the mitigation of GHG emissions. The use of a systems fertilization with applications of N in pasture, tend to reduce GHG emissions.

Keywords: *Zea Mays*, height of pasture, nitrous oxide, methane.
Financial support: Fundação Agrisus.

(8390 - 1774) Methanotrophic activity of isolated bacteria from dairy manure used as fertilizer

Valentina García[1]; Homero Urrutia[2]; Erick Zagal[3]; Cristina Muñoz[3]
University of Concepción, Campus Chillán, Avenue Vicente Méndez 595, Chillán, 3812120, Chile (valentinagarcia@udec.cl)[1]; Biotechnology Center, Barrio Universitario s/n Building Biotechnology Center, Concepción, 4070386, Chile.[2]; University of Concepción, Campus Chillán, Avenue Vicente Méndez 595, Chillán, 3812120, Chile[3]

The climate change is produce by a progressive increase in the greenhouse gases emissions, damaging the Chilean farming activity, which directly affects its economy. Methane (CH_4) is the second most relevant greenhouse gas, it stays on the atmosphere around 9 to 15 years and whose power of heat retention is 25 times more powerful than CO_2's. This gas is mainly produced during the processes of enteric fermentation and manure handling. The liquid manure, a mix of feces, urine, and wastewater coming from washing and rainwater in the dairy industry, is high in nitrogen, potassium oxide, and phosphorus oxide, which makes it widely used as an organic fertilizer; however, its handling and, mainly, its storage in manure pits, reduces the airing process which generates partial oxidation products such as CH_4. An alternative for mitigating this gas are the methanotrophic microorganism, bacteria that use this and other small carbon compounds as a source of energy, due to the presence of the enzyme methane monooxygenase, which produces methanol as an intermediary to the aerobic oxidation of CH_4. These microorganisms live in environments that have an interface between aerobic and anaerobic processes, this means that they can be found in manure, whose identifying process is a challenge and a search of mechanism to strengthen its action on manure and reduce the CH_4 emissions in agriculture.

Keywords: Methane; manure; methanotrophic microorganism
Financial support: Proyecto FONDECYT 1160795

(7594 - 1673) Mitigation alternatives of the soil nitrous oxide emission associated with eucalyptus nitrogen fertilization

Mariana Alves Ibarr[1]; Josiléia Acordi Zanatta[2]; Jeferson Dieckow[1]; Marcos Fernando Gluck Rachwal[2]; Rosana Clara Victoria Higa[2]
Universidade Federal Do Paraná[1]; Embrapa Florestas[2]

The enhanced-efficcieny nitrogen fertilizers (EENFs) are an alternative to mitigate the nitrous oxide (N_2O) from fertilized soils, since they act

by slowly releasing the nitrogen in the soil and/or inhibiting the enzymes responsible for the N_2O emission, in both cases allowing greater utilization by the cultivated plants. The study aimed to evaluate the EEFNs potential in reduces the soil N_2O emission under eucalyptus. The study was carried out in a greenhouse, with clayley dystrophic Red Oxisol. The treatments consisted of control (C); urea (U); urea with urease inhibitor (U-NBPT); urea with nitrification inhibitor (U-DCD); urea with urease and nitrification inhibitors (U-NBPT-DCD); polymer-coated urea (U-P); ammonium sulfate (AS); ammonium sulfate with nitrification inhibitor (AS-DCD) and polymer-coated ammonium sulphate (AS-P), in a 13.6 kg N ha^{-1} rate, applied at 10 days after *Eucalyptus urograndis* (I144) seedlings planting. The air sampling for N_2O flux evaluation was performed by the closed static chamber method, with four chambers per pot and three replicates per treatment. The cumulative emission was calculated to the 90 days period after fertilization. The soil N_2O flux remained low up to 50 days after planting (dap), when it increased, reaching more than 900 µg m^{-2} h^{-1} at 78 dap in the urea treatment, which together with U-NBPT, U- NBPT-DCD and UP presented the highest soil N_2O fluxes (on average 215.1 µg m^{-2} h^{-1}). The U-DCD presented fluxes equivalent to the control, with low fluxes (on average 16 µg m^{-2} h^{-1}) throughout the evaluation period. As consequence, the lowest accumulated emissions were observed in the soil of the U-DCD treatment (average of 0.15 kg N-N_2O ha^{-1}), and the highest losses occurred in U and U-NBPT treatments (on average 4.38 kg N-N_2O ha^{-1}). Only the DCD addition to the nitrogen fertilizer was able to reduce soil N_2O losses, possibly due to the monooxygenase enzyme inhibition, thus reducing the nitrification rate and consequent N_2O emission. The enhanced-efficcieny nitrogen fertilizers by the DCD addition represented technically viable alternatives to mitigate N_2O emission from the soil under eucalyptus.

Keywords: greenhouse gas; forest system; enhanced-efficieny nitrogen fertilizers.
Financial support: Embrapa Saltus Project 01.05.001.16.00.00 and CNPq process 442042/2014-0.

(2886 - 1045) Mitigation of nitrous oxide emissions from soils by coconut coir application

Yutaka Shiratori[1]; Haoyang Shen[2]; Sayuri Ota[1]; Keishi Senoo[2]
Niigata Agricultural Research Institute[1]; The University of Tokyo[2]

Nitrous oxide (N_2O) emissions from soils are widely accepted to be mainly resulted from denitrifications and nitrifications of soil bacteria. However, recent evidences suggest that fungal denitrifications also play important roles in mediating the N_2O production from soils in certain ecosystems. In our previous research, N_2O emissions after organic fertilizer application were demonstrated to be mainly resulted from fungal denitrifications. Therefore, suppressing the growth of fungal denitrifiers could be a strategy to mitigate N_2O emissions from organic fertilizer applied soils. In recent years, the antifungal property of coconut coir has been reported by an increasing number of researches. Coconut coir, as a natural material made from the husk of coconut, is with low environmental risk and low-cost. This makes it worthwhile to test the possibility to use coconut coir for suppressing N_2O-producing fungi in agricultural soils. In this study, the effect of coconut coir on the mitigation of N_2O emissions from agricultural soils was tested based on a microcosm experiment and two times of field experiments. In the microcosm experiment, 200 g of Andisol was applied with 5 g of surface granular organic fertilizer and with/ without 1 g of air-dried coconut coir. N_2O emissions were decreased by 30% in microcosms amended with coconut coir compared to non-amended control. The field experiment in the spring of 2016 was performed on an upland field (Andisol) planted with sweet corns. A 50 g/ m^2 of air-dried coconut coir application resulted in a 53% of mitigation of N_2O emissions in the 2.5 months after granular organic fertilizer application. Furthermore, there was no significant impact on sweet corn yields from the coconut coir application. In the field experiment in the autumn of 2016, a 50 g/ m^2 of air-dried coconut fiber was applied to an upland field (Andisol) with no plant. Soil and granular fertilizer samples were sampled during the N_2O emitting period. DNA extraction and quantitative PCR targeting fungal 18S rRNA genes were performed accordingly. As a result, N_2O emissions were decreased by 39% in plots amended with coconut coir compared to non-amended plots. In addition, quantitative PCR revealed lower copy numbers of fungal 18S rRNA genes in plots amended with coconut coir. These results suggest that it is effective and practical to use coconut coir for the mitigation of N_2O emissions from agricultural soils after organic fertilizer application.

Keywords: Coconut coir, Fungal denitrification, Nitrous oxide, Organic fertilizer
Financial support: The Science and Technology Research Promotion Program for Agriculture, Forestry, Fisheries and Food Industry from the Ministry of Agriculture, Forestry and Fisheries of Japan

(6810 - 1956) N_2O emissions from soil subjected to a history application of organic sources application

Rodrigo Otavio Schneider Souza[1]; Alessandra Bacca[1]; Wagner Squizani de Arruda[1]; Jacson Hindersmann[1]; Letícia Morsch[1]; Gustavo Brunetto[1]; Beatriz Batissini Vito[1]; Lucas Telles[2]; Cledimar Rogério Lourenzi[3]; Carlos Alberto Ceretta[1]
UFSM[1]; UFRGS[2]; UFSC[3]

Successive applications of animal manures can increase N accumulation in the soil organic pool. It is expected an increase of NO_3^-content with the mineralization of organic N, which might intensify the emissions of nitrous oxide (N_2O), especially in soils subjected to applications of animal manures with high concentrations of organic N. The aim of the study was to evaluate N_2O emissions from a soil subjected to 17 and 18 applications of types of animal manures, in sandy soil under no-tillage system. The experiment was installed in 2004 at the experimental area of the UFSM Soil Department, souther Brazil. The N_2O emissions were analyzed during the cultivation of black-oat and corn in 2015/2016. The experiment was set in a randomized block design with four replications. The treatments consisted of a control, mineral fertilization (MF), pig slurry (PS), dairy slurry (DS), and pig deep-litter (PL). The collections of N_2O initiated the day after the application of treatments to the crops, and were sustained along the crop cycles. The gases were kept in static chamber in each plot and collections were performed by using a 20 mL-polypropylene syringe at 0, 15, 30, and 45 minutes. The concentration of N_2O was analyzed by gas chromatography. The application of animal manures showed the highest N_2O emissions, highlighting the DS treatment. This is explained by the fact that the DS were derived from grazing cows, whose wastes had partiallymdigested forage with high concentration of organic N. Thus, the successive application of DS might have favored the accumulation of N in a more labile soil pool, augmenting the mineralization and, consequently, the denitrification. Although the PS presented higher concentration of mineral N and soluble C, there were fewer emissions in relation to other treatments. Even if it is expected that higher emissions occur from animal manures like PS, there was a significant increase in N_2O emissions in treatments DS and PL, which contained the highest organic matter and organic C

content. The contents of mineral N remained high since the beginning of the evaluations. The successive application of animal manures with high contents of organic N and a not-so-high C/N ratio can increase the rate of N_2O emissions by promoting changes in the N dynamics in these areas.

Keywords: historical application, denitrification, organic *pool,* N_2O

Financial support: CNPq, Capes

(6532 - 3081) Nitrous Oxide and Ammonia Emissions from N-Fertilization of Maize and Common Bean in the Brazilian Cerrado

Maria da Conceição Santana Carvalho[1]; Nelson Horowitz[2]; Adriano Stephan Nascente1[1]; Paulo César Teixeira[1]

EMBRAPA[1]; Yara Brasil[2]

The Cerrado region is responsible for more than 50% of maize (*Zea mays* L.) and common bean (*Phaseolus vulgaris* L.) produced in Brazil. These crops are large consumers of synthetic N-fertilizers in Brazil, which is an agricultural practice of growing environmental concern as one important source of Greenhouse Gas Emissions (GEE). During three growing seasons, we quantified N_2O emissions and NH_3 volatilization from three fertilizers applied on maize and on common bean grown in a clayey Oxisol in the State of Goiás, Brazil. The fertilizers evaluated were calcium ammonium nitrate - CAN, urea, and ammonium sulfate. The rates of N applied were 150 kg ha^{-1} (maize in 2013/14 growing season), 100 kg ha^{-1} (maize in 2014/15, 2015/16, and 2016/17 growing season), and 80 kg ha^{-1} (common bean in 2015/16 growing season). We also evaluated the GEE emissions from a control treatment, without N application. The treatments were arranged in a randomized block design with five replications. The N fertilization increased the N_2O emissions due to the increasing of soil nitrogen availability. The high peaks occurred within the first week after fertilizers application. The calcium ammonium nitrate promoted the higher N_2O emissions in all growing season, which were clearly associated with high soil NO_3^--N availability, interacting with high soil moisture (WFPS > 50%). The N_2O-N emission factor ranged from 0.07% to 0.59 for ammonium sulfate, from 0.17% to 0.49% for urea, and from 0.46% to 0.84% for CAN, depending on the growing season and on the N rate. As we expected, urea presented the highest NH_3-N emissions in all growing seasons. The main losses occur within the first four days after N application. The cumulative N loss as NH_3 volatilized ranged from 3.4% (common bean, 2015/16 growing season) to 38% (maize, 2014/15 growing season) for urea, from 0.7% to 2.4% for ammonium sulfate, from 0.53% to 2.0% for CAN. Considering the total N losses (N_2O + NH_3) per grain yield, urea was the less efficient fertilizer.

Keywords: Nitrogen losses, fertilizers, nitrous oxide emission factor

Financial support: Yara International and Yara Brasil

(3012 - 557) Nitrous oxide and methane in integrated crop-livestock system with nitrogenated fertilization

Felipe Bratti[1]; Jorge Luiz Locatelli[1]; Luiz Gustavo do Prado[1]; Guilherme Romani de Mello[1]; Maria Luiza Camargo Magnani[1]; Guilherme Seiki Iwasaki[2]; Ricardo Henrique Ribeiro[2]; Kelen Cristina Basso[1]; Jonatas Thiago Piva[1]; Cimélio Bayer[3]

Universidade Federal de Santa Catarina[1]; Universidade Federal do Paraná[2]; Universidade Federal do Rio Grande do Sul[3]

The agricultural sector has adopted strategies for reduction of greenhouse gases (GHG) emissions, mainly nitrous oxide (N_2O) and methane (CH_4). In this aspect the Integrated Crop-Livestock System (ICLS) emerges as a model of adequacy environmental, social and economic adaptation to the current productive system. The objective of this work was to evaluate N_2O and CH_4 emissions in an ICLS with residual management of winter black oat pasture and nitrogen (N) rates. The experiment was conducted at the Federal University of Santa Catarina (UFSC), campus Curitibanos, under a clayey Cambissolo Háplico in Cfb climate. The experimental design was a randomized blocks in a factorial scheme. The main plot was three N rates (0, 75 and 150 kg of N ha^{-1}) and in subplot was two heights of residual management of oats (7 and 15 cm) and one control without grazing. Gas sampling was performed by the method of closed static chambers. The samples were analyzd by gas chromatography to determine the concentration of N_2O and CH_4. At the same sampling dates, soil was collected to determine the moisture and N-mineral content at 0,0-0,20 m layer. The treatments 75 and 150 kg of N ha^{-1} both with residual of 7 cm and 150 kg of N ha^{-1} with residual of 15 cm obtained the highest rates of CH_4 emissions, after the N fertilization. These higher emission peaks are associated with higher soil moisture and N-mineral content. In addition, the animals management and consequently of the soil, influence the methane oxidation, enhancing methanotrophic bacteria activity that uses CH_4 as energy source. The highest emissions of N_2O were observed in the treatments with 75 kg of N ha^{-1} and residual of 7 and 15 cm, observing a constant flow in most of the evaluations dates, mainly after N fertilization. The animals management in the area may have contributed with emissions, due to deposition of manure and urine. In general, the treatments with residual of 15 cm, due to the greater contribution of biomass, behaved like a sink, due to the greater soil coverage and smaller physical impact generated on the soil. The without grazing resulted in the lowest emission rates, regardless of the N rate, which may be related to the short development time of the experiment (3 years), as well as absence of animal excreta on the soil. The fertilization with 150 kg of N ha^{-1} in the pasture in an ICLS alongside with residual pasture management of 15 cm was the best option to GHG mitigation.

Keywords: Integrated systems, grazing effect, denitrification.

Financial support:

(4450 - 1521) Nitrous oxide emission from soil with urea and biochar

Julia Gonçalves Dias Fonseca Ferreira[1]; Jeferson Dieckow[2]; Josiléia Acordi Zanatta[3]; Cláudia Maria Branco de Freitas Maia[3]; Caroline Amadori[2]; Priscila Luzia Simon[2]; Mariana Alves Ibarr[2]; Bruna Ramalho[2]; Cimélio Bayer[4]

Universidade Federal do Rio Grande do Sul[1]; Universidade Federal do Paraná[2]; EMBRAPA Florestas[3]; Universidade Federal do Rio Grande Sul[4]

Biochar (Bc) is able to reduce nitrous oxide (N_2O) emissions from the soil, as it affects nitrogen (N) availability, reducing the substrate of the nitrification and denitrification reactions. In addition, the conditioned soil with biochar can increase the reducing activity provided by the functional groups of the biochar, which favors the emission of nitrogen gas. However, much of the work involving biochar and N_2O was performed under controlled conditions. Therefore, the aim of the study was to evaluate the potential of biochar in mitigating N_2O emissions from nitrogen associated fertilizer, aiming at the applicability of these inputs to field in summer and winter grain crops. The study was carried out at the Universidade Federal do Paraná Experimental Station located in the city of Pinhais - PR, the first upland of Paraná. Two field experiments were carried out to evaluate the potential of biochar in mitigating N_2O emissions. The first one, tested methods of applying urea in sidedress, broadcast or in the furrow,

with and without biochar in maize (*Zea mays* L.) and the second, rates of biochar in oats (*Avena strigosa* Schreb.) Gas samples were collected by the closed static chamber method and analyzed by gas chromatography. In the experiment with maize, the application of biochar reduced the emission of N_2O by 43%, which occurred mainly by denitrification. The highest flow occurred at 18 days after application, and the gas emission range from 17.2 to 542 mg N m^{-2} h^{-1}. However, when the inputs were applied broadcast, there was no effect of the treatments. In the experiment with oats, N_2O flow was due to nitrification, a process that was not influenced by the different doses of biochar, 0; 2 and 10 Mg Bc ha^{-1}. The emission peak was recorded three days after application, with the highest gas emission rate 119 µg N m^{-2} h^{-1} by the treatment with the intermediate dose of biochar. It was concluded that the biochar reduces the N_2O emission associated with nitrogenous sidedress fertilization, when the inputs are applied together in the furrow.

Keywords: Biochar. Greenhouse gases. Application methods. Rates.
Financial support: UFPR, EMBRAPA Florestas, SLB do Brasil, CNPq and UFRGS

(2075 - 243) Nitrous oxide emissions from a soybean-corn succession under conventional and no-tillage systems

Rafael Cassador Monteiro[1]; Julio C. Franchini[2]; Robert M. Boddey[3]; Claudia P. Jantalia[3]; Segundo Urquiaga[3]; Bruno J. R. Alves[3]
UFRRJ[1]; Embrapa Soja[2]; Embrapa Agrobiologia[3]

No-tillage based systems are considered strategic to control soil erosion while preserving soil carbon, contributing to the mitigation of greenhouse gas emissions. However, the concentration of nutrients and labile carbon at the soil surface and the preservation of soil moisture due to soil mulching may potentially increase N_2O emissions from no-tilled soils after N fertilization, limiting the mitigation potential of the system. Hence, this study aimed at comparing N_2O emissions of a soybean – corn succession under conventional and no-tillage. In addition, a relationship between emissions and some soil variables was evaluated. The experiment was carried out at Embrapa Soybean experimental station at Londrina, Paraná state, Brazil. The studied area has been managed under the tillage systems for 21 years. The treatments imposed to the area were conventional tillage with (CT+N) and without (CT) N fertilization (90 kg N ha^{-1}) and no-tillage with (NT+N) and without (NT) N fertilization. Nitrogen fertilization was applied to the corn cycle only. Six static-closed chambers were used per treatment to monitor N_2O fluxes. Gas monitoring lasted from corn seeding, in April 2015, to soybean harvest in March 2016. During this time, soil samples were taken to determine moisture, mineral nitrogen and soluble carbon. Integrated N_2O emissions for CT and NT areas were not statistically different from each other in both crop cycles. Emissions of N_2O from corn growing on CT+N and NT+N soils were greater and statistically different from those without N fertilization even though no differences were observed during soybean crop. Baseline N_2O emissions rarely exceed 20 mg N m^{-2} h^{-1} irrespective of treatments, but the largest N_2O fluxes after N fertilization in corn reached 486 µg N m^{-2} h^{-1} in CT+N and 364 µg N m^{-2} h^{-1} in NT+N. Soil mineral N content seemed to be the major soil variable regulating N_2O emissions in corn cycle. None of the variables were significantly correlated with N_2O fluxes in soybean cycle. Approximately, 0.58 kg N ha^{-1} were emitted as N_2O on average during soybean cycle under CT or NT. Similarly, the soil under unfertilized corn emitted 0.65 kg N ha^{-1} as an average of CT and NT areas, but the N fertilization raised it up to 1.79 kg N-N_2O ha^{-1} in CT+N and to 1.31 kg N-N_2O ha^{-1} in NT+N. Considering the corn-soybean cropping year, N_2O losses were equivalent to 0.62% and 0.36% of the fertilizer N added to corn, respectively to CT and NT areas.

Keywords: Nitrous oxide; Soybean; No-Tillage; Nitrogen Fertilization
Financial support:

(6355 - 1032) Nitrous Oxide Fluxes, Sources and Processes in an Temperate Agricultural Soil: Moisture and N Addition Effects

E.M.S.K.Thilakarathna[1]; G. Hernandez-Ramirez[1]
University of Alberta[1]

Fertilized soils in agricultural lands have become a major source of nitrous oxide (N_2O) emissions, yet the relative contributions of sources and processes on N_2O emissions are still uncertain. A laboratory soil incubation study was conducted to investigate the effect of regular fertilizers and inhibitors on N_2O emission at different moisture contents. Soils from wheat fields of Central Alberta, Canada were collected in the mid spring and fertilized with 6.67 mg N g^{-1} soil (equivalent to a rate of 100 kg N ha^{-1}) of regular urea or ^{15}N labelled urea in order to establish five N fertilizer treatments; (1) untreated control, (2) unlabeled urea, (3) ^{15}N labeled urea at 5 atom%, (4) ^{15}N urea with nitrification inhibitor (nitrapyrin additive), and (5) ^{15}N urea with two urease inhibitors; N-(N-butyl) thiophosphoric triamide (NBPT) and N-(2-nitrophenyl) phosphoric triamide (NPPT). Under room temperature, soils were pre-incubated for 2-day followed by a 30-day incubation period at five different water-filled pore spaces (WFPS): 38%, 50%, 65%, 80%, and 95%. The fluxes and source-partitioning were derived from concentrations and isotopic N composition of N_2O measured using a quantum cascade laser spectroscopy analyzer (Aerodyne™) with flow-through recirculation. Cumulative mean N_2O emissions of N treatments were not significantly different at the level of p=0.05. Based our N-N_2O isotope analyses using Keeling plots, 75 % of the emitted N_2O from wetter treatments during peak emission was derived from the added urea, and the rest of the N_2O production was attributed to the soil N pool. The N_2O emissions increased with increasing soil moisture content; the cumulative N_2O emissions of 95 % WFPS treatment was significantly greater than the other moisture content treatments ($P < 0.05$), confirming that soil moisture content has a triggering effect on N_2O fluxes. Results from ^{15}N-N_2O site preference analysis will also be discussed and interpreted to identify the partitioning and relative contributions of microbial processes (nitrification versus denitrification) to N_2O fluxes. Findings of this study will be used to improve prediction ability and develop best management practices to mitigate N_2O emissions from croplands.

Keywords: Key words: inhibitors, water-filled pore space, site preference
Financial support:

(7728 - 1649) Relationships between nitrous oxide emission and soil microbial activity under different irrigation modes and nitrogen treatments

Fusheng Li[1]; Yan Zeng[1]
Guangxi University[1]

Irrigation and fertilization affect soil microbial population and enzyme activity related to nitrogen transformation, which impacts nitrous oxide (N_2O) emission from paddy fields, therefore the objective of this

study was to study how N_2O emissions from paddy field are influenced by the change in soil microbial activity under different irrigation methods and N treatments. Field experiments of late rice and early rice were conducted with three irrigation methods (CIR conventional irrigation, TIR "thin-shallow-wet-dry" irrigation, DIR alternate wetting and drying irrigation) and two nitrogen treatments (FM1 100% urea-N, FM2 50% urea-N and 50% pig manure-N). Results show that DIR had higher cumulative N_2O emission than CIR. Compared to CIR, TIR augmented nitrifying bacteria population (NB) but decreased denitrifying bacteria number (DNB) at the milky stage, and DIR enhanced ammonia-oxidizing bacteria population (AOB) and NB, and hydroxylamine reductase activity (HyR) at the tillering, booting and milky stages, but reduced DNB and nitrate- and nitrite-reductase activities. FM1 had lower cumulative N_2O emission than FM2. Compared with FM1, FM2 enhanced AOB at the other growth stages except at the tillering stage under CIR, HyR at the milky and ripening stages under TIR, and NB at the milky and ripening stages and DNB at the mid-late stage under DIR. Correlation analysis shows that N_2O emission flux had significantly positive correlations with AOB, NB and HyR. Thus the change in AOB, NB and HyR influenced N_2O emission flux under different irrigation methods and N treatments.

Keywords: N_2O emission, water-saving irrigation method, soil nitrogen transformation,microbial population, enzyme activity
Financial support: National Natural Science Foundation of China (51469003),Guangxi Science and Technology Project(AD17195060)

(4060 - 2419) Simulating soil organic carbon and nitrous oxide fluxes after pig deep litter addition in annual crops using DayCent model

Getúlio Elias Pilecco[1]; Douglas Adams Weiler[1]; Carlos Alberto Ceretta[1]; Alessandra Bacca[1]; Rafael Bick[1]; Roberta Lago Giovelli[1]; Sandro José Giacomini[1]

Universidade Federal de Santa Maria[1]

Several studies have been conducted with the DayCent model around the world, but only a few evaluate the model´s ability to simulate organic fertilizers application into annual crops. In this study, we used DayCent model to simulate an oat/corn system successively fertilized with pig deep litter (PDL) or mineral fertilizer (MF). A 2-year dataset was used to DayCent calibration and an independent dataset from a 12-year experiment was used to model validation. Both studies were carried out in Santa Maria, Brazil. We also tested alternative scenarios (2016-2046) to simulate the new technical recommendation to PDL in Southern Brazil, which reduced PDL N efficiency index (NEI) from 0.5 to 0.2. The effects of PDL and the combination of PDL and MF on SOC and N_2O emission were evaluated. The model performance was evaluated using the following statistical criteria: correlation coefficient (r), root mean square error (RMSE) and mean difference (M) with t test. DayCent model was able to reproduce the system with addition of organic residues, indicating a higher SOC and N_2O emission in the treatment with organic fertilization than control and mineral fertilization. Statistical model performance was the following: r: 0.97; RMSE: 1.10 Mg C ha^{-1} and M: 0.39 Mg C ha^{-1} for SOC; and r values range from 0.02 to 0.35, RMSE and M (g N-N_2O ha^{-1} day^{-1}) range from 4.29 to 121.9 and -1.16 to 32.3, respectively, for N_2O. DayCent model simulated daily N_2O fluxes fairly well after fertilizer addition, but was not able to reproduce the same magnitude of some events. The model slightly underestimate N_2O emissions by 0.4 and 0.9 kg N-N_2O ha^{-1} yr^{-1} to control and PDL, respectively, but with no significant bias. Annual N_2O emissions of MF treatment simulated by DayCent were close to observed values (3.13 *vs* 3.06 kg N-N_2O ha^{-1}, respectively). DayCent model indicated an increase on SOC when PDL was used as an N source for oat and corn, at rate of 0.24 and 0.87 Mg C ha^{-1} yr^{-1} to 0.5 and 0.2 NEI, respectively. The amount of PDL recommended for 0.2 NEI increases annual N_2O emissions by 45% compared to 0.5 NEI. DayCent simulations shows that the continued application of PDL increase SOC, but also N_2O emissions. The combination of PDL and mineral fertilizer may be a strategy to increase SOC associated with intermediate N_2O emissions.

Keywords: modeling; greenhouse gas; manure; corn
Financial support: This work was supported by the Brazilian government through the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES)

(5686 - 2309) Variation of nitrous oxide emission from combined organic and synthetic fertilizer in *Citrus unshiu* field in Southwestern Japan.

Yo Toma[1]; Takeshi Higuchi[1]; Osamu Nagata[2]; Seiichi Nishimura[3]; Hideto Ueno[1]

Graduate school of Agriculture, Ehime University[1]; NARO Tohoku Agricultural Research Center[2]; NARO Hokkaido Agricultural Research Center[3]

Nitrous oxide (N_2O) is one of the important greenhouse gas emitted from agricultural field. We measured N_2O emission for 5 years to investigate the emission N_2O emission from combined organic and synthetic fertilizer in citrus orchard. Two treatments, fertilized (F) and unfertilized (NF) plots, were set up in Ehime prefecture, southwestern Japan from January 2013 to December 2017. Combined organic and synthetic fertilizer was applied in every January and March at each 96 kg N ha^{-1}. N_2O fluxes were measured under the tree crown of *Citrus unshiu* by closed chamber technique. Differences in those gas emissions between in F and NF were defined as the emission from applied fertilizer N. Cumulative N_2O emission were calculated in the period after basal (F1) and supplemental (F2) fertilizations, summer (S), and the other period. Emission factor (EF) of N_2O induced by the applied fertilizer N was also calculated. Annual N_2O emissions were varied from 1.89 to 8.28 kg N ha^{-1} (Ave. 3.61 kg N ha^{-1}) in F and from 0.58 to 2.60 kg N ha^{-1} (Ave. 1.19 kg N ha^{-1}) in NF. Significant differences in annual N_2O emission among treatment and year indicate that organic and synthetic fertilizer application increase annual N_2O emission and annual N_2O emission was yearly varied. EF was ranged from 0.31 to 2.95% (Ave. 1.25%; 95% confidence interval 0.01-2.49%). Observed significant difference in EF in each year suggested that environmental factors controlled N_2O production from applied fertilizer N. Cumulative N_2O emission from fertilizer N in F1 and F2 increased with increasing N_2O emission for two weeks and maximum N_2O flux after the fertilization. Moreover, the maximum N_2O flux was positively correlated with mean air temperature after the fertilization. On the other hand, days after fertilization until observed maximum N_2O flux increased with increasing precipitation during that period. Those suggested that N_2O production was enhanced under warm and dry condition. Because precipitation may delay activity of N_2O production, N_2O emission can be increased due to increase of temperature after the rainfall. Consequently, in citrus orchard, N_2O emission from combined organic and synthetic fertilizer can be decreased when the fertilizer is applied based on weather forecast at the cool and dry weather condition.

Keywords: Nitrous oxide; citrus orchard; emission factor
Financial support:

(6300 - 1116) Various types of biochar effect on reducing greenhouse gas emission

Sunil Lee[1]; Eunjung Choi[1]; Jongsik Lee[1]; Hyuncheol Jung[1]; Gunyeob Kim[1]

National Institute of Agricultural Sciences[1]

Biochar is a carbon-rich solid product obtained by pyrolysis of biomass. It has been suggested to mitigate climate change through reduction of greenhouse gas emission. However, the biochar has a wide range of natural physical and chemical properties depending on the feedstock. The objective of this study was to evaluate carbon dioxide (CO2) and nitrous oxide (N2O) emissions from soil after addition of various types of biochars. The biochars were made from a pyrolyzer, which a reactor was operated about 400~500℃ for 5 hours. The treatments were consisted of a control and four biochars (pear branch, rice hull, soybean stalk, woodchip) addition treatment. Emissions of CO2 and N2O from soil were determined using closed chamber for 60 days at 25℃ of incubation temperature. Soil pH, total carbon and total nitrogen were significantly influenced by biochar type. Soil pH for all treatments ranged from 7.3 to 7.8. Alkaline biochars (pear branch, rice hull, soybean stalk) increased soil pH, while acidic biochar (woodchip) decreased pH. The concentration of total carbon and total nitrogen were significantly higher biochar treatment than control. Soil nitrate was significantly influenced by biochar type, whereas ammonium was not different between biochar treatments and control. The concentration of nitrate was significantly lower in control (191~512 μg g?1) than in biochar treatments (235~1,446 μg g?1). The cumulative N2O emissions over the 60 day incubation were significantly lower in all biochar treatments by 82~87% compared to the control, but they were not significantly different from biochar treatments. While no significant differences were CO2 emissions. The biochar from crop byproducts could suppress the soil N2O emission. The results from the study imply that biochar can be utilized to reduce greenhouse gases emission from the cropland.

Keywords: Biochar, Greenhouse gases, Incubation, Nitrous oxide

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C3.3.5 - Soils for mitigating global warming: greenhouse gas emission reduction and/or enhancing carbon sequestration

(3883 - 1436) Annual methane emissions of production systems in lowlands of Rio Grande do Sul

Walkyria Bueno Scivittaro[1]; Thaís Murias Jardim[2]; Miguel David Fuentes Guevara[2]; Lillian Medeiros Barros[3]; Renata Abreu Rodrigues[3]; Rogério Oliveira de Sousa[2]; Rosa Maria Vargas Castilhos[2]

Embrapa Temperate Agriculture[1]; Federal University of Pelotas[2]; Instituto Federal Sul-Rio-Grandense[3]

Irrigated rice cultivation, the main productive activity of the lowlands of Rio Grande do Sul, Brazil, constitutes a major anthropogenic source of methane (CH_4) to the atmosphere, contributing to global warming. The production and emission of CH_4 occurs only in a reduced environment, being also associated with the amount of organic carbon (C) available in the soil. Thus, the production systems influence the potential of C incorporation and, therefore, CH_4 emissions from the soil. The objective of this work was to evaluate annual CH_4 emissions in representative production systems of the Rio Grande do Sul lowlands and in a natural area. The study was conducted in a Planossolo (Typic Albaqualf) in Capão do Leão, State of Rio Grande do Sul, Brazil. CH_4 emissions evaluations were performed from June 2015 to May 2016. Three production systems (irrigated rice/fallow, soybean/ryegrass/corn and improved pasture) and a natural area were evaluated. In each area, three greenhouse gas collectors systems (closed static chamber) were distributed, constituting the replications of the treatments. CH_4 fluxes and CH_4 total emissions were measured seasonally (fall/winter period - 2015 and spring/summer period 2015/2016 (summer season)) and throughout the year. During the fall/winter period, there were practically no CH_4 emissions from the soil, regardless of the production system. It was observed alternation between low intensity fluxes and influxes of CH_4. During the summer season, the area cultivated with irrigated rice presented several high peaks of CH_4 emission, due to the anaerobic condition established by soil flood irrigation. The other production systems and the natural area did not presented significant CH_4 emissions during the summer season; the emissions were characterized by low intensity fluxes alternated by eventual CH_4 absorption events. Total CH_4 emissions during the fall/winter period were low for all treatments (irrigated rice/fallow: 7.6 kg CH_4 ha^{-1}; natural area: 6.8 kg CH_4 ha^{-1}; improved pasture: 1.5 kg CH_4 ha^{-1} and soybean/ryegrass/corn: 0.3 kg CH_4 ha^{-1}). During the summer season, CH_4 emissions from the irrigated rice/fallow system (339.3 kg CH_4 ha^{-1}) were higher than the other systems (natural area: 3.2 kg CH_4 ha^{-1}; soybean/ryegrass/maize: 1.3 kg CH_4 ha^{-1} and improved pasture: 0.8 kg CH_4 ha^{-1}). Irrigated rice/fallow system presents higher annual CH_4 emission than the other production systems mainly due to emissions associated with irrigated rice.

Keywords: greenhouse gas; mitigation; flooded rice; crop rotation; pasture

Financial support: Embrapa; FAPERGS

(1046 - 2982) Biological attributes in integrated crop-livestock-forestry (ICLF) systems in the Maranhão State Amazon, Brazil

Joaquim Bezerra Costa[1]; Henrique Antunes de Souza[2]; Luciano Cavalcante Muniz[3]; Ivanderlete Marques de Souza[4]; Maria Diana Melo[4]; Lucélia de Cássia Rodrigues de Brito[5]; Elimilton Pereira Brasil[3]; José dos Santos Benício[1]; Diana Signor Deon[6]

Embrapa Cocais[1]; Embrapa Meio-Norte[2]; Universidade Estadual do Maranhão - UEMA[3]; Universidade Estadual Vale do Acaraú - UVA[4]; Universidade Federal do Piauí - IFPI[5]; Embrapa Semiárido[6]

Soil microbial biomass Carbon (MBC) and Nitrogen (MBN) are indicative of the changes caused by different systems of land use and soil management. The evaluation of biological quality of soil is a strategy that aims to define appropriate systems for maintaining and improving the sustainability of agricultural enterprises. This research aimed to determine the levels of MBC and MBN of the soil microbial biomass in six agricultural management systems. Soil samples were collected within each system/management, at Muniz Farm, in the municipality of Pindaré-Mirim – MA, in a Haplic Plintosol, at 0-0.1 m depth, during the rainy season of 2017, in 4 replications, in all systems. The evaluated systems were (T1) corn intercropped with *brachiaria* grass and double rows of eucalyptus every 28 m implanted in 2016; (T2) corn intercropped with *massai* grass; (T3) corn intercropped with *massai* grass and double rows of *sabiá* tree (Mimosa *caesalpiniaefolia*) every 30 m implanted in 2017; (T4) corn intercropped with *massai* grass and babassu (native palm); (T5) corn intercropped with *massai* grass, babassu and double rows of *sabiá* tree every 30 m implanted in 2017; and (T6) *brachiaria* grass pasture (reference treatment). In each soil sample, the levels of MBC and MBN were determined. The analysis of variance of the data was performed by the F test. The averages were compared by the Tukey test. The MBC variable from T6 area (637

mg kg^{-1} of soil) was higher in relation to T1 (343 mg kg^{-1} soil), T2 (238 mg kg^{-1} of soil), T4 (210 mg kg^{-1} of soil) and T5 (203 mg kg^{-1} soil). However, T6 did not differ from T3 (433 mg kg^{-1} of soil). The highest concentration of MBN was observed in T6 (2.4 mg kg^{-1} of soil). In general, the biological attributes of soil were significantly affected as a function of the soil management. The *brachiaria* grass pasture presented the highest activity when compared to other silviagricultural systems evaluated in 2017.

Keywords: integrated systems; organic matter; soil quality
Financial support: BASA, Rede ILPF, CAPES

(2390 - 2292) Carbon of humics fractions in latossolo (oxisoil) under different forms of use in Cerrado

Adilson Alves Costa[1]; Bruno de Oliveira Dias[1]; Tales Emanuel Duarte Santos[1]; Vandayse Abades Rosa[2]; Daniel Ferreira de Lima Eliziário[1]
Federal University of Paraíba[1]; Federal University of Bahia[2]

The change in land use, due to anthropogenic action, has a significant effect of altering the soil organic matter dynamics, thus modifying the carbon contents in its different compartments. In this scenario, the use of conservation practices, such as no-tillage, can promote higher soil quality. The objective of this work was to evaluate the carbon content of humic substances in areas under conventional tillage and no - tillage in the Cerrado. The geographical coordinates of the study site are 11 ° 51'8 "S and 45 ° 37'50" W and 763 m altitude, located in Luís Eduardo Magalhães municipality, Bahia, Brazil. The soil was classified as Latossolo Amarelo distrófico típico (Oxisoil), with a clay-loamy texture. Soil samples were collected in layers of 0-0.5 cm and 0.5-10.0 cm in three areas in different forms of land use, and area under native vegetation sensu stricto Cerrado the area under cultivation with cotton and conventional area under no-tillage five years of implementation, with current soybean crop. Carbon content in the fulvic acid fraction (C-FAF), humic acid (C-FHA) and humin (C-FHU) was determined. The carbon of humic substances (C-HS) was also obtained through the sum of C-FHA and C-FAF. Among the different humic fractions, it is observed that the C-FAF content under conventional tillage was similar to the area under native Cerrado, however, both being larger than the samples collected under no-tillage system at 0-0.5 cm depth. On the other hand, the C-FHA was higher in the area under conventional planting in relation to the other areas. For many authors the elevation of C-FHA may be related to the increase of the biological activity that promotes the synthesis of the humic substances. The no-tillage system presented lower values of C-HS when compared to the other areas evaluated, in the 0-0.5cm depth with a 59% reduction, thus demonstrating lower mineralization rates of organic matter in the soil. The C-HUM increased up to 21% in the area under no-tillage compared to the area under tillage at the surface depth of up to 0-0.5 cm and 39% in the depth of 0.5-10 cm. It can be concluded that area under tillage favored an increase of C-FAF and C-HS for the 0-0.5 cm depth, while no-till improved C-HUM, regardless of depth studied.

Keywords: humic substances, no-tillage, soil organic matter
Financial support: National Council for Scientific and Technological Development (CNPq)

(1809 - 2638) Chemical carbon fractioning in different land uses

José Rafael Vásquez Polo[1]; Felipe Macías Vásquez[2]
Universidad del Magdalena[1]; Universidad Santiago de Compostela[2]

Land use change and management can affect the soil's ability to capture carbon; the magnitude of these changes is unknown in the Caribbean region. For this reason, we studied the relationship of the different land uses to contents and forms of carbon in six soil and climate zones in northern Magdalena, Colombia, with altitudes between 5 and 956 m, average temperatures between 24 and 30 °C, and average rainfall between 663 and 2000 mm. In each area, two sites were sampled: tropical crops and forests (Humid and Dry Tropical). Four samples consisting of ten random subsamples per site were taken. In each subsample, we determined total C (Ct), oxidizable C total (Cox), hidrolizable C with 6N HCl (Ch), C linked to humic material (Cp) by extraction with sodium pyrophosphate, rust free C (Cnox) or recalcitrant C calculated as the difference between Ct-Cox, total stored C (Cta) per unit of surface area, which is calculated by taking into account bulk density (Da) and sampling depth. Statistically signif icant differences were found for the effect of area; the highest percentages of Nt (0.32), Ct (3.90), Cox (3.85), Ch (2.05) and Cp (1.15) and Cta (109 Mg ha^{-1}) were found in soils of humid forest zone 1 with the highest altitude (956 m), precipitation (2000 mm) and the lowest temperature (24 ºC). Land uses showed significant differences only for NT, CT, Cox, and Ch; in general, the values of the more stable forms of C of forest soils exceeded those of crop soils. Cox and Cnox accounted for 95% and 5% of Ct, respectively, for the different land uses; an average loss of 26% of Ct was observed in cultivated soils as compared with forest soils.

Keywords: carbon forms, carbon fixation, carbon stocks
Financial support: Universidad del Magdalena, Universidad Santiago de Compostela

(8779 - 579) Contribution of microbial biomass carbon to below-ground biomass carbon budget in an agricultural field in Southern Hokkaido, Japan

Yuma Michinobu[1]; Putri Okutariani[1]; Ryusuke Hatano[1]
Hokkaido university[1]

Below-ground biomasses, plant roots and soil microbes, are important components controlling terrestrial carbon budget. However, the contribution of microbial biomass carbon (MBC) is not fully evaluated yet. Therefore, this study aimed to investigate the dynamics of MBC and the factors of MBC change at an agricultural field on Mollic Andisol in Southern Hokkaido, Japan (42°24'N, 142°28'E), for three years. The field was used as cornfield. After the corn harvest at September 2015, the field was converted to fallow until grass seeding at September 2016. After the seeding, the field was managed as grassland. Chemical fertilizer plot (F plot) and manure and chemical fertilizer plot (MF plot) were established in both cornfield and grassland. Fertilizer and tillage managements followed the regional recommendation were conducted. CO_2 flux, climate and soil environmental variables were monitored every 1-4 weeks. At the same time, soil samples were taken from 0-5 cm depth to measure MBC by the fumigation-extraction method, and to calculate MBC budget (MBCB. In MF plot, plant biomass was sampled to obtain above- and below-ground net primary production (ANPP and BNPP, respectively). The ratio of MBCB/BBCB (below-ground biomass C budget: BNPP + MBCB) indicated the contribution of MBC to below-ground biomass carbon. Mean MBC was significantly different among the landuses (cornfield < grassland < fallow: $p<0.001$) and there was no significant difference between MF and F plots. Root biomass was significantly higher in grassland than cornfield ($p<0.001$). Result of Pearson's test showed that, in entire term, MBC has significant positive correlation with soil moisture content and pH. In fallow, MBC has significant positive correlation with soil temperature and soil moisture content. In grassland, MBC has significant positive correlation with soil moisture content and negative with soil temperature. In cornfield, there are no significant correlations with the environmental variables. Those results indicated that MBC was mainly controlled by soil moisture content, and root biomass might be a factor affecting MBC change. In MF plots of cornfield and grassland, ANPP was 8.34±0.87 and 6.52±0.50 Mg C ha^{-1}, respectively, BNPP was 0.40±0.92 and 0.73±0.56 Mg C ha^{-1}, respectively, MBCB was 0.22±0.12 and -0.20±0.03 Mg C ha^{-1}, respectively, and MBCB/BBCB was 0.35 and -0.38, respectively. Those result suggested that MBC

contributed greatly to below-ground carbon and the carbon budget.
Keywords: microbial biomass carbon; below-ground carbon; carbon budget; glassland; cornfield
Financial support:

(1375 - 973) Developing an unmanned air vehicle deployed sensor platform for studying atmospheric emissions of soil carbon dioxide

Leandro Boari Naves Silva[1]; Marx Leandro Naves Silva[2]; Pedro Velloso Gomes Batista[2]; Danilo Alves de Lima[1]; Arthur de Miranda Neto[1]
UFLA/DEG[1]; UFLA/DCS[2]

Carbon dioxide emissions from vegetal biomass burning, deforestation, and inadequate soil management cause relevant alterations on soil carbon stocks. New technologies such as Unmanned Air Vehicles (UAVs) are a potential tool for the enhancement of methodologies and the development of innovative solutions for monitoring the earth surface, especially considering the use of deployed sensors. Hence, the objective of this study was to develop an on-board sensor platform for UAVs in order to measure spatially referenced data of carbon dioxide emissions (CO2), relative air humidity (RAH), and atmospheric temperature (AT). Such data will be used for the continuous monitoring of environmental changes caused by land use and soil management on agricultural systems. An on-board platform of the electronic systems used for the automated measurements, data storage and interfacing, was dimensioned based on a DJI Phantom 3 four rotor UAV (quadcopter) (ANAC registration number PP-11111110 – series P76DDC18B271). A microcontroller Atmega 328P – Arduino Nano V3 was used as the electronic prototyping platform for data input and output. A module MG811 was used for CO2 detection and DHT22 for measuring RAH and AT. Data is sampled at a two second temporal resolution, which is georeferenced by a NEO-6 U-Blox GPS module. A recording module stores the measured data in a Micro SD memory card after each flight. Weighting 200g, the platform and couplings did not interfere with the UAV flight stability. The DHT22 module has a maximum energy consumption of 2.5 mA during use and takes AT measurements between -40 °C and 80°C, with a precision of ±0.5 °C. RAH is measured between 0 and 100 % with a ± 2.0 % precision. The MG811 module has an energy consumption of 3.0 mA during use and takes CO2 measurements between 0 and 10,000 ppm. Initial tests indicate that the platform is efficient for data collection and information recording. Next steps will be focused on developing an interface for extraction, visualization, storage, and analysis of the sampled data, as well as on the examination of precision and accuracy of the sensor measurements.
Keywords: Soil carbon stocks; Arduino; Robotic; Control and Automation;
Financial support: CNPq, FAPEMIG

(9327 - 2408) Dynamics of methane and nitrous oxide emissions in lowland production systems.

Miguel David Fuentes Guevara[1]; Thaís Murias Jardim[1]; Walkyria Bueno Scivittaro[2]; Lillian Medeiros Barros[3]; Renata Abreu Rodrigues[3]; Cristiano Weinert[1]; Thaís Antolini Veçozzi[1]; Anderson Dias Silveira[1]; Rogério Oliveira de Sousa[1]; Jaqueline Trombetta da Silva[1]
Universidade Federal de Pelotas[1]; Embrapa Clima Temperado[2]; Instituto Federal Sul-Riograndense[3]

The main greenhouse gases (GHG) associated with agricultural activity are methane (CH_4) and nitrous oxide (N_2O), providing significant emissions when expressed in carbon dioxide (CO_2) equivalent, as they have the capacity to absorb infrared radiation 25 and 298 fold higher than CO_2, respectively. The objective of this work was to evaluate CH_4 and N_2O emissions in representative production systems of the Rio Grande do Sul lowlands. The study was developed at an Embrapa Temperate Agriculture experimental area, in Capão do Leão, State of Rio Grande do Sul, Brazil, during 2016/2017 summer season. Three production systems (native pasture with extensive livestock, irrigated rice/fallow and soybean/corn rotation under no-tillage system - cultivating corn during the evaluation period) and a natural area, used as a reference. Gas collection was performed using closed static chambers with three replicates per treatment. The fluxes and total emissions of CH_4 and N_2O were determined. Significant CH_4 emissions were found only in irrigated rice system; the maximum CH_4 emission peak occurred on the 60th day after sowing (2,048.04 g CH_4 ha^{-1} h^{-1}), being attributed to the anaerobic condition promoted by flooded soil. On the other hand, higher N_2O emissions were observed in the soybean/corn rotation system, which presented high magnitude peaks at the 19th, 40th and 63rd day after sowing, corresponding to 800.08; 11,980.5 and 25,832.7 mg N_2O ha^{-1} h^{-1}, that were associated to topdressing nitrogen fertilization and to the variation in the conditions of soil oxidation, conditioning nitrification and denitrification processes, promoted by rainfall events. The irrigated rice system provided higher total CH_4 emission (803.83 kg ha^{-1}), followed by soybean/corn rotation (4.35 kg ha^{-1}), native pasture (0.97 kg ha^{-1}) and the natural area (0.82 kg ha^{-1}); while the highest total N_2O emission was determined for the soybean/corn rotation (10.92 kg ha^{-1}). The emission of methane and nitrous oxide from the lowland production systems is greater than in the natural area.
Keywords: greenhouse gas; irrigated rice; crop rotation; grassland.
Financial support: EMBRAPA, FAPERGS, CAPES

(1371 - 1820) Effect of different soil bulk density and temperature on soil CO_2 emission from tropical peatland

Nur Azima Busman[1]; Nagamitsu Maie[2]; Che Fauziah Ishak'[3]; Muhammad Firdaus Sulaiman[3]; Lulie Melling[4]
1. Sarawak Tropical Peat Research Institute, Lot 6035, Kota Samarahan Expressway, 94300 Kota Samarahan, Sarawak, Malaysia 2.3Department of Land Management, Faculty of Agriculture, Universiti Putra Malaysia, 43400, Serdang, Selangor, Malaysia[1]; School of Veterinary Medicine, Kitasato University, Towada, Aomori 034-8628, Japan[2]; Department of Land Management, Faculty of Agriculture, Universiti Putra Malaysia, 43400, Serdang, Selangor, Malaysia[3]; Sarawak Tropical Peat Research Institute, Lot 6035, Kota Samarahan Expressway, 94300 Kota Samarahan, Sarawak, Malaysia[4]

Tropical peatland store 68.5 Gt of C and since 1990s, ca. 25% of the tropical peatland area in Malaysia has been converted for oil palm plantation where drainage, compaction, and groundwater table (GWT) control are pre-requisites. However, the information on the simultaneous effect of soil compaction and rise in temperature on soil CO_2 emission from tropical region is scarce. Soil compaction causes the reduction of the pore size, increase in soil bulk density (BD) which eventually affects the soil moisture content. Nonetheless, the effect of soil BD, GWT, and rise in temperature as a whole towards the production of CO_2 are ambiguous. Therefore, the objective of this study is to examine the effect of soil BD and temperature on CO_2 emission from tropical peat soils. Soil samples (50–70cm depth) collected from a Mixed Peat Swamp forest in Sarawak, Malaysia were packed and compacted in a PVC pipe to four different BD; 0.14 g cm^{-3}, 0.18 g cm^{-3}, 0.22 g cm^{-3}, and 0.24 g cm^{-3} and incubated in a laboratory condition under two temperature regimes, 25°C and 35°C. Soil CO_2 fluxes and redox potential (E_h) were measured weekly for three

months. It was found that CO_2 emission from soil with a different BD shows similar trend in 25°C and 35°C, with soil CO_2 emission from BD 0.24 g cm^{-3} was significantly lower than other soil BD ($P < 0.05$) throughout the incubation period. Meanwhile no significant differences were observed between soil BD 0.14 g cm^{-3}, 0.18 g cm^{-3} and 0.22 g cm^{-3}, possibly due to the sufficient presence of O_2 in the soil, when the E_h value recorded during incubation period was high. The effect of soil BD was insignificant towards CO_2 production rate when sufficient amount of O_2 is available. However, greater soil compaction to a BD 0.24 g cm^{-3} resulted in prolonged water saturation in the soil pore space, cause the reduction in the O_2 diffusion rate into the soil throughout the incubation period, thus lowering the soil CO_2 flux. The low O_2 level is represent by E_h values ranging between +400 to -300 mV (Pezeshkiez & DeLaune 2012). E_h value recorded from BD 0.24 g cm^{-3} ranges between 170 to 367 mV and 180 to 272 mV at temperature 25°C and 35°C, respectively. Overall, soil CO_2 emission is higher at temperature 35°C compared to 25°C ($P < 0.05$). CO_2 emission from soil BD 0.14 g cm^{-3} and 0.18 g cm^{-3} were significantly higher at temperature 35°C, but no significant difference was observed from soil compacted to BD, 0.22 g cm^{-3}, and 0.24 g cm^{-3}.

Keywords: *soil CO_2 emission, soil compaction, soil bulk density, temperature, tropical peat soil*
Financial support:

(7988 - 851) Effect of the endogenous and exogenous minerals on the stability of biochar

Ke SUN[1]; Yan YANG[1]; Haoran SUN[1]; Baoshan XING[2]
State Key Laboratory of Water Environment Simulation, School of Environment, Beijing Normal University, Beijing 100875, China[1]; Stockbridge School of Agriculture, University of Massachusetts, Amherst, MA 01003, USA[2]

The stability of biochar is a major determinant of its potential for carbon sequestration. In previous studies, the biochar stability was evaluated by analyzing the oxidation resistance property of biochar, for which, $K_2Cr_2O_7/H_2O_2$ oxidation and thermogravimetric analysis (TGA) were widely used to measure the high oxidation resistance of biochars. In this study, rice straw (RI)- and swine manure (SW)-derived biochars produced at different heating treatment temperatures (HTTs) and their corresponding de-ashed biochars and iron-biochars were selected to investigate the effect of minerals on these biochars stability. There was a significantly positive correlation between carbon remaining values (CRVs) obtained after $K_2Cr_2O_7/H_2O_2$ oxidation and ash (mineral) contents of biochars ($p < 0.05$). Moreover, the decreasing CRVs of most biochars were observed after de-ashing treatment. These $K_2Cr_2O_7/H_2O_2$ oxidation results indicated that endogenous minerals in biochars can protect biochars from chemical oxidation. On the other hand, the R_{50} (C recalcitrance index) values of iron-biochars (33.3−57.4%) were lower than those of corresponding biochars (38.6−60.8%), indicating that Fe-bearing mineral formed in biochars can promote the thermal decomposition of biochars. In H_2O_2 oxidation, the different change trend of CRVs between biochars produced at 450 °C and biochars produced at 600 °C after iron mineral treatment showed that the effect of exogenous Fe-bearing mineral on biochar stability was related to biochar category regulated by HTTs. This study indicated that endogenous minerals could increase biochar stability, and exogenous Fe-bearing minerals had dissimilar effects on different kinds of biochars, which critically regulates the potential of biochar for long-term carbon sequestration. Our findings will help understand the stability of biochars and provide a theoretical basis for efficient use of biochars in environment as a carbon sink.

Keywords: Biochar; Stability; Mineral; Oxidation resistance.
Financial support: The National Natural Science Foundation--Outstanding Youth Foundation (41522303).

(8514 - 702) Effect of tillage method and timing in grassland renovation on soil greenhouse gas emissions

Arata Nagatake[1]; Vecky dwi[2]; Sota[3]; Kaho[4]; Hiromichi[5]; Yuma[6]; Chiho[7]; Masahito[8]; Ryusuke[9]
Hokkiado University[1]; Kuswandra[2]; Nishi[3]; Yasuda[4]; Takahashi[5]; Michinobu[6]; Sugiyama[7]; Kawai[8]; Hatano[9]

Managed grassland is occasionally renovated to improve grass yield by plowing and reseeding, and different plowing depth and renovation season may affect soil organic matter decomposition and plant growth. We conducted field experiment in grassland on a Mollic Andosol in Southern Hokkaido, Japan to assess the effect of tillage method and timing of grassland renovation on greenhouse gas emissions. Split tillage (ST) every 10 cm interval to 10 cm depth, 15 cm and 30 cm inversion tillage (T15 and T30) were conducted in autumn renovation (AR) and spring renovation (SR). Timothy grass seed and chemical fertilizer were applied in each treatment in rate of recommended level in this region. CO_2, N_2O, CH_4 fluxes were measured by closed chamber method at three replicates, and root-excluded plot was set up to estimate heterotrophic respiration (RH). Carbon (C) balance was estimated as net biome production (NBP), and calculated as difference between C inputs (net primary production (NPP) and plant residue) and C outputs (harvested C and RH). Global warming potential (GWP) was estimated as the sum of CO_2 equivalents of CH_4, N_2O and NBP. Greenhouse gas intensity (GHGI) is estimated as GWP divided by grass yield. This experiment was repeated in 2015-2016 and 2016-2017. RH and net C loss (–NBP) were higher in T30 and T15 than in ST ($p < 0.05$) except 2016-AR which was conducted after typhoon. N_2O and CH_4 emissions were not significantly different across tillage methods and renovation seasons, but N_2O emissions in T30 were tended to be lower than ST and T15. There was negative correlation between CO_2 fluxes and water filled pore space (WFPS)($p < 0.01$), and WFPS in T30 and T15 were lower than ST ($p < 0.01$). This indicates that soil organic C decomposition was stimulated under better soil aeration due to tillage in T15 and T30. N_2O emission showed positive week correlation ($p = 0.053$) with plant residue N decomposition estimated by litter bag method, but not with chemical fertilizer input. This might indicates that dissolved organic matter and mineral nitrogen from residue is a driving factor of N_2O emission. Contribution of NBP and N_2O emission to GWP were 60~92% and 7~40%, respectively, and contribution of CH_4 emission was less than 4%. There were no significant differences in net GWP between tillage methods and renovation season. Grass yield was not different among tillage method, but AR showed significantly lager yield than SR. Therefore AR more decreased GHGI than SR.

Keywords: greenhouse gas emission, grassland renovation, tillage method, renovation timing
Financial support: Development of crop production technology to adapt to climate change" run by the Ministry of Agriculture, Forestry and Fisheries of Japan(2015-2019)

(7087 - 844) Effects of Elevated Atmospheric CO_2 on Soil Organic Carbon in Rice Paddy Field

Jianguo ZHU[1]
Institute of Soil Science, CAS[1]

This research was carried out on China FACE (Free-air Carbon-dioxide Enrichment) experimental platform with the concentrations of carbon dioxide in the atmosphere as main treatments and the levels of nitrogen fertilizer as sub-treatments. A split plot design was used in the experiment. The carbon dioxide concentration treatments had two levels, i.e. Ambient (atmospheric carbon dioxide concentration) and FACE (Ambient + 200 ppm). The nitrogen application rates were

LN (low nitrogen application rate, 125 kg ha^{-1}) and NN (normal nitrogen application rate, 250 kg ha^{-1}). After nine years, SOC at plow layer (0-15 cm) increased significantly (9.95 %, $p<0.05$), about 1.1 % per year under medium to long-term atmospheric [CO_2] enrichment condition. The storage of SOC in microaggregates (250-53 µm) increased about 15.1 % ($p<0.05$) and the storage of SOC in small macroaggregates (2000-250 µm) decreased about 6.4 % ($p<0.05$). Elevated [CO_2] had a trend to increase the turnover of two macroaggregates (>250 µm) of the 0-5 cm soil, as a result more quantity ($p<0.05$) and SOC of microaggregates were found under elevated [CO_2]; elevated [CO_2] didn't change the composition of the 5-15 cm soil, but it had significant negative effects ($p<0.05$) on SOC of macroaggregates. It also showed that normal level of nitrogen fertilizer (NN) decreased the quantity and SOC of large macroaggregates (>2000 µm) at 5-15 cm soil depth. iPOM-C was about 17.8-33.7 % of total SOC. Elevated [CO_2] significantly increased mSOC and iPOM-C in aggregates at 0-5 cm soil depths ($p<0.05$), however it had no effect on concentrations of iPOM-C at 5-15 cm soil depth. Elevated [CO_2] has no effect on SOC of light-fraction (LF-C) and LF-C was only 4.0-8.5 % of total SOC. In conclusion, elevated [CO_2] increased soil organic carbon by allotting them in microagggregates in the form of mineral associated organic carbon mainly.

Keywords: Elevated [CO_2], Rice paddy field, Aggregates, Carbon fractions, Mineralization

Financial support:

(5517 - 1397) Effects of rice straw field burial on methanogenesis: a laboratory assessment

M.Carreras[1]; B.Fernández[1]; M. Martínez-Eixarch[1]; F. X. Prenafeta-Boldú[1]; M.Viñas[1]

IRTA[1]

Rice paddy fields are one of the major sources of greenhouse gas (GHG) emissions, being the main source of anthropogenic methane emissions (CH_4) (20%). The project LIFE EBRO-ADMICLIM is evaluating the annual pattern of CH_4 emissions in the rice paddy fields in the Ebre Delta. Ebre Delta is one of the main wetland of western Mediterranean and Biosphere's reserve. It's main anthropogenic activity is the rice cultivation, being the 65% of the total surface. It represents the 1% of the Europe's rice paddy. Annual CH_4 emissions in the Ebre Delta displayed a bimodal pattern, with a peak of 70% of the methane produced during the post-harvest season. Preliminary results revealed that both the incorporation of rice straw into the soil, and the water management at the end of the harvest, were the main factors contributing to the annual GHG emissions in rice paddy fields. Two mechanisms of methane emission has been proposed so far: i) the capacity to massively detach the methane accumulated beneath the sediment during the crop season, and ii) the higher bioavailability of organic's matter in the soil, still wet, when the tillage incorporate the straw at the beginning of the post-harvest season. The aim of the study is to gain insight on the potential contribution of mixing rice straw in the sediments in the rice paddy fields of Ebro's Delta during the postharvest season. Microbial key players linked to methane emissions and strategies to diminish methanogenesis has also been assessed. Although, the strong influence of the straw's incorporation on the CH4 emissions has been previously described, there is limited information about the type, quality and dose of straw and its effects on boosting methane emissions from natural sediments, and regarding the microbial populations implied in the fermentative and methanogenic activities. The present shows the results of different in-vitro methanogenic batch assays containing sediment and surface water from Ebre Delta to study i) the direct influence of growing amounts of rice straw in the sediment; ii) and the potential effect of different methanogenic inhibitors based on the inhibition of HMG CoA reductase in Archaea linked to membrane lipid biosynthesis pathway to decrease methane emissions. Molecular microbial assessment of total and metabolically active microbial populations has been performed throughout incubation time to identify those microbial key players that are contributing to methane emission in the sediments.

Keywords: Green house gases, wetlands, methane, methanogens, Archaea.

Financial support:

(6724 - 2048) Effects of soybean expansion on soil chemical indicators in the matopiba region, brazilian savanna

Marcos Siqueira-Neto[1]; Gustavo Vicentini Popin[2]; Maurício Rogério Cherubin[2]; Isabela Gomes Pires[2]; Tiago Osório Ferreira[2]; Edmilson Igor Bernardo Almeida[1]; Gregori da Encarnação Ferrão[1]

UFMA[1]; USP[2]

The savanna biome in Maranhão State represents a large ecotone between Caatinga-Savanna-Amazon biomes. This region has been focus of land use change (LUC) to soybean expansion in Brazilian savanna, and currently one of the biggest grain producers in the world. Our objective was to quantify the effects of time after LUC (from native vegetation to soybean) on soil chemical indicators (SCI) in the MATOPIBA Savanna. Soil samples (0-30 cm) was collected in a Xanthic Ferralsols Dystric cohesive located in the municipality of Chapadinha (MA, Brazil) in areas under soybean over 1, 8 and 15 year and an area under native vegetation (NV-reference). The selects SCI evaluated were: active acid (pHCaCl2), bulk density (BD), carbon (SOC), nitrogen (TN), available-phosphorus (P), potassium (K), base (BS%) and aluminum saturation (m%). Overall, LUC from NV to soybean reduced one-third of original SOC (from 12 to 7.5 g kg-1), while TN not showed changes (0.6 g kg-1), as well as BD (1.46 g cm-3). However others SCI as soil pH increased from 3.9 to 5.0; base saturation increased more than four times (from 10 to 45%); aluminum saturation reduced from 57 to ~10%. The potassium content increased 40% (from 13 to 20 mg kg-1), while available-P showed drastically increased between seven to eighteen times (from 0.5 to 9.3 after 15 yr). These results indicated that due the lower natural fertility, LUC had the capacity to improve soil chemical indicators, however, the SOC depletion can be to consider a high cost-effectiveness to ecosystem soil service.

Keywords: land use change, depletion, soil organic carbon, preserving soil quality.

Financial support: Fundação De Amparo À Pesquisa E Ao Desenvolvimento Científico E Tecnológico Do Maranhão/CNPq - "DCR 03572/2016".

(1144 - 2812) Emission factor of nitrous oxide from urine cattle and dicyandiamide use as a mitigation strategy in a subtropical Brazilian grass.

Ezequias Cloy Ferreira[1]; Priscila Luzia Simon[1]; Bruna Ramalho[1]; Mariana Alves Ibarr[1]; Ricardo Henrique Ribeiro[1]; Caroline Amadori[1]; Bruno da Silva Pereira[1]; Jeferson Dieckow[1]; Josiléia Acordi Zanatta[2]

Federal University of Parana, Rua dos Funcionarios 1540, Curitiba, 80035-050, Brazil[1]; Empresa Brasileira de Pesquisa Agropecuária (EMBRAPA), Centro Nacional de Pesquisa em Floresta 83411- 000, Colombo, PR, Brazil[2]

Searching for a conservationist production system, the Brazilian agriculture sector has been concerned in adopting strategies to smooth greenhouse gas emissions, mainly nitrous oxide (N_2O) from cattle urine, responsible for 41% of national N_2O gas emission. The proposals of this work were to evaluate the dicyandiamide efficiency (DCD), a nitrification inhibitor, on N_2O emission reduction, and to compare the emission factor from cattle urine with 2% default

suggested by Intergovernmental Panel on Climate Change (IPCC). The study was carried out at the experimental farm of the Federal University of Parana, Pinhais-PR, Brazil under an Inceptisol and subtropical climate. The trial design was in randomized block with three treatments of cattle urine application over aries grass (*Panicum maximum cv. Aries*) and four replicates. The treatments were: soil without urine application (control), urine application and urine + DCD application. The urine application was done in a single portion, simulating one animal urination, by means of dosage equal to 103 g N m^{-2}. The air samplings were performed by the static chamber method and analysed by gas chromatography. The data was submitted to analysis of variance and applied Tukey´s test ($p < 0.10$). There was a considerable positive effect of DCD use on N_2O emissions reduction, with a cumulative emission of 726 mg N m^{-2} compared to urine application (1436 mg N m^{-2}) and a total of 49% reduction. The effects of DCD are related to its action in the first step of the nitrification process, inhibiting the ammonia monooxygenase enzyme, responsible for oxidizing ammonia to nitrite, which is the substrate to N cycling and thus N_2O production. The lower temperatures in subtropical regions are most likely one of the major reasons of the high efficiency of DCD in our study, and thus, being an effective alternative to reduce N_2O emissions. The emission factor of N_2O from cattle urine obtained was 1.33%, which suggests a revision to the 2% IPCC default for subtropical regions.

Keywords: Nitrification inhibitor, livestock, global warming.
Financial support: National Council for Scientific and Technological Development (CNPq) - Federal University of Parana (UFPR)

(2088 - 1646) Emissions of biogenic greenhouse gases in grasslands and croplands of the Chiloé Island, Chile.

Patricia Ibaceta[1]; Mauricio Galleguillos[2]; Bruce Osborne[3]; Jorge F. Pérez-Quezada[2]
Programa de Magíster en Manejo de Suelos y Aguas, Universidad de Chile, Casilla 1004, Santiago, Chile[1]; Departamento de Ciencias Ambientales y Recursos Naturales, Facultad de Ciencias Agronómicas, Universidad de Chile, Casilla 1004, Santiago, Chile[2]; School of Biology and Environmental Science, University College Dublin, Belfield, Dublin 4, Irlanda[3]

Soil is a critical regulator of the global balance of carbon (C) and nitrogen (N) through their storage, capture and emission mechanisms. Both elements interact between the soil and the atmosphere through the biogeochemical cycles that involve their transformation to greenhouse gases (GHG) such as carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). This is especially important in southern Chile, due to the increasing conversion of natural ecosystems into croplands and grasslands, whose effects have been poorly documented. Our study is a pioneer assessment of biogenic GHG emissions in a native forest and two typical agroecosystems of the Chiloé Island: 1) potato crops and 2) grazed grasslands mainly by sheep, with predominance of perennial herbaceous plants, such as *Dactylis glomerata*, *Holcus lanatus*, *Lolium perenne* and *Trifolium repens*, which were sampled in three locations (41°53' S, 73°39' W; 42°0' S, 73°53' W; 42°15' S, 73°38' W) or replicates. To measure these GHGs we used at field level a portable closed chamber system with an infrared gas analyzer (model LI-840A, LI-COR) for CO_2 and the cavity ring-down spectroscopy technology (model G2308, Picarro Inc.) for CH_4 and N_2O, along a day of each month and during six months. The daily GHG fluxes were modeled using continuously recorded environmental variables, such as soil (Andisol) water content, photosynthetically active radiation, soil, air and canopy temperature. When comparing the GHG balance in agroecosystems with the GHG balance previously obtained for a native forest of Chiloé (-660.1 g CO_2-eq m^{-2} $year^{-1}$), we found that the managed ecosystems release more C to the atmosphere (in form of CO_2 or CH_4) than natural ecosystems, thus showing the effect of forest conversion to agricultural systems.

Keywords: Agriculture; andisols; land use change; greenhouse gases; ruminant livestock.
Financial support: Fondecyt Regular 2017, Project Number 1171239

(9573 - 2466) Emissions of nitrous oxide and methane in vitro influenced by soil management systems of a long-term field experiment from the south of Brazil

Anaí Sangiovo Ottonelli[1]; Murilo Gomes Veloso[1]; Cimelio Bayer[1]
Universidade Federal do Rio Grande do Sul[1]

Greenhouse gas (GHG) emissions are linked to the dynamics of C and N in different management systems of soil. The objective of this study was to validate the influence of tillage and culture system on GHG emissions in disturbed and undisturbed samples in soils from long term experiments. The study was performed in soil samples were collected in an experiment installed in 1985 located at the Agronomical Experimental Station of the Federal University of Rio Grande do Sul. The experiment consisted of a combination of two tillage systems: conventional tillage (CT) and no-tillage (NT). Each tillage system was associated to three cultures systems: oat/maize (O/M), vetch/maize (V/M) and oat + vetch /maize + cowpea (OV/MC). The soil was classified as an Ultisol. In laboratory, the emissions of N_2O and CH_4 were validated as undisturbed and disturbed samples of incubation determined by gas chromatography. The C and N contents were analyzed by dry combustion. The disturbed samples reported N_2O emissions of about twice as much as the undisturbed samples of the management systems. Overall, disturbed samples reported efflux of CH_4 while undisturbed samples reported influx of this gas. The undisturbed samples approached closer to the results obtained in field. Also, the undisturbed samples were more appropriate the regulatory processes of GHG emissions. It was verified that the accumulated emissions of CH_4 in laboratory the soil in NT and with crop cover legumes favored the consumption of CH_4., which probably occurred due to the improvement of structure of the soil and the recovery of the metanotrofic population. The soil there were observed more emission of N_2O on the system covered by legumes, which was probably related to the increase in mineralization of N during decomposition of residual. Moreover, the no-tillage with insertion of legume cover crops was the one with more vegetal residual contribution due the highest stocks of C and N on the soil for 0-20 cm. The undisturbed samples were more consistent to the field performance. Such data agree with the data obtained on field all the management systems, it was observed that only aerobic environments reported low or influx of CH_4. Also, the highest emission of N_2O of soil occurred with the presence of cover crop legumes, were counterbalanced with most sequester of C in the no-tillage and cover crops legumes systems of soil, when it is estimated the global warning potential.

Keywords: greenhouse gas, soil carbon sequestration, no-tillage, cover crops
Financial support: Coordination for the Improvement of Higher Level -or Education- Personnel (CAPES), Brazilian Council for Scientific and Technological Development (CNPq)

(7366 - 1475) Grazing management contributions to global warming potential in Pampa Biome.

Janquieli Schirmann[1]; Diego Fernandes Bastos[2]; Douglas Adams Weiler[1]; Paulo Cesar de Faccio Carvalho[2]; Cimélio Bayer[2]
Universidade Federal de Santa Maria[1]; Universidade Federal do Rio Grande do Sul[2]

Pampa is recognized as the most important forage source to livestock production in South America. The impacts of Pampa grazing management on net global warming potential are still unknown. The study was performed to quantify the global warming potential (GWP) of four forage allowance in a native grassland: 4, 8, 12 and 16% (kg dry matter 100 kg animal live weight^{-1} day^{-1}). Experimental site was located in UFRGS Experimental Station in Rio Grande do Sul State, Brazil. Native grassland has been managed with four forage allowance for 30 years. Experimental design was randomized blocks, with two replicates. Soil methane (CH_4) and nitrous oxide (N_2O) emissions were measuring with static chamber method during two years. Soil samples to evaluate organic carbon concentration and stocks were collected in stratified layers up to 100 cm deep in four trenches per replicate. Soil carbon sequestration was calculated taken 4% forage allowance as reference. GWP was calculated for each forage allowance treatment as the sum of emitted CO_2 equivalents from three factors: carbon sequestration, CH_4 emission from soil and enteric fermentation, and N_2O emission from soil and bovine excreta (urine and dung). Soil carbon stock in 0-100 cm in the 8% forage allowance (135.7 Mg C ha^{-1}) was 20 Mg C ha^{-1} higher than in 4%, but did not differing from the 12% (124.2 Mg C ha^{-1}) and 16% (122,2 Mg C ha^{-1}). Cumulative N_2O (0.19 kg N ha^{-1}) and CH_4 (1.53 kg C ha^{-1}) emissions were low, with no difference among forage allowance on 2-year average. The 8% forage allowance showed the lowest GWP (-442 kg CO_2eq ha^{-1} yr^{-1}) and the lowest GHG intensity (-3.5 kg CO_2eq kg animal live weight^{-1}). GWP were predominantly determined by CH_4 production from enteric fermentation and carbon sequestration rates. Results suggests that 8% forage allowance may promote an increase in soil carbon stock in native Pampa grassland compared to 4% forage allowance. Forage allowance of 8% associated animal production and low GHG emissions, featuring environmental benefits for livestock production on native grassland in Pampa biome.

Keywords: Grassland, Carbon, Nitrous oxide, Methane, Livestock
Financial support: Capes, CNPq

(3212 - 2904) Greenhouse gases fluxes as affected by water potential in soils under sclerophyllous vegetation of Central Chile

Juan-Pablo Fuentes-Espoz[1]; Horacio Bown[1]; Amanda Martínez[1]; Daniela Celedón[1]; María-Andrea Díaz[1]; Jorge Pérez-Quezada[2]
University of Chile, Faculty of Forestry Sciences and Nature Conservation[1]; University of Chile, Faculty of Agronomy[2]

In natural systems, most of the greenhouse gases (GHG) are sequestered or emitted by soils. The fate of CO_2, CH_4, and N_2O is mostly biologically mediated, hence soil properties affecting microbiota play a key role. Soil water content (swc) affect aerobic and anaerobic microorganisms, inducing shifts in the fluxes of GHG. Most studies of soil GHG fluxes use swc as an explanatory variable. However, microorganisms can have different responses to similar swc, particularly when comparing different soils. Consequently, the use of soil water potential (P_T) could be a good surrogate variable. We determined the effects of P_T on GHG fluxes in soils under 4 sclerophyllous plant species of Chile. Soil samples (0-10 cm depth) were obtained under *Quillaja saponaria* (QUI), *Lithraea caustica* (LIT), *Colliguaja odorifera* (COY), and *Acacia caven* (ESP), all growing in the same landscape area. Soil samples (50 g) were brought to swc equivalent to saturated (P_T= 0 MPa), near saturated (P_T ~0.005 MPa) and field capacity (P_T =0.01 MPa), and then incubated at 23°C in 1L jars for 3 days (n=5 per plant species and P_T). GHG fluxes were measured using a Cavity Ring Down Spectrometer (G2308, Picarro Inc., USA). CO_2 fluxes were affected by P_T ($p<0.001$) and plant species ($p<0.05$). Higher P_T (Y_T *= 0 and 0.005)* caused a decrease in CO_2 fluxes of about 50% as compared to the lower P_T (0.45-0.78 and 1.95 umol m^2 sec^{-1}, respectively). ESP had 3.5 times lower fluxes as compared to QUI (0.45 and 1.56 umol m^2 sec^{-1}, respectively). Such difference might be caused by soil organic carbon availability. In contrast, P_T and plant species did not affect CH_4 fluxes, which were very variable, particularly for P_T=0.01 (-0.0227 to 0.6361 nmol m^2 sec^{-1}), showing either emission or sequestration patterns. Mean values of CH_4 fluxes were positive, suggesting that saturated and near saturated conditions, and even lower P_T, create conditions for methanogenesis. N_2O fluxes were affected by Pt ($p<0.001$) but not plant species. N_2O emissions were greater with near saturated and saturated conditions (176.65 and 93.58 nmol m^2 sec^{-1}, respectively) as compared to the lower P_T (2.81nmol m^2 sec^{-1}). Our findings suggest that, under saturated and near saturated conditions, methanogenesis and denitrification start shortly after water saturation. Emissions of CH_4 and N_2O at lower P_T, suggest that production of these GHG in sclerophyllous soils can occur despite aerobic conditions.

Keywords: Methane, Nitrous oxide; Soil Water Potential; Soil Respiration
Financial support: Chilean National Scientific and Technology Fund, Fondecyt regular # 1150877.

(9745 - 1947) Impact of *Eucalyptus* Harvest Residues Management on Soil Carbon Storage and Greenhouse Gas Emission (GHG) in sandy soil in southern Brazil

Jackson Freitas Brilhante de São José[1]; Cimélio Bayer[1]; Andressa Classer Bender[1]; Juscilaine Gomes Martins[1]; Deborah Pinheiro Dick[2]; Elias Frank de Araújo[3]; Renato de Aragão Ribeiro Rodrigues[4]; Eduardo Carniel[1]; Daniela Ulian da Silva[1]
Department of Soil Science and Graduate Program on Soil Science, Faculty of Agronomy, Federal University of Rio Grande do Sul; Porto Alegre, RS; Brazil[1]; Department of Physical-Chemistry, Institute of Chemistry, Federal University of Rio Grande do Sul; Porto Alegre, RS; Brazil[2]; Technology and Forestry Development, CMPC Celulose Riograndense, Guaíba, RS; Brazil[3]; Researcher Climate Change, EMBRAPA Soils, Brazilian Agriculture Research Corporation, Rio de Janeiro/RJ; Brazil[4]

In the last years, Brazilian companies in the forestry sector have discussed the use of waste left by the forest harvest residues for energy generation as an alternative to the use of fossil fuels. These residues are basically composed of leaves, branches, bark and parts of wood, and are usually left in the field, thus maintaining soil organic matter contents and forest productivity. In Brazil, studies on the impact of harvest residues (HR) on GHG emissions (N_2O, CH_4 and CO_2) and soil organic matter are scarce. We investigated the GHG emissions in an eucalyptus plantation in function of five alternative strategies for management of HR: (i) SRCS- all forest residues from the previous rotation were removed; (ii) CRC- bark, leaves and litter layer from the previous rotation were maintained on the soil; (iii) CRG- branches, leaves and litter layer from the previous rotation were left in the soil; (iv) CR- presence of all harvest residues (leaves, branches, bark, + litter); and (v) SRSS- all forest residues were removed and litter from the new plantations were also removed. These treatments were installed in plots of 900 m^2, using a randomized block design with four replications. The experiment was conducted in the forest Park of the company CMPC, located in the county of Barra do Ribeiro/RS, Brazil in sandy entisol. In each plot, one trenche was opened up to 100 cm

depth, and soil samples were collected in two sides of the trenche and soil carbon was analyzed by dry combustion (Shimadzu TOC-VCSH analyzer). Annual campaign of GHG colletion was performed by method of closed chamber where air samples were collected each three weeks, and analyzed in regarding the contents of N_2O and CH_4 contents by gas chromatography. The maintenance of HR of eucalyptus CR led to an increment of 8 Mg ha^{-1} of soil C storage in 0-100 cm mineral soil compared to SRSS. Soil N_2O fluxes were very low under all HR management.The highest accumulated emissions of N_2O were obtained in CR, with 0.45 kg ha^{-1}. There was a predominance of CH_4 influx in practically all treatments. Similarly to N_2O, CR also showed higher cumulative annual emissions influx of CH_4 reaching 5.7 kg ha^{-1}. All HR managements presented negative GWP values, showing the potential of forest plantations as drainage for GHG. Our results indicated that the maintenance of eucalyptus HR is an environmentally interesting strategy with the greatest potential to mitigate GHG emissions, as it promotes greater soil carbon retention.
Keywords: Eucalyptus; Harvest residues management; Greenhouse Gas Emission ; Soil carbon;
Financial support:

(2648 - 1067) Influence of irrigation on photosynthetic carbon inputs under ryegrass-white clover pasture in New Zealand

C.R. Medina[1]; S. R. McNally[2]; T. Clough[1]; M.H. Beare[2]; J. E. Hunt[3]; C.S. Tregurtha[2]
Department of Soil and Physical Sciences, Faculty of Agriculture and Life Sciences. Lincoln University, Lincoln 7647, New Zealand.[1]; Sustainable Production Portfolio, New Zealand Institute for Plant and Food Research Limited, Private Bag 4704, Christchurch 8140, New Zealand[2]; Landcare Research, P.O. Box 69040, Lincoln 7640, New Zealand[3]

Carbon (C) stocks under grazed pasture in New Zealand represent ~50% of the national soil C inventory. The use of irrigation is increasing to improve dry matter production (DMP). However, it is not clear whether irrigated pastures act as a sink or a source of atmospheric CO_2. Our objective was to study the effects of irrigation on the allocation of photosynthetic-C in a plant-soil system under a perennial ryegrass (*Lolium perenne L.*) and white clover (*Trifolium repens L.)* pasture. The experiment consisted of two treatments (dryland [37-80 % of field capacity] and irrigated [69-92% of field capacity] pasture) applied to pots (15 cm dia x 25 cm deep) with soil (0-15cm, sieved <6 mm) from a non-irrigated site. Well established ryegrass-clover pasture was continuously pulse labelled with $^{13}CO_2$ (10 atom %) over three months. A further set of pots were maintained at natural abundance CO_2. After labelling, the allocation of fixed-C to plant-soil compartments was determined by harvesting 8 pots/treatment. The soil organic C derived from the newly fixed-C at the end of the labelling phase was calculated using a two-pool mixing model. During the labelling period, DMP was greater under irrigated (65 ± 1 kg ha^{-1} d^{-1}) than dryland conditions (55 ± 1 kg ha^{-1} d^{-1}). Total annual DMP was also higher for irrigated (17400 ± 370 kg ha^{-1}) than dryland pasture (14700 ± 380 kg ha^{-1}). The total DMP of the dryland system was higher than would typically be expected under field conditions. After labelling, approximately 76% of the added ^{13}C was recovered in the herbage, 8% in above-ground residue, 7% in roots, 5% in the bulk soil and 1% in the rhizosphere soil. The allocation of ^{13}C into these respective compartments was similar between the irrigated and dryland systems. The C input to bulk soil was 1479 ± 144 kg ha^{-1} and 1433 ± 85 kg ha^{-1} (0–15 cm) and 750 ± 131 kg ha^{-1} and 557 ± 72 kg ha^{-1} (15–25 cm) for irrigated and dryland systems, respectively. There was no significant effect of the irrigation treatments. These results show that despite greater aboveground production there was not an increase of C inputs to the soil under irrigated pasture. However, the effects of more extreme differences in soil moisture on pasture production and belowground C allocation under irrigated and dryland conditions are not know and require further study. On-going work is also investigating the longer term stability of new pasture-fixed soil C under both irrigated and dryland conditions.
Keywords: ^{13}C, irrigation, pasture-soil systems, soil C inputs, soil organic C
Financial support: The New Zealand Fund for Global Partnerships in Livestock Emissions Research (GPLER), Plant and Food Research and Lincoln University

(7570 - 977) Legume cover crops favour soil organo-mineral formation through microbial products

Murilo Veloso[1]; Denis Angers[2]; Martin Chantigny[2]; Janaína Costa[3]; Deborah Dick[1]; Cimélio Bayer[1]
UFRGS[1]; AAFC Canada[2]; UFGRS[3]

The implementation of no-till coupled with legume cover crops results in high carbon sequestration rates in subtropical soils of Southern Brazil. We hypothesized that this effect is due to the accumulation of organo-mineral associations enriched in microbial products induced triggered by the absence of tillage and the high-quality of legume biomass. We sampled soil in a 30-yrs old field experiment and used density and particle size fractionation in combination with carbohydrate and *n*-alkane analyses to compare the effect of conventional tillage (CT) vs. NT, combined or not with legume cover cropping, and combined or not with mineral N fertilization. In general, the amount of microbe-derived carbohydrates (galactose, manose, fucose and rhamnose) exceeded plant-derived carbohydrates (arabinose and xylose), especially in clay fraction of 20-30 and 75-100 cm layers (microbe-derived-to-plant-derived carbohydrate ratio of 1.9 and 2.2, respectively). Due to the large abundance of LF-C in the 0-5 cm soil layer, leading an overwhelming contribution of plant-derived carbohydrates, the relative contribution of microbial residues was lower than from microbial-derived, but still dominant. In 20-30 and 75-100 cm, the contribution of microbial over plant-derived carbohydrates in the clay fraction was 19 and 7%, respectively, greater with than without legume cover-crops. These findings were in good agreement with the assessment of *n*-alkanes biomarkers: Short *n*-alkanes chains (15-25) instead of long chains (25-35) were favoured by legumes under NT in clay fraction of superficial and deeper soil layers, indicating predominance of microbial residues. The nitrogen fertilization favoured the increase only in LF-C but not in clay-C due to increase of maize input. This result suggests that the high lability of legume residues might be the main driver to C accumulation in organomineral association. This study confirmed our hypothesis that carbon accumulating in organomineral associations is dominated by microbial-derived carbohydrates, and that legume cover crops under NT further favour the dominance of microbial over plant-derived residues, and consequently the SOC accumulation.
Keywords: Organic matter; no-tillage; *n*-alkanes; soil carbohydrates; soil carbon accumulation
Financial support: UFRGS, AAFC Canada, CNPq, CAPES

(4572 - 1450) Liming increases carbon sequestration in tropical cropping systems

Murilo de Souza[1]; Danilo Silva Almeida[1]; Kassiano Felipe Rocha[1]; Gustavo Prestes Gomes[1]; Ciro Antonio Rosolem[1]
School of Agricultural Sciences, Sao Paulo State University[1]

Lime application for soil-acidity amelioration has been considered a

practice contributing to CO_2 emissions to the atmosphere, not only by C loss during its dissolution, but also due to a priming effect resulting from raising soil pH. On the other hand, improvements in soil fertility by liming increase grain yields and biomass production, and in the long term, can raise soil carbon. Our hypothesis is that C sequestration due to liming overcomes emissions to the atmosphere, and so liming is an environmentally sound practice. The objective of this work was to evaluate soil carbon accumulation due to applications of acid-neutralizing amendments to the soil. Two experiments were conducted from 2012 to 2016, one under no-till (NT) and other under conventional-tillage (CT), in Botucatu, SP, Brazil. The treatments consisted of lime (3.7 Mg ha^{-1}), silicate (6.7 Mg ha^{-1}), lime + gypsum (3.7 + 2.0 Mg ha^{-1}), silicate + gypsum (6.7 + 2.0 Mg ha^{-1}) and a control treatment with no amendment. In the CT system, the plots were disk-plowed every year from 2012 to 2015 in the summer, five days before soybean (*Glycine max*) planting. NT and CT experiments were carried out with soybean as summer crop, followed by Maize (*Zea mays*) intercropped with ruzigras (*Urochloa ruziziensis*) in 2013 and 2015, and pearl millet (*Pennisetum glaucum*) intercropped with ruzigrass in 2014. Soil pH amelioration and Al neutralization increased both root and shoot plant biomass, resulting in a greater soil organic matter content in the soil. Soil C down to 0.60 m was increased by 1.7 and 2.75 Mg $year^{-1}$ on average under CT and NT systems, respectively, compared with the control. The total grain yield from 2012 to 2015 was increased with both by lime and silicate application, by 2.6 Mg $year^{-1}$ under CT and 3.3 Mg $year^{-1}$ under NT, on average. There was no difference between lime and silicate as to soil C accumulation. Therefore, the priming effect of lime and the increased C emission are not significant under field conditions, because the correction of the exchangeable acidity results in improved soil fertility for root and plant growth and, thus, increased yields. Despite a peak of C emission right after liming, the results on the long term show that soil acidity amelioration promotes soil carbon sequestration by improving plant root growth, grain and biomass yields. The rate of C sequestration with liming or silicate application is higher in systems under no-till as compared with conventional tillage.

Keywords: Neutralizing action, carbon dioxide, carbon sequestration
Financial support: FAPESP grant 2015/50305-8 and BBRSC/Newton Fund grant BB/N013201/1

(1742 - 3001) Linking vegetation and litter-soil profile properties reveal pathways of soil carbon storage

Fernando Vieira Cesário[1]; Fabiano de Carvalho Balieiro[2]; Masha van der Sande[3]; Marcel Hoosbeek[3]; Lucas Mazzei[2]

Universidade federal do Rio de Janeiro[1]; Embrapa[2]; Wageningen University[3]

Tropical forests contain ~25% of the carbon in the terrestrial biosphere (Bonan 2008), which is divided into different pools, such as vegetation and litter-soil (Grace et al. 2014). Between these pools, the soil carbon stock represents a significant part (~ 2000 Gt) (Stockmann et al. 2013), and therefore even a small release may increase the atmospheric greenhouse gases (Lehmann and Kleber 2015). Hence, soil carbon in tropical forest plays an important role in regulating climate change (Malhi 2012, Crowther et al. 2016). However, much uncertainty still exists about which factors drive soil carbon stabilization in forest tropical ecosystems. To disentangle the direct and indirect effects of the vegetation and litter-soil profile attributes on soil carbon, here we used a structural equation model that links the vegetation (i.e., species diversity, functional traits, aboveground biomass) through the litter-soil profile (i.e., litter quality, enzyme activity, soil texture) to estimate soil carbon using 44 plots in a high diversity tropical Amazon forest. We expect that (i) functional traits will increase aboveground biomass (AGB) since a high abundance of species with high nitrogen leaf would increase photosynthetic rates; (ii) diversity enhances niche complementarity (Tilman 1999) increasing total AGB; (iii) AGB gain would increase root turnover enhancing belowground carbon; (iv) functional traits affect litter quality, a high nutrient in leaves may decrease litter quality because speed up decomposition; (v) litter quality can increase or decrease the decomposition process, a recalcitrant litter (i.e., high C:N) slow down litter decomposition increasing soil carbon; (vi) a recalcitrant litter may increase the microbial production of enzymes; (vii) enzyme activity could increase soil carbon through organic matter breakdown and mineralization; (viii) soil texture can increase both enzyme activity and carbon stock via stabilization and protection with the mineral phase. We find that high nutrient content in the leaves was associated with high C:N in a litter, which in turn increase soil carbon. Suggesting a microbial N preference in early decomposition stages and a litter quality control in later stages. Additionally, diversity increase AGB, which in turn enhance soil carbon. Indicating species richness control in forest growth that leads to accumulating carbon. This study has shown that we can better predict soil carbon connecting vegetation via litter-soil.

Keywords: Litter, enzyme activity, tropical forest, ecosystem functioning, structural equation modeling, functional traits
Financial support: Embrapa and Wageningen University

(1503 - 2966) Magnetism of the Archaeological Black Earth as an agricultural and environmental indicator

Ivanildo Amorim de Oliveira[1]; Ludmila de Freitas[1]; José Marques Júnior[2]; Milton César Costa Campos[3]; Diego Silva Siqueira[2]; Renato Eleotério de Aquino[2]; Daniel Teixeira de Bortoli[2]; Laércio Santos Silva[2]

Instituto Federal do Pará[1]; Universidade Estadual de São Paulo[2]; Universidade Federal do Amazonas[3]

The Amazon region presents a great diversity of soils, especially those with anthropic horizon known as Indian Black Earth (IBE) or Archaeological Black Earth (ABE), which are of great economic importance to the region and to the world. The aim of this work is to understand the spatial variability of environmental attributes (soil CO_2 emission), and agricultural (related to physics and fertility) attributes, using a methodology to understand the sustainability of soil with Indian Black Earth in the Amazon, using magnetic susceptibility as an agricultural and environmental indicator, relating these attributes to the mineralogical composition of this soil, located in the southern region of Amazonas, Brazil. The study was realized in Argissolo Vermelho (Ultisol) whit anthropic horizon or Archaeological Black Earth. In the área grids of 70 × 70 m were established, and the soil was sampled in regular spacing of 10 m in the depth of 0.0-0.20 m. Was determination of chemical properties (pH in water, organic matter, phosphorus, sum of bases (SB), cation exchange capacity, base saturation (V%), organic carbon (OC), stock of organic carbon (STOC)), iron forms (oxide free extracted with dithionite–citrate–bicarbonate (Fe_d) and low crystallinity oxide extracted by ammonium oxalate (Fe_o)) physical properties (texture, and bulk density, magnetic susceptibility and CO_2 flux of soil (FCO_2).To characterize the variability, descriptive and geostatistical statistics were performed through the use of scaled semivariograms to evaluate the spatial relationship between magnetic susceptibility and physical, chemical, iron and FCO_2 attributes. The SM can be used to understand the variability of some agricultural and environmental attributes in Indian Black Earth.The high values of SM can be associated with the presence of maghemite found in the soils and in the ceramic fragments present in the Indian Black Earth.Magnetic susceptibility presents a pattern of spatial variability similar to the CO_2 flux, with the same semivariogram adjustments, presenting a positive spatial correlation between FCO_2 and χfd and negative spatial correlation between FCO_2 and SMbf.

Sites with higher magnetic susceptibility (4.7 to 5.1 × 10^{-6} m^3 kg^{-1}) presented 1.2 times more CTC and emitted 1.4 times less CO_2 compared to areas with lower magnetic values (3.5 to 3.9 × 10^{-6} m^3 kg^{-1}).

Keywords: magnetic susceptibility, spatial variability, CO2 flux of soil.
Financial support: Unesp, FAPEAM e IFPA.

(9182 - 790) Manure type affects manure degradation rate, soil biogeochemistry, and greenhouse gas emissions

Tien Weber[1]; Scott Chang[2]; Xiying Hao[3]; Karen Beauchemin[3]
University of Alberta & Agriculture and Agri-Food Canada[1]; University of Alberta[2]; Agriculture and Agri-Food Canada[3]

Reducing greenhouse gas (GHG) emissions from agriculture is an important way to mitigate climate change. Diet manipulation influences enteric fermentation and has the potential to reduce GHG emissions; however, few studies have examined the effect of diet composition on GHG emissions after manure is applied to the soil. We conducted a 70-day lab incubation experiment to investigate this knowledge gap and analyze how different manure types affect soil biogeochemical cycling and GHG emissions. Soil samples from three sites in Alberta, Canada were treated with manure from beef cattle fed corn or barley, and no manure was applied. The flux of nitrous oxide (N_2O), carbon dioxide (CO_2), and methane (CH_4) was measured. Nitrogen (N) mineralization to ammonium (NH_4^+) under 60% water filled pore space (WFPS) conditions and the nitrification and denitrification roles of N_2O under 80% WFPS conditions were tested using soil incubations. Ammonium (NH_4^+) and nitrate (NO_3^-), microbial biomass, carbon (C) to N ratio, and the activity of β -1,4-Glucosidase (N cycling) and β-1,4-N-acetyl-glucosaminidase (C cycling) were measured to better understand the relationships between soil biogeochemical cycling and GHG emissions. We hypothesize that manure from corn diets reduces GHG emissions correlated to lower levels of nitrification and denitrification due to lower levels of nitrogen excretion from the animal. The results of this study will be used to develop best manure management practices for current and future feeding practices in the beef industry.

Keywords: Manure, biogeochemistry, GHG
Financial support: Agriculture and Agri-Food Canada, Beef Cattle Research Council, Natural Science and Engineering Research Council of Canada (NSERC), & University of Alberta

(9584 - 2492) Multifunctional agroecosystems in the semi-arid environment to mitigate the impacts of climate change

Vanderlise Giongo[1]; Maria do Socorro Conceição de Freitas[2]; Monica da Silva Santana[3]; Alessandra Monteiro Salviano[1]; Tony Jarbas Ferreira Cunha[1]
Embrapa Semiárido[1]; IFSertão[2]; Universidade Federal do Ceará[3]

The governments of the world have been concerned about climate change and how they can ensure access to sufficient food, water and energy resources to safeguard human wellbeing. The Brazilian semi-arid, covering approximately 969.589 km^2, has 21 million people and 1.6 million of agricultural establishments of which 95% are classified as family farms. The typical agricultural systems are characterized by high grazing density, slash and burn practices and fruits and legumes irrigated monocultures. Consequently, soil degradation occurs due unsustainable soil management, decreasing soil carbon stock and the biodiversity. The aim of the work was to design sustainable multifunctional agroecosystems adapted to the soil and climatic conditions and that deal with climate change through carbon sequestration. The study was carried out in two long-term experiments with mango trees (*Mangifera indica* L.), implanted in 2008, and melon crop (*Cucumis melo* L.), implanted in 2012, in Ultisol, located in Pernambuco, Brazil, latitude 09 °09'S, longitude 40°22'W and altitude 365,5m. Experimental areas contemplate models of multifunctional agroecosystems that include two phytomass management systems as main plots (tillage and no-tillage) and three types of plant mixture (PM), as subplots, two of which are composed of 14 species of green manure in different proportions of grasses, oilseeds and legumes (PM1- 75% leguminous + 25% grass and oilseeds; PM2 - 25% legumes + 75% grasses and oilseeds) and one with spontaneous species (PM3), between the lines or in succession, in a randomized complete block design, with four replications. The phytomass production and changes in soil carbon stocks were evaluated over time. The green manures, regardless of the soil management system, promoted significantly higher production of phytomass (PM1= 7,87±0,44 Mg ha^{-1} and PM2= 7,63 ± 0,53 Mg ha^{-1}) than spontaneous vegetation (PM3= 4,00 ±0,34 Mg ha^{-1}). The cultivation of plant mixtures with no-tillage were the agroecosystems more efficient in increasing the soil carbon stocks (0,6 Mg ha^{-1} $year^{-1}$) than agroecosystems with spontaneous vegetation and or soil tillage (0,09 Mg $ha^{-1}year^{-1}$), in first layer (0-5 cm). Multifunctional agroecosystems designs that contemplate the use of green manures and no tillage are efficient in increasing the carbon stock in irrigated semiarid environments, composing a technological strategy to mitigate the impacts of climate change.

Keywords: Green manure, no tillage, dryland.
Financial support: Embrapa.

(2243 - 1234) Nitrogen stock in latosolo (oxisoil) under different forms of use in Cerrado

Adilson Alves Costa[1]; Bruno de Oliveira Dias[1]; Belchior Oliveira Trigueiro da Silva[1]; Erlane Souza de Jesus[2]; Liliane da Silva Soares[1]
Federal University of Paraíba[1]; State University of Bahia[2]

Soil represents an important component in the biogeochemical cycle of nitrogen and other elements. However, the activity of land use change in biomes, such as the Cerrado, has been highlighting the reduction of nitrogen stocks. The objective of this work was to evaluate the nitrogen stocks in Cerrado soils under different forms of land use. The study was carried out in commercial areas located in the municipality of Luís Eduardo Magalhães, West of Bahia, Brazil (12 ° 33'50 '' South and 46 ° 23'35 '' West, altitude 763 m) under Cerrado biome. The soil was classified as Latossolo Amarelo distrófico típico (Oxisoil), with medium texture. Soil samples were collected in the 0-5, 5-10, 10-15, 15-20, 20-30, 30-40 and 40-60 cm layers in three areas under different forms of soil use: area under vegetation native of Cerrado (ACN), no-till area with four years (APD) and area under Eucalyptus plantation with eight years (AEU). The total nitrogen contents and, consequently, the nitrogen stocks were calculated, whose correction of the mass was made by the equivalent mass of the soil. With the data, the analysis of variance was done and the means were submitted to a Tukey average test at 5% of probability. Regarding the total soil nitrogen results, it was observed that there was no difference between AEU and ACN up to the depth of 10 cm and that APD obtained the lowest values in all depths evaluated. The increase of the nitrogen in the first depths in the AEU was due to the time of implantation of the crop of eight years, occurring in this period greater biomass production, which increased the organic matter content of the soil and, consequently, greater nitrogen storage. There were changes in the stocks, where the AEU was similar to the soil under Cerrado at depth of up to 20 cm. The APD presented the lowest stocks in all depths, due to the fact that the implementation time of four years, insufficient to consolidate the system in Cerrado areas. Considering the 0-60 cm depth, it was observed that by replacing ACN (9.25 Mg N ha^{-1}) with AEU (7.49 Mg N ha^{-1}) there was a reduction of

19% in nitrogen and APD stocks (3.79 Mg N ha^{-1}) there was a 41% reduction. It can be concluded that the cultivation of eucalyptus increased in the nitrogen content, contributing with the increase in the nitrogen stocks over the years in the superficial depth.
Keywords: soil organic matter, vegetal residue, soil use
Financial support: National Council for Scientific and Technological Development (CNPq)

(5436 - 773) Nitrous oxide emission from urine and dung patches in subtropical Brazil and its reduction by the nitrification inhibitor dicyandiamide

Priscila Luzia Simon[1]; Jeferson Dieckow[1]; Cecile A. M. de Klein[2]; Josileia Acordi Zanatta[3]; Tony van der Weerden[2]; Bruna Ramalho[1]; Cimélio Bayer[4]

Universidade Federal do Parana[1]; AgResearch Invermay Agricultural Centre[2]; Embrapa Florestas[3]; Universidade Federal do Rio Grande do Sul[4]

The Brazilian cattle herd exceeds 200 million heads and its excreta contribute with 41% of the national emission of nitrous oxide (N_2O). This study aimed at (i) determining the N_2O emission factor (EF) for cattle urine and dung in subtropical condition, and comparing it with the IPCC default EF of 2%; (ii) evaluating the efficiency of the nitrification inhibitor dicyandiamide (DCD) at reducing N_2O emission from urine and dung patches; and (iii) evaluating the efficiency of DCD at curbing emissions when sprayed over excreta patches. Field experiment was conducted in in a kikuyu grass (*Pennisetum clandestinum*) over a haplic Cambissol, in Pinhais-PR, Brazil. Urine and fresh dung of Frisian dairy cows, at volume equivalent to one urination and mass equivalent to one defecation, were deposited in circular microplots of 0.083 m^2. Excreta were combined with or without application of DCD; and when applied, DCD was dissolved into the excreta before its application or was sprayed on the excreta patch after its application. Treatments were applied four times during the year 2014, once per each season (in different spots). After excreta application, N_2O fluxes were monitored in 10 air sampling sessions over 63-68 days, by using closed static chambers. Urine and dung were important sources of N_2O, with an average EF of 0.34% for urine and 0.11% for dung; what urges the investigation and establishment of corresponding mitigation strategies for livestock production. Yet, those emission factors were not as high as the default EF of 2% that the IPCC recommend for national greenhouse gas inventories, what suggest that this default value should be revised for the subtropical region. And revised separately for urine and for dung, which emits less; so that each excreta type has its own emission factor. As a mitigation strategy in subtropical pastures, the use of DCD had a potential to curb N_2O emission from urine patches, particularly in the cooler seasons of autumn and winter, when it significantly reduced the emission by 60-82% after being dissolved in urine. However, improvements on the application method of DCD are still needed, once the most common application method of spraying DCD reduced N_2O emission only in autumn, and by 46%; hence less efficient than when dissolved in urine. With respect to dung, there is no clear evidence that N_2O emission from this excreta is mitigated by DCD, either dissolved into the dung mass or sprayed over the dung pat.
Keywords: Emission factor, Greenhouse gases, Southern Brazil
Financial support: CAPES and CNPq (Brazilian agencies)

(5533 - 2451) Nitrous oxide emissions of production systems in lowlands of Rio Grande do Sul

Thaís Murias Jardim[1]; Walkyria Bueno Scivittaro[2]; Miguel David Fuentes Guevara[1]; Lillian Medeiros Barros[3]; Renata Abreu Rodrigues[3]; Rogério Oliveira de Sousa[1]

Universidade Federal de Pelotas, Campus Universitário, s/n, Capão do Leão, RS, 96160-000, Brazil (thais.murias@hotmail.com)[1]; Embrapa Clima Temperado, Caixa Postal 403, Pelotas, RS, Brasil, CEP 96010-971[2]; Instituto Federal Sul-Rio-Grandense, Praça 20 de setembro, 455, Pelotas, RS, Brasil, CEP 96015-360[3]

The lowlands of Rio Grande do Sul, Brazil, are mainly used for irrigated rice cultivation, being an important source of methane (CH_4) to the atmosphere, due to the establishment of anaerobic environment by flood irrigation of the soil. However, nitrous oxide (N_2O) emissions may also be relevant, especially for production systems involving crop rotations or grazing crop, that require the application of high amounts of nitrogen fertilizers. The objective of this work was to evaluate N_2O emissions in representative production systems of the Rio Grande do Sul lowlands and in a natural area. The study was conducted in a Planossolo (Typic Albaqualf) in Capão do Leão, State of Rio Grande do Sul, Brazil. N_2O emissions evaluations were performed from June 2015 to May 2016. Three production systems (irrigated rice/fallow, soybean/ryegrass/corn and improved pasture) and a natural area were evaluated. In each area, three greenhouse gas collectors systems (closed static chamber) were distributed, constituting the replications of the treatments. N_2O fluxes and N_2O total emissions were measured seasonally (fall/winter period - 2015 and spring/summer period 2015/2016 (summer season)) and throughout the year. During fall/winter period, N_2O emissions were generally low, except for improved pasture system, which presented several high emission peaks associated with the application of nitrogen fertilizer and the deposition of feces and urine of grazing animals. The natural area provided small N_2O absorption in both periods (fall/winter: -0.04 kg N_2O ha^{-1} and summer season: -0.29 kg N_2O ha^{-1}). During the summer season, N_2O emissions were higher than in fall/winter period for all production systems, decreasing from improved pasture (22.8 kg N_2O ha^{-1}) > soybean/ryegrass/corn (10.8 kg N_2O ha^{-1}) > irrigated rice/fallow (2.5 kg N_2O ha^{-1}). The sum of emissions from fall/winter period and summer season shows that the soybean/ryegrass/corn and improved pasture systems provide greater annual emission of N_2O than irrigated rice/fallow system and natural area. Thus, the irrigated rice/fallow system, contrary to CH_4, presents low N_2O emission potential. On the other hand, production systems involving rainfed and pasture crops increase the emission of N_2O.
Keywords: Greenhouse gas; Mitigation; Flooded rice; Crop rotation; Pasture
Financial support: Embrapa, FAPERGS, CNPq

(8333 - 391) Organic carbon stock in Haplic Cambisol under winter cover crops and corn in summer

Jorge Luiz Locatelli[1]; Eduardo Brancaleoni[1]; Felipe Bratti[1]; Luiz Gustavo do Prado[1]; Priscila Grella Moretti[1]; Ricardo Henrique Ribeiro[2]; Jonatas Thiago Piva[1]

Universidade Federal de Santa Catarina[1]; Universidade Federal do Paraná[2]

Soil organic carbon is an indication of the quality of management that is used in the system. Although it is a variable strongly influenced by environmental factors, agricultural practices are determinant for the establishment of a conservationist system. The objective was to evaluate the carbon stock in the 0-0,6 m layer, in the succession of corn (*Zea mays*) in the summer, with seven winter coverage crops, a consortium and fallow, under no-tillage in a temperate climate. The

experiment was implemented in 2013 at the experimental farm of the Universidade Federal de Santa Catarina, located in the city of Curitibanos-SC, in a Cfb-temperate climate, with an annual average rainfall of 1500 mm, and an average temperature of 15 °C. The soil is classified as a Haplic Cambisol of clayey texture, 550 g kg^{-1} of clay. In the summer the corn crop (*Zea mays*) was cultivated, and in winter the different cover crops, *Avena sativa*, *Avena strigosa*, *Lolium multiflorum*, *Brassica napus*, *Vicia craca*, *Raphanus sativus*, *Trifolium pratense*, the consortium between *Avena strigosa* and *Vicia craca* and a fallow, in plots 4 x 4 m. During the summer crops, no nitrogen (N) fertilization was used, only potassium and phosphate fertilization was applied. In winter, in addition to potassic and phosphate fertilization, the cover plants received 30 kg ha^{-1} of N in topdress. The soil samples were collected by the excavation method, 4 years after the implantation of the experiment, in the depths of 0-0,05, 0,05-0,10, 0,10-0,20, 0,20-0,30, 0,30-0,45 and 0,45-0,60 meters. The determination of the soil organic carbon content was carried out by the wet combustion method. Data were submitted to analysis of variance and the Scott-Knott test was applied to 5%. The carbon stock for the 0-0,60 layer did not show variation under different cropping systems, which may be justified by the short period of experiment conduction, since the carbon dynamics in soil is slow, and influenced by several environmental and anthropic factors, mainly in a temperate climate. Among the evaluated depths, the succession of *Zea mays* + *Vicia craca*, and *Zea mays* + *Avena strigosa* was superior to the other treatments in the layer of 0,45-0,60 meters, which may be related to the greater dry matter addition provided by these crops, and also by the root system growth in depth. The establishment of a high-quality cropping system acts positively, increasing soil quality and mitigating environmental effects.

Keywords: Carbon content, mineralization, no-till.
Financial support:

(6054 - 920) Organo-mineral interaction is the main stabilization mechanism of C from animal manures in a subtropical sandy Acrisol under no-tillage

Lucas Antonio Telles Rodrigues[1]; Roque Junior Sartori Bellinaso[2]; Matheus Severo de Souza Kulmann[2]; Rodrigo Knevitz Hammerschmitt[2]; Isac Aires de Castro[2]; Rodrigo Otávio Schneider Souza[2]; Cimélio Bayer[1]; Carlos Alberto Ceretta[2]

Universidade Federal do Rio Grande do Sul[1]; Universidade Federal de Santa Maria[2]

Establishing the long-term effect of different types of manure (animal species, solid or liquid) on soil organic matter fractions (SOMF) has high agronomic and environmental importance. In addition, are scarce long-term field trials comparing the effect of different types of manure (in comparison to mineral fertilizer) on labile and stable fractions of soil organic matter (SOM), mainly in subtropical regions. This study aimed to evaluate the impact of successive applications of pig slurry (PS), cattle slurry (CS), pig litter (PL) and mineral fertilizer (MF) for 12 years on physical fractions of SOM (free and occluded light fractions and sand and silt+clay-size heavy fraction) within a 0-20 cm layer of a sandy Acrisol (~ 100 g kg^{-1}clay). The quantity of manures and MF were applied according to local recommendations to maize on summer, in succession to black oat or wild radish or Wheat on winter, cultivated under no-tillage system. Animal manures (PL and CS) provided higher increases in C in all SOMF compared to PS and MF up to 10 cm. We verified greatest accumulation of C in the silt+clay-size heavy fraction with application of PL (50.5%) in relation to control (19.62 Mg C ha^{-1}), followed by CS (25.6%), PS (15.0%) and MF (6.8%) (non-significant) in the 0-20 cm soil layer (sum of 0-4, 4-10 and 10-20 cm). It was possibly due to the high amount of C added and possibly to differences in its constitution. In the PL, further to C plants residues input there were C from the rice husk used as litter in pig breeding. In addition, the digestive system of cattle and swine and diet of both species is also distinct (cattle - rich in fiber vs. swine - rich in grains). On free and occluded light fractions, the high C accumulation were verified with PL (346 and 316%, respectively), and CS (154 and 47%, respectively) application in relation to control (0.329 Mg C ha $^{-1}$), while PS and MF did not or had little effect, which may be linked to an insufficient C input to offset a possible PS-induced priming effect on soil OC mineralization. Twelve years of PL and CS applications improve soil C accumulations in all soil SOMF up to 10 cm soil layer. On the other hand, PS an MF had little effect on the C pools, which was possibly related to their small content of C and or the PS-induced priming effect. Application of PL as fertilizer to plants by long time stood out because improve soil organic carbon occlusion in aggregates and its stabilization in organo-mineral complexes.

Keywords: Cattle slurry. Physical fractions. Pig litter. Soil quality.
Financial support: National council for scientific and technological development, coordination for the improvement of higher level education, Research Support Foundation of the State of Rio Grande do Sul

(1396 - 2778) Participatory technology demonstrations for enhancing climate resilience in varied agro-ecologies across India

A.K. Singh[1]; Y.G. Prasad[2]

ICAR[1]; ICAR-ATARI, Hyderabad[2]

Participatory technology demonstrations for climate resilience in agriculture are in progress since 2012 in diverse agro-ecological situations spread across 121 climatically vulnerable districts in India under the National Innovations in Climate Resilient Agriculture (NICRA) project implemented by Farm Science Centres, locally known as KrishiVigyanKendras (KVKs), of the Indian Council of Agricultural Research (ICAR). Transplanted paddy is largely cultivated in irrigated tracts of delta areas across the country. However, facing erratic rainfall onset and distribution and depleting groundwater resources, farmers in recent years, have shown more acceptance for direct seeded rice cultivation. Direct seeding with drum seeder in puddled conditions and line sowing in un-puddled conditions along with effective weed management was more widely adopted in demonstration areas. Direct seeding not only saved water, reduced cost of cultivation but also contributed to reduction in methane emissions. Soil test based nutrient application in rice crop reduced use of nitrogenous fertilizer. In rainfed agro-ecologies (<750 mm rainfall), *ex-situ* rainwater harvesting technologies and *in situ* soil moisture conservation practices such as bunding, conservation furrows, planting across slope, practice of mulching, manuring, choice of crops/ crop combinations and short duration varieties depending on onset of rainfall enhanced coping ability of farmers in the semi-arid tracts.In rainfed areas with higher rainfall (>1000 mm), promising resource conservation practices included planting of rainy season crops such as soybean and pulses adopting ridge-furrow/ raised bed systems in vertisols, zero till planting of post rainy season crops such as wheat, maize, oilseeds and pulses along with adoption of mulching techniques. Potential of a wide range of climate resilient practices and technologies was demonstrated and evidences generated across the country for sustainable use of natural resources. Efforts to integrate identified practices in the local adaptation plans for enhancing coping with climate variability are underway in a number of states across the country.

Keywords: Technology demonstrations, climate resilience, rainwater harvesting, resource conservation, zero tillage, mulching
Financial support: Indian Council of Agricultural Research

(5196 - 1966) Passive mineral carbonation as a potential atmospheric C sink: exploratory samples from Brazil.

Antonio Carlos de Azevedo[1]; David A. C. Manning[2]; Marcos Canto Machado[1]; Marcos Yassuo Kamogawa[1]

USP-ESALQ[1]; New Castle University[2]

Calcium (Ca) and magnesium (Mg) in solution may react with carbonate anions to precipitate Ca- and Mg-carbonates. This process relates to the CO_2 concentration in the atmosphere over geological timescales by producing pedogenic and marine carbonates. Establishing the conditions for this process to occur in natural or constructed soils will contribute as a carbon sink to atmospheric CO_2. Mineral carbonation in batch reactors is extensively studied, but there are few studies about passive carbonation in open systems such as mining stockpiles or construction debris. The objective of the EPSRC-funded SUCCESS Program was to evaluate the potential of carbon capture by mineral carbonation in terrestrial, particularly urban, environments. A combination of chemical and stable isotope analysis (C, O) has been used to identify recent, biogenic, carbonate products. This showed removal of up to 85 T CO_2 per hectare annually in a soil dominated by demolition materials at Science Central, Newcastle, UK. A set of three samples from construction debris recycling facilities in the Piracicaba region, Brazil, was submitted for preliminary analysis by this method. The results showed delta ^{18}O and delta ^{13}C ratios similar to the samples collected from Science Central site, indicating that the same process of capture of atmospheric CO_2 takes place in Brazil. These preliminary results encourage further investigation on the potential of passive mineral carbonation as a carbon sink in tropical conditions in Brazil and elsewhere, especially in urban soils.

Keywords: Construction debris; Carbon sink; Urban environment;
Financial support: Engineering and Physical Sciences Research Council (EPSRC) project number EP/K034952/1 and Natural Environment Research Council (NERC) project number GGR NE/P019501/1

(8593 - 2794) pH modulation of microbial communities driving the methane cycle in the Amazon Forest-to-Pasture conversion

Leandro Fonseca de Souza[1]; Dasiel Obregon Alvarez[1]; Fabio Vitorino Gomes[1]; Naissa Maria Silvestre Dias[1]; Paulo Sergio Pavinato[2]; Siu Mui Tsai[1]
CENA/USP[1]; ESALQ/USP[2]

The amazon rainforest soils are relevant global sinks to methane, but the forest-to-pasture conversions turn these soils in methane sources. The process that leads to this change are few understand, regarding the microorganisms and soil pH modulation. Addressing this, the structure of microbial communities and methane flux through different land uses and pH amendment were determined in mesocosm experiment. Soils from Ariquemes/RO (09°54'58"S 63°02'27"W - Apr/2017), of Primary Forest (FP), Degraded Pasture – established in 2004 (P04) and Conserved Pasture – established in 1972 (P72) were collected, sieved to 5mm and moisture standardized to 70% of pot water retention capacity. The pots were filled to a 10cm layer and the initial pH_{CaCl2} (FP – 4,0; P04 – 4,7; P72 - 4,6) of all soils were changed to $5,8_{CaCl2}$ (85 - V%). The gas fluxes were measured by 120 days in static chambers for 10 minutes using infrared gas analyzer (UPGGA, Los Gatos Research) and linear regression to determine fluxes. After 40 days of amendments, DNA was extracted (PowerSoil, QIAGEN) and molecular analysis performed: qPCR of genes to methane consumption (*pmoA*) and production (*mcrA*) and high throughput sequencing of 16S gene DNA of Bacteria and Archaea (Illumina Miseq). The gas fluxes and qPCR data were analysed with *t*-test ($\alpha < 0,05$), the analysis of differential composition in community with ANCOM (q-values < 0,05). All soils exhibited methane consumption at atmospheric conditions. The consume scale was FP> P72> P04 for both control and modified pH soils. The pH amendments reduced the methane oxidation in all soils, intensely in FP, but with small impact in pastures well managed than in the degraded pasture area. The pmoA/mcrA ratio reduced with pH amendments for all soils, intensely in FP. The methanotrophic bacteria identified in Forest soils belong to the *Beijerinckiaceae* family; methanogenic were not detected. In Pastures the *Methylocystaceae* family predominate (fewer in degraded pasture area), as well the methanogenic (decreasing order): *Methanocellales, Methanosarcinales and Methanobacteriales*. The composition of methane associated communities was not affected in terms of relative abundance with pH modulation, but the relative increase of *mcrA* copies indicate increase of producers. We conclude that the microbial methane consumers in the Amazonian soils are diverse, occupying contrasting environments (soil usage and pHs), but the efficiency of soils in consume methane is distinct.

Keywords: climatic changes, soil microbial ecology, *Methylobacteriaceae*, liming, bioinformatics
Financial support: CNPq, CAPES and FAPESP

(8738 - 1852) Plant diversity affects GHG fluxes in an ecological engineering experiment in a disturbed *Sphagnum* peatland (La Guette, France)

Sébastien Gogo[1]; Christophe Guimbaud[1]; Fabien Leroy[1]; Benoit D'Angelo[1]; Léonard Bernard-Jannin[2]; Fatima Laggoun-Défarge[3]
Université d'Orléans[1]; Univesité D'Orléans[2]; CNRS[3]

Many *Sphagnum* peatlands are experiencing vegetation change caused mainly by hydrological disturbances. In this, greenhouse gases (GHG) fluxes are affected by peat oxygenation, changes in litter composition (and thus decomposition) and rhizospheric processes. This could lead a C sink system to switch to a source. To restore peatland functioning, ecological engineering works can be undertaken. Our study site, La Guette peatland (central France) is invaded by *Molinia caerulea* because a drain at the output decreased the water table depth. It was shown that it functioned as a source of C. In 2014, hydrological works were undertaken: 8 dams were installed, ditches were dug perpendicular to the water flow and back-filled with a mixture of shales and bentonite. In addition, a biodiversity experiment with 2 identical experimental stations was implemented: “downstream”, close to the hydraulic works (relatively wet), “upstream”, (relatively dry), with types of 3 vegetation plot (2m x 2m, n=4): 1) “control”: intact vegetation (Molinia caerulea, Erica tetralix), 2) “bare” peat: vegetation and 5cm of peat were removed, 3) “Sphagnum”: bare peat+*Sphagnum*. Our study aims to assess the effect of the vegetation treatment on the GHG fluxes. CO_2 (ecosystem respiration or ER, Gross Primary Production or GPP, and Net Ecosystem Exchange) and CH_4 fluxes (manual accumulation chamber), air and soil temperature, water table level, soil moisture were measured. After 18 months, half of the surface of “bare” and “Sphagnum” plots were covered by vegetation (*Eriophorum angustifolium*, *Rynchospora alba*, *Trichophorum cespitosum*). With time, as succession unfolds in these 2 types of station, ER and GPP increased. The sensitivity of ER to temperature increased sharply in “bare” and “Sphagnum” plots with years and became higher than the sensitivity in “control” plots. GPP increased with the total vegetation percentage cover, especially in “bare” peat plots. NEE were still lower in the “bare” and “sphagnum” peat plots than in “control”. However, the difference tends to decrease. In November 2015, the “sphagnum” peat plots were still functioning as a sink of C, whereas the other plots functioned as a source. As a conclusion, the “bare” and “sphagnum” treatments, after 3 years, were not able to store C as much as the control during the daytime measurements undertaken. C budget for each treatment still have to be calculated to determine the sink or source functioning of the different treatment.

Keywords: Greenhouse gas emissions; Net ecosystem carbon exchange; *Sphagnum* mosses; Vegetation changes
Financial support: Projet CarBioDiv Région Centre-Val d Loire, Labex VOLTAIRE (ANR-10-LABX-100-01)

(6687 - 1728) Shoot:root ratio and belowground carbon inputs of oats (*Avena sativa* L.) in a southern Brazil Inceptisol under grazing intensities.

Ricardo Henrique Ribeiro[1]; Bruna Ramalho[1]; Priscila Luzia Simon[1]; Caroline Amadori[1]; Guilherme Romani de Mello[2]; Felipe Bratti[2]; Jorge Luiz Locatelli[2]; Elisandra Cristina Ribeiro[2]; Jeferson Dieckow[1]; Jonatas Thiago Piva[2]

Federal University of Parana[1]; Federal University of Santa Catarina[2]

The carbon dioxide (CO_2) fixed into the plants by photosynthesis is the primary carbon (C) source the soil receives carbon (C). In the case of pastures, as the shoot biomass is removed by animal grazing, roots are the main component of C input. The grazing intensity is one of the major management practices influencing rooting patterns and thus C inputs to soil. The objective of this work was to evaluate black oats shoot and root biomass production and belowground C inputs to soil under grazing intensities in a tree-year experiment in a subtropical Inceptisol, Curitibanos, Santa Catarina, Brazil. The experimental design was randomized block with three treatments and four replicates. The treatments were high and moderate grazing intensities that corresponded to the residual plant height after grazing cycles (0.7 and 0.15 m respectively) at a black oat (*Avena sativa* L.) pasture, besides the treatment without grazing. The treatments were fertilized with 150 kg N ha^{-1} before beginning the grazing. Shoot biomass was determinated at each grazing cycle. Soil samples were taken at 0.0-0.3 m depth, at oats flowering, after two grazing cycles. The samples were washed, roots manually removed from the soil and dried at 45 ^{o}C to determine dry biomass and C content by dry combustion method. Belowground C input was calculated with the total C in root plus rhizodeposits (considering 0.65 of total C-root). No grazing resulted in the greatest shoot:root ratio (3.9), shoot biomass (5.6 Mg ha^{-1}), and C-root content (31.9 %), while the other treatments did not differ among them, with average values of 2.6, 3.7 and 31.3, respectively. This can be related to the constant renewal in shoot, caused by grazing, stimulating root carbohydrates translocation to shoot meristems and leading to lower C-root content. Also, grazing could increase root growth rate, resulting in less aromatized C compounds, thus lower C content in root tissues. There were no significant differences among other variables. The average belowground C input was 1.2 Mg C ha^{-1} and root dry mass was 1.5 Mg C ha^{-1}. No grazing resulted in the greatest shoot production, but did not affect belowground C input. Regardless of grazing intensity, shoot and root production and belowground C input were similar, resulting in the best pasture management of the soil, with the benefit of beef production and additional income.

Keywords: Root biomass; soil organic carbon; annual pasture.

Financial support: The National Counsel for Scientific and Technological Development (CNPq).

(1589 - 1000) Short-term effects of deep ploughing on soil C stocks following renewal of a dairy pasture in New Zealand

Roberto Calvelo Pereira[1]; Michael J. Hedley[1]; James Hanly[1]; Mike Bretherton[1]; Dave Horne[1]; Peter Bishop[1]; Jorn Dijkstra[2]; Mike Beare[3]; Sam McNally[3]

Massey University[1]; Massey Univeristy[2]; Plant & Food Research[3]

In New Zealand's high producing permanent pastures the topsoil constitutes a large reservoir of soil organic carbon (SOC), which shows a marked stratification with depth. As consequence, sub-surface layers can contain 10 times less carbon than the surface soil. In permanent pastures with high carbon inputs, the formation and decomposition of these surface SOC stocks are often at equilibrium and C storage shows little change over time. Pastoral based dairy systems utilising ryegrass plus clover cultivars require renewal every 7-10 years to avoid reversion to less productive grasses. This may involve spring cultivation (either no-till, shallow till or full cultivation), summer forage cropping and autumn re-grassing. It has been hypothesised that SOC stocks can be increased by inverting the soil profile at pasture renewal through infrequent (once in 25-30 years) deep mouldboard ploughing (up to 30 cm depth). Increased C sequestration occurs when the new grass quickly rebuilds SOC stocks in the new topsoil (exposed low C sub-soil) at a rate faster than the decomposition of SOC in the rich former topsoil transferred to depth (now below 15 cm). However, benefits form accelerated C storage may be offset if crop and pasture production is adversely affected by the ploughing event (e.g., as result of compaction or excessive drainage). Hence, the aim of this work was to assess the short-term effects of infrequent inversion tillage of long-term New Zealand pastoral-based dairy soils under summer crop management and autumn re-grassing. An imperfectly drained Typic Fragiaqualf under dairy grazing was deep ploughed (approx. 25 cm) and re-sown with turnip in October 2016; other treatments included were shallow (< 10 cm) cultivation and no-till. The site was core sampled (0-40 cm) before cultivation and after 5 months of turnip growth to assess changes in SOC. Plant growth, herbage quality, and nutrient leaching were monitored during the 5-month period; root growth was assessed at the end of the crop rotation. Full cultivation transferred SOC below 10 cm depth, as expected. Soil bulk density decreased whereas root mass increased (10-20 cm depth; $P < 0.05$) under deep cultivation only. Besides, losses of mineral N were attenuated under deep tillage, resulting in a relative increase in crop yield. The potential for infrequent inversion tillage increasing soil C sequestration as a greenhouse gas (GHG) mitigation tool is currently being tested at other sites in New Zealand.

Keywords: soil carbon sequestration; soil carbon stocks; cultivation; deep ploughing; inversion tillage; pasture renewal

Financial support: Massey University, New Zealand; Ministry for Primary Industries, New Zealand

(3362 - 667) Soil Carbon and Nitrogen content in areas of agricultural expansion in southern Brazil

Felipe Bonini da Luz[1]; Lucas Aquino Alves[2]; Cícero Ortigara[2]; Carlos Augusto Bonini Pires[3]; Julio Cezar Franchini[4]; Henrique Debiasi[4]; Vanderlei Rodrigues da Silva[1]

Federal University of Santa Maria, 98400-000 Frederico Westphalen, RS, Brazil[1]; Federal University of Rio Grande do Sul, 91540-000 Porto Alegre, RS, Brazil[2]; Federal University of Santa Maria, 97105-900 Santa Maria, RS, Brazil[3]; Embrapa Soybean, P.O. Box 231, 86001-970 Londrina, PR, Brazil[4]

In Brazil, in recent years, areas of light soils (sandy) have been incorporated into the productive process of grains, cultivated pastures and bioenergy. However, there is a lack of information about the expansion of agriculture to sandy soils, as well as the implementation of production systems that aim at improving soil quality. The objective of this work was to evaluate the content of soil carbon (C) and nitrogen (N) in sandy soils of the southern region of Brazil due to different land uses. Soil samples were collected in a Entisols (Quartzipsamments) with 10% of clay in Santo Inácio-PR, in three layers to the depth of 0.30 m in the land uses under native vegetation, pasture managed at 17 years, sugarcane with 12 years and integrated crop-livestock system (ICLS) managed at 13 years. The results show that in the 0.0-0.10 m layer, the land uses with pasture managed and ICLS presented contents of C (6.72 g kg^{-1} and 5.67 g kg^{-1} respectively) and N (0.91 g Kg^{-1} and 0.72 g Kg^{-1} respectively) similar to native vegetation (5.72 g Kg^{-1} of C and 0.89 g Kg^{-1} of N) and higher contents of C and N that the soil cultivated with sugarcane (2.42 g Kg^{-1} of C and

0.30 g Kg^{-1} of N). The uses of land with pasture managed and ICLS correspond to some of the actions described in the Brazilian plan for low carbon agriculture (ABC Plan) and based on the results of this work, these uses have total conditions to maintain and/or raise the quality of the tropical soils, even sandy ones, through the accumulation of C and N in the soil. In addition, the results of this study suggest that the expansion of sugarcane areas in the center-south region of Brazil should be avoided in sandy soils, because due to their fragility, and a subsoiling at each planting/renewal of sugarcane plantations, it demonstrates potential to reduce C and N content, compromising soil quality.

Keywords: soil quality, sugarcane, ABC Plan, integrated crop-livestock
Financial support:

(7328 - 208) Soil carbon dynamics from a degraded pastureland to an agrisilviculture system in the Cerrado

Thais Rodrigues Coser[1]; Cícero Célio de Figueiredo[1]; Boban Jovanovic[1]; Túlio Nascimento Moreira[1]; Thamires Dutra Pinheiro[1]; Sara Kananda da Silva Rocha[1]; Letícia Pereira da Silva[1]; Mateus Oliveira Gomes[1]
Universidade de Brasília[1]

To decrease deforestation and land degradation in agricultural-environmental-hotspots, ecological intensification of agriculture has been proposed and stimulated by various countries. Among Brazil`s measures to reduce deforestation, improve ecosystems services and stimulate a low-carbon (C) economy, there is an incentive to restore 15 million hectares of degraded pastures and to increase five million hectares of agroforestry and/or integrated cropland-livestock-forestry systems by 2030. Agrisilviculture systems may potentially increase soil organic matter (SOM) and its quality due to its diversified and large C inputs. However, few studies have investigated SOM labile and stable carbon fractions within cropping seasons in agriculture and pastoral systems. Therefore, this study aimed to evaluate the transition of a degraded pasture to an agrisilviculture system of corn + *Gliricidia sepium* + *Panicum maximum* cv. Massai along a four-year field experiment under a clayey Oxisol in the Brazilian Cerrado on SOM fractions. Soil samples were collected in four cropping seasons: T0 - under degraded pasture, T1, T2, T3 – 2^{nd}, 3^{rd} and 4^{th} years after implementing the integrated production system, respectively. C from the particulate SOM increased by 476%, 305% and 368% at 0.00 – 0.10, 0.10 – 0.20 and 0.20 – 0.40 m layers, respectively, and was found to be the most sensitive indicator for changes in soil management systems. The microbial biomass C ranged from 265 mg kg^{-1} at the 0.00 – 0.10 m layer to 113 mg kg^{-1} at the 0.20 – 0.40 m layer and showed no difference between the evaluated seasons, except at the 0.10 – 0.20 layer where T0 was found to be 45%, 46% and 59% lower than T1, T2 and T3, respectively. Both mineral associated and total soil organic C increased from T0 to T3. Surprisingly, inert C increased up to 0.20 m layer from T0 to all the other seasons and represented 21 to 42% of total soil organic C. The agrisilviculture system with the use of corn, *Panicum maximum* cv. Massai and *Gliricidia sepium* increased soil organic C and SOM quality in a short-term period, thus showing its potential to be used as an ecological intensified agricultural practice.

Keywords: soil organic carbon fractions; *Gliricidia sepium*; *Panicum maximum* cv. Massai; *Zea mays*; Brazilian savannah
Financial support: Brazilian National Council for Scientific and Technological Development (CNPq). Project number: 473378/2013-2

(8168 - 212) Soil carbon stock predictive models on archaeological black lands - natural and transformed

Renato López Noronha[1]; Marcelo Dayron Rodrigues Soares[1]; Ingrid Nehmi de Oliveira[1]; Camila Viana Vieira Farhate[2]; Zigomar Menezes de Souza[1]; Stanley Robson de Medeiros Oliveira[3]
State University of Campinas (UNICAMP)[1]; State University of State University of Campinas (UNICAMP)[2]; Brazilian Agricultural Research Corporation (EMBRAPA)[3]

In the Amazon region, types of soil known as Archaeological Black Lands (ABL) present anthropic horizon A and are associated with prolonged human occupation by indigenous societies from the pre-Columbian period, where chemical and physical attributes have better quality than other types of soil in the Amazon, setting a large organic carbon reservoir. However, the conversion of these natural ecosystems into cultivated environments make emerge changes in soil carbon dynamics, often leading to a decline in soil organic carbon content. Therefore, our aim was to use data mining techniques to generate predictive models for the effect of soil use on carbon stock in natural and transformed areas of Archaeological Black Lands. We carried out our experiment in Manicoré and Apuí, Amazonas State, Brazil. After field data collection and laboratory analysis, we obtained a set of data consisting of 21 attributes, 20 predictive attributes consisting of 13 soil physical attributes, 6 soil chemical attributes, 1 soil use related attribute, and 1 response variable, referring to soil carbon stock (SCS), which is the classification target. Due to the large number of attributes, we performed a selection procedure to eliminate attributes of low correlation to the response variable. For data classification, we used the binary induction technique of the decision tree through software Weka 3.8. The results obtained showed that for the depth of 0.00-0.05 and 0.05-0.10 m, the best selected subset was determined using the Wrapper method for attribute selection. In the depth of 0.00-0.05 m, we generated a model of 79% accuracy containing only six rules, including, as the most important classification attribute was soil use. For the depth of 0.05-0.10 m, we generated an eight-rule decision tree of 74% accuracy including sand as the most important attribute. In this context, we highlight the Wrapper method efficiency to select subsets of predictive attributes, capable to generate more understandable decision trees, using a smaller number of attributes in the classification process, making it faster and with a lower computational cost. In addition, data mining techniques were efficient at providing predictive models capable to assist the decision-making process on possible management practices with the potential to conserve or increase soil carbon stock in archeological black lands.

Keywords: Soil management system, data mining techniques, decision tree, anthropic soils
Financial support:

(9594 - 1157) Soil carbon, nitrogen and phosphorus stocks of forest islands of west Africa

Caleb Melenya[1]; Vincent Logah[1]; C. A. Queseda[2]; J. O. Azeez[3]; H. Compaore[4]; E. N. Tetteh[5]; K. Ouattara[6]; S. A. Mesele[3]; A. B. Bougma[7]; J. Lloyd[8]
Department of Crop & Soil Sciences, Kwame Nkrumah University of Science and Technology, Ghana[1]; Istituto Nacional de Pesquisas da Amazonia, Manaus, Brazil[2]; Department of Soil Science and Land Management, Federal University of Agriculture, Nigeria[3]; Institut de l`Environnement et de Recherches Agricoles, Kaboinse, Burkina Faso[4]; Crops Research Institute, Council for Scientific and Industrial Research, Fumesua, Ghana[5]; K. OUATTARA[6]; Université Polytechnique de Bobo-Dioulasso, Burkina Faso[7]; Department of Life Sciences, Imperial College, London[8]

The biogeochemical mechanisms underlying the 'forest island' phenomenon in open savanna landscapes of West Africa remain under investigated despite the potential of utilising such information in community carbon offset programs in the era of climate change. In

this study, we report soil carbon, nitrogen and phosphorus stocks of eleven forest islands across a range of landscapes in three West African countries comparing them with adjacent farmlands. Soils were sampled in each forest island using stratified random sampling technique at half canopy radius from tree trunks (T) and at half the maximum distance between two adjacent trees (G). Soil carbon stock of the forest islands ranged from 9.9 to 45.5 Mg ha^{-1} at 0-5 cm depth and from 17.6 to 273.6 Mg ha^{-1} at 0-30 cm depth across all sites in all three countries. The corresponding soil N stock of the forest islands were in the ranges of 0.8 to 3.3 Mg ha^{-1} and 1.3 to 19.8 Mg ha^{-1}. The soil C and N stocks of adjacent farmlands were markedly lower ranging from 2.5 to 8.6 Mg C ha^{-1} and 0.2 to 0.8 Mg N ha^{-1} across all sites at the 0-5 cm depth. Values ranging from 11.9 to 56.6 Mg C ha^{-1} and 1.0 to 5.0 Mg N ha^{-1} were observed at the 0-30 cm depth. Results showed higher distributions of C and N at T than at G positions. Soil total phosphorus stocks of the forest islands were also greater than that of the adjacent farmlands. With our observed forest island C and N concentrations being much higher than what is considered typical characteristic of West African soils, this study suggests that there is a considerable potential for forest islands to serve as significant carbon sinks aiding climate change mitigation in Africa.

Keywords: Forest islands, climate change, carbon, nitrogen and phosphorus

Financial support: British Government Royal Society-DFID

(1057 - 3232) Soil CH_4 and N_2O fluxes in an improved-fallow slash-and-mulch agroforestry system for one year in secondary forest and one year of crop cultivation in eastern Amazonia of Brazil

Aaron Joslin[1]; Daniel Markewitz[1]; Lawrence Morris[1]; Francisco de Assis Oliveira[2]; Steel Vasconcelos[3]; Oswaldo Kato[3]

University of Georgia[1]; Universidade Federal Rural da Amazônia[2]; Embrapa Amazônia Oriental[3]

Agricultural practices and associated activities account for approximately 25% of global GHG emissions. Slash-and-burn preparation methods are common among tropical, smallholding farmers, contributing to CO_2, CH_4, and NO_x gases to the global emissions budget via burning. Slash-and-mulch technology has been developed to replace burning during site preparation, reducing total GHG emissions compared to slash-and-burn practices. Improved-fallow practices incorporate N-fixing plants into the crop-fallow cycle in an effort to increase N stocks and biomass in the agricultural system without the use of mineral fertilizers. Increased system C and N content may also cause increased CH_4 and N_2O fluxes from the soil, negating GHG sequestration via soil and biomass C storage. We investigated the CH_4 and N_2O fluxes of an improved-fallow, slash and mulch agroforestry system in eastern Amazonia of Brazil for one year prior to, and one year following, conversion of secondary forest to cropped field. Fertilization with P+K fertilizer was the main-plot treatment and the inclusion of an N-fixing tree (*I.* edulis) in the improved-fallow planting mix was the sub-plot treatment in the split-plot design. Samples were taken along a transect, at distances of 0.25, 0.5, 1.0 and 2.0 m from the base of each of 2 trees in each plot. No significant increases in CH_4 or N_2O fluxes during the year pre-conversion in either the main or sub-plot treatments were found, yet there was a significant increase in the flux of N_2O in the N-fixer sub-plot treatment during the year post-conversion. Rates of N_2O flux were significantly different, and greatest, only at 1.0 m from the base of the tree. There was a trend of increasing N_2O and CH_4 fluxes with P+K fertilizer.

Keywords: Agroforestry, Greenhouse gas emissions, smallholding agriculture, N-fixing trees, Slash-and-mulch, Improved-fallow, biogeochemistry, Nitrogen cycling

Financial support:

(8302 - 2443) Soil CO_2 emission and correlations with soil properties in under no-tillage with different crops rotations

Gustavo André de Araújo Santos[1]; Mara Regina Moitinho[1]; Bruna Oliveira Silva[1]; Luiz Fernando Favacho Morais[1]; Katharine Viana Batista[1]; Daniel De Botoli Teixeira[2]; José Eduardo Corá[1]; Newton La Scala Júnior[1]

Universidade Estadual Paulista[1]; Universidade de Marília - UNIMAR[2]

Agriculture is one of the human activities that contribute most to the emission of greenhouse gases, among them CO_2. Understanding the dynamics of this gas in the soil still very complex, since several factors influence this process. The objective of this study was to relate the soil CO_2 emission (FCO_2) with the soil physical attributes in under no-tillage with different crops rotations in tropical soil. The study was conducted in an area under no-tillage system in the municipality of Jaboticabal-SP, Brazil. The treatments were combinations of three sequences of summer crops and two winter crops, assuming as summer crops: maize monoculture (MM), soybean monoculture (SS) and soybean with corn rotation. The winter crops were: sunhemp and corn. The experimental design was in blocks with three repetitions. Between July and August 2016 FCO_2, soil temperature and moisture were conducted with 16 evaluations. FCO_2 evaluated with a portable system from the company LI-COR (LI-8100). Soil temperature was evaluated using an automatic thermometer and soil moisture using a TDR-Campbel® (0-20cm). The soil undisturbed samples was collected in depth 0.2m for soil porosity analysis. No interaction ($p>0.05$) was observed on the summer crops with the winter crops on the attributes of the soil, for this reason the winter crops were compared isolated from the summer crops. FCO_2 showed no difference between the summer sequences ($p>0.05$). However, for winter crops, soil under sunhemp residues showed higher FCO_2 (1.03µmol $m^{-2}s^{-1}$) when compared to corn crop (0.94µmol $m^{-2}s^{-1}$). Soil temperature explained the FCO_2 in all treatments, (MM) ($R^2_{aj.}$=0.40; $p<0.0001$), (SM) ($R^2_{aj.}$=0.28; $p=0.003$) e SS ($R^2_{aj.}$=0.38; $p<0.0001$) corn ($R^2_{aj.}$=0.39; $p<0.0001$) and sunhemp ($R^2_{aj.}$ =0.31; $p<0.0001$). In the soil under residue (MM) the FCO_2 was explained only for soil microporosity ($R^2_{aj.}$=0.26; $p=0.004$). In (SM) FCO_2 correlated with macroporosity ($R^2_{aj.}$ = 0.33; $p = 0.001$) and soil microporosity ($R^2_{aj.}$=0.21; $p=0.03$). For (SS) was with microporosity ($R^2_{aj.}$=0.51; $p=0.0001$) and soil total porosity ($R^2_{aj.}$=0.25; $p=0.004$). For winter crops, for sunhemp that FCO_2 was explained with macroporosity ($R^2_{aj.}$=0.27; $p=0.001$) while corn with microporosity ($R^2_{aj.}$=0.20;$p=0.02$). Therefore, in tropical soils under no-tillage, FCO_2 can be explained by soil temperature, macroporosity, microporosity and total soil porosity.

Keywords: soil respiration, climate change, sustainable agriculture, soil porosity

Financial support: Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – CAPES

(9326 - 2843) Soil CO_2 emission in Eucalyptus and silvopastoral systems with 30 years of conversion in the Brazilian Cerrado

Christtiane Fernandes Oliveira[1]; Diego dos Santos Pereira[2]; Fernando Pavanin Martins[2]; Jean Carlos de Almeida Ramos[2]; Jaqueline Bonfim

de Carvalho[2]; Bruno Horschut de Lima[2]; Rafael Montanari[2]; Newton La Scala Junior[3]; Alan Rodrigo Panosso[2]
FEIS/UNESP – College of Engineering of Ilha Solteira, São Paulo State University, Av. Brasil Sul, 56 – Centro, Ilha Solteira, São Paulo, 15385-000, Brazil. (chrisnandes20@gmail.com).[1]; FEIS/UNESP – College of Engineering of Ilha Solteira, São Paulo State University, Av. Brasil Sul, 56 – Centro, Ilha Solteira, São Paulo, 15385-000, Brazil.[2]; FCAV/UNESP – College of Agricultural and Veterinarian Sciences, Sao Paulo State University, Via de Acesso Prof. Paulo Donato Castellane s/n, Jaboticabal, SP, 14884-900, Brazil.[3]

Understand how soil CO_2 emissions (FCO2) varies in space is an important task since few works have studied the spatial variability of carbon loss in Brazilian Cerrado soils. The objective of this work was to evaluate the spatial dependence of FCO2 and its relation with soil carbon stock (EstC) and humification index of soil organic matter (H_{LIF}), in areas of Cerrado with 30 years of conversion from conventional tillage (annual crops, maize and soybean) to silvopastoral system (aroeira and *brachiaria* - SI) and Eucalyptus plantation (EU). The experiment was conducted in the Fazenda de Ensino e Pesquisa area of the Faculty of Engineering of Ilha Solteira (UNESP), located in the municipality of Selvíria (Mato Grosso do Sul State). FCO2 measurement using the LI-COR system (LI-8100). The experiment was conducted during two periods: rainy period from February to March and dry period in June of 2017. Soil samples were collected in the 0.0-0.10 m depth layer to calculate the carbon stock (EstC) and to determine the H_{LIFS} by the laser-induced LIFS technique fluorescence. The spatial dependence of the variables were analyzed by geostatistical techniques from the fit of theoretical mathematical models to the experimental variograms and the interpolation of spatial patterns by the ordinary kriging. During rainy period, we observed a significant difference ($P<0.05$) in FCO2 when SI (4.47 µmol m^{-2} s^{-1}) was compared to EU (5.84 µmol m^{-2} s^{-1}). In dry period the same results were observed, SI showed the emission of 2.96 µmol m^{-2} s^{-1}, significantly inferior ($P<0.05$) when compared to EU, 3.86 µmol m^{-2} s^{-1}. EU presented the higher value of EstC (21.75 Mg ha^{-1}) when compared to SI (20.26 Mg ha^{-1}), however, EU presents higher H_{LIF} value, indicating more recalcitrant material on soil organic matter. The variographic analysis indicated that the range of spatial dependence of FCO2 for SI ranged from 9.7 m to 86.9 m (dry period) while in the EU the range values ranged from 15.3 m (dry) to 100.8 m (rainy). The FCO2 and EstC presents positively and significantly ($P<0.05$) spatial correlation in both areas only in the dry season, 0.23 and 0.33 to SI and EU, respectively. On the other hand FCO2 presented a negative and significant spatial correlation ($P<0.05$) with H_{LIF} for the rainy season in SI (-0.22) and for the dry period with EU (-0.31).

Keywords: geostatistics, soil respiration, humification index, ordinary kriging.
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(3467 - 1467) Soil fluxes of nitrous oxide and methane in Pampa grassland afforested with *Eucalyptus* spp.

Frederico Costa Beber Vieira[1]; Josiléia Acordi Zanatta[2]; Cimélio Bayer[3]; Daniel Alexandre Iochims[1]; Cristiano Carvalho da Silva[1]
Federal University of Pampa[1]; EMBRAPA Forestry[2]; Federal University of Rio Grande do Sul State[3]

Plantation of eucalyptus trees can contribute to mitigate global warming potential (GWP) through carbon sequestration in plant biomass, but few is known regarding the effect of the conversion on soil nitrous oxide (N_2O) and methane (CH_4) fluxes. This study aimed to investigate the effect of the conversion of a representative grassland in the Brazilian Pampa biome to *Eucalyptus* spp. forest on soil N_2O and CH_4 fluxes. Field experiment was located at São Gabriel, Brazil, on an Acrisol soil, in a completely randomized design, three replicates and four adjacent treatments: eucalyptus forest with one (E1) and six (E6) years of plantation in the beginning of the study, native grassland with cattle breeding (NG+C) and native grassland isolated from breeding since one year before the beginning of the study (NG-C). Gas sampling (by static chamber method), analysis (by chromatography) and soil and climate monitoring was performed biweekly for 39 months. Emission of N_2O from the E6 soil was similar to those from the grassland soils (NG+C and NG-C), usually below 40 µg N_20 m^{-2} h^{-1}. However, top dressing fertilizations with urea in E1 increased significantly N_2O emission, peaking at 286 µg N_20 m^{-2} h^{-1}. Effluxes from E1 soil remained larger during all the first year of evaluation, with average of 103 µg N_20 m^{-2} h^{-1}, coinciding with bigger contents of NO_3 and NH_4 in the soil. After that, flux rates were similar to those from the other treatments. The accumulated emission of N_2O in 39 months from the E1 soil was 8045 g N_2O-N ha^{-1}, while E6, NG+C and NG-C had 753, 423 and 2633 g N_2O-N ha^{-1}, respectively. For CH_4, in turn, the presence of eucalyptus tended to promote influx of this gas, while native grassland tended to promote efflux. Such result is probably due to the smaller humidity in the soil with eucalyptus. Average values of water-filled porous space were 80 and 83% for NG+C and NG-C, respectively, while it decreased to 54 and 35% for E1 and E6, respectively. Accumulated CH_4 fluxes in 39 months were -3470, -3540, +1846 and +5178 g CH_4-C ha^{-1} for E6, E1, NG-C and NG+C, respectively. When N_2O and CH_4 are transformed to equivalent-carbon, it can be inferred that their contribution to the GWP is much smaller than that from the C sequestration in the biomass of the trees. Afforestation of grassland soil in the Pampa can contribute to mitigate GWP, but special care is required in the first two years of plantation in order to diminish N_2O emission from N fertilization.

Keywords: Greenhouse gases; forest; accumulated emission.
Financial support: EMBRAPA Projeto Saltus (01.11.01.001.00.00); CNPq Project Number 473484/2012-9.

(1165 - 798) Soil organic carbon dynamics in traditional rubber tree agroforestry systems in southern colombian Amazon

Adriana Silva Olaya[1]; Fausto Andres Ortiz Morea[1]; Juan Pablo Chavarro[1]; María Paula Llanos Cabrera[1]; Vanessa Tique Mendoza[1]
University of the Amazon[1]

Agroforestry systems have been pointed out as a potential strategy for global warming mitigation due to its contribution on reducing soil degradation and improving SOM stocks. Here, we assessed soil C dynamic in three typical agroforestry systems (AFS) in southern Colombian Amazon region established in 1999, using a native vegetation (NV) area as reference. Our results indicated not significant differences at soil C stocks between NV and AFS, however when considering the time span since establishment AFS, annual C losses in the average of 0.75 Mg ha^{-1} where detected when conversion from NV to this typical AFS is performed. Soil C microbial biomass and basal respiration were also affected by that land use transition, with lower microbial C at AFS than NV and similar respiration rates between the study areas. Carbon content at particulate organic matter fraction also diminished significatively from NV to AFS. Converting tropical forests into rubber tree agroforestry system could cause important C losses in those soils. Alterations at the quality of litter, soil C inputs rates and

in the activity of the soil microbial component could be some of the causes of this response, since our results showed a low efficiency of microorganisms to utilize the available substrates.
Keywords: Rubber tree, agroforestry, carbon stocks, microbial C, particulate organic matter, Amazon
Financial support:

(8660 - 1558) Soil potential to methane uptake in native and planted forests

Josiléia Acordi Zanatta[1]; Marcos Fernando Glück Rachwal[1]; Rosana Clara Victoria Higa[1]
Embrapa Florestas, Estrada da Ribeira, km 111, Colombo – PR, 83411-000, Brasil[1]

Naturally, soils have capacity to uptake methane (CH_4) from atmosphere and so contribute to reduce greenhouse gas emission and mitigate global warning potential. However, the conversion of native forest to agriculture or plantation forest can effect this sink due promotion of changes in nitrogen dynamics, stocks of carbons pools and others soil properties that resonate in the activity of methanogenic and methanotrophic microorganisms, responsible for the production and consumption of CH_4 in the soil, respectively. The objective this study was assessed the potential of soil methane oxidation on mixed ombrophilous forest and loblolly pine plantation (*Pinus taeda*). The survey was realized in Rio Negrinho – SC (South of Brazil), where pine has a favorable climatic condition to expressed high productivity. For two year (2014 and 2015) the soil methane uptake was performed in several conditions using static chamber procedures and analyses by chromatography. Native forest was monitored in four environments that represent medium and initial preservation stage of forest. Pine plantation was investigated in the conversion from forest with 3, 9 and 13 years in second rotation and from pasture with 1, 3 and 9 years in first rotation. The environments were located on a Cambisol with 50% clay in three replicates. In both native and pine forests CH_4 fluxes were negative, indicating that CH_4 sink was kept. However, in native environments the fluxes was three times more elevated (-60 to -120 µg C m^{-2} h^{-1}) than in pine plantation (-20 a -60 µg C m^{-2} h^{-1}). Among native environments the highest uptake of CH_4 were observed in more preserved forest (-9.9 kg C ha^{-1} $year^{-1}$) indicating that the partial withdrawal of native vegetation has a suppressive effect (30%) on soil sink capacity as much as pasture use (-0.17 kg C ha^{-1} $year^{-1}$). With regard to previous use of the soil there was minor oxidation of CH_4 in environment with pine that was converted from pasture (pine 1 year: -0.58 kg C ha^{-1} $year^{-1}$), coinciding with bigger contents of NO_3 and NH_4 in the soil. The increase in the age of reforestation, independent of previus use, indicated a tendency to increase in the rates uptake of CH_4 by soils (3 years: -2.02 kg C ha^{-1} $year^{-1}$; 9 years: -3.04 kg C ha^{-1} $year^{-1}$; 13 years: -3.35 kg C ha^{-1} $year^{-1}$). Native forests and pine reforestation soils have potential to mitigate CH_4 emission although this potential can be improved.
Keywords: reforestation, loblolly pine, sink of methane, native forest preservation, greenhouse gas
Financial support: EMBRAPA Projeto Saltus 01.11.01.001.07.00 and CNPq processo 442042/2014-0

(2104 - 2476) Soil-aggregate groups at various depths under silvopasture in comparison with planted and native forests and managed pasture in a Brazilian Oxisol

Felipe M. Pinheiro[1]; P.K. Ramachandran Nair[2]; Vimala D. Nair[3]; Maria C. M. Viana[4]; Ramon C. Alvarenga[5]
University of Florida, School of Natural Resources & Environment[1]; University of Florida, School of Forest Resources & Conservation[2]; University of Florida, Soil and Water Sciences Department[3]; EPAMIG Centro Oeste[4]; EMBRAPA Milho e Sorgo[5]

Soil management practices and land-use systems (LUS) have considerable influence on the soil's aggregate hierarchy. We evaluated the relative distribution of three soil aggregate-size classes: macroaggregates (MA: 250–2000 µm), microaggregates (MI: 53–250 µm), and silt + clay size-fraction (<53 µm), in four soil-depth classes (0–10, 10–30, 30–60, and 60–100 cm) under different LUS in a replicated field experiment on an Oxisol at EPAMIG research station, Prudente de Morais, MG, Brazil. The objective was to compare silvopasture (SPS) with three other LUS: planted forest, native (Cerrado) forest, and managed pasture. The SPS had three tree-planting configurations: i) trees 3 m apart in double rows, 20 m between rows; ii) trees 2 m apart in double rows, 9 m spacing, and; iii) trees 2 m apart in single rows, 9 m spacing. Eucalyptus hybrid was the tree in SPS and planted forest treatments, and *Urochloa decumbens* was the grass in SPS and Pasture treatments. The trees were 8 years old at the time of sampling and cattle had been introduced three years after planting trees. The native forest was semi-deciduous, with > 10 tree species, ~ 10 m height. From each treatment, composite soil samples were collected from the depth-classes, three replications, and from two sites each in SPS: NT (near trees, 1.5 m from trees) and MR (middle of two rows). In the laboratory, 100 g of each sample was manually fractionated by wet sieving into the three aggregate-size classes. The data were analyzed using ANOVA and Tukey's test at 95% confidence interval. The results showed that MA were significantly higher under pasture and SPS 20 m between rows, NT than under other treatments. The MI were higher under SPS 9 m single rows, MR than under other treatments, and the silt + clay fraction was higher under tree plantation and 9 m double rows SPS (NT and MR). Comparing the depths, the amount of MA decreased and that of MI increased, up to 1 m depth. Given that soil organic carbon (SOC) in MA is relatively easily decomposable, the managed pasture, the SPS of 20 m between double rows, and the native forest can be considered as LUS with higher capacity to retain easy-to-decompose SOC. These LUS were observed to have more soil cover (either by tree litter or grass), while the two SPS of 9 m between rows and the Eucalyptus plantation had lower grass productivity and more bare soil, which might have affected the MA formation/stability.
Keywords: silvopastoral systems, soil quality, tropical soils
Financial support: CNPq, FAPEMIG, FINEP and MAPA

(3337 - 1202) Stock and carbon aculmulation in latosolo (oxisoil) under eucalyptus cultivation in Cerrado

Adilson Alves Costa[1]; Bruno de Oliveira Dias[1]; Erlane Souza de Jesus[2]; Auriléia Pereira da Silva[1]; Vânia da Silva Fraga[1]
Federal University of Paraíba, Post-Graduation in Soil Science, Center of Agrarian Sciences, Areia, PB, Brazil,[1]; Graduated in Agronomic Engineering from the State University of Bahia, Barreiras, BA, Brazil[2]

The current concern about climate change and the use of land and forests as a means to minimize the impact on CO_2 emissions from deforestation and burning activities has attracted the attention of researchers to understand the dynamics of soil organic matter. Thus, with the opening of agricultural frontiers in the Cerrado, demands for forest products gain representativeness. The objective of this work was to evaluate the carbon stocks and accumulation in areas cultivated with eucalyptus with different planting ages in the Cerrado. The geographic coordinates of the study site are 12 ° 20'33 "S and 45 ° 56'27" W and an altitude of 810 m, located at Palmeiras I farm, Luís Eduardo Magalhães municipality, Bahia, Brazil. The soil was classified as Latossolo Amarelo distrófico típico (Oxisoil) with medium texture.

Soil samples were collected in the 0-10 cm, 10-20 cm and 20-30 cm layers in four different eucalyptus plantation areas under different ages, being an area under native vegetation of stricto sensu Cerrado (ACN), two-year-old eucalyptus (EU2), five-year-old eucalyptus (EU5) and eight-year-old eucalyptus (EU8). The total organic carbon content and, consequently, the carbon stocks were calculated, whose correction of the mass was made by the equivalent mass of the soil. The rate of carbon accumulation was made relative to the area under native vegetation. Among the total organic carbon contents there was a significant difference in the area of EU2 in the depth of 10-20 cm when compared to the other areas. However, when comparing the depths, the largest carbon stocks were as follows: 0-10 cm > 10-20 cm > 20-30 cm, regardless of the age of the eucalyptus. In relation to the carbon accumulation, all areas presented lower values when compared to the soil under Cerrado, except for AEU8 that presented increase of up to 2 $Mg.ha^{-1}$. Eucalyptus cultivation for 8 years in the Cerrado has increased carbon stocks in depth, favoring a greater accumulation of carbon over the years.

Keywords: soil organic matter, vegetal residue, soil use
Financial support: National Council for Scientific and Technological Development (CNPq)

(8445 - 2529) The Changes of Soil Carbon Content According to Organic Material Types in Upland Soil

Hyeoun-Suk Cho[1]; , Myung-Chul Seo[1]; Tea-Seon Park[1]; Jun-Hwan Kim[1]; Wan-gyu Sang[1]; Pyeong Shin[1]; Geon-Hwi Lee[1]
National Institute of Crop Science[1]

Organic matter is a substance that contains carbon. When applied to soil, it can improve the physical and chemical properties of soil and supply nutrients to plants. Also, it is decomposed in soil due to microbe activity, and utilized by crops. The remaining differential to materials is accumulated in the soil and increases organic matter content in soil. Therefore, we analyzed the types of carbon content according to time while cultivating beans in soil with 4 different kinds of organic matter applied. Total carbon content was higher in organic matter application than in control (non-organic matter). Among the other organic matters, it was especially high in livestock manure(LM) application with 11.38 g kg^{-1}, Hairy vetch(HV, 8.88gkg^{-1}), Oil cake(OC, 8.92gkg^{-1}), and Rice strow(RS, 8.24gkg^{-1}) did similar. According to soil carbon form, Humin carbon(HnC) had the highest total carbon content of 62.6 ~ 64.4 %, Humic acid carbon(HC) had 35.6 ~ 37.7 %, and Fulvic acid carbon(FC) had 17.0 ~ 19.3 %. This pattern was the same in both control and organic matter application. Every type of carbon was the highest in LM application. Therefore, it was concluded that LM, which had a high level of humin carbon that is difficult to decompose, was the best for accumulating carbon in soil.

Keywords: upland soil, soil carbon, organic matter
Financial support:

(2131 - 3147) The effect of bamboo powder application on the yield of Japanese white radish (*Rhaphanus sativus* L.) and soil properties

Atsunobu Kadono[1]; Yasutaka Inoue[2]; Tamaki Nanjo[2]; Ayumi Fukumoto[2]; Kaoru Kominami[2]; Kota Migishita[2]
Tottori University of Environmental Studies[1]; Tottori University of Environmental[2]

The application of organic matter on soils have been studied widely because of its positive effects on carbon sequestration and the diversity of soil ecosystems. We tested different dose (30, 3 and 0 Mg/10a) of bamboo powder to enhance the amount of soil organic carbon (SOC) and microbial biomass and diversity in a soil under the growth of Japanese white radish (*Rhaphanus sativus* L.). SOC was measured by a dichromate oxidation method, microbial biomass by substrate induced respiration method and microbial diversity by BIOLOG method. We found significant increase of SOC, microbial biomass and microbial diversity in the high dose site, while the yield was significantly lower than the none dose site. After the observation in the field and some additional experiments *in vitro* to confirm that the high amount of organic amendment caused inhibiting effect on the yield of the radish, we might conclude the lower oxygen concentration (probably with the higher hydrogen sulfide concentration) in the soils in the high dose site attributed the lower yield.

Keywords: carbon sequestration, microbial biomas, microbial diversity, reduction
Financial support:

C3.3.6 - Sustainable phosphorus fertilizer use in tropical soil

(5015 - 1783) Agronomic characteristics of *Brachiaria ruzizienses* grass in response of different doses of phosphorus

Renan Marré Biazatti[1]; Lucas Vinícius Albuquerque de Oliveira[1]; Rogério Gonçalves Teixeira[1]; Pablo Rogério Ciechorski[1]; Ramaiany Lohanny Sousa Cremer[1]
Fundação Universidade Federal de Rondônia[1]

Choose of forage and a chemical equilibrate fertilization, in formation of pasture are the base for a cattle breeding highly productive. In this context a forage specie very used is Brachiaria ruzizienses that have a good develop in wet conditions but no flood. However, like all agricultural production, this grass has limitations according to the fertilization of the soil, principally with the phosphorus availability. So that being, the study search consider the best dose of triple superphosphate fertilization that express the best increase o dry mass, that is the agronomic characteristic more searched in the extensive cattle. There was five treatments in different doses (0, 100, 200, 400 e 800 Kg.ha-1) with four repetitions each, conducted in polyethylene vessels. The dry mass was evaluated in 30 and 60 days, the dose of 400 Kg.ha-1 was indicated the most expressive of dry mass production. In 60 days, the dose with more significant results was 800 $kg.ha^{-1}$. The justification of these results is due to the essentiality of the mineral phosphorus, which participates in the production of vegetal energy, negatively affecting the accumulation of photo-assimilated. When it compared to the control treatment (with no fertilizer) there was an increase almost 2-fold in dry mass production. Therefore, was observed that the phosphorus affect directly the initial growth and subsequently the forage development. Thus this higher productivity reflect in the management activity of the extensive cattle, is that can reduce increasingly the nutritional increments of cattle feed with mineral rations.

Keywords: Key words: Forage; Phosphate fertilizer; Dry mass
Financial support:

(9148 - 2658) Agronomic response to different doses and forms of application of organomineral phosphate fertilizer produced with chicken manure

Jerusa Maia e Sá[1]; Adelson Paulo de Araújo[1]; José Carlos Polidoro[2]; Paulo César Teixeira[2]; Bianca Braz Mattos[2]; Vinícius de Melo benites[2]
Federal Rural University of Rio de Janeiro[1]; Embrapa Soils[2]

The efficiency of phosphate fertilization is very low because of the chemical, physical, and mineralogical characteristics of the soil and of the solubility, composition, and physical structure of the fertilizer. Organomineral fertilizers can supply part of the nutrient demand to crops and ensure better management of agricultural waste. Peak application of P represents a practical way to expedite the implantation step in grain crops. The objective of this work was to evaluate the agronomic performance of an organomineral fertilizer (FOM) produced from chicken manure, in relation to the use of soluble

phosphate fertilizers, in different fertilizer application forms. Maize and soybean were cultivated in succession in a sandy loamy Yellow Latosol with corrected fertility in Luis Eduardo Magalhães, BA. The experimental design was a randomized complete block design in a 3x3x2 + 1 factorial arrangement with 4 replicates, combining FOM, monoammonium phosphate (MAP) and single superphosphate (SSP) fertilizers, applied in three doses (40, 80 and 160 kg ha^{-1} of P_2O_5), with fertilization in total area cover or buried in the sowing furrow, in addition to a control without P. The accumulation of phytomass in maize (at 21, 63, 84 and 148 days after emergence - DAE) and soybean (at 36, 44, 82 and 104 DAE), the productivity and accumulation of P in the grains were evaluated. There was no response to increased doses on productivity. Localized fertilization promoted greater accumulation of phytomass, productivity and P accumulation in maize. There was no residual effect of the fertilization form on the agronomic variables evaluated in soybean in succession. Therefore, the phosphate application in total area presents a promising possibility to practice the stage of implantation of grain crops. FOM and MAP provided greater accumulation of P in the grains in relation to SSP. The results indicate good potential of using chicken manure as a component of organomineral formulations.

Keywords: phosphorus, *Zea mays*, *Glicine max*, fertilizer sources, no tillage

Financial support: Embrapa Soils; FertBrasil Network; Colorado Farm; Rural Union of Luis Eduardo Magalhães, BA

(9096 - 922) Chemical attributes of the soil in pasture area arising from application form of phosphorus doses after seven years in western Amazon

Andressa Gregolin Moreira[1]; Edinelia Roos[1]; Bianca Souza Selhorst[1]; Adriele Laurindo Sobreira[2]; Vanessa Rodrigues de Brito[1]; Jairo André Schlindwein[2]; Fábio Régis de Souza[1]; Elaine Cosme Fiorelli-Pereira[1]
Federal University of Rondonia, Av. Norte Sul, 7300, Nova Morada, Rolim de Moura - RO, CEP 76940-000, Brazil[1]; Federal University of Rondonia, Av. Presidente Dutra, 2965, Centro, Porto Velho- RO, CEP 76801-974, Brazil[2]

This work had as objective evaluate the alterations of chemical attributes of soil arising from application forms of phosphorus doses in cultivated soil with Brachiaria brizantha after seven years (2010-2017), The experiment was develop in a property in the municipally of Rolim de Moura, Rondônia, Brasil in an Oxisol, representative of the major pasture areas on Rondônia, on October 2010 to July 2017. The pasture was found established more than 10 years with no management of correct fertilization. The experimental design was in randomized blocks, in a factorial scheme 5x2, five doses of phosphorus (0, 100, 200, 400 and 800 kg ha^{-1} o P), and two applications form of phosphorus on soil (surface and incorporated with subsoiling). Was realized the collect in two depth 0,0-0,10 and 0,10-0,20 m. The chemical analyses were incurred using standards methods. The attributes evaluated were pH in water, levels of changeable Al, P, Al+H and organic matter of soil. There was no interaction with phosphorus dose and the form application of P in any of the studied factors, in two depth 0,0-0,10 and 0,10-0,20 m. The variations of P doses promoted alterations in pH in the two depths studied linearly. The soil phosphorus in the layer 0,0-0,10 m had a quadratic behavior with rising doses of P, and at the highest dose 800 kg ha^{-1} of P obtained 3 mg dm^3 of P, (Al+H) the results were similar of phosphorus in the same layer. The level of changeable Al in the 0,10-0,20 m layer linearly reduced with rising doses of P. After seven years the phosphorus application, any studied factors interacted with the applications form. However the variations in the doses of P promoted alterations in the residual form of concentrations of P and Al+H in the depth soil at 0,0-0,10m and in the changeable Al in the 0,10-0,20 layer.

Keywords: pasture degradation, subsoiling, soil fertility.

Financial support: Universidade Federal de Rondônia, CAPES.

(7696 - 1564) Diffusion flow of phosphate sources in different contact time

Miguel Martins Neto[1]; Maila Adriely Silva[2]; Gustavo Ferreira de Sousa[2]; Paulo Henrique Soares[1]; Murilo Mendes Machado[1]; Carlos Henrique Eiterer de Souza[1]
Centro Universitário de Patos de Minas[1]; Universidade Federal de Lavras[2]

Due to the high levels of weathering in the tropical region, there is a greater index of phosphorus adsorption, therefore, technologies has been seek to increase the phosphates sources efficiency. Thereby, the objective of this study is evaluate the diffusion flow of the polymer-coated and conventional phosphates fertilizers, in different contact time. The experiment was conducted at the laboratory Central de Análises e Fertilidade de Solo – CEFERT, located at Centro Universitário de Patos de Minas – UNIPAM in Patos de Minas, Minas Gerais State, Brazil. A randomized complete block design was used, in factorial scheme (4 x 6), with 4 phosphate sources (Conventional monoammonium phosphate [MAP], polymer-coated MAP, conventional triple superphosphate, polymer-coated triple superphosphate) and 6 times (3, 6, 14, 21, 40 and 60 days after the application). To the experiment conduction, were used samples of dystrophic red latosol with clayey texture, they were dry, sifted to 2 mm to get the air-dry soil. Incubation chambers with 0,25 dm^3 of volume were used as experimental unit. To the determination of the diffusion flow, the resin anion was used. The used resin was the AMI-7001S treated with sodium bicarbonate with 2,5 x 5 cm of dimensions. To the incubation chambers assembly 1/3 of the soil was put it and inserted the resin on the horizontal position, after that, it was added more 1/3 of the soil, put the fertilizer parallel to the resin and finally covered with the rest of the soil. After the assembly, the soil was irrigated with 80% of the field capacity and the chambers were closed. The data were submitted to the variance analyses, and the sources were compared with Tukey test 5% and adjusted to the regression model. There was interaction between the source and time, at the conventional and polymer-coated MAP had the decreasing regression linear adjustment. On the day 3, the conventional MAP showed higher values of diffusion flow than the polymer-coated, on the following times, the polymer-coat source was superior, this happened because of the slow-release provided by polymer, also reduce the phosphorus direct contact with the soil colloids, minimizing the loss of that nutrient by the adsorption process on the clay mineral. Concluded that the diffusion flow from conventional MAP in a short time is better, and the polymer-coated is more efficient in a prolonged time.

Keywords: Key Word: Diffusion, Phosphorus, Polymer

Financial support: Centro Universitário de Patos de Minas

(2994 - 2383) Diffusion of phosphorus from granular monoammonium phosphate with different proportions of phyllosilicate in Oxisols of Brazil

Marco Antonio Pereira de Ávila[1]; Paula Castanho Borges[2]; Thiago Cardoso de Oliveira[3]; Takashi Muraoka[3]
University of São Paulo, Center of Nuclear Energy in Agriculture (CENA/USP), 303 Centenário Ave, Piracicaba, Zip Code 13416-000, São Paulo State, Brazil. (marcopereiraavila@yahoo.com.br)[1]; São Paulo State University (UNESP)[2]; University of São Paulo, Center of Nuclear Energy in Agriculture (CENA/USP)[3]

Phosphorus (P) is an essential element for agriculture worldwide and is considered one of the most limiting nutrients of crop yield. Soils in Brazil have low P content available to plants and soluble phosphate fertilizers have low performance due to complex reactions, from the

interface soil/granule to its diffusive path in the soil. The objective of this study was to evaluate the behavior of granular monoammonium phosphate (MAP) with different proportions of Silicon (Si) (source: phyllosilicate) on the pH, as well as diffusion and availability of P in the soil around the granule. For that purpose, two Oxisols (Latosols) with contrasting textures and maximum phosphorus adsorption capacity (Pmax) were used. The soils were classified as dystrophic Red-Yellow Latosol medium-textured with Pmax 660 mg kg^{-1} and dystrophic Red Latosol clayey with texture showing Pmax 1495 mg kg^{-1}. The incubation experiments were carried out in Petri dishes and assembled in a completely randomized design with 11 treatments (10 phosphate fertilizers produced from MAP and phyllosilicate in P-Si proportions in the granule from 1 to 9 and 10 to 0 and the control treatment) and five repetitions. In the center of each Petri dish, 10 mg of P was added and the dish was incubated for five weeks. After this period, soil samples were collected in the form of concentric rings from the center and subjected to the analyses of the pH, P-total and P-available. The results showed that all fertilizers tested promoted changes in the soil pH around the granules, especially in the first and second sections from the point of application. The dystrophic Red-Yellow Latosol of P applied spread to the third section of soil, and in the dystrophic Red Latosol, significant amounts of P were found only up to the second section of soil from the point of application of the granule. In both soil fertilizers with higher Si proportions in relation to P in the granule provided higher levels of P-total and P-available in the first soil section. Only fertilizers with proportion P-Si 1-9 and 2-8 increased the total P-available in Petri dishes filled with dystrophic Red-Yellow Latosol, and this result was not observed for dystrophic Red Latosol. The results suggest that the presence of phyllosilicate in the granular structure of MAP changed the diffusive dynamics improving P availability in the microregion of influence of the granule of the fertilizer applied.

Keywords: Phosphate fertilizer; adsorption; phosphorus availability.
Financial support: Coordination for the Improvement of Higher Level Education (CAPES).

(7222 - 1810) Do Content, Concentration and Co-Applicants Spatially Impact Liquid Phosphorus Fertilizer Fixation in a Brazilian Oxisol?

Joseph J Weeks[1]; Ganga M Hettiarachchi[1]
Kansas State University[1]

Fixation reactions with iron and aluminum can significantly reduce the use efficiency of phosphorus (P) fertilizers in tropical acid soils. Finding economical and simple methods grower's can implement to keep the nutrient in a plant available form will mitigate deficiency increase yield, lower production costs and reduce non-point source pollution of nearby surface waters. Understanding how P fertilizer type and the concentration in which the nutrient is applied contributes to or prevents fixation is one step to making progress on the use efficiency front. An additional proposed solution that often receives attention, albeit controversially, is to coapply humic substances with fertilizers to complex solution cations that immobilize P and compete with P for sorption sites on soil colloids. Commercial humic substances can vary considerably in composition as their categorization is operationally defined by their extraction procedure thus requiring deeper scientific inquiry to illuminate the mechanisms through which their efficacy is observed. This study investigated the effects of fertilizer type, concentration, and commercially distributed co-applicants on phosphorus applied as liquid fertilizers in a Brazilian oxisol. Monoammonium phosphate (MAP), diammonium phosphate (DAP), ammonium polyphosphate (APP), and an 80/20 MAP/APP mixture were applied at two rates using a concentrated or 5x diluted formulation and with/without commercial fertilizer enhancement products. Soils were incubated for four weeks in Petri dishes and sectioned in concentric rings from the point of application. Anion exchange resin extractability as a percent of total P assessed potential plant availability, while a suite of other wet chemical assessments were employed to investigate how P fate and transport were impacted. Orthophosphates remained more labile than polyphosphates and concentrated P applications outperformed more dilute solutions applied at the same total P rate. These results agree with the site saturation model that assumes a given volume of acid soil possesses the ability to sorb a finite amount P leaving the rest available for plant uptake. Co-applicant results varied and did not consistently alter lability. Further study will be necessary to determine how and if humic substances can best be utilized in future agricultural systems and whether the results of the fertilizer trials are reproducible across acid soils possessing a range of inherent characteristics.

Keywords: Humic, acid, fixation
Financial support: USDA National Institute of Food and Agriculture NC-1187 Multi-state Research Project, Fluid Fertilizer Foundation, and Kansas State Research and Extension

(2546 - 1408) Economic analysis of different sources of phosphorus applied to oxisoils under no-tillage at different levels of fertility in the Central-South region of Paraná

Magno Batista Amorim[1]; Sandra Mara Vieira Fontoura[2]; Renato Moraes[2]; Joana Schroeder de Souza[3]; Tales Tiecher[3]; Cimélio Bayer[3]
Federal institute of Rondonia[1]; Agraria Foundation[2]; Federal University of Rio Grande do Sul[3]

The center-south region of Paraná is one of the major grain producers in Brazil. With the increase in production and, consequently, the demand for fertilizers and the emergence of new sources of phosphorus (P), producers need more information, since large-scale productions require more investment, and the profit is conditioned to the efficiency of the applied fertilizer. Thus, to evaluate how different sources of P influence productivity in soils with different levels of P under no tillage (NT), we have conducted experiments with seven P sources (Super Simple-SS, Super Triple-ST, Yoorin, Yookarin, FN Bayóvar, Shell TSPS and Mosaic MES9) in three Oxisoils, with three phosphorus levels (low, medium and high), in the center-south region. The treatments consisted in the annual application of the recommended dose (115, 190 and 350 kg ha^{-1} of P_2O_5 for soils with high, medium and low level respectively) for each source in two special fertilization programs (System and Culture) with three block repetitions by chance. After three years of cultivation, the total crop production and the economic efficiency of each source were evaluated. For the phosphorus-high soil, the total grain yield of six crops (Wheat / Soybean - Barley / Soybean - Oats / soybeans) exceeded 30 tons without application of P. All sources increased the total production of the system with the application of phosphorus, surpassing 32 tons. For the phosphorus-low soil, the most soluble sources (ST, SS and Yookarin) were higher than the others, reaching a total grain yield in four crops (Soybean / wheat - Soybean / Barley) of more than 12 tons. The rock phosphates Yoorin and Bayovar had the lowest total production among the analyzed sources (<10.3 t). Similar results were found in soil with average P content, where the highest total grain yields in five crops (Barley / Soybean - Wheat / Soybean) were from soluble sources (> 25 t) in relation to rock phosphates. The economic return on P deficient soils (medium and low) is higher when soluble sources are used, especially ST. However, for soils with high P content there was no economic difference for the sources used, and the producer could opt for lower cost sources. Therefore, when the P content in the soil is low, the supply of P to the crops and the replacement of P in the soil should be made using soluble sources. In corrected soils, all sources tested can maintain high yields.

Keywords: Rock phosphate; fertilization; economic return.
Financial support: Private Foundation of Agricultural Research (FAPA) da Cooperative Agrária Ltda.

(2736 - 2808) Effect of alternative phosphate applyed in differents conditions of pasture in Oxisols.

Natalia Rodrigues Ferreira Eloy[1]; Aline da Silva Sandim[1]; Elialdo Alves de Souza[2]; Marco Andre Grohskopf[1]; Dean Hesterberg[3]; Leonardo Theodoro Büll[1]

FCA UNESP-Botucatu[1]; FCA UNESP- Botucatu[2]; North Carolina State University[3]

The major limitation to establishing and maintaining productive pastures in Brazilian Oxisols is the extremely low levels of plant-available phosphorus (P). P is important in root development and tillering of grasses. When sulfuric and phosphoric acids are applied to phosphate rocks in high-grade fertilizer production, it generates some by-products that are also produced in wastewater treatment with phosphoric acid.These are relatively rich in P, but are considered an environmental liability. These waste byproducts are relatively rich in P, but are considered an environmental liability.With regard to interactions of P in the soil-plant system and its availability to crops, there is a need for greater fertilization efficiency.The objective of this study was to determine the effect of soil pH on the solubility of P in waste by-products from fertilizer production, and its availability to Marandu grass.We hypothesizes that P solubility and availability in the byproducts are greater than that of soluble phosphates due to the increase of the H protonation during growth of Marandu grass.A field experiment was carried out in randomized blocks in 3x5 factorial scheme and four replicates, totalizing 60 plots of 30 square m^2 each.The experiment continued across 4 growth/harvest sequences.Treatments included 4 sources of phosphate fertilizers:decanted phosphate (DP) and precipitated phosphate (PP) from the waste stream, reactive phosphate, and triple superphosphate, in addition to a control treatment without phosphorus application. All P amendments were applied at 100 kg ha^{-1} P_2O_5 .Two lime treatments for soil acidity included an unamended control, amendment with calcite at an intermediate rate to achieve 45% base saturation (V%), and a a corrected treatment to achieve 60% V%. Results were statistially analyzed for differences in crop biomass (dry matter - DM) and crop P contents using a Tukey test at 5% probability. The PD treatment showed better yields under the corrected acidity conditions. PP treatment gave better yields of DM, tillers, and accumulation of P, especially under conditions of intermediate acidity, and was generally superior to all analyzed P sources. FNR provided the highest dry matter production and the highest agronomic efficiency of P only in the treatment where there was no application of limestone in the fourth and last cut. Superior performance of PP indicates that the byproducts can provide high P efficiency and high biomass production.

Keywords: Urochloa brizantha; by-product; phosphorus
Financial support: CAPES

(5159 - 550) Effect of phosphate solubilizing microorganisms on maize yield and yield attributes in the Sete Lagoas region

Rafael Augusto Lima Rodrigues[1]; Vitória Palhares Ribeiro[1]; André Thomazini[1]; Ivanildo Evódio Marriel[2]; Christiane Abreu de Oliveira Paiva[2]

UFSJ[1]; Embrapa Milho e Sorgo[2]

Brazilian agribusiness is still highly dependent on the foreign market for fertilizer supply. In order to develop a safe and low-cost technology that could reduce and / or supplement phosphate fertilization in corn plantation areas, the use of phosphate solubilizing microorganisms (MSP) associated to fertilization with low solubility phosphate sources has been proposed. To address this, the use of bacteria as inoculants in the corn crop has been evaluated so that the efficiency of the crop's nutrient acquisition could be enhanced. The purpose of this study was to evaluate the effect of the MSP inoculation over the maize productivity as well as to analyse how the soil attributes change after maize cycle. The experiment was conducted by analysing the 2016/17 harvest in the experimental field of Embrapa Milho e Sorgo in Sete Lagoas-MG. The crop was planted in a split-plot design with four 5 - meter lines and three replicates, spacing 0.70 meters from each other. Three bacterial strains of the genus Bacillus were used. Phosphate fertilization was based on the total dose of 100 kg P_2O_5 / ha by using two different sources of phosphate: the triple superphosphate and the Araxá rock phosphate. The mixture of this two phosphate sources was conducted in the same proportion and the control treatment was carried without phosphate fertilization. It was examined: the grain productivity and the dry mass, the N, P and K contents in the grain as well as N and P in the aerial portion. They were quantified, submitted to analysis of variance and the medium values were compared by using the SCOTT-KNOTT test. The use of a fertilization mixture composed by Araxá rock phosphate and A strain has resulted in a 29% rise in the productivity in relation to the non-inoculated treatment . Another studied combination was Araxá phosphate with B strain that has showed an 52% increase in the Mg content on soil when compared to the uninoculated treatment with the same fertilization. The best solubilization performance was noticed by A and B strains : it has resulted in productivity increases, higher N, P and K contents in the grains as well as higher P and N contents in aerial portion. Among the microorganisms evaluated in this work, the A and B strains have presented a high potential to be used as inoculants in order to enhance the biosolubilization of nutrients.

Keywords: Key words: Inoculant, fertilization, phosphate biosolubilization.
Financial support: Embrapa Milho e Sorgo, UFSJ, CNPq, FAPEMIG

(6080 - 2074) Effects of phosphate fertilization on the growth of *Vochysia haenkeana* Mart. seedlings

Matheus da Silva Araújo[1]; Gustavo Matos Coelho[2]; Stephany Diolino Cunha[2]; Camila dos Santos Silva[2]; Adilson Pelá[2]; Barbara Elias Reis Hodecker[3]; Vitor Correa de Mattos Barretto[4]

University of Brasília[1]; University State of Goiás[2]; Union Pioneer of Integration Social[3]; University State of Paulista[4]

Due to the scarcity of information about fertilization in *Vochysia haenkeana* Mart, the objective of this study was to evaluate the initial growth of seedlings of *Vochysia haenkeana* Mart. in response to different doses of phosphorus. The experiment was conducted in a greenhouse, in plastic containers with a capacity of 5 dm^3 and used as substrate, soil samples identified as Oxisol (USDA soil taxonomy). The experimental design was completely randomized, with five treatments and five replications, totalizing 25 experimental units. The treatments had consisted of five doses of P: 0; 50; 100; 150 and 200 mg dm^{-3}, being the triple superphosphate the source of P fertilizer. After 120 days of growth were measured the plant height, collect diameter, number of leaves and shoot, root and total dry matter. Increasing doses of phosphorus did not promote the increment of plant growth. The species *Vochysia haenkeana* Mart. showed low phosphorus nutrition requirement in the early stages of growth, not demanding the application of phosphorus via fertilizers. The soil used as substrate contained 0.8 mg dm^{-3} of P, which was enough to satisfy the nutritional demands of the plants in the first four months of its development. Keywords: Macronutrients; forest nutrition; forestry. Financial Support: University State of Goiás.

Keywords: Macronutrients; forest nutrition; forestry.
Financial support: University State of Goiás

(1157 - 1147) Efficiency of phosphorus absorption in corn hybrids

Mussa Mamudo Salé[1]; Juliana Brito da Silva Teixeira[1]; Miguel David Fuentes Guevara[1]; Yasmin Dos Santos Lourenço[1]; Sibele Maria Porto Grill[1]; Thais Antolini Vecozzi[1]; Marlon Rodrigues[2]; Ledemar Carlos

Vahl[1]
UFPel[1]; UEM[2]

Among the nutrients that most limit plant growth and development, phosphorus (P) stands out mainly in acidic soils of the tropical and subtropical regions, although it is the macronutrient less absorbed by crops, this is one that provides more expressive answers in terms increase in production. The increase in the phosphorus absorption efficiency favors the reduction of the doses of phosphate fertilizers used in the fertilization, as well as the immediate use of the P before being fixed in the soil matrix, with favorable impacts on the agricultural sustainability, net income of the rural producer, utilization of marginal areas in terms of soil fertility, and in the fertilizer economy worldwide. There is a significant genetic variation of plants to tolerate stress due to P deficiency, a character called efficiency in use, which may be based on the ability of plants to acquire P from soil through changes in root morphology or architecture, exudation of components P mobilizers, or alterations in the transporters of organic P from the plasma membrane, in addition to that the efficiency can contribute with smaller quantities of P required at the cellular level, or more efficient remobilization of P within the plant. However, a phosphorus absorption kinetics test was carried out in two hybrids of the maize crop, in the greenhouse of the Federal University of Pelotas, Department of Soils, Faculty of Agronomy Eliseu Maciel. The assay was mounted in pots containing 2.4 liters of nutrient solution with pH ranging from 5.5 to 6.0 units and electrical conductivity at around 1.8 mS. Twenty days after the assay was set the morphological parameters (length, surface area, radius radius) and absorption kinetics (maximum inflow, Michaelis-Menten constant, minimum concentration and absorptive power) were measured, concluding that the hybrid GSS 40000 Thunder is more efficient in absorbing phosphorus than the Bandeirante hybrid.

Keywords: Keywords: kinetic parameters; morphological; GSS 40000 Thunder; Bandeirante.
Financial support: Financial Support: UFPel, MCTESTP

(4004 - 983) Efficiency of the calcined bone meal used as phosphate fertilizer in rice culture

Francisca Terezinha Feitosa Bezerra[1]; Claudia Roberta Braga de Azevedo[1]; Daniel Rodrigues Mafra[1]; Daniel Miranda dos Santos[1]; Veriton Viana da Costa[1]; Eliane de Oliveira[1]
Universidade Federal do Acre -UFAC[1]

Phosphorus is crucial in the initial growth of plants and in the process of energy storage and transfer. In the soil, phosphate fertilizers become progressively non-labile due to the specific adsorption phenomenon common in tropical soils. Animal waste is rich in nutrients and calcined bovine bones can act as a source of phosphorus and calcium for plants. The objective of this work was to evaluate the calcined bone meal (CBM), as a source of phosphorus, in relation to the Triple Superphosphate (TS) fertilizer in rice cultivation (*Oryza sativa*), Agulhinha variety. The experimental design was a randomized block with 9 treatments and 4 replicates in the first and second harvests and 8 replicates in the third harvest, totaling 144 plots constituted by 2 kg of fine earth air dry (FEAD). The fertilizers with CBM and TS were: 50, 100, 150 and 200 kg ha-1 of P2O5, and for the control 0 kg ha-1. All treatments were fertilized with urea (equivalent to 80 kg ha-1 of N) and potassium chloride (equivalent to 80 kg ha-1 of K). Six rice seeds were sown per pot, after germination, only two seedlings were left in each container, allocated in open air, with daily irrigation. The collect were carried out on 28/8/2017, 10/10/2017 and 09/11/2017. Afterwards, the aerial part was dried in an oven at 60ºC until reaching constant weight. In the first collection, the treatment with 200 kg ha-1 of P2O5 of TS obtained a higher average (1.40 g plant-1), contrasting with the control treatment (0.27 g plant-1) and treatment fertilized with 50 kg ha-1 of P2O5, with CBM (0.65 g plant-1). In the second harvest, the treatment with TS, 50 kg ha-1 of P2O5, presented a higher average (4.6 g plant-1), differing from the control (1.06 g plant-1) and fertilized treatment with CBM dose 50 kg ha-1 of P2O5 (2.74 g plant-1). In the third harvest, the treatments with TS or CBM, 200 kg ha-1 of P2O5, presented a mean dry weight of 4.3 and 3.4 g plant-1, respectively, differing statistically from the control treatment (1 , 01 g plant-1) and average grain yield of 1.91 and 1.57 g plant-1 respectively, whereas the control presented a mean of 0.33 g plant-1. It is concluded that the CBM used as phosphate fertilizer showed efficiency close to the TS fertilizer.

Keywords: *Oryza sativa*, Triple Superphosphate, adubation
Financial support: Universidade Federal do Acre – UFAC

(6508 - 2699) Estimation of reference values of foliar concentration of N, P, K and Ca, adjusted to Andean blackberry crops (*Rubus glaucus* Benth.), in Colombia

Cardona, William Andrés[1]; Bolaños - Benavides, Martha Marina[1]
Corpoica[1]

Soils cultivated with *R. glaucus* in Colombia are fertilized without to bear in mind their nutritional status. The objective of this research was to estimate foliar concentration of N, P, K, and Ca reference values for Andean blackberry crops in Colombia. Proposed five levels for each factor, as well as the combination of these factors, by means of an orthogonal central compound treatment design in randomized complete block arrangement. Each fertilization was carried out according to the growth of the plant. After each fertilization, destructive sampling was carried out: 72, 112, 138, 166, 195 and 225 days after transplant (dat) (vegetative stage), 293, 355 and 435 dat (reproductive), 481, 548, 625, 681 and 758 dat (production year 1), 793, 863, 919 and 972 dat (production year 2). In each sampling separated the different organs of each plant (leaf, stem, root, flower and fruit). The plant tissue complete analysis (macro- and micronutrients) was performed in each organ. Vegetative index (VI) was calculated with the concentration values (Valenzuela *et al*., 1993). Normal values between 1 and 2 were proposed to define appropriate ranges of VI. Taking as reference the ranges of concentration leaf for *Rubus* sp., reported by SBCS (2004). In the vegetative stage, plants had high leaf N concentration. Foliar P concentration was below the normal range in any of the five samplings. At 72 and 138 dat, plants presented deficit of K. Ca concentration was adequate in different sampling. At 435 dat, the concentration of N in leaf below the normal value. The concentration of N, P and K was highest during the stage of reproductive bud that in fruit set. The P concentration was low throughout the reproductive period. The concentrations of K and Ca showed normal values. VI values in reproductive bud, are much lower than in fruit set, demonstrating the importance of Ca and Mg in the emitting its floral buttons. During the production, excessive concentrations of N, K, and Ca were not found. The concentration of P in all sampling showed low values. The IV of fruits was greater than 2, in all sampling. It was necessary to adjust the ranges foliar P sufficiency; finding that, during the vegetative stage the normal sufficiency range must be 0.22 – 0.27%, at reproductive stage (0.12 – 0.22%) and finally during production (0.12 – 0.19 %.). For N, K, and Ca, it is proposed to work with the values of SBCS (2004). The foliar analysis must be carried out at two years of established crop.

Keywords: Fertilization, Sampling, Plant tissue, Range
Financial support: The authors express their thanks to the Ministry of agriculture and Rural development of Colombia (MARD) and the Colombian Corporation for Agricultural Research (Corpoica), for funding of this research.

(7826 - 877) Fused phosphates agronomic efficiency in soils with different P levels

Juliana de Lima Moretto[1]; Leonardo Theodoro Büll[1]
UNESP[1]

Experimental results point to high agronomic efficiency for fused phosphates (TFs) applied to the tropical soils, even when compared to water soluble phosphate sources. However, it is common between Brazilian agricultural producers the belief that such fertilizers are less efficient than water soluble sources, under low fertility soils (low P levels). The objective of this study was evaluate TFs efficiency under two soil conditions: Adequate and low P level for annual crops. The experiment was carried out in a greenhouse using 20L pots with a Nitosol collected at an agricultural production area and has medium concentration of P (35mg dm^{-3} – soil MP); adjacent to this area the same soil was collected, but in natural forest, with low P level (7mg dm^{-3} – soil BP). The sources used were three fused phosphates: magnesium (TM), potassium (TK) and "thick" (TG); and triple superphosphate (ST) as reference. A cycle with millet and another with maize were conducted, for approximately 50 days after emergence, as test plants. By the end of the experiments the soil labile P (resin) and the accumulated P in the plants shoot were evaluated. The variables were submitted to analysis of variance by the F test (α = 0.05) and the means compared by Tukey test (α = 0.05). The fused phosphates provided, since the first crop cycle, expressive higher amounts of P in the soils, in comparison to ST. The accumulation of P in plant tissues, in the first cycle, was TM = 44.29; TK = 41.29; ST = 44.16 and TG = 2.52 mg/pot, for soil BP; and for the soil MP: TM = 79.47; TK = 76.80; ST = 71.33 and TG = 56.12 mg/pot, the accumulation was similar between TM, TK and ST, in both soils, verifying that the powdered TFs have high efficiency in the P availability for annual crop, independent of the initial soil fertility. In the second cropping cycle, in soil MP, P accumulation was TM = 59.42; TK = 56.73; TG = 47.31 and ST = 43.56 mg/pot, showing that TM and TK provided the largest accumulations. In soil BP, TK surpassed the others, promoting the greatest accumulation of the nutrient: 44.17 mg/pot; TM = 30.29; TG = 16.57 and ST = 14.89 mg/pot. In these experiments the powdered phosphates exhibited greater capacity to increase P content in the soil. They are as efficient as a soluble source for the P accumulation in plants, and more efficient when considering the residual effect (second crop). Coarse fused phosphate has lower efficiency than the others TFs.

Keywords: fused phosphate; thermophosphate; phosphate fertilizers; agronomic efficiency; soil fertility
Financial support: CAPES

(1031 - 1573) Impact of subterranean clover (*Trifolium subterraneum* L.) root exudates on phosphorus availability for grapevine (*Vitis vinifera* L.) plants in intercropping systems in Andisols

Francisco Contreras[1]; Adamo Domenico Rombolà[2]; María de la Luz Mora[1]

University of La Frontera[1]; University of Bologna[2]

Phosphorus (P) is an essential nutrient required for plant growth and development. In Andisols, P availability is limited to crops because is sorbed in mineral surfaces or constituting part of soil organic matter. Continuous application of P fertilizers increases production costs making necessary to develop agricultural practices improving P use efficiency, in this context, intercropping is a feasible alternative for enhance nutrient management in soil. Intercropping is an agricultural practice where two or more crops grow simultaneously in the same field and time, preserving soil fertility and improving plant nutrition. Therefore, in this study was evaluated the effect of *Trifolium subterraneum* L. (*T. subterraneum* L.) on P uptake by *Vitis vinifera* L. (*V. vinifera* L.). The vegetal material used in this experiment were *V. vinifera* L. var. Chardonnay on rootstock 1103 Paulsen 1 year old and plants of *T. subterraneum* L. var. Seaton Park cultivated preliminarily during 1 month in germination dishes. To test the intercropping interaction under controlled conditions in greenhouse, both species were cultivated in Hoagland hydroponic solution during 2 months. The experimental design was completely random using three treatments: T1 (*T. subterraneum* L.); T2 (*V. vinifera* L.) and T3 (*T. subterraneum* L. + *V. vinifera* L.) with three replicates. To prove the interaction were evaluated the concentration of organic acids, flavonoids and amino acids in root exudates collected from the hydroponic solution. The most important organic acids found in both species were oxalic, malic and citric; where *T. subterraneum* L. exhibited the highest concentrations. The most important amino acids found were glycylglycine, glutathione and L-threonine; L-threonine was detected only in *T. subterraneum* L. exudates while glycylglycine and glutathione were detected in both species. Finally, flavonoids found were isorhamnetin and kaempferol-3-glucuronide in both species while epicatechin was detected only in *T. subterraneum* L. root exudates. For the compounds found above, there are significant differences in root exudates composition and concentration between species suggesting that there is an interaction where combining these species which can improve soil phosphate availability for grapevine plants cultivated under controlled conditions.

Keywords: Root exudates, phosphorus availability, intercropping.
Financial support: This study was supported by CONICYT scholarship (CRM:0001408).

(6834 - 1242) Impacts of lake sediment reuse on plant growth and soil properties in the field

Mina Kiani[1]; Asko Simojoki[1]; Olga Tammeorg[2]; Priit Tammeorg[1]
Department of Agricultural Sciences, University of Helsinki, Helsinki, Finland[1]; Department of Environmental Sciences, University of Helsinki, Helsinki, Finland[2]

Lake sediments are in many cases known to be rich in nutrients, organic carbon, and clay minerals. These compounds originate from eroded agricultural soils acting as primary sediment source. European countries produce about 200 million m^3 y^{-1} of sediment removed from waterbodies which provides the potential of recycling nutrients from sediments in crop production. There are just a handful studies available exploring the potential of recycling the nutrients from sediments and none have been conducted under field conditions. Therefore, there is a need to develop efficient ways to reuse sediments on agricultural lands to preserve phosphorus and other nutrients and respond to crop demands. The aim of this research was to investigate the effects of different ways of sediments applications to soil on grass growth, soil, and environment. The study was conducted in the shore of a 1-ha heavily eutrophicated lake from which sediments were excavated. Four different sediment application methods were tested in a RCBD design with four replicates. The treatments were pure topsoil, a mixture of soil and biochar on top of the sediment, a mixture of biochar with top 20 cm of sediment, and a 75–100 cm layer of sediment directly on topsoil. In June 2017, mixture of red fescue, Kentucky bluegrass, ryegrass, and white clover was sown to all plots with meat bone meal organic fertilizer. The leaf area index, the relative leaf chlorophyll values, aboveground biomass, soil moisture content, total carbon and nitrogen, GHG emissions, and the soil penetration were measured in all plots in August 2017. The analysis of representative samples of sediments revealed that the sediments were not contaminated by heavy metals, PAHs, and PCBs. The moisture content was significantly higher in sediment plots (33±5%) than soil (19±1%). Relative leaf chlorophyll value and leaf area index were significantly 1.3 and 1.7 times greater in sediment plots than in the soil plots, respectively. Moreover, the treatments containing biochar had the highest C:N ratio. Sediment phosphorus (P) content was high, providing sufficient available P to agricultural lands. The final presentation will include data on yields of 2018, GHG emissions, and the mechanical soil resistance in different treatments. Our results emphasizes the importance of preventing the transport of nutrients to water bodies and considering the assessment of sediment nutrient contents and pollutants in the disposal of removed sediments.

Keywords: Biochar, Eutrophication, Phosphorus, Recycling nutrients,

Sediment removal

Financial support: AGFOREE Doctoral School and University of Helsinki Future Fund

(3682 - 2943) Improving bone-based phosphate fertilizer by pyrolysis

Cristiano Dela Piccolla[1]; Dean Hesterberg[2]; Etelvino Henrique Novotny[3]; Takashi Muraoka[4]; Thalita Cardoso Anastacio[1]; Josimar Vieira dos Reis[1]

Soil Science Department, Luiz de Queiroz College of Agriculture, University of Sao Paulo[1]; Crop and Soil Science Department - North Carolina State University[2]; Embrapa Soils[3]; Center of Nuclear Energy in Agriculture - University of Sao Paulo[4]

Phosphorus is a macronutrient for all organisms, and its projected future scarcity generates a need for more efficient P recycling technologies. Because animal bones are rich in P, they could be employed to recycle part of P fertilizer inputs in agriculture, while diminishing environmental issues and health risks associated with cadmium in phosphate rock-based fertilizers. Moreover, pyrolysis is an alternative treatment to calcination that could both eliminate disease sources from bones and generate an efficient fertilizer ("bone char"). Our aim was to evaluate the physical and chemical characteristics of P in pyrolized pig bones as affected by temperature (400, 550 and 800 °C) and atmospheric conditions (sealed chamber, purging with N_2, or steam activation). In addition to characterization of specific surface areas, porosities, and mineralogy, pyrolysis products were evaluated for their potential to provide P to plants using chemical extractions with water, neutral ammonium citrate, and 2% citric acid. All bone chars met the minimum total-P requirements and maximum cadmium restrictions for commercialization in Europe, a reference market. Bone chars also showed higher solubility than bone subjected to calcination. Synchrotron-based X-ray diffraction showed that bones are composed of hydroxyapatite (HAP), and pyrolysis in a sealed chamber or with flux of N_2 diminished HAP crystallinity compared with pyrolysis performed under steam flux and calcination (800 °C). Linear combination fitting of calcium K-edge XANES spectra revealed that the 20% of poorly crystalline HAP was entirely converted to highly ordered HAP as pyrolysis temperature rose from 400 °C in a sealed chamber to 800 °C under steam activation. Triggered by organic matter losses, HAP crystallization decreased bone char surface area and solubility. Pyrolysis carried out in a sealed chamber at 550 and 800 °C showed higher total and citric-acid-soluble P contents, thus being recommended for a bone based-fertilizer production, whereas the 400 °C treatment diminished bone char pore volume, surface area, and 2% citric-acid-soluble P/total P. Pyrolysis is a promising waste-treatment technology in which the final product can be potentially used to fertilize P-deficient soils in the tropics. Moreover, the acidity of most tropical soils would promote HAP dissolution and P release.

Keywords: alternative phosphate fertilizer; bone treatment; synchrotron radiation

Financial support: The Brazilian agencies CNPq and Capes provided scholarships; University of Sao Paulo and NC State University Department of Crop and Soil Science provided resources; and XRD1, SXS and PGM beamlines of the Brazilian Synchrotron provided facilities.

(2357 - 3111) Maize cob productivity fertilized with different phosphorus sources and dosage

Ianna Bizerra Barros[1]; Iolanda Maria Soares Reis[2]; Carlos Alberto Costa Veloso[3]; Arystides Resende Silva[4]; Eduardo Jorge Maklouf de Carvalho[4]

Universidade Federal de Viçosa[1]; Universidade Federal do Oeste do Pará[2]; Embrapa Amazonia Orienatl[3]; Embrapa Amazônia Oriental[4]

The organic and inorganic phosphorus forms of the soil are influenced by the soil use and management. In cultivated soils, where there are periodic phosphates additions, the management system determines changes in the distribution of forms and phosphorus concentrations in the profile and, more specifically, in the surface layer. The objective of this work was to evaluate the maize cob yield fertilized with different phosphorus sources and dosages. The experiment was carried out in the experimental field of Embrapa Amazônia Oriental, in Belterra City - PA, under a dystrophic Yellow Latosol, with a clay texture. The experimental design was randomized blocks, arranged in a 3x5 factorial scheme, with three replications. Three sources (Simple Superphosphate (SS), Triple Superphosphate (ST) and Natural Reactive Phosphate (Arad) were used and five dosages (0; 60; 120; 180 and 240 kg ha-1) of P2O5 were used. The experimental plots, except control treatment, received mineral fertilization of 120 kg ha-1 of N (urea) and 90 kg ha-1 of K2O (Potassium Chloride), divided in sowing and cover. The maize cultivar used in seeding was AG 7088 PROX, with three seeds per linear meter, whose plots presented dimensions of 5x8 m. The harvest occurred at 141 days after seeding, to determine the maize cobs yield. The data were submitted to variance analysis and the means adjusted to the quadratic polynomial regression and compared by the Tukey test at 5% of probability. The interaction between phosphorus sources and dosages was significant for cob yield. The Arad proved to be inefficient in terms of phosphorus supply to the plants, in view of the non-occurrence of cob yields at any of the applied doses. This fact can be attributed to the low solubility of this type of fertilizer, which promotes longer phosphorus availability. The most efficient interaction in terms of cob yield (6.111 t ha-1) occurred between ST and the dose of 120 kg ha-1 of P2O5, decreasing thereafter. In general, the highest increase in cob yield for both SS and TS occurred until the dosage of 120 kg ha-1 of P2O5, making it unnecessary to apply higher dosages, noting that dosages greater than 120 kg ha-1 of P2O5 cost of production and reduce production. The maize cobs productivity presents a significant response to phosphorus application. The dosage of 120 kg ha-1 of P2O5, with ST as the source, provides higher cob productivity. There was no response in productivity when fertilized with Arad.

Keywords: phosphate fertilization, tropical soils, soil management

Financial support: Embrapa Amazônia Oriental and Fapemig

(8339 - 940) Natural phosphate efficiency use in corn applied with different nitrogen sources

Moniki Campos Janegitz[1]; Gustavo Faria Seródio[1]; Rafael de Paiva Andrade[1]

Colleges Gammon of Paraguaçu Paulista[1]

Phosphate (P) fertilizers as nitrogen are essential for high crop production. Ammonium application can improve phosphorus efficiency use and phosphorus available in soil to the crops. The aim of this study is evaluate the effect of ammoniacal fertilization impacts in the natural P efficiency use to the development initial of maize plants. The experiment was carried on greenhouse at Colleges Gammon in Paraguaçu Paulista –SP from June to September, 2017. The experimental design was randomized blocks in factorial: two nitrogen fertilization (ammonium sulfate and urea) x five doses of natural phosphate (0, 40, 80, 120, 180 mg P dm-1 of soil) with four replications. The experimental condition was in pots with 15 dm-3 of soil. After 30 days of emergency plants height, shoot dry matter, root dry matter, root/ shoot rate and natural phosphate efficient use were determined. Doses of P resulted in higher dry matter yield, plants height and efficient use of P in initial development corn plants. Ammonium sulfate plus doses of P, decreased the root / shoot rate. Natural phosphate efficient use was in 80 mg dm-3, independent of the source of nitrogen applied.

Keywords: Phosphate fertilization, N ammoniacal, ammonium sulfate

Financial support:

(9832 - 2595) Partial acidification of Arraias Rock Phosphate improves P use efficiency in tropical soils

Vinicius de Melo Benites[1]; Sulian Junkes Dal Molin[2]; José Augusto Cabral Santos[3]

Embrapa Solos[1]; UDESC[2]; UniRV[3]

Natural rock phosphates are characterized by low P water solubility. Acidification is the normal method to improve P solubility on these materials but it represents costs and operational issues. The aim of this study was to evaluate the agronomic efficiency of partially acidulated Arraias rock phosphate. The experiment was conducted in a greenhouse at the University of Rio Verde, Rio Verde, GO. A Red Yellow Oxisol from Cerrado was used as testing soil (pH_{CaCl2} = 5.17, clay = 540 g kg^{-1} and P = 0.3 mg dm^{-3}). Plastic pots (2 L) were filled with 2 kg of this soil (dry basis). The treatments consisted in Arraias Rock Phosphate (ARP) (Arraias, Tocantins, Brazil); Triple super phosphate (TSP) and three partially acidulated rock phosphate (PARP) with 5, 10 and 15 % H_2SO_4 relative to RP mass. Fertilizers were applied in the rate of 100 mg P per pot, mixed in the whole soil mass before seeding. Maize was seeded with 5 seeds per pot and one week after emergence were thinned to 2 plants per pot. Soil moisture was maintained between 60% and 50% of the field capacity. After 45 days, plant shoot was cut close to the soil surface. Shoot dry mass and its P concentration, after plant digestion, were measured, and P uptake was calculated. TSP treatment results in the highest shoot dry mass. Among PARPs, the highest dry mass yield was observed in the 15 % PARP which was higher than 5 %, the Arraias rock phosphate and the control. The higher dry mass yield in the 15 % PARP was due to higher water solubility of the phosphate. Unlike the dry mass yield, the ARP has shown the highest P content in shoot tissue, contrasting with the control and other fertilizers. Lower tissue P concentration in higher yield biomass treatments is due to a dilution effect on the P content in shoot tissue in the fertilizers of greater solubility. The amount of P uptake was correlated to shoot dry mass yield, with highest P uptake on TSP followed by the 15 % PARP which differed from control, ARP and 5 % PARP. The relative efficiency in shoot dry mass increase with rate of H_2SO_4 until 35.84 % in the 15 % PARP treatment. The partial acidification of the Arraias rock phosphate increased shoot dry mass and P uptake as well as its efficiency relative to TSP. We concluded that acidification with 10 % H_2SO_4 was the best alternative, since it was similar to 15 % and represents a lower industrial cost.

Keywords: Phosphate solubility, available P, P uptake

Financial support: DuSolo Fertilizers Inc.

(9014 - 1169) Partially acidulated rock phosphates containing zeolites for regulating the solubility in soils.

Ana Paula Bettoni Teles[1]; Paulo Sérgio Pavinato[1]; Gabriel Novoletti[1]

Escola Superior de Agricultura Luiz de Queiroz[1]

The consumption of phosphate fertilizers in Brazil has almost triplicated in the last decades and the most common ones used in agriculture are the solubles or with high reactivity, mostly with low efficiency in tropical soils. Thus, knowing that the sources of phosphate are finite, a study was developed aiming to: evaluate the solubility of partially acidulated phosphates with the incorporation of zeolites (Zeo), produced from distinct rock phosphates; Araxá (RFA), Bayóvar (RFB) and Morocco (RFM); and to evaluate P availability from these sources in the soil. To obtain the fertilizers the Zeo was mixed with rock phosphates in powder and then partially acidified (25 and 50% of the total chemical reaction) by the addition of sulfuric acid. Eleven treatments were evaluated: 1) RFA + Zeo + 50%; 2) RFA + Zeo + 25%; 3) RFB + Zeo + 50%; 4) RFB + Zeo + 25%; 5) RFM + Zeo + 50%; and 6) RFM + Zeo + 25%; 7) Triple superphosphate (TSP); 8) RFA; 9) RFB; 10) RFM and 11) Control (Without P). The solubility was evaluated in soil leaching columns (thermoplastic acrylic tubes with 2.1 cm internal diameter and 25 cm height). To each column was added 50 g of soil with low available P content and then it was saturated with distilled water. Fertilizer treatments were added in a dose of 100 mg P per column, superficially. For 60 consecutive days it was added 20 ml of deionized water to the columns and the leachates were collected for P content evaluation (Murphy and Riley, 1962). After, the soil was sampled in layers of 0-1; 1-2; 2-3; 3-6 and 6-10 cm from the top, and the available P by ion exchange resin was evaluated (first step of P fractionation proposed by Hedley et al., 1982). It was observed a partial solubilization of all fertilizers after 60 days, evidenced by the presence of P in the leachates. RFB and RFM both with 50% acidulation had 25 and 23% of the P leached, respectively, otherwise TSP presented highest leaching, with 63.7% of the total applied. No P leaching was observed under the control and under RFA, RFB and RFM without acidification. Phosphate fertilizers addition has provided increase in available P in all the layers of the soil, being this most significant increase in the toplayer (0-1 cm). The sources RFB + Zeo + 50% and RFM + Zeo + 50% provided available P values like those observed for TSP, and could become good options for slow-release fertilizer for crops.

Keywords: Phosphorus; leaching; rock phosphate

Financial support: Coordenação de Aperfeiçoamento de Pessoal de Nível Superior

(8088 - 1508) Phosphate Fertilization via monoammonium phosphate in Corn Crop in Oxysol from Brazilian cerrado region

Gustavo Ferreira Sousa[1]; Maila Adriely Silva[1]; Paulo Henrique Soares[2]; Miguel Martins Neto[2]; Larrissa Pereira da Cunha[2]; Carlos Henrique Eiterer de Souza[2]

Universidade Federal de Lavras[1]; Centro Universitário de Patos de Minas[2]

The phosphorus (P) is the element that exercises great influence on the crop development, however, it exhibits differentiated behaviour on the most soils cultivated, which makes to became unavailable for some plants. Thus, the objective of this study was evaluate that the aim of fertilizer to increase the efficiency of the nutrient utilization and with the use of the P stabilization technology. The experiment was carried out with the corn crop during the growing seasons 16/17, at the Fazenda Lanhosos, in Patos de Minas (Minas Gerais State – Brazil) under the Red Eutrophic Latosol. The soil has the following chemical attributes analyzed in depths of 0-20 cm; pH (H_2O) 5,84; H+Al (AcCa) 2,6 cmol dm^{-3}; Al (KCl) 0,08 cmolc dm^{-3}; Ca (KCl) 1,4 cmolc dm^{-3}; Mg (KCl) 1,4 cmolc dm^{-3}; K (Meh-1) 66,7 mg dm^{-3}; P (Meh-1) 0,22 mg dm^{-3}; P-rem ($CaCl_2$) + KH_2PO_4) 8,48 mg L^{-1}; V% 53. The area that the experiment installed was occupied for understory vegetation typical from Brazilian Cerrado region, therefore the current growing season was the first performed. It was used the randomized complete block design in factorial scheme (3 x 4) + 1, with 3 sources of monoammonium phosphate (MAP + humic substances, conventional MAP and polymer-coated MAP), 4 doses (30, 60, 90 and 120 Kg^{-1} of P_2O_5) + the additional treatment, without P application. To 92 days after sowing, evaluations of plant height, culm diameter, stem and leaves dry matter were performed. To 140 days after sowing evaluations of ears size, one thousand grain mass, predicting production. The data were submitted to the analyses of variances and when the significance mean among the sources were analysed by the Tukey test at 0,05 and the P_2O_5 doses were adjusted to the regression model. Significant difference was observed for the sources on the parameters of plant height, stem and leaves dry matter, therefor the conventional MAP source indicated higher values in relation to the others sources. When the doses application were evaluated, the increase linear adjustment was observed to the plant height, stem and

leaves dry matter and ears size were observed. Also were observed, interaction between the sources factors and doses in the stem diameter and productivity evaluation, therefor the conventional MAP source indicated superior. It is concluded that the corn crop is responsive in a linear way to the phosphate fertilization and the conventional MAP provided higher productivity.
Keywords: fertilizer, efficiency, phosphorus
Financial support: Centro Universitário de Patos de Minas

(8205 - 3127) Phosphorus and sulfur content in calcareous Vertisol under influence of elemental sulfur

Ewerton Gonçalves de Abrantes[1]; Alexandre Paiva da Silva[1]; Raphael Moreira Beirigo[1]; Josinaldo Lopes Araujo[2]
Universidade Federal da Paraíba[1]; Universidade Federal de Campina Grande[2]

Calcareous soils present low availability of phosphorus (P), as a function of the presence and sorption in calcium carbonates, and in different forms of calcium phosphates. Thus, the increase of P availability in these soils is due to the reduction of pH and increase in the solubility of the precipitated phosphates, which can be achieved with the use of elemental sulfur (S^0). The objective of this work was to evaluate the effect of the application of elemental sulfur rates on the pH and phosphate and sulfate contents in a calcareous Vertisol of Apodi Plateau, RN. The work consisted of an incubation test, using soil (4 mm ø), collected in the 0-0.20 m layer, presenting the following chemical attributes before installation: pH (H_2O) = 8.5; organic matter = 3.73 g kg^{-1}; P = 142 mg dm^{-3}; SO_4^{2-} = 44 mg dm^{-3}; Ca^{2+} = 29.0 $cmol_c$ dm^{-3}; Mg^{2+} = 10.7 $cmol_c$ dm^{-3}; $EqCaCO_3$ = 95.8 g kg^{-1}, remaining phosphorus = 16.7 mg L^{-1}; clay = 300 g kg^{-1}. The work was conducted in completely random experimental design with treatments arranged in a 5 × 5 factorial scheme, with four replications. The factors studied were five S^0 rates (0, 15, 30, 45 and 60 g kg^{-1}) and five incubation times (T) (14, 28, 42, 56 and 70 days). The experimental unit consisted of a pot containing 0.3 kg of soil, with humidity maintained at 75 % of the field capacity. In the respective incubation times, the soil samples were collected and dried in an oven (35 °C), and destined to the pH determinations in water (1: 2.5), P-Olsen and sulfate extracted with 0.01 mol $CaCl_2$ L^{-1}. There was a significant effect ($p \leq 0.01$) of the factors of S^0 rates and T, and the interaction between the factors in the variables evaluated. Elevation of S^0 rates reduced pH values (from 8.4 to 6.4) and increased sulfate contents (from 68.0 to 3800 mg dm^{-3}). However, the increase of S^0 rates reduced the phosphate contents (from 150.0 to 140.0 mg dm^{-3}). Regarding the effect of the incubation time, a decrease in pH (from 8.0 to 6.2) and increases in phosphate content (from 140.0 to 141.0 mg dm^{-3}) and sulfate (from 698 to 4,496 mg dm^{-3}). P values did not correlate with pH values (0.34^{ns}) and sulfate contents (-0.39^{ns}), but there was a significant negative correlation between pH values and sulfate content (r = -0.98*). It was concluded that the application of S^0 reduced the pH and increased the sulfate content, but little influenced the phosphate contents.
Keywords: phosphate, sulfate, phosphorus fixation
Financial support: CAPES

(8139 - 3007) Phosphorus availability in cultivated and non-cultivated soils by the Mehlich-1 and Mehlich-3 extractants

Josimar Vieira dos Reis[1]; Takashi Muraoka[1]; Cristiano D. Piccolla[1]; Aijânio G. B. Silva[1]; Mariana G.M. Gonçalves[2]; Thalita C. Anastacio[1]
"Luiz de Queiroz" College of Agriculture[1]; University of Lavras[2]

Due to the high doses of P applied in cultivated soils for decades, there is an increase of different soil P forms. In these soils, it may occur the loss of the predictive capacity of available soil P content by the Mehlich-1 extractant, the most used in Brazil. Our objectives were: to correlate the available P content by Mehlich-1 (P-M1) and Mehlich-3 (P-M3) extractants, in cultivated and non-cultivated soils with yield indices of maize plants, and to correlate the extractants' P recovery rates with soil characteristics related to the P buffering capacity, remaining-P (rem-P), P Maximum Adsorption Capacity (P-MAC), and clay content. The maize plants were grown under greenhouse conditions, in plastic pots with 2.0 dm^3 of soil. The treatments consisted of a factorial 10 × 6, with 10 soils samples, with contrasting characteristics related to the availability of soil P, and 6 doses of P (mixture of 70 % of Single Superphosphate and 30 % of Bayóvar). There were two successive cultivations, with 42 days each. The determinations of the available soil P content by the extractants were performed on soil samples collected after incubation with limestone, before the first cultivation, and in the samples collected before the second seeding. After the cultivations, the production of the shoot dry matter, the P content and the accumulated P in the plants were determined, and the P recovery rates by the extractants in the first cultivation were calculated. In both cultivations, the highest correlation coefficients were obtained with the P content in the plants (0.975*** and 0.901** for P-M1, and 0.980*** and 0.918*** for P-M3). As the P content in the plants suffer dilution effect, the conclusions should be based on the accumulated P in the plants. In the first cultivation, the correlation between P-M1 and the accumulated P was 0.874*** and decreased to 0.710*** in the second cultivation. For P-M3, the correlation was 0.870** in the first cultivation and 0.865*** in the second cultivation. There was a significant correlation between the P recovery rates by the two extractants with rem-P (M1 = 0.887**, M3 = 0.875**), P-MAC (M1 = -0.828**, M3 = - 0.769*) and clay content (M1 = - 0.717 * and M3 = -0.756*). Therefore, the two extractants are indicated for determination of the available soil P content in soils with low and high availability of P, although M3 showed slightly better correlations. As with M1, M3 is also influenced by the soil P buffering capacity.
Keywords: Soil phosphorus, soil buffering capacity, extractant
Financial support: Coordination for the Improvement of Higher Education Personnel (CAPES)

(4131 - 1527) Phosphorus extracted by Mehlich 1 and anion exchange resin in in dystrophic Clayey Red Latosol subjected to the anticipation phosphates fertilizer

Maila Adriely Silva[1]; Gustavo Ferreira de Sousa[1]; Pedro Rocha Santos[2]; Miguel Martins Neto[2]; Ariane Emilia Celita Barbosa[2]; Carlos Henrique Eiterer de Souza[2]
Universidade Federal de Lavras[1]; Centro Universitário de Patos de Minas[2]

The phosphorus (P) can be find it in labile fractions on the soil, non-labile and readily available on solution. The availability is directly connected to the development and productivity, as we know the P is the third most extracted nutrient for the most of the plants. Thereby, the objective of this study was evaluate the phosphorus extraction by Mehlich 1 and anion exchange resin methods in dystrophic clayey red latosol after the anticipated application of phosphate fertilizers. The experiment was conducted at Fazenda Santos Reis, Lagoa Formosa, Minas Gerais State, Brazil. The area soil is characterized as dystrophic clayey red latosol and has 1.09 mg dm^{-3} of P Mehlich 1. A completely randomized block design was used, with the factorial scheme 5 x 4, therefore the fertilizing was anticipated in five times (0, 7 , 14, 28 and 42 days) and four sources of phosphate fertilizer (Conventional MAP, polymer-coated MAP 1, polymer-coated MAP 2 and MAP with humic

substance) with four repetitions. It was used 120 Kg ha^{-1} of P_2O_5 and after the last application time, was sowing the maize crop. At the late crop season, soil samples were collected on the plot centrelines for the phosphorus extraction by Mehlich 1 and anion exchange resin methods. The results were submitted to the variance analyse, and the regression models were adjusted for the incubation time. Moreover, the Tukey test was used for the sources comparation, considering 5% of probability. The variables analyzed were influenced by the anticipation phosphate fertilizing time ($p < 0,05$), however did not adjusted to the regression model. The phosphorus extraction by the Mehlich 1 extraction the application of the fertilizer on the sowing day provided increasing P levels to the sources of conventional MAP, MAP with humic substance, polymer-coated MAP 2 and polymer-coated MAP 1, with 1,82 mg dm^{-3}, 1,74 mg dm^{-3}, 1,28 mg dm^{-3} and 1,02 mg dm^{-3}, respectively. The phosphate fertilizer application over time did not provide changes on the phosphorus availability classes, even after the application the rating is still very low. For the results found with the anion exchange resin methods, the availability for all fertilizers in every time remained as average (10,1 to 20,0 mg dm^{-3}). Therefore, concludes that the times of anticipation phosphate fertilizing and the sources used did not influence on the phosphorus extraction y Mehlich 1 and anion exchange resin methods.

Keywords: extractor, contact time, adsorption
Financial support:

(4434 - 477) Potential for the use of calcined bone meal as a source of phosphate fertilizer for corn

Daniel Rodrigues Mafra[1]; Daniel Miranda dos Santos[1]; Claudia Roberta Braga de Azevedo[1]; Francisca Terezinha Feitosa Bezerra[1]; Veriton Viana da Costa[1]; Eliane de Oliveira[1]
Universidade Federal do Acre-Campus Floresta[1]

Phosphorus is an essential element for plants, stimulating the plant and root growth. However, it constitutes a severe limitation for agricultural production in tropical regions, due to its low availability caused by the specific adsorption to the soil colloids and to the low purport in the soil source material. The use of alternative sources of fertilizers is a strategy to reduce production costs, when it is using phosphate fertilizers to correct soil fertility. With the objective to evaluate the performance of calcined bone meal (CBM) as a source of phosphorus, in relation Triple Superphosphate (TS) fertilizer, an experiment was carried out at the Universidade Federal do Acre - Campus Floresta, on city of Cruzeiro do Sul, state of Acre, Brazil, from 25/08/2017 to 11/12/2017, using maize (Zea mays) - early variety BM-810, Biomatrix. The experimental design was a randomized complete block design with nine kind of fertilizations and three collection seasons (or subplots), with four replications. The plots was constituted by pots with 5 kg of soil. The adubations tested were 0, 50, 100, 150 and 200 kg ha-1 of P2O5, adoting CBM or TS fertilizers as phosphorus source . The harvests were carried out on 10/10/2017, 11/14/2017 and 11/12/2017. The dependent variable was dry matter of the aerial part, dried in an oven at 60 ° C until constant weight. In the first harvest, the treatment corresponding CBM fertilized at level 100 kg ha-1 of P2O5 obtained a better average with 6.3 g plant-1, contrasting significantly by theTukey Teste ($P<0,05$), with the control treatments and treatments fertilized with 50 kg ha-1 of P2O5, regardless of the source of phosphorus used. The other treatments did not differ from each other. In the second harvest, ST at a dosage of 200 kg ha-1 of P2O5, presented a mean of 19.2 g plant-1 differing significantly, by the Tukey Test ($P<0,05$), from the control and the CBM dosage treatmen of 50 kg ha-1 of P2O5. In the third harvest, treatments with 200 kg ha-1 of P2O5, from both TS and CBM, presented averages of 22.1 and 17.6 g plant-1, respectively, differing statistically by Tukey Test ($P<0,05$) from the control treatment and from 50 kg ha-1 fertilization of P2O5 treatments with TS and with CBM. The results showed that the calcined bone meal, used as phosphate fertilizer, presented efficiency close to the triple superphosphate fertilizer.

Keywords: Zea mays; triple superphosphate; organic adubation.
Financial support: Universidade Federal do Acre- Campus Floresta

(5286 - 3035) Production system of *Lupinus mutabilis* Sweet "chocho" on terraces and hillsides with phosphate fertilization in Cajamarca

Silvia Aguero-Aguilar[1]; Luis Tomassini Vidal[1]; Mario Tapia Nuñez[1]
Universidad Nacional Agraria La Molina[1]

The grains of *Lupinus mutabilis* Sweet "chocho" are high in phosphorus and concentrate up to 50% protein, it is very important for food security. The production system of *L. mutabilis* and its response to phosphate fertilization are analyzed. In the district of La Encañada (2500 -3700 ma.s.l), Cajamarca (Peru), a RCBD was established on sloping plots and embankments, fertilized with triple calcium phosphate super (46% P_2O_5) at 0, 40 and 80 kg.ha-^{1}. We evaluated biological parameters, size and number of nodules, yield, whose results were processed in INFOSTAT v.2017 (LSD Fisher α=0.05). When the phosphorus dose was increased, significant differences were recorded for hillsides in grain yield, pod number/plant, pod length, number of grains/pod, weight of grains/plant, weight of 250 grains, size and number of nodules. In terraces, it responded significantly only in number of grains/pod, size and number of nodules. The 36.4% farmers planted chocho on fallow/fallow land. The profitability of the Benefit/Cost crop was 1 to 4. Phosphate fertilization to soils can be included in the slope fertilization plans under the principles of how much, how and when, to improve grain quality, farmer's economy and food security.

Keywords: phosphorus, andean grains, lupine, rhizobium, crop rotation
Financial support: CONDESAN- CENTRO INTERNACIONAL DE LA PAPA (CIP)

(7352 - 1312) Soil chemical attributes as a function of the superficial and localized phosphate fertilization for the soybean in the Cerrado

Mayara Martins e Martins[1]; Vitor Vargas[2]; Mathaus Mandro[1]; Paulo Sergio Pavinato[1]
ESALQ/USP[1]; SLC Agrícola SA[2]

The soybean crop is highly demanding in soil available phosphorus (P), and the supplement of this nutrient via phosphate fertilizers promotes significant increases in production, even in the first years of cultivation in cerrado opening areas. The P is almost immobile in the soil and can reach the plant root by diffusion. Phosphate fertilizers in Brazilian farms are usually applied localized at the planting furrow or broadcasted all over the soil surface with or without incorporation. Based on this, the objective was to evaluate soil chemical attributes in response to different levels and management of phosphate fertilizer application. The experiment, conducted at the Pioneira farm - SLC Agrícola SA, located in Querência (MT), a region of the current agricultural expansion of the Brazilian Cerrado, is in a recently cultivated area, which is under a soybean-millet (cover crop) succession system since 2014/15. The soil of the area is classified as Hapludox (Latossolo Vermelho-Amarelo distrófico) with 30% clay content. The experimental design in randomized blocks arranged in the factorial scheme 2x5+1, consisting in two phosphate management applications; in the sowing furrow (Xingu seeder) and broadcasted (Brutus distributor), with five doses of P_2O_5: 60, 120, 180, 240, 300 kg ha^{-1}, in addition to a control treatment without P application. Based on the soil chemical analysis performed after three consecutive years of cultivation, significant changes were observed in the resin-extracted P in the 0-5 and 10-20 cm layers, while the organic matter was only modified in the first layer. The superficial (broadcasted)

application was effective in increasing resin P in the layer 0-5 cm, being the localized application in the furrow more efficient to alter this attribute in the deepest layer, of 10-20 cm. For the other nutrients and chemical attributes (Ca, Mg, S, K, Al, H + Al, m% and V%) no trend was observed between the application management and the doses used. In general, localized fertilization (furrow) is more efficient when opening new areas of Cerrado since the P applied via fertilizer is better exploited in the soil profile, reaching layers of 10-20 cm.

Keywords: phosphorus in the soil, forms of application, absorption of P

Financial support: Capes

(1179 - 1454) Sugarcane yield and technological quality under phosphate sources and filter cake applied at plant establishment.

Thais de Marchi Soares[1]; Valdevan Rosendo dos Santos[2]; Amin Soltangheisi[1]; Gabriel Cato[1]; Henrique Coutinho Junqueira Franco[3]; Oriel Kolln[3]; André Cesar Vitti[4]; Paulo Sergio Pavinato[1]

Luiz de Queiroz College of Agriculture- ESALQ/USP[1]; Federal University of Alagoas - UFAL[2]; National Center for Research in Energy and Materials - CNPEM[3]; São Paulo Agribusiness Technology Agency - APTA[4]

The guarantee of high sugarcane productivity in restrictive environments, especially in soils previously occupied by pastures, with low natural fertility and low available phosphorus (P), is one of the main challenges of the Brazilian sugar and ethanol industry. Several strategies may be integrated in order to provide satisfactory P levels for good sugarcane productivity, like the use of soluble phosphate sources (single or triple superphosphate), natural rock phosphates and organic sources such as filter cake. The use of filter is profitable since it is a by-product of the sugar-ethanol plant and presents high P content, which is gradually made available through the mineralization processes, which can turn the use of this waste an environmentally feasible and inexpensive source of nutrients. However, there is still a gap regarding the action of this source in association with mineral fertilizers in soil P dynamics in restrictive areas. This work aimed to evaluate the effect of soluble and reactive phosphate sources associated with filter cake on the yield and quality of sugarcane in an expansion area (sandy soil) and in established area for long time (clayey soil). The sources used were triple superphosphate and reactive rock phosphate at the rates of 90 and 180 kg P_2O_5 ha^{-1}, associated with 10 Mg ha^{-1} DM of filter cake. The parameters evaluated were: sugarcane yield, biometry, nutrient extraction in the tissue and technological analysis (Pol%, total recoverable sugar (TRS), tonne of sugar per hectare (TSH) and total sugar). The association of filter cake with mineral fertilizers increased yield, TRS, TSH and extraction of P by sugarcane in the first year in both soils evaluated. In the second year, there was an increase in TRS, Pol% and in the yield just in the sand soil area with the addition of filter cake. The association of the filter cake with rock phosphate can be considered a good management option due to the higher release of P in the first year and by the important residual effect of the rock phosphate throughout the cycles of the culture.

Keywords: Keywords: Organic waste; Reactive phosphates; Solubility

Financial support: São Paulo Research Foundation (FAPESP); National Council for Scientific and Technological Development (CNPq)

(2058 - 1911) The anticipation of phosphate fertilization on the maize crop

Murilo Mendes Machado[1]; Pedro Rocha Santos[1]; Miguel Martins Neto[1]; Victor Gustavo Soares Ribeiro[1]; Bruna Resende Martins[1]; Carlos Henrique Eiterer De Souza[1]

Centro Universitário de Patos de Minas[1]

The phosphorus (P) is one of the main nutrients responsible for the limitation of the grains development in maize crop, having an important role on the breathing and photosynthesis. However, despite the great importance of phosphorus to the plants, the most of Brazilian soil the phosphorus present the lack of adequate concentrations of nutrient and the strong soil interaction, resulting in fixation as well as do not supply the demand of the plant. Although, the objective of this study was evaluate the earlier application of phosphate fertilizer on the maize crop. The experiment was conducted in a greenhouse located at Campus do Centro Universitário de Patos de Minas (UNIPAM), Patos de Minas, Minas Gerais State, Brasil, in plastic pots of 5 dm^{-3}. The used soil is classified as Dystrophic Clayey Red Latosol. It was used the randomized complete block design in double factorial scheme, corresponding to 4 phosphate fertilizer sources x 6 time of earlier fertilization with four repetitions. The phosphate fertilizers sources were conventional triple superphosphate, polymer-coated triple superphosphate, polymer-coated MAP and conventional MAP, the anticipation time are 0, 15, 60, 90, 120, 150 days before the sowing. The used dose was 200 mg dm^{-3} of P_2O_5, it was corrected to the respective used fertilizers concentration according to their concentration. The evaluation used were stem diameter, plant height, performed 60 days after the sowing. The data, were submitted to the variance analysis, the compared averages by Tukey test with significance of 0,05 and the time adjusted to the regression model. For the stem diameter analysis, there was significant difference between the sources, wherein, the conventional and polymer-coated MAP sources presented better results than the others. For this evaluation there is no regression adjustments for the time tested. For the height plant did not have interference from anyone factors. Thus, the conventional and polymer-coated MAP application enable greater gain in corn plant stem diameter, and the treatments did not influence on the corn plant height. On the studied conditions, the anticipation of phosphate fertilization up to 150 days before the sowing does not reflect in loss of stem diameter and corn plants height in a greenhouse.

Keywords: Phosphorus, Fertilizers, Adsorption

Financial support:

(8697 - 2503) Transitions to sustainable management of phosphorus in Brazilian agriculture

Paulo S Pavinato[1]; Paul J A Withers[2]; Marcos Rodrigues[1]; Amin Soltangheisi[1]; Teotonio S. de Carvalho[3]; Luiz R G Guilherme[3]; Vinicius de M Benites[4]; Luciano C Gatiboni[5]; Djalma M G de Sousa[6]; Rafael de S Nunes[6]; Ciro A Rosolem[7]; Fernando D Andreote[1]; Adilson de Oliveira Jr[8]; Edson L M Coutinho[9]

ESALQ/USP[1]; Bangor University, UK[2]; UFLA[3]; Embrapa Soils[4]; UDESC[5]; Embrapa Cerrados[6]; FCA/UNESP[7]; Embrapa Soybean[8]; FCAV/UNESP[9]

Brazil's large land base is important for global food security but its high dependency on inorganic phosphorus (P) fertilizer for crop production is not a sustainable use of a critical and price-volatile resource. A new strategic analysis of current and future P demand/supply concluded that the nation's secondary P resources which are produced annually (e.g. livestock manures, sugarcane processing residues) could potentially provide up to 20% of crop P demand by 2050 with further investment in P recovery technologies. However, the much larger legacy stores of secondary P in the soil could provide a more important buffer against future P scarcity or sudden P price fluctuations, and enable a transition to more sustainable P input strategies that could reduce current annual P surpluses by 65%. Here we examine the current and future P demand of Brazilian crop production, and investigate transitional strategies for meeting this demand more

sustainably by reducing reliance on costly and finite PR resources. In summary, there is large scope to expand cropland output in Brazil without impeding the nation's extensive grazed beef production systems or contravening deforestation rules. Brazil's high P fertilizer demand leads to large inefficiency because it does not account for legacy soil P reserves. Crop production to meet demand will continue to represent a drain on global P resources unless more sustainable P input strategies are adopted. These strategies should include (a) national and regional investment in P mining and P recovery technologies to provide cost-effective domestic PR sources, or secondary P resources that can substitute for imported P, and (b) transition to maintenance, or below maintenance, P input strategies where legacy soil P stocks provide all, or a portion, of crop P requirements and reduce reliance on diminishing PR reserves. With a bank of soil P fertility for long-term P security, farming systems could be redesigned to perform profitably and efficiently under lower levels of soil P fertility.

Keywords: Phosphorus scarcity; food demand; rock phosphate sources

Financial support: CAPES, project number: 88881.064953/2014-01

(3317 - 1581) Triple superphosphate granulation with biochar: kinetics of P release

Denison Pogorzelski[1]

Universidade Federal de Viçosa[1]

Phosphate fertilization presents low efficiency, mainly in tropical soils. In general, highly weathered soils had oxidic mineralogy, clayey texture and low organic matter content. These characteristics favor the adsorption of phosphorus (P) by soil, reducing the availability of P to plants. Slow release fertilizer (SRF) has been considered a promising strategy to improve the nutrient supply. Currently, SRF are composed of synthetic polymers that increase the cost of production. Biochar (BC) is a potential alternative to replace polymers, due to its low cost and sustainable technology. BC has physicochemical characteristics that can influence release kinetics, such as porosity and surface charges. In this sense, point of this study was to synthesize an SFR composed by BC. To investigate the P release kinetics of the triple superphosphate (TS) and organomineral, granules (3.35 – 4.00 mm) were synthesized from the feedstocks: BC (wood chips *Eucalyptus sp*. pyrolyzed at 350 °C for 1 h) and TS, both powders. The BC was added to the TS in two forms: blending or coating. In addition, BC was added to TS in three doses (5, 15 and 25 % of BC w/w). In granulator rotative, six organominerals and one control (TS) fertilizers were produced. P release assay was performed on a continuous stirred-flow system using deionized water (20 °C) with duration 6 h for each fertilizer. Briefly, the system consists of a high performance liquid chromatography (HPLC) piston pump and a Teflon reaction chamber (17 mL) and a fraction collector collects the solution passing through the chamber at each 2 min. Moreover, specific surface area (SSA), pore volume (PV), pore size (PS) of the fertilizers were measured by adsorption of N_2 and P adsorption isotherm was performed on BC. In summary, BC showed inert behavior for P. This result suggests that kinetics of P release on granule can be governed by physical interactions between TS and BC. Furthermore, TS released 94 % of the P content in 1.5 h, blending granule (25 % BC) releases 78 % and coating granule (25 % BC) released 30 % of the P for the same test time. In addition, increasing doses of BC to TS enhanced SSA and PV in the granules. However, the coating treatment provides lower PS, which increase the residence time of the water in the pore, reducing the release kinetics of P. The coating of the TS granules with 25 % of BC allows obtaining a slow release organomineral fertilizer.

Keywords: organomineral fertilizers; slow release; stirred-flow; pyrolysis.

Financial support: This study was supported by CAPES and Fapemig

C3.3.7 - Contribution of zero tillage (no-till) to sustainable use and management of soils

(3832 - 780) biological soil decompaction using forage radish and crotalaria

Daniel Dias Valadão Júnior[1]; Franciele Caroline de Assis Valadão[1]; Natalia de Oliveira Fiorillio[1]; Paulo Rogério Guimarães[1]

Instituto Federal de Mato Grosso, Campus Campo Novo do Parecis.[1]

In tropical no-till system, it is common the appearance of compacted layers due to the machinery traffic and the absence of coverage. Routinely, the elimination of this layer is done with the use of mechanical equipment, being the system undone. It is worth remembering that the reduction of the compaction observed in the first year after soil mobilization is temporary, besides favoring the subsurface compaction. In this context, the adoption of cover plants with a deep and well-distributed root system capable of breaking compacted layers may be an alternative to mechanical methods of soil preparation, which may improve the stability of aggregates, porosity and resistance to soil penetration with additional benefits by recycling nutrients in the profile and increasing organic matter. Thus, this study aimed to propose an alternative to the use of machines for the recovery of compacted soils with the use of cover plants. The experiment was carried out in a Latossolo Vermelho Distrófico tipico in a 5x2 factorial randomized block design with three replicates. The first factor was five tractor traffic-induced compaction levels (with no additional traffic, one pass, three passes, six passes and eleven passes of the tractor), and the second factor consisted of two cover plants (Raphanus sativus and Crotalaria ochroleuca). After the traffic, the physical properties of the soil were characterized. These same properties were determined at full flowering of the crops, where root growth, dry mass productivity and green cover rate were determined. Tractor traffic changed the physical properties of the soil, affecting the analyzed variables. Comparing the physical properties of the soil before and after the cover crops, there was a reduction in soil penetration resistance (RSP) in areas with crotalaria. Values higher than 1.82 MPa RSP prevented the forage radish root growth. Mean values of RSP showed a decrease of approximately 1 MPa after the cultivation of cover crops, and Crotalaria ochroleuca had a greater influence on the decrease of RSP when compared to forage radish.

Keywords: soil compaction, chisel, cover crops

Financial support: Fundação de Amparo a Pesquisa do Estado de Mato Grosso-FAPEMAT

(9580 - 2175) Bulk density and total porosity of a Dystric Planosol cultivated with pepper in conventional and no-tillage management systems

Isabela Beatriz Pereira da Cruz[1]; Pedro Araújo Garcia[1]; Raíza Ritielle Carvalho Scalzer[1]; Gustavo Candido da Silva Rodrigues[1]; Nivaldo Schultz[1]

Universidade federal Rural do Rio de Janeiro[1]

Compaction is a process that alters the physical soil characteristics, resulting in increased bulk density, reduction of pore volume and consequent water infiltration into the soil, as well as its aeration. The objective of this study was to evaluate the bulk density and total porosity of a Dystric Planosol of medium texture cultivated with pepper (*Capsicum annuum*), comparing the values of the rows and between the rows at conventional and no-tillage systems. The accumulation of straw of the cover plants was 17.2 Mg ha^{-1}. The straw was incorporated into the conventional system. The experiment was developed in the Horticulture sector of the Federal Rural University of Rio de Janeiro (Universidade Federal Rural do Rio de Janeiro - UFRRJ). The experimental design was divided into subdivided plots, where the plots are the management systems, and the subplots are the rows and between the rows, with 4 replications. The experiment

was implemented in November 2016 with the sowing of the cover plants, and the evaluation was carried out in November 2017, collecting in the rows and between the rows of each management system, 0.0-10, 0.10-0.20 and 0.20 -0.40 m depth. Sampling was performed with Uhland collector and a PVC ring of 88.67 cm^3.The macro and micro soil porosity were determined by the tension table method. Soil bulk density was determined from the relationship between the dry soil mass at 105 ^oC for 24 h and the volume of the PVC ring. The data were submitted to statistical analysis using the Sisvar 5.3 program, comparing the means by the Tukey test at 5% of probability. There was no difference in the total porosity in the rows and between the rows, independently of the management system (conventional and no-tillage), as well as in the mean between the systems, at depths of 0.0-0.10 and 0.20-0.40 m, however, at the depth of 0.10- 0.20 m, the conventional system presented higher total porosity than no-tillage (39.4% and 32.6%, respectively). The increase in porosity in the 0.10-0.20 m soil layer of the conventional system is the result of soil revolving and the absence of human traffic. About the soil density, the systems did not differ, with the values of 1.56, 1.64 and 1.69 g cm^{-3} on the rows, and between the rows values of 1.53, 1.54 , 1.60 g cm^{-3}, both for the layers of 0.0-0.10, 0.10-0.20 and 0.20-0.40 m, respectively. Based on these results it is concluded that management systems do not affect total porosity and soil density over a crop cycle.

Keywords: *Capsicum annuum;* soil compactation; black oats.
Financial support: Fundação Agrisus – Agricultura Sustentável

(4648 - 1378) Carbon and nutrient stocks in cronossequency of crops under no-tillage system in the eastern Amazon

Rúbia Carla Ribeiro Dantas[1]; Alessandra Danieli Miranda de Araújo[1]; Letícia Cunha da Hungria[1]; Sidney Daniel Araújo da Costa[1]; Edilson Carvalho Brasil[2]; Mario Lopes da Silva Júnior[1]
Amazon Federal Rural University[1]; Embrapa Eastern Amazon[2]

Different cropping systems and agricultural management can influence changes in organic carbon and nutrient stocks, interfering with soil quality. The objective of this study was to evaluate the influence of no-tillage (NT) system on carbon and nutrient stocks (P, K, Ca and Mg) on a Yellow Latosol (Oxisol) of the Eastern Amazon. The study was conducted in the municipality of Paragominas, southeast Pará, in an area under chronosequence of NT crops, using a completely randomized experimental design, with four replications, in subdivided plots. The plots were composed of management systems and depths (0-10, 10-20, 20-30 and 30-40 cm) were considered in the subplots. The management systems were: NT with nine (NT9), eleven (NT11), thirteen (NT13), fourteen (NT14) and fifteen (NT15) years of adoption, plus a reference treatment (native forest-NF). The stocks of organic carbon and nutrients (P, K, Ca and Mg) were adjusted to the same soil mass. Regardless of the depth, organic carbon stocks in NT9 (28.1 kg ha^{-1}) and NT11 (24.4 kg ha^{-1}) were highest than the other NT15 (18.5 kg ha^{-1}), NT14 (18.3 kg ha^{-1}), NT13 (20.5 kg ha^{-1}) and NF (19.7 kg ha^{-1}). These results may be due to management practices, such as subsoiling, carried out in areas under NT with longer adoption times, which may have caused oxidation of organic matter and as a consequence of carbon stocks. In the soil surface layers, the P stock increased in function of the time of adoption of the NT, observing that in the depth of 0-10 cm the quantities were equivalent to 18, 24, 26, 28 and 40 kg ha^{-1}, respectively, for the areas under NT9, NT11, NT13, NT14 and NT15. At depths of 10-20 cm, P stocks were equivalent to 12, 15, 18, 20 and 20 kg ha^{-1}, respectively, for the same management systems. In the 0-10 cm layer, NT15 (464 kg ha^{-1}), NT14 (484 kg ha^{-1}) and NT13 (453 kg ha^{-1}) presented highest K stocks than NT9 (360 kg ha^{-1}) and NT11 (238 kg ha^{-1}). However, in the other layers, we observed an inverse behavior, in which the NT9 and NT11 presented the highest stocks of K, in relation to the other systems. In the 0-10 cm layer, with the time of NT adoption, there was an increase in Ca and Mg stocks. However, in the subsurface layers the stocks were reduced over time of NT adoption, especially in NT13, NT14 and NT15.

Keywords: phosphorus stock, management systems, Oxisol.
Financial support: Embrapa Eastern Amazon

(8191 - 3022) Carbon content and aggregate stability in Oxisol after ten years of cultivation under no-tillage and fertilization with swine manure

Paulo Cezar Cassol[1]; Maria Sueli Heberle Mafra[2]; Marco André Grohskopf[3]; Paulo Roberto Ernani[1]
Universidade do Estado de Santa Catarina[1]; Universidade do Planalto Catarinense[2]; Universidade Estadual Paulista[3]

Soil fertilization with organic fertilizer, such as swine manure (SM), allows high crop productivity and may favour the soil aggregation. In addition, some studies have shown that manure isolated or combined with mineral fertilizer is more efficient than only mineral fertilizer for the increase in the soil organic carbon (SOC) content. Thus, the objective of this work was to evaluate the influence of continuous annual applications of SM, mineral and combined fertilization on the soil aggregates stability and to the SOC content, within the aggregates, of a Southern Brazilian Oxisol under no-tillage corn-oat succession. The evaluation was carried out after 10 years of conducting a field experiment with the annual application of the following treatments: soluble fertilizer (SF); 25 m^3 ha^{-1} of SM plus SF; SM at the doses: 25, 50, 100, and 200 m^3 ha^{-1}; and a control without fertilization. The experimental design was randomized blocks with 4 replicates. Undeformed samples of the layers 0-2.5, 2.5-5, 5-10 and 10-20 cm of soil depth were collected in order to preserve its structure. The stability of the aggregates was determined by the weighted average diameter (WAD) and by the geometric mean diameter (GMD). The SOC contained within the aggregates was determined by de Walkley-Black method after assessing the stability of the soil aggregates retained in sieves, separating the following three diameter classes: between 8.0 and 4.75 mm (class 1), between 4.75 and 2.0 mm (class 2) and less than 2.0 mm (class 3). The treatments and the SOC content did not affect the soil aggregate stability. The SOC content in the aggregates larger than 2.0 mm increased with the increase of the SM dose up to 50 m^3 ha^{-1} $year^{-1}$ and stabilizes with the doses greater than this. The stability of the soil aggregates did not vary with the increase in the dose of SM annually applied, however the SOC content within the aggregates greater than 2.0 mm increases with the SM dose up to 50 m^3 ha^{-1} $year^{-1}$.

Keywords: organic fertilizer; soil organic matter; pig slurry
Financial support: CAPES and UDESC

(5980 - 1057) Changes in spatial variability of soil properties due land use change

Valle, S.R[1]; Cárdenas, C.[2]; Zumelzu, M.[2]; Dörner, J.[1]
1Universidad Austral de Chile/Facultad de Ciencias Agrarias/Instituto de Ingeniería Agraria y Suelos. 2Centro de Investigación en Suelos Volcánicos (CISVo)[1]; 1Universidad Austral de Chile/Facultad de Ciencias Agrarias/Instituto de Ingeniería Agraria y Suelos[2]

Changes of land use, to provide land for agricultural use, livestock and forestry, is the main cause of the disturbances to the soil, not only affecting their quality and its functions, but also in the spatial variation of their properties. The objective of this study was to evaluate the spatial variability of soil properties as result of different land uses (LU) in two different soils of southern of Chile. The Hueicoya soil (HEY,

Ultisol, derived from schist) was sampled to register the total soil depth as well as samples were collected at 20 cm of soil depth under four forest land uses to measure soil organic carbon (SOC). In the second soil, Los Ulmos (ULM, Ultisol derived from volcanic ashes) two tillage systems were evaluated, conventional (CT) and No-tillage (NT), at two soil depths (0-10 and 10-20 cm). All samples were georeferenced. Different soil properties were evaluated in both studies as SOC, pH, extractable Al, Olsen-P, bulk density and air conductivity. The LU change in HEY induced differences ($p< 0.05$) for total soil depth (5-100 cm) and the SOC (1.1-10.5%), where higher differences show the consequence of soil horizon losses due to soil erosion. And, for ULM soil, there were differences ($p< 0.05$) between the tillage systems of for all the properties evaluated, where there was a decrease of some properties in NT as bulk density, kl and pH but an increase Olsen-P and SOC. These soil properties varied both spatially and considering their use, e.g., soil pH range was 5.5-6.8; bulk density, 0.56-0.81 g cm^{-3}; air conductivity, -3.28 to -5.7 (log m s^{-1}); exchangeable Al, 519-1487 mg kg^{-1}; SOC, 2.3-12.4% and Olsen-P, 2-46 mg kg^{-1}. Only for Kl can be determined the spatial dependence, for both tillage systems the model of semivariogram adjusted was exponential, but NT showed a range higher than under CT. On the other hand, soil pH and bulk density in both tillage systems cannot be possible to adjust a semivariogram model. In both soils, LU change provoked a change in soil variability pattern; for this would be advisable to shorten the separation distances in future studies.

Keywords: land use change, spatial variability, soil properties
Financial support: Instituto de Ingeniería Agraria y Suelos (UACH)

(6789 - 1440) Chemical attributes of soil and corn production under direct sequence as a function of calcary and plaster application in the eastern Amazon

Sidney Daniel Araújo da Costa[1]; Edilson Carvalho Brasil[2]; Mário Lopes da Silva Júnior[1]; Letícia Cunha da Hungria[1]; Rúbia Carla Ribeiro Dantas[1]
Universidade Federal Rural da Amazônia[1]; Embrapa Amazônia Oriental[2]

The correction of the soil acidity in the area under no-till from the application of limestone becomes limited, due to the low movement of bases without profile. The use of lime with agricultural plaster is a viable alternative, as it favors the vertical movement of bases in the profile. The objective of this study was to evaluate the effect of the combined application of lime and gypsum on soil chemical attributes and corn grain yield under no - till during three crop cycles. The experiment was conducted in Terra Alta, Pará, in the Brazilian Amazon, in the cycles from 2010 to 2012, in a dystrophic Yellow Latosol. A randomized complete block design with three replicates. The treatments were lime (0, 1, 2, 3, 4 t ha^{-1}) and gypsum (0, 500, 1000 kg ha^{-1}). The corn was sown with spacing of 70 cm between the rows, with five plants per linear meter. In the first and third agricultural years, in the 0-20 cm layer, an application of increasing doses of lime promoted a linear increase in soil pH (y_{2010} = 4.522+0.293x R^2 = 0.98; and y_{2012}=5.0148+0.236x R^2=0.94 while in the second year there was interaction between the doses of limestone and gypsum, however the pH remained, even on the influence of the gypsum. In all years, an application of reduced lime or Al^{3+} content, with more effective action in the superficial layers. Not the first year, the Al^{3+} had the behavior y_{2010}=0.5369e-0.449x R^2=0.980. In the second year, there was a greater reduction in Al^{3+} contents in the 0-10 cm layers (y_{2011}=0.392+0.141x-0.0171x2 R^2=0.89) and 10-20 cm (y_{2011}=0.584e-0.364x R^2=0.91). In the third year, there was a greater influence of the lime on the Al^{3+} levels in the layers of 0-10 (y_{2012} = 0.669 + 0.3004x-0.0492x2 R^2=0.97) and 10-20 cm (y2012=0.684+0,3359x -0.0538x2 R^2 = 0.98). In the first year, an interaction between limestone and gypsum increased Ca+Mg content in the 0-10 cm layer (y=1.493+0.4x R^2 = 0.98) and 10-20 (y=0.901+0.467x-0.0978x^2+0.4667x R^2=0.66). What is the measure of increases, especially in the layer up to 20 cm (y_{2011}=1.556+0.29x R^2=0.97, and y_{2012}= 0.828+1.0062x-0.1024x^2 R^2 = 0.98). There was an increase in the grain yield with an application of limestone and gypsum in the years (y_{2010}=2574+208.71x R^2=0.76, y_{2011}=3939+500.97x-59.869x2 R^2 = 0.70, and y_{2012} = 4653+256,54x-20.886x2 R^2 = 0.54). The application of limestone, associated or not with gypsum, promoted improvements in chemical attributes, with positive effects on the production of corn grain

Keywords: Soil fertility, conservation management, mineral nutrition.
Financial support: Embrapa Amazônia Oriental

(7332 - 1309) Chiseling efficiency in the reduction of soil mechanical resistance to penetration o under maize no-tillage system

Lizete Stumpf[1]; Paulo César Conceição[1]; Márcia Kochem[1]; Vitor Cauduro Girardello[2]; Maiara Karini Haskel[1]; Weslei Sbalcheiro[1]
Universidade Teconológica Federal do Paraná[1]; Universidade Regional Integrada do Alto Uruguai e Missões[2]

The objective of the study was to evaluate the chiseling efficiency in the reduction of soil mechanical resistance to penetration of an Oxisol under maize no-tillage. Before the implantation of the experiment, the soil presented a mechanical resistance to penetration greater than 3 MPa in the 0.05-0.20 m layer. In May 2015, the four chiseling systems were implanted under a randomized block design with three replications: a) No-tillage chiseling only in the start of experiment (2015) with Jumbo equipment; b) No-tillage chiseling only in the start of experiment (2015) with Terrus equipment; c) No-tillage chiseling annually (2015 and 2016) with Jumbo equipment; d) No-tillage chiseling annually (2015 and 2016) with Terrus equipment. No-tillage with no disturbance was used as a control. In July 2015 and May 2016, sowing of winter cover crops: Oats (60 kg ha^{-1}) + Vetch (30 kg ha^{-1}) + Radish (10 kg ha^{-1}), called the consortium. The soil mechanical resistance to penetration determination were made in March 2016 (after maize harvest and before chiseling), in April 2017 (after maize harvest and before chiseling) and November 2017 (after maize planting and 7 months after chiseling). The data presentation of 0.00-0.05 m, 0.05-0.10 m, 0.10-0.20 m and 0.20-0.40 m layers. Values of less than 0.5 MPa in the 0.00-0.05 m layer were observed in all evaluations, independent of the chiseling system. In the 0.05-0.10 m layer, the soil mechanical resistance to penetration values decreased substantially in relation to the initial characterization, remaining below 1.50 MPa after 12, 24 and 30 months, independent of the chiseling system. After 12 months, the initial soil mechanical resistance to penetration of the layer of 0.10-0.20 m (3.39 MPa) passed to 2.80 MPa in the soil under No-tillage, while the soil under chiseling had values between 1.5-2.0 MPa. However, after 24 months, the soil mechanical resistance to penetration under No-tillage was lower than 2.50 MPa, while the soil under chiseling, consecutive or not, continued to present values between 1.5-2.0 MPa. The initial soil mechanical resistance to penetration values of the experimental area indicated a restriction to the maize root development in the 0.10-0.20 m layer (values close to 3.5 MPa). However, during the evaluation period these were reduced in both chiseling systems, as well as in that in which only the root activity of the maize/consortium (No-tillage) succession was predicted.

Keywords: Oats; Radish; Vetch.
Financial support:

(5691 - 1653) CO_2 emission and rearrangement process of soil in short term after soil management submitted to different intensities

Bruna de Oliveira Silva[1]; Mara Regina Moitinho[1]; Gustavo André de Araújo Santos[1]; Ludhanna Marinho Veras[1]; Luiz Fernando Favacho Morais Filho[1]; Daniel de Bortoli Teixeira[1]; Carolina Fernandes[1]; Newton La Scala Júnior[1]
FCAV/UNESP – College of Agricultural and Veterinarian Sciences, Sao Paulo State University[1]

This study aimed to investigate the CO_2 emission (FCO_2) associated to physical properties in the rearrangement process of soil the in short term after soil management was submitted to different intensities. The study was conducted in an agricultural area located at FCAV / UNESP in the municipality of Jaboticabal, São Paulo, Brazil (21º15 'S 48º18' O). The soil was classified as a typical Oxisol Red eutrophic, a clayey texture. The study was conducted in three adjacent areas, measuring 10 x 3 m each, in which two soil tillage systems were performed: (i) rotary hoe + conventional harrow representing a much more intense soil tillage; (ii) disc plowing + disc harrowing, characterizing a reduced soil tillage, and in the third area was no-tillage, without disturbance. After the was management conducted 17 days of evaluations. The daily averages of FCO_2, soil density (g^3 cm^{-3}) and resistance to penetration (MPa) were compared for the different management systems, and they were done by the Scott-Knott test, at a significance of 5% probability. On the first day after management, FCO_2 was 87% higher in intense soil tillage (3,86 µmol m^{-2} s^{-1}) when compared to soil tillage (2,06 µmol m^{-2} s^{-1}) and it was 147% higher when compared to the area without disturbance (1,56 µmol m^{-2} s^{-1}). To soil bulk density ($F = 4.01$, $p < 0.0001$) and soil pentration resistance ($F = 2.26$, $p < 0.0001$), significance was observed in the interaction between managements and time. Soil under no-tillage management had higher average values of soil bulk density and soil pentration resistance, this fact is expected due to the characteristics of this soil, in which a small compaction occurs until the layer of 0-0.20 m depth, when compared to the areas with soil managent. The three treatments evaluated presented a similar pattern of temporal variation for soil bulk density and soil pentration resistance. This fact may be indicative of the process of soil consolidation in intense soil tillage and soil tillage, through the mechanisms of particle rearrangement. The physical soil attributes: soil bulk density, soil pentration resistance showed lower variation from day 12 after soil management, this effect was considered in this study as a natural process of soil consolidation, and this process may also have influenced the temporal variation of soil CO_2 emission.

Keywords: Consolidation of soil, Breathing soil, No tillage, Tillage.
Financial support: Sao Paulo Research Foundation (FAPESP) (Process nº. 2015/25615-3), and National Council for Scientific and Technological Development (Cnpq) (Process nº 142384/2017 – 8).

(5920 - 2614) Content of Deep Organic Carbon and Total Nitrogen in Oxisol: Long-Term Effect of Tillage and Crop Rotation

Enza Rigon[1]; Telmo Jorge Carneiro Amado[1]; Carlos Bonini Pires[1]; Geovane Reimche[1]; Cristiano Keller[1]; Charles W. Rice[2]
Universidade Federal De Santa Maria[1]; Kansas State University[2]

The expansion of agriculture with the intensive use of tillage systems (plowing, disking, among others) promoted the decrease of up to 75% of the original levels of organic matter of the soils under forest or natural pastures. In 12,000 years of agriculture and most notably in the last 200 years, about 133 trillion tons were lost due to the increase in the rate of mineralization of organic matter or erosion of agricultural soils under intensive tillage. In contrast, the development of new agricultural production systems, such as the no-tillage system, promoted the partial recovery of soil carbon content, contributing to greater sustainability in agriculture. In this way, the objective of this study was to evaluate the impact of 32 years of soil management systems and crop rotation about the carbon and nitrogen content up to 0.90 m deep of an Oxisol. The experiment was established in 1985 on a Typic Hapludox in Cruz Alta-RS (Brazil) under a no-tillage (NT) and conventional tillage (CT). Three different cropping systems were studied: wheat (Triticum aestivum L.)/soybean (Glycine max (L) Merr.) (R1); oat (Avena strigosa (L.) Schreber)/soybean/oat+vetch (Vicia sativa (L.) Walp.)/corn (Zea mays L.)/radish (Raphanus sativus L.)/wheat/soybean (R2) and oat/soybean/wheat/soybean (R3). The NT was performed by sowing the crops with a minimal soil disturbance while CT consisted of disk plow (20cm) followed by harrow disk (10cm) prior summer crops sowing and disk harrow before the winter crops. Further soil and crop management practices followed regional best management practices. Total C and N were determined by dry combustion using a CN Soil Flash Elemental Analyzer EA 1112 Series (Thermo Finnigan Italy, S.p.A., MI, Italy) using 50 mg soil sample. Results were tested throughout ANOVA using the R software. The main results show a tillage x depth interaction and means reveal that the use of NT enhance C and N levels when compared to CT, mainly at the 0-5cm top layer. The C contend was 2.77 and 1.72 g kg-1, under NT and CT respectively. The N contend was 2.20 and 1.30 g kg-1 under NT and CT respectively. The results demonstrate that NT system under tropical conditions is effective in maintaining and sustaining organic soil carbon and nitrogen.

Keywords: Soil management, Sustainability, Soil quality, No tillage
Financial support: CAPES/Brazil, Project Number: CAPES/PVE-88881.062185/2014-01

(4078 - 1950) Controlled traffic farming in no-tillage system in southern Brazil

Tiago De Gregori Teixeira[1]; Telmo Jorge Carneiro Amado[1]; Geovane Boschmann Reimche[1]; Emanuel Roggia[1]; Darlan Preuss[1]; Marcieli Piccin[1]; Arthur Kich Buhse[1]; Enza Rigon[1]; Gustavo Henrique dos Santos[1]
UFSM[1]

The increasing food demands are requiring the adoption of enhancing crop productivity techniques that are more economically profitable, and especially environmental friendly. Aiming the land usage efficiency and soil and water conservation, the no-till system is well adapted with tropical soils, climate and crops and is adopted in the most part of annual crop producers in Brazil. One of the common problem that areas managed under no-till face are the surface and subsurface soil compaction, harming annual crop root development. Soil compaction reduces micropores so affecting water infiltration capacity thereby stimulating the surface runoff water and consequently favoring the occurrence of rill and interrill erosion favored by steep relief. The increase in density in soil under no-till can be caused by a number of factors, such as cattle, or disorderly displacement of implements and soil managed under excessive soil moisture. Also, the increase of weight of new agricultural equipment by keeping similar area of soil contact, can contributed to compaction. The aim of this work is to study the controlled traffic technique to reduce random compaction in an area managed under no-tillage. For this purpose, traffic lines were established taking into account relief surveys and area format, adjusting the gauges and work widths of the equipment in order to reduce unnecessary strides. The implements have been adapted to work with a width of 3.05m, since the working widths of the seeder and harvester are 9.00meters (m), while the sprayer works in the width of 27.00m. The experimental area is located in the municipality of Carazinho - RS, southern Brazil, presenting a soil classified as a dystrophic Red Oxisol and the Cfa type

climate. The first results indicate that areas managed by traffic control when compared to tradition traffic present higher soil density (0.72%), macroporosity (26.41%) and total porosity (1.01%), while lower microporosity (-4.44%) Results show that soybean cultivated during 2016/17 summer season yield 10.9% higher grain yield and the cover crop (oat) during the 2017 winter season, cultivated after summer crop, presented 33.63% higher dry mass, under traffic control treatments compared to traditional ones.

Keywords: sustainable farming, traffic intensity, soil compaction management, porosity, soybean
Financial support: CAPES, Fundação AGRISUS

(7261 - 787) Corn-crotalaria intercropping systems

Franciele Caroline de Assis Valadão[1]; Daniel Dias Valadão Júnior[1]; Vinicius Rossi Ribeiro de Paula[1]; Rafael Torres de Souza[1]; Paulo Rogério Guimarães[1]
Instituto Federal de Mato Grosso, Campus Campo Novo do Parecis.[1]

In Brazil, corn is the crop that consumes most of nitrogen fertilizer; this is due to the requirement of the crop and the large loss of fertilizer applied. Thus, alternative methods that improve the efficiency in the use of N in the system are important for the sustainability of the productive process. In this sense, crotalaria can play a key role in reducing the use of synthetic nitrogen sources in the corn production system by being able to fix high amounts of N per hectare and make it available for the following crop. Another possibility is the intercropping where the main crop would take advantage from N fixed by the legume, either by the direct excretion of nitrogen compounds or by the decomposition of nodules and roots, which will decompose and release nutrients during the development of the main crop. Thus, the goal of this study is to find an intercropping system between corn and crotalaria aiming at the production of straw while maintaining corn yield. To do so, a randomized complete block experiment was carried out in 2015 and 2016, with 7x2 + 1 subplots and three replications on a Latossolo Vermelho Distrófico tipico, with seven intercropping types assigned to the plots, and the species of crotalaria (*Crotalaria spectabilis* and *Crotalaria ocrholeuca*), to the subplots with an additional treatment of single corn. The productive attributes of crotalaria, chlorophyll and total nitrogen, shoot height, shoot dry mass, and thousand grain mass were evaluated. *C. spectabilis* was more sensitive to water fluctuation during the development cycle. Crotalaria sown before corn cultivation with the incorporated seeds present higher phytomass production, but reduce corn productivity. The management in which the crotalaria is sown in the corn interrow using a furrower at the time of corn sowing, as well as the one in which the crotalaria is sown in the corn sowing furrow, are feasible because they provide straw production, do not reduce corn productivity, and not interfere with corn harvesting operations.

Keywords: Zea Mays, *Crotalaria spectabilis, Crotalaria ocrholeuca*)
Financial support: Instituto Federal de Mato Grosso.

(3970 - 205) Data mining techniques for classification of soil CO_2 emission

Camila Viana Vieira Farhate[1]; Zigomar Menezes de Souza[1]; Stanley Robson de Medeiros Oliveira[2]; Lenon Herique Lovera[1]; Ingrid Nehmi de Oliveira[1]; Euriana Maria Guimarães[1]
State University of Campinas (Unicamp), Agricultural Engineering (Feagri)[1]; Brazilian Agricultural Research Corporation (Embrapa), Agricultural Informatics, Computational Intelligence Laboratory (LABIC)[2]

A high priority objective currently in the scope of carbon cycle science is to understand the spatial and temporal controls involved in CO_2 dynamics in terrestrial ecosystems. However, estimates of CO_2 emissions from soil to the atmosphere through production systems are difficult and complex due to the diversity of agricultural practices in large areas and significant variations in both soil and climate. In contrast, data mining is a promising alternative to predict soil CO_2 emission from correlated variables. Thus, our objective was to construct a model using data mining techniques, such as selection of attributes and induction of decision trees to predict different levels of CO_2 emissions in the soil. The original data set was composed of 23 attributes (22 predictive attributes and one response variable). The response variable refers to the emission of CO_2 from the soil as the target of the classification. Due to the large number of attributes, a procedure for selecting attributes was conducted to remove those of low correlation to the response variable. For this purpose, we assessed four approaches to attribute selection: no attribute selection, correlation-based attribute selection (CFS), Chi-square method (χ^2), and Wrapper method. For data classification, we used the binary decision tree induction technique on Weka 3.6 software. Our results demonstrated that the data mining techniques allowed the development of an efficient model to classify soil CO_2 emission using the Wrapper method of attribute selection as well as algorithm C4.5 for induction of the decision tree. Wrapper method selected an efficient subset for soil respiration prediction with only five attributes, with the following influence order on the determination of soil CO_2 emission: soil temperature> rainfall> macroporosity> soil moisture> potential acidity. The attributes selected through the Wrapper method have high coherence with literature data regarding both the selected attributes and the decision tree rules.

Keywords: Decision tree, soil attributes, selection of attributes.
Financial support: National Council for Scientific and Technological Development – CNPq (PA: 140945 / 2015-6)

(8342 - 3121) Degree of clay flocculation and soil organic carbon stocks under no-tillage as affected by chiseling and gypsum application in southern Brazil

Esmael Lopes dos Santos[1]; Caroline Honorato Rocha[2]; Victor José Agassi[3]; Douglas Henrique Tonsic[3]; Henrique Debiase[1]; Julio Cezar Franchini[1]; Gislaine Silva Pereira[4]
Embrapa Soja, Londrina - PR[1]; Universidade do Oeste Paulista, Presidente Prudente - SP[2]; Universidade Filadélfia de Londrina, Londrina - PR[3]; Universidade Estadual de Londrina, Londrina - PR[4]

Soil compaction under no-tillage (NT) has been a major concern among soybean producers in Southern Brazil. High machinery traffic intensities in wet soils, and low adoption of diversified crop rotations have been pointed out as the main factors leading to critical levels of soil physical degradation to crop production. In some cases, soil chiseling has been indicated to mitigate compacted soil layers in NT, increasing soil macroporosity, water infiltration and reducing soil resistance to root growth. Additionally, gypsum has been widely used in Southern as soil amendment to increase Ca^{2+} and SO_4^- contents and neutralize Al^{+3} mainly at deep layers, enabling soybean deep-rooting. However, the effects of chiseling and gypsum application on water-dispersible clay and soil organic carbon (SOC) stocks are poorly understood considering clayey soils from tropical regions managed under long-term NT. This work aimed at evaluating the degree of clay flocculation and SOC stock in response to soil chiseling and gypsum application in a clayey Oxisol from Southern Brazil, managed under long-term NT. The experiment was carried out in Londrina, Parana State, Brazil, following a 2x2 factorial arrangement in a complete randomized block design, with three replications. Treatments consisted of two management systems [continuous NT, and chiseled NT (NTC)], with or without gypsum application (broadcast application of 3.5 Mg ha^{-1}). Chiseling and gypsum application were perfomed in

May, 2014. All treatments were cultivated with wheat from May to September, 2014, and with soybean from October to March, 2015. After soybean harvest, soil samples were taken from 0,0-0,1; 0,1-0,2; and 0,2-0,4 m soil layers, to determine SOC, water- and NaOH-dispersible clay contents. Degree of clay flocculation (DCF) was estimated as the ratio between water- and NaOH-dispersible clay. Soil cores were sampled at the same depths to determine soil bulk density, enabling SOC stocks quantification. Gypsum application significantly increased DCF under NT, improving soil aggregation and structure. Conversely, gypsum application did not influence DCF in NTC. SOC stocks at 0,0-0,4 m depth were higher in NT (48,4 Mg m^{-3}) than in NTC (45,2 Mg m^{-3}). Gypsum application did not affect SOC stocks. In conclusion, NT in association with gypsum application are important strategies to enhance soil aggregation and structure.

Keywords: Soil structure, aggregation, soil compaction.
Financial support:

(6699 - 2684) Glomalin-related soil protein after two decades of different tropical soil management

Aristides O Ngolo[1]; Sandro LS Moreira[1]; Maurílio Fernandes de Oliveira[2]; Genelício Crusoé Rocha[1]; Igor Rodrigues de Assis[1]; Raphael BA Fernandes[1]
Universidade Federal de Viçosa[1]; EMBRAPA MILHO E SORGO[2]

Glomalin is a glycoprotein released to the soil by arbuscular mycorrhizal fungi. This protein plays a fundamental role in the formation and stability of soil aggregates and is related to reducing soil losses by erosion. This study was carried out in an experimental area of EMBRAPA Milho e Sorgo (Sete Lagoas, MG, Brazil), where three types of soil management for long period (> 20 years) were selected [disc plough (DP), no-tillage (NT), Grid with subsoiler (GS)] besides a natural cerrado (NC) area, used as reference. Soil samples were collected in the surface layer (0.00 to 0.10 m) and were submitted to extraction of two fractions: easily extractable glomalin (EEG) and total glomalin (TG), which are quantified according to colorimetric method using serum albumin bovine as the standard protein. Data of contents of EEG and TG were submitted to ANOVA and mean values of the treatments were first compared using Dunnet test ($p < 0.10$) to verify differences between soil management practices and natural cerrado. After that, Tukey test ($p < 0.10$) was performed aiming comparison between soil management treatments. Results obtained for easily extractable glomalin (NC: 12.8 mg g^{-1}, DP: 14.0 mg g^{-1}, NT: 12.6 mg g^{-1}, GS: 12.2 mg g^{-1}) indicated no means differences between soil management practices and reference (NC). Among soil management treatments, difference were identified just between DP and GS, and values obtained for NT were similar to these both treatments. For total glomalin (NC: 50.2 mg g^{-1}, DP: 32.61 mg g^{-1}, NT: 27.8 mg g^{-1}, GS: 34.55 mg g^{-1}), just PD treatment differed and presented lower mean value than the reference (NC). No differences among soil management practices was verified. Based on these results, two decades of soil management practices do not result in changes in easily extractable glomalin, but present a tendency to reduce total glomalin. Since glomalin-related soil protein is related to physical soil quality, practices should invest in increasing soil organic matter contents aiming to increase the biological activity and glomalin production.

Keywords: Soil quality, Arbuscular mycorrhizal fungi, Soil management
Financial support: FAPEMIG (CAG-APQ-00887-17), PEC-PG and CAPES.

(1986 - 2847) Gypsum and Limestone application methods: Wheat yield, plant mineral nutrition and chemical soil attributes

Marcos Renan Besen[1]; Eunápio de Oliveira Costa[1]; Antônio Feijó Goes Neto[1]; Michel Esper Neto[1]; Fabricio Linhares Mazzi[1]; Lucas Simas de Oliveira Moreira[1]; Tadeu Takeyoshi Inoue[1]; Marcelo Augusto Batista[1]
Universidade Estadual de Maringá[1]

Brazilian tropical soils are mostly acidic soils, with the presence of toxic aluminum (Al^{3+}) and low calcium content (Ca). In no-till system (NT) liming is applied at the soil surface without incorporation of same. Due to the low limestone solubility, the corrective effects are limited as surface layers. Gypsum (GY) is an option to increase the Ca content and decrease the Al^{3+} activity in the soil subsurface. The objective of this work was to evaluate the effect of GY, surface (SL) and/or incorporated liming (IL) on the magnesium (Mg), Ca and sulfur (SO_4^{2-}) levels in an Oxisol and wheat mineral nutrition. The experiment was carried out in Campo Mourão, Paraná, Brazil. The experimental design was randomized blocks in a factorial arrangement 4 x 2 + 3, four levels of base saturation (BS) (44, 60, 70 and 90%); two methods of limestone application (SL and IL) and three additional treatments, involving the use of limestone associated with GY: BS-60% + 3.71 Mg ha^{-1} of GY; BS-70% + 3.71 Mg ha^{-1} of GY and BS-70% + 7.42 Mg ha^{-1} of GY. It was used dolomitic limestone (PRNT 82%). The cultivar TBIO Toruk was sown on May 12, 2017. It was applied 150 kg ha^{-1} of NPK formulation 16-16-16. Leaf tissue samples were collected during the flowering and soil samples were performed at 0.00-0.05, 0.05-0.10, 0.10-0.20, 0.20-0.30, 0.30 -0.40 and 0.40-0.60 m depths after a wheat harvest. The BS levels were unfolded in each liming application form and additional treatments compared to each factorial ($p < 0.10$). A harvest was performed on September 20, 2017. BS and form of limestone application did not influence S absorption, however, Mg and Ca increased linearly in IL. The higher GY dose increased Ca and S leaf contents and decreased Mg contents. SL increased pH and Ca content to 0.10 m and Mg up to 0.30 m, but IL increased Ca up to 0.40 m, pH and Mg up to 0.60 m. GY decreased Mg in superficial layers and increased Ca content in depth (0.40-0.60 m). BS levels did not influence SO_4^{2-}, but GY increased the SO_4^{2-} levels in all profiles. Yield in IL treatment was adjusted to the quadratic model, with a maximum point in 75% BS. GY treatments increased the yield in relation to the two BS lower levels of the IL. However, the mean SL yield (5,597 kg ha^{-1}) showed that although IL increased pH in depth, the best responses were observed without SL. In NT (SL) there was no increase in yield with the limestone application. The BS that provided the highest productivity was 75% in IL.

Keywords: leaching, tropical soils, no-till, superficial liming, incorporated liming
Financial support: CAPES-Coordenação de Aperfeiçoamento de Pessoal de Nível Superior

(6813 - 1974) Identifying indicators in a structurally fragile tropical soil to recommend management practices and prevent land degradation in the Amazonian periphery

Vinicius Ribamar Alencar Macedo[1]; Virley Gardeny Lima Sena[2]; Clemeson Cardoso Vale[3]; Stéfanny Barros Portela[1]; Carlos César Martins de Souza[1]; Alana das Chagas Ferreira Aguiar[4]
UEMA[1]; UNESP[2]; IFMA[3]; UFMA[4]

In the Amazonian periphery, farmers need to intensify their productivity and be assured of the sustainability of the areas designated for crops, to prevent illegal deforestation of new areas. The aim of this study was to identify the main indicators that affect crop productivity in a structurally fragile Amazonian soil, and to determine the importance of maize yield indicator and their relationships with promising management practices to intensify crop production in agricultural areas in a sustainable way. The experiment

was established with three leguminous species, *Clitoria fairchildiana*, *Acacia mangium* and *Leucaena leucocephala*, and an area without leguminous plants. Maize was sown between the rows of leguminous plants. Chemical and physical soil properties and maize grain yield were determined. Multiple linear regression, hierarchical partitioning analysis and spatial variability were used. Our results suggest the possibility of intensifying crop production in tropical soil prone to hardsetting through soil management practices, because Calcium (Ca) and soil organic matter (SOM) contents were highly correlated and exerted strong influence on maize grain yield (accounted for 30 up to 50 % of maize yield in two years). Other indicators like macroporosity, soil density and resistance to penetration, which also influenced the yield, were correlated with Ca and SOM, both of which can be increased or improved by agronomic practices. It is worth highlighting that due to negative influence of pH on total independent contributions to increased organic matter, higher calcium contents must be achieved by gypsum application rather than using liming material.

Keywords: calcium; carbon; gypsum
Financial support: We th ank CNPq (National Council for Scientific and Technological Development), Coordination for the Improvement of Higher Level Personnel (CAPES) and FAPEMA (Foundation of Research and Development and Technological of Maranhão, Brazil) for theirfinancial

(3133 - 2007) Land use and land cover dynamics in western Haiti

Wesly Jeune[1]; Eliana de Souza[2]; Márcio Rocha Francelino[2]; Elpídio Inácio Fernandes Filho[2]; Genelício Crusoé Rocha[2]
Université Quisqueya[1]; Universidade Federal de Viçosa[2]

The guidelines for public policies on environmental planning and recovery can be based on detailed studies on changes in land use. This work aimed at assessing the changes in land use and land cover in western Haiti (~4300 km^2), through imagery classification of three-date (1986, 2000 and 2014) on 28-year period. The satellite imageries of Landsat-5, Landsat-7, and Landsat-8 were processed for atmospheric and topographic corrections. Based on supervised classification technique, eight classes of land use and land cover were mapped through the classifiers: Maximum likelihood (Maxver), Logistic Regression (RLG), Artificial Neural Networks (RNA), Random Forest (RF) and Support Vector Machine (SVM). The performance of each algorithm was evaluated through the error matrix, specifically the Kappa index. The Z test was used for statistical comparison of Kappas; and change detection was achieved by comparing pixel-by-pixel the best thematic maps of each year. The 2014 maps were validated using an independent dataset of 180 ground points. All classifiers showed Kappa equal or greater than 0.90, which can be qualified as excellent. RF and RLG presented higher performances for the three dates, especially the RF classifier that showed Kappa of 0.95, 0.94 and 0.92 for 1986, 2000 and 2014, respectively. The RF outperformed the others by showing a statistically significant difference ($p<5\%$). In the external validation of the 2014 map, a statistically significant difference was confirmed between RF and the classifiers Maxver, RLG and SVM. A change detection analysis through the RF maps showed the period 1986-2000 to be the most affected by the changes in urban area (146.5%), bare soil (90.1%), shrub (-35.8%) and forest (-18.6%). For the period 2000-2014, deep alterations were observed in agriculture areas (79.1%), shrub (63.1%) and forest (-52.5%). Areas of waterbody increased from 5.1% in the first period to 16% in the second. The most rapid changes in the first period corresponded to the urban settlement and bare soil, whose change rates were 10.5% and 6.4% per year, respectively. In the second one, the annual changes with the highest rates were recorded for agriculture areas (5.7%), shrub (4.5%) and forest (-3.8%). The changes detected in the land use and land cover during the 28-year period have been greatly accelerated, driven by political and economic factors, which have been identified as the main determinants in increasing the land degradation in the region.

Keywords: Remote Sensing; Supervised classification; change detection; Land use.
Financial support: Support to agricultural research and development program (SARD Project), AID-OAA-A-15-00039

(8492 - 766) Mechanical soil properties in long-term, no-till, integrated crop-livestock system.

Jordano Vaz Ambus[1]; José Miguel Rechert[1]; Paulo César de Faccio Carvalho[2]
Federal University of Santa Maria[1]; Federal University of Rio Grande do Sul[2]

Integrated systems aim to manage land so that different components are integrated to increase environmental diversity and productivity. Integrated Crop-Livestock Systems (ICLS) combine agricultural production with livestock, and in the Brazilian Subtropics are generally characterized by summer crops producing grains, like soybeans (*Glycine max*), corn (*Zea mays*) and rice (*Oryza sativa*), followed by the establishment of pastures with cold-season grasses, such as black oats (*Avena strigosa*) and ryegrass (*Lolium Multiflorum*) intended for animal grazing. If well managed, ICLS can generate several benefits to soil chemical, physical and microbiological properties, but excessive trampling leads soil structure deformation by the pressure of animal's hooves that increases soil bulk density mainly in surface soil layers, with impediment to roots development. Soil compaction is commonly evaluated by means of compressibility tests; however, to evaluate the effects on soil structure caused by trampling of animals, the dynamism with which this process occurs in the field must be taken into account. In this study we performed uniaxial compressibility test, along with cyclic soil compressibility where the sample is subjected to loading/unloading cycles generating an effect similar to animal trampling. The treatments consisted of different grazing intensities determined by sward height, namely: 0.10 *m*, 0.30 *m*, and an area without grazing, in an experimental design of randomized blocks with three replications. Undisturbed soil samples were collected in core samplers in the 0-0.05, 0.05-0.10, and 0.10-0.20 *m* soil layers at the end of soybeans and pasture cycle. The samples were submitted to uniaxial compression at 12.5, 25, 50, 100, 200, 400 and 800 *kPa* and cyclic loading at 200 *kPa* in automatic consolidometer, for determination precompression stress, compressibility coefficient, decompression coefficient, and cyclic compressibility index. The greatest impact of animal trampling is on the topsoil, and without grazing areas the structural quality of the soil is preserved. The soil maintains its structural resistance even after moderate trampling. Cyclic compressibility showed the greatest damage to soil structure is caused in the first loading/unloading cycles, that is, at the beginning of the grazing cycle.

Keywords: Integrated system; animal trampling; soil structure.
Financial support: CAPES and CNPq.

(2731 - 673) Microbial biomass of a subtropical soil as affected by crop residue quality in long-term no-till cropping systems

Cristhian Hernandez Gamboa[1]; Cimélio Bayer[1]
Universidade Federal do Rio Grande do Sul, Departamento de Solos, Programa de Pós-Graduação em Ciência do Solo, Av. Bento Gonçalves, 7712 , 91540-000 Porto Alegre, RS- Brasil[1]

The quality of the residue left as cover in crop rotation systems influences the soil microbial populations. Increases in microbial biomass are more related to residues of nitrogen-rich labile coverages such as legumes (L) than with more lignified residues such as those produced by grasses (G). The objective was to evaluate soil microbial biomass in four crop systems under no-tillage with different qualities of the vegetal residue added to the soil, in a 35-year experiment at the experimental station of UFRGS in Rio Grande do Sul Brazil. The crop

systems were: low quality (oat/maize, G/G), medium quality (oats-vetch/maize, GL/G) and high quality (oats-vetch/maize- cowpea GL/GL). As reference, the soil was collected also in soil with no crop – bare soil under no-till (BS). At the beginning of spring 2017, soil was collected in the 0-5 cm layer and microbial biomass was quantified by substrate-induced respiration (glucose). 30 g of soil with glucose were incubated for 3 hours at 22 °C in closed containers glass, the CO_2 was collected in polypropylene syringes and analyzed by gas chromatography. The microbial biomass was determined by converting the CO_2 flux (mg CO_2.kg^{-1}.h^{-1}) in mg C-mic kg^{-1} according to equation [40.04*(CO_2 flux)+0.37] proposed by the methodology. The microbial biomass of the soil increased following the order of the levels BS <low <medium <high residue quality. There was a 27% increase between the no crop – bare soil BS and the high quality of the residue. In comparison with the crop system low quality (G/G), the culture system with residues that included legumes in the winter (G-L/G) increased microbial biomass by 9%, and 14% in the crop system that had legumes both in winter and summer (G-L/G-L). The impact of no-till with higher-quality residue cropping systems on soil microbial will have influence on important biological and physical processes and improving soil quality.

Keywords: cover crops; legumes; crop rotation
Financial support: Conselho Nacional de Desenvolvimento Científico e Tecnológico CNPq – Brasil

(5208 - 2680) No tillage and other soil and water conservation practices in Paraná State

Tiago Santos Telles[1]; Bruno Volsi[2]; Gustavo Vaz da Costa[2]; Ana Julia Righetto[1]
Instituto Agronômico do Paraná[1]; Universidade Estadual de Londrina[2]

No-tillage is an important conservationist practice, but to be considered a quality production system it must be associated with crop rotation and other soil and water conservation practices, such as contour farming and the use of agricultural terraces. Therefore, the aim of this study was to verify which Paraná State farms realize no-tillage, in addition to other soil and water conservationist practice. For this work, it was used data of the Agricultural Census 2006, from "Instituto Brasileiro de Geografia e Estatística (IBGE)". The information used refers only to the areas of temporary crops, of the agricultural farms with no-tillage in Paraná - that correspond to 50% of the total. For each city of Paraná State, were recorded the farms that employing no-tillage together with crop rotation, contour farming and agricultural terraces. To determine the more or less conservationist cities, that is, the ones that adopt no-tillage with other conservationist practices, it was performed principal component analysis (PCA). In addition, to identify the similarities between the farms, in relation to the conservation standard, a cluster analysis was made, using Ward's minimum variance method. It was verified that 14.70% of the agricultural farms use no-till associated with three other conservation practices, 25.17% with two practices, 57.07% use with one practice and 3.06% no practice associated. These observations suggest that 39.87% of agricultural farms use no-tillage associated with two or more conservation practices and 60.13% of the farms use no-tillage with only one or no conservationist practice. In addition, it is worth mentioning that of the farms with no-tillage that carry out two practices, 15.81% do crop rotation and contour farming, 7.14% use contour farming and agricultural terraces and 2.21% crop rotation and terraces agricultural activities. Among those who only do one practice, 30.66% only carry out contour farming, 21.72% crop rotation and 4.69% use the agricultural terraces. From the PCA, two components were identified, which explained almost 83% of the variability of the data. Using cluster analysis, 4 groups were identified, which indicated a heterogeneity in relation to the soil and water conservation pattern in Paraná. In order to no-tillage in Paraná be considered as quality, agricultural farms still need to make further use of other soil and water conservationist practice, especially in regions where soils are fragile.

Keywords: Terraces; contour farming; crop rotation.
Financial support: CNPq

(8320 - 3170) No-tillage as a conservation system

Kátia Luciene Maltoni[1]; William Dubbin[2]
Unesp/Campus de Ilha Solteira[1]; Natural History Museum - London[2]

The conversion of native vegetation (NV) to agricultural systems reduces soil organic matter (OM). The adoption of conservation management could maintain or improve the OM content, and thus improve fertility, reduce density (BD), increase porosity (TP), etc. The aim of this study was to evaluate the improvements in OM, BD, aggregates > 2000 µm, of two different fields, of 10 and 20 years of no-tillage, compared to natural vegetation soil (Cerrado). Undisturbed soil samples (0.0-0.05; 0.05-0.10; and 0.10-0.20 m depth) were collected from Brazil, Central Region, municipality of Selvíria (MS). The soils, Oxisols from Cerrado, were collected from a Natural Vegetation field (NV), and from fields that had been under conventional tillage since 1970s, and 10 and 20 years ago were changed to no-tillage system (NT10; NT20 respectively). The undisturbed samples were sieved (4mm) and the aggregates retained were further fractionated by wet sieving through five sieves (2000, 1000, 500, 250, and 53 µm) with the aggregates distribution expressed as percentage retained by each sieve. The OM, BD, TP, macro and microporosity were also determined. The OM varied among treatments (32.5 g dm^{-3} $Cer_{(a*)}$, 22 g dm^{-3} $NT20_{(b)}$, and 16.4 g dm^{-3} $NT10_{(c)}$), at the depth of 0-0.05 m. The BD varied in depth, from 0.0 to 0.05 m: $1.03_{(a)}$, $1.28_{(b)}$, and $1.29_{(b)}$ g cm^{-3}; from 0.05 to 0.10 m: $1.13_{(a)}$, $1.21_{(a)}$, and $1.41_{(b)}$ g cm^{-3}; and from 0.10 to 0.20 m: $1.21_{(a)}$, $1.29_{(a)}$, and $1.43_{(b)}$ g cm^{-3}, for Cer, NT 10 and NT 20, respectively, for each depth. This results shows that soil under NT system, after 20 years of implantation, has high BD, with values that can restrict productivity, and NT 10 presents the same tendency, with lower values. The macropores of Cer ($26\%_{(a)}$) presented higher values than those observed for NT10 ($22\%_{(b)}$) and NT20 ($14\%_{(c)}$), behavior maintained in the first 0.20 m of soil, corroborating the data of BD and indicating the occurrence of soil compaction due management system. Total porosity is similar between Cer (51%) and NT20 (52%), but does not represent the NT20 soil behavior. The larger amount of aggregates for Cer (88%); NT20 (68%) and NT10 (67%) was identified at >2000 µm, suggesting that for Cer the least occurrence of ruptures of larger aggregates, associating these with OM. *statistical analysis, the same letters meaning no statistical differences>2000 m

Keywords: aggregates, Oxisols, Cerrado,
Financial support: CNPq

(1551 - 661) Organic phosphorus fractions in an Oxisol cultivated with sugarcane under green-harvested management

Benedito Luiz CORREIA[1]; John KOVAR[2]; Michael THOMPSON[3]; Luís Reynaldo Ferracciú ALLEONI[4]
Universidade Federal Rural de Pernambuco (UFRPE), Colégio Agrícola Dom Agostinho Ikas (CODAI)[1]; National Laboratory for Agriculture and Environment[2]; Iowa State University[3]; Universidade de São Paulo (USP), Escola Superior de Agricultura Luiz de Queiroz (ESALQ)[4]

Conservative tillage systems favor the accumulation of organic phosphorus (P_o) in highly weathered soils. Thus P_o may constitute an important source of P for crops. The dynamics of P_o may be assessed by means of the fractionation or sequential extraction technique. This

study aimed to evaluate changes in the forms of P_O from samples of an Oxisol collected in Pradópolis, state of São Paulo, Brazil, cultivated for 14 years with sugarcane harvested without burning. Soil samples were collected in areas with sugarcane harvested with (CQ) and without burning (SQ), in the planting row and in the interrow, at 0-0.05 m, 0.05-0.1 m, and 0.1-0.2 m-layers, and in an adjacent forest (VN). Soil samples were kept under refrigeration until the analytical procedures. The following P_O fractions were evaluated: labile, biomass P_O (P_O bound to microbial biomass), moderately labile P_O, fulvic P_O (P_O bound to fulvic acid), humic P_O (P_O linked to humic acid) and residual or nonlabile P_O. Soil samples from the 0-0.05 m layer had higher contents of P_O biomass in CQ than those from SQ, probably due to the increased microbial activity favored by available inorganic P contained in the ash of burned sugarcane. Soil samples from the SQ system had higher values of moderately labile P_O in the 0.05-0.1 m-layer than in samples from CQ. At 0.1-0.2 m-layer, values of all P_O fractions were higher in SQ than in CQ harvesting system, except for the non labile P_O fraction, in which CQ was higher than SQ. There was no effect of soil sampling position (row and interrow) in the values of P_O fractions of samples from both SQ and CQ systems. The percentage distribution of the fractions had the following order: non-labile P_O > P_O fulvic > P_O humic > labile P_O > P_O biomass > P_O moderately labile, for VN, SQ and CQ systems. In the layer 0.1-0.2 m, soil samples under the non-burned crop had accumulated higher levels of P_O in the labile, biomass, moderately labile, fulvic and humic acids fractions.

Keywords: Sugarcane; Burning harvest; Green harvest; Organic P fractionation;
Financial support: CNPQ

(3604 - 3180) Phosphorus and organic matter contents as a function of rotation crops and cover crops under no-tillage system in the Cerrado

Edson Lazarini[1]; Raul Sobrinho Pivetta[2]; João William Bossolani[2]; Luiz Gustavo Moretti de Souza[2]; Lucas Fenelon Parra[2]; Fabiana Lopes dos Santos[2]; Izabela Rodrigues Sanches[2]
1Faculdade de Engenharia/UNESP – Campus de Ilha Solteira, Av. Brasil 56, Ilha Solteira - SP, 15385-000, Brazil (lazarini@agr.feis.unesp.br)[1]; Faculdade de Engenharia/UNESP[2]

In the Brazilian Cerrado, soybean and maize predominate, therefore, there is a low diversity of cultivated species. Currently, it has been in the no – tillage system is the most used in this region. Thus the present study was to evaluate phosphorus and organic matter contents in the soil as a function of monoculture corn or rotated with soybean in the summer and the use of cover crops in the spring, under no-tillage conditions. The experiment started in October 1999. Rotation involved corn and soybean crops and monoculture, only maize crop. Cover crops sown in the spring were: *Crotalaria spectabilis*, *Pennisetum glaucum*, *Crotalaria juncea* and *Panicum miliaceum*, and in addition to a fallow area. The levels of phosphorus (P) and organic matter (OM) of the soil in the layers of 0.00-0.10 and 0.10-0.20m, 15 years after the introduction of the no – tillage system, were evaluated in October/2015. Crop rotation and cover crops provide benefits to soil fertility. For the 0.00-0.10 m layer, in the rotated system or monoculture, the cover plants provided higher levels of phosphorus in the soil when compared to fallow area. In the 0.10 - 0.20 m layer, the phosphorus content did not change as a function of cover crops, however, in the rotational system, the highest levels were obtained in the plots with *C. spectabilis* (25.1 mg dm^{-3}) and *Pennisetum glaucum* (26.0 mg dm^{-3}). The organic matter contents of the soil in the 0.00-0.10 m layer did not increase as a function of cover crops, regardless of the cropping system. In the fallow area (13.6 g dm^{-3}), *Pennisetum glaucum* (14.4 g dm^{-3}) and *Panicum miliaceum* (14.3 g dm^{-3}), the organic matter content was higher when the cultivation system was rotated. In the 0.10-0.20m soil layer, the cropping system and cover crops did not influence the organic matter content of the soil.

Keywords: No – Tillage System, Crop Rotation, *Zea mays*, *Glycine max*
Financial support: Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES)

(3268 - 1374) Phosphorus fractions in chronosequence of crops under no-tillage system in the eastern Amazon

Rubia Carla Ribeiro Dantas[1]; Letícia Cunha da Hungria[1]; Sidney Daniel Araújo da Costa[1]; Edilson Carvalho Brasil[2]; Mario Lopes da Silva Jurnior[1]
Universidade Federal Rural da Amazônia[1]; Embrapa Amazônia Oriental[2]

The no-tillage (NT) system promotes the increase in the availability of P in the the surface layer of the soil, which may result in greater transformation of the inorganic P into organic fractions of P of different availability. The objective of this work was to evaluate the preferential fractions of P accumulation in a chronosequence of NT crops in the Eastern Amazon. The study was conducted in the municipality of Paragominas, southeast of Paraense, in an area under chronosequence of NT crops, using a completely randomized experimental design, in subdivided plots. The plots were constituted by the management systems: NT with 9 (NT), 11 (NTP11), 13 (NT13), 14 (NT) and 15 (NT15) years of adoption, plus one area under conventional tillage (CT) and one with native forest (NF); the subplots corresponded to depths (0-10, 10-20, 20-30 and 30-40 cm). Soil management systems presented differential P accumulation capacity. In areas under NT, the P is accumulated in the surface layer and drastically reduced with depth, while in CT this reduction is less pronounced. Up until to 20 cm depth, there was an increase in the labile P content (fraction available for biomass), in function of the time of adoption of NT, whose average values went equivalent to 51; 65; 75; 71 and 85 mg kg^{-1}, respectively, for NT9, NT11, NT13, NT14 and NT15, which were significantly highest than CT and NF. Moderately labile P also showed significant increases with the time of NT adoption, with values ranging from 31 mg kg^{-1} in NF to 242 mg kg^{-1} in SPD15. Regardless of the management system, the non-labile fraction of P was preferentially accumulated in the soil, not being verified difference between the evaluated systems, which suggests the high adsorption capacity of this soil. In the 0-10 cm layer, the total P (obtained by the sum of the fractions) presented significantly higher levels in NT15 (2882 mg kg^{-1}), compared to CT (848 mg kg^{-1}). The management systems were not able to change the P fractions in deeper layers of the soil, 30-40 cm, emphasizing that the Brazilian soils, especially the Latosol, are strong drains of P and their mobility is almost null.

Keywords: P lability, management systems, phosphorus lability
Financial support: Embrapa Amazônia Oriental

(3008 - 2437) Productivity of corn and soybean in iLPF or PD systems with organic or mineral fertilization

Luciane Cristina Lazzarin[1]; Paulo Hentz[2]; Juliano Corulli Corrêa[3]
UNESP[1]; Instituto Federal Catarinense[2]; Embrapa Suínos e Aves[3]

The practice of fertilization with organic fertilizers promotes productivity gains equal to or greater than mineral fertilizer when carried out for long years. The objective of this work was to evaluate the response of fertilization with poultry litter, swine manure and mineral fertilizers in relation to maize and soybean yields in the 2015/16 and 2016/2017 crops in the iLPF or PD system. The

experiment was set up in a randomized block design in subdivided plots, with three replications, and the plots were set up two conservationist systems of production (Direct Planting - PD and Integration of Plow - Livestock - Forest) and in the sub - plot three sources of fertilizers organic poultry litter or swine manure, a mineral) and control without fertilization. Summer crops with maize were sown in the 2015/16 and soybean 2016/17 crops for yield assessment. Fertilization with different fertilizer sources in a crop-livestock-forest integration system can bring benefits to the system, because it allows similar or higher yields to mineral fertilizers, in addition to contribute to aspects of soil quality improvement.

Keywords: Index terms: Poultry bed, swine manure, mineral fertilizer.
Financial support:

(6331 - 3123) Quality and quantity of crop residues: effects on nitrous oxide emissions.

Raquel Schmatz[1]; Sylvie Recous[2]; Lineu Trindade Leal[1]; João Henrique Fontana[1]; Emanuel Leonardi[1]; Mathias Roberto Leite Rambo[1]; Sandro José Giacomini[1]
Federal University of Santa Maria[1]; Institut National Recherche Agronomique[2]

Nitrous oxide (N_2O) is a potent greenhouse gas naturally produced in agricultural soils by nitrification and denitrification process. Crop residues may affect N_2O emissions directly (e.g., substrate supply) and indirectly (e.g., influence on moisture and soil temperature), and the magnitude of emissions, depending on the quality and quantity of residues added to soil. The experiment was carried out for 360 days in a Typic Paluedalf, at University Federal of Santa Maria, Rio Grande do Sul, Brazil. The experiment was laid out as a randomized complete block design replicate four times. The treatments were composed of vetch (3.5% N and 53% soluble fraction) and wheat (0.5% N and 16% soluble fraction) crop residues in amounts equivalent to 3, 6 and 9 Mg ha^{-1} of dry matter, and a treatment with no residues (control). N_2O fluxes were periodically measured using closed static chambers and N_2O concentrations in the samples were analyzed by gas chromatography. The N_2O emission factor (EF) were calculed by IPCC (2006). Six a priori contrasts were performed to assess differences among treatments. Crop residues addition to soil increased N_2O fluxes, especially after rainfalls events, independently of the quantities of crop residues added. The highest N_2O fluxes occurred in the first 50 days after the residues addition to soil and in treatments with vetch residues (3 g N m^{-2} h^{-1}). After 50 days, N_2O emissions reduced to levels close to baseline, even after rainfall events. Contrast analysis indicated that cumulative N_2O were two times higher in vetch than wheat (4.05 *vs*. 1.91 g N ha^{-1}). In contrast, the EF was higher for the wheat than vetch residues (4.81% vs 1.81%). For the two residues, the emission factor exceed the value of 1% suggested by the IPCC (2006). The quantity of residues affected cumulative N_2O emissions only for vetch, increasing linearly N_2O emission until the quantity of 6 Mg ha^{-1}. The highest emission with vetch residues is due to high N (low C: N ratio) and soluble fraction content in these residues, which are readily available C and N source to microorganisms. In addition, higher decomposition rates of vetch residues increased soil inorganic N, another key factor for N_2O production. Thus, our results suggest that residues from cover crops such as vetch contribute more to N_2O emission than residues from crops harvested at maturity such as wheat; the effect of quantity of crop residues added to soil on N_2O emissions is related to residues quality.

Keywords: decomposition; C:N ratio; greenhouse emissions.
Financial support: This work was supported by the Brazilian government through the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) and Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq)

(8848 - 2782) Resistance to soil compaction of an Acrisol under different soil management systems

Wellingthon da Silva Guimarães Júnnyor[1]; Isabella Clerici De Maria[2]; Cezar Francisco Araujo Junior[3]; Etienne Diserens[4]; Camila Vieira Viana Farhate[5]; Zigomar Menezes de Souza[5]
Instituto Agronômico (IAC), Campinas, São Paulo – Brasil (wellingthon.agro@gmail.com)[1]; Instituto Agronômico (IAC), Campinas, São Paulo – Brasil[2]; Instituto Agronômico do Paraná (IAPAR), Londrina, Paraná– Brasil[3]; Agroscope Reckenholz - Tänikon ART Research Station, Ettenhausen - Switzerland[4]; Faculdade de Engenharia Agrícola, UNICAMP (FEAGRI), Campinas, SP – Brasil[5]

The intense traffic of agricultural machinery in the course of harvest has been responsible for the increase of soil compaction in sugarcane agrosystems. This study evaluated the influence of management systems on soil resistance to compaction caused by the machines used to harvest sugarcane. Three soil management systems were evaluated: no-tillage with peanut (PNT); no-tillage with sorghum (SNT) and conventional tillage without cover crop (CT), in an Acrisol, clay loam texture, in RBD experimental design, with three replicates. Undisturbed samples were collected from the center of the traffic line, in the depth of 0.10-0.13 m. The samples were equilibrated in four water contents and submitted to the uniaxial compression test. The preconsolidation pressure (σp) values were adjusted as a function of the volumetric moisture content, to produce load bearing capacity models (LBCM), which were compared by the homogeneity test. The maximum vertical stresses applied to the soil by each wheel of the machines, a sugarcane harvester John Deere 3520, a trailer ATA 10.500 and a tractor Valtra BH 180, were estimated. In general, the degradation of the soil structure due to the effect of the machinery wheel in the traffic line followed the order: peanut no-tillage < sorghum no-tillage < conventional tillage. The LBCM suggest that, if sugarcane harvesting is executed with soil moisture near to field capacity (0.23 m^3 m^{-3}), additional compaction will occur in all management systems. The σp in soil field capacity was 236, 138 and 52 kPa, respectively, for CT, SNT, PNT. The trailer loaded with sugarcane exerts a vertical stress of 272 kPa on the soil and may cause additional compaction on PNT and SNT, for volumetric moistures content > 0.11 m^3 m^{-3}. This machine can also cause additional compaction on CT, even though this management system has the highest resistance to soil compaction. The maximum vertical stress applied by the harvester (94 kPa) can cause additional compaction only for PNT, under soil volumetric moisture content greater than 0.16 m^3 m^{-3}. In CT, after soil tillage operation with a disc harrow, the soil remains unprotected, as any cover crop was sown and there is direct contact of the wheels with the soil. Then this can promote increases of the LBC in the depth of 0.10 -0.13 m. The cover crops has an influence on the load bearing capacity model. The PNT system presents the lowest LBC, which makes this management system more susceptible to soil compaction.

Keywords: No-tillage, vertical stress, cover crop, preconsolidation pressure.
Financial support: Grant #2014/07434-9, São Paulo Research Foundation (FAPESP) and Coordination for the Improvement of Higher Education Personnel (CAPES).

(9822 - 1387) Soil and sugarcane yield response to tillage management in southern Brazil

Ricardo de Oliveira Bordonal[1]; Leandro Carneiro Barbosa[2]; Henrique

Coutinho Junqueira Franco[1]; João Luís Nunes Carvalho[1]
CTBE/CNPEM – Brazilian Bioethanol Science and Technology Laboratory, National Center for Research in Energy and Materials[1]; FEAGRI/UNICAMP – Faculty of Agricultural Engineering, University of Campinas[2]

Soil organic carbon (SOC) is of primary importance for maintaining soil functions, and agricultural management practices may significantly influence physical properties, SOC and crop yields. Importantly, in a scenario with straw removal for bioenergy production, the adoption of no-tillage during sugarcane crop renovation could be an opportunity to offset possible adverse effects on soil quality and crop yields. A field experiment was carried out in an Oxisol (sandy soil) located in Quatá-SP (22º14'S–50º42'W), southern Brazil, to assess the effects of no-till (NT) on selected physical properties, soil C stocks and sugarcane yields in relation to conventional tillage (CT) on a short-term basis (three crop cycles). Trials were established in a randomized block design with four replications and two management systems: CT and NT. Disturbed and undisturbed soil samples were collected for determination of SOC content, soil bulk density (BD), total porosity (TP) and soil resistance to root penetration (PR), and stalk yields were accounted through an instrumented truck equipped with a loading cell. The short-term effects of adopting NT during sugarcane crop renovation showed evidences of higher SOC content to a depth of up to 40 cm, with significant differences in the upper layer of soil (Tukey's test, p<0.05). Although not statistically significant in deep sub-soil layer (0-100 cm), a transition from CT to NT significantly increased soil C stocks at a rate of 0.5 Mg ha^{-1} yr^{-1} in the 0-40 cm layer (p<0.05). The data also showed significant differences in soil physical attributes for both treatments over three years (p<0.05), with reductions in TP and increases in BD and PR. Differences between treatments on physical attributes occurred only in the first crop cycle (p<0.05), in which NT presented higher PR compared to CT. Regarding the impact of tillage management on stalk yields, there was no difference between CT and NT in terms of biomass production. These results suggest that additional long-term studies should be encouraged to fully understand the potential of conservationist management practices coupled with controlled traffic as a key strategy for improving soil physical quality and increasing cane yields. Our findings support the conclusion that NT increased C stock, while the degradation of soil physical quality occurred for both treatments over the assessed period, especially because of intense machinery traffic during sugarcane crop management.

Keywords: *Saccharum* spp., soil quality, physical attributes, soil carbon, soil management, no-till
Financial support: Sugarcane Renewable Electricity project – SUCRE/PNUD (grant number BRA/10/G31), the National Council for Scientific and Technological Development – CNPq (grant 150160/2016-0) and Sao Paulo Research Foundation (FAPESP)

(8015 - 2288) Soil structural properties under addition of crop residues and limestone

Jorge Lemainski[1]; José Eloir Denardin[2]; Guilherme Kangussú Donagemma[3]
Embrapa Trigo, Rodovia BR 285, km 294, Caixa Postal 3081, CEP 99050-970 Passo Fundo, RS, Brasil. E-mail: jorge.lemainski@embrapa.br[1]; Embrapa Trigo. E-mail: jose.denardin@embrapa.br.[2]; Embrapa Solos, Rua Jardim Botânico, 1024, Jardim Botânico, CEP 22460-000 Rio de Janeiro, RJ, Brazil. E-mail: guilherme.donagemma@embrapa.br[3]

Soil structure depends on physical, chemical, and biological factors. The interaction of these factors is a result of quantity and quality of residues and other inputs added to the soil, as well as their physicochemical conditions. Liming is an essential management practice in acid soils. When in excess, liming alters the electrolytic solution of the soil with impacts on its structure. In this sense, negative charges increase with pH, reducing the attraction between clay particles and resulting in increased clay dispersion and soil aggregate destabilization. In Brazil, Oxisols under no-till management system with biomass production lower than 12 ton/ha/year, the concentration of limestone in the uppermost soil layer aggravates these effects. The readily dispersed soil clay increases the concentration potential in the percolated water through soil profile, resulting in clay deposits into soil pores, and, consequently, changes pore size and continuity. These processes decrease soil permeability to water and air, and increase soil density in subsurface layer, soil penetration resistance, and soil susceptibility to erosion. The results of a study carried out in an Oxisol, located at subtropical region of Brazil confirm these statements. Liming at the soil surface or the incorporation of limestone in the topsoil layer of 0–5 cm depth increased soil pH to values higher than 7.0 and the electronegative potential of the surface of soil colloids, enhancing clay dispersion in topsoil layer. The migration of the clay through soil profile altered soil structure in subsurface layer, obstructing soil pores, reducing pore continuity, and increasing soil density and soil penetration resistance. In another study, in the same soil, associating liming on the soil surface or the incorporation of limestone in the layer 0-15 cm deep, soybean monocropping under no-till (production of crop residues lower than 4 ton/ha/year) or crop diversification with two or more harvests per year under no-till system (production of crop residues higher than 12 ton/ha/year), clay dispersion increased only with soybean monocropping. Conversely, in crop diversification with two or more crops per year, the high stability of soil aggregates avoided clay dispersion. Thus, liming, that is essential to acid soil management under no-till, should always be associated to production models that produce crop residues in amount, quality, and frequency, in order to maintain the stability of their aggregates.

Keywords: oxisol; clay dispersion; soil pH; production model; no-till
Financial support:

(2300 - 2101) Structural changes of dystrophic yellow latosol in the function of the adoption of the direct plantation system

Jéssica Rodrigues Dalazen[1]; Renan Garcia Malikouski[1]; Andréia Lopes de Morais[1]; Carla da Penha Simon[1]; Kamila Cabral Mielke[1]; Elcio das Graça Lacerda[2]
Universidade federal do Espírito Santo[1]; Instituto Federal de Educação, Ciência e Tecnologia do Espírito Santo[2]

Soil compaction is one of the main problems encountered in conventional agriculture because it affects the physical quality of the soil, hindering the root development of the plants. This effect is enhanced by the intense traffic of agricultural machinery. With the use of no-tillage, soil compaction and density are less intense due to the reduction of machine traffic, without the soil preparation steps required in the conventional method. In this way, the objective of this work was to evaluate the compaction and density history of a clayey eutrophic Yellow Latosol soil, during the implantation of the no-tillage system in the bean crop. This study was developed at IFES Campus Santa Teresa, state of Espírito Santo, in the period of August 2014 and July 2015, in a sample mesh of 3 x 10, measuring 20 x 20m each, totaling 12 data collection points all georeferenced through the demarcation of latitude and longitude with the aid of GPS. Initially, the planting of melga (sorghum spp.) was carried out in order to form the vegetative cover on the soil, after the sowing of the bean (phaseolus vulgaris L.) variety Ouro Vermelho, under the central pivot system. Three soil physical characterization analyzes were carried out, one prior to the planting of the melga, another after the development of the same, and the last one in the development stage of the bean crop. The parameters of density and resistance to penetration (at 12 points) at different depths (0.0 - 0.20 and 0.20 - 0.40 m) were evaluated. It

was observed by the average values of density that the layer of 0.20 – 0.40 m has a higher density, consequently the level of compaction of the same one is higher due to the greater amount of particles of the soil in a certain volume, thus presenting a smaller porosity. This is due, in fact, to sequential years of conventional cultivation, and by not decompressing the deeper layers. For the resistance to penetration there was a decrease in the values of the first to the second evaluation, such phenomenon could have occurred due to the activity of the root system of the melga, which, when growing in search of water and nutrients, promoted a soil particles rotation. In the third sampling, an increase in soil resistance to penetration was observed. This value can be explained by soil moisture, where the larger the amount of water present, the easier it will be to move the soil particles. Soil density and resistance to soil penetration decreased with no-till practice.

Keywords: Physical impediment; density of soil; resistance to penetration.
Financial support: Instituto Federal de Educação, Ciência e Tecnologia do Espírito Santo - campus Santa Tereza.

(7967 - 1505) Sustainable alternative to increase organic matter in soil profile

Miguel Ángel Martínez-Gamiño[1]; Martín Espínosa Ramírez[1]
INIFAP[1]

Traditional soil tillage for sowing agricultural crops in the plateau of San Luis Potosi, Mexico, is performed with a fallow and one or two harrowing steps. These practices destroy soil structure, invert its profile, dilute and accelerate the oxidation of organic matter, increase runoff, and promote compaction. In addition, crop residues are removed almost entirety to use as fodder and the free grazing after harvesting reduces the amount of plant leftovers that reincorporates into the soil. Conservation agriculture is a technique where soil is not removed, crop residues are left on the surface, crops are rotated, and roots are accumulated in the soil profile. The Lima-Paris Action Plan on climate change and global warming, calls for alternatives to increase organic matter by 0.4%, to ensure food production of a world population that by 2050 will reach 9 billion. The objective of this study was to evaluate the effect of conservation agriculture on the accumulation of organic matter, due to crop roots, in the soil profile. This study was conducted in the Experimental Station San Luis, located in Palma de la Cruz, Soledad de Graciano Sánchez, S.L.P., Mexico, in a field experimental plot that began in 1995 with different soil tillage methods and an irrigated corn-oat rotation. In 2017, dry weight of corn and oat roots was evaluated in the tillage treatments of fallow plus harrow (F+H) and conservation agriculture (CA). Three random samples were taken per treatment in two replications. Roots were washed and dried at 40 °C. Data were analyzed by a randomized block analysis with three replications. Statistical analysis of corn root dry weight reported differences ($p < 0.05$) favorable to CA with a value of 10,297 t/ha and 3.39 t/ha in F+H. The same analysis for oat showed also statistical differences ($p < 0.05$) in the dry weight of roots, favorable to the treatment of CA, with 3.4 t/ha against 1.2 t/ha of F+H. The total dry matter per year that is left in the profile of the soil product of the sum of roots of corn and oats indicated that CA recorded 13.697 t/ha while with F+H was 4.59 t/ha. The contribution of organic matter based on the volume of soil at a depth of 0.3 m was 0.109% with F+H and 1.57% with AC. The rotation of corn-oats with CA is a sustainable alternative to increase the organic matter in the soil profile and maintain and improve soil fertility.

Keywords: Roots; corn; oat; conservation agriculture.
Financial support: INIFAP, CIMMYT.

(8266 - 1897) Total Carbon Stock of Soil unde Cover Crops and Nitrogen Fertilization

Leandro Alves Freitas[1]; Paulo Cesar Conceição[1]; Márcia Kochem[1]; Weslei Sbalcheiro[1]; Dieyson Fernando Peruzzolo[1]; Felipe Lunardelli Sandrin[1]; Larisa Ianca Vagner Schaedler[1]
Universidade Federal Tecnológica do Paraná[1]

Carbon plays multiple roles in the soil, as well as being used as an indicator of the sustainability of agricultural systems. Thus, the soil organic carbon stocks was quantified on cover crops, with or without nitrogen fertilization, in an experiment conducted since 2010 in the experimental area of the University of Technology Federal Parana (UTFPR), Campus Dois Vizinhos, under a Red Latosol. The experimental design was a randomized complete block design in a factorial scheme (8x2), with three replications, that is, seven summer cover crops and one fallow areas, with or without the application subplots of mineral N (0 and 180 kg ha -1) in corn cover crop . The C content was evaluated by wet combustion and the total soil carbon stocks calculated based on soil density at depth of 0.00-0.40m. There was a significant difference in the interaction between the cover crops and nitrogen fertilization. The contrast in carbon stocks at depth (0.00-0.40 m) were the bitter only for Crotalária spectabilis, Guandu dwarf and Mucuna gray when not used nitrogen fertilization, respectively (117.69 Mg ha $^{-1}$; 143.79 Mg ha $^{-1}$; 138.1 Mg ha $^{-1}$). It is interesting to note that the treatment with Mucuna gray without nitrogen fertilization obtained a soil carbon content of 30.5% more than the treatment with the use of nitrogen fertilization. Possibly these values are related to the decomposition characteristics of the species in question, together with the smaller amount of decomposing organisms in the soil. Additional, possibly the plots with cover crops and nitrogen fertilization export more nutrients because was obtained more grain production of maize.

Keywords: cover crops; nitrogen fertilization; carbon stock
Financial support:

(9490 - 1787) Water retention, non-saturated hydraulic conductivity and soil porosity under different preparation systems and cultivation plans

Cícero Ortigara[1]; Lucas Aquino Alves[1]; Henrique Debiasi[2]; Vanderlei Rodrigues da Silva[3]
Universidade Federal do Rio Grande do Sul[1]; Embrapa Soja[2]; Universidade Federal de Santa Maria[3]

The aim of this work was to evaluate the effect of no-tillage system and conventional tillage and different soil cultivation plans in the distribution of pore size and water flow and indicate the use of new methodology to evaluate the porosity continuity in a very clayey Rhodic Eutrudox. The study was carried out in a long-term experiment, implemented in 1993, on a very clayey Rhodic Eutrudox. The experiment presents a 2x3 factorial scheme (soil preparation system *versus* rotation planes), in a randomized block design with four replications. The soil preparation system consists of: I) Conventional tillage system (CT); And II) No-till system (NT). The cultivation plans factor is composed of: I) wheat/soybean (WS) succession; II) rotation lupine/corn-oats/soybean-wheat /soybean-wheat/soybean (ROT) and III) corn + brachiaria/soybean (CS). Soil samples with preserved structure were collected in eight soil layers (0.00-0.05, 0.05-0.10, 0.10-0.20, 0.20-0.30, 0.30- 0.40, 0.40-0.60, 0.60-0.80 and 0.80-1.00 m) for each plot. The available water fraction, hydraulic conductivity of unsaturated soil, frequency and volume of pores and uniformity of distribution of pore classes were obtained from the adjustment of the Van Genuchten model. The no-tillage system (NT), despite having a lower moisture amplitude in the retention curves and water availability in some layers, presented less restrictive layers to the water flow in the soil, and presented better distribution uniformity of larger pores along the profile compared to the conventional tillage system. The cultivation plans influenced the frequency of soil pore classes and the uniformity of distribution of soil pore classes (UDP), the other parameters are less influenced by this factor. The UDP attribute presents potential for the estimation of soil pore continuity.

Keywords: Soil management; Uniformity of distribution of pore classes; Soil compaction
Financial support: Fundação Agrisus - FEALQ; Capes

C3.3.8 - International nitrogen initiative

(2789 - 2017) Assessment of fertilization efficiency in a vineyard at the Maule region, central Chile

Priscila Tapia[1]; Osvaldo Salazar[2]; Ranvir Singh[3]; Helena Ponstein[4]
Programa de Magíster en Manejo de Suelos y Aguas, Universidad de Chile, Casilla 1004, Santiago, Chile (priscila.tapia@ug.uchile.cl)[1]; Departamento de Ingeniería y Suelos, Facultad de Ciencias Agronómicas, Universidad de Chile[2]; School of Agriculture and Environment, Massey University[3]; Deutsches Institut für Nachhaltige Entwicklung e.V.[4]

One of the major problems caused by agriculture nowadays is water pollution which stems from traditional practices such as the excess use of inorganic fertilizers and irrigation water. The main goal of this study is to assess practices and efficiency of the current fertilizer program and its potential improvement in a vineyard located at the Maule Region of Central Chile. A comprehensive field experiment is established to assess effects of different amounts of water and fertilizer applied by fertigation, on grape yield and quality, fertilizer use efficiency, and N-lixiviation in the vineyard (*Vitis vinifera* L). The experiment includes a control treatment, that receives the amount of water and fertilizer supplied on the current management program, the second treatment that receives 75% of both the current irrigation and fertilizer amounts, the third treatment that receives 75% of the current irrigation volume and 85% of the current fertilizer dose, and a fourth treatment that receives 50% of the current irrigation volume and 75% of the current fertilizer dose. The soil $N\text{-}NO_3$ and $N\text{-}NH_4$ concentrations are being monitored three times along the season (October to May), at two soil depth intervals (0-25 cm and 25-50 cm) to compare changes in N accumulated in the soil profile. In addition, soil water samples are being taken fortnightly to measure $N\text{-}NO_3$ and $N\text{-}NH_4$ concentrations at a soil depth of 50 cm in each treatment. At the end of the growing season the grape yield and some quality grape-juice parameters will be measured for each treatment. The soil solution samples started to be taken with the first application of N fertilizer, which was on December 30, 2017, around six weeks after blooming. The initial measurements showed a higher concentration of $N\text{-}NO_3$ in the soil water for the control treatment, with a mean value of 7.23 mg/L, as compared to the other treatments that showed mean values from 1.57 to 3.95 mgL^{-1}. This paper will present a comprehensive analysis of the data being collected for the complete growing season, assessing and making recommendations for optimal N use efficiency for vineyards in the study region.

Keywords: Agriculture, Diffuse pollution, Nitrate, N-lixiviation, N use efficiency
Financial support: This study is supported by the German Institute for Sustainable Development (DINE, Deutsches Institut Nachhaltige Entwicklung e.V.) addressed in Max-Planck-Str. 39. D-74081 Heilbronn, Deutscheland.

C3.3.10 - Beneficial management practices for sustaining soil fertility

(5669 - 2077) Aggregate stability in a Oxisol ustox under different management practices in State of Bahia, Brazil

Paloma Cunha Saraiva[1]; Cácio Luiz Boechat[1]; Adaílton Conceição do Santos[2]; Marcela Rebouças Bomfim[2]; Jorge Antonio Gonzaga Santos[2]
Federal University of Piauí[1]; Federal University of Recôncavo da Bahia[2]

The aggregate stability (AS) affects the erodibility being used as an indicator of the process, besides being a synthetic soil parameter, and it is linked to several factors, such as organic matter content, bulk density, porosity, pH, texture, mineralogy and crop. The aim of this study was to evaluate the influence of different soil management practices on AS in a semiarid region. Treatments were: AL10 – Area with 10-year old orange trees, hand weeding under the canopy and management of weeds between rows, receives annual fertilizer correction and, acidity is corrected by liming, which was done only at planting; AFMA - Consortium (two years tobacco, one cassava and one year peanuts). Conventionally tilled with a disk harrow and disk arrow and fertilized when tobacco is planted with correction of the soil pH; AL30 - Area with thirty-year old orange trees, hand weeding under the canopy and between the lines without any management of weeds. The area receives fertilizer maintenance, and this was only done after planting in conventional tillage with a harrow pass, followed by liming and incorporation, and AFA - Consortium (tobacco for two years, followed by peanuts). Conventional tillage with disk harrow. Thus, 25 g of the selected aggregates were air-dried, the weight was corrected to oven-dry weight and then pre-moistened by spraying with distilled water. The separation of the size of aggregates as well as their stability was determined in three replicates and, consisted of the diameter classes of >2.00, < 2.00 < 1.00 < 0.50 < 0.25 < 0.05 and <0.053 mm, vertically agitated for 4 minutes in a container with water. The AS was expressed as the percentage of stable aggregates (PAE). In the 0-10 and 10-20 cm layer, AL10 and AL30 showed a higher PAE. The relationship with the perennial crop and soil tillage is not followed in the 0-10 cm layer of the AFMA and the AFA layer 10-20 cm. In the 0-20 cm layer the proportion of aggregates larger than 0.50 mm were between 53.4 (AL30) to 68.7% (AFA). Therefore, in the 10-20 cm layer, the ratios were between 59.1 (AL10) to 71.2% (AFA). At the depth of 20-40 cm there are differences in the proportion of stable aggregates, as this layer is not affected by tillage implements and particularly harrowing, so there is an increase in the percentage of aggregates larger than 0.50 mm, indicating more aggregation, while the AFA showed 82.06%, even under intensive soil compaction and with bulk density values above the critical limit.

Keywords: Soil basal respiration; Organic matter; Legumes; Grasses; C/N ratio.
Financial support:

(7254 - 473) Agricultural land application of sanitary sludge

Arrarte Gimena[1]; Takata Virginia[2]; Arló, Laura[2]; Casanova Omar[3]; del Pino Amabelia[2]
Facultad de Agronomía, UDELAR, Av. Garzón 780, Montevideo, 12900, Uruguay (garrarte@fagro.edu.uy)[1]; Facultad de Agronomía, UDELAR, Av. Garzón 780, Montevideo, 12900, Uruguay[2]; Facultad de Agonomía, UDELAR, Av. Garzón 780, Montevideo, 12900, Uruguay[3]

Sewwage sludge obtained in wastewater treatment plants is result of a biologic process. This sludge forms a substrate of high humidity and organic matter, with variable contents of nutrients, heavy metals and presence of pathogens. These characteristics make it suitable as a soil improver for agriculture, but it also implies a risk at a sanitary and environmental level. In order to reduce pathogens, there are various mechanisms for hygienization and stabilization of the sewage sludge; among the most widespread are the addition of lime and composting. To date, in Uruguay there are only some preliminary studies on the application of sludge in cultivated soils which showed positive results in the production obtained. The objective of this work was to quantify the response to the application of sanitary sludge on forage crops of ryegrass and sorghum in a typical soil from the south of the country. Another aim was to evaluate if the application of this type of material modifies certain soil physicochemical properties. Before planting ryegrass, 2 doses of fresh sludge, limed sludge and composted sludge were applied in 2x4 m plots, leaving control plots without

amendments and a commercial fertilizer was used as a chemical control. The second crop of the rotation (sorghum) was planted without further sludge addition. By means of two cuts per crop, the aerial biomass and its nutrient content (N, P, K, Ca, Mg, Na, Cu, Fe, Zn, Mn) were determined. The soil was analyzed at the harvest of each crop (pH, exchangeable bases, available P). The application of fresh, limed and composted sludge produced significant increases in plant growth compared to the control, especially in the ryegrass crop. It highlights the contribution of nutrients, especially N and P, although it also increased the absorption of other nutrients. It should be noticed that the effect of the composted sludge was of lesser magnitude compared to the others. The observed effect of different amendment rates on the biomass production will contribute, to the adjustment of the doses to be applied in production situations. A relatively low residual effect of the amendments was observed in the second crop (sorghum), except for the case of the higher rate of limed sludge. Regarding the effects of the amendments on the soil properties analyzed, there were few changes after one year of application, which is important to assure the sustainability of the sludge utilization at farm level.

Keywords: sewage sludge, nutrients, forage production, Uruguay
Financial support: Obras Sanitarias del Estado (OSE, Uruguay)

(2675 - 2917) Agroindustrial Residues to Improve Water Consumption and Productivity of *Lolium perenne* in a Sandy Soil

M. Cristina Diez[1]; Juan Curiqueo[2]; Marcela Levío[2]; Felipe Gallardo[3]
Chemical Engineering Department and Biotechnological Research Center Applied to the Environment (CIBAMA-BIOREN). University of La Frontera[1]; Biotechnological Research Center Applied to the Environment (CIBAMA-BIOREN). University of La Frontera[2]; Chemical Sciences and Natural Resources and Biotechnological Research Center Applied to the Environment (CIBAMA-BIOREN). University of La Frontera[3]

Sandy soils have a wide range of limiting factors for agricultural use, between them nutrient deficiencies, acidity, water stress and poor physical properties. In these conditions, nutrient decline, erosion, leaching, salinity, and acidification could occur. To improve these soils, organic and inorganic amendments are commonly added for improving its physical and chemical characteristics which promoting plants productivity. We studied different combinations of diatomite earth (D) from brewery production, biochar (B) from biomass boiler and sawdust (Sw) from wood process industry, as amendment to improve the water holding capacity (WHC) and productivity of *Lolium perenne* (ryegrass) in a Sandy soil (S). The soil contains 58.3% sand, 32.6% silt and 9.1% clay, with low organic matter content (3.0%). Also, we used an organic soil (Trumao) (37.1% sand, 34.2% silt and 28.7% clay) with high organic matter content (12%) for comparative purposes. For *L. perenne* productivity assay, pots of 4 kg of the soil amended with the residues in different combinations were used and maintained in greenhouse conditions. The assay consisted of three periods in which water was added to the pots corresponding to 100, 75 and 50% of the soil WHC. Chemical, biological and physical paremeters of the amended soil were measured at initial and final time (240 days). TDR-100 equipment was used to water volumetric content evaluation and, water loss by gravimetry. Vegetal biomass was evaluated four times during the assay and chlorophyle content at the end of the assay. The WHC of Sandy soil without amendment was low (30-32%) compared with Trumao soil (60-65%). The addition of all materials (1%) increased WHC in both soils. The cumulativy productivity (240 days) of ryegrass increased in SSwD, SSwDD and SBD treatments, respect to the control soil (S), obtaining more than 80% of productivity in the soil amended with B + D. However, the SSw and SSwB treatments showed cumulative productivity less than the control soil, probably by the type of sawdust wood and the alcalinity associated with biochar. Biological (urease, phosphatase and dehydrogenase activities) and chemical properties of the Sandy soil were also improved by addition of the different combinations of agroindustrial wastes. The chlorophyl content was the highest in SBD treatment and the lowest in the control soil. On the other hand, no differences ($p<0.05$) were found between SSwD, SSwBD SB SBD SSwB treatments.

Keywords: Sandy soil, agroindustrial residues, productivity, ryegrass
Financial support: CONICYT/FONDAP/15130015, FONDECYT 1161481 and DIUFRO DI16-2015 projects.

(2853 - 1395) Ammonium and nitrate in yellow latosol in chronosequence of crops under no-tillage in the eastern Amazon

Letícia Cunha da Hungria[1]; Edilson Carvalho Brasil[2]; Rúbia Carla Ribeiro Dantas[1]; Jamil Chaar El Husny[2]; Mário Lopes da Silva Júnior[1]; Sidney Daniel Araújo da Costa[1]
Universidade Federal Rural da Amazônia[1]; Embrapa Amazônia Oriental[2]

The time of use of the soil conservation management systems can to influence ammonium ($N\text{-}NH_4^+$) and nitrate ($N\text{-}NO_3^-$) dynamics, during the process of nitrogen (N) organic mineralization in the soil. In the Amazon, especially in the state of Pará, there are few studies that evaluate impacts caused by changes of soil management and system adoption time on the dynamics N inorganic forms ($N\text{-}NH_4^+$ e $N\text{-}NO_3^-$) in soil. The objective was to evaluate the influence of no-tillage (NT) on the $N\text{-}NH_4^+$ and $N\text{-}NO_3^-$ dynamics in a Yellow Latosol (Oxisol) in the Eastern Amazon. The study was carried out in the Paragominas city, southeast of the state of Pará, where soil samples were collected at depths of 0-5, 5-10 and 10-20 cm during the rainy period of the region. The experimental design was completely randomized, in subdivided plots, with four replications. The treatments consisted of a chronosequence of crops under no-tillage with four (NT4), six (NT6) and ten years (NT10) of adoption, besides an area under conventional tillage (CT) and another with native forest (NF). The $N\text{-}NO_3^-$ and $N\text{-}NH_4^+$ contents were determined by extraction with KCl 1,0 $mol.L^{-1}$ solution and further reading through the spectrophotometer. According to the results, the $N\text{-}NO_3^-$ contents obtained in the 0-5 and 5-10 cm layers were, respectively, 21,2 and 15,4 mg kg^{-1} in NT4; 23,0 and 17,0 mg kg^{-1} in NT6 and 24,1 and 18,7 mg kg^{-1} in NT10, demonstrating that throughout the time of adoption the NT promoted increases in $N\text{-}NO_3^-$ contents at these depths. Regardless of the time of adoption, the NT promoted $N\text{-}NO_3^-$ stratification, while the CT promoted a more homogeneous distribution between the depths. In all depths, the highest $N\text{-}NH_4^+$ contents were obtained in NT6 (14,8 mg kg^{-1}) and CT (15,3 mg kg^{-1}), which did not differ among themselves, but were highest than NT4 (10,0 mg kg^{-1}) and NT10 (10,4 mg kg^{-1}), which did not differ between them either. Evaluating the individualized layers was found that in the 0-5 cm layer, the $N\text{-}NH_4^+$ content of the NT6 (21,4 mg kg^{-1}) was higher than CT (15,2 mg kg^{-1}). The NT was efficient in increasing the $N\text{-}NO_3^-$ contents in the soil, during the time of adoption, indicating its capacity to maintain the N in the system.

Keywords: N inorganics forms; N ammoniacal; system adoption time
Financial support: Embrapa Amazônia Oriental

(3213 - 2674) Anaerobic incubation as an estimate for the nitrogen mineralization rate in organic wastes

Jessica Zuanazzi Fioritti Corbo[1]; Aline Renée Coscione[1]; Adriana

Marlene Moreno Pires[2]; Ruan Carnier[1]
Agronomic Institute[1]; Embrapa[2]

The agricultural use of organic wastes is based on the supply of nitrogen (N) to crops, as it is usually the most limiting nutrient in soils. The nitrogen mineralization rate (NMR) of organic wastes and fertilizers can be estimated by several methods. However, but the most used and widely accepted is the long-term aerobic incubation (AE). This is a laborious, costly and time-consuming method. The anaerobic incubation (AI) method can be an alternative to the standard procedure since it is robust, faster and cheaper. The aim of this work was to compare the NMR of anaerobic and aerobic methods, using 10 organic waste samples. For this, hen manure (HM), coffee silverskin (CS), chicken manure (CM), sugar cane filter cake (FC), cattle manure (BM), expired coffee powder (CP), castor bean cake (CB), dry sewage sludge (SS), peat (PT) and poultry litter (PL) were incubated aerobically according to the standard aerobic and the an aerobically procedures, in triplicate. The anaerobic incubation occurred under water saturation for 7 days, at 40^{O}C. The incubations were performed using a Rhodic Ferralsol at pH 4.1. Three doses of wastes were used in the incubations, corresponding to 150, 300 and 450 g kg^{-1} of N-Kjeldahl (NK), summing 30 incubation units plus a soil reference without nitrogen addition. The amounts of mineralized N were determined in extracts obtained with saline solution after steam distillation with the addition of MgO and Devarda alloy. The calculate NMR obtained for both methods were submitted to the correlation analysis ($p<0.05$). The recovered N by the anaerobic incubation represent 56% of the incubation aerobic, by obtaining the following equation: (TMN_{ai} = 0,559*TMN_{ae} - 3,9418; r^2 = 0.66; $p<0.01$). For both methods, the higher NMR was found for CB and SS (6.3% of NK, C/N=7 and 5.4% of NK, C/N=5.8, respectively). On the other hand, the lower NMR was found for FC in both methods (0.12% of NK, C/N=46). Besides FC, the CS and CP wastes presented N immobilization in the AI, probably due to the characteristics of these material, that have amounts of toxic polifenols. These composts may have affected the decomposition of the wastes by microorganisms. Nevertheless, such results indicate that the anaerobic method can be used alternatively to estimate NMR at organic wastes.

Keywords: aerobic incubation, decomposition, immobilization biological
Financial support: COORDINATION FOR THE IMPROVEMENT OF HIGHER LEVEL EDUCATION- CAPES

(4488 - 2688) Analysis of quantitative parameters of the meso and macro edaphic fauna found in corn culture under different forms of fertilization.

Domenico Marcelo Rafaele[1]; Alexandre Pozzato[1]; Daniel Fontanive[1]; Marco Antonio De Oliveira[1]; Patrick Gustavo Dunke[1]; Danni Maisa Silva[1]; Bárbara Clasen[1]
UERGS[1]

Soil fauna organisms play an important role in the soil. Techniques that favor the increase of the edaphic organisms are of great importance. The use of Liquid Swine Manure (LSM) as an alternative source for mineral fertilization is widely used in regions that share agricultural activities and pig farms. This work had as objective to analyze the classes of organisms of the meso and macro edaphic fauna found in corn crop under different forms of fertilization. This work was carried out on private property located in Tenente Portela - RS. In order to conduct a survey of soil fauna, Provid-type traps was used (Antoniolli et al., 2006), were installed in a R7-stage maize experiment with seven treatments with four replications in a randomized block design (RBD), (16m^2 each treatmen), they was: CFR, chemical fertilization as recommended for corn crop in latosol by the Manual of Liming and Fertilization for the RS and SC states described in publications (CQFS-RS / SC, 2017); MTR, Dose of 31.875 m^3 / ha of LSM stabilized according to its nitrogen concentration equals the same as CFR; MT-10, which is equivalent to MTR less 10% of recommended N; MT0, without fertilization; MT10, which is equivalent to MTR plus 10% of recommended N; MT20 equivalent to MTR plus 20% of recommended nitrogen and NFT, native forest. The evolution of the addition of LSM increased considerably abundance of organisms such as some species of Collembola that provided greater abundance in all the treatments that received LSM compared to NFT that demonstrated greater diversity of groups which is expected in natural environments. Similar results were also obtained by Sauer et al. (1996), who verified that colembolla populations increase with the increase of the organic matter content in the soil surface. 31753 organisms were collected and classified into 15 different groups of which 30336 belonged to the Colembolla group and 1417 organisms divided into the other groups. The results showed that natural environments (NFT) preserve greater diversity (0.75 Diversity of Simpson), while environments that provide food favorable to organisms concentrate higher amounts of these, raising the dominance (0.97 Simpson dominance) as is the case of the MT20 which received high doses of DLS and favored the dominance of Collembola (18023 out of 18276 organisms). The meso and the macro edaphic fauna showed variable abundance and diversity under different fertilizations in the maize crop.

Keywords: Sustainability. edaphic organisms. Liquid Swine Manure.
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(3630 - 1918) Analysis of soil chemical fertility level under cashew trees (*Anacardium occcidentale*) in North of Côte d'Ivoire (West Africa)

Diomande Loua Barthélémy[1]; Coulibaly Fanlégué Lacina[2]; Diabate Donourou[3]; Soro Sibirina[1]
Université Peleforo GON COULIBALY, Institut de Gestion Agropastorale, Filière Economie et Gestion Agropastorale[1]; Université Peleforo GON COULIBALY, UFR Sciences Biologiques, Département de Biologie Végétale[2]; Université Félix Houphouët-Boigny, UFR SSMT, Laboratoire de chimie physique[3]

Côte d'Ivoire is the first producer and exporter country of brute cashew nut. But, the yield by orchard is very low with 350 kg.ha^{-1} against 1000 kg.ha-1 in India and 2000 kg.ha^{-1} in Vietnam. For explaining the low yield of cashew orchard in Côte d'Ivoire, influence of soil pH and essential nutrients content under orchards of cashew trees were evaluated in Korhogo, Ferkessédougou and Bondoukou departments in Côte d'Ivoire. Ten (10) orchards old more than 15 years were selected randomly in each department. Under each orchard, one composite sample from thirty two (32) elementary samples was collected by auger to a depth of 0-30 cm on one (1) ha. These samples were sent to laboratory in order to evaluate pH and nitrogen, phosphorus, potassium, calcium, magnesium, iron, zinc and copper content. The values from analysis were compared to critical levels. The results of analysis showed that soils under orchards are moderately acid and nitrogen, phosphorus, calcium and zinc contents are strongly low. Concerning magnesium and potassium contents, the level varies between strongly low and low. In contrast, iron, copper and manganese have got high level. The cashew trees studied suffers from serious nutritional deficiency in major, secondary and trace nutrients. For increasing the yield of cashew nut in north of Côte d'Ivoire, adjustment fertilisation is necessary which must put at normal level the soil pH and all deficient nutrients following an appropriate fertilisation plan.

Keywords: Cashew trees, yield, soil nutrients, deficiency, Côte d'Ivoire
Financial support: UNIVERSITE PELEFORO GON COULIBALY

(2655 - 899) Analytical quality program of soil fertility laboratories that adopt Embrapa methods in Brazil – 2016/2017 results

Daniel Vidal Perez[1]; Marcelo Francisco Costa Saldanha[2]

Embrapa Soios[1]; Embrapa Meio Ambiente[2]

Accuracy and precision of soil fertility results is constantly questioned by customers. To promote its credibility, laboratories generally participated of external performance testing programs. The analytical quality program of soil fertility laboratories that adopt the Embrapa methods (PAQLF) is a voluntary sample-exchange program established since 1992. PAQLF is managed by Embrapa Solos and evaluate P and K extracted by Mehlich1 solution; Al, Ca, and Mg by KCl 1 mol L^{-1} solution; H + Al by Ca Acetate 0.5 mol L^{-1} ; soil pH in water; and organic C by wet combustion. Accuracy is based on a confidence interval: average ± a.SD; where, SD = standard deviation; a = 1, when CV> 50%; a = 1.5, when 20%> CV <50%; and a = 2.0, when CV <20% (CV means coefficient of variation). Precision is determined by the average CV of the analytical results of two samples sent in triplicate. Inaccuracy and imprecision composes an Index of Excellency rank: A for IE> 91; B for 71> IE <91; and C for IE <71. Only A and B laboratories are considered approved by PAQLF. In the 2016/2017 program, 122 laboratories from all Brazilian states had participated. The Midwest region contained the largest number of participants (37%). Southeast, Northeast, North and South regions comprises, respectively, 25%, 17%, 11% and 9% of the laboratories. Only 66% of the 122 laboratories reached the A and B ranks of IE classification. However, Midwest laboratories were by far the ones that presented the best performance, with 87 percent being approved. Northeast laboratories showed the worst results with 38% approval. These findings highlighted the different laboratories profiles of each region. The laboratories of the Midwest are in its most private and possess the greater analytical capacity, some of them exceeding 100,000 yearly analyses. The permanence in the market of soil analysis is clearly dependent on its ability to demonstrate its analytical quality to the customers. And this occurs through its results in quality programs like PAQLF. On the other hand, laboratories in the Northeast region are mostly public and, therefore, dependent on government resources. In this way, due to the weakness of the Brazilian economy in recent years, it's easy to understand why they have the lowest performance. Considering the last seven years, although the number of participants has been growing annually (34%), there is no evidence of lowering of the percentage of approved laboratories.

Keywords: Accuracy, precision, soil analysis

Financial support: Embrapa, Funarbe

(3582 - 746) Availability of phosphorus in soils amended with dairy manure, urban and industrial sludge.

Amabelia del Pino[1]; Lucía Bentancur[1]; Nadia Freire[1]; Melina Fernández[1]; Omar Casanova[1]

Facultad de Agronomía - Universidad de la República[1]

Dairy manure, urban and industrial sludges can provide important amounts of nutrients when used as soil amendments for pasture and crop production. However, management difficulties arise due to uncertainties regarding to the dosage of these materials. An important proportion of P in manures and sludges is in organic form, and from the inorganic fraction not all is water soluble. This study was aimed to: 1) Assess the soil P availability for crops of three amendments: dairy manure (DyM), sludge from dairy industry (SDI) and urban sanitary sludge (SU). 2) Evaluate the residual available P in soils amended with these materials. A greenhouse experiment was conducted with ryegrass as the test crop, in a soil representative of dairy production region in Uruguay (A horizon texture: silty clay loam). Two rates of each amendment were compared to P fertilizer (K_2HPO_4), plus a control without any addition. The application rates of the amendments and fertilizer, based on total P content, corresponded to 40 and 80 mg kg^{-1} of soil. The amendments and fertilizer were mixed with the soil, transferred to plastic pots (3 per treatment), and ten pre-germinated ryegrass seeds were planted in each pot. Three months after planting the aerial biomass of ryegrass was cut, weighed, dried and ground for P concentration analysis. Soil samples from each pot were collected to evaluate residual P availability (Bray 1). The biomass production of the treatments SDI and SU represented 2.7 and 1.6 folds the yield of the control (average of two rates). In contrast for DyM ryegrass yield was lower than control, while in the fertilized pots biomass production was slightly above the control. The absorbed P showed similar trends, with the highest values for sludge amended soils. But also ryegrass in DyM and fertilized pots more than doubled the P absorption of the control. For SDI, SU and fertilizer significant differences were found between application rates, in biomass production and absorbed P. The residual soil P was higher for SDI and fertilizer compared to SU and DM. The reasons for these results could be linked to the slow decomposition of DyM, which presented a higher C/N ratio compared to sludges. In the case of SU, higher soil P retention was attributed to the addition of $FeCl_3$ during sludge processing. It was concluded that the dosage of DyM and sludges should take into consideration not only total P content, but also other characteristics that affect their reaction with the soil.

Keywords: Uruguay; ryegrass; absorbed P

Financial support: Obras Sanitarias del Estado (OSE) Uruguay.

(9764 - 2852) Biosolid microbial stabilization for potential use as soil improver in Costa Rica.

Fabiola Segura[1]; Andrea Quesada[1]; Federico Masís[1]

Costa Rica Institute of Technology[1]

Phosphorus, nitrogen and potassium are key elements in plant growth. Therefore, essential to accelerate land use recovery and food security improvements. The projected increase in the demand for fertilizers in Latin America and the Caribbean, between 2005 and 2050, is estimated to be 180%. In Costa Rica, nitrogen is considered a generalized limiting factor and 74% of agricultural soils present phosphorus deficiencies. On the other hand, septic waste, depending on its origin and dewatering degree, contains varied but significant amounts of nutrients such as nitrogen, phosphorus and potassium. By 2017, domestic wastewater treatment in Costa Rica was covered using septic tanks at 75.8%, indicating an increasing generation of domestic sewage sludge, which can contain large number of pathogenic bacteria, viruses and parasites eggs. Thus, the need for appropriate disposal and treatment. Up to now, there are countries that have already attained management and disposition strategies of biosolids in soils, for example: U.S.A and Canada. So far, production of biosolids derived from domestic sewage sludge comprehend three phases: microbiological stabilization, physical-chemical stabilization and storage or final disposal of treated biosolids. From laboratory-scale to pilot-scale, this research seeks to establish three sanitary treatments to cover the first phase and to minimize potential risk of biosolids land application. Three approaches are undertaken: lactic acid fermentation, liming and biosolid solarization. To improve handling disposal and reduce public concern regarding the recycling of domestic sewage sludge in soils, this research aims to show the usefulness of “faster and unexpansive techniques” to reduce microbial pathogens during biosolids production. Therefore, in accordance with related legislation, the microorganisms of focus are intestinal nematodes and fecal coliforms. The high content of organic matter and nutrients of biosolids make them excellent substrates to produce soil improvers. Furthermore, soil physical properties like water holding capacity and total porosity are enhanced when biosolids are mixed with materials such as biochar.

Keywords: Biosolids, sanitation, soil amendments, land use recovery, domestic sewage sludge.

Financial support: Research Project: Production of carbon neutron

amendments using sanitation alternatives to the recovery and conserve of soil.

(6955 - 1305) Boron content as a function of N rates in Oxisol cultivated with coffee

Danilo Marcelo Aires dos Santos[1]; Michele Ribeiro Ramos[1]; Enes Furlani Junior[2]; Talita Maia Freire[1]; Thalline Rodrigues da Silva[1]; Lorena dos Santos Campos[1]; Dara Chaves Paixão[1]; Dione Joaquim Pereira[1]; Sebastiana Patricia Alves Coelho[1]

Universidade Estadual do Tocantins[1]; Universidade Estadual de São Paulo[2]

The addition of N to agricultural crops is usually accomplished through the application of fertilizers. In many cases, the requirements of the crop and the dynamics of the availability of this nutrient in the soil are not known, thus opting to apply a greater amount of fertilizers to guarantee high yields that can cause imbalance of the soil fertility, being able to decrease the availability of micronutrients. In order to study the influence of nitrogen rates and different application systems, in the soil B levels this study was carried out. The work was installed in FE / UNESP Campus of Ilha Solteira, in the municipality of Selvíria-MS, in a Oxisol Dystrophic cultivated Catuaí red cv. The experimental design was a randomized block design in a 5x3 factorial scheme with 4 replications, 5 nitrogen doses (0, 50, 150, 250 and 350 kg ha-1) and three application modes (single, split twice, split three times), source used was urea. Soil collection was performed after coffee harvesting at depths of 0 to 40 cm and the determination of boron levels were obtained through the methodology described by Raij & Quaggio (1983, 1987), Raij et al (2001) and Embrapa (1999). There was a significant effect for interaction between doses and the N application system, with linear adjustment for single and split application mode in two moments, but the adjustment was negative, that is, the higher the N dose the lower the B content in the soil, this fact can be explained by the acidification of the soil by the use of nitrogen fertilizer inhibiting the absorption of micronutrients, which requires the pH between 6.0 to 7.0, for greater availability. Single and piecewise application at two N times decreases soil B contents.

Keywords: Nitrogen fertilization, application, micronutrientes

Financial support: FAPESP

(4037 - 1519) Boron release from different fertilizer sources in two soil types

Gabriel Barth[1]; Helio Antonio Wood Joris[1]; Marcel Barbier[2]; Fabiano Silvestrin[2]

Fundação ABC[1]; Rio Tinto[2]

Boron (B) is an essential element for plants, participating of several physiological processes. The known effects on crop yield have resulted in efforts to provide the right B source, especially considering its solubility. The higher the source solubility, the greater the theoretical amount of B released in soil solution. In order to determine B release after application of different sources, an experiment was established in soil columns, by testing two soils with contrasting texture and B content: Sandy (299 g kg^{-1} of clay and 0.2 mg dm^{-3} of B) and clayey (727 g kg^{-1} of clay and 0.4 mg dm^{-3} of B). The B sources were the treatments, consisting of two sources of low solubility (ulexites) and three sources of high solubility (one boric acid and two sodium tetraborate). Experimental design was complete randomized block with four repetitions. Each experimental unit was a 0.0157 m^3 PVC column pipe (0.7 m height by 0.1 m diameter). Soils in columns were saturated at 60% of water filled pore space, then B sources were applied to soils surface. Next, dripping of deionized water initiated on a weekly basis, at rates of 0.5 ml and 0.8 ml on sandy and clayey soils, respectively. At the end of each week, B content was analyzed in percolated solution. This study was carried out through 40 weeks. Analysis of percolated solutions showed an intense B release from highly soluble sources, with more than 90% of B released during the first 10 weeks of the study on both soils. After 30 weeks, B released reached more than 95% of the total B that was applied to these columns. On average, during the first 10 weeks, an amount of 9.3 mm of water for each percent point of released B was estimated. On the other hand the less soluble B sources, in average for both soils, showed a maximum of 47% of total B released, after 40 weeks. At the end of the experiment, the soil B content was analyzed. In sandy soil, was found that B was higher on soils where the less soluble sources were applied, while in clayey soil, all treatments exhibited higher B than in the untreated control, but indicated no differences between sources. The high solubility B sources released almost 100% of B, while less soluble sources released less than 50% of B. The remaining boron in soil from low solubility was not released through a great amount of percolated water (average of 3300 mm). In order to improve B availability, the right B source and application time are an important aspect to keep in mind.

Keywords: Micronutrients; Subtropical soil; Boron desorption

Financial support:

(3410 - 2180) Brachiaria substrate and subsoil for the production of teak seedlings

Leonardo Júnior de Oliveira Medeiros[1]; Reginaldo Antonio Medeiros[2]; Carlos Alberto Ramos Domiciano[3]; Paloma Emanuela Braga Martins[4]; Helen Caroline Rodrigues Correa[5]; Elyson Thiago de Souza Florentim[6]; Milson Evaldo Serafim[7]

Federal Institute of Mato Grosso, Ave of Ramires, PoBox 244, Cáceres-MT, Zip Code 78.200-000, Brazil . Email: medeirosleonardo100@gmail.com[1]; Federal Institute of Mato Grosso, Ave of Ramires, PoBox 244, Cáceres-MT, Zip Code 78.200-000, Brazil . Email: reginaldo.medeiros@cas.ifmt.edu.br[2]; Federal Institute of Mato Grosso, Ave of Ramires, PoBox 244, Cáceres-MT, Zip Code 78.200-000, Brazil. Email: carlosramos.domiciano@gmail.com[3]; Federal Institute of Mato Grosso, Ave of Ramires, PoBox 244, Cáceres-MT, Zip Code 78.200-000, Brazil. Email: palomabraga07@gmail.com[4]; Federal Institute of Mato Grosso, Ave of Ramires, PoBox 244, Cáceres-MT, Zip Code 78.200-000, Brazil . Email: helen.correa05@gmail.com[5]; Federal Institute of Mato Grosso, Ave of Ramires, PoBox 244, Cáceres-MT, Zip Code 78.200-000, Brazil . Email: thiagoflorentim28@gmail.com[6]; Federal Institute of Mato Grosso, Ave of Ramires, PoBox 244, Cáceres-MT, Zip Code 78.200-000, Brazil . Email:milson.serafim@cas.ifmt.edu.br[7]

Teak (*Tectona grandis* L.f.) is one of the most cultivated forest species in the State of Mato Grosso, which requires a large amount of substrates, such as subsoil, to produce seedlings. Currently, alternative substrates have been requested for the productive process, such as the use of forages, especially the brachiaria brizantha (*Urochloa brizantha*), which is widely cultivated in the State. The objective of this work was to evaluate the effect of the brachiaria substrate on the growth in height and lap diameter of seminal teak seedlings. The experimental design was in randomized blocks and with four replications, the experimental plot consisting of two teak plants. The seedlings were produced in pots and the substrate used was subsoil. The treatments consisted of aerial part and the roots of the brachiaria, which after being harvested and ground, is incorporated into the substrate at the concentrations of 0, 5, 10, 20, 33 and 50% of its volume. At 60 days after repication, the height and diameter of the lap of the teak seedlings were evaluated. The growth in height was not influenced by the aerial part of the brachiaria, whereas lap diameter was influenced by the concentrations above 20% of the substrate volume, and these averages did not differentiate between each other

($p < 0.05$). In the treatment with 50% concentration of brachiaria roots, a lower height ($p<0.05$) was observed for the others. For the diameter, the effect was more pronounced at concentrations above 20%. As the forage concentration in the substrate composition was increased, teak growth decreases, which demonstrates inhibitory effect, either by allelopathy or by immobilization of nutrients, the object of further studies. The brachiaria influences less the growth in height than the lap diameter of seminal teak seedlings. The roots of brachiaria interfere more and negatively in the growth in height and lap diameter when compared to aerial part. Brachiaria has potential for use as a substrate at lower concentrations.

Keywords: *Tectona grandis*, *Urochloa brizantha*, subsrate
Financial support: CNPq, EDITAL Nº 15/2017, called 2017 - 2018 of Scientific Initiation Grants PIBIC-EM

(4915 - 3100) Carbon stock in fine roots of agroforestry-based oil palm productionin eastern Amazon, Brazil

Saime Rodrigues[1]; Steel Vasconcelos[2]; Daniel Markewitz[3]; Alzinei Simor[4]; Sandro Chaves[5]; Roberto Paiva[6]; Debora castellani[7]; Alessa Costa[2]; Osvaldo Kato[2]
Federal Rural University of Amazon, 2501 Tancredo Neves, Belem, 66.077-830, Brazil (saimecrodrigues@gmail.com)[1]; Embrapa Eastern Amazon[2]; University of Georgia[3]; College Estacio of Belem[4]; Federal University of Para[5]; Para State University[6]; Natura Innovation and Product Technology Ltda[7]

Agroforestry systems (AFS) can be an alternative to monocultures for oil palm production that can improve both above and below ground species diversity. A potentially positive benefit of diversification in oil palm cultivation is the possibility of increasing the soil carbon stock due to increased below ground competition and niche differentiation in fine roots. The biomass of fine roots (<2 mm) is important for the carbon cycle of ecosystems since this pool often accounts for a substantial portion primary production (up to 30%) in forested ecosystem, is a fast cycling pool, and can increase the soil carbon reservoir. In AFS, particularly in oil palm, little is known about fine root biomass. Working in the eastern Amazon of Brazil, we measured the spatial variation of the carbon stock in fine roots within an AFS containing oil palm and other species (herbaceous, shrubs, and trees). Carbon stocks were also quantified in fine roots of a 20-year-old secondary forest as a benchmark for comparison with the oil palm based AFS. Oil palm seedlings were planted in double rows interspersed with strips consisting of nine rows of herbaceous, shrub, and tree species. Organic fertilization was carried out quarterly with residues of palm oil fruit and from semi-annual pruning of some species in the AFS planting lines. Root samples were collected at a depth of 0-0.01 m on the palm planting line at two distances from the trunk (0.06 and 2.5 m) and at different sites (frond pile, between plants, and random spots within the AFS). In general, the stock of carbon in the fine roots was higher in the secondary forest than in the oil palm AFS, showing that even with the diversification of oil palm production, the potential of carbon accumulation in the root biomass is lower than within secondary forest. Carbon stocks in the fine roots (<2 mm) were higher nearer to the palm trunk (0.06 m) and at the frond pile, possibly due to the oil palm architecture and the accumulation of organic nutrient at the frond pile. Under the conditions of the current study, the conversion of a secondary forest into oil palm cultivation in organic agroforestry systems is not an efficient alternative for carbon storage in the biomass of fine roots.

Keywords: Oil palm, fine roots, soil carbon stocks, agroforestry
Financial support: Coordination of Improvement of Higher Level Personnel (CAPES); National Council for Scientific and Technological Development (CNPQ), Embrapa Eastern Amazon, and USAID (United States Agency for International Development)

(2980 - 963) Changes in nutrient cycling processes due to the introduction of exotic species in Cerrado native areas

Jonas Inkotte[1]; Marco Bruno Xavier Valadao[1]; Sarah Camelo da Silva[1]; Karla Monique Silva Carneiro Valadão[2]; Alcides Gatto[1]; Reginaldo Sérgio Pereira[1]
University of Brasília[1]; Mato Grosso's Estate University[2]

Exotic species have been used for the recovery of degraded areas because they have rapid growth and a cover of exposed soil, which promotes the reduction of erosion, and consequently the recovery and stabilization of soils. However, little is known about the impacts of this practice on the balance of edaphic processes. This issue has been gaining more attention in recent years due to the amendment of the 1965 Forest Code by Law No. 12,651 of May 25, 2012, in Article 61-A, paragraph 13, item IV admits the restoration of permanent preservation areas - borders of watercourses like gallery forests, mangroves, hill tops - by planting exotic species interspersed with native species in up to 50% of the total area to be surveyed. Therefore, the objective of this study was to evaluate the speed of eucalyptus leaf decomposition in a commercial plantation area and in a gallery forest Cerrado area, in order to verify if there is a difference in the speed of eucalypt leaf decomposition between the two areas of study, which may indicate a possible disequilibrium in edaphic processes.The work was conducted at the Água Limpa farm, which belongs to the University of Brasília, located in the Federal District - DF (15 ° 56'-15 59 'S and 47 ° 55'-47 58' WGr.), In a planting area of Eucalyptus clonal hybrid: Eucalyptus grandis x urophylla with 49 months of age and spacing of 3x2m, where the soil was characterized as Red Latosol, and a native area of gallery forest in an Organosol. Thirty litterbags with 20cm² of size were then allocated in each area, with 20g of eucalyptus leaves in each bag. These were then randomly allocated to each study area and rescued after 30 and 60 days of field exposure. The foliar decomposition was estimated by means of the initial and final mass difference after each exposure time, by the expression: remaining mass (%) = (final mass / initial mass) × 100. The two areas were compared by means of the t-test independent. Leaf masses after 30 days of field exposure showed a significant difference, being the fastest decomposition in the gallery forest area (5.83g decomposed) in comparison with the eucalyptus area (1.86g).The same occurred at the time of 60 days, being decomposed 4.64 g to the area of eucalyptus and 9.96 g decomposed in the gallery forest. The results showed that there is a difference in the speed of leaf decomposition between the areas and that this may indicate a possible imbalance in soil processes of nutrient cycling.

Keywords: Leaf decomposition, Eucalyptus, Gallery forest
Financial support: Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – CAPES

(7322 - 2348) Characterization of residual substratum originated by leaf cutting ants, used in the restoration of soils in colombian tropical dry forest

Yury Alexandra Fonseca[1]; Miguel Eugenio Cadena[1]
Universidad Distrital Francisco José de Caldas[1]

In the region of Quimbo Dam, located in southwestern-central Colombia, with Entisols and Inceptisols soils, a process of restoration of the area of damping is under development. This process requires to afforest the delimited damping area with native forest species, that need for their rapid establishment of a management of fertilization. The residual substratum originated of refuse of the leaf cutting ants (*Atta colombica*, Hymenoptera: Formicidae) can be used like natural fertilizer in the propagation of forest species. The aim of this study was to characterize the chemical properties of the residual substratum of ants. Three representative anthills in each one of the following vegetal cover were selected: Dense Forest (DF), Open Grassland (OG) and Dense Shrub (DS). The study was carried out at three depths in the external piles of the anthills (top TD, medium MD, and low LD), and at

two climatic seasons (dry and wet). The pH, C:N ratio, and concentrations of P, K, Ca, Mg, B, and Cu in the substratum were determined. The variables were analyzed by means of a Combined Analysis of Variance, a Randomized Complete Block Design with factorial arrangement (3 anthill depths x 3 vegetal covers) in series of experiments (equal place – different season), where the blockade form corresponded to three intervals of time during the day (6 to 9 am, 11 am to 2 pm, and 4 to 7 pm). The results showed that pH of substrates changes with the depth of the anthill, 6.47 for top, 7.34 for medium and 7.17 for low depth. The C:N ratio ranged between 3.9 and 12.0, showing that the lowest value is obtained for the interaction of Dry Season (DS) with Open Grassland (OG) and Low Depth (LD). Likewise, in the existing interaction DS:OG:LD, the elements P (11.29 mg/kg), Ca (5.43% dm), Mg (0.89% dm), B (84.57 mg/kg) and Cu (17.77 mg/kg) presented the highest concentrations. The K presented its biggest concentration (1.90% dm) for the Wet Season in the Open Grassland and Top Depth. In Dry Season, the same concentration of K was found, but for Dense Shrub and same depth (TD). It is recommended for the propagation of species in its seedling stage in nursery and open field, to use the refuse that comes from low stratum of pile anthill, collected at dry station and under Open Grassland, mixed with a proportion of the refuse of top stratum, to provide a substratum with the better nutritional content.

Keywords: *Atta colombica*, Ant refuse pile, Organic fertilization
Financial support: ONG Fundación Natura, Colombia

(1500 - 1280) Characterization of soil fertility variables cocoa planting indifferent areas in the State of Bahia

Thainara Brenda Lameira das Neves[1]; Joicelene Costa de Moraes[1]; Eduardo Cezar Medeiros Saldanha[2]; Marluce Reis Souza Santa Brígida[3]

Universidade Federal Rural da Amazônia-UFRA, Belém-PA[1]; Yara Brasil Fertilizantes, BR[2]; Universidade Federal Rural da Amazônia, Capitão Poço-PA[3]

The cocoa tree originates from regions of rain forests of Tropical America, where even today is found so Silvestre (CEPLAC, 2010). The cultivation of the cocoa in Brazil began in 1679, when Royal Chanter authorized the planting. With the growth in consumption as raw material for chocolate, the cocoa crop a expansion, where the mined-18th century, was implement in the South and Southeast of Bahia, witch concentrates most of the area cultivated with cocoa in Brazil (Soares, 2013), by presenting relevant productivity especially amongst the largest producers (FAO, 2009). Due to environmental conditions in tropical and humid areas with predominantly acidic soils, it is necessary to fix fertility for proper nutritional balance to achieve satisfactory productivity. In the context, the present study aimed to characterize the variability of fertility in different areas of cultivation. The samples were collected in large production area in six municipalities in the State of Bahia, kept in sixteen farms, with 15 simple sample collected with the help of Dutch Auger, 0-20 cm and 20-40 cm depth, forming composite samples taken a in front of plants another two on the sides (right and left) of these. The collection was made in zigzag for a better use of the area. The samples were taken to private lab for chemical analysis and the results were described in a spreadsheet and treated by the described statistics. The attributes were evaluated; Hydrogen potential (pH), Cationic Exchange Capacity (CTC), Base Saturation (v%), Aluminum Saturation (m), Phosphorous (P), Potassium (K), Magnesium (Mg), Sulfur (S), Boron (B), Copper (Cu), Iron (Fe), Manganese (Mn), Zinc (Zn). The results of the analysis showed that the attributes P, K, Mg, Cu, Mn and Zn had an imbalance of distribution in the cultivated areas, which required a fertility adjustment under the planting of cocoa, homogenizing the spatially of the cultivation areas balancing these elements for greats inefficiency and raise productivity.

Keywords: Theobrama cacao *L.*, fertility, plant nutrition
Financial support:

(3239 - 2495) Characterization of the structure and analysis of microbial diversity in soil exposed to long-term nitrogen fertilization under contrasting agricultural stubble situations

Mónica Boccolini[1]
Instituto Nacional de Tecnología Agropecuaria. Marcos Juárez, Córdoba, Argentina.[1]

Agronomic practices involve changes in soil physical chemical properties which modify the function and structure of microbial communities. Molecular methods allow us to quickly and accurately evaluated changes in the structures of these communities. The aim was to characterize the structure and to estimate microbial community diversity of soil with long-term urea application and under two contrasting residues. The field experiment established in 1993 is located in INTA Marcos Juárez. It presents a design in completely randomized blocks with three treatments and three repetitions: A: without fertilization; B: 90 Kg ha^{-1} of N and C: 165 Kg ha^{-1} of N as urea. In 2010 and 2011 two samplings were carried out on stubble of soybean and corn respectively. Soil samples were collected from 0 to 10 cm depth. Were amplified DNAr of fungi and bacteria. The products of amplification were separated in gels of polyacrylamide denaturing. The Shannon index diversity was estimated and analyzed by ANOVA. The molecular profiles were analyzed by cluster analysis (CA). The variation in the composition of the communities was visualized by multidimensional scaling (MDS). The diversity of bacteria did not change with the treatments for both residues, whereas the diversity of fungi of the treatments B and C was significantly lower ($p< 0,05$) under soybean. In the CA of bacteria the separation was observed A and B to C for both residues, whereas in fungi, A it separated of B and C in both residues. The analysis MDS showed that the microbial communities of the soil changed depending on the rate of urea applied. The bacterial communities of A and B they were located united and separated of C in both residues; whereas in fungi only under soybean differences between communities were observed, separated A of C. In general, the pH correlated significantly ($p< 0,05$) with the variation in the composition of the microbial communities in both types of residues. Therefore, the fungi diversity of the soil it was more sensitively to the urea application. The urea caused changes in the composition of species and the structure of the communities. This would be determined principally by the variations in the pH of the soil and might be influenced by the type of residue in surface.

Keywords: Bacteria Fungi Urea
Financial support: Instituto Nacional de Tecnología Agropecuaria, INTA. Argentina.

(2203 - 2145) Chemical and microbiological attributes in different areas of agriculture and fragment of native forest

Leopoldo Sussumu Matsumoto[1]; Leandro Mazo Rocha[1]; Rodrigo Domiciano Marques[1]; Teresinha Esteves da Silveira Reis[1]
State University of North Paraná[1]

Soil is one of the main basic resources whose function is to support several species on the planet and also acts as a substrate for plants, providing them with water and nutrients, which ensures the maintenance of life on earth. Therefore, different systems and techniques of soil management act directly in the physical, chemical and biological properties, since the preparation is directly associated with the quality and availability of nutrients to the plants. The objective was to evaluate chemical and microbiological parameters of soil quality in areas of cultivation and forest fragment in the winter and summer. The study was carried out in the city of Bandeirantes – PR/Brazil, considering areas of soybean, maize, sugarcane, pasture, around the forest fragment and four areas located in the central portion, border one and border two and in reforested area of the

fragment. Among the soil chemical parameters, organic matter, total organic carbon, hydrogenation potential, calcium, magnesium, aluminum, phosphorus, potassium, base sum and cation exchange capacity were evaluated, and the microbial biomass carbon was determined in the microbiological biomass, soil basal respiration, metabolic quotient and microbial quotient. The experimental design was completely randomized, arranged in an 8 x 2 factorial scheme. The data were submitted to analysis of variance and the means were compared by the Tukey test ($p < 0.05$). The chemical and microbiological attributes were submitted to multivariate analysis by main components separately. The results obtained in the native vegetation areas presented in most parameters analyzed, greater microbial community, organic matter content, lower stress, better efficiency in the availability of nutrients when compared to the areas of agriculture. Thus, in the different areas of study, soil management can influence the activity of the microbiota. The agrosystems presented good soil fertility, it was observed that soybean and maize presented better fertility when compared to the agricultural areas, with better P, K, Ca, Mg and CTC indexes, as well as sugarcane and pasture obtained lower levels of fertility. Soil management and vegetation substitution may favor changes in chemical and biological attributes. Studies aimed at this line of research may be of great help to the producer in choosing soil quality monitoring techniques, being more efficient and sustainable, aiming at the conservation and increase of organic matter in the soil.

Keywords: Soil; microbiology; vegetation
Financial support: CAPES - Coordenação de Aperfeiçoamento de Pessoal de Nível Superior

(5810 - 680) Chemical attributes of an Oxisol submitted to management and organic fertilization in the system of crop-livestock integration in the western Amazon

Rodrigo Maciel Nunes[1]; Weder Vinícius de Oliveira Silva[1]; Fabio Régis de Souza[1]; Anderson Cristian Bergamin[1]; Jairo Rafael Machado Dias[1]; Luciana Sônia da Silva[1]; Cauandrey Deyverson Fagundes[1]; Júnior Antônio Rodrigues Mello[1]; Wesley Santana Ferreira[1]
Fundação Universidade Federal de Rondônia[1]

The livestock, for milk or beef, be part of the major source of income for the rural producers in the state of Rondônia, however, the inappropriate management in formation and development of the pasture promote a rise in the pasture degraded and soil, and consequently cause changes in the quality of the chemical attributes. The system o crop-livestock integration comes to be a promising alternative to recuperate de degraded pasture and promotes a higher input of waste vegetables, that improve the physical, chemical and biological quality of the soil when it is compare with conventional system of production. The objective of this work was evaluate the chemical attributes of an Oxisol submitted to a crop-livestock integration using an organic fertilization and management with limestone application. The experiment was conducted in the municipally of Pimenta Bueno-RO in the property of Alto Alegre Farm at RO 010 Km 30 area of pasture degraded. The delineation was randomized blocks in arrangement of subdivided parcels. Soil management treatment was implemented in February 2015. Principal parcel consists the management of soil: application limestone in surface on *Brachiaria* with no turn over of soil (CS), application limestone incorporated with harrowing (CIG), application limestone incorporated with an subsoiling followed by a harrowing (CIS), no limestone, just prepared with harrowing (G), no limestone, just prepared with subsoiling and harrowing (SG). The subparcels were constituted by source of fertilization: organic fertilization (manure of laying birds) and mineral fertilization. Application with mineral fertilization and organic happen in the moment of corn sowing, being the mineral in the furrow and the organic in surface. Was applied 300 $kg.ha^{-1}$ of NPK 04-30-16 formulation of mineral fertilizer an 5,5 $t.ha^{-1}$ of organic fertilizer. The properties chemical evaluate was pH in $CaCl_2$ 0,01 mol. L^{-1}, Al^{3+}, P, K^+, Ca^{2+}, Mg^{2+}, M.O, $H^+ + Al^{3+}$, effective CTC, CTC at pH 7,0, SB and V%. The best results for chemical attributes were obtained when realized the limestone application, independent of application mode. The fertilization with manure of lying birds rise the chemical attributes of the soil with pH, M.O, K^+, Ca^{2+}, Mg^{2+}, effective CTC and V% reduce the levels of toxic aluminium. For the P levels in the soil, is obtained the higher value with limestone incorporated application with the aid of harrow and organic fertilization with manure of laying birds.

Keywords: Lime, manure of laying, Rondônia
Financial support: FAPERO - Foundation for the Support of Scientific and Technological Actions and Research of the State of Rondônia

(6745 - 2296) Clay dispersion in a Ferralsol under raw sugarcane management system

Lucas Augusto de Assis Moraes[1]; Thiago Ometto Zorzenoni[1]; Jean Carlos Santos de Oliveira[1]; Thadeu Rodrigues de Melo[1]; Alex Figueiredo[1]; Gislaine Silva Pereira[1]; Cláudia Maria do Prado Furquim[1]; Adriana Pereira da Silva[1]; Cristiane de Conti Medina[1]; João Tavares Filho[1]
Universidade Estadual de Londrina[1]

In the State of Paraná, the raw sugarcane harvesting method (SCC) has been ascending which has contributed to the mitigation of the fires and guaranteed the permanent maintenance of vegetal cover. However, with the encouragement of straw gathering, a scenario of return to the post-harvest straw removal was established. The objective of this work was to evaluate the clay dispersion in different periods without burning and three types of straw management. The work was carried out in an experiment implemented in August 2010, in an area submitted with a burned sugarcane harvesting system since 1960. The design was a randomized block design, with three replications and the soil of the area classified as a clayey Ferralsol. The treatments evaluated were: A) 2 years without burning (SQ) + no harvesting of straw (HS); B) 6 years SQ + no HS; C) 6 years SQ + partial HS and, D) 6 years SQ + total HS. Samples were collected at 60 and 160 days after the 2015/16 harvest at 0.00 - 0.05 m, 0.05 - 0.10 m and, 0.10 - 0.15 m depth. The evaluated attributes were water-dispersible clay (WDC), total organic carbon (TOC), pH_{H2O}, pH_{KCl}, ΔpH, PCZ, Ca^{2+}, Mg^{2+} and K^+. The results obtained allowed us to infer there were no significant difference between the treatments and that the variables with the highest correlation for WDC at 60DAC were ΔpH, PCZ and Mg^{2+}. For 160 CAD, there was a negative correlation between WDC and TOC. Therefore, it is concluded that, regardless of SQ time and straw management, there were no significant changes on clay dispersion.

Keywords: sugarcane, resilience, organic carbon, Paraná.
Financial support: Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) e ao Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq).

(9615 - 1404) Colorimetric dosage of phosphorus by the phospho-molybdic complex reduced in extracts of Mehlich-3

Victor Hugo Alvarez V[1]; Carlos Antonio da Fonseca[1]; Reinaldo Bertola Cantarutti[1]
Universidade Federal de Viçosa[1]

The reduced phospho-molybdic complex with vitamin C (cPMoVitC) method used to determine P in the Mehlich-1 (M1) extract has low spectrophotometric efficiency for the determination of P in Mehlich-3 (M3) extracts. To improve this efficiency, the amounts of bismuth subcarbonate (ScBi), ammonium molybdate (MoAm) and sulfuric acid

(AcSu) in the composition of reagent 725 (R725) were adjusted. In addition, the amounts of ascorbic acid (VitC) in the working reagent composition (WR) were adjusted. In addition, the WR should be adjusted according to the volume of the M3 extract aliquot.We studied 17 WR_i initially working with calibration curves for the dosing method (DM) using 5.0 mL of M3 extract and 5.0 mL of WR (DM: 5 + 5). The composition of each WR_i studied was according to the Baconian matrix (5 + 5 + 5 + 5). The first three factors are the R725 components, which correspond to five doses of ScBi (0.6, 0.8, 1.0, 1.3 and 1.7 g L^{-1}), five of the MoAm (16, 18, 20, 25 and 30 g L^{-1}) and five doses of AcSu (120, 130, 138, 160 and 180 mL L^{-1}). The last factor was VitC with doses of 1.2; 1.4; 1.6; 2.0 and 2.4 g L^{-1}. To prepare each WR_i, initially, 1 L of each of R725i was prepared. Then to prepare each of the WR_i, 200 ml of the R725i were taken with the respective doses of VitC and the volume was completed to 1 L. In the sequence, WR was defined for DM with 2 mL of extract M3 plus 8 mL of RT and with 8 mL of the extract 2 mL of WR, (2 + 8) and (8 + 2), respectively. The spectrophotometric efficiency of the DM was evaluated by the slope of the calibration curves and by the sensitivity, limit of detection and precision. Higher slope, better sensitivity, better detection limit and high precision were achieved with the R725 composed of 2.0 g L^{-1} ScBi, 30.0 g L^{-1} MoAm and 138 ml L^{-1} AcSu. Thus, it has been defined that 125, 200 and 500 mL of this R725 and 1.0, 1, 2, and 5 are required to prepare 1 L of WR for DM (2 + 8), (5 + 5) and (8 + 6 and 4.0 g of VitC, respectively.

Keywords: bismuth subcarbonate, sensitivity, detection limit, precision

Financial support: Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq)

(2307 - 2900) Compositional analysis of cations and potential acidity of soil for Marandu palisadegrass fertilized with nitrogen sources

Elisângela Dupas[1]; Salatiér Buzetti[2]; Tárik Cazeiro El Kadri[1]; Maílson Vieira Jesus[1]; Marlene Estevão Marchetti[1]; Marcelo Carvalho Minhoto Teixeira Filho[2]

UFGD[1]; UNESP[2]

The objective of this work was to perform the compositional analysis of the cations ($N\text{-}NH_4^+$, K^+, Ca^{2+}, Mg^{2+}) and the potential acidity (H+Al) of the soil in the 0-20 cm layer, in Marandu palisadegrass (*Urochloa brizantha* cv. Marandu) in response to sources of nitrogen - N (urea, urea with urease inhibitor, polymer coated urea, ammonium sulfate, ammonium nitrate, ammonium sulphonitrate and without N) in five harvests in Ilha Solteira, SP, Brazil (20^o 21′ S, 51^o 22′ W and 226 m), applied 100 kg ha^{-1} of N per harvest. The compositional analysis was made based on the following sequential binary partitions of the *isometric log ratio* (*ilr*), where *ilr-1* = [$N\text{-}NH_4^+$, K^+, Ca^{2+}, Mg^{2+}|H+Al] and *ilr-2* = [$N\text{-}NH_4^+$|H+Al]. The *ilr-1* contrast was used to evaluate the balance between cations and soil acidity, and the *ilr-2* evaluated the effects of the addition of N sources on soil acidity, that is, the decrease in the value of pH and, consequently, increase in Al^{3+} content due to nitrification. The experimental design was a randomized complete block with four replications. There was significant effect isolated for N sources and cuts for *ilr-1* and *ilr-2*. The treatment without N presented higher value and positive of *ilr-1*, not differing from treatments urea with urease inhibitor and polymer coated urea, demonstrating a lower *isometric log* ratio of cations in soil than H+Al, responsible for soil acidity. The treatment with ammonium sulfate obtained the lowest value of *ilr-1*, not differing from the treatments urea, ammonium nitrate, polymer coated urea and ammonium sulphonitrate, indicating a higher proportion of cations than H+Al. In the first and third harvests, the *ilr-1* presented a negative value, demonstrating that there was a higher proportion of cations than H+Al, and these values did not differ from the fifth harvest. For the second and fourth harvests, the highest proportion of cations occurred in relation to H+Al, not differing from the fifth harvest. The *ilr*-2 not showed difference between N sources, however, for all N sources, the H+Al ratio was higher than $N\text{-}NH_4^+$. In relation to the harvests, the second was the only one that expressed negative value and differed from all other observations, meaning that the proportion of $N\text{-}NH_4^+$ was higher than H+Al. The highest values were from the first and fifth harvests, which differed from the third and fourth harvests. There were higher proportions of H+Al than $N\text{-}NH_4^+$, indicating that nitrogen fertilizers acidified the soil.

Keywords: acidity of soil, ammonium sulphonitrate, isometric log ratio (ilr), polymer coated urea, urea with urease inhibitor

Financial support: CNPq

(2541 - 1049) Corn inoculated with *Azospirillum brasiliense* grown under cover crops and ash

Jonas Guerra[1]; Gabriela Naibo[2]; Rodrigo Roani[2]; Cristiane Pain[2]; Wilson Galli[3]; Cristiano Nunes Nesi[4]; Mauricio Vicente Alves[4]

University of West of Santa Catarina, 696 - Dirceu Giordani Street, Jardim Tarumã, Xanxerê, Zip Code: 89820-000, Brazil (guerraagronomia88@gmail.com);[1]; University of West of Santa Catarina, 696 - Dirceu Giordani Street, Jardim Tarumã, Xanxerê, Zip Code: 89820-000, Brazil[2]; University of West of Santa Catarina, 696 - Dirceu Giordani Street, Jardim Tarumã, Xanxerê, Zip Code: 89820-000.[3]; Professor, University of West of Santa Catarina, 696 - Dirceu Giordani Street, Jardim Tarumã, Xanxerê, Zip Code: 89820-000.[4]

The aim of this study was to evaluate the effect of soil management in winter, the use of ash and nitrogen supply on yield and yield components in the corn. The experiment was carried out at the experimental plant of Unoesc - Xanxerê / SC, from May 2016 to April 2017. The soil of the experimental area is classified as dystrophic Red Latosol (Oxisoil), and the climate classified as Cfb. The experimental design was randomized in blocks with four replications under the arrangement in sub-divided plots. In the plots the winter management treatments were randomized: fallow, fallow with ash application, black oats / common vetch mixtures and black oats / common vetch / ash residues mixtures. No-tillage was the system used for sowing, with intercropping between vetch (40 kg ha^{-1}) and oats (50 kg ha^{-1}) and fertilization according to soil analysis and crop requirements. The ash dose was indicated according to the potassium content of the ash and the required by the culture. After the end of the cover crop cycle, the area was desiccated and the ashes reappeared (23.81 t ha^{-1}), starting the second step of the experiment (November, 2016 to March, 2017). Fertilizers were calculated according to the interpretation of the soil analysis, for a production expectation of 12 t ha^{-1} of grain. The subplot was corn seeded with and without inoculation with *Azospirillum brasiliensis*, with the inoculant being applied to the seeds at the dose of 500 ml ha^{-1}. In the sub-subplot, the application of mineral nitrogen (within or without) at a dose of 200 kg / N ha^{-1}, was been spread at 21, 33 and 44 days after emergence of the corn. Upon reaching the stage of physiological maturation, a thousand grain weight (TGW), number of grains, number of rows per cob and productivity. Sample datas were submitted to analysis of variance using F test, with 95% confidence. The results showed no statistical difference of the biological fixation for the number of rows per cob, number of grains per spike and TGW. However, for the yield of the corn culture, a positive statistical difference was obtained for the use of *Azospirilum brasiliensis* (11.596 kg ha^{-1}) when compared to treatments without

inoculation (10.447 kg ha^{-1}). This result demonstrated the potential of inoculation with *Azospirillum brasiliensis* as an alternative source to increase corn crop yield. The use of ash did not change any variables.
Keywords: *Zea mays*, biological fixation, oats and vetch, industrial residue
Financial support: Research and Extension Scholarships FUMDES-SC, FAPESC, Celulose Irani, Unoesc – Xanxerê

(1013 - 1034) Corn nutrition cultivated with organic and mineral fertilization

Eric Victor De Oliveira Ferreira[1]; Luis Artur Batista de Andrade[2]; Jennifer Alves Camilo[2]; Elizete dos Reis Lima Carvalho[2]; Greice Leal Pereira[3]; Samuel Petraccone Caixeta[2]
Universidade Federal Rural da Amazônia[1]; Universidade Federal de São João Del Rei[2]; Universidade Federal de Viçosa[3]

Under natural conditions, most of the tropical soils present high acidity and low availability of nutrients, mainly macronutrients, which reduces their uptake by plants. Such scenario requires correction and fertilization of these soils to obtain high yields. The objective of this work was to evaluate the macronutrient contents of the silage corn shoot (hybrid RB 9004 VT PRO) by the substitution (partial and total) of the mineral fertilization by organic fertilization via barn compound. An experiment was carried out at Barreiro Alto Farm (Sete Lagoas, Minas Gerais State, Brazil), from November 2016 to February 2017, in soil cultivated under no tillage system. Before the installation of the experiment, the soil (0-20 cm) presented pH (H_2O)= 5.5; organic matter= 2.0 %; P and K (Mehlich 1)= 26 and 135 mg/dm³ respectively; base saturation= 51 % and clay= 70 %. It were evaluated nine treatments in a randomized complete block design, with four replications (15 m² each plot). The treatments consisted of combinations of mineral fertilization (200 to 400 kg/ha of 30-0-10) and organic (4 to 8 t/ha) in the topdressing, applied on the soil surface near the planting line, besides the control (without fertilization). At planting, all treatments (except for the control) received 230 kg/ha of 9-44-0 (N-P_2O_5-K_2O) and 70 kg/ha of 0-0-60. There was a treatment with only organic fertilization, being applied 6 t/ha of the barn compound in both the planting and the topdressing. Barn compound (C/N= 16, organic matter= 43.5 %, CEC= 64.5 $cmol_c$/kg, P and K= 2.49 and 2.48 % respectively) consisted of waste (manure and urine) of dairy cows mixed with pieces of eucalyptus wood, being this material mixed twice by day. At the end of the experiment (90 days), were randomly collected the shoot (stem, leaves and ears) of ten plants within each plot, being three of them dried (70 ºC/96 h), ground and sent to the laboratory for determination of macronutrients. The results were submitted to analysis of variance ($p<0.05$) and to the Tukey test in the Sisvar software. There was no statistically significant difference between treatments on nutrient content in corn shoot, with mean values (g/kg) of N= 12.1; P= 1.4; K= 8.9; Ca= 2.2; Mg= 1.5 and S= 0.8, probably due to the initial good soil fertility. Under such conditions, the barn compound provides corn nutrition similar to mineral fertilization.
Keywords: macronutrients; tropical soils; silage corn; *Zea mays*
Financial support: Financial Support: Barreiro Alto Farm

(3319 - 2063) Correction of soil acidity and nutrient availability in a Oxisol

Luis Felipe Rodrigues de Aquino Sousa[1]; Ricardo Miranda dos Santos[2]; Carlos Alberto Kenji Taniguchi[3]; Márcio Cleber de Medeiros Corrêa[1]; William Natale[1]
Universidade Federal do Ceará[1]; Universidade Federal de Viçosa[2]; Empresa Brasileira de Pesquisa Agropecuária - Embrapa[3]

Brazilian soils are mostly characterized by being acidic reaction and low natural fertility. Several factors affect the availability of nutrients, one of them is pH. Liming is a practice widely used for soil acidity correction. Its main effects are the increase of pH, decrease of acidity, increase of Ca and Mg concentrations and, increase of the availability of P. Thus, the objective of this work was to evaluate the effect of liming on the availability of P, K, Ca and Mg in acid soil. For this, samples of Oxisol were collected in the municipality of Maracanaú-CE, Brazil, with the following chemical properties: pH(water) 4,6; 5.4 mg dm^{-3} of P; exchangeable contents of K, Ca, Mg, Na, H + Al, Al, cation exchange capacity (CEC) of 1.1, 1,3, 2.5, 0.3, 38.8, 10.0, 43.9 mmolc dm^{-3} respectively; base saturation (V%) of 12%. The soil was incubated with increasing amounts of limestone, CaO = 32% and MgO = 15%, in amounts sufficient to raise the base saturation (V%) to: 25%, 35%, 45%, 55%, 65%, 75% and 85%; with four replicates, in a completely randomized design. The amounts of limestone were calculated by the base saturation method. After thirty days of incubation soils were removed from the vessel and sent to the laboratory for chemical analysis of pH, P, K, Ca and Mg, to evaluate the availability of these elements. at end, the regression method was applied to evaluate the data, relating them to V%. Based on the results it was found that there was an increase in pH, in the concentrations of P, K, Ca and Mg so in linear trend ($P<0.05$). The pH increase (pH = 4.03 + 0.03V% R^2 = 95%) is the result of the reaction of the H + ions with the hydroxide produced by the limestone reaction. The elevation of Ca (Ca = 1.52 + 0.224V% R^2 = 97%) and Mg (Mg = 0.82 + 0.151 V% R^2 = 93%) results from the application of limestone, which is composed of carbonates of Ca and Mg. The same applies to P, which had its availability increases at P = 5.93 + 0.013V% R^2 = 86%. This increase is due to the release of P adsorbed to the oxides, which become more soluble with increasing pH. The availability of K increased by K = 1.03 + 0.001V% R^2 = 31%. This low effect on the availability of K can be explained by the low initial concentration of K in the soil. It is concluded that liming, in fact, reduces the acidity and increases the availability of nutrients in the soil.
Keywords: Liming; Base saturation; Soil fertility.
Financial support: Embrapa Agroindústria Tropical

(4817 - 2051) Cover Crop Cocktails as N and P Source in the Brazilian Semiarid

Antonio Pereira Filho[1]; José Teixeira Filho[2]; Tamires Santos de Jesus[3]; Vanderlise Giongo[4]
Universidade Federal do Vale do São Francisco[1]; Universidade Estadual de Campinas[2]; Universidade de Pernambuco[3]; Empresa Brasileira de Pesquisa Agropecuária - Embrapa Semiárido[4]

Many studies have shown the benefits of the single cultivation, but the value of varied cover crop plant cocktails has received less attention. The objective was to evaluate the availability of N and P by plant cocktails used as cover crop and green manure in the semiarid. The treatments were arranged in four blocks in a split-plot design with two soil management systems (tillage and no-till) and three cropping systems (Plant Cocktail 1 - 75% legumes + 25% non-legumes; Plant Cocktail 2 - 25% of legumes + 75% non-legumes; and Natural Vegetation). Fourteen species were included in the composition, comprised legumes, oilseeds and grasses. Dry biomass production and decomposition, nutrients accumulation and mineralization by plant cocktails and natural vegetation were evaluated. Decomposition and release of N and P was monitored by the litterbag-method. Plant cocktails reached a Dry Biomass production (~9.0 t ha^{-1}) twice higher than Natural Vegetation, essential for adoption of no-tillage systems in the region. Natural Vegetation showed less accumulation of N and P due to lower production of biomass in relation to Plant Cocktail 1 and 2. Dry biomass production and P and N accumulation by Plant Cocktail 1 and 2 had no significant differences. The decomposition of

50% of plant cocktails takes approximately 116 days by no-till system and 100 days by tillage system, showing a small difference between the types of soil management. The 50% of N mineralization occurred during the first 3 months which the higher N release ranged from 163.2 to 171.6 kg ha^{-1} with Plant Cocktail 1, varying with the type of soil tillage. P mineralization was influenced by soil management. Plant Cocktail 2 took 105 days to release 50% of P while no-tillage system took about 135 days. Plant Cocktail 2 released a mean of 29.8 kg ha^{-1} P during the first 3 months by conventional tillage. The use of Plant Cocktail was more effective than Natural Vegetation and proved possible alternative to supply the nutritional demands of N and P for a successional crop.

Keywords: plant mixture, dry biomass, green manure, mineralization rate, macronutrient
Financial support: Embrapa Semiárido, CNPq, Capes

(2814 - 2844) Cowpea: spacing and density of plants in cerrado soil.

Mauro Gomes dos Santos[1]; Weslany Silva Rocha[1]; Rogel Galvão Prates[1]; Ana Paula Ribeiro Barros[1]; Marcelo Alves Ribeiro[1]; Tânia Rodrigues Peixoto Sakay[1]; Eduarda Fernanda Gomes Viegas[2]; Raimundo Laerton de Lima Leite[2]; Rodrigo Ribeiro Fidelis[1]; Manoel Mota dos Santos[1]
Universidade Federal do Tocantins[1]; Instituto Federal do Tocantins[2]

The cowpea presents for planting, high adaptability to adverse conditions of the environment, such as climate, soils, as well as water deficit. Plant population and spacing have been emphasized among many farmers, as they are directly related to increased productivity; are key points to obtain good results in the production of grains. The objective of this study was to evaluate the behavior of cowpea, cultivar BRS Sempre Verde, on the spacing and density of plants in Cerrado soil, in the 2013/2014 harvest. The experiment was carried out at the Experimental Farm of the Federal University of Tocantins – Gurupi, on a Dystrophic Yellow Red Latosol. The experimental design was a randomized complete block design, with a 2 x 3 factorial scheme, with four replications of 4 m in length, spacings of 0.35 and 0.70 m between rows and three densities (4, 8 and 12 plants / m), the results were submitted to the Tukey test at the 5% level. The evaluated characteristics were flowering, stem diameter, mass of one hundred grains, total chlorophyll and productivity. There was interaction of plant densities per linear meter with the spacings between rows for the stem diameter characteristic; and line spacings and plant densities per linear meter did not influence productivity.

Keywords: Keywords: Vigna unguiculata; Latosols; Performance.
Financial support: Federal University of Tocantins and Federal Institute of Tocantins

(1059 - 723) Critical limits for microbial indicators in tropical clayey Oxisols: towards the FERTBIO soil sample concept

Ieda de Carvalho Mendes[1]; Leandro Moraes de Souza[2]; Djalma Martinhão Gomes de Sousa[1]; André Alves de Castro Lopes[2]; Fábio Bueno dos Reis Junior[1]; Marilusa Pinto Coelho Lacerda[2]
Embrapa Cerrados[1]; Universidade de Brasilia[2]

The FERTBIO soil sample concept considers the advantages that the unification of the time of sampling and of the sample pretreatment procedures for soil chemical fertility (FERT) and microbiological (BIO) analyses, would bring for farmers and commercial laboratories. This study examined the effects of two soil sampling/handling strategies (flowering stage /field-moist soil samples (FFM) and post-harvest stage/air-dried soil samples (PHAD)) on the critical limits (CLs) for microbial biomass carbon (MBC), and soil enzymes β-glucosidase, arylsulfatase, acid phosphatase and dehydrogenase. Soil samples (0 to 10 cm depth) were collected in the years 2013 and 2015, from 24 treatments from three long-term experiments, on a Cerrado clayey Red Oxisol, in which P fertilization management was used to modulate crop yields and soil organic carbon (SOC). Linear regressions showed that the PHAD sampling was representative of the FFM. In spite of significant reductions of MBC (19%), β-glucosidase (62%), arylsulfatase (56%), acid phosphatase (64%) and dehydrogenase (63%), the PHAD sampling preserved the ranking of the treatments and did not alter the adjustment of regression models between SOC and the microbial indicators. Adequacy classes for each microbial indicator as a function of SOC were established based on the following criteria: ≤40%: low; 41 to 80%: moderate; and >80%: adequate. At the PHAD, the CLs equivalent to 80% of the SOC for MBC, β-glucosidase, arylsulfatase, acid phosphatase and dehydrogenase were: 325 mg C kg^{-1}, 116 µg p-nitrophenol g^{-1} h^{-1}, 71 µg p-nitrophenol g^{-1} h^{-1}, 495 µg p-nitrophenol g^{-1} h^{-1} and 41 mg TPF kg^{-1}soil $24h^{-1}$. The interpretative tables generated using the FERTBIO soil sample concept represent an important step towards the research efforts to incorporate microbial indicators in routine commercial soil analyses in Brazil.

Keywords: β-glucosidase, arylsulfatase, acid phosphatase, dehydrogenase, microbial biomass carbon, soil quality
Financial support: Embrapa; CNPq (National Council for Scientific and Technological Development), FAPDF (Research Support Foundation of the Federal District) and MCTI/CNPq/CAPES/FAPS (INCT-MPCPAgro)

(4957 - 2106) Crop residues amendments shaped the N transformation processes in soil during solarization

Chen Wang[1]; Guitiong Li[1]; Kun Zhu[1]
College of Resources and Environmental Sciences, China Agricultural University[1]

Biosolarization, where soil is amended with organic residues prior to solarization, can accelerate pest suppression, compress the solarization timetable, and facilitate effective treatment in relatively short time periods. The advanced understanding of N transformations in soil during solarization would be crucial for the optimization of biosolarization strategies. However, the N transformations in soil during solarization is rarely investigated. A greenhouse trial was employed in this study to examine the effects of crop residues amendment on soil heating, pH,microbial biomass carbon and nitrogen （MBC and MBN）, enzyme activity dynamics during biosolarization. Four treatments were designed in greenhouse in Shunyi, Beijing.We used wheat straw as the organic amendments. Control treatment had no amendments. To study the impact of pre-immobilizaton of NO_3-, another treatment was added with wheat straw 5 days earlier. Biochar was co-incorporated with wheat straw as the last treatment. We were aiming to verify microbial biomass carbon and nitrogen dynamic changes in soil during biosolarization period. Stable isotope tracing technique was applied to study the key N transformation processes during solarization. The current results suggested that wheat straw is an effective organic amendments for biosolarization, Furthermroe, earlier addition of wheat strawcould substantially reduce N loss and increase MBN and MBC, co-application of biochar could enhance the N retain in soil during the biosolarization process.

Keywords: solarization,crop residues,N transformation,^{15}N tracing
Financial support: Chinese National key R&D plan 2017YFD0200801-02

(5338 - 2370) Determination of the degree of humification of organic matter in production systems by laser-induced fluorescence spectroscopy (LIFS)

Jean Carlos de Almeida Ramos[1]; Jaqueline Bonfim de Carvalho[1]; Diego dos Santos Pereira[1]; Christtiane Fernandes Oliveira[1]; Deise Cristina Santos Nogueira[1]; Paulo Alexandre da Silva[1]; Ludhanna

Marinho Veras[1]; Maria Elisa Vicentini[1]; Debora Marcondes Bastos Pereira Milori[2]; Alan Rodrigo Panosso[1]
Paulista State University[1]; Embrapa Instrumentação[2]

The quantity and quality of soil organic matter (SOM) are influenced by climate, soil type and agricultural practices. Humic substances account for about 80% of the soil MOS content formed by a combination of polyelectrolytes from the biological action of microorganisms on plant and animal remains that are more stable fractions of MOS that remain for a long period in the soil. HLIFS is used as an index to evaluate how stable or humidified MOS is, since the more humidified the MOS is, the more durable it will be. Therefore the determination of HLIFS is an important indication of the stability of this component in soil. The objective of this work was to evaluate the influence of five different production systems on the degree of organic matter humification (HLIFS), in the municipality of Selvíria - MS. The data were collected in areas of native forest (MN), eucalyptus forest (EU), no - tillage (PD), pinus forest (PI) and silvopastoral system (SI), located in the municipality of Selvíria - MS, in the year 2017. For the determination of HLIFS, the laser-induced fluorescence (LIFS) analyzes were used. The LIFS technique has as basic principle the excitation of the soil samples with a laser, resulting in the fluorescence of functional groups of the organic matter, related to the humification process (MILORI et al., 2006). Samples were analyzed with 2 replicates per pellet, totaling 4 replicates per sample, in order to remove the mean of the HLIFS from each pellet. The highest HLIFS index was found in the PI, while the MN and SI had the lowest HLIFS in the depth of 0.0-0.1 cm. The difference in HLIFS among all evaluated areas shows how this attribute is influenced by management systems. This result evidences that the SI for integrating two crops in the same area promotes the accumulation of labile organic material similar to the MN area, so it is a system that most imitates native ecosystems, that is, it aims to reduce the effects of anthropic interference , therefore it is less labile, presenting a behavior similar to MN, thus being an important system for use in environmental and economic sustainability.

Keywords: degree of humification of organic matter, conservation systems, quality of organic matter.
Financial support: CAPES and FAPESP

(1319 - 1214) Development of new predictive models to estimate lime requirement of soils from Minas Gerais state, Brazil.

Welldy Gonçalves Teixeira[1]; Víctor Hugo Alvarez V[1]; Júlio César Lima Neves[1]; Rodrigo Bazzarella Paulúcio[1]
Universidade Federal de Viçosa[1]

Numerous methods have been developed to estimate lime requirement (LR) in Brazil, but discrepancies exist in relation to their efficiency in this determination. This study aimed to develop new models for LR estimation, in order to achieve target pH values on a wide range of soils from Minas Gerais state, Brazil. Treatments derived from a factorial with 22 soils and 10 lime rates. Soil samples (0 - 20 cm) were collected throughout Minas Gerais state, in native areas under forest and savanna (Cerrado) that had never been limed. These soils were incubated for 60 d with lime rates determined by seven LR methods traditionally used in Brazil: exchangeable acidity; base saturation; exchangeable acidity and Ca + Mg contents (two versions); SMP buffer pH; potential acidity, and soil pH and organic matter (OM) content. In addition, a non-limed treatment and other two lime rates were included. Soil pH_{H2O} measured at the end of incubation period was plotted as a function of lime rates. Then LR needed to attain pHs 5.8 and 6.0 (incubation LR) were estimated. Incubation LRs were plotted against relevant chemical and physico-chemical properties of unlimed soils. As a result, four nonlinear regression models for estimating LR to pHs 5.8 and 6.0 were fitted. The new LR methods developed in this study consist in models relating incubation LR with ΔpH (target pH_{H2O} - initial pH_{H2O}) multiplied by either OM or potential acidity (HAl). Predictive models based on OM to pHs 5.8 (R^2 = 0.86) and 6.0 (R^2 = 0.89) showed nearly identical goodness of fit, which was higher than the models based on HAl to pHs 5.8 (R^2 = 0.76) and 6.0 (R^2 = 0.84). Nevertheless, the four predictive models have high R^2 values and are similar at providing good LR predictions. LRs as predicted by traditional and new methods were related to incubation LR through linear regression analysis. We observed that traditional LR methods were less correlated ($r \geq 0.67$, $p < 0.05$) with the standard incubation method than the new predictive models ($r \geq 0.87$, $p < 0.01$). All traditional LR methods under or overestimated LR to pHs 5.8 and 6.0, as indicated by intercepts > 0 and slopes < 1. However, intercept and slope values of the regression lines for the new predictive models were not significantly different ($p > 0.05$) from 0 and 1, respectively. Thus, the new predictive models were found to be better than the traditional LR methods as they efficiently predict the amount of lime needed to achieve the desired target pH

Keywords: Lime rates; potential acidity; organic matter.
Financial support: Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq), Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES)

(4688 - 829) Distribution of C and N in mineral-associated and particulate organic matter within aggregates in a calcareous silty clay loam soil under high-input agro-ecosystems

Xueping Wu[1]; Jing Li[1]
Institute of Agricultural Resources and Regional Planning, Chinese Academy of Agricultural Sciences[1]

Multiple studies on the formation of soil aggregates and occlusion of organic matter therein have provided valuable insights into the nature and stability of management-induced organic carbon (OC) and nitrogen (N) storage. However, the intensified agro-ecosystems in North China with large mineral fertilizer and organic manure inputs are not represented by past field experiments. We applied a combined soil aggregate size, and particle density and size fractionation procedure to obtain physical fractions including free and occluded particulate organic matter (fPOM and oPOM) and mineral associated fractions ($Mineral_{>53}$ and $Mineral_{<53}$) within three aggregate sizes (> 2 mm, 0.25-2 mm and < 0.25 mm). Soils were collected from a medium-term field trial involved 4 fertilization treatments: no fertilizer, CK; nitrogen (N) and phosphorus (P) fertilizer, NP; maize straw combined with NP fertilizer, NPS; manure plus straw and NP fertilizers, NPSM. The application of N and P fertilizer alone was not capable of increasing the OC and N in the three aggregates investigated, while the application of NPSM and NPS significantly and evenly augmented OC and N sequestration in all aggregates. NPS and NPSM led to higher amounts of organic C and total N accumulated in unprotected fPOM, and this process predominantly took place in > 2 mm and 0.25-2 mm macroaggregates. NPS and NPSM application also resulted in larger OC and N storage of physically protected oPOM, which explained the highest portion of newly loaded C and N. Furthermore, at least 50% of increased oPOM was stored within 0.25-2 mm aggregates. Extra manure application on top of straw did not further increase the storage of $Mineral_{<53}$-OC or -N, indicating these fractions appeared to be saturated. Thus, we concluded that the increased C and N inputs due to organic fertilizers are predominately stored as fPOM and oPOM in macroaggregates, which would be easily lost again by continuous tillage practices. These have to be carefully taken into account when setting realistic and effective goals for long-term sequestration of OC in intensively agricultural ecosystems.

Keywords: Fertilization; Soil organic carbon; Aggregate; Physical fractionation; Manure; Straw
Financial support: Science and Technology Project of China (2015BAD22B03)

(3179 - 2428) Do biowastes change the essential oil quality and quantity?

S. Seyedalikhani[1]; J. Esperschuetz[1]; N.M. Dickinson[2]; R. Hofmann[1]; J. Breitmeyer[1]; J. Horswell[3]; B.H. Robinson[4]
Lincoln University - Faculty of Agriculture and Life Sciences, Department of Soil and Physical Sciences, P O Box 84, Lincoln 7647, New Zealand[1]; Lincoln University - Faculty of Agriculture and Life Sciences, Department of Ecology, PO Box 84, Lincoln 7647, New Zealand[2]; The Institute of Environmental Science and Research Limited, Kenepuru Science Centre, PO Box 50-348, Porirua 5240, New Zealand[3]; School of Physical and Chemical Sciences, University of Canterbury, Christchurch 8041, New Zealand[4]

Biowastes are unwanted materials of biological origin, including biosolids and dairy shed effluent. Potentially, these wastes are low-cost sources of plant nutrients. However, they can also contain contaminations such as pathogens, heavy metals, and xenobiotics. Biowastes are widely used to improve plant growth on degraded or low-fertility soils, with a view to producing non-food products such as essential oils. We sought to determine the effect of biowastes on the quantity and quality of essential oils produced by lavender (*Lavandula angustifolia*), rosemary (*Rosmarinus officinalis*), and thyme (*Thymus vulgaris*). In a greenhouse experiment we grew the plants in a low fertility soil (Lismore stony silt loam) amended with either biosolids (1000 kg ha^{-1} N equiv.) or dairy shed effluent (200 kg ha^{-1} N equiv.). The maximum increase of the biomass was related to the thyme by biosolids addition (62%). Biosolids generally augmented the oil production of all three plants more than dairy shed effluent. The essential oil production of lavender, rosemary, and thyme increased by 71%, 39%, and 102% when biosolids were applied. Although biosolids increased the concentration of Zn, Cu, and Cd in the plant leaves, the levels were below than what can make a risk to ecosystems or human health. As a result, biosolids could be diverted from landfill to low-fertility lands, where they can enhance the essential oil production using lavender, rosemary, and thyme. To evaluate production economics and ecological variables field trials are essential.

Keywords: biosolids, biowastes, dairy shed effluent, essential oil, lavender, rosemary, thyme
Financial support: New Zealand International Doctoral Research Scholarship (NZIDRS) and The Centre for Integrated Biowaste Research

(8059 - 262) Do Land Characteristics Affect Farmers' Soil Fertility Management?

Shuhao Tan[1]
Renmin University of China[1]

Soil fertility management (SFM) has important implications for sustaining agricultural development and food self-sufficiency. Better understanding the determinants of farmers鈥 SFM can be a great help to the adoption of effective SFM practices. Based on a dataset of 315 plots collected from a typical rice growing area of South China, this study applied statistical method and econometric models to examine the impacts of land characteristics on farmers鈥 SFM practices at plot scale. Main results showed that in general land characteristics affected SFM behaviors. Securer land tenure arrangements facilitated effective practices of SFM through more diversified and more soil-friendly cropping pattern choices. Plot size significantly reduced the intensities of phosphorus and potassium fertilizer application. Given other factors, one hectare increase in plot size might reduce 3.0 kg ha-1 P2O5 and 1.8 kg ha-1 K2O. Plots far from the homestead were paid less attention in terms of both chemical fertilizers and manure applications. Besides, plots with better quality were put more efforts on management by applying more nitrogen and manure, and by planting green manure crops. Significant differences existed in SFM practices between the surveyed villages with different socio-economic conditions. The findings are expected to provide important references to the policy-making incentive for improving soil quality and crop productivity.

Keywords: Land tenure, land fragmentation, rice farming, soil fertility management
Financial support: This work was supported by the National Key Research and Development Program China (2016YFD0300903)

(9770 - 1206) Dynamics of nutrients in maize cultivation under application of various organic fertilizers with different C/N ratios.

R. Tamele[1]; H. Ueno[1]; Y. Toma[1]; N. Morita[1]
Ehime University[1]

The rising cost of inorganic fertilizers coupled with their inability to condition the soil in a long term application has directed attention to organic fertilizers in recent times. The application of organic materials (OMs) to soil is considered as a good management practices in any agricultural production system because it improves plant quality and soil fertility. The results below mentioned are products of a study on effect of different OMs with different C/N ratios on corn (*Zea mays*, dent corn) nutrients dynamics and soil properties. The study was conducted on a sandy-loam soil in Ehime University, Japan. Six treatments applied with chemical fertilizer (CF), rapeseed waste (RW), chicken manure, cow manure, bamboo compost (BC) and bamboo tealeaf compost were used in a randomized complete block design (RCBD) with five replications. Dynamics of N was also analyzed by application of ^{15}N tracer. The major distribution of N in all treatments trended as following: grains > leaves > stem, root. RW took up half of N compare with CF in spite of same yield, suggesting that the N use efficiency in RW is two times higher than that in CF. Corn mainly took up N from the fertilizers, and the amount of N was correlated with N mineralization rate (R^2 = 0.6724). The plant in CF took up the highest amount of N, in contrary plants in BC treatment took up the lowest amount of N derived from soil due to its high C/N ratio and low nitrogen immobilization rate during the cultivation. Moreover, almost of the soil N was accumulated in grain. It is assumed that the soil N taken up at the early stage accumulate in stem, then the N was translocated into grains at ripening stage of the experiment. The concentration of mineral nutrients in corn grains, in all treatments showed a trend: K > P > Mg > Ca. There is no significant difference in Ca and P concentrations among the treatments ($P < 0.05$). However, K and Mg concentrations in BC was significantly lower than those in CF. The lower concentrations of total nutrients in BC, may be due to the low growth.

Keywords: Organic fertilizer, nutrient concentration, mineralization, immobilization
Financial support: United Graduate School of Agric. Sci., Ehime University, Japan

(5371 - 206) Dynamics of the decomposition of sugarcane straw in the function of different levels maintained on the surface of the soil

Zigomar Menezes de Souza[1]; Camila Viana Vieira Farhate[1]; José Luiz Rodrigues Torres[2]; Ana Paula Guimarães Santos[1]
State University of Campinas (Unicamp), Agricultural Engineering (Feagri)[1]; Federal Institute of Triângulo Mineiro Campus Uberaba[2]

In the current scenario, the large volume of straw produced resulting from mechanized sugarcane harvesting may have two destinations: i) be kept in the field to decompose naturally, or ii) be removed to be use in bioenergy. The idea which naturally prevails is the partial collection of this field material for industrial use. However, the question of how much straw can be removed from sugarcane fields still needs to be scientifically clarified. Thus, we aimed at assessing the

dynamics of sugarcane straw decomposition as function of different levels maintenance on soil surface under different edaphoclimatic conditions. Our experimental design was a randomized block with four levels of dry biomass (straw) maintained on the soil surface: 0, 5, 10 and 15 Mg ha^{-1} in two areas with different conditions granulometric of soils (sandy and clay) and four replicates. We assessed sugarcane straw decomposition by using decomposition bags at days 90, 180, 270 and 360 after field distribution. When analyzing the rate of decomposition of sugarcane cultural residues at different soil straw levels (5, 10 and 15 Mg ha^{-1}), we observed a proportional increase to straw levels rise for two types of soil present in this study. Probably, a higher amount of straw resulted in higher soil moisture associated with lower thermal amplitude, which favored an increase in microbial biomass activity and consequently residue decomposition. The values of decomposition constant (k) and time half-life (T½) of the cultural residues calculated confirm the results presented for the decomposition rate, in which for both types of soil assessed, T½ of sugarcane straw decreased with an increase in biomass amount in the soil. Thus, we conclude that the maintenance of higher straw levels on the soil surface (10 and 15 Mg ha^{-1}) promotes decomposition acceleration regardless the type of soil.

Keywords: Bioenergy production; straw removal; decomposition constant.
Financial support: Foundation for Research Support of the State of São Paulo (FAPESP). Process: 2013 / 02792-1.

(8622 - 1008) Effect of different weed control methods on soil properties on a young teak stand in Costa Rica

Paola Hernández Rodríguez[1]; Edwin A. Esquivel Segura[1]; Mario Guevara_Bonilla[1]
TEC[1]

Weed control is a fundamental practice in plantation forestry. Null or inadequate plantation management can lead to growth reduction and economic losses. Several techniques are used in tropical forest plantations, however, few evidence exists on the effect of these methods on soil properties. The objective of the work was to evaluate the effects of different weed control methods in soil properties in a young teak stand. To perform the experiment, a trial was carried out in a randomized complete block design consisting of 7 treatments: Control, Chemical Control, Manual Control, Canavalia ensiformis cover crop, Vigna radiata cover crop, mix of Pueraria phaseloides with V. radiata, Crotalaria juncea cover crop and three repetitions. Changes in time of organic matter, soil carbon, soil fertility and nutrient content at foliar level were evaluated. No statistical differences were found in organic matter content and soil carbon. Soil fertility and nutrient content at foliar level were constant at 6 and 12 months. Significant differences were found in the nutritional concentration in soil of the elements Cu, Fe and Mn, as well as for K and P in the foliar analysis.

Keywords: soil fertility, cover crops, nitrogen, leguminous plants, forest production
Financial support: Instituto Tecnológico de Costa Rica

(2925 - 275) Effect of glyphosate application on biological variables in soils with different agronomic practices

Sterren Maria Alejandra[1]; Benintende, Silvia[1]; Uhrich, Walter[1]; Barbagelata, Pedro[1]
FCA-UNER[1]

Glyphosate is a broad-spectrum herbicide which use has increased since 2002, and the environmental consequences of its application are not clearly elucidated. There is no regional information available about the effects of the use of glyphosate on soils under different management practices. The aim of this study was to evaluate the effect of glyphosate herbicide after 2 days of its application, on some biological variables in Vertisol and Mollisol soils with good and deficient agronomic practices. The research was conducted on a long-term fields trials in a Vertisol and Molisol soil: continuous soybean (deficient agronomic practice, DAP) and sequence wheat/soybean-corn (good agronomic practice, GAP). Samples were taken from 0-2,5 cm in both soils types and management. We applied 2.14 L. ha^{-1} of active principle of glyphosate in each sample. We evaluated the following variables after 2 days of glyphosate application: Microbial Biomass C (MBC), respiration activity (RA) and hydrolysis of fluorescein diacetate (FDA). We performed Student' t- test to compare glyphosate application effect. In the Mollisol the effect of glyphosate application inhibited the RA in GAP (p=0,0172) and DAP (p=0,673). Microbial Biomass C also showed a lower level in both management practices (GAP: p=<0,0001 and DAP: p=0,0006). Glyphosate application provoked a decrease of 34 % in MBC in GAP, while in DAP, the decrease was of 62%. In the FDA variable, similar effects were observed although no significant differences were found. The enzymatic activity was 11% lower in GAP and 3% in DAP. In the Vertisol, the effect of glyphosate application decreased the RA only in DAP (p=0,0031), while in GAP, both treatments behaved in a similar way. In this soil order, differences between managements caused marked diminutions in organic matter content (11.3% in GAP and 8.7% in DAP). The clays content and differences of organic matter probably had a protector effect on biota activity (RA and FDA). However, MBC showed a lower level in GAP when the herbicide was applied. Glyphosate application provoked a decrease of 48 % in GAP (p=0,0001). In DAP no differences were found in MBC.

Keywords: glyphosate, biological variables, agronomic practices.
Financial support: Universidad Nacional de Entre Rìos

(8728 - 3064) Effect of manganese in a transgenic maize crop in sandy and clay soils

Daniele Scudeletti[1]; Leontino De Oliveira Neto[1]; Jader Luis Nantes Garcia[1]; Murilo de Souza[1]; Rafael Do Val Müller[1]; Dirceu Maximino Fernandes[1]; Leonardo Theodoro Bull[1]
São Paulo State University, School of Agricultural Sciences[1]

Maize (*Zea mays* L.), has a worldwide economic importance, being high productivity as a consequence of the adoption of technologies such as using transgenic plants for insect resistance and tolerance to herbicides such as glyphosate. In soybean plants, glyphosate interferes in mineral nutrition due to its action on shikimic acid metabolism, which may show lower efficiency in Mn accumulation than conventional materials. Our aim was to evaluate Mn behavior in the soil and absorption of $Mn2^{+}$ by the transgenic maize plant under the effect of glyphosate in soils with different water retention capacities, in manganese presence and absence. Our trial was carried out in a greenhouse at the University of Agronomic Sciences FCA / UNESP, Botucatu (SP, Brazil) with a genetic material of transgenic maize hybrid from Syngenta, cultivated in sandy soil and clayey soil with levels close to Mn in a water stresses of 60 and 90% of the water retention capacity, in Mn absence and presence. Daily weighing maintained the humidity and it was carried out until its vegetative stage V4. We analyzed height, stem diameter, shoot dry mass accumulation per pot and leaf content of Fe, Mn, Cu, and Zn. Soils were sampled and analyzed for Mn content.The experimental design was a randomized complete block with 2x2 double factorial, two values of water stresses, retention capacity of 60% and 90%, and Mn presence and absence. We performed a Tukey test at 5% by SAS software. Manganese sulfate in sandy soil provided higher manganese content on leaves, however, there was no difference for stem diameter, height and dry mass of shoot. Nevertheless, manganese sulfate in clay soil did not show a difference for the variables analyzed. As for the water slides, in sandy soil, the smallest blade provided higher dry matter mass and plant height, but the higher micronutrient contents were obtained when the largest water

blade was applied. In clay soil, the higher water depth provided higher plant height, stem diameter and higher manganese content in the top growth, but there was no difference between variables analyzed in the lowest water depth.
Keywords: Manganese behavior, transgenic maize, water retention
Financial support:

(8468 - 366) Effect of the application of olive mill waste on some chemical properties of a soil of the Souhtwest of Buenos Aires, Argentina.

Minoldo Gabriela[1]; Laurent Gabriela[1]; Suñer Liliana[2]
Universidad Nacional del Sur[1]; Universidad Nacional del Sur, Comisión de Investigaciones Científicas[2]

The southwestern area of Buenos Aires Province on Argentina has suitable ecological conditions for growing olive trees. Is for that, several oil mills in the area next to Coronel Dorrego city have been established. Since oil is extracted by two-phase system, an olive mill waste composed of pomace plus waste water is obtained (Spanish "alperujo"). For the year 2017, the olive production was about 20000 t, which represents around 15000 t of wastes. Alperujo could be used as soil amendment due to its fertilizing properties. The objective of this experiment was to study the effect of alperujo on some chemical soil properties of a 50 years old olive orchard. The soil in which the experiment was performed classify as *Petrocalcic Paleudolls*. Two laboratory experiments were conducted: one, was carried out on soil columns, where the horizons were placed following sequence and thickness of horizons at profile (Ap-A2-Bt-BC) within acrylic tubes. Alperujo was mixed with soil of the Ap horizon at a rate of 0, 20, 40 and 80 t ha^{-1}. Four irrigations were performed totalizing 669 mm. Cation exchange capacity (CEC), exchangeable cations; Ca^{2+}+ Mg^{2+}, Na^{+} y K^{+} and exchangeable sodium percent (ESP) were determined before and after application of alperujo. The other experiment consisted of soil + alperujo (0-5-10-20-40 t ha^{-1}) incubations for 75 days. Soil organic matter (SOM), total nitrogen (Nt), extractable and inorganic phosphorous (Pe and Pi, respectively) and pH were determined. Soil CEC of the Ap horizon increased from 17,10 to 24,35 meq $100g^{-1}$ as alperujo doses increased. At the same time, the Ca^{2+}+ Mg^{2+} increased from 13,0 to 18,10 meq $100g^{-1}$ and K^{+} from 2,66 to 4.91 meq $100g^{-1}$. Exchangeable sodium increased significantly for doses 40 and 80 t alperujo ha^{-1}, however the ESP did not step up to risky values (highest value 5.39% at 40 t ha^{-1}). In leachates the electrical conductivity (EC) diminished from 1.90 dS m^{-1} (L1) to 0.42 dS m^{-1} (L4). The pH values were variable. The cations showed the following tendency to leaching: Ca^{2+}+Mg^{2+} > Na^{+} > K^{+}. The Ca^{2+}+Mg^{2+} fell from 17.63 me L^{-1} (L1) to 5.22 me L^{-1} (L4). Na^{+} decreased after L4 (1.66 – 1.01 me L^{-1}) and K^{+} stayed between 0.42-0.73 me L^{-1}. After the mineralization process, the greater differences for SOM, Nt and Pi were observed for the dose of 40 t ha^{-1}. This increase in Pi is explained by a pronounced increase in Pe at the beginning of the incubation together with a drop in pH. The latter stabilized after 75 days.
Keywords: alperujo, soil, chemical properties
Financial support: Universidad Nacional del Sur (PGI 24 A/220); Municipio Coronel Dorrego, Province of Buenos Aires, Argentina.

(8369 - 3018) Effect of the K-N application levels on two oil palm genotypes in nursery stage

Maria do Rosário Lobato Rodrigues[1]; Emmanuelle Lamade[2]; Jean Ollivier[2]; Bernard Dubos[2]; Ricardo Lopes[3]; Wenceslau Geraldes Teixeira[3]
Brazilian Agricultural Research Corporation – Embrapa Western Amazon[1]; CIRAD[2]; Brazilian Agricultural Research Corporation[3]

Recently some researchers focus on the identification of planting material presenting a better efficiency towards nutrient applications and consumptions. Our work is focusing on the internal functioning of the mineral reserves of the plant, especially the absorption processes and the remobilization of some nutrients essential to oil palm as potassium, in addition with nitrogen. An experimental has been conducted in controlled conditions, with the objectives to study the effect of K-N gradient on the mineral allocation at the plant scale and to compare two progenies (G1 and G2), presenting contrasting leaf potassium content (G1 will be characterized as K- - and G2 as K++). Pre-germinated seeds, after 3 months of pre-nursery, were transferred to plastic pots (6 kg) with a growing medium composed of 50 % sand and 50 % vegetal commercial compost. The plants were submitted to four potassium levels (K0, K1, K2, K3) and two levels of nitrogen (N1, N2) in a block design with three repetition. A first set of measurements started with three months, a second eight months on 36 plants by progeny (G1 and G2) belonging to N1K0, N1K1, N1K2, N1K3, N2K0 and N2K3 treatments. The results concerning foliar mineral analyses show out high levels for nitrogen (N), potassium (K) and magnesium (Mg) for G2 genotype. The levels were N%=2.26 (±0.17), K%=1.64 (±0.21), Mg%=0.476 (±0.04) for G2. For Genotype G1 the foliar levels were N%=1.89 (±0.20), K%=1.478 (±0.24), Mg%=0.394 (±0.04). The evaluations of chlorophyl content, using SPAD 502 (Minolta, Japan) on the three youngest leaves of each plant, showed an increase of the chlorophyll content from leaf rank one to leaf rank three. The chlorophyll content was higher in K- of leaves than in K+ ones for the two measurement dates. The results concerning the biomass showed differences between genotypes in all evaluations. Leaf and and roots biomass were higher for G1 in both dates of measurments. G1 and G2 showed contrasted "above ground/roots" ratios that increased during plant growth (first sampling of G1=1.65 (±0.21) and G2=1.80 (±0.19), second sampling G1=2.18 (±0.40) and G2=2.63 (±0.78). Significant differences were observed for starch between G1 and G2 with higher concentration for G1 compared to G2. The first investigations undertaken just after germination stage for the two genotypes do confirm their potassium characterization K- - for G1 and K++ for G2. This difference could be a genetic characteristic plant?.
Keywords: Elaeis guineensis, starch, nutritional efficiency
Financial support: Embrapa e CIRAD

(6666 - 257) Effectiveness of a micronutrient delivery system fertilizer in jatropha plants is related to enhanced photosynthesis, gas exchange and biomass allocation

Alexandre Bosco de Oliveira[1]; Wagner A. Vendrame[2]
Federal University of Ceará[1]; University of Florida[2]

This study aimed to compare the growth and physiological changes in *Jatropha curcas* L. (jatropha or physic nut) young plants fertilized or not with a commercial product based on a micronutrient delivery system (MDS), under different doses of NPK. Measurements of growth, chlorophyll content and leaf gas exchange were performed in the greenhouse, where plants were arranged in a split-split plot design. Plants were grown for 120 days in 3.9 L pots containing local soil, with or without MDS (main plot), combined with NPK doses (0; 1.8; 4.7 and 7.4 g L^{-1}) in subplots. Dose-response curves showed that most variables were positively responsive to NPK doses in plants growing without MDS, whereas slight responses or even opposite behavior was observed in MDS-fertilized plants. MDS application under low NPK doses resulted in higher biomass allocation in leaves and roots, increases in number of leaves and chlorophyll content, plant height, stem diameter, shoot and root dry weight, stomatal

conductance, photosynthesis, leaf transpiration, and water use efficiency, as well as decreases in intercellular CO_2 in the leaf and vapor-pressure deficit. The enhanced biomass allocation, photosynthesis and gas exchange in MDS-supplemented plants indicates the relevant role played by this fertilizer in jatropha metabolism, resulting in more vigorous plants.

Keywords: *Jatropha curcas* L.; Biofuel crops; Ecophysiology; Sustainable fertilizer management; Bioavailable mineral nutrients.
Financial support: Coordination for the Improvement of Higher Education Personnel (Coordenação de Aperfeiçoamento de Pessoal de Nivel Superior – CAPES, Brazil) and University of Florida.

(7242 - 428) Effects of Agricultural wastes on Potassium Quantity – Intensity parameters of some soils in Ogun – state, South – Western, Nigeria

Taiwo, Adebimpe Abidemi[1]; Adetunji, M.T[2]; Elemo, K.T[2]; Azeez, J.O[2]
Moshood Abiola Polytechnic, Abeokuta,Ogun state Nigeria[1]; The Federal of University Agriculture, Abeokuta[2]

The study was conducted to investigate the effects of three agricultural wastes, namely poultry, cattle and goat manure on the quantity- intensity of potassium and uptake as it relates to maize cultivation in some soils of Ogun –state, South-western Nigeria. The research was carried out at Moshood Abiola Polytechnic, research and teaching farm; the treatments were arranged in completely randomized design. The agricultural wastes were applied at following rates; 0.49 t ha^{-1}, 0.94 t ha^{-1}, 1.41 t ha^{-1} and 1.88 t ha^{-1}. Results of the study showed that the studied soils were predominantly sandy and slightly acidic. Large portion of K in the studied soils occurred in non –exchangeable form. The quantity - intensity parameters in the soil samples were low initially but higher values were observed after manuring, a reduction in energy of exchange (ΔG) was observed in all treatments these enhanced the K supplying power of the studied soils. leaf area, dry matter yield and K – uptake by maize increased with increase in rates of manure. Hence, higher concentration of organic manure can be employed where considerable quantities of K are required and high crop yields are needed. Two weeks after planting the maize plant were thinned to one plant per pot. At the end of each cycle, whole plant tops were harvested, oven dried at $60^{o}c$ for 48 hours. 5 gm of the plant tissue was milled digested with H_2SO_4-H_2O_2 mixture and K content was determined by flame photometry.

Keywords: Agricultural wastes, quantity, intensity, Potassium – uptake, maize
Financial support:

(8242 - 2328) Effects of the use of agricultural gypsum on the concentration of calcium, magnesium and aluminum in soils of southern Brazil.

Carla Fernanda Ferreira[1]; Antônio Carlos Vargas Motta[1]; Marcos Vinícius Martins Bassaco[1]; Cleiton Frigo[1]
UFPR[1]

The reactions that occur in soils after the application of agricultural gypsum are dependent on the solubility of this product and it acts in a different way between the layers in the soil. The main changes in the sorption complex after the application of gypsum are related to the increase of the Ca^{2+} and SO_4^{2-} ions, available to the soil solution, forming new ionic pairs such as $CaSO_4$, $MgSO_4$ and KSO_4, complexes that have high mobility and translocate to the deeper layers. The objective of this work was to quantify the concentrations of Aluminum (Al), Calcium (Ca), Magnesium (Mg) and other parameters of the sorghum complex of Dystrophic Red-Yellow Latosol by effect of different dosages of gypsum applied to the surface under hybrid cultivation Eucalyptus urophylla x Eucalyptus grandis (E. urograndis). This experiment was installed in two forest areas located in subtropical Brazilian conditions, in the municipality of Jaguariaíva and in the municipality of Ventania, Moquem district, and state of Paraná. Seven doses of agricultural gypsum 0, 300, 600, 1200, 2400, 4800 and 9600 kg ha^{-1} were applied to the haul. Soil collection was carried out every 6 (six) months, at depths between 0 and 0,20 m; 0,20 to 0,40 m; 0,40 to 0,60 m; 0,60 to 0,80 m and 0,80 to 1,00 m. In the samples collected at 6 (six) the pH ($CaCl_2$), Al^{3+}, $H^+ + Al^{3+}$, Ca^{2+}, Mg^{2+}, K^+, P (Mehlich), $C_{organic}$ acid were determined to quantify the Basal Sum (SB), Substitution of Cations (T), Basal Saturation (V%) and Saturation by Aluminum (m%). Already at 6 (six); 12 (twelve); 18 (eighteen) and 24 (twenty-four) months soil chemical parameters were quantified by determining the levels of Al^{3+}, Ca^{2+} and Mg^{2+}. An effect of the gypsum on pH ($CaCl_2$) was not expressed in absolute values. The agricultural gypsum did not interfere on the levels of K, P and Organic Carbon. The sum of the bases and the saturation of the bases presented higher indices in the deeper layers and responded to the addition of gypsum. The saturation by Al (m%) presented significance in practically all the layers of the evaluated soil. Agricultural gypsum reduced Al^{3+} contents, but concentrations remained very high in the soil. Ca^{+2} remained below the desired rates for crop development, although the percentage of increment of this element was high. On the other hand, the Mg^{2+} contents presented indices ranging from low to medium. For these parameters, the effects of gypsum were more significant in the evaluations at 6 and 12 months.

Keywords: Cation distribution; Aluminum; Calcium; Magnesium
Financial support: Universidade Federal do Paraná

(7849 - 1042) Effects of Tillage and Crop Residue Management on Soil Organic Carbon Stock Under Four Different Soil Types in Sudan-Savanna of West Africa

Eeusha Nafi[1]; Isaac Danso[2]; Thomas Gaiser[1]
Institute of Crop Science and Resource Conservation, University of Bonn, Germany[1]; CSIR-Oil Palm Research Institute, Kusi, Ghana[2]

Erosion of topsoil from agricultural lands due to increasingly intense rainfall and improper soil management practices has become one of the most crucial threats to crop productivity in Sudan-Savanna of West Africa, causing removal of soil organic carbon and loss of soil inherent fertility. To counteract the problem, a alternative management practices (a combination of tillage, crop residue incorporation and nutrient management) is proposed that has potential to prevent and/or reduce the severity of soil nutrient loss, sustain soil quality as well as improve crop productivity. The objective of this research is to evaluate the single and combined effects of tillage and crop residue management on soil organic carbon (SOC) stock in five-year, multiple site experiment (2012-2016) with maize-cotton rotation under four different soil types in Sudan-Savanna of West Africa. The study was established in 2012 at two different soil types (Eutric Plinthosol and Ferric Lixisol) in Tambiri (Dano watershed), Burkina Faso, and two other soil types (Plinthic Lixisol and Haplic Lixisol) in Ouriyouri (Dassari watershed), Republic of Benin. The experimental setup was a strip-split-plot design with four replicates comprising two tillage systems (contour ridge, CR and reduced, RT) in main plots, and two levels of crop residue (with, R1 and without, R0) and three mineral nitrogen fertilizer rates (0, 60, 120 kg/ha) randomised within the sub-plots. After five years, we sampled soil from different depths and measured soil organic carbon stock. The result showed that SOC stock was always higher under contour ridge tillage condition than the reduced tillage for all four soil types. The highest amount of SOC stock was observed for the Ferric Lixisol under contour tillage practice. On the contrary, the lowest content of SOC stock was recorded for the Haplic Lixisol under reduced tillage practice. Incorporation of crop residue had additive effects on SOC

stock. The results indicate that contour ridge tillage along with crop residue incorporation has potential to better preserve SOC stocks in the Sudan Savanna of West Africa.
Keywords: climate change, soil erosion, soil management, contour ridge, reduced tillage, crop residue, Sudan-Savanna, soil organic carbon stock
Financial support: German Federal Ministry of Education and Research (BMBF), Stiftung Fiat Panis

(4585 - 1168) Efficiency of soil-applied ^{67}Zn-enriched fertilisers in three consecutive crops

Edson M. Mattiello[1]; Eduardo L. Cancellier[2]; Rodrigo C. da Silva[3]; Fien Degryse[3]; Roslyn Baird[3]; Mike J. McLaughlin[3]
Universidade Federal de Viçosa[1]; Universidade Federal de Lavras[2]; Univesity of Adelaide[3]

A very small amount of applied Zn is taken up by crops, resulting in low apparent recovery by plants. Adding elemental sulphur to ZnO fertilisers could potentially improve Zn solubilisation and provide a higher residual effect for crops than soluble sources. We produced and evaluated the performance of an isotope-labelled Zn-elemental sulphur fertiliser for a sequential crop cultivation. Three ^{67}Zn-labelled fertilisers: ZnO, $ZnSO_4$ and ZnO cogranulated with elemental sulfur ($ZnOS^0$) were produced. Their contribution to the uptake of Zn by three consecutive crops of wheat, ryegrass and corn was assessed in a pot trial with a total experimental duration of 294 days. The contribution of fertiliser Zn followed the order: $ZnSO_4$>ZnO³ $ZnOS^0$. The relative contribution of fertiliser Zn was lower in the first crop than in the consecutive crops. The overall recovery of applied Zn by the three crops was higher for $ZnSO_4$ than for ZnO and $ZnOS^0$, reaching values of 1.56, 0.45 and 0.33%, respectively. Residual effects existed for all Zn fertilisers, including soluble source. The ES-Zn-containing fertilisers were ineffective in supplying Zn in the first crop cultivations, but their efficiency improved over time. However, these products were still much less effective than $ZnSO_4$ in supplying Zn to plants both initially, and over an extended time. Furthermore, fertilisers based on ZnO and ES have higher nutrient concentrations and lower costs compared to traditional soluble sources of S or Zn. Our study using labelled ^{67}Zn sources help us understand that soil Zn application has an important residual effect regardless Zn source.
Keywords: micronutrients, isotopes, elemental sulphur
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(3666 - 3069) Emission of N_2O from urine and feces of cattle grazing *Brachiaria brizantha* pasture fertilized with N or mixed with the forage legume *Desmodium ovalifolium*

Camila Almeida dos Santos[1]; Claudia de Paula Rezende[2]; Robert Michael Boddey[3]; Segundo Urquiaga[3]; Claudia Pozzi Jantalia[3]; Bruno José Rodrigues Alves[3]
Soils Department, IA, UFRRJ[1]; ESSUL, CEPLAC[2]; Embrapa Agrobiologia[3]

Bovine excreta (feces and urine) contribute to the increase of greenhouse gases (GHG), mainly nitrous oxide (N_2O), but there is a lack of information to estimate these emissions in pasture areas in Brazil. The objective of this study was to determine the fraction of N in urine or feces of Nelore cattle that is converted to N_2O. Excreta were taken from animals grazing pastures of *Brachiaria brizantha* cv Marandu fertilized (50 kg N ha^{-1} applied every four months) with urea (FP) or mixed with *Desmodium ovalifolium* (MP), apart from a control. The experimental design was a 3 x 3 factorial in randomized blocks, with 2 replicates. The main treatment corresponded to the pasture management, and the subplot, to the addition of excreta (urine, feces or without excreta). In each pasture, exclusion areas were set up to allow grazing but not trampling or dejection, in with static chambers were installed. In the area of each chamber, 1 L of urine or 1 kg of fresh feces were added. A third chamber were left without excreta as the control. The highest N_2O fluxes were observed with the addition of urine derived from the animals of FP, and the lowest when derived from the control. The fractions of the added N emitted as N_2O were 0.45%, 0.23% and 0.16% of the total N applied as urine, respectively for the treatments FP, MP and control. For feces, the fractions of the existing N that was emitted as N_2O were 0.008%, 0.011% and 0.018 % respectively for FP, MP and control. Urine was the main source of N_2O, but either for urine or feces emissions were lower than the 2% of any excreta N as described in the IPCC methodology for GHG inventories. The disaggregation of excreta type is fundamental for more accurate GHG inventories. N_2O emissions from excreta produced from animals grazing mixed pastures with *D. ovalifolium* is less impacting than that from N-fertilized pasture, although an analysis involving stocking rate and excreta production is required to a more accurate conclusion on this respect.
Keywords: Greenhouse gas; Cattle excreta; Nitrogen
Financial support: Embrapa, CEPLAC, Faperj, CNPq

(6520 - 2496) Eucalyptus yields response to the conditioning of a tropical Brazilian Cerrado soil

Leonardus Vergütz[1]; Rodrigo Nogueira de Sousa[1]; Bernardo Amorim Silva[1]; Vanderlayne Verônica Costa[1]; Lucas Vinícius Torres Lima[1]; Reinaldo Frederico de Siqueira Montalvão[2]; Ivo Ribeiro da Silva[1]
Universidade Federal de Viçosa[1]; MetalSider Florestal[2]

Most of Brazilian tropical soils are acidic, high in Al^{3+}, poor in nutrients and with high P fixation capacity, especially in the Cerrado, the greatest and most important agricultural and forestry frontier in the country. The fairly high yields achieved in these soils are due to the use of fertilizers and soil conditioners. The fate of gypsum in tropical soils is well known. It is an important tool to improve soil chemical conditions in depth in tropical soils and to improve crops nutrients and water use, increasing productivity. However, its benefits are rather underestimated and it is use is only marginal. Recently, the Brazilian Soybean Strategic Committee (CESB) has shown that even for an annual crop like soybean it is mandatory to have Ca in deeper soil layers in order to achieve high yields. In their annual soybean productivity contest, the only soil property constant in all high yield areas (≥ 97 bags/ha) was high Ca content down to 110 cm (≥ to 1 $cmolc/dm^3$), which increased root growth and distribution, improving plants water and nutrients use. Even though eucalyptus is known for its tolerance to drought stress and to acidic and low fertility soils, it is also responsive to fertilization. Thus, the aim of this work was to evaluate the productivity of eucalyptus in response to gypsum, among other soil conditioners, on a Brazilian Cerrado soil commonly used for eucalyptus plantation. Without any soil conditioner and only receiving 200 kg/ha of MAP at planting, the productivity of a 7 years old eucalyptus plantation was 212.0 m^3/ha. When the MAP was replaced by 500 kg/ha of a natural rock phosphate (Bayóvar), the productivity increased to 241.9 m^3/ha. When lime was applied (3,000 kg/ha), the best result came when it was applied banded as a 70 cm wide band and incorporated into the topsoil, that way the productivity increased to 302.8 m^3/ha. When lime was applied (2,400 kg/ha) with gypsum (1,000 kg/ha), allowing Ca to descend into the soil profile, the

productivity reached 334.1 m^3/ha, an increase of 57.6 % comparing to the control and 10.3 % comparing to highest productivity without gypsum. This increase is related to the better growth and distribution of the root system throughout the soil profile, giving more access to nutrients and water to the plants. Even though eucalyptus is a plant tolerant to low fertility soils, it responds to soil fertility buildup in the soil profile. In that sense, eucalyptus fertilization programs should be rethought.

Keywords: tropical soil; soil conditioner; soil conditioning; gypsum; soil profile; soil fertility
Financial support: NUTREE Group, FAPEMIG, and Metalsider Florestal

(3872 - 1122) Evaluation of coffee ground influence on the soil pH

Cleberson Tiago de Souza[1]; Jonas Guerra[1]; Jaqueline Gaio Spricigo[1]; Augusto Henrique Debiasi Orsatto[1]; Cristiane Pain[1]; Cristiano Nunes Nesi[2]; Mauricio Vicente Alves[2]
University of West of Santa Catarina[1]; Professor, University of West of Santa Catarina[2]

The disposal waste in the soil has historically been considered a solution for the most diverse sectors of society, materials that can provide improvements in chemical properties of soil, correcting acidity. The coffee grounds are generated from roasting and milling of the coffee in the industrial process, and have a low value and abundant waste, and can bring great benefits to the soil if applied correctly. Thus, the objective of this study was to evaluate the effects of coffee grounds on soil pH. The experiment was carried out at the University of Western Santa Catarina – UNOESC, campus Xanxerê at Xanxerê/SC, Brazil, from September to December, 2017. During the period of 105 days, the soil characterized as Dystrophic Red Latosol/Oxisoil was incubated in plastic bags with 2 kg of soil and percentages of coffee grounds. The experimental design was completely randomized, with six treatments: 0, 1, 2, 4, 8 and 16% (v/v) of coffee grounds in soil mixtures and five replicates. The soil moisture was maintained at 60% of the field capacity and at 105 days the water pH (1: 1) was evaluated. The data were submitted to regression analysis and the Mitscherlich model was the one that matched the data. The analyses have been done with R program (R Core Team, 2015). The water soil pH increases according to the dose of coffee grounds, stabilizing from the 10.85% (v / v) dose, the dose that ensured 99% of the maximum asymptote to pH was 8.79% (v / v), increasing soil pH from 5.1 to 5.9. Regarding for the characterization of the residue used, it was observed that it presents in its composition considerable amount of nutrients enhancing the plant nutrition besides conditioning the pH of the soil.

Keywords: residues, acidity correction, spent coffee
Financial support: Celulose Irani, Unoesc – Xanxerê

(6989 - 2896) Evaluation of dispersant solutions for the determination of available phosphorus in Particule Size fractions in a Brazilian Sandy Soil

David Vilas Boas de Campos[1]; Livia da Silva Chaves[2]; Bianca Braz Mattos[1]; Fabiano de Carvalho Balieiro[1]
Embrapa Solos[1]; Embrapa Solos / Universidade Severino Sombra[2]

Due to the complexity of soil organic matter, it is necessary to identify the components that are homogeneous in relation to properties, dynamics and function. Using the particle size fractionation it is possible to obtain fractions that serve as indicative of the quality and quantity of organic matter in soils. The objective of this work was to evaluate different dispersant solutions for subsequent soil fractionation, and analysis of available P in particulate organic matter and in the heavy fraction. The granulometric fractionation was performed, according to Cambardella and Elliot et al. (1992), in brazilian sandy soil samples. 10 g soil sample was placed in contact with 100 mL dispersing solution, with stirring at 130 rpm for 15 h. Were used the dispersion in water, with sodium hexametaphosphate (HMP), NaOH 1 mol L^{-1} solution, $Ca(OH)_2$ 0,01 mol L^{-1} solution and ultrasonic dispersion (400 J mL). After dispersion, the material was passed through a 0.053 mm sieve. The material retained in the sieve was dried and weighed, called particulate organic matter (MOP). The heavy fraction (PF), which passed through the sieve, was also dry and heavy. The available P of the granulometric fractions obtained with the different dispersants was determined. From the results obtained, the dispersing solutions with HMP and NaOH were the most efficient with obtaining 129 and 120 g of clay per kg of soil, respectively. The dispersants $Ca(OH)_2$, water and ultrasonic application were not efficient for dispersion of the sandy soil sample. Samples with HMP dispersant showed phosphorus contamination in both granulometric fractions. There was no statistical difference on the levels of P between the different extractive solutions. The available P contents varied between 0.17 and 3.77 mg kg^{-1} in particulate organic matter, and between 2.90 and 5.97 mg kg^{-1} in the heavy fraction. The extractive solution NaOH 1 mol L^{-1} can replace the solution with HMP in granulometric fractionation studies in sandy soils, when it is desired to determine the available P in the fractions.

Keywords: Particulate organic matter Organic Matter Fractionation Dispersant Solution
Financial support: Embrapa

(9567 - 1792) Evaluation of organic and inorganic residues for organic production systems and small properties of paraguay

Carlos Leguizamón Rojas[1]; Marcos Sanabria Franco[1]; Silvia Bobadilla Galeano[1]; Celeste Saucedo Valverde[1]; Alicia Rivas Mendieta[1]; Astrid Reichert Duarte[1]; Pedro Morinigo Ferreira[1]; Doralicia Zacarias Servin[1]; Alba González[1]
Universidad Nacional de Asunción - Facultad de Ciencias Agrarias[1]

Organic or inorganic residues can be used as inputs to maintain or improve soil fertility in organic production and in the 250,000 small properties (<20 ha) with limited capital for access to inputs and responsible in the prevailing food production in the country. The objective of this study was to evaluate the effect of organic and inorganic residues in the soil and agricultural products of the small property. Were evaluated doses of ash obtained from the soybean processing industry, doses of compost made from residues of the sugar industry and dose of bovine manure from the farm itself. The nine doses of ash were evaluated in a Rhodic Paleudult with a sandy texture and in a Rhodic Kandiudox with a clay loam texture, in pots. Two types and seven doses of compost were evaluated in pots, in a Typic Paleudalf of the area of influence of the sugar industry, using wheat (*Triticum vulgare*) as an indicator plant. Three doses of bovine manure were evaluated in a small property on a Rhodic Paleudult with sandy texture in a sequence of *Manihot esculenta* - *Zea mays* L. Ash doses produced pH increases in sandy soil from 3.88 to 5.79 and in clay loam soil, from 4.3 to 5.60 with 2.5 and 7.5 t ha-1 of ash, as well as allowed to neutralize exchangeable acidity; the pH even reached 9.19 in the sandy soil. The ash also increase the available phosphorus, low to high level, in both soils; increased levels of exchangeable potassium, going from low to high level in sandy soil and increased the exchangeable magnesium concentration in both soils. The two compost evaluated increased the aerial and radicular dry matter of the wheat, they did not produce significant increases in interchangeable calcium, magnesium and potassium levels and had differentiated effects on the pH levels and available phosphorus. The application of bovine manure produced a significant increase in the production of the cassava-corn sequence. The yield of commercial roots of cassava (in kg ha-1) was adjusted to an equation y=6,956.5 x + 29,189.6 with R2=0.92, in the range of 0 to 30 Mg ha-1 of manure

applied. In the corn yield there were successive increases of 0.64 to 2.92 and 3.86 Mg ha-1 with the doses of 0, 7.5 and 15 Mg ha-1 of bovine manure, respectively. These results indicate the potential of organic and inorganic residues processed or not in the process of organic production and low input agriculture. Furthermore, the use of each residue should be evaluated in the soils in which it will be used.

Keywords: ash; compost; bovine manure; cassava; corn; soil chemical properties

Financial support: Consejo Nacional de Ciencia y Tecnología, Project Number. 14-INV- 130 "Soil fertility management for food production".

(5020 - 2159) Evaluation of soil physical attributes in cover crops grown under fly ash applicatio

Matheus Antonio Arcego Filipin[1]; Gabriela Naibo[2]; Cleberson Tiago de Souza[2]; Augusto Henrique Debiasi Orsatto[2]; Juliano Marcarini Bordin[2]; Mauro Porto Colli[3]; Mauricio Vicente Alves[3]

University of West of Santa Catarina, 696 - Dirceu Giordani Street, Jardim Tarumã, Xanxerê/SC, Zip Code: 89820-000, Brazil (matheusfilipin@yahoo.com)[1]; University of West of Santa Catarina, 696 - Dirceu Giordani Street, Jardim Tarumã, Xanxerê/SC, Zip Code: 89820-000, Brazil[2]; Professors, University of West of Santa Catarina, 696 - Dirceu Giordani Street, Jardim Tarumã, Xanxerê/SC, Zip Code: 89820-000, Brazil[3]

Evaluation and quantification of the physical quality in the management of the soil with new fertilization alternatives in off season are fundamental to development of sustainable agricultural systems. This study aimed to evaluate the effect of fly ash application using different soil managements in the winter on the soil physical attributes. The experiment was carried out at the experimental plant in Unoesc - Xanxerê, from July 2016 to March 2017. The soil of the region has been classified as a dystrophic Red Latosoil/Oxisoil, under a Cfb climate classification, according to Koppen. The experimental design was randomized in blocks with four replicates. Four treatments was carried out in the winter: 1) Fallow (without cover plants and without application of ash); 2) Fallow + ash; 3) Cover crops without ash application (CC); and 4) CC within ash application (CCA). In the CC plots, a consortium was used between vetch (40 kg ha^{-1}) and oat (50 kg ha^{-1}), grown under no-tillage system. In the treatments with ash application, the applied dose was 10.500 kg ha^{-1}, being calculated according to the potassium content present in the ash along with the required for the cover crops. After the end of the cover crop cycle, the area was desiccated and ash was again applied (23.81 t ha^{-1}) for sowing of the corn in no-tillage. The fertilizers of the corn crop were calculated according by interpretation of the soil analysis, for a production expectation of 12 t ha^{-1} grains (according to Liming and Fertilization Manual for RS and SC Brazilian states). The both application of ash used was sampled from a boiler of a pulp and paper plant. Soil samples were taken before winter cover crops cultivation and after corn cultivation in summer, using 1 sample per plot at 0 to 10 cm depth. Soil density (SD); particle density (PD); mean weight diameter (MWD) and geometric mean diameter (GMD) was evaluated using the volumetric ring method (EMBRAPA, 1997). Data were submitted to analysis of variance using F test, with 95% confidence. All analyzes were computed using the R Core Team program (2016). There was no statistical difference in any physical attributes of the treatments within each season evaluated. The time factor had statistical difference found in the SD, MWD and GMD variables, decreasing them in the general mean of all treatments. Regarding for the PD variable, the values were only decreased in the CC and CCA treatments between the two evaluation periods.

Keywords: Soil density, porosity, oat and vetch, corn, residue

Financial support: Celulose Irani S.A, Fapesc, Unoesc, Art 171.

(2822 - 1438) Evaluation of the composting of municipal biosolids with eucalyptus bark and sugarcane bagasse.

Marianne Fidalgo de Faria[1]; Iraê Amaral Guerrini[1]; Roberto Lyra Villas Boas[1]; Caroline de Moura D'Andrea Mateus[1]; Caio Vilela Cruz[1]; Raquel Gonçalves Silva[1]; Roseli Vicentin[1]; Rosemary Marques de Almeida Bertani[1]; Robert Boyd Harrison[2]

Universidade Estadual Paulista "Júlio de Mesquita Filho" – UNESP, Departament of Soils and Environmental Resources, Box 237, Botucatu/SP, 18610307, Brazil[1]; University of Washington, School of Environmental and Forest Sciences, Box 352100, Seattle/WA, 98195-2100, U.S.A.[2]

Biosolids is a residue from the wastewater treatment that contains organic matter and nutrients in its composition and when applied in agriculture ensures to the soil fertility maintenance and greater resistance to erosion. However, in some countries, such as Brazil, the final disposal of sewage sludge is still inappropriate, often being deposited in landfills. Composting is a process of bio-oxidation of a solid organic substrate where there is decomposition and release of organic matter after maturation. The addition of a carbon source adjusts the Carbon / Nitrogen ratio (C/N) and improves the physical characteristics of the organic compost. The objective of this study was to evaluate the composting process of municipal biosolids mixture with two different sources of carbon – eucalyptus bark and sugarcane bagasse – and to determine if the process is effective in terms of temperature and moisture, as well as the final composting time. The experiment was installed and performed in the city of Botucatu, State of São Paulo, Brazil, inside a greenhouse located at the Wastewater Treatment Plant (WWTP) of the company SABESP. A compost pile was set up for each mixture with dimensions 1.5m x 3m x 16m, with a total volume of 36m³ per pile. The mixture ratio of biosolids:carbon source was 1:1. The temperature in the compost pile was monitored hourly by Decagon 5TM and Decagon RT1 temperature sensors, which were installed at five points of each pile at different depths. The samples for moisture analysis were collected weekly in five points of different depths, forming a composite sample for each pile. Once collected, the samples were incubated at 65ºC for 72h. In both materials the average daily temperature remained between 50ºC and 70ºC, which can be considered ideal for composting. The sugar cane bagasse was the one that retained better the moisture throughout the process, which ended up with moisture in the range between 40 and 50%. In the pile with eucalyptus bark, the moisture decreased faster in the same period, being the final product with moisture below 30%. Due to the difference in moisture, the composting time of the two materials were different, with 45 days for mixture with eucalyptus bark and 60 days for mixture with sugarcane bagasse. It is possible to conclude that both mixtures of biosolids with eucalyptus bark and sugarcane bagasse in the ratio 1:1 are viable and present ideal temperature and moisture indexes for an effective composting process.

Keywords: Sewage sludge; residues; organic fertilization.

Financial support: grant #2015/26261-0 São Paulo Research Foundation (FAPESP) and Companhia de Saneamento Básico do Estado de São Paulo (SABESP).

(9732 - 1638) Experiences with oil palm (Elaeis guineensis Jacq) biomass use at replanting

Floria Ramírez[1]; Andy Arguedas[1]; Eder Jiménez[2]; Montserrat Ulloa[3]; María Araya[3]

Palma Tica[1]; Palmosur[2]; [3]

Yield intensification and monoculture are prone to have less biodiversity at every level (vegetation, macro fauna, micro fauna and microorganisms), condition, which can difficult efficient nutrient recycling, and the maintenance and accumulation of organic matter (OM). The kind of fertility conferred by the organic fraction of the soil

cannot be substituted by inorganic fertilizer applications, hence the required complementary use of organic and inorganic sources of nutrients. The oil palm has certain advantage, since it produces a great amount of biomass at the mill (shredded empty fruit bunches) and in the field (recycling of leaves at every harvest; leaves, roots and trunks at replant). Incorporation of the crop´s biomass sources in the fertilizer programs calculations maximizes its use; in order to enrich the organic fraction of the soil, reduce the fertilizer bill and contribute to carbon neutrality. Oil palm replanting constitutes a great agronomic opportunity, which well accomplished, allows general land preparation, drainage upgrade and the addition of massive amounts of organic matter, which will help soil´s chemical and physical fertility, in order to secure the sustainability of the crop for the next 40 years (when using compact materials). Experiences documented, up to date in Palma Tica S.A., show significant improvement during the plant establishment period, when organic amendments (OA) produced by the same crop are applied. Results show more vegetative biomass development and hence higher yields during the first harvest months, besides an important reduction of inorganic fertilizer required. The space-time synchronization between the OA decomposition and the nutrient uptake of the new palm, explains the best response of replants where shredded empty fruit bunches or chips of the previous crop were within the reach of the new plant, compared with replants with no OA, or where OA was out of the weeded circle area. Best management practices, as is the use of OA, are essential in the first three years of a new plantation, in order to assure high yields during the lifetime of a palm generation. Poorly managed plantations cannot develop the amount of biomass required to achieve optimum yields, a close target must be to collect 60 tons of fresh fruit bunches per hectare (t FFB/ha) during the first 60 months after planting.

Keywords: oil palm, biomass, organic amendments, replanting, organic matter

Financial support: Compañía Palma Tica S.A.

(8790 - 2895) Forms of fertilizer application for coppice in Eucalyptus urophylla

Vitor Augusto Cordeiro Milagres[1]; Francisco Sérgio Gomes[1]

Gerdau Aços Longos[1]

Although Brazil leads the global ranking of forest productivity for eucalyptus, reaching an average of 35.7 m³ / ha / year, the productivity of forests managed by coppice is considerably inferior comparing it with the regime of high forests. In addition to the climatic factors that have negatively affected productivity in recent years, nutritional deficiency has also played a role in this outcome. One of the difficulties faced by the forestry sector has been the limited studies aimed at developing sowing fertilization techniques in order to optimize the growth of eucalyptus stands and reduce input costs. One of the difficulties faced by the forestry sector has been the limited studies aimed at developing techniques of fertilization of eucalyptus shoots in order to optimize the growth of eucalyptus stands and reduce input costs. Therefore, in this experiment, the following forms of fertilizer application were compared in a stand of a clone of Eucalyptus urophylla with Limestone in total area (LT), incorporated Limestone (IL), phosphorus in the total area (FT), phosphorus in groove (FG), potassium in total area (PT) and potassium in groove (PG) using three different inputs. The inputs are Araxá Phosphate (29% P2O5 and 36% CaO), Northwest Limestone (27% CaO and 14% MgO) and Potassium Chloride (60% K2O), and eight treatments: T1: LT + FT + PT; T2: LT+FG+PT; T3: LT+FT+PG; T4: LT+FG+PG; T5: IL + FT + PG; T6: IL + FG + PG; T7: IL + FG + PT; T8: IL + FT + PT. The test was carried out in the municipality of Três Marias, central region of Minas Gerais, in sandy loam soil with average precipitation of 1390 mm/year. The results show the importance of CaO top dressing application. The mean annual increment obtained IMA was 38.06 m³/ha/year, that is, 90% of the IMA obtained in the first rotation.

Keywords: sprout management, Cerrado, productivity

Financial support: Gerdau Aços Longos

(8177 - 1070) Forms of limestone application for the elevation of base saturation

Júnior Antônio Rodrigues Mello[1]; Junior Barbosa dos Santos[1]; Fábio Régis de Souza[1]; Anderson Cristian Bergamin[1]; Jairo Rafael Machado Dias[1]; Cauandrey Deyverson Fagundes[1]; Rodrigo Maciel Nunes[1]; Wesley Santana Ferreira[1]

Fundação Universidade Federal de Rondônia[1]

Brazil is among the world's largest producers and exporters of grain, being this one of the main bases of the national economy. It is necessary to boost production by area, because the crops are restricted to areas already deforested and the demand for food grows annually. In this way, it is necessary to reduce the limiting factors of production, such as soil acidity. The soils of the Amazon region present good physical quality, exceptional for agricultural cultivation, but are predominantly acidic. The practice of liming is the most recommended and necessary for good production. However there are doubts about recommending the application of limestone in surface or embedded and the answer the form of application are scarce in the region of Zona da Mata in the state of Rondônia. The objective of this experiment was to evaluate the application of limestone and the elevation of base saturation as a function of the doses, in the Zona da Mata of Rondônia. The work was conducted experimental campus of the Federal University of Rondônia, municipality of Rolim de Moura, at the geographical coordinates of latitude 11º34'58.60"S and longitude 61º46'22.30"W, in 277 meters of height. The design used was the randomized of blocks in a 2 x 6 factorial arrangement with four replications, being the factors, the forms of limestone applications on surface or embedded and the second factor elevation of V%, with application of increasing doses of limestone to raise the V% for (V0, V60, V80, V100, V120 and V140%). The antecedent base saturation was 56%. The experiment was implemented in November 2014. The data were collected in January 2016, in layers of 0.0-0.10m and 0.10-0.20m. The following variables were evaluated: Ca, Mg, K, P, effective CEC, CEC at pH 7.0, sum of bases, Al, Al + H, pH 7.0, pH in CaCl and V%. Among the obtained results, there was highlight in the limestone applied on the surface, which provided higher values in Ca, effective CEC, potential CEC, Mg, SB, pH 7.0, pH in CaCl, compared to the incorporated, in the layers of 0,0-0,10m and 0,10-0,20m. It was also observed that the P content in the soil increased linearly as a function of the V% increase, of 0.0-0.10 m, even with non-significant pH values. Only Al and Al + H were significant in relation to the increase in saturation by bases of 0,10-0,20 of depth. Al linearly decreased with the V% increase, Al + H had quadratic response presenting lower potential acidity with elevation from V% to 80.

Keywords: Liming, soil acidity, depth, Rondônia.

Financial support:

(6480 - 2745) Growth and yield of sugarcane as function of soil preparation and liming rates in sandy soil in two consecutive seasons

Ariani Garcia[1]; Gabriela Ferraz de Siqueira[1]; Jorge Martinelli Martello[1]; Tiara Moraes Guimarães[1]; Ciro Pozzi Garcia[1]; Daniele Scudeletti[1]; Murilo Campos[1]; Carlos Alexandre Costa Crusciol[1]; Juliano Carlos Calonego[1]

São Paulo State University, School of Agricultural Sciences[1]

Intense mechanization of harvest and planting now occurs in sugarcane production systems as a result of the abandonment of pre-harvest sugarcane burning practices, causing strong soil compaction, reduced root growth, and decrease the productivity and longevity of the cane field. Due to the new system of preparation and maintenance of the straw in the soil, more research is necessary to evaluate the interaction between the soil preparation systems and liming. The

official recommendations for liming for São Paulo State are no longer sufficient for the new system, which may limit sugarcane yield to lower values than the crop yield potential. Therefore, the aim of this study was to evaluate the effect of deep soil tillage compared with conventional tillage and liming rates on the sugarcane growth and yield in two years of production. The experiment was installed in 2015 in a Red-Yellow Latosol with a sandy texture, in the municipality of Borebi, SP, Brazil. The experimental design was a randomized block with split-plot design with four replications, where the plots consisted of three systems of soil tillage: conventional soil preparation (CSP); deep soil tillage (DST) with lime application spread in the entire area; and modified deep soil tillage (MDST) with lime application in the surface of the planting row, with ¼ of the dose in depth; and the subplots consisted of liming rates: 0, 1, 2 and 3 times the recommended dose (RD) for sugarcane production in São Paulo State, based on soil samples of 0.0-0.20 and 0.20-0.40 m. For the deep tillage treatments, all the machines were equipped with GPS equipment in order to control the traffic, allowing the definition of the plant growth and traffic zone. There was no significant difference between the soil preparation used and limestone rates for all the variables analyzed in the first year due to a frost that caused sugarcane yield reduction and an early harvest before full maturity. Yet, in the second year, CSP provided plants with longer stalk length compared to DST and MDST. However, MDST provided larger stalk diameter at all doses used. In relation to the stalks (TSH) and sugar production (TPH), the CSP system provided higher values of TSH and TPH at doses 2 and 3 x RD, higher than DST and MDST treatments.

Keywords: Soil conservation, controlled traffic, sugar yield, liming recommendation
Financial support: FAPESP grant 2014/20593-9

(2272 - 403) Growth of pre-sprouted sugarcane seedlings as a function of organomineral compost

Rodolfo Lizcano Toledo[1]; Leonardo Correia COsta[2]; Vera Lucia da Silva[2]; Mirela Peroni[2]; Mara Cristina Pessoa da Cruz[2]; Dilier Olivera Viciedo[3]
University of the Amazon[1]; UNESP[2]; UNISS[3]

The use of fertilizers is considered of great importance to achieving positive results in productivity; however, the mineral fertilizer has suffered price increase affecting the cost of production in the sugarcane industry. Thus, with prospective reduce dependence, reduce costs and optimize the use of fertilizers, researchers seek alternatives to boost the productivity of sugarcane. In this context it took place this work to evaluate the effect of applying organic-compound in pre-sprouted seedlings of cane sugar Quartzipsamment. The experiment was conducted in a greenhouse in FCAV / UNESP belonging to the land department. The experimental design was completely randomized in a 2x5 factorial design, with two ways of applying organic-mineral compost in transplanting seedlings of sugarcane and five evaluation periods, with 5 replicates. The application forms of the compost and interaction of the application form with the timing, does not have significant effect on any of the variables studied pre-sprouted seedlings of sugarcane. The timing, the evaluation shows significant effect for all variables, with linear fit for phosphorus and potassium and quadratic for the other variables in pre-sprouting of sugarcane seedlings.

Keywords: *Saccharum officinarum L*, fertilizer, soil fertility
Financial support: State University of São Paulo

(1866 - 917) Growth patterns and nutrient extraction by *Eucalyptus globulus* Labill in the eastern region of Uruguay

Alejandro Gonzalez[1]; Jose Pedro Ualde[1]; Jorge Hernandez[2]; Amabelia del Pino[2]
UPM[1]; UdelaR[2]

Sustainability of forest production in the long term depends to a large extent on the dynamics of nutrients in forest ecosystems. For this it is important to know throughout the cycle, the evolution of the biomass produced as well as the nutrients retained in the different fractions of the tree. This work quantifies the biomass production and extraction of nutrients by *Eucalyptus globulus* trees at ages 5, 7, 9 and 12 years, in the eastern region of Uruguay. In each of the 4 plantations, 9 trees were harvested with average height and diameter. The different fractions were separated and weighed (leaves, wood, bark and branches), taking samples for analysis. In the laboratory the samples were dried at 60ºC, ground and N, P, Ca, Mg and K were determined. The aerial biomass increased with the age of the forest, explained mainly by the wood fraction, although there were also increases in bark and branches. For the leaves fraction, there were no significant biomass increases after 7 years of the forest, representing only 3 % of the total aerial biomass in the 12 year plantation. The total of nutrients in the aerial biomass, increased with the age of the forest, and the wood fraction showed greater accumulation of N, P and K; while for Ca and Mg bark had the highest amount. For all ages, and all nutrients, the sum of the fractions that correspond to harvest residues (leaves, branches and bark) showed greater accumulation, compared with the nutrients in wood. The nutrient accumulation in aerial biomass increased until 7 years stabilizing from there on (up to 12 years), with the only exception of P, where the accumulation increased up to 9 years. For all the ages studied, the order of absorption of nutrients was: Ca> N> K> Mg> P. In reference to the concentrations, in general terms, no important differences were observed for each nutrient in the different ages for each fraction. The leaf fraction presented the highest concentration of nutrients in all ages, except for Ca, where the highest concentration occurred in bark. The fraction with the lowest concentration of nutrients was wood, except for P, because also the thick branches showed a low concentration. The exchangeable Ca, K and Mg contents in the soil upper horizon of the sites evaluated showed relationship with the concentrations of these nutrients in the wood and leaf fractions, indicating that soils with greater nutrient richness promote higher nutrient absorption by *E. globulus*.

Keywords: Eucalyptus globulus; extraction of nutrients; eastern coast of Uruguay.
Financial support: Empresas forestales Montes del Plata y Redalco.

(8823 - 1672) Growth, yield and quality of hydroponically-grown Pineapple plants supplied with different potassium sources

Esteban Loria-Solano[1]; Marco V. Gutiérrez-Soto[2]
ACCS, Agrocontrol, Guápiles, Limón, Costa Rica (erloso@hotmail.com)[1]; University of Costa Rica, Dept of Agronomy, Fabio Baudrit Experimental Station, Alajuela, Costa Rica[2]

Pineapple nutrient uptake, particularly of K and N, is far superior than most tropical crops, but only a small fraction is retained in the fleshy fruits. In the field, most of K uptake occurs during vegetative development, when nutrients are applied mostly to the foliage, but substantial amounts of K are also applied during fruit development under the belief that this nutrient is essential for high fruit quality, particularly sweetness and fruit mechanical integrity. It is important to know the content and distribution of K in the whole plant to improve fertilizer use and administration, and to produce well-nourished plants capable of sustaining higher fruit yield and quality. In this work, we present the content and distribution of essential nutrients in all organs of whole vegetative and reproductive pineapple plants grown in a greenhouse in Costa Rica (10^{O}N, 840 m elev.), under optimal nutrient and water supply compared to pineapples grown in K-deficient solutions. To achieve this, we suspended K addition to the nutrient solution three months after planting, after which K was supplied to the foliage using KCl and K citrate. Both sources of K were applied at different concentrations: 600Kgha^{-1} and 200 Kgha^{-1}

respectively. The results showed no differences in plant growth and phenology, the time required for plants to achieve appropriate weight for flower induction, fruit yield and quality, and slip number and fresh weight among treatments, suggesting that K uptake during the first three months was enough to produce high quality plants and fruits, and point to the root system as the main organ responsible for nutrient uptake in pineapples. No evidence of increased fruit deterioration, such as translucency and mechanical damage was obtained, under different K sources. However, general nutrient content, especially K, was lower in plant grown in deficient solutions. Because of the significant differences in the amount of K supplied from diverse sources (KCl and K citrate), we conclude that K uptake and use efficiency is substantially increased when K is supplied through organic sources such as K citrate. We conclude with recommendations regarding fertilizer use strategies to maximize nutrient use efficiency and reduce water consumption in field-grown plants.

Keywords: Pineapple, growth, potassium, quality
Financial support: ACCS-UCR-Agrocontrol

(1444 - 2804) Impact of conversion of land use on granulometric composition of soil in the maranhense Amazon, Brazil

Maria Karoline de Carvalho Rodrigues de Sousa[1]; Victor Roberto Ribeiro Reis[1]; Luciano Cavalcante Muniz[1]; Elimilton Pereira Brasil[1]; Diana Signor Deon[2]; Ilka South de Lima Cantanhêde[3]
UEMA[1]; EMBRAPA[2]; IFMA[3]

In the Amazon region, the practice of converting native forest to tradicional ranching, which commonly has poorly maneged pastures and the potential risk of soil degradation, is predominant. The identification of soil attributes that may be sensitive to changes in the conservation status of an environment is indispensable for the development of a more productive and sustainable livestock. The objective of this study was to evaluate the changes in the soil granulometric composition, as an indicator of soil quality, in different land uses in the Maranhense Amazon. The samples were collected in four environments in the municipality of Pindaré Mirim, Maranhão: Native forest with babassu (Attalea speciosa Mart.); Capoeira; Degraded pasture (with Urochloa brizantha cv. Marandu) and CLFI System (in the first year of the maize consortium, Marandu grass and eucalyptus). The samples were collected at seven dephts: 0-10, 10-20, 20-30, 30-40, 40-60, 60-80 and 80-100 cm. The granulometric analysis was performed according to the method of sieving and pipetting in standard fractions: sand, silt and clay. The means were submitted to analysis of variance by the Kruskal-Wallis method, followed by the comparison of means by the Bonferroni test (Dunn) at 95% confidence level. At dephts 0-10 and 10-20 cm, the soils under degraded pasture and CLFI system presented lower sand and higher clay content compared to other uses. The highest clay content in these layers, in a native forest and capoeira environment, probably occurred due to the greater protection of the soil to the process of erosion by the vegetation cover of the forest. A decrease in sand and an increase in clay content in depth were observed for areas with native forest with babassu and capoeira. In all layers evalueted, the silt content in the CLFI system was significantly higher than those with native forest and capoeira, and similar to degraded pasture. The samples in the different uses showed similar silt contents, except in the native forest with babassu. The granulometric composition of the soil is affected as a result of conversion of the forest or capoeira into pasture, which can result from the trampling of animals and the traffic of machines and implements, in addition to the loss of biomass. However, after the first year of implementation of the CLFI system, replacing the degraded pasture, no differences in granulometric were observed between these two uses.

Keywords: Degraded pasture; Soil conservation; Soil fertility
Financial support: Maranhão Foundation for the Protection of Research and Scientific and Technological Development (FAPEMA) and National Council of Scientific and Technological Development (CNPq)

(7278 - 782) Impact of potassium application on sown pastures and natural grassland in northern Uruguay

Maximiliano Cattani[1]; Monica Barbazán[1]; Teresa Rodriguez[1]
Facultad de Agronomia UDELAR[1]

In Uruguay, potassium (K) has recently been found as one of the factors that limits production in annual crops, but in sown pastures or natural grassland there is little information. This study evaluated the response in forage production of sown pastures to fertilizer K application from 2015 to 2017. Field trials were established at two sites on basaltic soils located in northern Uruguay, which had no history of K fertilization. At Site 1, the pasture was a mixture of white clover (*Trifolium repens* L.), red clover (*Trifolium pretense* L.), and perennial ryegrass (*Lolium perenne* L.). At Site 2, the pasture was Tall Fescue (*Festuca arundinacea*) and spontaneous species. The experiment was design with three repetitions and five treatments, each is an application rate (0, 30, 60, 120 and 240 kg K_2O ha^{-1}), applied as KCl, using a completely random block design with three repetitions, and P and S in non-limiting quantities. Plant K concentration and dry matter production were measured by periodic cuts with mower, eliminating crop residues from the plots and separating by hand grass species from legumes. At the beginning of the experiment, the soil K test (determined by the AcNH4 method) at 0- 15 cm depth were 0.45 and 0.32 $cmol_c$ kg^{-1} at the Site 1 and 2, respectively. In both sites, the fertilized plots tended to have higher total dry matter yield than the controls treatment, but significant differences among treatments were observed after the third cut at Site 1 and after the second at Site 2. The total amount of K extracted by pastures after two years varied from 365 to 553 kg K ha^{-1} at Site 1, and from 97 to 148 at Site 2. The soil K test after the first cut, increased 0.07 and 0.10 cmolc kg^{-1} in plots fertilized with 240 kg ha^{-1} of K_2O respect to the control plots, at Site 1 and 2, respectively. More research is needed to understand the K dynamic in these production systems.

Keywords: fertilization, potassium, pasture, basaltic soils
Financial support: IPNI-Canpotex

(5342 - 3201) Increase of the production of potatoes (*Solanum tuberosum* L.) in two localities of the Peruvian highlands by the application of nitrogen mixtures and humic acids

Edgardo Marcelino Alaluna Gutierrez[1]; Juan Miguel Guerrero Lazaro[2]; Silvia Aguero Aguilar[3]
Technical Area. Molinos & Cia. S.A.[1]; Technical Area. Laspaf. Univerisdad Nacional Agraria La Molina[2]; Univerisdad Nacional Agraria La Molina[3]

The dose of fertilization should be based on the demand for nutrients, soil quality and timely supply to achieve the expected productivity. The objective of the research was to compare the increase in production of potatoes (*Solanum tuberosum* L.) in two localities of the Peruvian highlands by the application of nitrogen mixtures and humic acids. The study localities were Huancas-Junín (3571 ma.sl) and Sacsara-Ayacucho (2994 ma.sl). A CRB with a factorial arrangement of 6 treatments with three replications was applied. Three commercial mixtures (A: NPK 15-25-15 + 2MgO + 3S, Urea, B : NPK2 12-24-12 + 3 MgO + S, Ammonium sulphate and C: NPK 10-24-12 + 3 MgO + 8S Urea and ammonium sulfate) were evaluated combining these with and without humic acids (300 $kg.ha^{-1}$) in plots of 24 m^2. The tubers of each of the treatments were harvested, selected and weighed. The production and quality of tubers for first and second class in Huancas (33.72 and 30.64 $t.ha^{-1}$) were higher than those of Sacsara (23.81 and

8.33 t.ha^{-1}) according to the statistical analyzes ($p < 0.05$) showed significant differences. The total production in Huancas (64.36 t ha^{-1}) was 100% higher than Sacsara (32.13 t ha^{-1}). With humic acid mixture, the yields of first class tubers were increased by 20% in Huancas and 17% in Sacsara. Likewise, in both locations, the interactions of the three mixtures with humic acid showed similar results, however the C mixture with humic acid was higher than the application of the mixtures alone.

Keywords: fertilization in potatoes, humic acids, magnesium, nitrogen, yield
Financial support: MOLINOS & CIA S.A.

(1292 - 2953) Influence of agrominerals on chemical attributes of two soils of Rio Grande do Sul State, Brazil.

Milena Moreira Peres[1]; Carlos Augusto Posser Silveira[2]; Adilson Luís Bamberg[2]; Ivan dos Santos Pereira[2]; Rosane Martinazzo[2]; Rogério Oliveira de Sousa[1]

Universidade Federal de Pelotas[1]; Embrapa Clima Temperado[2]

The agricultural use of rocks with minerals that contain available nutrients for crops (Agrominerals) has been the focus of new and recent research in Brazil, aimed at reducing production costs, to create alternatives for market niches and to reduce the Brazilian external dependence of inputs. In Brazil, the Law N. 13,891 / 2013 included the "remineralizers" as a new class of agricultural inputs. This Law also enables the use of mining wastes, especially those that are rich in calcium, magnesium, potassium (K) and silicon (Si), but only if they have solely passed by physical processes to reduce the size of particles or separate them. In some cases, certain rocks may also have the potential to correct or elevate the soil acidity. The objective was to evaluate the influence of three rock types on pH and electrical conductivity (EC) of two representative soils from the Rio Grande do Sul State, Brazil. The experiment was conducted with monitored environmental conditions at Embrapa Clima Temperado, Pelotas/RS/Brazil. The treatments were: T1 - Control, T2 - Fonolite, T3 - Dacite and T4 - Dacite (90%) + Basalt (10%) and the soil types were: Quartzarenic Neosol and Red Nitosol. The rate of each rock was dimensioned and applied to raise the available K content of each soil up to the high level, according to local recommendation, being the rocks samples with 100% passing through a 140 mesh (0.105 mm) sieve. The experiment was conducted in a randomized block design with three replicates. At 180 days, samples of each treatment were collected and determined the pH and EC in the soil:water (1:2.5) ratio. Data were submitted to analysis of variance and, when a significant effect was observed, the Tukey test was performed at 5% of probability error. For soil pH, no significant effects were observed for the studied treatment factors, indicating that the evaluated rocks did not change the soil acidity levels. In relation to EC, only between the two soil types a significant difference was observed, however, the addition of the three types of rocks did not significantly affect the EC in both soils. In general, the rates and the types of the studied rocks did not influence the soil acidity nor presented risk of salinization for the studied soils until 180 days after rock incorporation.

Keywords: soil chemistry; rocks; remineralizers.
Financial support: Embrapa Clima Temperado.

(1975 - 2090) Influence of limestone and phosphogypsum on eucalypt productivity in Curvelo - MG

Rodrigo Nogueira de Sousa[1]; Vanderlayne Verônica Costa[1]; Lucas Vinícius Torres Lima[1]; Bernardo Amorim da Silva[1]; Leonardus Vergutz[1]; Ivo Ribeiro da Silva[1]; Samuel Vasconcelos Valadares[1]; Fernando Antonio Vieira Rodrigues[2]

Universidade Federal de Viçosa[1]; CEFET-CURVELO[2]

The Eucalyptus plantations are increasing mainly due to economic viability and need to reduce demands for native species. The liming in the eucalyptus is made to reach base saturation around 50%, also to provide Ca and Mg for the plants. However, Ca and Mg applied by limestone have little mobility in soil profile. To increase their availability in depth and reduce phytotoxic forms of Al^{3+}, many studies have shown that phosphogypsum (CaSO4.2H2O) has great effectiveness. Thus, the main objective of the authors with this work was to determine the influence of limestone and phosphogypsum on eucalyptus growth and productivity. The Eucalypt planting is already in pre-harvest step (74 months). The experiment was setted up in december of 2010 on oxisoil with 62,5 % of clay in Curvelo–MG. The experiment was arranged in a factorial ($2^3 - 1$) + 2 + 2 with randomized blocks and four replicates, totaling 44 experimental units. In this abstract we focused in four treatments, the treatment +L+P (with limestone and phosphogympsum), in which limestone was applied in total area and gypsum in strip; the +L+P, with limestone and phosphogympsum applied in total area; the +L, just limestone in total area and the control treatment, -L-P (without limestone and phosphogympsum). The amount of limestone used was 3 Mg ha^{-1} and phosphogympsum (when applied) was 1 Mg ha^{-1}. The planting was done seven days after limestone and phosphogympsum application. The +L+P applied in strip showed productivity of 370 m^3 ha^{-1}, 33,7% higher than the control treatment, which it was 281 m^3 ha^{-1}. The +L+P applied in total area had productivity of 341 m^3 ha^{-1} (21,5% higher than control). The aplication of limestone (+L) promoted 14% more productivity than the reference. Our findings are explained by the fact that, Ca and Mg provided by the liming (mainly) and gypsum, improved the nutritional and chemical characteristics of the soil, pH increase, cation exchange capacity (cec), (Zambrosi et al., 2007). The phosphogympsum probably promoted more roots growth, consequently contributed to higher development of the trees leading to high productivity. Thus, we conclued the effectiveness of limestone and gypsum, mainly applied in strip, on eucalypt productivity.

Keywords: Nutrients, soil acidity, roots groth, Ca, Mg
Financial support: FAPEMIG, CNPq, CAPES, DPS-UFV

(9322 - 2940) Initial growing of *acacia mangiumin* in soil classes incorporated with carnauba straw (*copernica prunifera*)

Brito, Ana Clecia Campos[1]; Damasceno, Ayrton Senna da Silva[1]; Boechat, Cácio Luiz[1]; Morais, Joacir[1]; Gonçalves, Breendon Patrick da Silva[1]; Arauco, Adriana Miranda de Santana[1]; Baiano Júnior, Denir da Silva[1]

UFPI[1]

Acácia mangium has been used for recuperating degraded areas. This paper aims to evaluate the *Acacia mangium* seedlings nutrition with the incorporation of commercial fertilizer and organic residue in different soil classes. Soil samples were classified as Quartzenic Neosol, Yellow Red Latosol, Yellow Argisol, and Haplic Gleysol. Five samples of carnauba straw (0.25%, 50%, 75%, and 100%), treatment with soil with mineral fertilization, and four classes of soil, arranged in fully randomized blocks (FRB). At the ninetieth day, Ca, K, Mg, Zn, Cu, and Mn contents in the aerial part were evaluated. Was observed for calcium (Ca) in the aerial part (AP), and the higher Ca (8.6 g kg^{-1}) amount was observed in the substrate contained 100% carnauba straw within the Argisol, no difference among the other treatments. On the Gleysol, were observed in the 0% and 50%, while in the Latosol in all treatments, and in the Neosol, in the soil treatment with N-P-K (17.2 g kg^{-1}). Ca content in AP of cultivated plants in the Neosol stands out from others, except for 100% treatment. For Argisol and Latosol, there was increase in Ca content as the carnauba straw percentage was increased. The magnesium content (Mg) in the aerial part was higher in the pure soil; the worst result was in the soil treatment with

N-P-K in the Argisol class, except in the Neosol, in which there was no significant difference. Among the soil classes, the best results inside each treatment were observed in the Latosol, except in the treatment with 100% that did not differ among the soil classes. Potassium (K) with maximum mean of 216.6 g kg^{-1} in the substrate with 50% of carnauba straw with Latosol. Except the means of the Gleisol treatment, it is able to realize that there was K decrease with the increase of carnauba straw doses. Among the soil classes, the lowest concentrations in the Gleisol treatments were observed. The highest K contents were observed in the aerial part of cultivated plants in substrate with Neosol and Latosol. In this study, there was little variation among treatments inside the four soil classes for the Cu content in the aerial part of *A. mangium*. Zn presented range from 7.16 to 20.70 mg kg^{-1} with 75% carnauba straw, and in the only soil treatment inside the Latosol. Considering the micronutrients, Mn was the most absorbed by the *A. mangium* seedlings, presenting maximum AP content (144.42 mg kg-1). All the four soil classes can be used in the *Acacia mangium* seedlings production.

Keywords: Organic residues. Fertilizing. Seedlings production.
Financial support:

(8731 - 2893) Inorganic phosphorus in soil after four years of integrated systems of crop-livestock-forest

Gessica de Carvalho[1]; Maurel Behling[2]; Anderson Lange[3]; Diego Camargo[3]; Jaqueline Bento Farias[3]; Leticia Helena Campos de Souza[3]
UFV[1]; Embrapa Agrossilvipastoril[2]; UFMT[3]

The study was conducted in the 2015/2016 harvest at Embrapa Agrosilvopastoral in Sinop, MT. The evaluated systems were: eucalypt planted forest (F); exclusive crop (soybean) (L); pasture with brachiaria (P); and integrated systems of crop-livestock-forest (ICLF) established with eucalyptus provisions in triple lines ((3,5 x 3,0) x 30 m East-West orientation) with soybean crop annually. The experiment used a randomized block design with four replications. Soil samples were taken at the layers of 0-5, 5-10, 10-20, 20-30 cm. In the ICLF system, samples were collected in four equidistant transects per treatment in the transverse direction of the lines of forest species, at the distances of 1.5; 3; 6; 10 and 15 m on both sides (north and south faces). In the determination of Pi, Air-dried soil (0.5g) was weighed and placed in tubes with sodium carbonate solution ($NaHCO_3$ 0.5 mol L^{-1}) for agitation. The quantification was realized by the blue molybdate method and the reading was realized by spectrophotometer. After meeting the assumptions (normality and homoscedasticity) the data were submitted to analysis of variance, the effects of the treatments unfolded by contrast and the distances in relation to the row of the trees compared through the standard error of the mean. Pi differs between the ICLF and the exclusive systems (F, L and P), in the depth up to 10 cm. The same occurs between the contrasts F vs (L+P), the L vs P. The contrast ICLF-L vs L differs only in the superficial layer of the soil (0-5cm) and the contrast F vs L only occurs difference in layer 0-20cm. The Pi has higher availability in the crop of the ICLF system and in the exclusive crop up to 10 cm of soil. In the ICLF, the levels of Pi in the superficial layers were smaller in the position 1.5 m away from the trees in the south and north face. Thus, up to the fourth year, in the ICLF there is still no pronounced effect of the forest component on the subsurface layers of the soil. However, it acts as a drain of Pi in the range of crops near the trees reducing the availability of P to the agricultural crop

Keywords: agrosylvopastoral production systems forest component
Financial support: CNPq, Embrapa e Rede de Fomento ILPF

(7253 - 2834) Integral use of pineapple plant residues for biorefinery and production of an organic soil amendment

Mariana Murillo[1]; Paola Fuentes[2]; Carolina Hernández[3]; Wei Liao[4]; Lidieth Uribe[5]
Instituto Nacional de Innovación y Transferencia en Tecnología Agropecuaria[1]; Centro de Electroquímica y Energía Química[2]; Instituto Costarricense de Electricidad[3]; Michigan State University[4]; Centro de Investigaciones Agronómicas[5]

Agricultural residual biomass can be used as a source for biorefinery. In Costa Rica, pineapple production generates over 250 tons of residual biomass per harvested hectare, which are left in the field to decompose. During the degradation process, aromatic compounds are released, attracting the hematophagous fly *Stomoxys calcitrans*. This insect feeds on cattle, causing great losses to nearby ranchers. With the aim of reducing the impacts of pineapple production and finding an integral utilization of the residues, a double-purpose approach was studied. Pineapple plants were separated into two fractions; solid and liquid, which were used for fatty-acid methyl esters (FAMEs) and biogas production, respectively. The solid fraction was pretreated for one hour at 121 °C and exposed to 17 FPU cellulase (Sigma C2370) and 37 U xylanase (Sigma X2753) per gram of cellulose. The hydrolyzed material was then used to grow the oleaginous fungus *Umbelopsis isabellina*. By controlling the nutrient content in the culture media, the accumulation of lipids in the fungal cells was encouraged. Using the Bligh & Dyer extraction protocol, the lipids were separated from the fungal biomass, and thereafter, where transesterified to FAMEs. A yield of 3.5 g biomass / kg of solid fraction of pineapple plants was obtained. The residues generated throughout the FAME production process, in combination with the liquid fraction of the pineapple plants, were used to produce biogas in anaerobic digester systems. With the obtained results in lab-scale assays, an electric potential of 4145 KW/m^3 of liquid residues was estimated. Finally, the digested material from the anaerobic reactors could be incorporated to the pineapple plantations to increase the organic matter input to the system.

Keywords: pineapple residues, biorefinery, organic soil amendment
Financial support: Costa Rican Ministry of Science, Technology and Telecommunications, Project Number FI-027-16

(8204 - 2124) Labile Carbon in bauxite mined-soils under rehabilitation process with *Eucalyptus spp.* and *Anadenanthera peregrina*

Matheus Andrade Ferreira[1]; Luiz Fernando Negris Gardioli[1]; Ricardo Cardoso Fialho[1]; Rafael da Silva Teixera[1]; Caroline Moreira Análio[1]; Ivo Ribeiro da Silva[1]
Universidade Federal de Viçosa[1]

In Brazil, the rehabilitation of mining areas is a legal obligation of the companies responsible for mineral exploration. The planting of forest species such as *Eucalyptus* spp. and N-fixing species such as *Anadenanthera macrocarpa* might be a satisfactory alternative to promote the rehabilitation of soil, especially carbon stocks, essential to the system's sustainability. The labile organic carbon (LOC), due its high sensibility to changes in soil, is considered an important parameter for evaluating rehabilitation techniques. In this study, our objective was to evaluate the LOC in bauxite mined-soil under rehabilitation process with forest species. The study was carried out near to the city of São Sebastião da Vargem Alegre, Minas Gerais state. After the mining process and properly soil layers reconstruction, the experiment was set up using a complete randomized block design, with five replicates and three treatments: Eucalyptus (*Eucalyptus spp*.), Angico Vermelho (*Anadenanthera peregrina*) and no plants (control). Soil samples were collected (0-20cm) six months after the end of mining activities and six years (0-10 cm) after treatments implantation for LOC determination. An undisturbed native forest fragment (Atlantic Forest), adjacent to the mining area, was also sampled as a reference of natural environment. The results vary from 0,423 mg g^{-1} to 3,808 mg g^{-1} of LOC in the area without plant or

native forest fragment, respectively. The Angico Vermelho and Eucalyptus plantations increased the soil LOC content in approximately 300% and 271% in comparison to the post mining area. The increase in the soil LOC indicates that the cultivation of these forest species, mainly Angico Vermelho, are able to promote the reestablishment of soil functionality in bauxite mined-soil. However, a longer period of time is necessary to reach desirable values as those found for Atlantic Forest.

Keywords: Reclamation; Mining; Forest
Financial support: Companhia Brasileira de Alumínio – Votorantim Metais and Fapemig

(8363 - 812) Late application of potassium fertilizer to soybean: effects on yield and nitrogen concentration in grain

Monica M. Barbazan[1]; Lucia S. Rocha[1]
University of the Republic, Uruguay[1]

Soybean [Glycine max (L.) Merr.] , one of the main crops in the world, requires a large amount of potassium (K) to complete its cycle. However, there is limited information of the effects on yield and seed composition when potassium fertilizer is applied in advanced stages of the soybean growth. This information is important, especially for Uruguay, where agriculture depends strictly on imported fertilizers and where K has recently been found as one of the main factors limiting the crop production. The objective of this study was to evaluate the effects of K fertilizer on the yield and concentration of nitrogen (N) of soybean seeds, when K is applied to the soil in two stages of the growing season . Field experiments were conducted in four different sites, using a randomized complete block design. Treatments were three rates (0, 50, and 100 kg of K ha-1) applied at 2-3 leaves or at R1-R2 stages. Granulated K fertilizer (potassium chloride) was applied to soil, on four commertial soybean crops under no-tillage system. Initial soil K tests (STK) (NH4Ac method) were 0.15, 0.22, 0.37, and 0.60 cmolc kg-1. Trifoliolate leaf- and petiole-K concentrations and STK at R1-R2, and yield and N concentration (Kjeldahl method) in seed were determined. The results showed significant yield increase in the two sites with lower STK, but no statistic differences were observed between rates or timing of K application. Trifoliolate leaf- and petiole-K concentrations at R1-R2 showed a better relationship with the yield than STK at that stage. In seeds, the concentrations of N ranged from 4.8 to 6.1% of N. This N concentration decreased in one of the sites compared with the control (without K application), in other site increased, whereas in the other two sites were stable. Our results suggest the possibility of correcting K deficiency of soybean by K fertilization at early reproductive stages. Further research is needed to make K fertilizer recommendations.

Keywords: granulated fertilizer, in season, trifoliate leaf-and petiole-K
Financial support: IPNI-Canpotex

(1721 - 235) Leaf litter decomposition in silvopastoral systems in Colombian Caribbean

Martínez-Atencia, Judith[1]; Osorio-Vega, Nelson[2]; Loaiza-Usuga, Juan[2]; Cajas-Girón, Yasmin[3]
CORPOICA[1]; Universidad Nacional de Colombia[2]; Consultor[3]

The degradation of soils and grasslands in the livestock systems of the Colombian Caribbean region decreases plant and animal productivity. The silvopastoral systems can favor the recycling of carbon and nutrients from the addition of litter and its subsequent decomposition. However, there is little knowledge about the actual contribution of nutrients by plant species within multi-stratum silvopastoral systems and the speed with which they are released into the soil. The objective of this work was to determine the rate of decomposition and the release of nutrients from fallen litter of five plant species in thirteen years old silvopastoral arrangements and a grass-only meadow in the Middle Valley of the Sinú River, Colombia. The results show that (i) the decomposition of leaf litter and the release of nutrients (C, N, P, K, Ca and Mg) depended on the plant species that originated the litter and independent of the silvopastoral arrangement; (ii) these arrangements presented a real return of nutrients greater than that of the pastures; (iii) the litter decomposition was significantly related to the N / P ratio and the P and Mg concentration of the litter and not to the C / N ratio.

Keywords: Leaf litter, Soil fertility, Nutrient cycling
Financial support: Corporación Colombiana de Investigación Agropecuaria – CORPOICA

(8364 - 544) Lignin and lignin / nitrogen ratio associated with arboreal-shrub components in an agroforestry system without semiarid.

Rafaela Batista Magalhães[1]; Lucas de Sousa Oliveira[1]; Rafael de Souza Miranda[1]; Mirian Cristina Gomes Costa[1]
Federal University of Ceará[1]

Agroforestry systems (AFSs) constitute a more sustainable alternative of land use. The tree components present in AFSs are environmentally important for the adequate functioning of the systems. The amount of lignin directly influences the rate of decomposition of plant material from the tree components. The objective was to analyze the soil and roots of the tree species of SAF in relation to the lignin content and to the lignin: nitrogen ratio. The study was carried out in an agrosilvipastoril system in the semi-arid region. The experimental design was completely randomized, with split plots and four replicates. Four tree-shrub components randomly located in the area were evaluated in the plots: A – 'Catingueira' (*Poincianella pyramidalis*); B – 'Pau Branco' (*Auxemma oncocalyx*); C – 'Sabiá' (*Mimosa caesalpiniaefolia*); and D – 'Gliricídia' (*Gliricidia sepium*). Two sampling sites were evaluated in the subplots: A - inside crown projection area; B - outside crown projection area. For lignin contents in the roots, *Auxemma oncocalyx* showed higher value inside the crown projection area. Only *Poincianella pyramidalis* and *Auxemma oncocalyx* resulted in higher mean values inside the crown projection area, in the comparison between sampling sites. Regarding lignin:N ratio, *Auxemma oncocalyx* resulted in the highest mean value among the species and inside the crown projection area. Among the studied species, *Gliricidia sepium* and *Mimosa caesalpiniaefolia* showed the lowest values of lignin:N ratio. For lignin contents in the soil, *Auxemma oncocalyx* and *Poincianella pyramidalis* led to higher mean values inside the crown projection area. It is concluded that due to the lower lignin:N ratio, which will result in faster decomposition, *Gliricidia sepium* is promising to supply nutrients in the AFSs in shorter time among the studied species. The *Poincianella pyramidalis* and *Auxemma Oncocalyx* have higher lignin:N ratios, resulting in long-term improvements associated with an organic soil matter that takes longer to decompose.

Keywords: non-humic substances; agroforestry; polyculture
Financial support:

(4132 - 2707) Long term impacts of integrated crop-livestock system with different grazing intensities and stocking methods on soil chemical attributes

Lucas Aquino Alves[1]; Tales Tiecher[1]; Luiz Gustavo Denardin[1]; Mateus Goulart[1]; Amanda Posselt Martins[1]; Ibanor Anghinoni[1]; Paulo César de Faccio Carvalho[1]
Federal University of Rio Grande do Sul[1]

The insertion of the animal component into the crop production (integrated crop-livestock systems – ICLS) can alter the nutrient dynamics and, consequently, the soil fertility status of the soil over time. This change occurs differently according to the arrangement adopted, depending on both, the intensity and frequency of animal grazing and crop rotation. The objective of this study was to evaluate

the long-term (13-yr) impact of sheep grazing in different intensities and grazing methods in the winter, on soil chemical attributes, in a monoculture and crop rotation in summer season of an ICLS. The study was performed in an experiment established in 2003, in a subtropical Acrisol in southern Brazil, arranged in a randomized block design with split plots. The treatments are two grazing intensities (moderate - 2.5 times the potential of consumption of animals and low - 5.0 times the potential of consumption of the animals), two methods of grazing (continuous and rotational) subdivided into two crop systems (monoculture of soybean/soybean and soybean/corn rotation). The evaluated chemical attributes were: water pH; exchangeable Al, Ca and Mg; available P and K; potential acidity (H+Al); base saturation (V); Al saturation (m); cation exchange capacity CEC (*t*), and organic carbon (C), at 0-5, 5-10, 10-20, 20-30, and 30-40 cm soil layers. Rotation with maize/soybean resulted in acidification of soil over time, with a pH of about 0.3 units (pH = 3.9) lower than in the monoculture (pH = 4.2) for the 0-40 cm soil layer. On the other hand, CEC was approximately 20% higher in crop rotation (3.9 $cmol_c\ dm^{-3}$) than in the monoculture (3.3 $cmol_c\ dm^{-3}$) in the 0-5 cm soil layer. In the same soil layer, CEC was 15% higher at low grazing intensity (3.9 $cmol_c\ dm^{-3}$) compared to moderate grazing intensity (3.4 $cmol_c\ dm^{-3}$). The C content in the monoculture was higher (1.4%) than in rotation system (1.1%) up to 10 cm depth. Moreover, low grazing intensity resulted also in an increase of C content up to 10 cm soil depth. The other evaluated soil chemical attributes were not affected by the treatments. The soybean monoculture system combined with low grazing intensity increases the levels of C in the most soil superficial layer. Monoculture coupled to low grazing intensity is more effective in maintaining soil fertility, and the grazing method does not seem to affect soil fertility over time.

Keywords: soil fertility, crop rotation, sheep grazing.
Financial support: CNPq and Agrisus.

(6621 - 487) Long-term organic amendments under a mediterranean climate: effects on soil pore shapes

Alcira Sunilda Valdez-Ibañez[1]; María Rosa Yagüe Carrasco[2]; Josep Maria LLop[3]; Elena Puigpinós[3]; Àngela Dolores Bosch-Serra[2]
University of Asunción, Km 11, San Lorenzo, E-2160, Paraguay (alcira.valdez@macs.udl.cat); University of Lleida, Av. Alcalde Rovira Roure 191, Lleida, E-25198, Spain[1]; University of Lleida, Av. Alcalde Rovira Roure 191, Lleida, E-25198, Spain[2]; Department of Agriculture, Livestock, Fisheries, Food and Natural Environment, Generalitat de Catalunya, Avda. Alcalde Rovira Roure 191, Lleida, E-25198 Spain.[3]

A long-term application of organic amendments, in Mediterranean dryland agricultural systems with low organic matter (OM) soil content, could improve physical fertility and cause porosity changes (total, size and shape). Shape pore parameters: Circularity (*C)*, Aspect ratio (*AR)* and Solidity (*S*) reveal the irregularity, tortuosity and roughness of pores that affect water retention capacity, a relevant parameter in dryland systems. This study was aimed to evaluate the effects of organic amendments on soil pore shape parameters after a long-term (19 years) application period. The experiment was established in the 1997-98 cropping season in Lleida, Spain. Winter cereals are the main crops. Five fertilization treatments were distributed in three randomized blocks. Organics were applied annually, just before sowing: pig slurry (30 t $ha^{-1}\ yr^{-1}$; ≈ 50 kg OM t^{-1}; 30PS), low and high rate composted sludge (10 t $ha^{-1}\ yr^{-1}$ and 20 t $ha^{-1}\ yr^{-1}$, ≈ 290 kg OM t^{-1}). They were compared with an unfertilized control (CO) and with a chemical fertilization (MI). In April 2015, undisturbed soil samples (0–0.05 m depth) were taken and later they were dried, impregnated in polyester resin to obtain a thin section (0.05 m wide, 0.13 m long). From each thin section two images were taken under crossed polarisers to obtain digital binary images. From them, shape pore parameters: *C* (4π pore area/pore perimeter^2), *AR* (major axis/minor axis), and *S* (area of the pore/convex area of the pore) were quantified and analysed in four intervals of pores (apparent diameter: 30–60 µm*,* 60–100 µm*,* 100–200 µm*,* 200–400 µm and >400 µm). In all treatments, the *C* and *S* tended to decrease as pore size increased and an opposite trend occurred in the *AR*. The results indicate that shapes are modified by treatments at pore ranges of 60–100 µm (*AR*), 200–400 µm (*S*) and >400 µm (*C*) The *AR* values were lower in 20CS (1.668) and CO (1.662) than in 10CS (1.785) and 30PS (1.786) treatments. Treatments with added OM tended to decrease *S* (PS: 0.736; 20CS: 0.734; 10CS: 0.702) compared with no OM addition (CO: 0,766 and MI: *S*: 0,742). Similar differences were detected in *C* between organic treatments (PS: 0.304; 20CS: 0.300; 10CS: 0.261) and the rest (CO: 0.337 and MI: 0.325). These changes in pore shapes could be considered a positive effect of organic amendments in Mediterranean dryland agricultural systems.

Keywords: micromorphology, organic fertilizers, slurry, composted-sludge, dryland-agriculture
Financial support: This research was financially supported by the Department of Agriculture, Livestock, Fisheries and Food (Generalitat de Catalunya, Catalonia, Spain) in the framework of the improvement of fertilization practices in Catalonia (NE of Spain).

(2437 - 1701) Microbial community changes in red latosol under swine liquid manure treatment

Deisi Navroski[1]; Graziela Moraes de Cesare Barbosa[2]; Maria Aparecida de Matos[2]; Adonis Moreira[3]; Arnaldo Colozzi Filho[2]
Londrina State University[1]; Agronomic Institute of Paraná State[2]; Brazilian Agricultural Research Corporation[3]

Brazil is the fourth largest producer of pork meat worldwide and as result, a great amount of swine liquid manure (SLM) has been commonly used as organic fertilizer in farming areas. This study focused on evaluating microbial community changes in a soil under SLM treatment. The experiment was performed in 1988 at an experimental station of IAPAR, on a soil classified as eutrophic Red Latosol (Oxisol) under no-till grain crops (NT). Soil samples were collected in October 2016, in a depth range of 0 to 10 cm, after ten days SLM application. Soil samples from a native primary forest (PF) nearby the experimental area were also gathered. Soil total DNA was extracted using a commercial kit, following the manufacturer's instructions. PCR amplifications of 16S rDNA gene fragment from *Archaea* and Bacteria and of the fungal 18S rDNA gene were made using universal and domain-specific oligonucleotide primers. Amplification products were denaturated by gel electrophoresis (DGGE) with 8% polyacrylamide gel (fungi and Archaea) and 6% (bacteria). PCR-DGGE profiles were analyzed by BioNumerics software package, and the dendrogram built using the UPGMA algorithm and Jaccard coefficient, with tolerance of 1%. The similarity among all treatments, including FP, was 38.1% for fungi, 38.6% for Archaea, and 63.2% for bacteria. A 70% similarity cutoff was used to define clusters; the Archaea community profile revealed a similarity of 84% among doses, and only 38% in relation to PF. Bacterial community was assessed by the same criterion, forming three clusters, one comprising the doses of 15 and 30 $m^3\ ha^{-1}$ (78% similarity), while the others were composed by control (0 $m^3\ ha^{-1}$) and PF. The fungal profile showed the same behavior, and the doses of 15 and 30 $m^3\ ha^{-1}$ had a 95% similarity, while control and PF remained separated again. In all cases, bands were greater in intensity at the dose of 15 $m^3\ ha^{-1}$, followed by that of 30 $m^3\ ha^{-1}$, but to a lesser degree at control; therefore, microbial diversity seems to be greater when SLM is used. The high similarity between the doses of 15 and 30 $m^3\ ha^{-1}$, as well as their

greater intensity of bands show that SLM addition to the soil surface may provide carbon and other organic compounds, which can be beneficial to autochthonous and zymogenous microorganisms therein. Our findings showed that the soil microbial community was altered after SLM addition, besides the fact that the most diverse microbial profile also reached a new break-even point.

Keywords: Organic fertilizer; fingerprinting; microbial diversity.
Financial support: We thank the Coordination for the Improvement of Higher Education Personnel (CAPES) and Agronomic Institute of Paraná State (IAPAR)

(7891 - 2301) Multifunctional agroecosystems contributing for nutrients cycling in irrigated environments of the Brazilian semi-arid

Alessandra Monteiro Salviano[1]; Lincoln Monteiro Bagagi[2]; Andreia Amariz[2]; Maria do Socorro Conceiçao de Freitas[3]; Vanderlise Giongo[1]
Embrapa[1]; UPE[2]; IFSertão[3]

The Brazilian semi-arid region is characterized by monoculture that eventually degrade the soil. Due to this reality, there is a need to recover degraded areas and to preserve those that still are productive. Different practices are used for soil management and conservation, the most important being the green manure, which consist of the use of plant mixture that cover the soil. Therefore, the present work aims to evaluate the micronutrient cycling capacity by the use of green manure in mango production systems in the Brazilian semi-arid to mitigate the excessive use of fertilizer in agroecosystems. The study was carried out in long-term experiment installed in Petrolina, Pernambuco, local climate classified as BSwh' and Ultisol dystrophic plinthic, loamy/clayey plain relief. The experiment was conducted in a randomized block design with four replications and treatments arranged in subdivided plots. The plots consisted of two soil management systems (tillage and no-tillage), and the subplots consisted of 3 types of green manures: plant mixture 1 (PM1); plant mixture 2 (PM2) and spontaneous vegetation (SV). The litter bag technique was used for the evaluation of the release of nutrients. Altogether, there were used 312 litter bags, with monthly collections of 13 samples, during 12 months. The micronutrients accumulation on the phytomass of the green manures wasn't influenced by the soil management, but changed the cycling capacity of Mn on green manure. The soil's stirring speeds up the decomposition of the vegetable residue, providing a faster release of most micronutrients. In the tillage systems, the Fe was the micronutrient that took longer to release in all of the green manures, but the release of the remaining micronutrients changed from study to study, due to the type of fertilizer. The Mn, followed by the Zn, were the micronutrients that released first in every green manure, and the release of the remaining nutrients changed due to the type of fertilizer. In general, the Cu was the slowest element to release, the liberation speed being PM1>PM2>SV. To this nutrient, the release speed in on its maximum on tillage. The practice of cultivating plant mixtures in between the orchard's rows, as well as the maintenance of the spontaneous vegetation is a very promising technology to the cycling of soil's micronutrients and to improve or maintain the soil's quality, providing sustainability to the irrigated mango crop on the Brazilian semi-arid.

Keywords: micronutrients, Plant mixtures, green manure, spontaneous vegetation
Financial support: Embrapa, Banco do Nordeste

(7033 - 448) Nitrogen mobility, ammonia volatilization, and estimated leaching loss from long-term manure incorporation in red soil

Jing Huang[1]; Yinghua Duan[2]; Minggang Xu[2]; Boren Wang[1]; Nan Sun[2]; Suduan Gao[3]
Institute of Agricultural Resources and Regional Planning, Chinese Academy of Agricultural Sciences / National Engineering Laboratory for Improving Quality of Arable Land, Beijing 100081, China/Red Soil Experimental Station of CAAS in Hengyang / National[1]; Institute of Agricultural Resources and Regional Planning, Chinese Academy of Agricultural Sciences / National Engineering Laboratory for Improving Quality of Arable Land, Beijing 100081, China[2]; USDA Agricultural Research Service, San Joaquin Valley Agricultural Sciences Center, 9611 South Riverbend Avenue, Parlier, CA 93648-9757, USA[3]
Nitrogen mobility, ammonia volatilization, and estimated leaching loss from long-term manure incorporation in red soil J. Huang [1,2], Y. Duan[1], M. Xu[1], B. Wang[1,2], N. Sun[1] and S. Gao[3] [1]Institute of Agricultural Resources and Regional Planning, CAAS; [2] Red Soil Experimental Station of CAAS in Qiyang, Qiyang 426182, China; [3]USDA Agricultural Research Service, San Joaquin Valley Agricultural Sciences Center, 9611 South Riverbend Avenue, Parlier, CA 93648-9757, USA.

Nitrogen (N) loss from fertilization in agricultural fields has an unavoidable negative impact on the environment and a better understanding of the major pathways can assist in developing best management practices. But there has been a challenge in quantifying the leaching loss in agronomic cropping systems. The aim of this study was to evaluate the fate of N fertilizers applied to acidic red soil (Ferralic Cambisol) after 19 years of different mineral (synthetic) and manure fertilization treatments under a cropping system with wheat-maize rotations. Five field treatments were examined: control (CK), mineral fertilizer combinations of NK, NP or NPK, and the NPK with manure (NPKM, 70% N from manure). Using the soil total N changes in 0−100 cm depth, plant uptake, ammonia (NH_3) volatilization, and nitrous oxide (N_2O) emission data measured in the field, a mass balance approach was used and potential N leaching loss was estimated. In contrast to the NPKM, all mineral fertilizer treatments (NK, NP and NPK) showed nitrate (NO_3^-) concentration increased with greater soil depth indicating higher leaching potential. However, total NH_3 volatilization loss was much higher from the NPKM (19.7%) than other mineral fertilizer treatments (≤4.2%). The N_2O emissions were generally low (0.2-0.9%, highest from the NPKM). Total gaseous loss accounted for 1.7, 3.3, 5.1, and 21.9% for NK, NP, NPK, and NPKM treatments, respectively. Estimated N leaching loss from the NPKM was only 5% of those from mineral fertilizer treatments. All data demonstrated that manure incorporation improved soil productivity, increased yield, and reduced potential leaching, but with significantly higher NH_3 volatilization, which could be reduced by improving application method. This research confirms that manure incorporation is an essential strategy in N fertilization management in dryland red soil cropping system. Keywords: soil NO_3^-−N; ammonia volatilization; nitrogen leaching, long-term field experiment; mass balance; nitrous oxide emission

Keywords: soil NO_3^-−N; ammonia volatilization; nitrogen leaching, long-term field experiment; mass balance; nitrous oxide emission
Financial support: Key Laboratory of Nonpoint Source Pollution Control, Ministry of Agriculture, P. R. China (20130104), National Key Research and Development Program of China (2016YFD0300901)

(8724 - 625) Nutrient absorption by *capsicum annuum* l cv. topito and cubanel in santa marta, colombia

Nelson Virgilio Piraneque Gambasica[1]; Sonia Esperanza Aguirre Forero[1]; Ceiny Jimena Jimenez Turizo[1]
Universidad del Magdalena[1]

Pepper is considered a promising crop for the Colombian Caribbean region economy, due to its growing national and international

demand, high yield and low production costs, thus becoming one of the most cultivated vegetables in the Magdalena department of Colombia. At the Center for Agricultural Development and Forestry of the University of Magdalena, macronutrients and micronutrients absorption by the cultivars Topito and Cubanel (Capsicum annum L.) was determined. For this, based on Bertsch (2003) methodology, and wet mineralization method for plants described by ICA (1993), random samplings were performed every 15 days by taking 3 to 10 plants (according to phenological stage) with suitable physiological and morphological characteristics, growth parameters (stem diameter, number of leaves, plant height, biomass and dry mass) were evaluated to establish the growth and biomass accumulation curves by the cultivars. The nutrients absorption was determined according to IGAC (2006) methodology. Results allowed to establish that the nutrient most absorbed by the two cultivars was nitrogen and that the macronutrients absorption, although different in each cultivar, followed the sequence N> K> Ca> Mg> S> P> Na. Micronutrients had different sequences, where Topito was Fe> Mn> Zn> B> Cu and in Cubanel Fe > Mn> Zn> Cu> B. Topito exceeded 29% in biomass accumulation and 51% in dry matter accumulation to Cubanel. Arguments of judgment are contributed in this work, in order to incorporate them to existent knowledge on pepper crop management in the studied zone. It is also shown the relevancy of integrating adequate nutrients supply as an active component in the productive system in modern agriculture or management by specific site.

Keywords: biomass accumulation, growth curve, macronutrients and micronutrients absorption curve, *Capsicum annuum* L.
Financial support: Universidad del Magdalena

(6659 - 1989) Nutrient accumulation and shoot dry matter production by cover crop species

Guiverson Ferreira Bueno[1]; Rodolfo Bedeu[1]; Jayme Ferreira Neto[2]; Laerte Gustavo Pivetta[3]; Luis Fernando Correira de Mello[1]; Camila de Aquino Tomaz[1]; Juliana Pereira Bravo[1]
Faculdade La Salle[1]; Universidade Católica Dom Bosco[2]; Instituto Federal do Mato Grosso[3]

In the choice of cover crops for no-tillage system it is very important to consider the amount of shoot dry matter produced in order to protect soil surface against erosion processes and the ability to accumulate nutrients extracted from the soil avoiding, for example, nutrient leaching. In this context, grasses and legumes such as pearl millet (*Pennisetum glaucum L.*), sun hemp (*Crotalaria spectabilis*), sudangrass (*Sorghum bicolor*) and finger millet (*Eleusine coracana L.*) can be attractive alternatives for no-tillage system. This study aimed to evaluate the nutrient accumulation and shoot dry matter production from pearl millet, sun hemp, sudangrass and finger millet evaluated in the flowering of each specie. This experiment was set up in March 2017 in Lucas do Rio Verde, Mato Grosso, Brazil. A randomized block design consisted of the four cover crop species, sown in March and collected for shoot dry matter and nutrient accumulation evaluation around the end of April and beginning of May by the flowering occasion. Sudangrass produces greater amounts of shoot dry matter followed by finger millet, pearl millet and sun hemp but the cover crop specie that accumulates more N, P, K, Ca, Mg, S, was finger millet.

Keywords: Nutrient extraction, *Pennisetum glaucum, Crotalaria spectabilis, Sorghum bicolor, Eleusine coracana L*.
Financial support:

(6619 - 1735) Organic and inorganic phosphorus in yellow latosol under chronosequence of crops under no-tillage system in eastern Amazon

Edilson Carvalho Brasil[1]; Rubia Carla Ribeiro Dantas[2]; Leticia Cunha da Hungria[2]; Sidney Daniel Araújo da Costa[2]; Alessandra Danieli Miranda de Araújo[2]; Mario Lopes da Silva Júnior[2]
Embrapa Amazônia Oriental[1]; Universidade Federal Rural da Amazônia[2]

Phosphorus deficiency (P) is one of the main limiting factors of productivity in Brazilian soils. However, soil management under no-tillage (NT) system may alter soil P availability. The objective was to evaluate the organic and inorganic fractions of P in a Yellow Latosol (Oxisol), in chronosequence of crops under no-tillage system in the Eastern Amazon. The study was conducted in the Paragominas city, southeast Pará, in a chronosequence of crops under NT, using a completely randomized experimental design in subdivided plots. The plots were constituted by the management systems and the subplots corresponded to the depths (0-10, 10-20, 20-30 and 30-40 cm). The management systems were: NT with nine (NT9), eleven (NT11), thirteen (NT13), fourteen (NT14) and fifteen (NT15) years of adoption, plus one area under conventional tillage (CT) and another with native forest (NF). The soil samples were submitted to the chemical fractionation of P and the obtained fractions were classified in inorganic P - Pi (sum of Pi_{RTA}, Pi_{BIC}, $Pi_{Hid0,1}$, Pi_{HCl} and $Pi_{Hid0,5}$) and organic P - Po (sum of Po_{BIC}, $Po_{Hid0.1}$ and $Po_{Hid0.5}$). In general, the organic fractions were predominant in the NT, while the inorganic fractions were the predominant ones in the area under CT, suggesting that in the soil managed under NT the P accumulates, preferably, in organic forms. In the layers 0-10 and 10-20 cm, all the areas under NT presented values of Pi highest to the CT, while in the layers 10-20 and 20-30 cm no difference was observed between the treatments. Considering the 0-10 cm layer, there was significant increases in the content of Po, in function of the time of NT adoption, with mean values of 256, 297, 319, 324 and 333 mg kg^{-1}, respectively, for treatments NT9, NT11 , NT13, NT14 and NT15. The Pi fraction presented similar behavior, but with absolute values in a smaller magnitude, with mean values of 133, 142, 180, 242 and 253 mg kg^{-1}, respectively, for the same systems. In the result of the higher organic matter input, soil non-tillage system and higher nutrient cycling, the NT promotes greater availability of the Po fraction when compared to CT.

Keywords: P fractionation, management systems, organic phosphorus.
Financial support: Embrapa Amazônia Oriental

(1753 - 1418) Parameters of Soil fertility as function of soil tillage systems and liming in Sugarcane

Murilo de Campos[1]; Gabriela Siqueira de Ferraz[1]; Jorge Martineli Martello[1]; Vinicius Barreto[1]; Daniele Scudeletti[1]; Ciro Pozzi Garcia[1]; Carlos Alexandre Costa Crusciol[1]; Juliano Carlos Calonego[1]; Tiara Moraes Guimarães[1]
São Paulo State University, College of Agricultural Sciences, Botucatu-SP[1]

The intense mechanization from planting to harvest in sugarcane production submits the soil to a strong compaction, reducing the root growth and yield. For these reasons, new soil tillage systems are being studied, aimed longevity and the maximum economic return. It is also necessary to evaluate the interaction with soil chemical attributes, as well as the use of limestone, since the recommendations of limestone in sugarcane were developed for the conventional soil tillage and harvest after burning. The aim of this study was to evaluate soil chemical attributes in function of the soil tillage systems and limestone doses. An experiment was carried out in a Oxisol, in Pirajú-SP, with a randomized complete block design, in a subdivided plot scheme, with four replications. The plots consisted of two soil tillage systems: 1. Conventional Soil Tillage (CST) with limestone applied in surface total area; 2. Modified Deep Soil Tillage (MDST) - Preparation

with rod up to 0.80 m and rotating hoe, with limestone only in the tillage range, applying ¼ of the limestone dose in depth. In the subplots, were used four different doses of limestone (0, 1, 2 and 3 times the recommended dose). Soil samples were collected in tillage range soon after the plant harvest at deeps of 0-0.2, 0.2-0.4, 0.4-0.6, 0.6-0.8 and 0.8-1.00 m. The evaluated parameters were: Sum of Bases (SB); Effective Cations Exchenge Capacity (CEC_e); Percentage Aluminum Saturation (AS) and Percentage Bases Saturation (BS). In all evaluated profiles, there was significant interaction ($p < 0.01$) between soil tillage systems and limestone doses at the parameters SB, BS and CEC_e. For these three variables, MDST was higher than CST at the highest limestone doses (2 and 3 times the recommended dose). When the recommended dose was used, the CST had higher values, evidencing the need of higher limestone doses in MDST, possibly due to the greater volume of explored soil. The variables Al^{+3} and AS showed significant interaction ($p < 0.01$) between soil preparation and limestone doses. The values of Al^{+3} and AS at all depths, were statistically lower in the CST with the recommended limestone dose. However, with 3 times the recommended dose, the MDST showed lower values of Al^{+3} and m%, mainly in subsurface. As these evaluations are related to the first year of cultivation, the values obtained show that the MDST can be a promising technique for sugarcane longevity, acting mainly in the deeper layers of soil.

Keywords: Deep soil tillage; limestone; Convencional soil tillage
Financial support: São Paulo Research Foundation (FAPESP – Project Number 2001/20593-9).

(5633 - 1278) Percolate displacement and soil phosphorus content from the application of bovine livestock wastewater

Morais Carneiro dos Reis[1]; Ludimila Lucas da Silva[1]; Willian Geraldo da Silva[1]; Raysner Cesar Gral[1]; André Santana Andrade[1]
Centro Universitário de Patos de Minas[1]

The application of wastewater (WW) in soils has been a viable alternative for its final destination, both in industries and in farming systems. The utilization of WW in the fertirrigation of agricultural crops has been shown as an option in the reduction of environmental pollution, besides promoting better soil characteristics. Although application of WW in soils be viable, there is a shortage in technical criteria for proper application and environmental monitoring. Among the important parameters for monitoring and soil phosphorus content, biochemical oxygen demand (BOD) and percolate pH. Thus, the objective of this work was to quantify these parameters considering columns of soil submitted to different rates of application of WW. The work was conducted at Farm Terra Molhada, municipality of Lagoa Formosa, MG. The experiment was carried out in a randomized complete block design (RCB), with eight treatments and three replications, totaling 24 plots distributed in a 2x4 factorial scheme, represented by columns with two soil depths (0.30 m and 0.60 m) and four increasing ARB rates (0, 7.69, 15.38 and 23.07 kg / ha / week of N) calculated by the N content of dairy cattle WW applied. Five weekly applications were performed. The P extractor was the Mehlich-1. The analysis of variance was performed for all the characteristics evaluated by the Ftest ($P<0,10$). The averages were compared by the Tukey's test ($P <0,10$). Statistical analysis was performed by SISVAR software. Was observed an increase in the BOD rate of 41.58 mg L^{-1} for percolated effluents in the soil columns of 0,30 m. It was verified that there was no statistical difference between the treatments and as different depths analyzed. As for the P content of the soil, the result can be justified by the reduced experimental time, which was insufficient for the occurrence of significant mineralization of organic P present in WW. , not altering, consequently, their contents in the soil. As for ph, the result can be justified by the low volume of WW application, and by the high oxidation capacity and soil buffer power, which was able to oxidize the organic load of the WW and to absorb alterations in the pH of the percolated water. It is concluded that the amount of RA applied to the soil, even in the highest studied dose, in the studied period, does not pose environmental risks.

Keywords: BOD, bovine manure, fertigation, pH
Financial support: Centro Universitário de Patos de Minas – UNIPAM

(5059 - 2226) Phosphorus efficiency and grain yield response of oat cultivars to soil-phosphorus levels.

Pedro Alexandre Varella Escosteguy[1]; Jonas Manica[1]
University of Passo Fundo[1]

This study was carried out to assess the nutritional efficiency of phosphorus (P) and the grain yield response of oat cultivars to soil-P levels. The treatments were evaluated in an 8 x 3 factorial scheme (Cultivars x P levels), with four replicates, in a randomized experimental design. Cultivars of *avena sativa* were grown in a greenhouse under low, medium and high soil-P level. To assess the nutritional efficiency indices and the oat response to soil-P levels, dry mass and P concentration of the aerial (stem, leaves, grains) and root part of the plant were evaluated, at physiological maturation. The cultivars with higher nutritional efficiency were distinguished by the higher efficiency of P use for grain yield which was due to the accumulation of this nutrient in the aerial part, mainly in the grains. Cultivars Barbarasul, Ouro and Taura are nutritional efficient for P, while FAEM 007, URS 21, Farroupilha, and Afrodite are inefficient. FAPA Slava is on the edge of efficient and inefficient group of cultivars. Most of the cultivars (Barbarasul, Ouro, FAEM 007, URS 21, and Farroupilha) are responsive to soil-P level, where Afrodite, FAPA Slava and Taura are not responsive to the increase of P in soil.

Keywords: *Avena Sativa*; grain yield, efficiency of use, efficiency of utilization, efficiency of acquisition.
Financial support: UPF-PPGAgro; Fapergs (Project Number 16/0484-6).

(5972 - 884) Phosphorus fractions of Southern Chilean soils according to their genetic evolution

Dante Pinochet[1]; Gerardo Otzen[2]; Susana Valle[1]
Instituto de Ingeniería Agraria y Suelos. Facultad de Ciencias Agrarias. Universidad Austral de Chile. Centro de Investigación en Suelos Volcánicos (CISVo)[1]; Instituto de Ingeniería Agraria y Suelos. Facultad de Ciencias Agrarias. Universidad Austral de Chile.[2]

Total phosphorus (P) is composed by different reservoirs, which represents different mineral and organic components and their lability. By using sequential extraction methodology, these pools can be assessed and related to changes in P availability occurred during soil development and maturity. In Chile there are few studies comparing P fractions in function of soil maturity and no studies are known about the accumulation and distribution of P fractions in the soil profile. This study evaluates the hypothesis that the accumulation of P in soil varies with the genetic development of their horizons and soils with greater genetic evolution show different pattern the P accumulation in the P soil fractions. Three soil series profiles with different degree of evolution from the South Regions of Chile were evaluated: Valdivia soil, derived from volcanic ashes (duric Hapludand) from the Holocene period, the Fresia soil from volcanic materials (typic Haplohumult) from Pleistocene and Hueicoya soil (Haplohumult) a soil from before the three last glaciations on the region. The soils were sampled in all the horizons until C horizon and by sequential extraction method de Total P was fractionated in 8 different fractions. The total P is reduced with the soil evolution degree. Valdivia soil (the youngest soil evaluated) has 2 times more P than Fresia soil and 8.5 times more P Hueicoya soil, the oldest in evolution development. In all the soils the greatest accumulation of P was determined in the superficial Ap horizon and they have similar

proportions of their total P in the subsuperficial horizons. The inorganic P dominates over organic P in all the soil horizons being over 55% in all the soils. The soil series varied their relative P accumulation according to their permanent features related to P retention capacity. Independent of their total P the the Hueicoya soil (with low retention capacity) presented the greatest proportion of its P in the labile P fractions (Resin and bicarbonate) compared to the other soils which accumulated their P in their moderately labile fractions (NaOH and HCl 1M).

Keywords: P sequential fractions; total P, inorganic P, organic P, genetic soil evolution

Financial support: Instituto de Ingeniería Agraria y Suelos (UACh).

(1704 - 580) Phosphorus organic forms release in long term field experiment depending on maize fertilization and growing systems

Stanko Milić[1]; Jordana Ninkov[1]; Jovica Vasina[1]; Živanov Milorad[1]; Jelena Marinković[1]; Branka Žarković[2]

Institute of Field and Vegetable Crops, Laboratory for soil and agroecology, Novi Sad, Serbia[1]; Faculty of Agriculture-University of Belgrade, Department of Agrochemistry and Plant Physiology, Belgrade, Serbia[2]

Since phosphorus is a non-renewable resource and one of the main pillars of modern agriculture the majority of global studies are directed toward more efficient use of phosphorus fertilizers, its recycling, and the use of alternative sources. Soil samples for the study were taken from long-term trial of the Institute of Field and Vegetable Crops at the experimental station at Rimski Šančevi. The trial was set up in 1965 as two-factorial, and replicated four times, according to the plan of divided plots (split-plot design with randomized variants). This study is based on monitoring the effect of crop rotation and fertilizers (manure, harvest residues and mineral fertilizers) on the presence of phosphorus and its organic fractions in different layers of rhizosphere by long-term use of particular maize growing and fertilization systems. The following factors were analysed: 1. Fertilizing systems: single-crop system (Ø, NPK, NPK+maize remains, NPK+manure) and two-crop rotation – maize/barley (manure, NPK+manure); 2. Soil depth: 0-20 cm; 20-40 cm; 40-60 cm. Chemical parameters, which was monitored on 324 number of soil samples, during the this investigating period was: basic chemical characteristics of soil, content of total phosphorus, content of total organic phosphorus, fractionation of organic phosphorus, activity of acid and alkaline phosphatase and yield. Organic matter content ranges from 1.88% to 2.98%. The highest values are characteristic for the treatments where manure was included together with mineral fertilizer. The highest content of total and organic phosphorus was found in the treatments with manure application, increase ranging from 27% to 70% depending of the variant. Characterisation of different types of organic phosphorus (labile, moderately labile, nonlabile) showed clear demarcation among studied treatments. Significant differences in all studied fractions and depths divided two basic groups, with and without use of organic fertilizers, wherein the highest values were actually found in the treatments with manure application. This was also proved by achieved statistical significances of LSD test between analysed components. In the year of the study, as well as for the long-term period, the lowest yields were achieved in the control variant of maize cultivation in single-crop system. Treatment two-crop rotation NPK+manure has statistically significantly highest yield comparing to all investigated variants.

Keywords: phosphorus; maize; calcic chernozem; phosphorus organic fractions; long term experiment

Financial support:

(5303 - 2335) Potential reduction of fertilizer application in paddy soils: Nutrient reserve approach from soil mineralogical composition in Indonesia

Markus Anda[1]; Dedi Nursyamsi[1]

Indonesian Agency for Agricultural Research and Development[1]

Paddy soils occupied about 155 million ha of the world land surfaces and about 144 countries grow rice as the crucial source of food. The strategic approach to promote high yield, efficient use of fertilizer, environmentally sound and sustainable rice production in rice cultivation area worldwide is crucially required. The objectives of the study were (i) to evaluate easily weatherable minerals as natural nutrient reserves in various paddy soils developed from different parent materials in Indonesia, and (ii) to relate nutrient reserve-minerals with availability of soil K-nutrient as management strategy to omit or reduce K fertilizer rate without loss of rice yield. In this study, the soils were selected to represent paddy soils derived from volcanic, alluvial, and sediment materials at four main islands of Indonesia. Soils were sampled from each layer of soil profiles to determine easily weatherable and resistant minerals using a polarization microscope and to analyze various available nutrients. Results showed that soils deriving from acid volcanic material (rhyolite, Sumatera island) and intermediate sediment parent material (marl tuff, claystone and karst, Sulawesi island) contain high sanidine (25-42%) and biotite minerals, corresponding to high status of available K in whole soil profile layers. In addition, soils derived from brownish dark tuffaceous pumice and andesitic materials in Sumbawa Island also contain high status of available K due to K trapping in pumice structure during volcanic eruption. All those soil available K-derived parent materials (not from fertilizer) were more than enough to meet rice requirement, hence K-fertilizer could be omitted. For soils derived from alluvium materials (consisting of mainly quartz minerals, 74-80% in Java island), the available soil K was very low (< 0.1 $cmol_c\ kg^{-1}$). This indicates rice crop could experience severe K nutrient deficiency, hence high rate of KCl fertilizer should be applied as a management strategy to satisfy rice requirement. Implication of the study is the ignorance of naturally available K derived from K-bearing minerals in current management practices of paddy soils worldwide has led to wasting fertilizer and environmental pollution in soils containing high K-bearing minerals. Hence, the strategy should be made to apply fertilizer in paddy soils on mineral based composition to effectively reduce chemical fertilizer, cost and pollution and to sustain rice yield production.

Keywords: Paddy soils; fertilizer efficiency; soil minerals; rice yield

Financial support: Indonesian Agency for Agricultural Research and Development

(3997 - 980) Production and quality of 'Syrah' grapes fertigated with nitrogen and potassium

Davi Jose Silva[1]; Luís Henrique Bassoi[2]; Alexsandro Oliveira da Silva[3]; Diogo Ronielson Marinho de Souza[4]; Juliana Quixaba Barros[5]; Palloma Cavalcante Pereira Lima[6]

Embrapa Semiárido, BR 428, km 152, CP 23, Petrolina, PE, CEP 56302-970, Brazil. davi.jose@embrapa.br[1]; Embrapa Instrumentação, Rua 15 de Novembro, 1452, Centro, São Carlos, SP, CEP 13560-970. Brazil[2]; Universidade Federal do Ceará, Departamento de Engenharia Agrícola, Av. Mr. Hull, 2977, Campus do Pici, Fortaleza-CE, CEP 60356-001. Brazil[3]; Instituto Federal de Educação, Ciência e Tecnologia do Sertão Pernambucano, BR 407 Km 08, Jardim São Paulo, Petrolina, PE. Brazil[4]; Universidade de Pernambuco, Campus Zona Rural, Petrolina, PE. Petrolina, Brazil[5]; Universidade de Pernambuco, Campus Petrolina, Petrolina, Brazil[6]

Vitiviniculture is an activity of great social and economic importance in the Lower Middle São Francisco region. The soils cultivated with grapevine in this region are poor in organic matter content, presenting in general low natural fertility. Thus, nitrogen and potassium fertilization generally have a great impact on the production and

chemical characteristics of grape and wine. This work was carried out with the objective of evaluating the effect of nitrogen and potassium fertilization on wine grape cultivation. The experiment was installed in the Bebedouro Experimental Field - Embrapa Semi-arid, in Petrolina, state of Pernambuco, Brazil. Grapevines of the Syrah cultivar were grafted onto the 1103 Paulsen rootstock. The planting was carried out in the 3x1 m spacing in the espalier system. Irrigation was performed by drip irrigation, with emitters spaced 0.5 m in the plant line and with 4 L h^{-1} flow. The treatments consisted of five levels of nitrogen (0, 15, 30, 60 and 120 kg ha^{-1}) and five levels of potassium (0, 15, 30, 60 and 120 kg ha^{-1}). These treatments were combined in a fractionated 5^2 factorial scheme, making a total of 13 combinations. The experiment was arranged in a randomized block with four replicates. The experimental unit consisted of 17 plants. Nitrogen was supplied as potassium nitrate and urea and potassium was supplied as nitrate, chloride and potassium sulfate, applied via fertigation. The production and quality characteristics of the grapes were evaluated during three harvests. Production increased linearly with increasing nitrogen rates; potassium fertilization did not change production. Volume of must, pH and total acidity increased as a function of nitrogen fertilization. The evaluation of the phenolic compounds revealed a higher concentration of polyphenols with increasing nitrogen levels and an increase in the concentration of anthocyanins and flavonoids in the higher levels of potassium. Nitrogen fertilization promoted even higher concentrations of citric and tartaric organic acids, but reduced the concentration of malic acid in the must.

Keywords: *Vitis vinifera*; mineral nutrition; fertilizer
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(3409 - 489) Productivity and Dry Response of Eucalyptus and Its Relations with Soil Attributes in Brazil

Vinícius Evangelista Silva[1]; Salatier Buzetti[1]; Jean-Paul Laclau[2]; Rafael Montanari[1]; Alan Rodrigo Panosso[1]; Sharlles Christian Moreira Dias[3]
UNESP - Ilha Solteira[1]; CIRAD (France)[2]; Eldorado Brasil Celulose S/A[3]

It is observed that there is a great scientific effort to isolate and quantify the factors of the forest production, as well as the response to drought of the eucalyptus, but sometimes it becomes difficult and complex to separate them, due to the spatial and temporal confusions intrinsic to forest productivity and the response to drought. Thus, the objective of the present study was to evaluate the impacts of soil physical and chemical characteristics on productivity and response to drought of eucalyptus in climatically similar sites. For this, 33 experiments were installed in Brazil and Uruguay to obtain strong edaphoclimatic contrasts, and thus, to measure productivity and the response to drought and to describe its relations with soil attributes. Dry response was assessed with a 30% ratio rain exclusion system (70% of the rain left on the forests).The attributes of the soil Sand, Silt, Clay, organic material (O.M), cations exchange capacity (CEC), have a "maximum value" behavior in relation to eucalyptus productivity. The optimal values of Sand, Clay, Silt, CEC, O.M to maximize the wood productivity were 54.68%, 18.94%, 7.02%, 31.49 $mmoml_C$ / dm^3, 27.17 g / cm^3. Productivity correlated strongly in the sub-humid climate with the sand; and to a lesser extent with clay and silt; for the drought response, strongly correlated with the T variable. For the sites located in the Wet aridity class, productivity correlated strongly with O.M and clay, and positively with sand. For the dry response, the correlations were observed for Sub-Humid climate for the CEC and Sand variables, and for the Humid climate, no correlation was observed between the soil attributes and the dry response. It is observed that for the sub-humid climate it will be necessary to reduce 1.58% of the sand texture to increase 1m^3 / ha of productivity (R^2 = 0.47); already for Drought Response an increase ratio of 1.47 mmolc / dm^3 of Cations Exchange Capacity (CEC) was observed for a 1% increase in dry response. (R^2 = 0.67). In Brazil, similarly to Australia, most species of eucalyptus react well when planted to deep soils and medium texture. Soils in classes situated in the wet drought class behave as true hydroponics, and sub-humid regions are extremely more dependent on higher natural fertility soils to ensure reasonable levels of productivity. In addition, much of the soil attributes that are beneficial to plantations in Súb-Humid areas are not for soils located in humid regions.

Keywords: climate, edafoclimatic groups, tolerance to forest aridity.
Financial support: 1566/5000 The TECHS Project relied on contributions from more than 150 people from 26 companies, and we thank everyone for their contributions to the Project. The project was funded by 26 companies.

(7002 - 1714) Productivity and quality of watermelon fruits according to Potassium fertilization in Amazon

Wesley Santana Ferreira[1]; Fabio Regis de Souza[1]; Francisco de Assis de Menezes[1]; Reginaldo Almeida de Andrade[1]; Anderson Cristian Bergamin[1]; Cauandrey Deyverson Fagundes[1]; Rodrigo Maciel Nunes[1]; Júnior Antônio Rodrigues Mello[1]
Fundação Universidade Federal de Rondônia[1]

Watermelon is a fruit that present different cultivars, can be distinctive with each other by the size, fruit format, color of the pulp and peel. The management of planting, cultural tracts like irrigation, control of pests and diseases, fertilization, conduction of the tillage until harvest point are factors that can influence in productivity, as theydirectlyinfluence, and when are realized on the correct way, resulting in good earnings of the culture. The objective of this work was evaluate the agronomic performance of watermelon culture submitted a potassium fertilization doses. The experiment was installed at experimental farm of Foundation Federal University of Rondônia (UNIR), municipally of Rolim de Moura. Geographic coordinates 11°43' 18" S e 61°46' 00" W, located at RO 479, km 15-North, municipally of Rolim de Moura RO, in the understood period between 20/04 and 10/07/2016. The delineation was in randomized blocks with five treatments and four repetitions. The treatments consisted in potassium doses: 0; 50; 100; 150 e 200 kg of K2O ha-1 applied on potassium chloride (60% of K2O). Application of the treatments occurred in fragmented form to 15, 30, 45 and 60 Days After Emergency (DAE), applied 25% of the tasted doses. The cultivar used was Crimson Select Plus. The variables analyzed were: average weight of the fruits, longitudinal and transverse diameter of the fruits, number of fruit by plants, content of soluble solids total (SST), thickness of peel and area total of productivity. Potassium doses not affected the average weight, in longitudinal and transverse diameter of the fruit. Was significant for number of fruit by plants presented a good result when was applied (200 kh.ha-1 de K2O). Thickness of peel reduces linearly according to the rise of the potassium doses. The rise of the doses has significant effects for the content of soluble solids total (SST), and area total of productivity, where the bests results were when applied (157,04 kg ha-1 of K2O) and (147,02 kg ha-1 de K2O) respectively.

Keywords: Potassium doses; Crimson; soluble solids.
Financial support: Fundação Universidade Federal de Rondônia

(4637 - 1643) Productivity of summer crops due to organic or mineral fertilizers in ILP.

Paulo Hentz[1]; Juliano Corulli Correa[2]; Élita Terezinha de Azevedo Weschenfelder[1]; Carla Luíza Silvestrini[1]; José Juscelino de Oliveira[1]; Lucas Balena[1]
IFC Campus Concórdia, SC[1]; Embrapa - Suínos e Aves[2]

The practice fertilization with organic fertilizers promotes a productivity gain equal to or greater than mineral fertilizer when carried out for long years. The objective of this work was to evaluate

the fertilization response with doses of poultry litter, swine manure and mineral fertilizers in corn yield in the ILP system. The experiment was set up in a randomized block design in factorial 5x3 + 1, with four replications. Fertilizer treatments were composed of three organic fertilizers, poultry litter, swine manure, and mineral compound and two minerals, Mineral 1 - M1 and Mineral 2 - M2 with nutritional concentration equivalence to organic pairs, in interaction with three doses which corresponded to 75, 100 and 150% of the recommended fertilization applied to the crop of interest in question and the control (absence of fertilization). The recommendation of fertilization with increasing doses of organic or mineral fertilizers in the ILP system allowed raising corn productivity in the years 2015 and 2017 and soybeans in 2016. The history with more than five years of use of these good fertilizer use practices allows recommending 100% when using compound, M1 and poultry litter and 150% for swine manure and M2 in soybean crop and, again, 150% for all fertilizers in maize to obtain high productive levels in the ILP system.

Keywords: Poultry litter, swine manure, soybean
Financial support: Embrapa, IFC Campus Concórdia, CNPq

(8997 - 378) Quantifying phosphorus loss in surface runoff from different crop-pasture rotations in Uruguay.

Barreto, Patricia[1]; Mario Perez Bidegain[1]; Oswaldo Ernst[2]; Carlos Perdomo[1]
University of the Republic of Uruguay, Agronomy Faculty, Soils and Waters Department[1]; University of the Republic of Uruguay, Agronomy Faculty, Plant Production Department[2]

Phosphorus (P) runoff losses from agricultural soils contribute to surface water eutrophication. In Uruguay there are ample reports of high levels of P concentration in surface water, however, few studies have quantified P losses in our agricultural production systems. In this study, P losses were measured under natural rainfall with runoff microplots (1.5x1.5m) installed in 2012 in the northwest region of Uruguay. The soil was classified (USDA) as a fine, mixed, active, thermic Typic Argiudoll with a 4% slope. The experiment was arranged in a randomized complete block design with three replications, and the treatments were some combinations of tillage methods (CT= conventional tillage and NT= no till) and rotations (CC= continuous cropping and PR= pasture rotations), namely NTPR, NTCC, and CTPR. Additionally, PR combinations were split by two P rates (0 and 200 $kgP_2O_5.ha^{-1}$). The croppasture rotation used in the experiment consisted of three years of agriculture (two crops per year) and three years of a planted legume-grass meadow under livestock grazing. A natural pasture (NP) nearby was used as a control. From 2012 to 2014 total P (TP) and soluble P (SP) concentrations were determined in runoff water. The concentration of particulate P (PP) was estimated as the difference between TP and SP, and P loads as the product of runoff volume by P concentrations. Annual TP loads ($kgP.ha^1.yr^{-1}$) in the treatments receiving no P fertilizer were lower in CTPR and NTCC (0.8 and 1.5, respectively) than in NTPR (1.8), while the TP load in NP was 0.6 $kgP.ha^{-1}.yr^{-1}$. In the PR fertilized plots, TP losses in CT and NT were 2.3 and 5.2 $kgP.ha^{-1}.yr^{-1}$ respectively, but the interaction between tillage method and P rate was not significant. The annual PS loads ($kgP.ha^{-1}.yr^{-1}$) were also higher under NT, both in the unfertilized (0.9 vs 1.3) and in the fertilized plots (2.0 vs 4.5) for CT and NT, respectively. Therefore, the trends found in TP were also reflected and even augmented in SP. The flow-weighted mean TP concentrations followed the order NTPR_200P > CTPR_200P > NTCC_0P > CTPR_0P > NTPR_0P > NP. These results suggest that under Uruguayan conditions NT increases soil P runoff losses in relation to CT, especially in soluble form after fertilizer application.

Keywords: no till, eutrophication, runoff microplots
Financial support: CSIC Program: Research Initiation

(7395 - 2668) Reduction of the active acidity of the soil due to the application of limestone doses based on different methods of recommendation

Rafael Felippe Ratke[1]; Tiago André Kulzer[2]; Julian June of Jesus Lacerda[2]; Sammy Sidney Rocha Matias[2]; Denise Batista de Moraes[2]; Tamara Araújo Schenfert[2]
Universidade Federal do Mato Grosso do Sul[1]; [2]

Agriculture in Brazil is practiced largely on acid soils. To correct the soil acidity, limestone is used. The limestone dose recommendation is performed by methods and calculation based on the physical and chemical attributes of the soil, as well as the nutritional needs of the crops. There are different methods and calculation of liming in Brazil. The methods of liming in Brazil are method based on aluminum, calcium and magnesium exchangeable, SMP buffer method, base saturation method and Al^{3+} neutralization method and the increase of $Ca^{2+} + Mg^{2+}$ contents. However, the method is efficient and provides an improvement in soil chemistry for plant cultivation. Therefore, the objective of this research was to evaluate the increase of soil pH after the application of limestone doses based on liming methods and calculation. The soil used was collected at a depth of 0.20 to 0.40 m from a dystrophic Red Latosol. The chemical analysis of this soil showed initial pH (H_2O) of 4.3. The experiment was carried out in a completely randomized design in a 12 x 2 factorial scheme, being (12 methods and 2 classes of soils) with 4 replications. An additional treatment (without limestone) was also carried out. The limestone doses were based on the following methods: SMP buffer (4 pH levels: 5.5, 6.0, 6.5 and 7.0), base saturation (4 levels of base saturation: 30%, 50 %, 70% and 90%) and the method of neutralizing Al^{3+} and increasing $Ca^{2+} + Mg^{2+}$ levels. The soil was placed in 500 mL containers. The limestone doses used were: 0; 0.66; 0.72; 0.78; 0.82; 0.84; 0.92; 0.95; 1.16; 1.45; 2.08 and 2.71 g pot^{-1}. The soil was kept moist at 80% of the capacity of the vessel conferred with constant weighing on a precision scale. Soil samples were collected at each reaction time (90 days after application of limestone) in each plot. The soil samples were analyzed chemically for pH (H_2O). The obtained data were statistically analyzed by applying the F test in the analysis of variance through software R. Significant results were submitted to polynomial regression analysis. The pH of the soil increases in proportion to the dose of limestone applied. The method of base saturation showed a greater amplitude of soil pH reaching 6.7. The limestone doses estimated by the SMP method did not decrease the soil acidity as predicted, and the pH was below 5.2 when expected was that the pH of 7.0 at the dose of 0.84 g $plot^{-1}$ limestone.

Keywords: pH, Liming, Oxisol
Financial support:

(1912 - 1568) Reduction of the effects of water deficit on soybean and corn grain yield by the chemical improvement of the rooting layer

Marcieli Piccin[1]; Douglas Dalla Nora[1]; Telmo Jorge Carneiro Amado[1]; Antonio Cesar Batista Mazuco[1]; Tiago de Gregori Teixeira[1]; Fábio Henrique Gebert[1]
Universidade Federal de Santa Maria[1]

The Oxisols represent 31% of Brazilian soils and their main limiting factor is directly related to their acidity. The grain yield of soybean and corn crops grown in Oxisols with acid subsoil is strongly affected by the availability of water, and the acidity coupled with the chemical and physical impediment, have reduced the deepening of the root system of these crops, intensifying the deleterious effects of the deficit water on the grain yield. The present study aimed to evaluate the effect of the associated use of gypsum and lime as a chemical tool to improve

the conditions of the soil rooting layer and, consequently, to mitigate the damage that the water deficit can cause on the soybean and maize grain yield under no-tillage system (NTS). The experiment was carried out in the 2014/15 (soybean) and 2015/16 (maize) crops in a Dystrophic Oxisol with clay texture (Embrapa, 2006) in São Miguel das Missões in Rio Grande do Sul (Brazil), the region's climate is classified as subtropical (Cfa), according to Köppen-Geiger (1948). The treatments contained different doses of gypsum and associated lime, T0 (control); T1 (0.0 Mg ha^{-1} gypsum + 2.0 Mg ha^{-1} lime); T2 (3.0 Mg ha^{-1} gypsum + 2.0 Mg ha^{-1} lime) and; T3 (5.0 Mg ha^{-1} gypsum + 2.0 Mg ha^{-1} lime). The experimental arrangement was of subdivided plots with three replicates. The treatments received rain restriction chambers in subplots during the most critical period of the crop, which excluded 100% of the rainfall. For soybean, there were 30 days of exclusion and 20 days for maize. The soil samples collected was stratified from 0.00 m to 0.60 m. The associated application of gypsum and lime was able to increase the productivity of soybean and corn crops regardless of precipitation being excluded. However, when submitted to water deficit, accumulated productivity increased with the application of inputs (gypsum and lime) was 46% higher in both seasons. The chemical improvement of the soil rooting layer was able to attenuate the productivity losses that the water deficit would cause in soybean and corn crops.

Keywords: Gypsum, lime, soil subsurface, water deficit.
Financial support: Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq).

(1434 - 2366) Revised soil survey by changing landuse in Korea

byung keun HYUN[1]; Yeon Kyu Sonn[1]; Sang Ho Jeon[1]; Soon Gan Yun[1]; Hyun Jun Cho[1]; Sug Jae Jung[1]; Jung Won Choil[1]
NAS[1]

Agricultural lands have decreased continuously, which was caused by urbanization, land consolidation, and road construction etc. Especially, Chungju city near Daejeon city has the severe land use change. Therefore, we studied changes of land use, soil properties, and soil information in order to provide the basic soil information and soil management practices in this city. The area of crop cultivated land in Korea (2016) reduced by 35,424 ha compared to ones from the previous year (2014). The paddy field decreased by 12,455 ha, upland field by 22,969 ha also. One of the reasons for the reduction of the paddy field was converting paddy field to upland (22,780 ha) > others (3,646) > public facilities (2,740) > building(2,642) > idle land (1,439). But, reasons for increase of upland field were switching paddy to upland (22,780 ha) > others(5,330) > land developed (1,415). The main reason of converting paddy field to upland was changing from rice to more profitable speciality crops or orchard. The cropland area of Chungju city reduced by 1,087 ha (2014/1999). The ratio of cropland area in this city reduced by 47.9% dramatically compared 2014 to 1999. The paddy fields located in alluvial plains in Chungju city were changed into upland or green house. In particular, paddy fields have been changed to not only upland, orchard, greenhouse cultivation but also to fallow in Chungju city. To analyze result of soil survey of Chungju city, 3686 soil codes (soil phases) were used and the area was 3834.2ha. The number of soil series increased from 65 to 74, and that of soil phase increased from 126 to 160. The largest increased area was Sachon(coarse loamy fluvaquentic endoaquepts) soil series. 536.3ha of Sachon soil series was incorporated from the existing Yecheon, Sanju, Wolgog, and Seongsan soil series.

Keywords: Soil survey, Landuse, Paddy field, Chungju city
Financial support: NAS

(2136 - 2911) Second-crop corn responses to different residual potassium fertilizer management

Michel Esper Neto[1]; Carolina Fedrigo Coneglian[1]; Eunápio José Oliveira Costa[1]; Antonio Feijó de Góes Neto[1]; Éder Júnior de Oliveira Zampar[1]; Evandro Antônio Minato[1]; Marcos Renan Besen[1]; Bruno Maia Abdo Rahmen Cassim[1]; Fabrício Linares Mazzi[1]; Tadeu Takeyoshi Inoue[1]; Marcelo Augusto Batista[1]
UEM[1]

Potassium is an essential macronutrient and is the most abundant cation in plants tissue. The corn crop can reach uptake rates of 2.6 kg ha^{-1} day^{-1} according to development stage, however, only 7 kg ton^{-1} are extracted by corn kernel produced. In Brazil, successive soybean and corn crops in no-tillage system are common. Some researchers show that loams and clayey soils will hardly occur potassium leaching. The objective of this work was evaluated corn components production after different fertilization management carried out in previous crop (soybean). The experiment was carried out in Unidade de Difussão de Tecnologia (UDT) of the COCAMAR Agroindustrial in Floresta, Paraná, Brazil. The soil was classified as Red Latosol (Oxisol) with clayey texture. The potassium level in soil was 0.2 $cmol_c$ dm^{-3}, that was considered medium. The commercial corn hybrid (*Zea mays* L.) AG 9010 was cultivated. The experiment carried out as a factorial (5x2x2) at randomized block design with four replicates. The first factor were K_2O doses (0, 40, 80, 120 and 160 kg ha^{-1}). The second factor was potassium application (broadcast) time: before (15 days) or after (15 days) soybean sowing. The third factor was sowing fertilization (banded): 0 or 30 kg ha^{-1} of K_2O. All potassium fertilizer was applied in soybean crop. Corn was evaluated in two crop seasons (2016 and 2017). Each plot consisted of 10 corn lines of 8 m length spaced 0.45 m. The variables analyzed were number of rows in corn ear (NR), number of kernel per row (NK), mass of one thousand kernel (MTK) and yield (YD). The data were submitted to statistics basic assumptions (Shapiro-Wilk and Bartlett) and after to joint analysis of variance and regression (p<0.05). There were differences for all variables for the year. In 2016, frost decreased corn YD, NK MTK and NR. In 2016 NK and NR were significantly lower than 2017. Despite this, increasing linear models were adjusted according to the potassium doses for YD:YD = 3704 + 3.3x (R^2 = 0.84) and YD = 7473 5.6x (R^2 = 0.88) for 2016 and 2017, respectively, showing that residual fertilization was important and may be a management alternative to reduce costs and increases corn yield. MTK and YD also increased due K sowing fertilization. Normally, the potassium critical level in soil is considered to be around 0.16 $cmol_c$ dm^{-3}, although the initial soil content was higher than this, corn increases yield with potassium fertilization increasing.

Keywords: Soil fertility, System fertilization, Yield.
Financial support: COCAMAR

(5654 - 1546) Shoot dry mass production of the sunflower crop under irrigation levels and potassium fertilization

Raphael Pereira França de Paula[1]; Luana Glaup Araujo Dourado[1]; Marcio Koetz[1]; Edna Maria Bonfim-Silva[1]; Tonny José Araújo da silva[1]
Federal University of Mato Grosso - UFMT[1]

Sunflower (*Helianthus annuus* L.) is among the four crops with the largest production of edible oil in the world, and is among the plant species with the highest potential for renewable energy production in Brazil. Sunflower cultivation presents characteristics of adaptability to several regions, reaching high yields. Soil fertilization and cultivation in areas with good water availability are important strategies to achieve good production. Thus, the objective of this study was evaluating the shoot dry mass production of the of the sunflower crop in response to soil water replacement levels and potassium levels in Cerrado Oxisol. The experiment was carried out in a greenhouse at the

Federal University of Mato Grosso, Campus of Rondonópolis - MT. The statistical design used was in randomized blocks, in a 5x4 factorial scheme, with 20 treatments and four replications, making 80 experimental plots. The treatments consisted of five potassium doses (0, 40, 80, 160 and 240 mg dm^{-3} of K_2O) and four levels of soil water replacement (75, 100, 125 and 150% of field capacity). Irrigation management was carried out by the reading of tension in the tensiometers installed in the experimental units with 100% replacement of the recommended water depth, and calculated to raise the values of the tension to those of the field capacity (6KPa) when the established tension was achieved. The water depth was applied according to the percentages for each treatment. The results were submitted at 5% probability regression analysis, using the statistical program SISVAR. The unfoldment of potassium doses within irrigation levels had a significant effect. The potassium doses of 240, 187.75, 204.52 and 197.73 mg dm^{-3} combined with the levels of 75, 100, 125 and 150% of the field capacity provided the highest shoot dry mass, with 55.09, 65.17, 76.69 and 95.69 g $vessel^{-1}$, respectively. A linear increase of the shoot dry mass (71.48, 82.89, 91.80 and 92.01 g^{-1}) was observed in the irrigation levels within the potassium doses of 40, 80, 160 and 240 mg dm^{-3}) with increasing irrigation levels.
Keywords: *Helianthus annuus* L., Cerrado, water depth, tensiometer
Financial support:

(4632 - 3060) Short-term dynamics of exchangeable and nonexchangeable K pools in tropical soils under eucalypt

Naiara Fernanda de Souza[1]; Filipe Bruno de Oliveira[1]; Sérgio Henrique Carneiro[1]; Ianna Bizerra Barros[1]; Samuel Vasconcelos Valadares[1]; Ivo Ribeiro da Silva[1]
Universidade Federal de Viçosa[1]

The releasing of K from nonexchangeable pools (NEK) help to explain the variable responses of plants to K fertilization. Some long-term studies have reported an important role of NEK for eucalypt nutrition. The aim of this study was assessing the extraction of NEK and EK during the initial development of eucalyptus plants in tropical soils. The experiment was carried out in a greenhouse. The treatments were five soils with different textures and mineralogy. The experiment was carried out in randomized blocks with four replicates. The experimental units were pots containing 2 dm^3 of soil. Soil samples were collected (0.2 dm^3 of soil) at the beginning of the experiment in each experimental unit and 114 days after planting when the plants were cut at the soil level. The extraction of EK was performed with Ammonium Acetate (1 mol L^{-1} pH 7). A hot Nitric Acid (2 mol L^{-1}) solution was used to extract NEK forms. A 1:10 soil/solution ratio was used for both extractions. The total K content in plant shoots was also measured. The K content in soil and plant extracts were analyzed using a flame photometer. Variations of NEK (Δ - NEK) and EK (Δ - EK) pools were obtained by subtracting it´s values measured in the initial soil samples from those measured in the final soil samples. A two-way ANOVA followed by a Tukey test (P <0.05) was used to compare the different soils regarding Δ – NEK and Δ - EK. Pearson correlation tests were used to assess the relationships between dependent variables. Higher values of Δ – EK were observed for the soil with higher initial EK. An opposite behavior was observed for the Δ – NEK (i.e.: soils with lower initial EK presented higher Δ – NEK). We found good correlations of Δ – EK with plant K (r=0.65 P<0.05). High correlations were observed between the initial EK and plant K (r=0.84 P<0.05). We found no correlations between Δ – NEK or initial NEK with plant K. No correlations were also observed for final EK or NEK with plant K. Our results support the evidence that the release of NEK in soils under eucalypt are linked to the availability of this nutrient (i.e.: plants activate mechanisms to release NEK when EK is low). Despite the extraction of NEK during the early development of eucalypt, the EK pools are better predictors of plant K during this stage. Soil K tests that extract EK will be more suitable to predict short term K availability for eucalypt (e.g.: soil K to guarantee a better initial growth of the plants).
Keywords: Potassium, soil K, K availability
Financial support: Klabin, Capes, Fapemig

(1079 - 930) Shrub encroachment effects on key soil properties and restoring potential of Patagonian rangelands

Braian Vogel[1]; Ludmila La Manna[2]
Centro de Estudios Ambientales Integrados (CEAI) - Universidad Nacional de la Patagonia San Juan Bosco (UNPSJB)[1]; Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET) - Universidad Nacional de la Patagonia San Juan Bosco (UNPSJB)[2]

In Argentinian Patagonia, rangelands have been under intense grazing pressure since late XIX century. Vegetation growing on volcanic soils in the forest-steppe ecotone, has seen dramatic physiognomic changes. Its fragmentation increased, perennial grasses reduced their cover and shrubs incremented it. We choose 4 study sites of this ecotone in NW of Patagonia, to evaluate soil changes associated to shrub encroachment. For every site 4 transects were established in both grass and shrub dominated areas, to characterize the vegetation. Dominant shrub was *Mulinum spinosum*, and dominant perennial grasses were *Festuca pallescens, Poa ligularis* and *Pappostipa speciosa* var. *speciosa.* At each transect, we took soil samples (0-5 cm) in bare soil patches and beneath vegetation canopies for laboratory analysis. Resulting data were analyzed using ANOVA with blocks. Significant differences *(p <0.05)* were found between samples. Soils under canopies were higher in organic matter (OM) and porosity (PS) and lower in coarse fragments (CF) (i.e., 2 - 75 mm), compared to bare soil patches. Non erodible fraction (NEF) (i.e., 0.84 - 2 mm) was lower in shrub areas, whether the soil was covered or not. Electric conductivity (EC) was higher under shrubs, compared to the other conditions. Bare soil patches in shrub areas had lower values in OM and PS, and higher in CF and sodium fluoride pH (NaF pH, non-crystalline aluminosilicates indicator). Higher CF could indicate more intense historic erosion processes, with losses of first soil centimeters and rocks concentration. This loss could expose layers containing finer textures, hence, with lower NEF values. Some of this subsurface layers contained imogolite, a non-crystalline silicate originated from volcanic ashes. Higher NaF pH in bare soil patches of shrub areas could indicate active erosion processes exposing this layers. When this minerals are exposed to desiccation, progressive crystallization occurs. Hence, where erosion is lower in magnitude, crystalline clays predominates resulting in lower NaF pH. Basic soil fertility properties like OM and PS have similar values, both under grasses and shrubs. Higher EC values (always at normal level) found under the hemispheric canopy of *M. spinosum* could show greater bases incorporation. Our results shows that present soil conditions are not limiting a potential recolonization by perennial grasses. It seems possible to recover some of the carrying capacity of this Patagonian rangelands.
Keywords: shrub encroachment soil erosion Patagonia volcanic soils
Financial support: Agencia Nacional de Promoción Científica y Tecnológica (ANPCyT - FONCyT) PICT 2013-1876 BID

(9993 - 535) Soil carbon variability across different agricultural land use types in Oye-Ekiti, Nigeria

Shittu O. Olubunmi[1]; Ayodele O. Julius[1]; Ilori A. O. Akinmayowa[1]; Nkemjika, J. Nkeonyediriya[1]
Department of Soil Resources and Environmental Management, Ekiti State University, Ado-Ekiti, Ekiti State, Nigeria.[1]

Decline in soil organic carbon and nutrients, with deterioration of soil structure characterized the conversion of native forest land to agricultural lands. Effects of four agricultural land use types; arable land, fallow land, forest plantation and ranchland with soil depth on

soil organic carbon fractions was evaluated in Oye-Ekiti, Nigeria. Core samples were collected at 0-5, 5-10, 10-20 and 20-30 cm depths for organic carbon fractions determination and one bulked sample at depth 0-30 cm at each site using a soil auger for routine analysis. The predominantly loamy sand soils in Oye-Ekiti were slightly acidic (pH 6.21, ranchland) to neutral (pH 7.0, forest plantation) in reactions with medium available P levels and generally sufficient total N with balanced cation contents. On average across depths, contents of particulate organic carbon (POC), total organic carbon (TOC), soil microbial biomass carbon (SMBC) and water soluble organic carbon (WSOC) showed that converting native land to forest plantation had better capacity for sustaining the various forms of soil organic carbon. Forest plantation recorded highest values of 10.36, 1.26, 5.80 and 2.11 g kg^{-1} for TOC, SMBC, POC and WSOC except for TOC in ranchland (16.78 g kg^{-1}), while arable land had the least values except for WSOC in ranchland (1.55 g kg^{-1}). Across the land use types, the surface soils had the highest mean concentrations of the various soil organic carbon fractions attributable to the slow rate of decomposition, mineralization and natural mixing of organic materials with the soil particles in relation to litter fall and decreases with depth except for POC that had the higher means at the subsurface depths and the SOC fractions had medium to high variations across the depths. Fallow contribution to TOC, SMBC and POC was minimal compared to forest plantation and ranchland except for WSOC where it had non-significantly higher contents than others except forest plantation, with arable land having the least content of all SOC forms. Soil organic carbon fractions showed low to medium non-significant relationships with the soil properties except POC with percentage base saturation ($r = 0.675^*$; $p < 0.05$) and WSOC with SMBC ($r = 0.600^*$; $p < 0.05$). Management practices in line with conservation agriculture that will immediately restored the poorly managed agricultural lands contributing to low SOC forms, for sustainable agricultural production and environmental protection should be encouraged.

Keywords: Agricultural soil, Depth, Land use, Particulate organic carbon, Soil organic carbon fractions.
Financial support:

(3537 - 2207) Soil Chemical Attributes on the Function of Different Kinds of Limestone and Reaction Time

Catharina Bertollini Vassão[1]; Bruna de Lima Fávaro[1]; Graziela de Biaggi Cantaccei[1]; Ana Maria Conte[1]; Osvaldo Sato[1]
UENP[1]

Soil is a fundamental part of the development of life on earth from which we extract the food necessary for human food, animal and the constitution of essential elements for the planet's biodiversity. In order to verify 4 reaction times in the soil and 3 correctives found commercially to improve the soil chemistry, an experiment was installed in a protected environment in the Experimental Farm. Dr. Eduardo Meneghel Rando from the State University of Northern Paraná, Luiz Meneghel-Bandeirantes Campus in soil classified as LATOSOLO RED. The experimental design was a randomized complete block design using 4 incubation times (0, 30, 60 and 90 days) and 3 types of limestone (limestone powder, liquid and granulate), by the base saturation methodology, for limestone powder, for commercial granular limestone the commercial recommendation is the use of a 20% dose of limestone with 80% PRNT, liquid limestone according to the manufacturer's recommendation is a dose of 10L ha -1, and the basis for the liming calculation was to achieve a base saturation of 70%. These recommendations resulted in the following doses: for 9 Mg ha-1 limestone, 1.5 Mg ha-1 granules and 10 L ha-1 liquid limestone, and one control without liming. The soil was sampled and analyzed according to the incubation time for each type of limestone. The soil chemical parameters were analyzed by the soil and plant laboratory of the UENP for organic matter, pH, phosphorus, calcium, magnesium , potassium, aluminum, potential acidity -H + Al, cation exchange capacity (CEC), aluminum and base saturation. For the statistical analyzes, the SASM-Agri program was used and the means of the significant interactions were evaluated by the ESTAT program. The Tukey test was used in a 1% and 5% to treatments and interactions that were significant. According to the results, there was a significant interaction between the different reaction times of the applied correctives, in which the organic matter content of the soil showed a decrease from the first 30 days after the application of the products during the experimental period. It was also observed that the limestone and liquid limestone presented similar behavior at 30 days after application, while the granular limestone obtained a statistical increase at 90 days after application. The results of the study allowed the conclusion that from the 30 days the limestone powder resulted in the chemical improvement of the soil used in the experimental condition.

Keywords: productivity, agriculture and limestones.
Financial support:

(9986 - 1466) Soil chemical attributes, nutrition and yield of corn and soybean as a function of the application of magnesium silicate

Luiz Gustavo Moretti[1]; Carlos Alexandre Costa Crusciol[1]; Ricardo Rossi[2]; Pietro Hunger Micheri[1]; Cleiton José Alves[1]
São Paulo State University (Unesp), School of Agriculture, Botucatu, São Paulo, Brazil[1]; C MAG Fertilizantes, Jaboticabal, São Paulo, Brazil[2]

The magnesium fertilization is frequetly neglected and its lack affects plant growth. Many essential functions in plants require adequate sources, their role being most visible in root formation, chlorophyll and photosynthesis. The magnesium silicate comes from the igneous rock milling, being essentially a peridotite. It is consists mostly of olivine $(MgFe)_2SiO_4$. It is contains approximately 40% magnesium oxide (MgO) and 34% silica (SiO_2). The experiment was conducted in a greenhouse in School of Agriculture of UNESP, in Botucatu city - São Paulo State - Brazil, from November 2016 to March 2017. The experimental design used was completely randomized blocks, with 5 doses of Mg, and 4 replicates. The tests were performed in two soils granulometry, sandy texture and in clay texture. The application of the silicate powder was done 20 days before sowing [Glycine max (L.) Merr.] and corn [Zea mays (L.)] in 25 L pots of corrected soil (70% base saturation). The treatments were constituted by the absolute control (0 kg ha_{-1}), and 4 doses of the magnesium silicate stipulated to maintain the 1/1 ratio; 2/1; 3/1 and 4/1 between Ca/Mg, respectively 1866; 822; 476 and 300 kg ha^{-1} in sandy soil, and 3084; 1084; 416 and 84 kg ha^{-1}, respectively, in clayey soil. All treatments and phytosanitary management was performed according to the necessity and recommendation for each crop. Was analyzed the chemical attributes of the soil after harvesting, with the following variables being the levels, sum and bases saturation (Ca, Mg and K), phosphorus (P), sulfur (S), silicon (Si), potential acidity, cation exchange capacity, pH, content and saturation by aluminum (Al). For both cultures were analyzed the macro and micronutrient contents, production components and yield. The data were submitted to the Shapiro-Wilk normality test and then to analysis of variance - ANOVA by the F test ($p \leq 0.05$). Polynomial regression was performed for the doses of the powdered silicate. The source of magnesium and silicon promove the elevation of magnesium contents in the soil and improvements in the same chemical attributes, in sandy and clayey soil, for the potential acidity, sum and saturation bases, besides providing silicon to the soils. Was found increase magnesium and silicon in the leaf contents in the soybean and corn crops in sandy and clayey soil. It is also provides increased dry matter mass on the plants, and increased of grain to the yields for the crops tested in both soils.

Keywords: Glycine max (L) Merr., Fertilizing, Plant nutrition
Financial support: C-MAG Fertilizantes

(1658 - 1123) Soil factors affecting sugarcane productivity in Kitadaito and Kume Islands, Okinawa, Japan.

Naoko Miyamaru[1]; Koichi Yoshida[2]; Takeshi Kawanaka[3]; Koki Toyota[4]
Okinawa Prefectural Agricultural Research Center[1]; Okinawa Agricultural Technology & Development Co. Ltd[2]; Okinawa Environmental Analysis Center Co. Ltd[3]; Tokyo University of Agriculture and Technology[4]

The Okinawa Islands are located in the south area of Japan and belong to subtropical climate. The main crop in the Okinawa Islands is sugarcane (*Shaccharum officinarum* L.) and the sugarcane cultivation greatly contributes to the regional economies, especially in small islands such as Kitadaito Island and Kume Island. The average sugarcane yield in Kitadaito Island for the past 30 years was 44 Mg ha^{-1}, 31% lower than that (64 Mg ha^{-1}) in Okinawa prefecture. On the other hand, the yield in Kume Island has decreased for the past 30 years, from 80 Mg ha^{-1} in 1985 to 48 Mg ha^{-1} in 2015. Many reasons are considered for the low sugarcane productivity in both islands and the effects of soil factors have not been sufficiently studied. The objective of this study was to clarify the soil factors affecting the sugarcane yield in each Island. Soil physical and chemical properties were investigated in 50 fields of spring planting in Kitadaito Island in 2013. The sugarcane yield was positively correlated with the soil available nitrogen, available phosphate, humus, EC and plow layer depth. Statistical analysis of classification and regression trees (CART) showed that the sugarcane yield was low in fields with low available nitrogen (less than 16.5 mg kg^{-1}) and with shallow plow layer depth (less than 29 cm). The soil available nitrogen had a significant positive correlation with soil humus. Two-times of subsoiling in fields before planting and during growing period resulted in the significant increase of the plow layer depth, compared to fields with single or no subsoiling. In 2014, the same experiment was conducted in 40 fields of spring planting in Kume Island. Typhoon hit the Island twice in October and its damage was seen at random. However, the sugarcane yield was positively correlated with the soil plow layer depth. The average plow layer depth was 24.8 cm in fields without subsoiling, which was significantly shallower than 34.7 cm in fields with subsoiling. The main soil type of both Islands is Red-Yellow soils, and their soil texture is LiC to HC. A plow pan is liable to be formed in such heavy textured soils. Our study showed that subsoiling is a primarily important soil management to increase the sugarcane productivity in fields with heavy textured soils.

Keywords: sugarcane; Red-Yellow soil; available nitrogen; plow layer depth; subsoiling
Financial support:

(1177 - 1733) Soil Fertility Survey in St. Vincent and the Grenadines

Renrick Williams[1]; Michael Delpesche[1]; Basil Nash[1]; Lucia Ballantyne[1]; Chun-Chun Huang[2]; Chu-Chung Chen[3]; Chien-Hui Syu[3]
Ministry of Agriculture(Plant Protection and Quarantine unit)[1]; International Cooperation and Development Fund[2]; Taiwan Agriculture Research Institute[3]

Saint Vincent and the Grenadines is a small volcanic country, 389 km^2, located between the Caribbean Sea and the Atlantic Ocean. This tropical country is known for its mountainous terrain. Agriculture, tourism and construction are the main economic activities. The main export crops are banana, plantain and root crops such as eddoes, dasheen, sweet potatoes and arrowroot which are exported mainly to the regional markets. Approximately 26% of the land is used for agriculture which employs 26% of the labor force. Soil testing capabilities were limited due to the absence of a soil fertility lab and the high cost of sending samples abroad. A soil laboratory was established in 2015 to provide soil analytical services to farmers and other stakeholders. During the period from May 2016 to November 2017, three hundred and forty soil samples were collected from farmlands at a depth of 15cm and analyzed for pH, organic matter (OM), electrical conductivity (EC), texture, available nitrogen (NO_3^-, NH_4^+), phosphorus (P), potassium (K) and calcium (Ca). Seventy-one (71%) of samples ranged between 5.5 to 6.5 pH was considered ideal for most crops. The OM content in 51% of the samples was higher than 4%. High OM would help to keep nutrition from leaching and help to retain moisture. However, the stable organic matter would retard mineralization or nitrogen release that reflects on results for EC and nitrogen. EC values were low with 90% below 100 μScm^{-1}.This can be related to the soil texture or indication of low nutrient holding capacity. Sixty-five (65 %) of soil samples were sandy loam which indicates well drained and low water and nutrient holding ability. Sixty percent (60%) of samples had a Nitrogen content less than 25 $mgkg^{-1}$. Fifty-nine percent (59%) of the available P content was less than 17 $mgkg^{-1}$ which are considered insufficient for most of the crops, however, some noticeably high values (9%), higher than 34$mgkg^{-1}$, were observed in the northeastern area of the island. Potassium content in 75% of samples was higher than 125 $mgkg^{-1}$ which are considered sufficient for most crops. Sixty-five percent (65%) of the calcium content showed medium range values from 800 to 3000 $mgkg^{-1}$.

Keywords: St Vincent and the Grenadines, soil samples, soil Analysis, soil fertility, farmlands
Financial support: Government of St Vincent and the Grenadines, Ministry of Foreign Affairs, Republic of China (Taiwan), International Cooperation and Development Fund (Project for Strengthening Farmers' Organization and Improving Fruit and Vegetable Production Technology.

(1943 - 2037) Soil organic matter and productivity of boreal clay soils

Helena Soinne[1]; Riikka Keskinen[2]; Mari Räty[2]; Sanna Kanerva[1]; Visa Nuutinen[2]; Eila Turtola[2]; Tapio Salo[2]
University of Helsinki[1]; Natural Resources Institute Finland[2]

Soil organic matter plays a key role in soil functions by maintaining biological activity, increasing water holding capacity and enhancing the stabile structure formation. Further, increasing the soil organic carbon content is promoted as a mean to reduce the concentration of atmospheric carbon dioxide and to slow down the climate change. In this study we aimed to find out whether increasing the soil organic carbon content has measurable beneficial effects on clay soil (clay% >30) productivity in boreal conditions. Soil samples were collected in the autumn 2016 and each field was divided into two plots: unfertilized plot and plot receiving N fertilization. From each plot, yield and soil samples were collected from four sampling points. Soil samples were analyzed for texture, organic carbon (C%), bulk density. Four fields were further sampled for an incubation experiment to study the net nitrogen mineralization and respiration and for water extractable dissolved organic carbon (DOC) and water extractable nitrogen (N). According to preliminary results, there was no clear relation between surface soil C% and yield. The bulk density was lower in soils with higher C% and the lowest yields were collected from plots with high bulk density. Net nitrogen mineralization and respiration correlated negatively with water extractable DOC/N -ratio. Preliminary results suggest that for unfertilized clay soils, low clay/C -ratio predicts higher yields. Further, the water extractable DOC/N -ratio appeared to correlate negatively with the yield.

Keywords: organic carbon, clay, productivity, yield
Financial support: Ministry of Agriculture and Forestry, Finland

(4595 - 265) Soil quality indicators in crop sequences with a high proportion of soybean: effects of cover crops inclusion and fertilization.

Fontana, Marianela[1]; Novelli, Leonardo[1]; Sterren, María[1]; Uhrich, Walter[1]; Barbagelata, Pedro[1]; Benintende, Silvia[1]
FCA - UNER[1]

The aim of this study was to evaluate the effect on soil properties, of cover crops and fertilization in sequences with a high proportion of soybean. The research was conducted on a long-term field trial in an Aquic Argiudoll. We studied: soybean monoculture (S), soybean monoculture fertilized with P and S (Sf), cover crop/soybean (CC/S), cover crop/ soybean fertilized with P and S (CC/Sf), cover crop fertilized with N/soybean fertilized with P and S (CCN/Sf), and cover crop/soybean in a crop rotation with maize (CCN/Sf rot). Samples were taken from 0-5 cm and 0-15 cm. Evaluated variables were: Microbial Biomass C and N (MBC and MBN) and N from anaerobic incubation (Nan), soil organic matter (SOC), total N (TN) and particulate organic matter (POM) C and N. The cumulative mass approach was used to estimate variables stocks based on measured bulk density and concentration of variables. ANOVA for DBCA was performed and treatments were compared using an LSD test. We applied a discriminant analysis to evaluate the separation among groups of treatments. In both layers SOC differed among treatments showing the highest values in the CCN/Sf. In the 0-5 layer, from highest to lowest, the treatments order was CCN/Sf, CCN/Sfrot, CC/Sf, CC/S, S and Sf. Total N (TN), also differed among treatments and ordered treatments similar to SOC in the 0-5 cm layer. Particulate organic matter C (POM-C) and N (POM-N) differed among treatments. For POM-C and POM-N, crop sequences were separated similarly in 0-5 cm. Treatments CCN/Sfrot and CCN/Sf had the highest values, showing statistical differences with CC/S, S and Sf. Microbial biomass C and N did not show differences among crop sequences. The lowest value of Nan in the 0-5 cm layer was found in S. We performed a discriminant analysis in the two soil depths separately. In 0-5 cm, apparent error rate of classification was 25.0 %. Treatments without cover crops (S and Sf) were clustered in the right side of the plot, and there were no samples that belonged to these two treatments classified in the groups of the treatments that include CC (CCN/Sf, CCN/Sf rot, CC/Sf and CC/S). In the other side, only 2 samples (of a total of 24) that belonged to CCN/Sf rot and CC/S were classified in the Sf treatment. The cross-classification table emphasizes that the inclusion of cover crops, especially with fertilization treatment, had a significant effect on soil variables reflecting improvement of soil quality of this management practice.
Keywords: Soybean, cover crops, fertilization, soil quality
Financial support: Universidad Nacional de Entre Ríos

(6218 - 988) Sol Organic matter in a Integrated Crop-Livestock Integrated System in different grazing intensities in a subtropical Oxisol

Gabriel Furtado Garcia[1]; Deborah Pinheiro Dick[1]; Ibanor Anghinoni[1]; Paulo César de Faccio Carvalho[1]
Universidade Federal do Rio Grande do Sul[1]

Soil management systems usually provide an adequate environment for the development and availability of nutrients for the roots and for the microorganisms along the profile, which is essential for soil organic matter (SOM) maintenance and for a sustainable production system. The objective of this work was to investigate the influence of grazing intensity on the SOM composition and carbon (C) stocks in a Brazilian subtropical soil profile under Integrated Crop Livestock System (ICLS) after 15 years. The experiment was conducted in a oxisol, in randomized blocks with three replications, employing different grazing intensities, evaluated from the pasture height left after grazing: 10 cm (P10), 20 cm (P20) and 40 cm (P40) cm). Soil samples were collected in different layers within 100 cm soil depth from grazing treatments and from in a forest area (reference), as well as litter. C and nitrogen (N) contents were determined by dry combustion and the isotopic signature $d^{13}C$ was analyzed by dry combustion in a mass spectrometer coupled to an elemental analyzer. Soil density was calculated by the volumetric ring method and the carbon stock by apparent density in each soil layer in the soil profile. The highest accumulated C stock up to 100 cm was observed under P40 treatment and the lowest was verified in the forest area. In contrast, the highest stock in the 0-5 cm layer was observed in the forest in comparison to grazing treatments. Probably, this result is related to the greater accumulation of C from the forest, due to its slower cycling in comparison to the residue from the grazed area. Soil density down to 0-10 cm layer was higher in P10 and P20 treatments compared to the P40 and forest, but in deeper layers higher densities were observed in P40. This effect may be related to a lower root production due to the increase in forage availability for the animals. In relation to C and N contents, a decrease with depth occurred, as expected. Contribution of the new plant material introduced by ICLS to the SOM composition was identified only at the 0-5 cm layer, as indicated by $d^{13}C$ values. Our results showed that in a heavy clayey Oxisol under ICLS, SOM cycling occurred only at 0-5 cm depth regardless the grazing intensity. Soil C stocks tended to increase with the decrease of grazing intensity.
Keywords: carbon stock, livestock farming system integration, organic matter, isotopic signature
Financial support: Capes, CNPq

(9198 - 756) Spatial distribution of soil chemical properties as affected by dairy effluent application system

Omar Casanova[1]; Amabelia del Pino[2]; Virginia Takata[3]; Andrei Assanelli[3]; Ana Bianco[4]; Soledad Gutiérrez[5]
Facultad de Agronomía, Universidad de la República, Garzón 780 Montevideo, Uruguay[1]; Facultad de Agronomía, Universidad de la República, Garzón 780, Montevideo, Uruguay[2]; Facultad de Agronomía, Garzón 780, Montevideo, Uruguay[3]; Instituto Nacional de la Leche, 19 de Abril 3482, Montevideo, Uruguay[4]; Facultad de Ingeniería, Universidad de la República, Herrera y Reissig 565, Montevideo, Uruguay[5]

soil application of dairy effluents has been widely used in Uruguay, recently has gained importance, due to environmental concerns. The risk of water pollution by nutrients and organic matter (OM) led to the prohibition of effluent discharge to water courses and the recommendation to reuse and recycle. At the moment coexist in the country many systems of manure and effluent management, which are intended to adapt to the characteristics of the different farms. Our aims were: 1) To characterize the effects of different effluent management/irrigation systems on soil properties (pH, OM content, available P and exchangeable cations). 2) To assess the spatial distribution of soil properties. 3) To use the generated information to make guidelines for effluent application. Five farms were selected to encompass different management systems: 1) Irrigation with fresh effluents through tubes and spreader, 2) gravity flow of effluents from an anaerobic pond through a fixed irrigation line, 3) and 4) Distribution of anaerobic pond slurry with tanker. 5) Spreading with liquid effluent from a solid screw press separator. The paddocks that had been under grain and fodder crops received effluents for at least 4 years. The soil was sampled alongside 5 divergent transects, separated by 30º angles. The starting point of transects was the closest to the effluent generation, and composite soil samples were taken every 20 m (25 samples per paddock). All the paddocks showed effects of effluent application in one or more of the evaluated soil properties. Regarding available P, except for one case, average values were above critical levels for crops and pastures, making it unnecessary to add P fertilizer

to effluents. A high spatial variability was observed in all parameters, with the lowest variation in pH (Variation coefficient (VC): 4 to 8 %), and the highest for available P (VC: 26 to 47 %). The study of the spatial distribution of different soil properties showed significant effects of distance, indicating a higher accumulation of nutrients, especially P, in the vicinity of the effluent generation or storage facilities. It was concluded that the sampling methodology allows to successfully assess the high spatial variability generated by effluent application. Moreover it is possible to separate areas affected by elevated nutrient levels, specially P, in which it will be advisable to discontinue effluent applications, from those which admit further additions.
Keywords: Uruguay; available P; systematic soil sampling
Financial support: Instituto Nacional de la Leche – Uruguay

(6825 - 1427) Spatial heterogeneity of tillage increases the resilience of the PLFA profile, but not the size, of the microbial community

Iain Dummett[1]; Professor Jane Rickson[1]; Dr Lynda Deeks[1]
Cranfield University[1]

Reducing tillage intensity results in an increased reliance on the functioning of soil biological communities to generate the soil conditions necessary to support crop yields. There is, therefore, a need to identify soil management practices which can limit the harm to, and maximise the resilience of, soil microbial communities whilst maintaing crop yields. Plant and animal ecology provides examples of undisturbed areas of habitat increasing the rate of recovery of proximate areas of disturbed habitat following ecological disturbance events such as forest fires. This concept was tested in the context of soil microbial ecology and tillage. Undisturbed soil samples measuring 40 cm x 20 cm were taken to a depth of 10 cm and subjected to a) no tillage, b) simulated tillage (achieved by passing soil through a 5mm sieve) and c) simulated strip tillage where half the soil was not tilled and the other half was subjected to the simulated tillage treatment. Samples were stored in a polytunnel, and microbial biomass carbon and PLFA profiles were measured over a 99-day period. Compared to the soil of the samples which were all subject to simulated tillage, the undisturbed soil of the simulated strip tillage treatment showed increased resilience of the structure, but not the size, of the microbial community. Thus this study suggests that the spatial heterogeneity of tillage can increse the resilience of the structure of soil microbial communities.
Keywords: Spatial soil ecology tillage
Financial support: Frontier Agriculture Ltd., Douglas Bomford Trust, NFU Mutual, Cranfield University

(4042 - 1512) Spatial variability of fertility and productivity in a fertigated açaí area in State of Pará

Graziele Rabelo Rodrigues[1]; Felipe Oliveira Ribeiro[1]; Jeane Oliveira da Silva[1]; Antonio Anizio Leal Macedo Neto[1]; Gilson Sergio Bastos de Matos[1]; Lincoln Stephano Lima Costa[1]
Universidade Federal Rural da Amazônia[1]

The açaí tree (Euterpe oleracea Mart.) Is a palm tree very demanding in K and Ca for the production of bunches and fruits. The objective of this study was to evaluate the spatial variability of productivity and the exchangeable contents of K, Ca and Mg in the soil in a fertigated açaí area. The study was conducted on a farm in the city of Tomé-Açu, PA, with a sample area of 5.75 ha and density of 400 tussocks/ha planted in a yellow latosol. In the seventh year of planting, a sampling grid, with 80 georeferenced points, was made, at each point a group of five plants was considered as a reference for soil collection and productivity. Spatial variability was performed using the geostatistical tool. The K and Ca contents showed a coefficient of variation above 20%, considered high, indicating low precision sampling, as for productivity and Mg the CV was 30%, a value classified as very high, which also indicates a low precision. Mg had 56.2% of samples in medium status, followed by K with 93.7% and Ca with 95% in good soil status. The good availability of exchangeable bases in the soil, which naturally has low fertility, may be related to the adequate management of the fertigated fertilization in this area. Productivity was on average 5 t / ha, considered low for a 7-year crop, which has an average of 8 t / ha. The semivariogram models found were spherical for Ca, exponential for K and Mg and Gaussian for productivity. There was spatial dependence for the three nutrients and for the productivity variable. The values of spatial dependence varied between 0.5 and 0.9, being classified as medium for K and high for productivity and for other nutrients. The range was 138.9m for K, 60m for Mg, 48.4m for Ca and 44m for productivity. Most of calcium and potassium samples showed high fertility, whereas magnesium had most of its samples with medium fertility. It was possible to determine the spatial variability of nutrients through geostatistics, there was spatial dependence for all variables and potassium was the nutrient that presented the greatest range.
Keywords: exchangeable bases, soil fertility, geostatistics
Financial support: Fazenda Opatta

(4364 - 1382) Spatial variability of teak leaf nutrition on a farm in the State of Pará

Jeane Oliveira da Silva[1]; Graziele Rabelo Rodrigues[1]; Antonio Anizio Leal Macedo Neto[1]; Gilson Sergio Bastos de Matos[1]; Rodolfo Daniel Vieira de Assunção[1]
Universidade Federal Rural da Amazônia[1]

Teak is a tree species with wood of great commercial importance. One of the determining factors in the production of wood is related to the good nutrition of the plant, which combined with precision agriculture can increase the productivity of the species. The objective was to perform the nutritional diagnosis and to evaluate the spatial variability of the N, P and K foliar contents in a commercial teak cultivation. The study was carried out on a farm in the City of Capitão Poço, State of Pará, Brazil, on a 52 ha area. A total of 155 georeferenced points were collected to determine the spatial variability of leaf nutrients, each point was composed of three trees to form a composite sample. About the 155 foliar samples, 51% presented deficient status for phosphorus, 82% for nitrogen, and 100% for potassium. A large number of deficient samples, especially in K, may be associated with reduced fertilization of this nutrient in the area. In addition, K is one of the most demanded nutrients by forest species and is directly related to the reduction of trunk size. In relation to the DBH, this presented an average of 0.24 cm, a value considered low for the farm's own reference parameters and also for the literature. The models of semivariograms found were exponential for nitrogen, Gaussian for phosphorus and spherical for potassium and DBH. There was spatial dependence for the three nutrients and for the DBH, which presented values ranging from 0.35 to 0.79, and all four variables presented moderate spatial dependence. Regarding the four variables studied, three presented a coefficient of variation below 20% (N, K and DBH), which shows that their sampling was of high precision, the phosphorus presented a coefficient of 29%, presenting a medium precision. The range values were 120 m for nitrogen, 180 m for phosphorus, 200 m for potassium and 125 m for DBH. It was possible to generate maps of spatial variability for the three nutrients. In all of them, potassium showed the highest frequency of deficiency. Potassium was the variable that presented the greatest range and the variations in N, P and K and DBH levels are well explained by spatial variability.
Keywords: Keywords: *Tectona grandis*, geostatistic, teak nutrition.
Financial support: Tietê Agrícola Ltda.

(9647 - 1780) Spatial-temporal variability of available phosphorus in integrated crop-livestock systems in lowlands

Mateus Westerhofer Goulart[1]; Luiz Gustavo de Oliveira Denardin[1]; Filipe Selau Carlos[1]; Paulo César de Fáccio Carvalho[1]; Ibanor

Anghinoni[1]

Universidade Federal do Rio Grande do Sul[1]

The irrigated rice is one of the systems that more cause modifications in the natural cycles. Besides that, with the introduction of different managements and the presence of animals, characterizing an integrated crop-livestock system (ICLS), providing greater complexity to the system, the study of spatial-temporal variability become fundamental for understand better the soil fertility and provide the use of betters practices of managements for the farming. Thus, the objective of this study was evaluate the spatial-temporal variability of available phosphorus (P) in a lowland soil (Albaqualf) from 2013 to 2015, submitted to different arrangements of ICLS in comparison to the traditional system (TS) of irrigated rice cultivation, with ploughing and heavy disking. The study was conducted in a long-term ICLS trial at the Corticeiras Farm, located in Cristal County, Rio Grande do Sul State, Brazil. The treatments consisted of five production systems: (S1): rice monocropping with fallow in winter; (S2): rice/annual ryegrass (AR); (S3): rice/AR/soybean/AR; (S4): AR + white clover (WC)/sudan grass/AR + WC/soybean/AR + WC/corn/AR + WC/rice and (S5): AR + WC + birdsfoot trefoil/ succession field (native pasture species). The results indicated non-constant coefficient of variation (CV) differences among treatments over time, with increase in S2 and S3 only, of 4% and 36%, respectively. However, in S1, S4 and S5 there was decrease in CV of 15%, 59% and 32%, respectively. In relation to the temporal variation, all the treatments presented increases in available P content, but in different proportions. While the TS showed an increase of only 74%, all other ICLS showed increases of 162, 349, 142 and 200% in T2, T3, T4 and T5, respectively. Based on the results, it was concluded that the adoption of conservation management practices in lowlands, such as no-tillage, combined with ICLS promote increases in soil available P in comparison to the TS. In addition, the adoption of ICLS from insertion of the animal don't significantly increase the spatial variability of P content in the soil.

Keywords: available phosphorus; integrated crop–livestock system; irrigated rice;

Financial support:

(4760 - 737) Study on multi-scale simulation and scale effect of organic carbon in regional soil using a combination of variogram, spatial autocorrelation and multi-fractal methods

Zhang Shiwen[1]; Huang Yuanfang[2]

Anhui University of Science and Technology[1]; China Agricultural University[2]

Under the background of global environmental change, carbon storage estimation has become one of the hottest topics in soil carbon sequestration, and soil carbon pool is the largest carbon pool of terrestrial ecosystems. The spatial variability of soil organic carbon (soil organic carbon, SOC) is one of the reasons for the uncertainty in the estimation of carbon reserves. The spatial distribution characteristics on multidimensional scale, is of great significance for revealing soil nutrients, pollutant transport, precision management of farmland and achieving sustainable development of agriculture. Combined with the current research progress and shortcomings on spatial distribution characteristics and scale effects of soil properties, using a combination of variogram theory, spatial autocorrelation theory, multi-fractal theory and other methods from the aspects of the spatial variability of soil properties and the structure, the paper gradually revealed the spatial distribution characteristics of SOC (soil organic carbon) and its scale effects under 4 kinds of scales. The results show that: Ratio of nugget to sill of SOC under 15, 25, 35 and 45 km scales were 61.78%, 42.65%, 49.98% and 39.34%, respectively, which showed a moderate spatial correlation. The spatial correlation from high to low was 45, 25, 35 and 15 km in turn. Except the 15km scale, the spatial variability caused by random factors including representative measurement error and the micro-scale process, was less than the structure variance, namely the ratio of nugget to sill was less than 50%, the structural factors were dominant, and spatial variability from the random part showed a decreasing trend with the scale increasing.The variation function couldn't be described with discrete characteristics (i.e. spatial negative correlation), which was also impossible to make a significant test for variable range. As the separation distance increased, the Moran index decreased from full positive to negative, then the positive and negative values alternately occurred, and eventually the values turned out to be negative totally.Nearer positive correlation distance represents the spatial correlation distance, which is the first cross point of positive and negative conversion under different scales, and were 1 607, 7 520, 8 649 and 9 053 m for 15, 25, 35, and 45 km scale.

Keywords: multi-scale simulation, scale effect, soil organic carbon, variogram theory

Financial support: The National Key Research and Development Program of China (2016YFD0300801)

(8623 - 1743) Sugarcane growth and yield as a function of deep soil tillage and liming rates in a clay soil

Gabriela Ferraz de Siqueira[1]; Jorge Martinelli Martello[1]; Daniele Scudeletti[1]; Murilo de Campos[1]; Ariani Garcia[1]; Ciro Pozzi Garcia[1]; Juliano Carlos Calonego[1]; Carlos Alexandre Costa Crusciol[1]

School of Agricultural Sciences, Sao Paulo State University[1]

The intense mechanization in the sugarcane production system, in which the soil is revolved each 5 years an average, lead to strong compression and consequently reducing productivity and longevity due to the impediment of root growth. Besides that, the liming recommendation on sugarcane for Sao Paulo State is been considered underestimated what could be limiting the sugarcane yield causing productivities under the potential for the crop. The soil tillage system associated with a correct lime rate may be the mainly factors for high yields, therefore, the aim of this study was to evaluate the effect of deep soil tillage compared with conventional tillage and liming rates in the sugarcane growth and yield. The experiment was installed in 2015 in an oxisoil soil at Macatuba, SP, Brazil. The experimental design was a randomized block with split-plot design with four replications, where the plots consisted of three systems of soil tillage: conventional soil preparation (CSP); deep soil tillage (DST) with lime application in surface total area; and modified deep soil tillage (MDST) with lime application in the surface planting strip, with ¼ of the dose in deph; and the subplots consisted of liming rates: 0, 1, 2 and 3 times the recommended dose (RD) for sugarcane production in São Paulo State, based on soil samples of 0.0-0.20 and 0.20-0.40 m). For the deep tillage treatments all the machines were equipped with GPS equipment in order to control the traffic and it was possible to define a plant growth zone and a traffic zone. The treatments DST and MDST provided higher stalk length compared with CSP in the dose 3 x RD. For all tillage systems the dose 2 x RD provided plants with higher stalk length. Regards the diameter, the dose 2 x RD also provided higher values for all tillage systems. In relation to the stalk and sugar yield the results for CSP and DST systems were fitted in quadratic functions, increasing from dose 0 until 2 x RD, but decreased in 3 x RD, but for MDST the results were fitted in linear function, increasing from dose 0 until 3 x RD.

Keywords: Soil conservation, controlled traffic, sugar yield, liming recommendation

Financial support: FAPESP grant 2014/20593-9

(3019 - 462) Sugarcane roots growth as function of deep soil tillage and liming

Juliano Carlos Calonego[1]; Ciro Pozzi Garcia[1]; Carlos Alexandre Costa Crusciol[1]; Gabriela Ferraz de Siqueira[1]; Tiara Moraes Guimarães[1]; Erilene Romeiro[1]

São Paulo State University, College of Agricultural Sciences[1]

Soil compaction has been a recurrent problem for sugarcane yield increases due to several factors, including the impediment to root growth. Another factor that influences the root growth of sugarcane is the supply of calcium and the soil acid alleviation. The aim of this experiment was to evaluate the root growth of sugarcane as a function of the soil tillage system and the presence or not of liming with machinery traffic controlled. The experiment was installed in 2015 in a sandy soil at Borebi, SP, Brazil, with pH 4.5 and base saturation of 42% in the 0-0.2 m layer. The experimental design was a randomized complete block with four replications, where the plots consisted of three systems of soil tillage: conventional soil preparation (CSP) – standard / control; deep soil tillage (DST); and modified deep soil tillage (MDST). The subplots were established by the presence and absence of limestone. The CSP system was characterized by the tillage with disk harrow, chiseling and disk harrow again, with application of limestone in total area before the first operation of the soil tillage. In the DST was used deep tillage with rod up to 0.80 m and rotating hoe, with application of limestone in total area. The MDST was differentiated from DST by the application of limestone only in the tillage range. After three months of liming the sugarcane was planted with a double spacing (0.90 m x 1.50 m). All the machines were equipped with GPS equipment in order to control the traffic and it was possible to define a plant growth zone and a traffic zone. Sugarcane roots samples were collected soon after the plants harvest at depths of 0-0.20, 0.20-0.40, 0.40-0.60, 0.60-0.80 and 0.80-1.00 m in the middle of the plant growth zone and the traffic zone. The liming increased the roots dry matter at 0.80-1.00 m layer in the traffic zone with DST and MDST. In plant growth zone, the absence of liming increased the amount of roots in the 0-0.2 m layer with the CSP, and in the layer of 0.80-1.00 m in the DST and MDST treatments.

Keywords: soil conservation soil compaction controlled traffic farming

Financial support: Sao Paulo Research Foundation (FAPESP-Project Number 2014/20593-9)

(8437 - 3025) Sugarcane straw decomposition as a function of quality and quantity of green tops and dry leaves associated with climate conditions

Lauren M. S. Menandro[1]; João L. N. Carvalho[2]; Heitor Cantarella[3]; Clovis D. Borges[2]; André C. Vitti[4]; Henrique C. J. Franco[2]

UNICAMP / CTBE-CNPEM[1]; CTBE-CNPEM[2]; IAC[3]; APTA[4]

Sugarcane straw decomposition can be influenced by several factors, including the quality and quantity of green tops (Gt) and dry leaves (DL) and climatic conditions. Our goal was to evaluate how the relation between these factors influence the decomposition. An experiment was conducted across two years (2014-2016) in sandy soil located in Agudos- SP, Brazil. The treatments were: Gt (4 Mg ha^{-1}), Gt+25%DL (6 Mg ha^{-1}), Gt+50%DL (8 Mg ha^{-1}), Gt+DL (12 Mg ha^{-1}) and DL (8 Mg ha^{-1}). In both years, litter bags were installed and collected about 90, 180, 270 and 360 days after they are installed. In the 1st year, the greater the increase of DL to Gt, the greater is the rate and constant (*k*) of decomposition and shorter is half-life time ($T_{1/2}$) (51, 55, 57 and 65%, 0.0019, 0.0022, 0.0023 and 0.0029 days-1, 352, 311, 293, 235 days, for Gt, Gt+25%DL, Gt+50%DL, Gt+DL, respectively). With the Redundancy Analysis (RDA), we verified that this occurred due to the relation between the amount of bulk straw and the water deficit (-175 mm vs -32 mm in the 2nd year) in the first three months of crop growth (ie., crop canopy not closed and major influence of treatments). With water restriction, the presence of larger amounts of straw may have favored the decomposing organisms, increasing decomposition. In the 2nd year, the highest rainfall (510 mm) and temperature (23.1 ºC) in the first three months (1st year - 226 mm and 21.4 ºC) were responsible for reversing the process, with rates and *k* lower and higher $T_{1/2}$ in treatments with lower DL (87, 85, 83 and 74%, 0.0055, 0.0049, 0.0044, 0.0035 $days^{-1}$, 126, 141, 157 and 196 days, for respective treatments). Without climatic restrictions, treatments with a higher proportion of Gt were more easily decomposed. This is because the quality of Gt and DL also determines the decomposition, which was evidenced by DL treatment. Regardless of year, DL had lower rates and k and higher $T_{1/2}$ (38%, 0.0013 $days^{-1}$ and 533 days, 66%, 0.0029 $days^{-1}$, and 237 days, for 1st and 2nd year, respectively). This is associated to the higher lignin, cellulose and hemicellulose contents and higher C/N ratio in DL than in Gt. We conclude that the relation between quality, quantity and climatic conditions interferes in the decomposition and Gt are more easily decomposed than DL. The differences between these are plausible for recommendations of straw management, in which, for example, Gt are more indicated to nutrients recycling while DL is better for soil cover.

Keywords: straw management; constant of decomposition; half-life; C/N ratio, nutrient recycling

Financial support: CNPq PROC 476718/2013-9; CTBE/PNUD; Project BRA/10/G31 – Sugarcane Renewable Electricity; CNPq - PROC 134063/2014-7

(1745 - 3044) The impact of quality and proportions of composting organic materials on the solubilisation of Kodjari phosphate rock in semi-arid West Africa

Elisee Ouedraogo[1]; Ousmane Badogo[2]; Leo Stroosnijder[3]

World bank/CEAS-Burkina[1]; Ministry of Agriculture[2]; Wageningen University[3]

A study was conducted at Gomtoaga (Burkina Faso) in the Albert Schweitzer Center for Ecology Research Center to assess the possible effect of Kodjari phosphate rock (PR), composting organic resource quality and proportions on compost carbon dynamics, N and P recovery and the solubilisation of Kodjari PR. The design was a split plot with three replicates. PR and no-PR were the main treatments. The sub-treatments consisted of 75 % *Andropogon spp.* straw + 25 % cattle dung (T1), 25 % *Andropogon spp.* straw + 75 % cattle dung (T2) and 50 % *Andropogon spp.* straw + 50 % cattle dung (T3). PR affected significantly N recovery only in T1 with 41 % in PR treatments vs. 53 % in no-PR treatments. Total P recovery is affected significantly by PR in all treatments, the highest recovery being observed with 47 % in T3 followed by T1 (33 %) and T2 (24 %). PR enhanced compost carbon loss when increasing the *Andropogon spp.* straw proportion up to 75 % (T1). The highest and significant difference in available P (33 mg kg^{-1}) was also observed in T1. It was concluded that the enhanced decomposition of composting organic materials and PR solubilisation is more efficient under P-limiting conditions. Although further composting time may be necessary, T1 responded well to PR on decomposition, N recovery and PR solubilisation. Farmers can save at least two months composting time and labour with added benefit in compost quality. Thus, improving composting techniques in West Africa requires integration of PR into the composting system, adoption of adequate proportions of organic materials during the composting process and suitable composting pits which prevent leaching and good composting management to control water supply.

Keywords: Composting; Carbon; Phosphate rock; West Africa

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(1101 - 492) The soil potassium contents and form transformation under long-term fertilization in red soil

Huimin ZHANG[1]; Tianfu HAN[1]; Kailou LIU[2]

Institute of Agricultural Resources and Regional Planning, Chinese Academy of Agricultural Sciences[1]; Institute of Agricultural Resources and Regional Planning, Chinese Academy of Agricultural Sciences/Jiangxi Institute of Red Soil, Jinxian, Jiangxi[2]

The soil potassium contents and form transformation under long-term fertilization in red soil

Huimin ZHANG[1], Tianfu HAN[1], Kailou LIU[1,2]

[1] Institute of Agricultural Resources and Regional Planning, Chinese Academy of Agricultural Sciences, Beijing 100081, China; [2] Jiangxi Institute of Red Soil, Jinxian, Jiangxi 331717, China.

Potassium (K) and lime application are necessary for attaining high crop yield in the red soil region. However, little is known about the soil K form transformation in organo-mineral complexes (OMCs) and rhizosphere soil (RS) after application of K fertilizer and lime. A long-term (since 1990) field experiment of wheat-maize rotations and a pot experiment of different soil pH were conducted to investigate soil potassium (K) contents and form transformation in OMCs and rhizosphere soil (RS) under lime and K application. Treatments selected were unfertilized (CK), nitrogen and phosphorus fertilizers (NP), NPK, NPK plus half of straw (NPKS), NPK plus pig manure (NPKM). After the soil sampled, lime treatments (NP, NP plus lime (NPCa), NPK, NPKCa, NPKS, and NPKSCa) were carried out.RS and bulk soil (BS) samples were collected at four stages of maize in 2014. The results showed that more K released from mica and/or 1.4 nm transition mineral in treatments without K (CK and NP) as compared to NPK, NPKS and NPKM. The exchangeable K (EK) and non-exchangeable K (NEK) contents of soil OMCs were increased only in K treatments.The accumulation of NEK of soil OMCs (released in 300 hours) followed as: (<2 μm) > (2~10 μm) > (10~50 μm and >100 μm) > 50~100 μm and of treatments followed as: NPKM > NPK > CK > NP. As compared to NPK and NPKS, the EK, NEK and KS (K saturation) of RS significantly increased in NPKCa and NPKSCa, respectively. Similarly, the K surplus and deficit rate in RS was higher in lime treatments due to lower EX- (Ca^{2+}+Mg^{2+}) in RS than BS. The highest K availability was at pH 5.5-6.5. So, NPKM was best treatment to increase the K supply in red soils. Further research on K depletion and balance is required. Keywords: soil potassium; red soil; long-term fertilization; organo-mineral complexes

Keywords: soil potassium; red soil; long-term fertilization; organo-mineral complexes

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(3899 - 1083) Total and dissolved organic carbon in deep soil profiles following pasture conversion, New South Wales, Australia.

Rubeca Fancy[1]; Brian R Wilson[2]; Heiko Daniel[3]; Yui Osanai[3]

University of New England, Armidale NSW 2351, Australia (rfancy@myune.edu.au)[1]; University of New England, Armidale NSW 2351, Australia; NSW Office of Environment and Heritage, Armidale NSW 2351, Australia[2]; University of New England, Armidale NSW 2351, Australia[3]

Globally, research attention is currently focused on the storage and cycling of organic carbon (OC) in soils, due to its importance in the global carbon cycle. Land-use change has significant impact on soil OC storage worldwide. In Australia and internationally, land-use change from cropland to pasture is a practice that is known to increase the amount of OC in the carbon depleted cultivated soils. Although the effect of land-use change on OC cycling in soils has been widely investigated, studies have typically focused on carbon dynamics in topsoils (0-30 cm). We investigated the quantity and depth distribution of total organic carbon (TOC) and the significance of dissolved organic carbon (DOC) to 1.0 m in the soil profile where land-use change occurred from C_3 (crop) to C_4 (pasture) vegetation. Here we discuss the depth distribution of TOC and DOC down the soil profile and the relative importance of DOC to soil OC transport and change in the soil profile. Using $\delta^{13}C$ of TOC and DOC we examine the source and quantity of "new" carbon in the soil system and the significance of C_4 vegetation for additional carbon storage in these Australian soils.

Keywords: Soil organic carbon; land-use change; Australian soils.

Financial support: Combined International Postgraduate Research Scholarship (IPRS) and Australian Postgraduate Award (APA)

(6926 - 2425) Total organic carbon as an indicator of the impact of soil management in mountain agriculture in the region of Nova Friburgo, RJ

João Victor Almeida Arantes[1]; Pedro Araújo Garcia[1]; Isabela Beatriz Pereira da Cruz[1]; Luiz Alberto da Silva Rodrigues Pinto[1]; Nivaldo Schultz[1]

UFRRJ - Federal Rural University of Rio de Janeiro[1]

Vegetable farming with soil revolving towards the slope of the ground is common in the mountainous region in Rio de Janeiro, causing the chemical, physical and biological soil degradation because it promotes water erosion. The analysis of the total organic carbon (TOC) in soil can be an indicator of the impact of soil use in this system. The purpose of this work was to evaluate the TOC contents of a Cambisol under different management systems. Four areas were selected on a hillside with slope varying between 20% and 40%. The areas are under the following management systems: 1. Conventional system with alternation of different vegetables for more than 30 years, with at least one action of soil revolving per year - CS; 2. Well managed pasture for 28 years – WMP; 3. Vegetable farming in a conservation system (cultivated in a conventional system for more than 30 years, but since 2012 the soil has been revolved, prepared for the vegetable farming and seeded with black oats (Avena strigosa) to form the soil cover in winter , for the vegetable farming in winter / summer) – CMS; and 4. Forest regeneration process for more than 30 years – RF. Within each area were selected four subareas of 9 m2 (3x3m), in which 8 single samples were collected to form a composite sample per layer. The layers were 0.0-0.10, 0.10-0.20 and 0.20-0.40 m depth. In these samples, the soil TOC contents were determined. Data were compared statistically through analysis of variance and the means compared by t-test (LSD) at 10% significance. At the depth of 0.0-0.10 m the TOC was 21.17, 28.85, 70.85 and 74.63 g kg-1 for CS, CMS, WMP and RF, respectively, differing from each other, except for WMP and RF that did not differ from each other. In the layer of 0.10-0.20m the TOC was 23.62, 26.74, 42.36 and 57.29 g kg-1 to CS, CMS, WMP and RF, respectively, with no difference between CS and CMS, but these were inferior to WMP and RF, being RF superior to WMP. In the 0.20-0.40 m layer the TOC contents were 15.05, 21.13, 31.96 and 38.12 g kg -1 for CS, CMS, WMP and RF, respectively, with no difference between CS and CMS, as well as between WMP and RF, but the latter two were superior to CS and CMS. Based on the TOC of the soil under forest, the results show that the conventional management system has significantly reduced the TOC content of the soil and that the conservation system is enabling the recovery of TOC over time.

Keywords: Mountain agriculture; soil management; conservation agriculture.

Financial support: Fundação Agrisus – Agricultura Sustentável

(6912 - 1396) Use of biofertilizer associated to nitrogen-fixing bacteria on yield and yield components of soybean crop

Jaqueline Gaio Spricigo[1]; Alvaro Fernando Portes[2]; Mateus Bedin[2]; Gabriela Naibo[1]; Carlos Alberto Casali[3]; Everton Skoronski[4]; Mauricio Vicente Alves[1]

University of West of Santa Catarina[1]; Federal Technological University of Paraná[2]; Professor, Federal Technological University of Paraná[3]; Professor, State University of Santa Catarina[4]

In order to increase the efficiency of biological nitrogen fixation in soybeans with a prospect in enhancing yield levels, an alternative is the use of biofertilizers, where it offers the maximum amount of viable cells for colonization of the plant's rhizosphere. This study aimed to evaluate the symbiotic efficiency between the inoculant (*Rhizobium*) and a liquid biofertilizer, on the components of soybean yield and yield. The experiment was carried out at Renascença - PR, in the 2015/2016 crop with no-tillage system sowing. The soil was classified as Red Latosol/Oxisoil. The experimental design was a randomized block design with four treatments and four replications, with the following treatments: Control, Seed inoculation, Seed furrow directed inoculation and Microgeo® furrow directed inoculation. The nodule number per plant (NN), root dry matter (RDM), shoot dry matter (SDM), number of pods per plant (PP), weight of a thousand grains (WTG), yield and foliar nutrients were evaluated in this study. The data were submitted to analysis of the variance and when significant to the means were evaluated by the Tukey test through Assistat program. The use of biofertilizer and inoculant in different forms in the crop did not obtain significant results, in both the yield and yield components; for NN, RDM and SDM the highest values were 40.3; 9.04 and 58.86 respectively in treatment with furrow inoculation via biofertilizer. Foliar nutrients did not differ between treatments, and nitrogen contents were above the range considered ideal, between 45.1 and 55.0 g kg^{-1}. However for the phosphorus, the contents remained within the sufficiency range of 2.6 to 5.0 g kg^{-1}. Regarding the potassium, the values were less than desirable, being indicated between 17.1 and 25.0 g kg^{-1}. No differences were found between the treatments, possibly due to all soybean cultivations, inoculation, as well as good physical, chemical and biological conditions of the soil, together with the crop rotation with winter cover crops and the use of the product in the first agricultural year.

Keywords: Inoculant; biological fertilization; furrow inoculation
Financial support: UTFPR, UNOESC, FAPESC

(4883 - 3052) Use of steel slag as a liming material on soil pH and microbial population in an acidic soil of the central Andes of Peru

Raquel Zea[1]; Sady Garcia[1]; Dixie Chuquimia[1]; Silvia Aguero-Aguilar[1]; Rosa Meneses Florian[1]
Universidad Nacional Agraria La Molina[1]

Steel slag is a solid waste from steel production. The disposal of slags is becoming a serious problem in Peru. The application of steel slag can be of interest as an amendment for acidic soils, although limited information is available concerning the effect of soil microbial population. A pot experiment was conducted to determine the effect of using steel slag (46% calcium carbonate equivalent) as a liming material on chemical and biological properties of an acidic (pH = 5.05, 1.0 $cmol_c$ kg^{-1} exchangeable acidity), loamy soil from Sincos (Central Andes of Peru). Steel slag was applied at doses to neutralize 25%, 50%, 100% and 200% of exchangeable acidity), and a non-amended treatment was included as a control. Soil was placed in 4 kg plastic pots and incubated at field capacity during 220 days. Barley var. Centenario was planted 30 days after amendment and received two doses on N fertilization (100 and 200 mg kg^{-1}). A complete randomized design with 2x5 factorial arrangement and five replicates, was used. Soil pH, soil respiration rate (alkali absorption), and total bacterial, actinobacterial and fungal populations (CFU g^{-1}) were evaluated after incubation. Soil pH increased gradually with the dose of amendment. Doses of 100% and 200% of exchangeable acidity were significantly different than control. The application of steel slag did not affect neither soil respiration rate nor fungal population. The dose of 200% of exchangeable acidity increased the population of actinobacteria compared to the control. The nitrogen doses did not affect soil pH, nor microbial populations, but 200 mg kg^{-1} significantly decreases soil respiration. The application of steel slag as a liming material showed to be adequate to acidic soils with low impact of microbial populations, although upscale to field level is needed to conclusive results.

Keywords: steel slag, acidic soils, liming, soil microbial population.
Financial support: Laboratorio de Microbiología de Suelos. Departamento de Suelos. Facultad de Agronomía UNALM.

(5202 - 1740) Variability spatial-temporal of potassium in different lowlands production systems

Luciano Pinzon Brauwers[1]; Luiz Gustavo Denardin[1]; Ibanor Anghinoni[1]; Paulo César de Faccio Carvalho[1]
UFRGS[1]

The adoption of no-tillage in integrated agricultural production systems affects directly the variability of the availability of nutrients in the soil profile. From this, has the premise that, compared to a conventional system of irrigated rice cultivation, with soil tickler and monoculture, the introduction of the animal in the system leads to greater heterogeneity in potassium available in space and time. The present study was conducted in a long-term experiment, started in 2013, situated in the municipality of Cristal - RS. 176 georeferenced soil samples were collected in may of 2013 and october of 2015, with further analysis of potassium available, in five production systems, contemplating different arrangements with different agricultural crops and animal frequency in the system. The results indicate an increase in potassium available in the soil in all production systems, however in different scales. The system only with the rice cultivation without the animal in the system presented the lowest potassium available in 2015 (116 mg dm^3), while the system that had more frequently of the animal, with permanent presence of grazing animal, presented the highest content of potassium (150 mg dm^3). With the exception of conventional system, that had increased in the coefficient of variation of 28% to 32%, all other integrated systems showed decrease in the coefficient of variation, with variation from 44% to 27%, indicating greater uniformity in the distribution of this nutrient in the soil. From this, we conclude that the adoption of integrated livestock-crop production systems in lowlands promote greater increase in the potassium content available, in the soil in the course of time, as well as, a lower spatial heterogeneity of these levels, in relation to the traditional system of cultivation of irrigated rice in lowland environments of the Brazilian subtropics.

Keywords: LIVESTOCK, NUTRIENT, VARIABILITY
Financial support: UFRGS - Universidade Federal do Rio Grande do Sul

(9718 - 712) Water use efficiency on sunflower crop under irrigation levels and potassium doses in Oxisol

Luana Glaup Araujo Dourado[1]; Márcio Koetz[1]; Edna Maria Bonfim-Silva[1]; Tonny José Araújo da Silva[1]; Tulio Martinez Santos[1]
UFMT[1]

Sunflower (*Helianthus annuus* L.) represents approximately 15% of all vegetable oil produced worldwide and occupies a prominent position placing the species currently as the fifth oilseed in production of feedstock. Sunflower has been increasingly cultivated for its various characteristics, such as short cycle, high quality and quantity of produced oil, resistance to drought, cold and heat, possessing a high degree of adaptability, in this way arises the need to seek modern technologies to meet their requirements and thus adapt or satisfy them according to what each region can offer. Thus, the objective was

to evaluate the water use efficiency in sunflower cv. SYN 042 in response to soil water replenishment levels and potassium doses in Cerrado Oxisol. The experiment was carried out in a greenhouse at Federal University of Mato Grosso, Campus of Rondonópolis - MT. The experimental design was randomized blocks, in a 5x4 factorial scheme, with twenty treatments and four replications. The treatments consisted of five potassium doses (0, 40, 80, 160 and 240 mg dm^{-3} of K_2O) and four levels of soil water replacement (75, 100, 125 and 150% of humidity equivalent to field capacity). To measure the levels of water tension in the soil were installed in the vessels, tensiometers of puncture, one per block, totaling 4 tensiometers. The irrigations were calculated to raise the values of the tension to those of the humidity equivalent to field capacity (6 kPa) for all treatments at the 100% level of soil water replacement, when the established tension of 10 kPa was reached. The water depths applied in each experimental unit were defined according to the percentages for each treatment. The results were submitted to the regression analysis at 5% of probability, using the statistical program SISVAR. The unfoldment of potassium doses within irrigation levels had a significant effect. The potassium doses 196.29, 187.5, 237.5 and 210.53 mg dm^{-3} combined with the levels of 75, 100, 125 and 150% of the humidity equivalent to field capacity, provided the maximum efficiency in water use, 1.67, 1.46, 1.29 and 1.08 g L^{-1}, respectively. In the unfoldment of the irrigation levels in the potassium doses of 40, 80, 160 and 240 mg dm^{-3}, as the levels of irrigation in the soil increased, there was a decrease of the water use efficiency, with greater efficiency in the lower applied water depth (75% of the humidity equivalent to field capacity).

Keywords: *Helianthus annuus* L., Cerrado, oleaginous, tensiometer
Financial support:

(2268 - 1624) Whey as a sourge of nutrients for farage grasses

Anderson Romão dos Santos[1]; José Ricardo Mantovani[2]; Ana Beatriz Carvalho Terra[2]; Gabrielle Oliveira Serafini Lima[1]

University José do Rosário Vellano - UNIFENAS[1]; University José do Rosário Vellano -UNIFENAS[2]

Whey is a residue from the manufacture of cheeses, generated in abundance in dairy products. As this residue has high levels of K and N, an alternative would be its use in agriculture. This study aimed to evaluate the effect of whey on the production of forage grasses: *Panicum maximum* cv. Mombasa; *Brachiaria brizantha* cv. Marandu; *Brachiaria ruziziensis*. The experiment was carried out in pots, in the greenhouse. A randomized block design was used in a 5 x 3 factorial scheme with four replications. The treatments consisted of the combination of 5 doses of whey: 0; 400; 800; 1200; 1600 mL pot^{-1}, equivalent based on the soil volume of each pot at 0; 114; 228; 342 and 456 m^3 ha^{-1}, and 3 forage grasses: Mombasa, Marandu, and *Brachiaria ruziziensis*, respectively, belonging to the most demanding; intermediate and low in nutrients groups. Portions of 7 dm^3 of the superficial layer (0 to 0.2 m) of clayey soil received dolomitic limestone and 250 mg dm^{-3} of P as superphosphate were transferred to pots, moistened with distilled water at about 70% of the retention capacity, and remained in incubation for 30 days. At the end of the incubation, the three grasses were sowed, and the doses of whey were applied to the soil surface, according to the treatments. The whey used had 1.1 and 1.4 g L^{-1} of N and K. After emergence, thinning was carried out to maintain 4 plants per pot. The experiment was conducted by 3 cuts, and after the first and second cuts the doses of whey were reapplied. The application of whey increased, in each cut, the height of the plants, the number of tillers and the dry matter production of the aerial part of the grasses. When comparing the extreme treatments (control and receiving the highest dose of whey), there were increases of 2.1; 2.0 and 2.7 times the accumulated dry matter production (sum of the three cuts) of forages Mombasa; Marandu and *Brachiaria ruziziensis*, respectively. The application of whey increases the production of the forages Mombasa; Marandu and *Brachiaria ruziziensis*.

Keywords: Organic waste; nitrogen; potassium.
Financial support: Pibic/CNPq

C3.3.11 - Biochar for soil fertility management

(4123 - 1207) Accumulation of macronutrients and dry mass in winter cover crops after application of forest biomass ash

Gabriela Naibo[1]; Jonas Guerra[1]; Rodrigo Roani[1]; Jaqueline Gaio Spricigo[1]; Augusto Henrique Debiasi Orsatto[1]; Cristiano Nunes Nesi[2]; Mauricio Vicente Alves[2]

University of West of Santa Catarina[1]; Professors, University of West of Santa Catarina[2]

The use of leguminous species as winter cover crops increases the availability of nitrogen in the agricultural lands facilitating its absorption by culture in succession. The main objective of this study was to evaluate the accumulation of macronutrients and dry matter in oat and vetch as winter cover crops under different levels of forest applied biomass ash. The experiment was conducted at the Unoesc - Xanxerê / SC experimental plant on a Dystrophic Red Latosol/Oxisoil. The experimental design was randomized in blocks with four replicates. No-tillage was used in the sowing, with a consortium between vetch (*Vicia cracca*) (40 kg ha^{-1}) and oats (*Avena sativa*) (50 kg ha^{-1}) and fertilization according to soil analysis and crop requirements. The ash dose was indicated according to the potassium content in the ash and the required of the culture. There was a single dose of 30 kg ha^{-1} of nitrogen in all treatments. At the end of the vegetative cycle of oats and vetches, all plots were sampled by cutting 0.25 m^2 in the flowering stage of the crops, in order to quantify the green biomass production. Samples were weighed, dried at 65° C and then mill-milled using a 1 mm mesh sieve. The nutrient analyzes, N, P, K, Ca and Mg in whole plant were performed according to methodology described by Tedesco (1995). Regarding the dry mass, ash + oat/vetch and oat + vetch treatments did not differ statistically between them, being 1459.27 kg ha^{-1} and 1227.9 kg ha^{-1}. However, they differed significantly from fallow and ash treatments, which was 237.05 kg ha^{-1} and 189.85 kg ha^{-1} respectively. The N, in the ash + oat/vetch and oat + vetch treatments did not differ statistically from the others, with 31.27 kg ha^{-1} and 26.22 kg ha^{-1} respectively. The phosphorus in the ash + oat/vetch and oat + vetch treatments did not differ statistically from the others, having 1.34 kg ha^{-1} and 1.02 kg ha^{-1} respectively. The potassium in the ash + oat/vetch and oat + vetch treatments did not differ statistically from the others, being 55.35 kg ha^{-1} and 50.95 kg ha^{-1} respectively. However, for magnesium and calcium, the ash + oat/vetch and oat + vetch treatments did not differ statistically from the others, being 2.95 kg ha^{-1} and 2.57 kg ha^{-1} respectively for calcium, and 0.65 kg ha^{-1} and 0.60 kg ha^{-1}, respectively for magnesium. It was observed that after ash application, both accumulation of macronutrients and dry mass of cover crops was improved.

Keywords: Oats; Vetch; Industrial residue;
Financial support: Celulose Irani S.A, Fapesc, Unoesc, Art 171.

(7186 - 1105) Adsorption isotherms for different kind of designer biochar.

Yuki Moriyama[1]; Shinjiro Sato[1]

Soka University[1]

Nitosol which covers 12.5% of Ethiopian land has originally very low soil fertility, and requires fertilization for sound agricultural practices. Biochar is a carbon-rich product obtained when biomass is pyrolyzed with little or no available air. It has been demonstrated that biochars when applied to soils could improve soil physicochemical and biological properties including soil fertility and nutrient-use efficiency. Also, it is known that biochars with high (>600), low (300–400), and middle (450–600) pyrolysis temperatures are generally prone to adsorb well NO_3^-, NH_4^+, and PO_4^{3-}, respectively. Recently, designer biochars, produced to possess enhanced specific physicochemical properties to meet specific soil environments, are attracting attention. It has been shown that biochars pretreated by lanthanum ($LaCl_3 \cdot 7H_2O$) enhanced adsorption capacity for NH_4^+, NO_3^- and PO_4^{3-} significantly. Also, pre-treatment by clay mineral (montmorillonite) significantly increased adsorption capacity of biochars for NH_4^+ and PO_4^{3-}. This study examined the adsorption capacities of different designer biochars treated by lanthanum and clay for NH_4^+, NO_3^- and PO_4^{3-}. Two different feedstocks (wheat straw and corn stover) were used for biochars and pyrolyzed at 300, 400 and 500°C. Each feedstock was pre-treated by lanthanum (LT) or montmorillonite (MM). Fresh biochars without any pre-treatments were also produced at each temperature. The adsorption capacity was evaluated for each biochar for NH_4^+, NO_3^- and PO_4^{3-}. For NH_4^+ adsorption, fresh wheat biochar (300°C) and fresh corn biochar (400°C) showed the best performance. MM-treated biochars showed better performance than LT-treated biochars. Fresh biochars did not show any NO_3^- adsorption. For most of temperatures, LT-treated biochars showed better performance than MM-treated biochars for NO_3^- adsorption. Most of biochars did not show any PO_4^{3-} adsorption, but only wheat LT-treated biochars showed some adsorption. There were almost no differences between feedstocks for NH_4^+ and NO_3^- adsorption, therefore only wheat straw will be used for developing adsorption isotherms. Pyrolysis temperatures will be 300 and 450°C for NH_4^+, 600 and 750°C for NO_3^- and 450 and 600°C for PO_4^{3-} to develop isotherms. In this experiment, it is expected that lower temperature biochars and higher biochars will do the best performance for NH_4^+ and NO_3^- adsorption, respectively. For PO_4^{3-}, it is expected that only LT-treated biochars will do good performance.

Keywords: designer biochar, ammonium, nitrate, phosphate
Financial support:

(3553 - 923) Biochar and biochar-treated poultry litter compost can reduce greenhouse gas emissions and leaching of inorganic nitrogen from soils

Eunice Agyarko-Mintah[1]; Annette Cowie[2]; Bhupinder Pal Singh[3]; Lukas Van Zwieten[2]; Flavio Fornasier[4]; Steven Harden[2]
University of new England, Australia[1]; Department of Primary Industries, Australia[2]; Department of Primary Industries, Australia[3]; CREA - Centro di Ricerca Viticoltura ed Enologia, Italy[4]

Release of inorganic N from mineralization of labile N-rich organic amendments is a significant source of N lost via gaseous emissions. We hypothesise that co-composting with biochar, a stable C-rich amendment with recognised sorption capacity, would regulate N release to minimise N loss from soils receiving compost. A nine-week incubation experiment was conducted to assess the influence of biochar and biochar-amended compost on emissions of N_2O and leaching of N from two contrasting soils, Ferrosol and Tenosol (Australian soil classification), over three wetting and drying (W-D) cycles. Treatments included co-composted greenwaste biochar and poultry litter (GWBC), co-composted poultry litter biochar and poultry litter (PLBC), poultry litter biochar (PLB), poultry litter compost (PLC) and control (nil organic amendment), applied to the soils at 2 % (dry w/w). Two extra sets of the same soils/ amendments were used to assess changes in leaching of N and soil chemical and biological properties. Results on N dynamics were expressed relative to the initial amount of total hydrolysable (HN) in soil + amendments. About 50 – 90 % of N_2O emitted from the Ferrosol was released in the 1st cycle and cumulative N_2O emissions per g of HN were 60 – 80 % lower across the PLBC, PLB, GWBC and PLC treatments *cf* control (19.1 mg N_2O g^{-1} HN). In the Tenosol, cumulative N_2O emissions per g of HN were ~ 40 % lower in the PLB treatment, and ~ 100 % higher in the PLC and ~ 30 % higher in the GWBC and PLBC treatments, *cf* control (1.4 mg N_2O g^{-1} HN). The cumulative NO_3^--N leached per g of HN in the PLB, GWBC and PLBC over the entire period was significantly lower, by 30 –50 % in the Ferrosol, and 60 – 86 % in the Tenosol, relative to the respective controls. The sorption ability of biochar may be enhanced as biochar ages during composting and/or during interaction in the soil. We further postulated that biochar and biochar-treated co-compost promoted biochar-organo-mineral interactions, particularly in the Ferrosol, stabilising organic N to decrease N_2O emissions and N leaching. Organic additions increased biological activity (dsDNA and enzyme content) *cf* control only when compost was supplied, and only in Tenosol at the first sampling, while these measures decreased in the 2nd and 3rd sampling due to W-D cycles. We therefore conclude that biochar and biochar co-composted could be beneficial in mitigating climate change challenges and improve N use efficiency when apply to soils.

Keywords: N_2O emission, nitrogen leaching, wetting and drying, sorption, denitrification
Financial support: Australia Awards Africa; Poultry CRC - UNE Australia; University of New England- Australia; Ministry of Food and Agriculture- Ghana

(2754 - 1933) Biochar application shaped the distribution of native soil organic carbon accumulation in soil aggregates in a long-term wheat-maize cropping system

zhangzhengcheng[1]; Liguitong[1]
Department of soil and water sciences, University of China Agricultural University[1]

Biochar application shaped the distribution of native soil organic carbon accumulation in soil aggregates in a long-term wheat-maize cropping system Zhang zhengcheng,liguitong Department of soil and water sciences, University of China Agricultural University An understanding of the influence of biochar on soil organic carbon (SOC) formed from different carbon (C) sources, other than biochar, at field scale is required to accurately assess and predict the C sequestration potential of biochar. For this study, we set up a field experiment in 2009, including four treatments (i.e. B0, B30, B60, and B90, where the biochar application rates were 0, 30, 60, and 90 t ha−1, respectively). We then assessed the impact of biochar after eight years (i.e. in 2017) on native SOC in different sizes of aggregate derived from C3 (wheat) and C4 (maize) crop residues, as well as the changes of different aggregates. Previous study has revealed that (xinliangdong find Biochar application constrained native soil organic carbon accumulation from wheat residue inputs in a long-term wheat-maize cropping system).0–20-cm soil samples were taken to measure the size distribution of soil water-stable aggregates by wet sieving, The present study is aiming to investiga-te the underline mechanisms. In

each fraction (different sizes) of aggregates, native SOC derived from C3 (wheat) and C4 (maize) crop residues will be evaluated through stable isotope (13C) analysis. After eight years, we will test the contents of TOC and TN as well as organic carbon in different size of aggregates,then we will dig into the effect of Biochar application for soil organic carbon accumulation in different sizes of aggregate from wheat residue inputs in a long-term wheat-maize. The findings from the present study will advance our understanding of were meaning biochar's influences on crop residue degradation and organic matter stability.

Keywords: Pyrogenic carbon 13C Soil organic matter Crop residue
Financial support: This work was supported by the National Natural Science Foundation of China (No. 41171211).

(6598 - 1877) Biochar impacts on earthworm and bacterial communities in two long-term field experiments in Finland

Jure Zrim[1]; Visa Nuutinen[2]; Asko Simojoki[3]; Petri Penttinen[4]; Bruno Glaser[5]; Priit Tammeorg[3]

University of Helsinki, P.O. Box 27 FIN-00014 (jure.zrim@helsinki.fi)[1]; Natural Resources Institute Finland (Luke)[2]; University of Helsinki, Finland[3]; Zhejiang A & F University, Lin'an, China[4]; Soil Biogeochemistry, Institute of Agronomy and Nutritional Sciences, Martin Luther University 2 Halle-Wittenberg, Halle/Saale, Germany[5]

Biochar is a carbon rich solid obtained via pyrolysis from biomass such as wood and crop residuals. Due to its beneficial physiochemical properties, biochar is considered as an efficient tool to sequester carbon, enhance soil fertility and potentially increase crop yields. Biochar amendment can have significant impacts on soil organic carbon levels and physicochemical conditions. Consequently soil micro- and macro-biota may be affected and it is therefore important to understand how key biological components in the soil such as earthworm and microbial communities response to biochar application in the long-term. The study was conducted in South Finland in a fertile Stagnosol and a nutrient deficient Umbrisol, four and five years after biochar amendment, respectively. Biochars were produced from spruce (*Picea abies* (L.) H. Karst.) and pine (*Pinus sylvestris* L.) and applied at the rates of 10 t ha^{-1} and 30 t ha^{-1}. Earthworms and soil samples for microbial analyses were collected in September 2015. Casts from the sampled earthworms were also collected to investigate the consumption of biochar and the potential of earthworm bioturbation to affect biochar distribution. In addition, greenhouse gas emissions from soil were measured at the same spots from which the earthworm samples were taken. In both soils, the species composition of earthworm community was typical for Finnish arable soils with the dominance of endogeic, *Aporrectodea caliginosa* Sav., followed by epigeic *Lumbricus rubellus* Hoff. The total earthworm density and biomass were higher in Stagnosol field compared with Umbrisol field, but the proportions of different species were similar at both sites. Biochar and fertilizer treatments or their interaction had no statistically significant effects on the earthworm abundance, community composition or greenhouse gas emissions in either field. The preliminary results also show that earthworms had ingested biochar as earthworm casts from biochar treated-plots contained significantly more black carbon than those in the control plots, demonstrating that earthworm bioturbation is a potentially important factor in the translocation of applied biochar in the soil profile. Microbial community structure data will be presented in the final presentation. Softwood biochar amendment seems to be a safe method for carbon sequestration in Southern Finland conditions.

Keywords: biochar, earthworms, field experiment, greenhouse gases, microbial community
Financial support: Olvi Foundation, August Johannes and Aino Tiura Foundation, Niemi Foundation

(7719 - 1469) Biochar improves productivity of degraded pasturelands in Brazil: environmental and socio-economic analysis

Agnieszka Latawiec[1]; Aline Rodrigues[1]; Ana Castro[2]; Andre Junqueira[2]; Catarina Jakovac[2]; Ednaldo Araujo[3]; Etelvino Novotny[3]; Gerard Cornelissen[4]; Luiz Fernando de Moraes[3]; Sarah Hale[4]

PUC-Rio[1]; International Institute for Sustainability[2]; Embrapa[3]; NGI[4]

Land covered with forage grasses for animal grazing occupies 26% of global ice-free land and livestock provides employment and sustenance to nearly one third of the world's population. Pasturelands have significant contribution (40%) to gross domestic product of the world's agriculture. Yet, pasture degradation due to inadequate handling and soil-fertility loss renders pasture productivity below its potential and leads to adverse economic and environmental impacts. Degraded, low-productivity pasturelands are predominant throughout the tropics. In Brazil, a country that holds the world's largest commercial cattle herd, pasture-fed cattle ranching occupies 158 million hectares corresponding to 75% of agricultural land in Brazil with more than 70% of pastures being degraded and of low stocking rates (mostly below 1 animal unit per hectare). Pasturelands' productivity is often compromised by low soil pH, carbon content and reduced water holding capacity, and could therefore benefit from biochar. Studies that look into the potential of biochar to improve forage grass productivity in Brazil are scarce. Here we provide the first analysis of biochar amendment effect on Brazilian pasturelands with the aim of increasing yield for the two common forage grasses in Brazil (*Brachiaria* and *Panicum*). We performed both pot trials in controlled conditions for six vegetative cycles as well as field study for two vegetative cycles. Biochar (in combination with organic fertilizer and/or with inoculum) significantly improved biomass volume for both grasses, which can be explained by significant improvement of macronutrient content in soil (P, K, Mg) and pH regulation. We also observed increased K and P in the aboveground biomass but lower than control contents of Mg, Ca, Mn and Zn. There were no significant differences in belowground biomass between the treatments. We also performed cost-benefit analysis of biochar in Brazilian pasturelands and we valuated ecosystem services (carbon and nutrient retention) that follow biochar addition. To our knowledge this is the first study that investigates in a comprehensive way the use of biochar on pastures in Brazil, and one of the very few worldwide. Given widespread degradation of pasturelands in Brazil the results of this study may have significant implications, especially for smallholder farmers.

Keywords: biochar; degraded land; land-use change
Financial support: NORAD, International Climate Initiative (IKI), Project title: Unlocking economic opportunities to scale Forest Landscape Restoration in Brazil, Project Number 17_III_089

(5200 - 2119) Biochar preparation for returning nutrients to soil

Stella Cristiani Gonçalves Matoso[1]; Paulo Guilherme Salvador Wadt[2]; Valdomiro Severino de Souza Júnior[3]; Xosé Lois Otero Pérez[4]

Instituto Federal De Rondônia[1]; Embrapa Rondônia[2]; Universidade Federal Rural de Pernambuco[3]; Universidade de Santiago de Compostela[4]

Mineral enriched biochars have demonstrated high stability and high nutrient content available to plants, especially under low pyrolysis temperatures. These characteristics are similar to the properties of the organomineral complex of Amazonian Dark Earths. The objective of this study was to evaluate the effects of adding two specific soil types (sandy and clayey) to rice or coffee husk in order to generate organomineral biochars via pyrolysis. The pyrolysis (350 °C for 2 h) of biomasses (organic biochars) and solid mixtures (enriched biochar) of biomasses + soils (0,6:0,4 biomass-to-soil ratio), was carried out, resulting in six biochars. Thermal analyzes (TG/DSC) and chemical analyzes were performed. The elemental composition was obtained

in elemental analyzer (N and S) and by acid digestion using HNO_3, H_2O_2 and HCl (P, K, Ca, Mg, Na, Fe, Zn, Mn and Cu). The available contents were extracted with solution of Mehlich 3 (P, K, Ca, Mg, Fe, Zn, Mn and Cu) and ammonium acetate at pH 7.0 (Na). The nutrients concentration was determined by colorimetry, flame photometry and atomic absorption spectroscopy. The coffee husk gave rise to biochars more resistant to thermal degradation than the rice husk. This effect was potentiated in the enriched biochars. The F1 axis (69.26%) of the principal component analysis separated the biochars according to the biomass. The three biochars derived from coffee husk were similar, presenting higher content of N, S (total), P, K, Ca, Mg, Na and Cu (total and available) and lower content of Zn and Mn (total and available), when compared to the three rice husk-derived biochars. In the F2 axis (21.99%) it was observed that the higher Fe content (total and available) and total Mg separated the enriched biochars from the organic biochars. The elemental composition (mg kg^{-1}) of biochar derived from coffee husk resulted in: N = 19.5; S = 0.9; P= 1,644.6; K = 42,200.0; Ca = 13,740.0; Mg = 900.0; Na = 84.0; Fe = 1,290.0; Zn = 16.0; Mn = 159.0 and Cu = 39.0. With available levels of (mg kg^{-1}): P = 102.1; K = 33,893.8; Ca = 4,288.2; Mg = 420.0; Na = 0.01; Fe = 101.0; Zn = 5.5; Mn = 87.4 and Cu = 1.7. Therefore, the biochar derived from coffee husk is a good alternative to return nutrients to soil. The enrichment with clay soil, despite decreasing the total and available contents of most nutrients, increases the Mg, Fe and Mn contents and the thermal stability of the biochar. Thus, enhanced potential as slow-release fertilizer is obtained.

Keywords: Biochar quality; enriched biochar; organomineral complex.
Financial support: Capes

(2064 - 741) Characterization of biochars produced from different animal manures and crop straws

Qamar Sarfaraz[1]; Gerson Laerson Drescher[1]; Fabiane Figueiredo Severo[1]; Leandro Souza da Silva[1]
Federal University of Santa Maria, 1000 Roraima Ave, Santa Maria - RS, 97105-900, Brazil[1]

Huge amounts of crop residues and animal wastes are produced each year in Southern Brazil as the region has plenty of rice, soybean, and corn production and huge number of animals (cattle and swine) are produced. Recently a new technique is introduced to compensate the animal manures and plant residues, making biochars and applying to soils to enhance soil fertility as well as crop yield. However, biochars produced from different materials may present different characteristics. This study was proposed with an objective to characterize the biochars produced from different animal manures and crop straws. Manures (swine, poultry, cattle) and crop straws (rice, soybean, corn) were collected from experimental areas of Centre of Rural Sciences (CCR) of the Federal University of Santa Maria. Biochars were prepared at low temperature (450^{O}C) under slow pyrolysis conditions (10^{O}C increase in temperature per minute) for 1 hour in a muffle furnace, as previously reported that biochars produced at low temperatures are more suitable for agricultural use as they contain greater quantities of functional groups and higher exchange capacity. All results were analyzed for ANOVA and LSD was used at 5% to indicate significant variations for different elements. The biochar production rate is low in the study ranging from 26 to 57% because oxygen was not completely limited during pyrolysis of biomass. All biochars are alkaline in nature with maximum pH 10.41 found in rice straw biochar. The alkalinity of biochar is influenced, might be due to disappearance of acidic functional groups such as −COOH at high temperature. These results are reasonable, biochars produced from straw feedstock containing more carbon and less nitrogen than manure biochars except soybean straw. Carbon contents in all biochars are higher except cattle manure biochar 16%. The lost C and N were presumably transferred to bio-oil or un-condensable exhaust. It is well known that pyrolysis conditions dramatically influence the yield and properties of biochar. Nitrogen, phosphorus, potassium, calcium and magnesium contents are high for each biochar. Cation exchange capacity (CEC) of all biochars is higher ranging from 117 to 170 cmolckg-1. Hence, it can be concluded that biochars produced at low temperatures are rich in total C, can sequester C in soil, alkaline in nature, might be beneficial for acidic soils and are rich in nutrient concentrations, may be used to enhance crop yield by improving soil fertility.

Keywords: Biochar, slow pyrolysis, animal manures, crop straws
Financial support: TWAS-CNPq postgraduate fellowship program with process number 190166/2014-2

(5243 - 2827) Crop yield and greenhouse gas emissions from sugarcane systems in Brazil: effects from biochar amendment with organic fertilizers

Tatiana F. Rittl[1]; Sara de Jesus Duarte[1]; Marina Colzato[1]; Carlos Eduardo P. Cerri[1]
USP-ESALQ[1]

Brazil is the largest producer of sugarcane in world. Sugarcane ethanol produced in Brazil is considered economic and environmental sustainable, however, management practices such as the addition of waste products from ethanol production (filter cake and vinasse) to sugarcane fields in the form of organic fertilizer may increase the greenhouse gas (GHG) emissions due their richness in carbon (C) and nitrogen (N). Therefore, although the recycling of vinasse and filter cake in sugarcane fields are desirable due their agricultural benefits, better management practices need to be developed to minimize their negative effects on GHG emissions. Biochar, the product of biomass carbonization, has the potential to reduce GHG emissions from agricultural systems, and to promote crop yields in the tropic regions. However, although the perspectives of using biochar to reduce GHG emissions and increase crop yield are promising little has been done, especially in the tropical areas. Here, we simultaneously investigated the potential of biochar amendment with sugar cane residues to increase crop yield and reduce GHG emissions in a sugarcane plantation in Brazil. For that, we carried on a field experiment with nine treatments and one negative control (without any amendment). Treatments comprised of four rates of biochar (0; 6.25; 12.5 and 25 Mg ha^{-1}) with addition of sugarcane filter cake and with or without addition of vinasse. The main findings of this study show that biochar addition improved soil fertility and promoted crop yield, however its effects on GHG emissions were variable and dependent on the applied biochar rate and type of organic fertilizer.

Keywords: *Miscanthus* biochar, nutrient leaching, microbial biomass, soil fertility
Financial support: CNPq Project Number 404150/2013-6; FAPESP 2015/10108-9

(3680 - 1174) Does softwood biochar act as a long-term fertilizer in boreal conditions?

Subin Kalu[1]; Asko Simojoki[1]; Priit Tammeorg[1]
Department of Agricultural Sciences, Faculty of Agriculture and Forestry, University of Helsinki[1]

Biochar addition to soil has been recently identified as a potential way to enhance productivity and environmental sustainability of agriculture. Due to the high aromaticity that slows down the decomposition of biochar and makes it persist in soil for long periods of time, biochar is credited as the most promising C sequestration tool. In addition to the effects enhancing C sequestration and soil physical properties, it has been reported that biochar could also act as slow-release fertilizer especially for P and K. However, studies on the longer-term (i.e. more than five years) effects of biochar are scarce, and more so in colder climates where soils typically have high initial

SOM contents as compared with (sub-) tropical climates. Also, the possible interactions with fertilizer type (organic vs. mineral) with biochar need to be explored before the practice can be recommended in larger scale. This study provides information about the effects of biochar on the plant nutrient uptake in a boreal Umbrisol with loamy sand texture for 7 years (2011 – 2017). The field experiment was set up with a split-plot design with the biochar application rate (0, 5, 10, 20 and 30 tons DM ha^{-1}) as the main-plot factor and fertilizer treatment (unfertilized control, meat bone meal and inorganic fertilizer) as the sub-plot factor. Biochar was added only in the first year in 2011 while the plots were fertilized every year. Only the plots with no biochar (0 tons ha^{-1}) and highest biochar application rate (30 tons ha^{-1}) were considered for this presentation. The crop rotation under study was wheat-wheat-barley-grass-grass-oats-peas, annually plant samples were taken during full flowering growth stage. The plant samples taken for the determination of aboveground biomass (AGB) were later ground for analyzing macronutrients and micronutrients. C and N were analyzed using Variomax C N analyzer while other nutrients were analyzed using ICP-OES after dry ashing of plant samples at 500^{o}C and dissolving the ash in 0.2 M HCl. The plant nutrient uptake will be calculated by multiplying the AGB with the nutrient concentrations. The detailed results will be presented in the final presentation. In short, the effects of experimental treatments on measured properties will be tested with a mixed model function with biochar level, fertilizer type, and their interactions as fixed effects and replicate and its interaction as random effects.

Keywords: biochar, boreal, nutrients, plant nutrient uptake
Financial support: This study was financially supported by OLVI Foundation, August Johannes and Aino Tiura Agricultural Research Foundation, Niemi Foundation, HiLife and Three-year Research Project of University of Helsinki (through Kristiina Karhu).

(6093 - 2509) Effect of biochar and phosphorus application on soil pH and phosphorus availability in a clay and sandy loam soil

Rolivhuwa Mudau[1]; Jude J.O Odhiambo[1]
Department of Soil Science, University of Venda[1]

The application of biochar (BC) in agricultural soils has gained prominence in the last few years. However, BC, due to its highly alkaline nature has the effect of increasing the soil pH and thus affecting availability of nutrients such as phosphorus (P) especially in highly weathered acidic soils which also have a high potential for P fixation. The objective of this study therefore was to determine the effect of three levels of application (BC rate) of three biochars (BC type) derived from different feedstocks (eucalyptus, hay and poultry litter), and P application rates (P rate) on soil pH and available phosphorus in a clay and sandy loam soil. A 70-day pot experiment in a 3×3×2 factorial arrangement was conducted in a plastic tunnel. Three (3 Kg) of soil or soil +biochar mixture was weighed into plastic pots (25 cm diameter and 25 cm height) and allowed to equilibrate for 10 days. 100 kg N ha^{-1} was uniformly applied to all pots as Limestone Ammonium Nitrate (LAN). Two levels of P (0 and 70 Kg ha^{-1}) were applied as superphosphate. Three hybrid maize seeds (variety PAN 6479) were planted in each pot. Four days after emergence thinning was done to two plants per pot. Seventy (70) days after emergence, shoots were harvested and soil samples were taken and analysed for soil pH and available P. Data was analysed using the general linear model (GLM) procedure of IBM SPSS software version 25. Application of biochar regardless of the feedstock source increased soil pH and available P in both soils. Biochar application rate had a significant effect on soil pH of the sandy loam soil and available P in both clay and sandy loam soil. Phosphorus application rate did not have any effect on the soil pH and available P. A significant ($p<0.001$) BC type* BC rate and BC type* P rate interaction was observed for soil pH in sandy loam and available P in clay and sandy loam soils, while a significant BC rate* P rate interaction was only observed for available P in both soils ($p<0.001$ in clay soil and $p<0.05$ in sandy loam soil). A significant BC rate*BC type*Prate was observed for soil pH in sandy loam soil and available P in clay and sandy loam soils. In summary, biochar application increased soil pH and available P, and poultry manure derived biochar showed the greatest influence on soil pH and available P compared to the eucalyptus and hay derived biochars.

Keywords: pot experiment, biochar rate, feedstock, available phosphorus
Financial support: National Research Foundation (NRF) of South Africa Thuthuka grant UID 99201

(8284 - 648) Effect of different biochar treatments on maize growth and foliar nutrient status: the good, the bad and the ugly

Eduardo Guimarães Couto[1]; Heiriane Martins Sousa[1]; José Fernando Scaramuzza[1]; Alicia B. Speratti[2]; Mark S. Johnson[2]
UFMT[1]; UBC[2]

Biochar is the product of the thermal decomposition of different organic materials when heated in the absence of oxygen (pyrolysis) at elevated temperatures. It has the potential to improve soil chemical attributes and consequently plant nutrition, characteristics required in low fertility soils such as Arenosols. The objective of this work was to evaluate the effect of twelve biochars on the growth and nutrition of *Zea mays* in Arenosol. A greenhouse experiment was carried out using twelve biochars derived from four feedstocks: cotton husks (CH), swine manure (SM), eucalyptus sawmill residue (ER), sugarcane filtercake (SF) pyrolyzed at 400, 500 and 600°C and applied at 5% w/w. The effect on maize biomass and foliar nutrient status was evaluated along with its contribution to soil chemical properties, pH and electrical conductivity (EC). After six weeks, corn plants treated with ER and, in particular, SF biochar, showed the highest plant growth compared to control soil and with SM and CH biochars. However, application of SM and CH biochars was detrimental to plant growth and development and, in some cases, plant death was observed. This toxic effect could be due to the high levels of sodium and carbonates present in these biochars, which increased EC of soils to harmful levels. Despite this negative effect, we concluded that our biochars, especially the ones obtained at 400°C, showed nutrient incorporation potential, allowing better plant growth and nutrition. Additionally, decreasing the application rate of SM and CH biochars to < 5% (w/w) could avoid high salinity and, at the same time, reduce costs and contribute to improved plant growth and nutrition in Cerrado Arenosols.

Keywords: Pyrolysis; Plant Nutrition; Electric Conductivity.
Financial support: Natural Sciences and Engineering Research Council of Canada (NSERC), Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) and Fundação de Amparo à Pesquisa do Estado de Mato Grosso (FAPEMAT).

(7634 - 1144) Effect of the biochar and manure application on the soil carbon dioxide emission

Ginebra Aguilar, Milagros[1]; Muñoz Vargas, María Cristina[1]; Vergara San Martín, Marcela[1]; Zagal Venegas, Erick[1]
Universidad de Concepción[1]

Soil degradation is defined as the loss of productivity. The management of animal manure can be an alternative to modify soil fertility and induce changes in greenhouse gas emissions. Biochar application in agricultural soils is an ancestral practice. Biochar is chemically and biologically more stable than its original sources. At present, biochar is produced by the pyrolysis of natural organic materials under oxygen limited conditions. Biochar has gained international research attention, but few studies have investigated the potential of biochar from manure in mitigation of climate change in Chilean agriculture. The objective of this study was to compare

biochar and manure application effect on soil carbon dioxide emissions. Two Chilean soils (Ultic Palexeralfs (Alfisol) from Cauquenes, Maule region and Typic Rhodoxeralfs (Alfisol) from Collipulli Araucania Region) were incubated with two manure (cow and pig) and two biochar from cow and pig manure. Carbon dioxide emission was evaluated during 56 days. The emissions of carbon dioxide did not increase significantly with the application of biochar in any soil. While soil-manure treatment had seven times more emissions than the soil alone. No significant differences were found between soil-biochar-manure and soil-manure treatments. Carbon dioxide emissions were higher in the first ten days. Soil- biochar treatment emissions were stabilized at the end of the study and soil organic carbon increased. Conversion of animal manure to biochar and its application to the soil is a promising alternative to increase soil organic carbon without increasing carbon dioxide emissions.

Keywords: Soil amendment; carbon sequestration; greenhouse gases; climate change

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(2133 - 2468) Effects of Biochar on Retention of Nutrients in a Tropical Sandy Loam Soil

Shih-Hao Jien[1]

Department of Soil and Water Conservation, National Pingtung University of Science and Technology, Pingtung, Taiwan[1]

Leaching of nutrients and organic carbon due to rainfall in tropics/subtropics not only lead to soil degradation but also adversely affects the aquatic environment. The incorporation of biochar to soil has been known to increase sustainability through carbon sequestration and soil quality improvement. However, its effects on nutrient leaching as well as soil and dissolved organic carbon (DOC) varies from different biochar and soil types and should be further clarified. A short-term column leaching experiment of 42 days was conducted to assess the effects of biochar application on nutrient retention. Two wood saw-dust biochars, produced through slow pyrolization at 300°C (WB300) and 600°C (WB600), were incorporated into a sandy loam soil with application rates of 2% (w/w), approximately 40 tons ha^{-1} respectively. Flushing of leachate was done at days 4, 7, 14, 21, 28, 35 and 42. The results indicated that the application of biochar improved soil health and retained organic carbon in the soil. The treatment of 4% 600°C was the most effective in impeding soil acidification, from pH 4.5 in the control to pH 6.0. As comparison with the control, the leachate volume was reduced by 20%, reflecting the increase in water holding capacity. In treatment of WB300, the soil organic carbon (SOC) was retained by 61%, and the DOC in the leachate was reduced by 50%. Besides, the WB300 remarkably reduced the leaching of NH_4^+-N by 31% which was better than WB600 (decreased by 11%). Regarding NO_3^--N, the treatments of WB300 and WB600 could prevent it from leaching by 14% and 16% respectively, compared with the control. The leaching of Ava. P was reduced remarkably by the WB600 at 68% indicating different surface charge properties between WB300 and WB600. Based on analyses of cation exchange capacity (CEC), anion exchange capacity (AEC) and zeta potential of WB300 and WB600, the biochar might prefer to adsorb anions than caitons due to very high AEC of biochar surface. The AEC obviously increased with pyrolized temperature of the biochar, which was agreed with our leaching results. The results of this study strongly indicate that the incorporation of wood biochar (Honduran mahogany (*swietenia macrophylla*)) can improve soil quality by increasing the capacity of soil to retain nutrients in sandy loam soil of the tropic/subtropical region.

Keywords: Biochar; dissolved organic cabon; leaching; nutrient retention; tropical region

Financial support:

(6179 - 1725) Evaluation of soil fertility before and after two crops of black oats under fly ash application

Wilson Galli[1]; Jonas Guerra[1]; Jaqueline Gaio Spricigo[1]; Cristiane Pain[1]; Whelyton Eduardo Candido[1]; Matheus Antônio Arcego Filipim[1]; Mauricio Vicente Alves[2]

University of West of Santa Catarina[1]; Professor, University of West of Santa Catarina[2]

Soil can be considered as a nutritional mediator to the plants, being highly dependent on the planting management. The combination of studies involving new alternative fertilizers such as the use of fly ash and the changes in the dynamic of soil fertility over an agricultural crop is necessary. The objective of this research was to evaluate the soil fertility before and after the oat-soybean-oat crops, after the planting under different doses of forest biomass ash. The experiment was conducted at the experimental plant of Unoesc-Xanxerê / SC, from May 2016 to October, 2017. The soil of the experimental area is classified as Distrophic Red Latosol/Oxisoil, and the climate classified as Cfb. The experimental design was completely randomized with 7 treatments and 5 replicates. Three applications of ash was carried out, on the soil surface without incorporation, prior to the sowing of oats /soybean /oats (May 2016, October 2016 and May 2017, respectively). The ash dose in each application was 25 t ha^{-1}, randomized in the 35 plots (0, 50, 100, 150 and 200 % of the ash dose recommended according to the potassium content in the ash and the need of the crop). It was also studied organomineral and chemical fertilizer (according to Manual of liming and fertilization for the Brazilian states of RS and SC). The sowing densities of the first year and second year of oats were 60 kg ha-1, with a fertilization of 90 kg N ha-1 and 120 kg K ha-1 in both crops. The sowing of soybean was in no-tillage, under density of 360 thousand plants ha^1, and with chemical fertilization of 100 kg P ha^{-1} and 90 kg K ha^{-1}, reaching with the expectation yield of 4000 kg ha^{-1} grains. Soil samples were collected in December 2016, after soybean cultivation, and in October 2017, after the second oat cultivation. Soil samples (P, K, Ca, Mg, Al, CEC pH7, acidity (pH), SMP index, CEC effective, and V) were collected from each plot at 0-10 cm depth, according to the methodology described in Tedesco. It was observed that some nutrients (such as K, Ca and base saturation) decreased with the use of oats due to the ash application along the crops, while other nutrients did not suffer relative alteration (Al, CEC pH7, SMP index). Effective CEC, P, Mg and pH were altered with the use of oats with any dose of ash, increasing their values throughout the seasons, contributing to the improvement of soil chemical quality.

Keywords: *Avena strigosa Schreb.* Residue. Biomass ash

Financial support: Research and Extension Scholarships FUMDES-SC, FAPESC, Celulose Irani, Unoesc - Xanxerê.

(5280 - 845) Modelling of thermal properties of biochar amended soils

Boguslaw Usowicz[1]; Jerzy Lipiec[1]; Mateusz Lukowski[1]; Zbigniew Bis[2]; Wojciech Marczewski[3]; Jerzy Usowicz[4]; Agnieszka Latawiec[5]

Institute of Agrophysics, Polish Academy of Sciences, Lublin, Poland[1]; Department of Energy Engineering, Faculty of Environmental Engineering and Biotechnology, Czestochowa University of Technology, Poland[2]; Space Research Centre, Polish Academy of Sciences, Warsaw, Poland[3]; Torun Centre of Astronomy of the Nicolaus Copernicus University, Poland[4]; Institute of Agricultural Engineering and Informatics, Faculty of Production and Power Engineering, University of Agriculture in Krakow, Poland[5]

Recently, biochar is increasingly used as a soil amendment. This results in improved water retention, fertility and pH, and this is particularly desirable for sandy and acidic soils. Biochar in the soil also can change

the heat and water balance on the soil surface and the temperature and moisture distribution in the soil profile through changes in albedo and the thermal and hydraulic properties. However, the researchers have also found some unfavourable aspects of biochar effects on the physical and thermal properties of the soil and various processes therein. To evaluate the effect of biochar on the thermal properties of the soil we have used the statistical-physical model (Usowicz et al., 2016). We have evaluated the effects of wood-derived biochar (0, 10, 20, and 40 Mg ha^{-1}) incorporated to a depth of 0–15 cm on the thermal conductivity, heat capacity, thermal diffusivity and porosity in sandy soil under field conditions and in various soil-biochar mixtures in the laboratory. In addition, the measured thermal data and those from the literature are compared with the data obtained from the analytic model of Zhao et al. (2016) and the mentioned above statistical-physical model based on the data on the soil texture, bulk density, and content of water and biochar. It turned out that the addition of biochar into the soil causes a significant reduction in thermal conductivity and diffusivity. The studied soil without biochar shows the largest thermal conductivity and diffusivity that decreases in biochar amended plots and pure biochar. The reduction of both thermal properties is mostly due to decrease in particle density and bulk density. Dependence of the soil thermal conductivity and thermal diffusivity on water content is non-linear and the shape of the non-linearity largely depends on the biochar content and the bulk density of the soil. The slope factor of the thermal conductivity as a function of water content at a given density increases with the share of mineral fraction of the soil. Usowicz B., Lipiec J., Łukowski M., Marczewski W., Usowicz J., 2016. The effect of biochar application on thermal properties and albedo of loess soil under grassland and fallow. Soil and Tillage Research, Vol. 164, 45-51. Zhao, J., T. Ren, Q. Zhang, Z. Du, and Y. Wang. 2016. Effects of Biochar Amendment on Soil Thermal Properties in the North China Plain. Soil Sci. Soc. Am. J. 80:1157-1166.
Keywords: modelling thermal properties, soil, biochar, water content, bulk density
Financial support: Research financed by Polish National Centre for Research and Development in "Environment, agriculture and forestry" BIOSTRATEG R&D programme: Water in soil - satellite monitoring and improving the retention using biochar No. BIOSTRATEG3/345940/7/NCBR/2017

(9387 - 1076) Nitrogen Dynamic and Crop Production in an Ethiopian Nitosol Applied by Biochars and Anaerobic Digestion Effluents

Takuya Nakajima[1]; Shinjiro Sato[1]
Soka University[1]

Low soil pH, nutrient deficiencies, and low levels of fertilizer application constrain crop production in Ethiopia. Anaerobic digestion effluents (ADEs) are remaining liquid residuals after organic biomass are anaerobically digested. The ADEs can be used as liquid fertilizer due to abundant plant nutrients such as nitrogen (N). Furthermore, biochars, pyrolysed from organic waste and used as soil amendment, have abilities to retain plant nutrients when applied to the soil and increase crop production. Therefore, in this study, incubation and field experiments were conducted to examine the effect of application of ADEs and biochars on N dynamics and crop production in Ethiopia. A soil used in this study was a Nitosol. Fresh biochar (FB), clay-treated biochar (CB), and H_2O_2-treated biochar (HB) were derived from corncob for incubation experiment, and separately FB and CB were produced from coffee husk for field experiment. ADEs were derived from cow manure (ADE-B) and food waste (ADE-D). After incubation soil NH_4^+-N, NO_3^--N, and pH were analyzed, and after field experiment soil NH_4^+-N, NO_3^--N, and pH as well as plant dry weight were analyzed. After incubation period, NH_4^+-N with FB and CB were increased, but that with HB was decreased. More NH_4^+-N might be adsorbed strongly by HB due to the highest cation exchange capacity. NH_4^+-N adsorbed on biochars may be released to soil slowly over time. The plant dry weights with ADE-B applied were significantly higher than those with no-N applied. Therefore, it appears that ADE-B can substitute for chemical fertilizer for crop production in Ethiopia.
Keywords: biochar, anaerobic digestion effluents, Nitosol, Ethiopia
Financial support:

(6945 - 1695) Nutrient content in the dry mass of *Avena strigosa Schreb* grown under fly ash doses.

Augusto Henrique Debiasi Orsatto[1]; Jonas Guerra[2]; Whelyton Eduardo Candido[2]; Matheus Antonio Arcego Filipin[2]; Mauricio Vicente Alves[3]
University of West of Santa Catarina, 696 - Dirceu Giordani Street, Jardim Tarumã, Xanxerê/SC, Zip Code: 89820-000, Brazil (gut-cho@hotmail.com)[1]; University of West of Santa Catarina, 696 - Dirceu Giordani Street, Jardim Tarumã, Xanxerê/SC, Zip Code: 89820-000, Brazil.[2]; Professor, University of West of Santa Catarina, 696 - Dirceu Giordani Street, Jardim Tarumã, Xanxerê/SC, Zip Code: 89820-000, Brazil.[3]

Ashes of plant origin can present high levels of organic matter and carbon/nitrogen ratio above 30/1, which can interfere in the nitrogen cycle omitting its absorption and significantly reducing the content of this macronutrient, as well as other nutrients in the dry mass of plants. The objective of this study was to evaluate the nutrient content of nitrogen (N), phosphorus (P), potassium (K), calcium (Ca) and magnesium (Mg) in the dry mass of black oats (*Avena strigosa Schreb*) grown under different fly ash from boiler. The experiment was carried out at the experimental plant of Unoesc - Xanxerê / SC, from June to September, 2017. The soil in the experimental area is classified as Red Latosol Distrophic/Oxisoil, and the climate classified as Cfb. The experimental design was completely randomized with 7 treatments and 5 replicates. The ash was applied before black oats no-tillage at a dose of 25,000 kg ha^{-1}. The treatments carried out were: 0, 50, 100, 150 and 200 % of the recommended ash dose according to the K present in the ash and required by the culture. Besides it was included a treatment with chemical fertilization (CF), and a treatment with organomineral fertilization (OM), according to the Manual of Liming and Fertilization for RS and SC Brazilian states (2016). The plots measure $15m^2$. At the full flowering stage, $1m^2$ was collected each plot, dried in the greenhouse at 55 degrees for 72 hours and milled to 2 mm sieve. The method of tissue nutrient analysis was done according by Tedesco (1995). Data were submitted to analysis of variance using F test, with 95% confidence using the R Core Team program. For Ca, Mg, P and N macronutrients, the best results were obtained with CF (4.30 g/kg, 3.49 g/kg, 4.85 g/kg and 23.31 g/kg, respectively). For K a better performance was obtained with OM fertilization (52.16 g/kg). The highest levels of Ca and Mg were obtained from OM fertilization (3.20 g/kg and 3.14 g/kg). Regarding P and N, the worst results were with the dose of 100% ash (4.14 g/kg and 14.30 g/kg, respectively), whereas K had its lowest content with 50% ash dose (44, 08 g/kg). Although the values found varied, the results did not show a significant difference in N, P, K, Ca and Mg content in the dry mass of black oats when using different doses of ash on the surface before sowing.
Keywords: Oat, residue, macronutrients, ratio.
Financial support: FAPESC, FUMDES-SC Research and Extension Scholarships, Celulose Irani S.A, Unoesc - Xanxerê.

(6859 - 1884) Nutrient content in the grain of *Avena strigosa Schreb* grown under fly ash doses

Juliano Marcarini Bordin[1]; Whelyton Eduardo Candido[1]; Jonas Guerra[1]; Cristiane Pain[1]; Cleberson Tiago de Souza[1]; Mauricio

Vicente Alves[2]

University of West of Santa Catarina[1]; Professor, University of West of Santa Catarina[2]

Black oats are used as a soil cover crop, grazing in the off season, and in the case of grains, in the formulation of concentrate feeds. The quality of ingested food is directly associated to the cationic balance of nutrients in the plant and soil and can be affected by excessive doses of chemical or organic fertilizers and the use of ash. This study aimed to evaluate nutrient (nitrogen, phosphorus, potassium, calcium, and magnesium) content in black oat grains grown under different doses of fly ash, from the burning of forest biomass. The experiment was carried out at the experimental plant of Unoesc Xanxerê /SC, from May to September, 2017. The soil in the experimental area is classified as Dystrophic Red Latosol/Oxisoil, and the climate is classified as Cfb. The experimental design was completely randomized with 7 treatments and 5 replicates. The ash was applied on the soil surface at 25 t ha^{-1}, before sowing in no-tillage oats, and after a soybean crop. The treatments were 0, 50, 100, 150, and 200 % of the recommended ash dose besides one treatment with mineral fertilization according to the Liming and Fertilization Manual for the RS and SC Brazilian states (2016). The plots measure $15m^2$. After physiological maturation, 1 square meter of oats were sampled from each plot and the grains were separated by a mobile thresh machine. The samples were dried in the greenhouse at 55 degrees Celsius for 72 hours, and milled with bark and sieved to 2 mm. Afterwards the nutrients N, P, K, Ca and Mg were analyzed according to Tedesco (1995). The data were submitted to analysis of variance and to the F test, with 95% confidence using the R Core Team program. The results obtained showed that N, P, K, Ca and Mg levels in the black oat grains did not differ statistically within the different doses of ash applied on the soil surface.

Keywords: Black oat, residue, macronutrients

Financial support: FAPESC, FUMDES-SC Research and Extension Scholarships, Celulose Irani S.A, Unoesc – Xanxerê

(2640 - 1090) Potential use of poultry litter derived hydrochar as soil amendment

Vlvian Mau[1]; Gilboa Arye[2]; Amit Gross[1]

Department of Environmental Hydrology and Microbiology, Zuckerberg Institute for Water Research, Ben Gurion University of the Negev[1]; French Associates Institute for Agriculture and Biotechnology of Drylands, Jacob Blaustein Institutes for Desert Research, Ben Gurion University of the Negev[2]

Hydrothermal carbonization (HTC) is a new technology that efficiently converts wet organic matter into a carbon-concentrated hydrochar, aqueous and gaseous phases. Differently from biochar, water is essential in the carbonization process which occurs at much lower temperatures than biochar with significantly smaller energy demand. HTC takes place under a typical temperature range of 180-250 °C, autogenous pressures, and reaction times varying from minutes to several hours. Like biochar, hydrochar is being considered as a potential soil amendment, however only a handful of reports have studied it. This study had the objective to characterize hydrochar produced from poultry litter in terms of its nutrient content, ion composition, hydrophobicity and surface free energy properties. Hydrochar was produced at temperatures of 180 °C, 220 °C and 250 °C, and reaction times of 5, 30 and 60 min. Nutrients and ions were analyzed by elemental analysis and inductively coupled plasma following standard methods. Hydrophobicity was assessed through the sessile drop and Wilhelmy plate methods. Surface free energy was calculated with contact angles formed between the samples and water, ethylene glycol, formamide and glycerol using the models OWRK and Wu. The resulting hydrochars had an acidic pH and contained significant nutrient concentrations that can potentially enhance plant growth. N and P concentrations were of 3%, while K concentration was much lower, around 0.1%. Considering other nutrient elements, 0.8% Mg was present, and Mn, Na, Fe, Zn were each present at 0.1%. It was also found that as treatment temperature increased hydrochar became increasingly more hydrophobic as evident by the contact angle that was less than 20° for the raw manure to 135° after carbonization at 250 °C. These changes were correlated with fiber composition. HTC lead to the degradation of hemicellulose at 180 °C, and cellulose at 250 °C. Hydrochar produced at 250 °C was composed mainly of lignin, and displayed high hydrophobicity over prolonged wetting period and repeated wetting cycles. As a result, the surface free energy decreased from 26 MJ/m^2 in the poultry litter to 8 MJ/m^2 after treatment at 250 °C for 60 min. Increasing hydrophobicity can enhance water holding capacity of soils and can positively affect irrigation efficiency, specifically in more porous soils such as sand. It is postulated that hydrochar can enhance soil fertility and properties thus improving soil productivity.

Keywords: Hydrochar, soil amendment, hydrophobicity, poultry litter

Financial support: Israeli Ministry of Environmental Protection, the Israeli Ministry of National Infrastructures, Energy and Water Resources, the Israeli Ministry of Science and Technology, the Rosenzweig–Coopersmith Foundation

(1480 - 2110) Poultry Litter Biochar as an Alternative to Inorganic Phosphorus Fertilizer in a Year-Round Cropping System

Andressa M Freitas[1]; Vimala D Nair[1]; Lynn E Sollenberger[1]; Willie G Harris[1]

University of Florida[1]

Use of biochar as a fertilizer has gained prominence recently as an alternative to inorganic phosphorus (P), supplies of which are dwindling. Biochar prepared from different feedstocks behaves differently with respect to P retention and release. We evaluated P release from biochars from different feedstocks, including mixed hardwoods, poultry litter and biosolids, using solid state and solution procedures. Poultry litter biochar (PLB) had a very high P concentration, with P in the form of a sparingly soluble calcium phosphate mineral. Therefore, PLB is expected to provide P to plants on a long-term basis while simultaneously reducing nutrient leaching relative to the more soluble commercial fertilizer. In a separate field study, we evaluated the effects of P sources including PLB, inorganic P fertilizer providing the same amount of P as PLB, and a no P control. Treatments were arranged in six replicates of a randomized complete block design at two locations differing in soil type (Entisols vs. Spodosols). At each location, the annual cropping system consisted of sequential plantings of rye, corn, and sorghum. Crop yield and N and P in plant tissue were measured for each component of the cropping system, and soil P storage capacity (SPSC, a measure of the amount of P a soil can hold prior to releasing P) was determined after each crop was harvested. There was no negative impact of PLB application on P and N in the plant tissue after the first three cropping cycles. Preliminary results also suggest that SPSC was similar at a given site with PLB or inorganic fertilizer applications. Evaluation of treatments over a longer time scale is needed; the hypothesis is that PLB will result in greater soil P accumulation and lesser loss of P compared with inorganic P fertilizer.

Keywords: Crop yield, Feedstock, Soil Phosphorus Storage Capacity, Tissue nitrogen

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(8429 - 1654) Sewage sludge biochar alters the microbiota involved in soil phosphorus cycling

Cícero Célio de Figueiredo[1]; Walda Monteiro Farias[2]; Thais Rodrigues

Coser[2]; Alessandra Monteiro de Paula[3]; Jhon Kenedy Moura Chagas[3]; Thamires Dutra Pinheiro[3]; Thais França Silva[3]
1University of Brasilia, Campus Universitário Darcy Ribeiro, ICC Centro, Faculdade de Agronomia e Medicina Veterinária, Brasilia, 70910970, Brazil (cicerocf@unb.br)[1]; 1University of Brasilia, Campus Universitário Darcy Ribeiro, ICC Centro, Faculdade de Agronomia e Medicina Veterinária, Brasilia, 70910970, Brazil[2]; University of Brasilia, Campus Universitário Darcy Ribeiro, ICC Centro, Faculdade de Agronomia e Medicina Veterinária, Brasilia, 70910970, Brazil[3]

Sewage sludge biochars (SSB) have shown great potential to improve soil quality and increase the availability of soil nutrients and crop productivity. However, there is still a lack of information on the effect of phosphorus (P) content from SSB on the soil microbiota, especially on arbuscular mycorrhizal fungi under field conditions. In the current study, the effects of the application SSB (produced under different pyrolysis temperatures) and their combination with mineral fertilization into an Oxisol cultivated with corn on soil P cycling microbial community were investigated. Six treatments were arranged in randomized blocks, with four replicates: 1) Control - without biochar; 2) Mineral fertilization with NPK; 3) Biochar 300 °C; 4) Biochar 500 ° C; 5) Biochar 300 ° C + NPK; 6) Biochar 500 ° C + NPK. 15 Mg ha^{-1} of SSB and mineral fertilizer (formula 4-14-8) were applied in two consecutives 2014/2015 and 2015/2016 seasons. The carbon contents of microbial biomass (MBC), percentage of mycorrhizal colonization and the levels of easily extractable glomalin (EEG) were evaluated. The application of SSB elevated MBC and the colonization of corn roots by arbuscular mycorrhizal fungi (AMF). As a consequence, SSB stimulated the synthesis and excretion of EEG. The high levels of P provided by the SSB applied together with NPK may limit mycorrhizal colonization, without, however, reducing the uptake of P by maize.
Keywords: biosolid, arbuscular mycorrhizal fungi, soil microbial biomass.
Financial support: Fundação de Amparo à Pesquisa do Distrito Federal (FAPDF). Project number: 0193.001548/2017

(8865 - 1932) Soil Water Retention and Plant Available Water in a Mexican Clayey Soil Applied with Designer Biochars Treated with Peroxide and Montmorillonite

Marcelo Takeda Ono[1]; Shinjiro Sato[1]
Soka University[1]

The world water consumption for agricultural purposes is estimated to account for approximately 70% of the world's fresh water volume. The demand for food has been increasing which leads to additional withdrawal of fresh water. Biochar is a carbon-rich material pyrolyzed by biomass with limited oxygen, and has been designed to possess specific properties enhancing important parameters such as water retention capacity. This study evaluated effects of soil application of biochars derived from "*Agave tequiliana*" treated with hydrogen peroxide and clay (montmorillonite) (including no treatment – fresh biochar) on soil water retention plant available water. Two pyrolysis temperatures of 400^{o}C and 800^{o}C were employed. Applications rates of biochar were 0 (control) and 3% (w/w). After biochar addition, the mixtures were incubated at 30^{o}C during 21 and 91 d and periodically wetted to keep the moisture at 40% of water filled pore space. Soil water retention curves using pressure plate apparatus were developed for the soil-biochar mixtures. Soils applied with clay- and fresh biochars at 400^{o}C increased water contents at saturation (pF 0) due to increased porosity, but showed sharp decreases from saturation to field capacity (FC) in soil water retention curve comparing to other biochar treatments. In general, 400^{o}C biochars presented greater plant available water contents than 800^{o}C biochars. Peroxide-biochars with both temperatures increased water contents at permanent wilting point (pF 4.2), which consequently decreased plant available water. Application of any types of biochars did not increase plant available water when incubated for 21 d compared to control. However, only clay- and fresh biochars at 400^{o}C improved soil water content at FC and plant available water when incubated for 91 d compared to control. Samples incubated for the longer period were more efficient to improve plant available water because soil-biochar mixtures became more compacted over time increasing cohesion forces among clay particles, biochars, and water molecules. Moreover, montmorillonite contributed to increase clay content in the mixture. The results of this study demonstrated that biochars should be used strategically to aim for improvement in soil water management.
Keywords: biochar, plant available water, field capacity, water retention curve, clay.
Financial support: Soka Universty - Tokyo – Japan

(4972 - 472) Spatial correlation of chemical attributes of soil in black earth area of archaeologicals in the south of Amazon

Sabrina Isabela da Silva Fernandes[1]; Elilson Gomes de Brito Filho[1]; Milton César Costa Campos[1]; Fernando Gomes de Souza[1]; Juliana Malta de Assis[1]; Maria Clécia Gomes Sales[1]; Luana Celestino Calista[1]; Ludimila Souza de Oliveira[1]; Wildson Benedito Mendes Brito[1]; Estefani de Souza Oliveira[1]
Federal University of Amazonas[1]

The soils of Amazonas are considered as few fertile soils, presenting low values of cation exchange capacity and high levels of aluminum, a differential of these soils are Black Archaeological Land spots (TPAs), they are soils of a fertility well above the great majority of the typical soils of the Amazon region. In this sense, the aim of this study was to evaluate the spatial distribution of soil chemical attributes in an area of black archeological soil under cocoa cultivation in Apuí Municipality (AM). The study area is located in the municipality of Apuí, Amazonas, Brazil, located along the Transamazon Highway (BR-230), under the geographic coordinates of 7º12'05 "S and 59º39'37" W. a 42 x 88 m mesh, with regular spacing of 6 x 8 m, totaling 88 points, and then deformed soil samples were collected at depths of 0.0-0.05; 0.05-0.10; (PH, CO, Est C, (H + Al), P, K, Ca, H 2 O, Mg, SB, CTC and V%). Data were analyzed using descriptive and geostatistical statistics techniques. By the descriptive statistics the Ca2 + and Mg2 + contents were higher in the superficial layer of 0.0-0.05 and 0.05-0.10 m, where, in general, the TPAs exhibit high levels of nutrients, mainly Ca and P , from the remains of human bones and animals, in addition to the formation of complex organic matter-calcium of high stability. The basal saturation revealed high values in all the layers evaluated, the levels of available phosphorus were high in the anthropogenic horizons, with a tendency to increase in depth, varying from 93.7 to 124.34 mg dm-3, the CTC tended to decrease in depth, in relation to the normality test KS all attributes were significant at 5% probability. In relation to Geostatistics, the models that best fit were the exponential and the spherical, the coefficients of determination above 0.70, by the classification of Cambardella et al. (1994), the attributes remained in a strong and moderate degree of dependence, reaching between 12 and 60m. Thus, geostatistics provided adequate information to understand the spatial distribution of chemical attributes in the area of Cocoa and in depth (0.00-0.05m) all variables studied had strong spatial dependence, except for Est C and TOC that did not present dependence.
Keywords: TPA; Geostatistics; South of Amazonas
Financial support: Foundation for Research Support in Amazonas (FAPEAM), National Council for Scientific and Technological Development (CNPq)

(2661 - 2400) The effect of biochar in Atlantic Forest Seedlings: environmental and socio-economic analysis

Aline Rodrigues[1]; Agnieszka Latawiec[2]; Etelvino Novotny[3]
International Institute for Sustainability/ Rio Conservation and Sustainability Science Centre[1]; International Institute for Sustainability/ Rio Conservation and Sustainability Science Centre/ Faculty of Production and Power Engineering, University of Agriculture in Kraków/ University of East Anglia, School of Environmental Science[2]; Embrapa Soil[3]

The Atlantic Forest used to cover vast areas of longitudinal stretch of the Eastern coast of Brazil but it suffered serious deforestation. Despite having lost approximately 90% of its vegetation it still provides habitat to thousands of endemic species and contributes to provision of crucial ecosystem services to Brazilian population. Over the last years, restoration has been promoted to recover habitat and ecosystem services in this fragile environment. One of the bottlenecks of restoration is seedlings production due to high costs and low survival of the seedlings in the field. This study assessed the effect of biochar on Atlantic Forest seedlings used in ecological restoration. Biochar is obtained from residue pyrolysis, which can be applied on soil to improve its chemical and physical properties. In this study biochar was produced from *Gliricidia sepium*. The seedlings species used in the experiment were: *Schinus terebinthifolius*, *Cariniana legalis*, *Senna multijuga* and *Trema micrantha* (30 replicates each). The treatments were: control, 20% of biochar, 40% of biochar and limestone. The species' germination, height and stem diameter were measured monthly. Focus groups with tree-nursery owners' and interviews with stakeholders and cost-benefit analyses of the substrate were also carried out. The treatments with biochar were the most efficient in the germination of *Senna multijuga* and *Trema micrantha*. For *Schinus terebinthifolius*, *Senna multijuga* and *Trema micrantha* the use of biochar in their substrates showed the best cost-benefit. Using biochar as alternative in substrates compounds attracted the interest of the vast majority of the seedlings' producers. We conclude that biochar can be used to improve the performance of the seedlings tested here and decrease the cost associated with the production, substituting part of the substrates used in nurseries.
Keywords: Forest Restoration; Atlantic Forest; Nursuries; Substrates.
Financial support: Norwegian Agency for Development Cooperation – NORAD

(5182 - 1645) The effect of using waste water treatment residual from pulp and paper industry on soil pH

Cristiane Pain[1]; Gabriela Naibo[1]; Jaqueline Gaio Spricigo[1]; Jonas Guerra[1]; Whelynton Candido[1]; Everton Skoronski[2]; Mauricio Vicente Alves[3]
University of West of Santa Catarina, 696 - Dirceu Giordani Street, Jardim Tarumã, Xanxerê/SC, Zip Code: 89820-000, Brazil[1]; Professor, Environmental Engineering Departament, State University of Santa Catarina, Av. Luis de Camões 2090, Zip Code: 88520-000, Lages/SC, Brazil[2]; Professor, University of West of Santa Catarina, 696 - Dirceu Giordani Street, Jardim Tarumã, Xanxerê/SC, Zip Code: 89820-000; Brazil[3]

In the current stage of society development, concerns about the correct destination of residues from the pulp and paper industries, instigate the research to know the effects of the application of this waste in the agricultural soils.The residues applications on the soil can a number of changes in their physical and cheminal properties and consequently affect agricultural production. This study aimed to evaluate the pH of the soil under different doses of waste water treatment residual (WWTR) from a pulp and paper industry, since this residue is abundant in our region. The experiment was carried out at Unoesc, Campus of Xanxerê/SC. The soil was incubated in plastic bags, with 2 kg of soil, one characterized as Dystrophic Red Latosol/Oxisoil (EMBRAPA 2013), and another one from a Latosol B horizon. The chemical characteristics of the used soil in the experiment were: P = 0.55 mg dm^{-3}; K = 36.1 mg dm^{-3}; Al = 1.7 Cmolc dm^{-3}; H + Al = 8.3 Cmolc dm^{-3}; Ca = 1.73 Cmolc dm^{-3}; Mg = 0.78 Cmolc dm^{-3}; SOM = 2.24%; pH = 5.43; pH SMP = 5.44; CEC = 10.9 Cmolc dm^{-3}; Base Saturation = 23.87%; Clay = 61%, evaluated by the methodology described in Tedesco et al. (1995). The experimental design was completely randomized with seven replications. The treatments consisted of different doses of WWTR: Control (only soil), 10 t ha^{-1}, 20 t ha^{-1}, 40 t ha^{-1}, 80 t ha^{-1}, 160 t ha^{-1}, 320 t ha^{-1} and 640 t ha^{-1} of WWTR, calculated on a volume/volume basis (sludge with 23% moisture). Soil samplings for pH determination in water were performed each every 15 days after mixing and incubation, with the total experiment time of 120 days. After each sampling,50 ml of distilled water was added to maintain ideal soil moisture. It was observed that the pH value of the initial soil was 5.43 and an increasing was observed during the experiment, independent of the used WWTR dose. The highest pH value was found at 640 t ha^{-1} of sludge for all collection times. When comparing within the doses, the highest pH value found was 7.47 at time 8, in the treatment of 640 t ha^{-1}. It was observed that there was a tendency for pH stabilization over time and there was a significant increasing on soil pH when increasing the applied waste water treatment residual dose.
Keywords: Cellulose fiber, besidue, acidity scale.
Financial support: Celulose Irani S.A, Unoesc- Xanxerê

(5802 - 1832) Using Phosphorus Rich Biochar to Immobilise Pb in an Urban Contaminated Soil

Pacian Netherway[1]; Suzie Reichman[1]; Mark Laidlaw[1]; Jorge Paz-Ferreiro[1]
RMIT University[1]

There is no safe level of blood lead (Pb), nor is it known to serve any beneficial purpose in any process within the human body. The ingestion of Pb contaminated soils is a significant contributor to blood Pb levels; particularly in children. In soil, Pb can be present in many different mineral forms; some being more soluble than others. Once ingested, Pb travels down in to the stomach; an acidic environment with pH as low as 1.5 units. Generally, the solubility of Pb increases as pH decreases and so the stomach acts to extract Pb from the solid soil matrix, placing it in solution. This amount of Pb extracted is termed the bioaccessible fraction, which continues down to the small intestine where it can cross the intestinal epithelium and enter the blood stream. Pb phosphate minerals are the most insoluble form of Pb across a wide pH range, including in the stomach environment. As such, phosphorus can be added to Pb contaminated soil to facilitate the precipitation of Pb phosphates with the aim of decreasing the bioaccessible fraction. Biochar is the engineered product of heating biomass in an oxygen free environment (pyrolysis). The pyrolysis of feedstocks including poultry litter and biosolids produces high-ash biochar, possessing more available phosphorus than in the feedstock. In this study, these biochars were tested as a means to reduce in vitro soil Pb bioaccessibility. Our results found biochars to be comparable with phosphates for lead immobilization.
Keywords: Lead, biochar, phosphorus
Financial support:

C3.3.12 - Sustainable land management in rural basins belonging to the south cone of Latin America

(7943 - 2439) Can we intensify rice-pastures rotations in Uruguay? Midterm impacts on soil organic matter.

Ignacio Macedo[1]; Virginia Pravia[1]; José Terra[1]

Instituto Nacional de Investigación Agropecuaria[1]

Soil organic carbon (SOC) is an important soil quality indicator. Rice-pastures rotations in Uruguay are unique sustainable production systems, challenged in the last decade by an increasing interest of production intensification. We evaluated soil use intensity impacts in a field-scale rice rotation systems experiment (33° 16' 23'' S; 54° 10' 24'' W; 22 MASL). Treatments were established in 2012 in a 34 yr rice-pasture rotation field (Natraquoll), including: 1) rice monoculture (RM, 1 yr), with *Trifolium alexandrinum* (TA) in winter; 2) rice-soybean (RSy, 2yr) with *Lolium multiflorum* (LM) and TA in winter; 3) rice-row crops (RC, 4 yr): rice-soybean-rice-sorghum with the same cover crops as RSy in winter; 4) rice-soybean-short pasture (RSySP, 6 yr) rice-soybean-soybean-rice with TA and LM during winter followed by 2.5 yr of a perennial pasture of *Festulolim sp.* and *Lotus corniculatus*; 5) rice-short pasture (RSP, 2 yr) rice rotating with a biannual pasture (1.5 yr) of LM and *Trifolium pratense*; 6) rice-long pasture (RLP, 5 yr) rice-rice followed by 3.5 yr of a perennial pasture of *Festuca arundinacea*, *Trifolium repens and Lotus corniculatus*. All rotations phases were present in time and replicated in space. Total SOC (TSOC), total nitrogen (TN) and particulate SOC and nitrogen (C-POM and N-POM; respectively, 53-2000 µm) (0-15 cm depth) were used to evaluate soil quality. After five years, no differences were found between rotations in TSOC and TN (29.3 Mg C ha^{-1} and 3.16 Mg N ha^{-1}). No differences were found in C-POM and N-POM when RLP was compared with RSP or RSySP. However, RLP had respectively 18% and 19% greater C-POM and N-POM content than cropping rotations (RSy and RC) (6.06 Mg C ha^{-1} and 0.48 Mg N ha^{-1}), representing around 23.6% and 20% of TSOC for RLP and RC-RS, respectively. The aggregate of data suggests that, for soils under rice-pasture rotations in temperate climates, there are possible pathways for intensification without losing SOC in the midterm. However, the absence of perennial pastures in the rotation can make SOC more vulnerable to loses.

Keywords: Sustainability; soil health; sustainable intensification.
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(8880 - 2436) Carbon stocks in Caatinga forest soils under cutting management in a chronosequence

Renisson Nepomuceno de Araújo Filho[1]; Maria Betânia Galvão dos Santos Freire[1]; Fernando José Freire[1]; Rinaldo Luiz Caraciolo Ferreira[1]; Flávio Adriano Marques[2]; Bradford Paul Wilcox[3]; Jason Brossard West[3]
UFRPE[1]; EMBRAPA[2]; Texas A & M[3]

Storage of carbon (C) in soils contributes to C sequestration from atmosphere and has to be improved to achieve sustainability. In tropical humid forests the cutting management of vegetation may be applied at short time intervals because the vegetation grows quickly and promotes the constant uptake of C and its contribution to soil C. However, in dry forests as Caatinga, successive cuttings may change all the dynamics of the C in the soil-plant system. So this study aimed to investigate C stocks and microbial activity in soils under dry forest in Brazil submitted to cutting at different times in a chronosequence. Seven sites representing a chronosequence of forest cuttings: 0.5 year (6 months), 6, 9, 12, 25, 50 years, and undisturbed area (at least 80 years). Soil samples were collected at three depths (0–5, 5–10 and 10–20 cm). And were analyzed in: total organic carbon (TOC) concentration and stock, C in humic substances (FA, HA, HUM), labile-C, and microbial biomass-C. Microbiological activity was evaluated by: basal respiration, microbial quotient, and metabolic quotient, determined for the two shallow layers. C stocks and microbiological activity were changed by forest cuttings, promoting significant C losses related with the management time, especially in the shortest intervals. The return of C levels after cuttings spends long time periods. The recovery of C in soil on these sites is slow, requiring long time periods following disturbance. Maintenance of vegetation for long periods in Caatinga can return C storage to levels close to native areas. We estimate that TOC and C in humic fractions had recovered to only about 32% of the presumed maximum found for the 80-year site 20 years after cutting. At least 33 years between successive cuttings are necessary to recovery 50% of soil C in general. We concluded that forest management in Caatinga dry forests should restrict cuttings campaigns at time intervals longer than 30 years to rebuilt C stocks in soils, very important issue in the context of mitigating climate change on a global scale.

Keywords: Dry forests Organic matter Soil degradation
Financial support: CAPES, CNPq

(5561 - 571) Chemical attributes of the soil in the passover / poultry / forest transition on the transamazonic road in the south of the Amazonas

Elilson Gomes de Brito Filho[1]; Alicia Rebeca de Souza Santos[2]; Elyenayra Nogueira Pinheiro[1]; Edivânia de Oliveira Santana[3]; Lucivania Izidoro da Silva[1]; Wildson Benedito Mendes Brito[1]
Universidade Federal do Amazonas[1]; Universidade Federal Rural da Amazônia[2]; Instituto Federal de educação, ciências e tecnologia do estado do ACRE[3]

Along the Transamazonian Highway that finishes in Lábrea a municipality of the South of the Amazon, are found several pasture areas that were once native forest , in Brazil it is estimated that the pasture area is 158,753,865 ha, of these 26,524. 174 ha are located in the North of which 806,300 ha in the State of Amazonas . The conversion of these forest areas into pasture areas ends up exposing the soil to changes, and its attributes are modified according to their use. The objective of this work was to verify the behavior of soil chemical attributes in this pasture / capoeira / forest transition. The study area is located on the Transamazon Highway at 11.5 Km from the center of the municipality of Lábrea in the south of the Amazon, the classification according to Köppen is of type Am. The material was collected in three areas, dirty pasture with predominance of Brachiaria spp. , Capoeira, and native forest, where samples were collected through two depths (0.00-0.10 and 0.10-0.20 m), where from the collected samples, these were used to dry the shade , where fine dry air (TFSA) was obtained after sieving and from this material followed the chemical analyzes (pH in water, phosphorus, potassium, calcium, magnesium, aluminum and organic carbon), and afterwards with the results of the analyzes followed for discussion through the averages obtained by each attribute. In relation to the pH values, this decreased in the transition, ie, it had the highest value in the pasture area (4.48) and the lowest in the forest area (3.83) . As for the values of potential acidity (H + Al), this had high values with the highest values in the forest area , calcium decreased during transition and potassium had no difference between areas. In relation to the organic carbon levels, this was higher in the pasture due to the organic matter already formed and stable and the second larger was the area of forest where it is justified with greater deposit of organic material, but not yet stable, what influence in the values of acidity, aluminum and consequently in low CTC (cation exchange capacity). As aconclusion we have that from the transition it is observed that the attributes change through their use, and that the conversion of the forest area into the pasture area is beneficial for the increase of the chemical attributes in the soil

Keywords: Transamazone soils, Chemical attributes, Transition.
Financial support: Fund for Research Support in the State of Amazonas (FAPEAM)

(1305 - 3020) Comparative hydrology in paired watersheds with

different soil uses in Southern Brazil

Mayara Torres Mendonça[1]; Décio Oscar Cardoso Ferreto[1]; José Miguel Reichert[1]; Miriam Fernanda Rodrigues[1]; Mirian Valente[1]; Karina Wegermann[1]; Thaynara Diuliane Paz[1]; Rosane Barbosa Lopes Cavalcante[1]

Universidade Federal de Santa Maria[1]

Eucalyptus cropping for commercial purposes in southern Brazil has intensified in the least years. However, there is much divergence in the scientific community regarding the possible impacts of this practice on hydrological processes. Therefore, the objective of this study was to evaluate the influence of different soil uses on hydrological processes in two paired watersheds. We describe the water balance components (rainfall – P, interception – INT, streamflow – Q, actual evapotranspiration – ETa, groundwater recharge – G, and soil water storage – S) in a forest watershed (FW; 0,83 km²) with *Eucalyptus saligna* (10 year-old) and another watershed occupied with degraded grassland (GW; 1.10 km²) used for livestock production. The study was conducted from January to September 2017. The input parameters (P quantified by means of pluviometers and pluviograph) and output (INT, soil water percolation and Q, quantified by means of pluviometers, drainage channels and limnigraphs, respectively; and ETa water of the watershed. The ETa was obtained from the difference between the P and the other output variables. The total P occurring in the first, second, and third quarters of 2017 was 638, 559, 564 mm for FW and 535, 554 and 552 mm for GW, respectively. The output variables presented differences for the trimester and watershed studied. The P in the third trimester of 2017 was 563.9 and 552.3 mm for FW and GW respectively, however, the Q in this period was 60.7% higher in GW, which evidences the regularization of Q in periods of greater precipitation. The main water outlet in the FW was by ETa (1262 mm), which represented 71.6% of the P, of this total 38.4% was lost by INT. In the GW, the main water outlet was ETa (729 mm), which represented 44.4% of P. The Q in the first and third trimester of 2017 was 57.3% and 60.7% higher in GW compared to FW, respectively. S in FW was 392.9 mm, 22.3% of P, while G was higher in GW 530.4 mm, 32.3% of P. The different vegetation cover of the soil interfered in the hydrological dynamics of the watershed studied. The watershed with the main use with eucalyptus presented greater losses of water by ETa, being influenced by the greater water loss by plant interception, which contributed to a reduction of the streamflow of this watershed in relation to the watershed with degraded grassland.

Keywords: Water balance; evapotranspiration; interception.

nancial support: CMPC Celulose Riograndense, FAPERGS, CNPq, CAPES.

(3585 - 2374) Delineating homogeneous management zones according soil fertility – Case study in a watershed in São Paulo, Brazil

Rafael Lacerda Cobra[1]; Mara de Andrade Marinho[1]

UNICAMP/FEAGRI[1]

By starting from the knowledge of the spatial variability of soil properties, the delineation of homogeneous zones of soil management (HZM) is a valuable approach to site-specific soil management. The objective of this work was to develop a procedure for delineating HZM with emphasis on soil fertility. The study was carried out in the Ceveiro watershed (Piracicaba, SP, Brazil). To generate the homogeneous zones according to soil fertility we made use of data from 234 sites distributed along the watershed. The conditioning factors of the soil fertility were the following: soil texture, organic matter content (MOS); potassium content (K^{+}); hydrogen content (H^{+}); exchangeable aluminum content (Al^{+3}); Calcium content (Ca^{+2}); magnesium content (Mg^{+2}); cation exchange capacity (CEC), base saturation (V%) and aluminum saturation (m%). Steps of the methodology included the modeling of the continuous in-depth variation of the soil attributes (up to 100 cm) by using the *spline of equal area* function, the estimation of average values to the depth of 0-40cm for each conditioning factor, and the interpolation of data in GIS environment to generate the maps of each conditioning factor. Each map was reclassified in five classes according to degrees of limitation for soil fertility: null, slight, moderate, strong and very strong. The maps of degrees of limitation were successively combined by addition to obtain the weighted cumulative indexes (WCI). At the end of the process, the value (total sum) of each polygon represented the WCI of that area. Finally, this map was reclassified according levels of the WCI (Lal, 1999) to distinguish the different homogenous zones of management according their deficiency in soil fertility. The final classification is homogeneous zones of very low, low, moderate, high, and very high deficiency of fertility. Results showed that in majority of the area (77%) the degree of deficiency by fertility is moderate. In this case, the soils are medium textured, the *solum* depth varies between 0.5 to 1.0 m, organic matter content varies between 10-20 g kg^{-1}, CEC > 5.0 $cmol_c\ kg^{-1}$, V% > 80%, Al^{+3} < 1 $cmol_c\ kg^{-1}$ and m% < 20%. However, in 18% of the area, the degree of deficiency is strong. We conclude that the methodological approach was efficient to delineate the HZM and segregate areas according to their degrees of soil fertility deficiency. The delineation of homogenous zones is a promisor tool to orient decisions on land use and management.

Keywords: Pedometrics, digital soil mapping, site-specific soil fertility management, Cevero watershed

Financial support: Coordination for the Improvement of Higher Education Personnel (CAPES).

(4254 - 1358) Evaluation of the impact caused by the urban and industrial development to the natural soil resource in the Cienfuegos municipality.

M Sc Ing. Yodani López Fonseca[1]; M Sc Ing. Yamila Vigo Cuza[1]; M Sc. Mario Fuentes Gallardo[2]

Provincial Department of Soils.Ministry of Agriculture[1]; Agricultural Projects Company[2]

With the objective of updating the inventory of soils altered by the investment process in the municipality of Cienfuegos, as well as, the evaluation of the impact caused to the agricultural surface and the determination of its reduction by agro productive category in the agricultural sector, was developed the present investigation in the Provincial Department of Soils of the MINAG of said province. A participative methodology was applied that included the realization of a Territorial Workshop of this activity with the central provinces and a collective diagnosis, where the performance of the Office of Control and evaluation of the Earth (OCET) was evaluated in relation to the application of the current legislation regarding the change in land use. The information generated from the microlocalization files processed with change in land use was used over a period of 10 years (2006-2015). The analysis of the information obtained was processed by the AGRO Software 24 determining the agro productive categories of the affected soils in the process. With the investigation it was possible to determine the decrease of 240.43 ha of the agricultural area in the evaluated period, the soils with greater affectation were the Red Rendzina, with a total of 187.43 ha, representing 50.4%, the categories III and IV were the most affected, with forest areas having the greatest impact.

Keywords: Keywords: agroproductive, evaluation, impact, microlocalization, soils

Financial support: International Proyect GEF-IWECO

(6066 - 3043) Hydrological components in small watersheds with eucalyptus and grasslands: monitoring and SWAT modeling

Miriam Fernanda Rodrigues[1]; José Miguel Reichert[1]; Rosane Barbosa

Lopes Cavalcante[2]

Federal University of Santa Maria[1]; CMPC Celulose Riograndense[2]

Grasslands of the Pampa biome, in South America, are being substituted by crops and commercial eucalyptus, with potential impacts on ecological and hydrological response, especially in hydrological cycle of watersheds and river basins. We evaluated the influence of vegetation cover on hydrological components, by monitoring and modeling with SWAT and describing the water balance in two paired watersheds - one with natural grassland (1.10 km^2) and the other with eucalyptus (0.83 km^2), located in southern Brazil. The study was conducted from October 2012 to September 2014. SWAT model realistically simulated streamflow in small paired grassland and eucalyptus watersheds. Estimated actual evapotranpiration (ETa) and groundwater recharge (G), based on measured water balance components, were respectively 44.0 and 43.5% in FW, and 33.3 and 31.3% in GW. However, ETa and G simulation by SWAT showed ET was 658.7 and 730.9 mm, corresponding to 49 and 45% loss of the annual rainfall by ET for eucalyptus watershed and natural grassland. Model results showed 33 and 47% of groundwater, in eucalyptus and in natural grassland watershed, respectively. The small differences between estimated and SWAT-simulated ETa indicate efficiency of methods to quantify the water balance components, even though the differences in techniques were higher to represent groundwater recharge. Although the forest watershed had greater ETa compared to the grassland watershed, benefits such as greater interception and less surface runoff can be highlighted, for a condition where grassland was degraded and provided low aboveground biomass. Thus, the cultivation of eucalyptus stands may provide better structural conditions and ground cover, greater infiltration and soil water retention, and increased groundwater recharge, with consequent reduction of soil degradation by erosion and increased water availability during dry periods. Water balance in different land use watersheds may be simulated with SWAT model, and calibrated results are encouraging for hydrological processes simulation in small paired watersheds based on “acceptable” statistical indicators.

Keywords: Water balance; evapotranspiration; streamflow; groundwater recharge.

Financial support: CMPC Celulose Riograndense, FAPERGS, CNPq and CAPES.

(4134 - 1377) Land systematization for soil and ecosystem services conservation. A Watershed level approach

José Daniel Oszust[1]; Marcelo Germán Wilson[2]; Emmanuel Adrián Gabioud[2]; Roxana Guadalupe Ramírez[3]; María Carolina Sasal[2]; Silvana María José Sione[1]; Celio Ignacion Chagas[4]

UNER Facultad Ciencias Agropecuarias[1]; INTA EEA Paraná[2]; UTN Facultad Regional Paraná[3]; UBA Facultad de Agronomía[4]

Water erosion is one of the main constraints of the current agricultural production, characterized by deforestation of native forest and the simplification of crop sequences. Taking advantage of the existing Soil Conservation Law in Entre Rios province (Argentina) that promotes water evacuation terraces to mitigate water erosion, systematization projects are usually carried out at the plot level and two types of terraces are currently predominant: narrow ridged terraces (non-cultivated) and wide ridged terraces (cultivated). To improve landscape heterogeneity and biological connectivity, the concept of linear elements was incorporated and a new type of terrace was promoted: reservoir terraces. This type, with wider dimensions and specific management guidelines, promotes the conservation of the soil and the conservation of ecosystem services, based on an integral view of natural resources management. It considers the ecosystem as a management intervention scale, inside the limits of the watershed. The objective was to evaluate the benefits of land systematization to reduce the loss of soil by water erosion and to increase the soil carbon stock and vegetable carbon stock. The study area is located in Aldea Santa Maria (Entre Rios province). A watershed of 2474 ha was selected. Three scenarios were simulated: i) reforestation for connection of isolated native vegetation patches and protection of watercourses, including the incorporation of linear landscape elements (i.e. reservoir terraces); ii) incorporation of soil conservation practices, in the plots of the watershed; iii) scenarios 1 and 2 combined. Carbon stock was determined in soil up to 30 cm and vegetable aerial biomass (arboreal, shrub and herbaceous strata) and soil loss was estimated with MUSLE model. Thus, with targeted reforestation, it is possible to increase the area of native forest from 12% to 20.5%, increase landscape heterogeneity and connectivity, which allows increasing structure and functionality to the agroecosystem. Scenario iii showed the best conditions. The soil loss was reduced in 10.16 T ha^{-1} $año^{-1}$ and carbon stock (includes soil and vegetation) was increased in 8% in the watershed.

Keywords: soil erosion, soil conservation, reservoir terrace, ecosystem service, watershed

Financial support: UNER Facultad de Ciencias Agropecuarias

(9473 - 504) Land use systems: the effect of cryptofauna on stubble decomposition

Cassani Mariano Tomás[1]; Sabatte María Leticia[1]; Perez Silvia Patricia[2]; Sfeir Alberto Jorge[3]; Massobrio Marcelo Juan[1]

Universidad de Buenos Aires. Facultad de Agronomía. Cátedra de Manejo y Conservación de Suelos, 4453 Avenida San Martín, Buenos Aires, 1417, Argentina.[1]; Universidad de Buenos Aires. Facultad de Agronomía. Cátedra de Climatología y fenología agrícolas, 4453 Avenida San Martín, Buenos Aires, 1417, Argentina.[2]; Universidad Nacional del Centro de la Provincia de Buenos Aires. Facultad de Agronomía. Cátedra de Conservación y Manejos de Suelos, 780 República de Italia, 7300, Azul, argentina.[3]

Soil regulates the most significant processes at the ecosystem level: production and decomposition processes. Cryptofauna communities play a key role in the functioning of ecosystems, as they control to a large extent the rate of decomposition of stubble. Cryptofauna is sensitive to disturbances generated by tillage systems. The aim of the work is to analyze the effect of cryptofauna on the rate of stubble decomposition in sites with different use histories. The study area is located in the peripheral hills of Azul, Buenos Aires, the soil is a typical Argiudol. Four sites with different degrees of artificialization of land use were selected (Site 1: 25 years closure, Site 2: no-tillage in favor of the slope for 15 years and no-tillage 10 years, Site 3: grid and weir in favor of the slope for 15 years and 10-year no-tillage, Site 4: 25 years of conventional tillage). Stubble losses were determined using litterbags with different mesh aperture diameters, microfauna ≤ 0.1 mm, mesofauna ≤ 2 mm and macrofauna ≤ 10 mm. Bags were removed from each site, every two months for 6 months, which were weighed after drying in a stove for 48 hours at 60°C. Decomposition was measured by dry weight loss resulting in residual stubble values. The rates of stubble decomposition were calculated for each size. Olson's negative exponential model was used to obtain decomposition rates. As a result, Site 1 showed the highest rates of decomposition and the greatest differences in participation percentages for each size of cryptofauna. Microfauna was responsible for the greater participation in stubble decomposition being followed by macrofauna while mesofauna had a very insignificant degree of participation. On Site 4, decomposition rates are the lowest of the sites, decomposition rates are the most similar among cryptofauna sizes. Sites 2 and 3 do not show any significant differences in the rates of decomposition in relation to Site 2 with Site 1 and the rates of Site 3 with Site 4. Differences in decomposition percentages were observed for these relationships, but not between site 2 and 3. The participation of mesofauna in sites 2,3 and 4 is highlighted, acquiring

increasingly important values in relation to Site 1. The observed results determine that in sites with a higher degree of artificialization, mesofauna becomes more important. The varying degrees of intensity of land use modulate the decomposition capacity of each group of cryptofauna.
Keywords: rate of stubble decomposition, litterbag, microfauna, mesofauna, macrofauna.
Financial support: Universidad de Buenos Aires, Proyecto UBACyT 20020130100690BA

(8336 - 1018) Patterns in time and depth of soil water contents at some soil conservation practices. Mediterranean and arid zone of Chile.

Manuel Casanova[1]; Oscar Seguel[1]; Osvaldo salazar[1]; Yasna Tapia[1]
Universidad de Chile[1]

Irregular distribution in time and space of rainfalls in several zones of Chile significantly hinders the development of vegetal cover, triggering severe soil erosion processes. This work aims to evaluate the behavior of some soil and water conservation practices at hillsides level, analyzing the temporal profile of soil water contents with a FDR probe device (DIVINER 2000, Sentek), considering both dry and rainy season. At the Mediterranean rainfed zone (Inceptisol; 33° 28'S – 70° 50'W), soil water contents were measured in the soil profile (0-50 cm) within *Acacia saligna* and/or natural prairie and/or runoff harvesting plots after 15 years from establishment. At the semiarid rainfed zone (Aridisol; 31º26'S - 71º33'W) i) stone-lines with *Atriplex nummularia* and/or goat manure (0-30 cm), ii) half-moons with *A. saligna* and/or goat manure and/or organic emulsions (0-30 cm), and iii) graded soil material deposited above stone check-dams of gullies without vegetation (0-100 cm) were also monitored, after a recent establishments (1-3 years). Water harvesting, tillage and tree canopy influence were important factors in soil water dynamics within Mediterranean rainfed zone, with higher water contents (1-2%) and lower available critical soil water limit, compared with bare soil and not water harvesting system. At the semiarid rainfed zone, only goat manure additions increased soil water contents with a persisting effect in time for conservation practices (i & ii). Besides, natural deposits of sediments behind stony check-dams by runoff (iii) determine poor water storage conditions, but water retention is improved during winter and spring if goat manure in these structures is used or the sediments are artificially sorted in a particular layer sequence in depth with different soil textural classes (coarse-medium-fine). Although for a irrigated agriculture the reported soil water contents may seem unimportant, under degraded dry rainfed conditions these amounts are enough and can be critical for sustain a soil protective vegetal cover.
Keywords: water dynamics; drylands; soil and water conservation practices; water harvesting.
Financial support: Universidad de Chile- Ministerio de Agricultura (Servicio Agrícola y ganadero)

(2673 - 1472) Rate of reaction and neutralization of two calcareous byproducts in acid soils under different productive systems

Maria Paula Codina[1]; Valeria Cejas[1]; Omar Casanova[1]
Facultad de Agronomia, Universidad de la República[1]

The diversity of the soils in Uruguay is consequence of different parent materials and chemical characteristics, therefore each situation requires specific management. After many years of continuous extraction of nutrients by crops, and specifically due to the implementation of direct sowing, a progressive and sustained acidification of soils has occurred, limiting the growth of crops. For that reason, alternatives are needed to mitigate the consequences soil acidification, aiming to eliminate the exchangeable Al, one of the main sources of acidity. The aim of this research was to evaluate liming for soil acidity mitigation, testing two liming materials with different particle sizes, comparing their reaction velocity, as well as their neutralization capacity. The study was carried out under different production systems: grass-legume pastures, silvopasture, olive tree plantation, agriculture, and forestry. Field experiments were conducted in different regions of the country with six treatments: control (without liming), 2000 kg ha^{-1} of fine limestone, 2000 kg ha^{-1} of coarse limestone, 4000 kg ha^{-1} of fine limestone, 4000 kg ha^{-1} thick limestone, 2000 kg ha^{-1} of each material (fine and thick limestone). The soil was sampled at the beginning of the experiment; 30, 60, 120 and 180 days after lime application. With the samples dried, pH and exchangeable acidity were determined. The main result of this research was to demonstrate the differential behavior of the limestone sources, especially regarding their rate of reaction (measured as the change of pH and exchangeable acidity in time). In average the soil with coarse limestone had a pH of 5.8 in the last sampling, while in the soils with fine limestone pH was 5.0. The treatment with fine and coarse limestone showed the highest liming effect (pH 6.2), except in the sandy soils. These soils are extremely acidic, the application of high lime amounts produced a fast reaction, especially when fine lime was used. For both materials, the neutralizing capacity at the end of the evaluation did not show significant differences. As a side effect of the limestone application, there was an increase of mineral nitrogen and available phosphorus that should be highlighted, revealing an extra gain of these nutrients. We concluded that the soil type influenced in the reaction velocity of liming materials, with the highest rates in high fertility soils, while low fertility soils required longer periods to react.
Keywords: Liming; soil acidity; Uruguay.
Financial support: Facultad de Agronomia, Universidad de la República - Cementos del Plata, ANCAP

(6550 - 594) Responses of water resources to land and soil management in a tropical small watershed under a Payment for Environmental Services public policy

Ricardo de Oliveira Figueiredo[1]; Timothy Richard Green[2]; Alexandre Ortega Gonçalves[3]; Matheus Martins Simioli[4]; Talita Varela Utsuni de Camargo Jesus[5]; Patrícia Porta Nova da Cruz[6]; Lucas de Camargo Reis[7]; Marisa de Cássia Piccolo[7]; Plínio Barbosa de Camargo[7]
Embrapa Environment[1]; USDA-ARS, Center for Agricultural Resources Research[2]; Embrapa Soils[3]; CNPq Scientific Initiation Scholarship[4]; FAPESP Technical Training Scholarship[5]; CNPq Pos Doc Scholarship[6]; CENA-USP[7]

The 12-km^2 Ribeirão das Posses Watershed (RPW), which is dominated by Ultisols and Inceptisols, is located in the south of Minas Gerais, Brazil. RPW discharges into the Jaguarí River, one of the most contributing rivers to supply the São Paulo metropolitan area. Over the last century in this watershed, the land use changed from native forests to more homogeneous vegetation for pastures, crops and forest plantations of eucalyptus, which have cumulative impacts on water yield and quality. To address this, a public policy was adopted establishing the Payment for Environmental Services covering three small watersheds of this river basin, including RPW. Since 2004, under such initiative, some small areas with vegetation of native species have been planted, especially in riparian zones, around springs, and at hilltop positions. Also some soil management has been conducted using small dams over the steep slopes and readjusting lines of cultivations to level counters. Therefore it is expected that water and soil ecosystems services will recover over time. The present work compares a streamwater quality monitoring conducted in 2017-2018 to the streamwater chemistry results obtained by other previous studies conducted from 2011 to 2016 in RPW. The main hydrobiogeochemical parameters evaluated here were: flow, temperature, pH, electrical conductivity, dissolved oxygen, carbon,

nitrogen and major dissolved ionic elements as well as suspended particulate matter. The results express how it is important that the stream sampling schedule cover rainy periods, which was possible using an automatic water sampler. Overall only a very small increase in water quality parameters was detected. The same was concluded for stream discharge, which depended primarily on the rainfall over the studied years. In the future, it would be interesting to compare the loss of sediments and nutrients from soils during the larger rainfall events, and how this can be accentuated if the changing climate confirms the increase of such events along with the amplification of dry periods. It is important to be aware that the ecosystem services provided by water in fact derived in part from good soil management, in a way that soil provides many ecosystem services, together with water by providing food, water filtration, regulating nutrient cycling, and other essential goods for life. In fact soil processes and functions are fundamental to assess ecosystem services and the effects of land use on them.

Keywords: Biogeochemical, small catchments, ecosystem services, water quality

Financial support: FAPESP, Project Numbers 2016/02890-1 and 2016/20335-5; CNPq, Project Numbers 800629/2016-7 and 150043/2016-3

(4419 - 569) Space variability of chemical attributes of the soil with cupuaçu cultivation (Theobroma grandiflorum) in south of Amazonas

Carlos Henrique Gima Relvas[1]; Elilson Gomes de Brito Filho[1]; Elyenayra Nogueira Pinheiro[1]; Milton César Costa Campos[1]; Juliana Malta de Assis[1]; Francisca Xavier Quintino Neta[1]; Anderson Vieria Rodrigues[1]; José Igor Silva Praça[1]; José Maurício da Cunha[1]; Fernando Gomes de Souza[1]

Universidade Federal do Amazonas[1]

The Amazon region is characterized by the enormous diversity of life, both vegetal and animal, as well as human societies. Most of the arable soils of this region are acidic in nature, with low cation exchange capacity (CEC) and low natural fertility. This region is characterized by its advanced stage of weathering, presenting physical characteristics suitable for agricultural use, however with strong nutritional limitations. In the Amazon, edaphoclimatic conditions tend to present limitations on agricultural practices due to soil management or natural conditions. O objective of this study was to evaluate the space willvariat d soil acidity in cupuaçu cultivation area in the settlement project San Francisco in southern Amazonas. The study area is located in the city of Canutama, Amazonas, Brazil, located along the highway BR-319 .F hi conducted a mapping c om mesh 70 x 90, with regular spacing of 10 x 10, totaling 80 points three depth, 0.0-0.05; 0.05-0.10; 0,10-0,20m for determination of soil chemical properties (pH, (H + Al)(Al + M). The soil properties were analyzed by descriptive statistical analysis, assumptions of normality of data performed by the Kolmogorov-Smirnov test (KS) ($p \geq 0.05$) , using Minitab 14 software (MINITAB, 2000). By the analysis of geostatistics , it was possible to obtain the degree of spatial correlation of attributes , using the classification of CAMBARDELLA and t al. At descriptive statistics , mean and median values of the soil attributes were close , tending to a symmetrical distribution of the data, which can be confirmed by the coefficients of asymmetry and kurtosis close to zero , with coefficients s of asymmetry and kurtosis between 0 and 3. By chemical analysis of the soils , were characterized as acid soils, with an average of pH 3.84 , with the highest indexes in the layer of 0.00-0.05 m, which is due to the decomposition of the organic matter releases humic acid. As geostatistics, the s spherical and exponential models were the ones that best fit the data, except for the pH in the 0.00-0.05 layer that presented - PureNitrogen Effect (EPP). The degree of spatial dependence attributes were shown to be strong and moderate, with low spatial correlation range. However, the soil presented acidic, with exchangeable aluminum was the one that presented less degree of spatial dependence and greater reach.

Keywords: geostatistics , acidity, Amazonian soils

Financial support: The National Council for Scientific and Technological Development (CNPq); Foundation for Research Support of the State of Amazonas (FAPEAM)

C3.5 - Soil Degradation control, remediation and reclamation

C3.5.2 - Native metallophytes from mine spoils as a potential source for phytoremediation

(9595 - 1334) Accumulation of heavy metals in metalliferous soils of the North Caucasus and *Brassicaceae* species in connection with the reclamation of soils

Natalya Alekseeva-Popova[1]; Jaume Bech[2]; Irina Drozdova[1]; Irina Kalimova[1]; Núria Roca[2]

Komarov Botanical Institute, Russian Academy of Sciences, St. Petersburg, Russia[1]; Laboratory of Soil Science, Plant Biology Dpto, Faculty of Biology, University of Barcelona, Spain[2]

We have studied mining technogenic centers and their specific landscapes within the Karachay-Cherkess Republic (KChR) and the Republic of Dagestan (RD). Pro-mining production is a major source of environmental stress and water pollution. The present study generalizes the heavy metals (HM) distribution in soils of the areas located within polymetallic ore fields of the southern Dagestan, Urupsky sulfide deposit and Bedensky ultramafic massif of the KChR and their bioavailability for *Brassicaceae* plants. Plants and soils were analyzed for Fe, Mn, Zn, Cu, Ni, Cr, Cd and Co. The maximum concentrations of acid-soluble forms of Cu (23000 $mg \cdot kg^{-1}$), Zn (14000 $mg \cdot kg^{-1}$) and Cd (80 $mg \cdot kg^{-1}$) are found in soils of disturbed habitats in the zone of action of the Urupsky copper mining, Pb (89 $mg \cdot kg^{-1}$) – in soils in the area of lead-zinc mineralization on the slopes of the Shalbuzdak mountain in RD and Ni (264 $mg \cdot kg^{-1}$) – in soils of Bedensky ultramafic massif in KChR. The report deals with the specific features of the accumulation of HM in typical *Brassicaceae* species in various geochemical conditions of the North Caucasus. It was revealed the Ni, Cu, and Zn accumulator *Arabis sagittata,* Zn accumulator *Alyssum gehamense* and Ni hyperaccumulator *Alyssum murale.* An experimental study of the accumulation of HM by 7 species of *Brassicaceae* has been carried out on nutrient medium with different doses of Zn, Cd, Ni. It revealed Zn accumulator – *Alyssum gehamense* (1700 $mg \cdot kg^{-1}$) and Ni hyperaccumulator – *Alyssum murale* (12,000 $mg \cdot kg^{-1}$). An experimental study of the accumulation of HM by *Brassicaceae* species has been carried out on nutrient medium with different doses of Zn, Cd, Ni. At the same doses of metals, the maximum accumulation levels were: *Neslia paniculata* (1600 $mg \cdot kg^{-1}$ of Cd), *Alyssum gehamense* (1650 $mg \cdot kg^{-1}$ of Zn) and *Alyssum murale* (3800 $mg \cdot kg^{-1}$ of Ni). Thus, in the experimental conditions the higher accumulative capacity of HM was confirmed for *Brassicaceae* species. These species are prospect for the reclamation of HM enriched soils.

Keywords: Phytoremediation, *Brassicaceae* plants, polluted soils

Financial support:

(9389 - 375) Arsenic, copper and zinc in the organic tissues and in the silica phytoliths of *Setaria vulpiseta* growing on a contaminated soil of in a gold mining area

Mariana Ferreira Rabelo Fernandes[1]; Igo Lepsch[2]; Regynaldo Arruda Sampaio[3]; Luiz Arnaldo Fernandes[3]; Nelson Moura Brasil do Amaral

Sobrinho[1]; Everaldo Zonta[1]; Essaid Bilal[4]
Universidade Federal Rural do Rio de Janeiro - UFRRJ, Seropédica, RJ, Brasil.[1]; Escola Superior de Agricultura "Luiz Queiroz" ” – EsalQ/USP, Piracicaba, SP[2]; Universidade Federal de Minas Gerais – UFMG, Montes Claros, MG[3]; Ecole Nationale Supérieure des Mines de Saint Etienne, GSE, CNRS UMR 5600, F42023 Saint Etienne, France[4]

Silica phytoliths from the leaves of *Setaria vulpiseta* (Lam.) Roem. & Schult growing spontaneously on gold-mine contaminated soil were extracted using the Environmental Protection Agency (EPA) 3052 method (HNO_3+HCl+HF) and analyzed for Cu, Zn, and As content. The leaves of the plants and the soil were also analyzed for Cu, Zn, Cr, Ni, and As content by the EPA-3050 method (HNO_3). The main objective was to determine the amounts of heavy metals present in the soil and organic part of the leaves and inside the structure of the silica phytoliths. The results show that the silica phytoliths comprise 3.9 % of the dry matter of leaves, and retain and store considerable amounts of heavy metals, especially Cu. In addition, we demonstrate that when the metals are estimated by the conventional acid digestion method (without HF), the amounts of metals absorbed by the plants are under-estimated because the silica phytoliths are not dissolved. Therefore, it is necessary to add the amounts of heavy metals found inside the phytoliths to the total amounts found in the organic part of the leaves. The silica phytoliths have high ability to sequester metals and make them unavailable in the environment. Our study should help in developing phytoremediation strategies using plants with high amounts of phytoliths.

Keywords: Biogenic opal, soil pollution, phytotoxicity, biominerals, heavy metals
Financial support: FAPERJ

(5536 - 513) Earthworms and arbuscular mycorrhizal fungi on the growth of *Canavalia ensiformis* in sandy soil contaminated with copper

Natielo Almeida Santana[1]; Helena Wichineski Trombeta[1]; Fernanda Cantoni[1]; Joice Aline Freiberg[1]; Zaida Inês Antoniolli[1]; Rodrigo Josemar Seminoti Jacques[1]
Universidade Federal de Santa Maria[1]

The high availability of copper in the soil causes reduced growth and even death of plants, and this problem is even greater in sandy soils such as those observed for grape cultivation in the Campanha Gaúcha region, Rio Grande do Sul, Brazil. The objective of this study was to evaluate the effect of arbuscular mycorrhizal fungi and earthworms on the growth of *Canavalia ensiformis* in a sandy soil with high copper content. A sandy soil was collected near a vineyard of the Campanha Gaúcha (30º48º27'00''S and 55º22'42''W), it was autoclaved, fertilized, added with limestone (to pH 6.0), the microbial population was reestablished and it was contaminated with 100 mg kg^{-1} of copper. The experiment was carried out in a completely randomized design in a greenhouse, soil moisture in 75% of the field capacity and four treatments which were: no fungus and without earthworm (control); with fungus; with earthworm; and with earthworm and fungus. Arbuscular mycorrhizal fungi inoculation was performed using 200 spores of *Rhizophagus clarus* and eight earthworms of *Eisenia andrei* were inoculated. Vegetal residue (5 g pot^{-1}) was added to the soil surface in all treatments, as a way of feeding the earthworms. The addition of 100 mg kg^{-1} of copper in the sandy soil resulted in the content of 97.77 mg kg^{-1} of Cu (Mehlich-1). Sandy soils have a low percentage of clay, oxides and organic matter, resulting in reduced cation retention capacity, with most of the copper added to the soil resulting in available forms. The treatments with the presence of arbuscular mycorrhizal fungi had a mean rate of colonization of 37%, not differing from each other. The presence of mycorrhizal fungi and earthworms favored the growth of the plant, with 53 and 50% increase in the shoot and root dry mass, in relation to the average of the other treatments. The earthworms become more active in the presence of mycorrhizal fungi, because they feed on hyphae, modify the bioavailability of nutrients in the soil and with this they favor the interception by the hyphae of the mycorrhizal fungi, increasing the nutrients absorption by the plants which results in greater growth. The mass of nodules was not modified (p= 0.5500) by the presence or absence of fungi and earthworms. The *C. ensiformis* plant present higher biomass production of shoots and roots in the presence of the mycorrhizal arbuscular fungi and earthworm.

Keywords: contamination, phytoremediation, *Rhizophagus clarus*, jack bean.
Financial support: CAPES, CNPq, FAPERGS.

(5779 - 2967) Effects of biochar on copper bioavailability and soil microbial communities in a metal-contaminated soils using metallophytes and agricultural plants

Sebastian Meier[1]; Francisca Moore[2]; María-Eugenia González[3]; Jorge Medina[2]; Alex Seguel[2]; Jaime Mejias[1]; Juan Hirzel[4]
INIA Carillanca[1]; Universidad de La Frontera[2]; Universidad católica de Temuco[3]; Inia Quilamapu[4]

The objective of this study was to investigate the effects of BCs on the Cu immobilization and over soil microbial communities in a Cu contaminated soil using a metallophyte and agricultural plants. A Cu contaminated sandy soil (338 mg kg^{-1}) was incubated with chicken manure biochar (CMB) oat hull biochar (OHB) and pine bark biochar (PBB) at the rate of 3 % w/w. The metallophyte *Oenothera picensis* and agricultural plants *Solanum lycopersicum* and *Lolium perenne* were grown in pots containing the incubated soils for three months. The BC promoted the plant biomass production and reduded de plant Cu uptake being its effect dependent of the biochar and plant used. The most evident effect was observed using CMB, which increased the shoot growth untill 14 times, whereas the root growth was increaded 4 times In the other hand, the BCs increased the soil pH (until 3 units), decreased Cu's easily exchangeable fraction and increased Cu bounded in organic matter and residual fractions. BCs provided favorable habitat for microorganisms that was evident in increased basal respiration and DHA activity. However, the BCs did not changed the microbial communities in all seasons and the changes were dependent on the type of BC and the doses applied. The above results suggest that biochars may be utilized to remediate Cu in contaminated soils and provide a favorable habitat for agricultural plants This research was supported by Fondecyt project number 11150480
Keywords: *Biochar Contamination Copper Immobilization Microorganism*
Financial support: Fondecyt project number 11150480

(6653 - 1140) Geochemical distribution of trace metals in urban soils of Hualpen, Chile.

Pedro Tume[1]; Elizabeth González[1]; Felipe Reyes[2]; Juan Pablo Fuentes[1]; Nuria Roca[3]; Jaume Bech[3]
Universidad Católica de la Santísima Concepción[1]; Universidad Católica de la Santísma Concepción[2]; University of Barcelona[3]

The objectives of this study were (1) to determine the concentrations background of As, Co, Cr, Cu, Ni, Pb, V and Zn in the urban soils of Hualpen (Chile); (2) asses the level of contamination in the urban soil based on different pollution indexes and (3) to identify natural or anthropogenic sources in order to obtain a spatial distribution of the pollutants. A total of 153 samples were collected from the study area as follows: 51 topsoil samples (TS) (0-10 cm), 51 subsoil samples (SS)

(10-20 cm) and 51 deep soil samples (DS) (150 cm). The soils were characterized and the concentrations of trace metals were analyzed by ICP following aqua regia digestion. Multivariate analysis combined with spatial analysis were implemented in order to distinguish the sources. Several simple and robust statistical methods were applied to datasets in order to explore their potential in the evaluation of a useful and robust background values. The degree of contamination along with the geoaccumulation index, enrichment factor and contamination factor were also evaluated. The median concentrations obtained for elements includes As 3 mg kg^{-1}, Co 15 mg kg^{-1}, Cr 14 mg kg^{-1}, Cu 25 mg kg^{-1}, Ni 36 mg kg^{-1}, Pb 5 mg kg^{-1}, V 97 mg kg^{-1} and Zn 51 mg kg^{-1}. Multivariate analysis suggest that Cr, Pb, V and Zn are contributed by external sources. The spatial distribution of Cr, Pb V and Zn displays a spatial pattern extending along industrial environments and emission sources. The estimate background values determined with the DS samples with MAD method includes As 5 mg kg^{-1}, Co 20 mg kg^{-1}, Cr 18 mg kg^{-1}, Cu 33 mg kg^{-1}, Ni 45 mg kg^{-1}, Pb 3 mg kg^{-1}, V 108 mg kg^{-1} and Zn 48 mg kg^{-1}. The ecological indexes register a moderate to considerable contamination in some soil samples.

Keywords: urban soils, trace metals, contamination
Financial support: Grant UCSC DIN 23/2016

(2107 - 801) Growth and potential for phytoremediation of native grasses of South American grasslands grown in copper-contaminated soils.

Lessandro De Conti[1]; Lincon Oliveira Stefanello da Silva[2]; Anderson Cesar Ramos Marques[2]; Tadeu Luis Tiecher[1]; Adriele Tassinari[2]; Vanessa Marques Soares[2]; Ricardo Fagam Vidal[2]; Gabriel Sans[2]; Rodrigo Krames[2]; Gustavo Brunetto[2]

Instituto Federal Farroupilha[1]; Universidade Federal de Santa Maria[2]

The application of cupric fungicides gradually increasing copper (Cu) levels in vineyard soils, reaching in some cases, toxic levels to grapevines or cover crop species that co-habit the vineyards. Native grasses may present mechanisms adaptive to adverse soil chemical conditions, which increase the tolerance to excess copper (Cu), enhancing their use in the phytoremediation of these environments. The aim of this study was to evaluate the growth, distribution of Cu chemical species in soil solution and nutritional parameters of native grasses of South American grasslands grown in sandy soil with increasing Cu levels. The soil used in the experiment was collected in natural grassland in southern Brazil. The samples were air-dried; acidity, phosphorus and potassium levels were corrected and samples were then incubated. We used three Cu levels - natural level (Dose 0) and the addition of 40 and 80 mg Cu kg^{-1} (Dose 40 and 80). The soil (4 kg) was placed in 5 L pots. In August, three seedlings of *Axonopus affinis*, *Paspalum notatum* and *Paspalum plicatulum* were transplanted per pot and cultivated for 121 days. We collected soil solution throughout cultivation using Rhizon (MOM) lysimeters. In the solution, the concentration of the main cations, anions, dissolved organic carbon, pH were analyzed and ionic speciation was carried out. At 121 days after transplanting, the plants were collected to determine dry matter and nutrient concentration in the roots and shoots. The Cu accumulated in biomass, the bioconcentration factor and translocation factor were estimated. The growth of native grasses was reduced by excess Cu, diagnosed by the reduction in shoot and root dry matter yield at higher Cu level. Among the evaluated species, the *Paspalum plicatulum* is a grass species of South American grasslands with great potential to be used as cover crops in vineyards with high levels of Cu, because it has a greater capacity to reduce Cu bioavailability (Cu^{+2}) and maintain nutritional balance, which resulted in higher dry matter yield and Cu accumulation. Native grasses of South American grasslands can be used as phytostabilizing plants in Cu-contaminated soils, by accumulating the absorbed Cu predominantly in the roots, verified by the low values of Cu translocation factor, benefiting grapevines grown intercropped.

Keywords: Copper bioavailability; cover crops; ionic speciation; vineyards.
Financial support: Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq), Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES), Fundação de Amparo a Pesquisa do Estado do Rio Grande do Sul (FAPERGS) through scholarships and financial resources

(4642 - 2176) Mine soil rehabilitation after hydrophilic polyacrylate polymers application and growth cycles with different autochthonous plant species

Erika S. Santos[1]; Luisa Carvalho[2]; Maria Manuela Abreu[2]; Maria Clara F. Magalhães[1]; Amarilis de Varennes[2]; Felipe Macías[3]

CICECO - Aveiro Institute of Materials, Department of Chemistry, University of Aveiro[1]; Universidade de Lisboa, Instituto Superior de Agronomia, Linking Landscape, Environment, Agriculture and Food Research Centre[2]; Departamento de Edafología y Química Agrícola, Facultad de Biología, Universidad de Santiago de Compostela[3]

The use of polyacrylate hydrophilic polymers can improved some characteristics of contaminated soils allowing a rapid herbaceous cover. In order to evaluate the environmental recovery of a soil developed on *gossan* materials (São Domingos mine, Portugal) with these polymers after growth periods with different autochthonous plant species, a mesocosm assay was performed in 3 phases. Four treatments were performed: (T1)control without polymer; (T2)with synthesized polymer; (T3)with polymer removed from diapers; (T4)with cut diapers. Firstly, *Spergularia purpurea* grew for 3 months followed by a plant cover with *Cistus ladanifer*, *Lavandula sampaiona* and natural herbaceous colonization for 10 months and *Erica australis* growth for 55 months. The objective of this study was to assess the chemical and biological characteristics of this remediated soil as well as the development and ecophysiological status of *Erica australis* in the 3rd phase. The initial soil had high total concentrations (g/kg) of Al (3.50–8.60), As (2.55–2.73), Cu (0.13–0.91) and Pb (4.48–6.16). At the end of the 3rd phase, the soil available fractions (rhizosphere method) of the elements were small and no differences were obtained among treatments (except Al, As, Mg). Available concentrations of Al and Mg in the remediated soil were higher than in T1 while the opposite occurred for As. The polyacrylate polymer did not lead to an increase of the pH (≈6.6), fertility ($C_{organic}$, $N_{mineral}$ and extractable P and K) and biological activities (dehydrogenase, β-glucosidase, acid phosphatase, celulase, urease) in the remediated soil compared to T1. Elements concentrations (nutrients, potentially hazardous elements) in *E. australis* shoots and fresh biomass amounts (g; T1: 36.1; Polymers treatments: 30.8-36.2) were similar independently of the treatment. Elements concentrations in shoots were below phytotoxicity except for Cu which can be considered as deficient (≈3 mg/kg). The highest H_2O_2 concentrations were quantified in control shoots (µmol/g; T1: 23.8; Polymers treatments: 8.4-14.8) indicating that these plants can be under stress. Total glutathione concentration in control shoots reached the lowest value while for total ascorbate no differences were obtained. Plants from T3 and T4 had lower concentrations of total chlorophyll, anthocyanins and carotenoids than the control. On the long term, the contribution of the plants seems to be more effective for the soil recovery than the type of polymer applied.

Keywords: Amendments, São Domingos mine, Phytostabilization, *Erica australis*, Soil rehabilitation
Financial support: CICECO-Aveiro Institute of Materials POCI-01-0145-FEDER007679 (FCT Ref. UID/CTM/50011/2013) and LEAF (FCT Ref. UID/AGR/04129/2013); FCT for postdoctoral grants (SFRH/BPD/117556/2016 and SFRH/BPD/109428/2015); Xunta de

Galicia (AMBISOL group GRC2014/003)

(9141 - 363) Performance of resistant-rhizobacteria bioaugmentation-assisted phytoextraction by grasses applied in multi-metal(loid) contaminated soils

Cácio Luiz Boechat[1]; Filipe Selau Carlos[2]; Patrícia Giovanella[3]; Clésio Gianello[4]; Enilson Luiz Saccol de Sá[4]; Flávio Anastácio de Oliveira Camargo[4]

Federal University of Piauí[1]; Rio Grandense Rice Institute[2]; State University of São Paulo[3]; Federal University of Rio Grande do Sul[4]

Phytoremediation can be enhanced with microbe associations, and it is better if compared with bioremediation or phytoremediation alone. The objective was to investigate heavy metal and bioaugmentation effects on the metal uptake by *Sorghum bicolor* and provide insight for using native bacteria for enhancing heavy metal accumulation. A factorial scheme was used, consisting of two soil samples with less (SS1) and more (SS2) metal concentration, and eight treatments, including the non-inoculated control, single inoculation with metal-resistant bacteria *K. intermedia* (Ki); *K. oxytoca* (Ko); and *C. murliniae* (Cm) metal-resistant rhizobacteria and four bacterial consortia, with five replicates. In plants grown in the SS1 values greater than one (>1) have been observed for the translocation factor for Ba in the control and Cm treatment. However, in the SS2 translocation factor > 1 for Ki; Cm; Ko; Ko + Cm and Ki + Ko + Cm for the Cd; for Ki; Ki + Ko; Ki + Ko + Cm and control for As and to Ki for Ba were observed. Tested metals accumulated primarily in the roots. The restriction of metal absorption and translocation to the shoots may be related to the avoidance mechanism in the roots. All treatments in the SS1 bioconcentration factor values were higher than 1 for cadmium (Cd) and lower for Cr, Pb, As and, Ba, except for Ba in the Ko + Cm treatment. In SS2 the bioconcentration factor values for Cd in all treatments were higher than 1. However, for Cr values were less than 1 in all treatments. The bioconcentration factor values for Pb ranged from 0.8 to 1.2 in SS2, being higher than in SS1. For As they ranged from 0.6 to 1.2 and for Ba they ranged from 1.1 to 1.4 in SS2. This result shows that sorghum plants have mechanisms that prevent the entry of heavy metals when it is at a high concentration in the substrate. Sorghum cultivated in SS1 had both factors higher than one associated with microbiological treatments, so this technology makes the species suitable for use in phytoextraction of these elements. Moreover, species tolerant to heavy metals with high bioconcentration factor and low translocation factor can be used in the phytostabilization of contaminated sites, along with other plant cover. From these studies, it can be concluded that by inoculating the rhizosphere soils with selected metal-resistant bacteria, it should be possible to improve bioavailable metal concentrations for plant uptake and thereby phytoextraction potential in metal-contaminated soils.

Keywords: Metal phytoextraction; Metal bioavailable; Biotechnology; Translocation factor; Bioconcentration factor.

Financial support: National Council for Scientific and Technological Development – CNPq

(4334 - 1435) Selection of native tree species for the phytoremediation of copper-polluted soils under tropical climate

Verónica Asensio[1]; Flávia Garcia Flórido[1]; Francisco Ruiz[1]; Fabio Perlatti[1]; Xosé Luis Otero[2]; Tiago Osório Ferreira[1]

Department of Soil Science, University of São Paulo (USP/ESALQ)[1]; Department of Edaphology and Agricultural Chemistry, University of Santiago de Compostela – USC[2]

Mine tailings containing metal sulphides may trigger acid mine drainage and the potential production of highly acidic waters, with high concentrations of sulphate metals. Reclamation of metal-polluted soils with phytoremediation plants have been proved as efficient, low cost and ecologically sustainable. Due to the lack of studies evaluating such technique in tropical soils by using native tree species, the main goal of the present work was to find these type of species for the phytoremediation of copper-polluted soils under tropical climate. The soils located in the abandoned copper mine "Pedra Verde", under semi-arid tropical climate, were selected for the phytoremediation study. Five tree species were selected (Pink Cedar, Yellow Ipê, Copaíba, Jatobá and Sabiá) by taking into account the natural flora of the surrounding area of the mine, a virtual herbarium, the vegetation recorded in a national park near to the mine and a review about Brazilian native plant species tolerant to high concentration of metals. Two more species were selected due to their incidence in the mine area and wide geographic distribution: Embaúba and Aroeira Preta. Seedlings of the seven species were planted in pots with an unpolluted Arenosol and grown under greenhouse conditions. Soils were polluted to rise 60, 100 and 500 mg kg^{-1} Cu, based on the prevention and intervention values for soils in residential areas according to the Brazilian legislation (60 and 500 mg kg^{-1}, respectively). Height and stem diameter were measured 15, 30, 45 and 60 days after planting. Plants were harvested, and biomass and total Cu concentrations were determined in leaves, stem and roots. Copper concentration in soils was analysed by a sequential extraction. The results shown that the seven studied native trees are promissory species for the phytostabilization of copper in soils under tropical climate. All studied species accumulated high concentration of Cu in roots and extracted a considerable amount from the soil within three months. Jatobá, Embaúba and Copaíba were the species extracting more. They took up from 3 to 20 mg Cu from the polluted soils. Embaúba can be considered as hyperaccumulator of copper according to the bioaccumulation factor (BAF). Although these results should be validated under field conditions in a soil naturally polluted with copper, the present study evidence the potential of seven tree species native from tropical regions for the phytoremediation of copper-polluted soils.

Keywords: copper; mine soil; remediation; tree species; sequential extraction.

Financial support: National Council for Scientific and Technological Development from Brazil (CNPq) through a scholarship to Flávia Garcia Flórido.

(3809 - 1352) Selection of winter cover crops for copper phytoremediation

Diogo Vendruscolo[1]; Natielo Santana[2]; Helena Wichineski Trombeta[2]; Alfredo do Nascimento Junior[3]; Rodrigo Josemar Seminoti Jacques[2]

Emater/RS[1]; Universidade Federal de Santa Maria[2]; Embrapa Trigo[3]

Copper is an essential nutrient for the growth of plants, however when it concentrates high levels of Cu in the soil, it becomes toxic to the metabolism of plants. Vine cultivation demands many applications of copper based pesticides for the control of fungal diseases. In Rio Grande do Sul state of Brazil, vine cultivation is widespread and, therefore, many areas are contaminated by copper in the soil. The aim of this study was to select winter soil cover crops that are promising for the phytostabilization and phytoextraction of copper in a soil with high levels of copper. A not contaminated Cambisoil was collected in a region with many vineyards in the Serra Gaúcha. Subsequently, 200 mg kg -1 of Cu in the form of copper chloride (66.66%) and copper sulfate (33.34%) were added. Nine genotypes of winter cover crops were grown under greenhouse conditions: Anahuac Wheat (*Triticum aestivum*), IPR89 Rye (*Secale cereale*), Wintestar Ryegrass (*Lolium multiflorum*), BRS serrano Rye (*Secale cereale*), EMBRAPA Triticale (*Triticosecale rimpaui* Wittm), IPR 111 Triticale (*Triticosecale rimpaui* Wittm), IAC Wheat (*Triticum aestivum*), PFS050 Rye (*Secale cereale*), Ponteio Ryegrass (*Lolium multiflorum*). Soil moisture was maintained

at 80% of field capacity. Results of dry mass production and copper contents in shoot and root system were evaluated. Data were submitted to analysis of variance through the statistical program Sisvar. Among the nine evaluated genotypes, "Ponteio" ryegrass and ryegrass "EMBRAPA" were the ones that presented the lowest dry mass production, probably due to a lower tolerance to high values of copper in the soil. Copper toxicity causes damage to the physiological metabolism of plants, interfering in processes such as electron transport, reduction in the number and volume of chloroplasts, which affects the photosynthetic activity and, consequently, will reduce the production of dry mass. The "Anahuac" wheat genotype, on the other hand, presented higher dry mass production of shoot and root, in relation to the others. Wheat "Anahuac" and "Wintestar" ryegrass genotypes presented a high concentration of copper in the root system and produced the highest root dry mass among the genotypes, in addition, they presented low copper concentration in the aerial part. Therefore, highlighting as potential phytostabilizers of copper in the soil, since in this process the metals are concentrated in the roots and there is a low translocation to the aerial part.

Keywords: Phytostabilization, Phytoextraction, Heavy metal, Vineyard

Financial support: The authors thank the Brazilian institutions for providing scholarships and financial support of this work: National Council of Technological and Scientific Development (CNPq) and Coordination for the Improvement of Higher Education Personnel (CAPES).

C3.5.3 - Frontier of soil quality evaluation after remediation of contaminated field

(3069 - 1819) Arsenic content and speciation in soil samplesduringrice growth cycle

Napatsorn Notesiri[1]; Prapaipit Srimawong[1]; Onanong Chomsiri[1]; Wirongrong Songarom[1]; Jutharat Yimchaluay[1]; Orathai Sukreeyapong[1]

Office of Science for Land Development, Land Development Department[1]

Arsenic content and speciation in soil samples from paddy field during rice growth cycle of four plots: Pathum Thani1, Khao Dawk Mali 105, Red Hawn Rice and Riceberry were study by sequential extraction. The nine sequential extraction methods include: 1) water 2) ammonium nitrate 3) ammonium sulfate 4) ammonium phosphate 5) ammonium fluoride 6) hydroxylamine hydrochloride 7) ammonium oxalate 8) ammonium oxalate – ascorbic 9) nitric : perchloric. The sequential extraction results from Pathum Thani1 soils expressed arsenic was mostly in bound to Fe oxide (28.6%). Most arsenic in Khao Dawk Mali 105 soils during seedling, tillering and panicle initiation stage are residual form (24.7-26.5%), whereas arsenic in other stage bound to Fe oxide (26.3-28.2%). Arsenic in Red Hawn Rice soils and Riceberry soils were mostly in bound to Fe oxide (23.1-26.9% and 23.6-32.4 respectively). Moreover, arsenic mobility percentage in soil growing rice of Pathum Thani1, Khao Dawk Mali 105, Red Hawn Rice and Riceberry were 21.9, 24.6, 24.5 and 24.4 respectively.

Keywords: Arsenic, paddy field, soil, sequential extraction

Financial support: Agricultural Research Development Agency (Public organization)

(3116 - 738) Attenuation of lead accumulation in rice grains with iron amendment on paddy soil and related to iron oxides formation in rhizosphere

Kai-Wei Juang[1]; Pei-Rong Du[1]; Yu-Cheng Lai[1]; Chien-Hui Syu[2]; Dar-Yuan Lee[3]

Department of Agronomy, National Chiayi University, Chiayi City, Taiwan[1]; Taiwan Agricultural Research Institute, Council of Agriculture, Executive Yuan, Taiwan[2]; Department of Agricultural Chemistry, National Taiwan University, Taipei City, Taiwan[3]

Accumulation of lead (Pb) in paddy soils exposed to various pollution sources has been posing risk to the food safety of rice (*Oryza sativa* L.). So far few studies were conducted on the uptake and distribution of Pb in rice plant, the Pb toxicity to rice plant growth and grain yield, and the differences among rice cultivars in Pb uptake and accumulation from soil. Recently, the iron oxides deposited on both the soil solid and the root surface in the rhizosphere have been found to be related to the Pb accumulation in rice plants. The use of agronomical practices and soil management techniques to enhance iron oxides deposited in the rhizosphere of paddy could prevent Pb levels in brown rice from exceeding the allowable level (0.2 mg kg^{-1}). In this study, a field experiment was conducted to evaluate the effectiveness of iron chloride treatment in paddy soil on reducing the Pb concentration in rice grain and to examine the relationships between iron oxides formation in rhizosphere and Pb accumulation in rice plant. The study site is a paddy field located in Wuxi river basin, central Taiwan, contained soil Pb concentrations in a range about 100-600 mg kg^{-1}. Four cultivars of Taiwan rice, that include three japonica rice (TK9, TK16, and KH145) and one indica rice (TCS10), were used in the experiment for illustration. The treatment level of iron chloride ($FeCl_3$) was as about 1000 mg-Fe kg^{-1}. In the results, the $FeCl_3$ amendment significantly reduced the soil available Pb in rhizosphere and the Pb concentrations in rice plant. The $FeCl_3$ amendment enhanced the Pb sequestration by the iron oxides on rhizosphere rather than on root surface. More strongly sequestered Pb by iron oxides on rhizosphere soil would result in less Pb accumulation in rice grain. In summary, the iron oxides deposited on rhizosphere maybe dominated the Pb sequestration and retarded the Pb absorption by rice plant. One could try to enhance iron oxides deposited on rhizosphere with $FeCl_3$ amendment to reduce Pb absorption by rice plant in a potentially contaminated paddy field.

Keywords: Heavy metal; paddy soil; rhizosphere; radial oxygen loss; iron plaque

Financial support: The Council of Agriculture of Executive Yuan, Taiwan (Grant Nos. 105AS-8.5.2-IEb1 and 106AS-15.2.4-CI-C2)

(9600 - 2957) Can fungi and bacteria counting be used as an indicator of soil recovery?

Thaís Soto Boni[1]; Kátia Luciene Maltoni[1]; Adriana Avelino Santos[2]; Ana Maria Rodrigues Cassiolato[1]

Unesp - Ilha Solteira[1]; [2]

The soil microbiological community study can be useful to indicate if changes are occurring, allowing in a short period of time to evaluate if a degraded soil is in recovery or not. The objective of this work was to evaluate the number of colonys forming units (CFU) of bacteria, and fungi, in a degraded area submitted to recovery processes, to verify if these can be used as recovery indicators of degraded soils. The experiment was conducted in the Cerrado domain, at central-western region of Brazil, municipality of Selvíria/MS, in an area degraded in 1960s, during Hydroelectric Power Plant construction. This area had the vegetation, and soil layers (10 m deep), removed, and remained without signs of recovery for 50 years. To induce the recovery, 3.4 ha of this area were mechanized, conditioned with residues organic (macrophytes, 0.0 to 32 t ha^{-1}) and agroindustrial (ash from sugarcane bagasse, 0.0 and 45 t ha^{-1}), in nov/2011, all with 03 replicates, established in plots of 600 m^2, which received 1,080 seedlings of 10 different Cerrado tree species (feb/2012), with the intention of inducing the soil recovery. After 5 years, the soil colonization by bacteria and fungi was evaluated, from composed samples (6 simple),

from 0.0-0.1 m deep, of experimental area (EA), degraded area without intervention (DAWI) and conserved Cerrado (CER). After sieved (2 mm), 10 g of soil received 90 mL of saline solution (0.85 %), and the serial dilutions (10^{-2} to 10^{-4}) were prepared and inoculated on petri dishes, with specific culture media, which were incubated at 28 °C for 3 days. Agar (pH 6.5) was used as a medium for bacteria, and Sabourad (pH 5.5) medium, plus colony reducer and antibiotic were used for fungi. The results, submitted to variance analysis and Dunnett's test ($p < 0.05$), showed different number of CFU among residue and areas. The number of CFU bacteria was quite high for CER and different of the other areas (966.66, 95.33 and 2.33 x 10-4 CFU mL^{-1} soil, for CER, EA, DAWI, respectively). The number of fungal CFU did not show differences among the considered situations, suggesting that these are common occurrences even in degraded areas. However, the CFU of bacteria pointed up to recovery, approaching the values of the CER and surpassing the DAWI. In this way, the interventions performed were positive, the CFU of bacteria were more sensitive to the treatments, and indicated recovery of the area under anthropic intervention.

Keywords: bare soil, residues, macrophytes, ash, Cerrado.
Financial support: CNPq and Capes

(8830 - 1517) Edafic mesofauna in constructed minesoil under different perennial grasses

Eloy Antonio Pauletto[1]; Luiz Fernando Spinelli Pinto[1]; Lizete Stumpf[2]
Universidade Federal de Pelotas[1]; Universidade Tecnológica Federal do Paraná – Campus Dois Vizinhos[2]

The reestablishment of the ecological balance of the post-mining soil depends primarily through the revegetation of the recomposed area, because the plants are responsible for the recovery of the landscape, for the control of the erosive processes and for the re-adaptation of the attributes of the constructed minesoil. Therefore, as already observed in soils under agricultural management, the type of vegetation cover can interfere in the population of the organisms of the constructed minesoil, reducing its density and diversity in relation to non anthropized natural areas. The objective of this work was to evaluate the influence of perennial grasses on chemical attributes and the population of mites and springtails of a constructed soil after coal mining. The study was conducted in a coal mining area, located in Candiota, State of Rio Grande do Sul. The treatments evaluated were: T1 – Hemarthria altissima; T2 – Cynodon dactylon cv Tifton 85; T3 – Paspalum notatum cv. Pensacola; T4 – Urochloa brizantha; T5 – spontaneous vegetation. For comparative effects were used the control treatments: T6 – soil constructed without vegetation; T7 – soil constructed under native vegetation for 15 years and the T8 – natural soil. In 2014, 64 soil samples were collected in 0.00-0.10 m soil layer for the determination of chemical attributes and soil mesofauna. After 11 years of revegetation, the different perennial grasses were efficient in promoting adequate conditions for the survival of mites and springtails when compared to the soil constructed without vegetation and the soil constructed under native vegetation for 15 years. However, in relation to the natural soil, the biological quality of the soil constructed is still much lower. The Hemartria altissima was the species that highlighted positively among the perennial grasses, providing better conditions for the survival of mites and springtails, until the present moment. The chemical soil condition showed a positive relationship with the development of plants and presence of mites and springtails.

Keywords: Mites; springtails; pH; acidity; principal component analyses
Financial support: CNPq

(5213 - 227) Effect of diesel and engine oil on the growth and yield of tomato (*Lycopersicon lycopersicum*)

Dr. S. Amhakian[1]; Audu Aminu[1]
Kogi State University, Nigeria[1]

This study evaluates the influence of diesel, engine oil, combined diesel and engine oil, and NPK fertilizer (NPK 15-15-15) on soil physico-chemical properties, growth and yield of tomato (Lycopersicon lycopersicum) during 2014 cropping season. The pot experiment was conducted at Faculty of Agriculture Complex, Kogi State University and the field experiment was conducted at Kogi State University Students Research and Demonstration Farm, Anyigba. The pot experiment was a Completely Randomized Design (CRD) and field experiment a Randomized Complete Block Design (RCBD) with fourteen treatments and three replicates. Results of the research showed that applied diesel, engine oil and mineral fertilizer (NPK) significantly influenced soil physical properties both in pot and field experiments. Application of diesel, engine oil and NPK fertilizer significantly ($p \leq 0.05$) increased nitrogen, available phosphorus, calcium, potassium, lead and copper while combined diesel and engine oil significantly ($p \leq 0.05$) increased organic carbon and soil p^H under both pot and field experiments. In this research, it was observed that all growth parameters (plant height, number of leaves and stem girth) decreased with application of diesel, engine oil and their combinations, while plots treated with NPK fertilizer alone (D0E0+NPK) gave higher fruit yield. However, single rates of diesel and combined diesel and engine oil showed severe decrease in all the growth and yield parameters. This study has demonstrated that diesel and engine oil had negative significant ($p \leq 0.05$) effect by affecting some soil chemical parameters such as Mg and Na, increased copper and lead uptake, and reduced growth performance whereas, mineral fertilizer application encouraged high growth and yield of tomato.

Keywords: Engine Oil, Diesel, Mineral Fertilizer, Phosphorus
Financial support: TETFUND

(4698 - 805) Effect of the incorporation of cu and fe nanoparticles in the availability of cadmium in agricultural soil

jonathan suazo[1]; Maria de la luz Mora[1]; Nicolas arancibia Miranda[2]
Universidad de la Frontera[1]; Universidad de Santiga de Chile[2]

The prolonged use of phosphate fertilizers and sewage sludge in Chilean agricultural soils to supply nutrient demand has led to the accumulation of Cd. Cd in soils can be absorbed by plants and subsequently enter the food chain, which can cause diseases such as bone degeneration, renal dysfunction, liver damage in humans. Considering this situation, the use of nanoparticles (NPs) to stabilize and decrease the mobility of Cd is an economical and efficient alternative because they have a high surface area and high reactivity. Accordingly, the objective is to evaluate the availability of Cd in agricultural soils after the incorporation of FeNPs and CuNPs. In this work, Fe and Cu NPs were synthesized according to Qing-ming et al., 2012. The adsorption kinetics were made with 1 g of soil, 10% NPs and 200 $mg \cdot L^{-1}$ Cd^{2+}, 0.01 M KNO_3, at pH = 4.0. For incubation, 27 mL of a solution of Cd^{2+} (200 mg L^{-1}), 0.01 M KNO_3, pH = 4.0 and 10% NPs were added to 100 g of Ultisol soil ((Collipulli, (HA)) and sequential extraction was performed at day 1, 30 and 60. The sorption kinetics of Cd^{2+} in Collipulli (C), and C-10% CuNPs and C-10% FeNPs showed a better adjustment to the pseudo second order model, being the sorption capacity (q_e) by Cd^{2+} C>C-10% CuNPs> C-10% FeNPs. Whereas incubation showed that, after adding 10% CuNPs the availability of Cd^{2+} increased, because it shifted from the reducible fraction to the exchangeable fraction. In similar way, 10% of FeNPs significantly increased the concentration of Cd^{2+} bound to the exchangeable fraction and reducible fraction, in addition to acid components. Therefore, it was concluded that FeNPs and CuNPs increase the availability of Cd^{2+} in agricultural soils.

Keywords: nanoparticles, soil , remediation
Financial support: The author thanks to the Comisión Nacional de Investigación Científica y Tecnológica (CONICYT-Chile) Ph.D. scholarships Nº 2117168

(2424 - 1611) Identification and classification of strong and severe soil degradation in Capão do Leão municipality, Rio Grande do Sul State, Brazil

Luiz Fernando Spinelli Pinto[1]; Ricardo Decker da Cruz[2]; Pablo Miguel[1]
Universidade Federal de Pelotas[1]; Mineral do Brasil[2]

The Global Assessment of Soil Degradation, GLASOD, has been used to assess the status of worldwide soil degradation considering the type, extent, degree, rate and causes of degradation. The present work aimed to identify, quantify and classify the strong and severe soil degradation in the municipality of Capão do Leão, Rio Grande do Sul State (Southern Brazil), through the use of geotechnologies. Besides the degree of degradation (strong or severe), in order to perform a local scale classification it was proposed a more detailed classification criteria including the identification of the agent of the degradation (agriculture, mining, urbanization, construction activities, borrow areas, flood, etc), the specific agent of the degradation, the erosive activity (weak, moderate, strong, and very strong), and the reclamation complexity type (0 to 4 in order of complexity). A total of 744 degraded areas were identified, varying in size, shape and intensity, totaling 474.9 ha (0.61% of the municipality area). Mining (sand, granite and clay) was the main agent, corresponding to 361.4 ha of the degraded areas (76% of the total), followed by borrow areas (61.8 ha - 13% of the total), mainly for dams and roads. Of the total, 69 areas (224.27ha or 47%) are in a degree of extreme degradation with strong or very strong erosive activity, requiring a reclamation that involves a continuous intervention with topographic conformation (3 and 4 order of complexity), needing redirection of use in some cases (4 order of complexity).
Keywords: GLASOD, severe soil degradation, mining, reclamation
Financial support:

(7068 - 793) *In Situ* Field-Scale Immobilization of Lightly-moderately Cadmium-Contaminated Paddy Soil Using Soil Amendments

Jiachun Shi[1]; Long Meng[1]; Laosheng Wu[2]
Zhejiang University[1]; University of California, Riverside[2]

In southern China, Cd-tainted rice produced in Cd-contaminated acidic paddy soils is a serious health concern. In order to develop effective management practices to reduce Cd uptake from soil by brown rice, four soil amendments(e.g., lime, biochar, soil conditioner and seaweed organic fertilizer) combined with two rice cultivars(Yongyou17, YY-17; and Xiushui09, XS-09) with different Cd accumulation abilities were selected to evaluate the efficacy of in situ immobilization in a lightly-moderately Cd-contaminated paddy soil. Results showed that lime, biochar and soil conditioner significantly increased soil pH and reduced Cd bioavailability compared with control. Linear regression analysis showed that the decrease in Cd bioavailability was significantly and positively correlated with soil pH increase ($P < 0.001$). The Cd concentrations in brown rice were 0.34 and 0.22 mg kg^{-1}, respectively, in controls for the cultivars, while the rice produced from the soil amendment treated plots was lower than the China Food Safety National Standard limit of Cd (0.2 $mgkg^{-1}$). Considering the costs and the convenience of actual practice, the soil conditioner was the best amendment. In conclusion, in situ immobilization combined with low Cd accumulation rice cultivar is an effective approach for food safety in lightly-moderately Cd-contaminated acidic paddy soils.
Keywords: Cadmium (Cd); Rice (Oryza satica L.); Soil Amendments; In situ immobilization; Bioavailability
Financial support: This work was jointly supported by the National Key Research and Development Program of China(2016YFD0200106), the National Key Technology Support Program (2014BAD14B04), and the National Natural Science Foundation of China (41571450, 41271470).

(4250 - 1715) Mycorrhizal spores distribution in soil under ecological restoration systems of Atlantic Forest in Paraná State, Brazil

carlos alberto casali[1]; Fernando Campanha Bechara[1]; Letícia de Alcântara Dores[1]; Paula Edriane Saugo[1]; Fernanda Gama Siqueira[1]; Bruna Larissa Feix[1]; Luiz Antônio Zeni do Prado[1]; Vinícius Renan Spiassi[1]; Anna FLávia Neri Almeida[1]; Flávia Lima Moreira[1]
utfpr-dv[1]

Paraná state accounts for 20% and 8% of grain and animal Brazilian productions, respectively (SEAB-PR, 2015). Those numbers were reached due to indiscriminate occupation and deforestation of the Paraná Atlantic Forest, mainly araucaria forests. Thus, an ecological restoration of several areas is needed, mainly to adapt rural properties to the new Brazilian forest code (Federal Law 12.651 / 2012). Ecological restoration takes place through human interventions that seek to improve and accelerate ecological succession, including soil. The objective of this study was to evaluate the effect of ecological restoration systems on soil arbuscular mycorrhizal fungi (AMF) in Paraná Southwest, Brazil. The study was carried out in experimental area to Universidade Tecnológica Federal do Paraná, Campus Dois Vizinhos (UTFPR-DV) (geographic coordinates 25º41'40.47 "S and 53º06'12.82" W), with 502 m of altitude on Subtropical Humid climate and average rainfall of 2,044 mm. The Biome is Atlantic Forest with elecotono between Mixed Ombrophylous Forest and Semidecidual Seasonal Forest on a red Nitosol. From the 80's until 2009 the area was cultivated with annual crops. In December 2010, the following treatments were implemented: passive restoration (RP); planting of trees in total area under fill and diversity (PA) lines; and nucleation (NC), under a randomized complete block design and 4 replicates. A marginal secondary forest was used as a reference area. In November 2016 the soil was sampled in the 0-5 cm layer, which were sieved in 2.0 mm and stored in a refrigerator. The AMF spores were extracted according to the wet screening method (Gerdemann; Nicolson, 1963) and computed by Binocular Stereoscope. The data were submitted to analysis of variance and when significant the Scott-Knott's test was applied at 5% probability. There was a significant effect of ecological restoration systems on the total amount of AMF spores in the soil, to the planting of trees differing from passive restoration and nucleation. However, none of the restoration systems reached the amount of spores that where found in established secondary forest soil, indicating that the areas are still in restoration process. In conclusion, planting tree is more efficient ecological restoration technique than passive restoration and nucleation to soil biological conditions improvement in Southwest of Paraná.
Keywords: ecological succession; soil microbiology; mycorrhizae.
Financial support: Fundação Araucária

(5301 - 485) Optimization of Pollution Induced Community Tolerance (PICT) method for evaluation of soil pollution by heavy metals.

Claudia Campillo-Cora[1]; Vanesa Santás-Miguel[1]; Juna Carlos Nóvoa Muñoz[1]; Manuel Arias Estévez[1]; David Fernández Calviño[1]
Universidade de Vigo[1]

The monitoring of soils under high risk of heavy metal toxicity, as well as the design of actions to minimize the impacts of heavy metal s accumulation in the soils are needed. However, there is an important problem to be solved. What heavy metal concentration must be taken for regulatory and/or remediation actions? The answer is quite complex for multiple reasons. Background levels of heavy metals in soils are highly variable depending on soil parent material, and also, their availability is not usually directly related to their total

concentration in the soil, as it depends on soil parameters such as pH, organic matter content or the diversity and amount of inorganic colloids. Therefore, indicators that provide information about the real effects of heavy metals pollution on soil functions become necessary. Indicators based on soil microorganisms may be useful as they play a key function in many ecosystem services. Among them, the Pollution Induced Community Tolerance (PICT) is one of the most promising and sensitive tools. Thus, if we detect an increase in microorganisms communities tolerance to any heavy metal, then this would be a direct consequence of soil pollution with that heavy metal. However, this method is not well developed yet and it presents different shortcomings that should be assessed and solved before PICT spreading for the assessment of heavy metals pollution in soils. The general aim of this work is to improve the performance of the PICT to heavy metals in soils using bacterial communities extracted from non-polluted soils, and estimate the bacterial community growth using the ^{3}H leucine incorporation method adapted for soils (Bååth, 2001; Soil Biology & Biochemistry 33, 1571-1574). Heavy metals tolerance of the bacterial community was measured essentially according to Fernández-Calviño et al. (2011; Soil Biology & Biochemistry 43, 2324-2331). Bacterial community tolerance to Cu, Zn, Ni, Pb and Cr was optimized in relation with pH, type of buffer and dissolved organic matter (DOM) in order to exclude tolerance detection artifacts. The results showed that 20 mM MES buffer solution at pH 6.0 can be used for a wide range of soils differing in pH (4.0-8.0). The occurrence of DOM in the bacterial suspension did not affect the bacterial community tolerance to Cr, Ni or Zn, but the presence of DOM can overestimate the bacterial community tolerance to Cu and Pb, for which the use of correction factors are needed.

Keywords: Microorganisms; Sustainability; Bacterial Communities; Tolerance; PICT.

Financial support: Project "Evaluation of soil pollution by heavy metals. Use of soil microbial communities as indicators of sustainable land use" financed by Ministerio de Economía, Industria y Competitividad (Spanish Government). CTM2015-73422-JIN

(5540 - 1086) Potential of Dichlorodiphenyldichloroethylene (DDE), and Dichlorodiphenyldichloroethane (DDD) degrading endophytic bacterial strains in enhancing phytoremediation

Ahmad Mahmood[1]; Ryota Kataoka[1]
Faculty of Life and Environmental Sciences, University of Yamanashi, Kofu, Japan[1]

Excessive use of certain pesticides led to widespread pollution throughout the world, and has become serious environmental problem due to their recalcitrant behavior, bio-accumulation potential, and toxicity towards living beings. The removal of such pollutants has been carried out by physical, chemical, and biological methods; where the biological methods include phytoremediation, and bioremediation. However, the integration of both is aimed at showing better results, and recently, the endophytic microbes assisted phytoremediation has gained importance due to potential degradation by the endophytes, stability of the environment, and better remediation. The following study was planned to find potential endophyte strains from *Cucurbitaceae* family which is considered accumulator of organochlorines. Bitter gourd, pumpkin, and zucchini stems from 2 months old plants were cut into small discs under aseptic conditions, and were subjected to endophytic bacterial isolation, after surface sterilization using sodium hypochlorite, and ethanol, spreading the suspension on R2A agar, and potato dextrose agar (PDA). A total of 80 endophytic bacteria, R2A (52), and PDA (28) were isolated, and were checked for possible degradation of Dichlorodiphenyldichloroethylene (DDE), and Dichlorodiphenyldichloroethane (DDD) by growing the strains with 5 ppm DDE, and DDD for two weeks, in broth media, followed by extraction of remaining chemicals using hexane, and measured using Gas Chromatography-Mass Spectrometry (GC-MS) against blank, and a set of standards, subsequently the final values were determined. Certain strains showed the potential of pollutant degradation (~73.2% DDE, and ~57.7% DDD), however, 17 most degrading strains (15.5-73.2% DDE, and 12.7-57.7% DDD) were selected for further analysis including growth in mineral salt medium with the pollutants as sole carbon source, and it was observed that except two, all other strains were found utilizing the either pollutant as sole carbon source on varying extents, and metabolized either, or both pollutants (Degradation percentage: ~38.7% DDE, and ~44.6% DDD). It is concluded that endophytic strains have potential role in phytoaccumulation of certain chemicals, and the synergism can be manipulated for enhanced remediation of polluted soils. The stability of endophytic environment also proposes the use of this alliance in co-contaminated soils, along with possible increase in bioavailability which still needs to be explored.

Keywords: bioremediation; Cucurbitaceae; endophyte; pesticide pollutants; phytoremediation.
Financial support: University of Yamanashi

(4923 - 1603) Quality Reference Values (QRVs) of metals in soils of Alagoas State, Brazil.

Adriano Barboza Moura[1]; Gilson Moura Filho[1]; Leila Cruz da Silva[1]; Guilherme Bastos Lyra[1]; André Moreira de Souza Filho[2]
UFAL[1]; CENPES/PETROBRAS[2]

The Quality Reference Values (QRV) are values that quantify the natural concentration of chemical elements in soils without anthropic influence, creating instruments for diagnostics of soil quality. Due to the distribution of soils in Alagoas, there's a wide variation in regards to the concentration of inorganic substances, however, since there isn't a QRV determined for the state, values developed for other states are used instead, which can bring inconsistences. The objective of this work was to establish Quality Reference Values to soils in Alagoas state, in compliance with the Resolution n0 420, of the 28th of December, 2009, from Conselho Nacional do Meio Ambiente – Conama. 56 soil samples were collected to represent the main classes of soil of the state, in areas under none or minimal anthropogenic action for the subsequent analysis of inorganic substances through the USEPA 3051a method, as well as physical and fertility analysis. The QRVs based on the 90th percentile for the soils of Alagoas state were (mg kg-1): Ag (< 0,003), As (0,66), Ba (133,48), Cd (0,21), Co (11,94), Cu (19,06), Cr (42,93), Fe (28.726,61), Hg (0,11), Mn (591,65), Mo (0,32), Ni (17,69), Pb (19,35), Sb (1,58), Se (1,55), V (42,07) and Zn (26,16). The QRVs established for the soils of Alagoas state were lower than the precaution values preconized by Conama.

Keywords: Heavy Metals, Environment Protection, Reference Values.
Financial support: CENPES/PETROBRAS

(4255 - 621) Revegetation of saline tailings contaminated with arsenic from gold mining

Lorena Abdalla de Oliveira Prata Guimarães[1]; Luiz Eduardo Dias[2]; Igor Rodrigues de Assis[2]; Amanda Longhi Cordeiro[3]
Incaper[1]; UFV[2]; INPA[3]

The processing of gold ores exploited in Paracatu, Minas Gerais, generates sulfide tailings that are challenging for revegetation, mainly because of the high content of arsenic (As) and salinity. The use of cover layers, called top layer (TL) and capillarity break layer (CBL), is an alternative to enable revegetation. The TL serves as a substrate for plant growth. The CBL prevents the capillary rise of solution containing As, metals and salts, avoiding the contamination of the planting substrate. The aim was to compare materials for the composition of these layers. The layers were spread on a blend of tailings of processing of ore B1 and B2 (called blend). The CBL was formed with limestone, when present. The TL was composed of tailings B1, blend, saprolite B1 or topsoil. Six treatments were evaluated: tailings B1 (T1),

blend (T2), saprolite B1 (T3), topsoil (T4), topsoil + limestone (T5), and saprolite B1 + limestone (T6). Thus, CBL was added only in T5 and T6 (TL + CBL). The T1, T2, T3 and T4 were established only with TL. The bottom of plastic containers of 1.0 m^3 was filled with the blend. Then, the CBL was added (when present). TL was deposited at the top (directly on the blend in the treatments without CBL). Seeds of leguminous species (*Crotalaria spectabilis*, *Stylosanthes capitata*, *S. macrocephala*, *Panicum melinis* and *Lolium multiflorum* Lam) were sown in all plots equally. The design was randomized blocks, with three replications. Six months after sowing, shoot dry matter of plants (DM) were evaluated. The DM values in T1, T2, T3, T4, T5 and T6 were, respectively: 0.30, 0.00, 1.94, 1.16, 1.36, and 1.96 t ha^{-1}. The treatments with saprolite B1 presented the highest DM values statistically. The low or absent biomass production in T1 and T2 showed that tailings B1 and blend are not suitable as substrate for plant growth. Possibly the main limiting factors were the high levels of As and electrical conductivity. Results from other studies have shown that factors such as salinity, As availability and physical characteristics of materials used as TL are more determinant for biomass production than the fertility. In the conditions evaluated, the presence of CBL did not provide benefits for the biomass production. It is necessary to use cover layers to enable the revegetation of tailings. The materials most suitable for the TL composition are the saprolite B1 and topsoil, with or without CBL. The saprolite B1 is the most economically viable alternative.

Keywords: sulfide substrates, cover layers, environmental reclamation

Financial support: Kinross Gold Corporation (providing the materials and resources). CAPES and CNPq (scholarship).

C3.5.4 - Antibiotics and their resistance in agricultural food production

(8405 - 2983) Assessing the impact of vermicomposting on bacterial community size and structure, and antibiotic resistance attenuation

Lorena Uribe-Lorío[1]; Lidieth Uribe[2]; Daniela Vidaurre[1]
Centro de Investigación en Biología Celular y Molecular, Universidad de Costa RIca[1]; Centro de Investigaciones Agronómicas, Universidad de Costa RIca[2]

Worldwide, the use of cow manure and compost like vermicompost as fertilizers it's a common practice in agriculture, and it's considered that this practice have exclusively positive effects in the soil and environment. However, it is now known that manure from cows treated with antimicrobials is a major source for the expansion of the antibiotic resistance gene (ARG) reservoir in the environment. Here, we tracked the abundances of bacteria resistant to Streptomycin, Oxytetracycline and Gentamicin (commonly used in agriculture and veterinary practice in Costa Rica), and the composition and structure of the bacterial communities in manure and vermicompost, using next generation sequencing of V3-V4 fragment of 16S RNA gene. DNA was extracted from fresh samples of cow manure and vermicompost prepared using same manure, and from liquid culture supplemented with antibiotics (10 ug/ ml) inoculated with 0.5 ml of each sample and incubated for 24h at 35 °C. DNA samples were processed in Macrogen Inc. (Korea) using MiSeq platform. The Qiime bioinformatics workflow (www.qiime.org) was used in order to obtain the final OUT table. Statistics were performed using Primer7 software (Quest Research Limited). A total of 366 OTUs were obtained including all the samples, with a minimum abundance of 0.01%. 145 OTUs were observed exclusively from cow manure (39.6%) related samples (raw sample and inoculated broths) dominated by phylum Firmicutes. 51% of the bacteria present in the raw sample grow in presence of antibiotics, 69% of them were Firmicutes, mostly Clostridiales. Resistant bacteria were dominated by tetracycline-gentamicin phenotype. 104 OTUs were observed only in Vermicompost samples, and, contrary to cow manure sample, were dominated by Proteobacteria (55.8%), and Bacteroidetes phylum (26%), with a different composition and distribution of OTUs. Interestingly, only 23% were resistant bacteria present in samples of antibiotic supplemented broth, majorly resistant to streptomycin-gentamicin. These results confirms the presence of abundant antibiotic resistant bacteria in cow manure and suggest that vermicomposting, as a waste management practice, can reduce, but not eliminate, the overall abundance of these bacteria, highlighting the importance to evaluating the use of these materials as bio-fertilizers in the agroecosystems.

Keywords: Next generation sequencing (NGS), Vermicompost, Antibiotic resistance

Financial support:

(3360 - 554) Root-uptake and dissipation of selected pharmaceuticals in soil-water-plant system

Radka Kodesova[1]; Ales Klement[2]; Oksana Golovko[3]; Miroslav Fer[2]; Olga Koba[3]; Martin Kocarek[2]; Antonin Nikodem[2]; Roman Grabic[3]
Czech University of Life Sciences Prague, Kamycka 129, CZ-16500 Prague 6, Czech Republic (kodesova@af.czu.cz)[1]; Czech University of Life Sciences Prague, Kamycka 129, CZ-16500 Prague 6, Czech Republic[2]; University of South Bohemia in Ceske Budejovice, Zatisi 728/II, CZ-389 25 Vodnany, Czech Republic[3]

Pharmaceutical, which are not entirely removed from wastewater in wastewater treatment plants, can pollute soils, if contaminated water is used for irrigation. Their mobility and potential root-uptake by plants depends on their behavior in soils, i.e., their sorption and degradation that depends on soil conditions. This study focused on a root uptake of one antibiotic sulfamethoxazole, beta blocker atenolol and analgesic carbamazepine from 3 soils: Chernozem, Cambisol and Arenosol. Five plants (radish, arugula, lettuce, spinach and green peas) planted in those soil were initially irrigated by fresh water and next (3 or 4 weeks)with water contaminated by a single compound or their mixture. After the harvest, each plant was divided into separate parts: roots (including bulbs of radish), leaves, stems (green peas) and pods (green peas). Plant tissues and soils were freeze-dried and dry-masses and concentrations of pharmaceuticals and their metabolites were measured. Despite that sulfamethoxazole and atenolol relatively rapidly dissipate from soils, they and metabolites of atenolol were detected in all plants. Carbamazepine is very stable in soils and fractions of its metabolites are usually low. However, very high concentrations in all plants were measured not only for carbamazepine but also for its metabolites. The degree of compounds' transformation depended on a plant family. Larger concentrations of carbamazepine metabolites were measured in leaves of lettuce, spinach and green peas than in leaves of radish and arugula (Order – Brassicales, Family – Brassicaceae).Transformation of compounds in plant bodies is attributed to enzymes CYP450.The impact of soil type on compound's uptake was not proven for all tested plants. The impact of application (single compound versus compounds' mixture) differed for different plants. Antibiotic sulfamethoxazole likely reduced dissipation of other two compounds in soils, which increased concentrations of compounds in plants. Another source of soil contamination is a sewage sludge used for soil amendment. Thus our study also focused on spinach-uptake of pharmaceuticals from seven soils mixed with the sewage sludge. For instance, while large amount of antibiotic clarithromycin (which is strongly sorbed in soils and very stable in this environment) was found in plant tissues, amount of antibiotic clindamycin (that is considerable less strongly sorbed in soils and less stable) was negligible, likely due to its dissipation.

Keywords: pharmaceuticals; metabolites; root uptake; degradation; sorption

Financial support: Czech Science Foundation, Projects No. 17-08937S and 13-12477S

(8795 - 3032) Veterinary Pharmaceutical Adsorption on Soils Amended with Biochar

Gonzalo Tapia Ulloa[1]; Mónica Antilén Lizana[1]; Gustavo Curaqueo Fuentes[2]
Pontificia Universidad Católica de Chile[1]; Universidad Católica de Temuco[2]

Over the last years, it has been of great interest the study related to the fate of the pharmaceutical waste, because around 75% of the administrate fluoroquinolones has been excreted in their bioactive form, that may be retained in soils or be leached to groundwaters. On the other hand, materials with high content of C, like the Biochar, can be used like a remediation system, due to their high capacity to retain organic compounds. The main objective of this study was to evaluate the impact of the biochar in the sorption of three antibiotics on two soils (one of alluvial origin and other of volcanic origin) amended with two different doses of biochar (25 and 50 ton/ha). The biochar comes from pyrolyzed oatmeal husk at 300°C. The physical-chemical characterization was carried out by using recommended methods for Chilean soils and the variable charge surface through electrophoretic migration. Sorption and kinetic studies were conducted by batch-type experiments, where the concentration of the analyte was determined by HPLC-DAD. The results of the characterization of the samples shows a significant variation with high doses of Biochar, while the surface charge present a high variable negative charge. The chromatography method was optimized, obtaining good linearity, precision and sensibility for the antibiotics studied. The results obtained for the kinetic adsorption of Ciprofloxacin in the alluvial soil (control soil and amended soil) shows a fast adsorption, where the maximum adsorption was obtained at 1h between the soil and the antibiotic. From these results it is obtained that the biochar influences on the adsorption of ciprofloxacin, because the samples amended with biochar shows an increase of the maximum adsorption of this antibiotic. With these results it is possible consider the biochar as a potential immobilizer of antibiotics of contaminated soils.
Keywords: Soil; Adsorption; Biochar; Fluoroquinolones
Financial support: Fondecyt 1130094 (M. Antilén), 11140508 (G. Curaqueo) and CONICYT PIA/ACM170002.

C3.5.5 - Radionuclides in soils: pollution sources and sustainable remediation approaches

(8138 - 1661) Behavior of chlorpyrifos insecticide on two tropical soils

Rafael Marques Pereira Leal[1]; Murilo Martins Bernardino[1]; Indi Assis Rodrigues[1]; Eliane Vieira[2]; Júlia Carina Niemeyer[3]
Instituto Federal Goiano, Rodovia Sul Goiana, Km 01, Zona Rural, Rio Verde – GO, CEP: 75.901-970 - Brasil[1]; Instituto Biológico, Centro de Pesquisa e Desenvolvimento de Proteção Ambiental. Av. Conselheiro Rodrigues Alves, 1252 Vila Mariana - São Paulo, SP, CEP: 04014-002 – Brasil[2]; Universidade Federal de Santa Catarina. Rod. Ulysses Gaboardi, Km 03, Faz. Pessegueirinho, Curitibanos, SC, CEP: 89520-000 – Brasil[3]

The behavior of pesticides and their interactions in the dissipation processes are still poorly understood in tropical climate and soil conditions. The retention and transformation processes of pesticides depend mainly on the physicochemical characteristics of the compound and the soil, in addition to local climatic conditions and management, thus making these processes unique to each type of pesticide. Chlorpyrifos is an insecticide and acaricide belonging to the chemical group of organophosphates, and may have high retention and low mobility. The objective of this study was to determine the sorption coefficients (Kf) of the chlorpyrifos pesticide in two tropical soils of contrasting texture (clayey and sandy), as well as to evaluate the mineralization at different depths, quantifying the percentage of extractable and non-extractable residues connected) on the ground. The soils used in the tests were Latossolo Vermelho distroférrico and a Neossolo Quartzarênico órtico típico. The insecticide 14C-chlorpyrifos was used, the compound being quantified by Liquid Scintillation Spectrometry. The coefficient Kf varied from 21.56 to 41.77 mL g^{-1} for chlorpyrifos in the sandy soil and from 23.11 to 29.85 mL g^{-1} in the clay soil, and the highest values were observed in the layers surface, due to the greater amount of organic matter in these layers. The values found suggest a medium soil retention capacity. The values of the desorption coefficient (Kfdes) ranged from 30.17 ml g^{-1} to 89.0 ml g^{-1}, the highest values being found in the sandy soil surface layer. The chlorpyrifos had a mineralization rate of 20.33% in the clayey surface layer and 13.09% in the sandy soil surface layer after the 62 days of study. The higher pH values in the clay soil may have been the main factor influencing the higher mineralization in this soil. influenced the highest values of mineralization in this soil. It was concluded that in the studied soils, chlorpyrifos had low soil mobility potential and obtained higher mineralization values in clayey soils when compared to sandy soils.
Keywords: Sorption, mineralization, pesticides
Financial support:

9197 - 1652) Sorption, desorption and mineralization of atrazine in different tropical soils

Murilo Martins Bernardino[1]; Indi Assis Rodrigues[1]; Rafael Marques Pereira Leal[1]; Eliane Vieira[2]
Instituto Federal Goiano, Rodovia Sul Goiana, Km 01, Zona Rural, Rio Verde – GO, CEP: 75.901-970 - Brasil[1]; Instituto Biológico, Centro de Pesquisa e Desenvolvimento de Proteção Ambiental. Av. Conselheiro Rodrigues Alves, 1252 Vila Mariana - São Paulo, SP, CEP: 04014-002 – Brasil[2]

The dynamics and impact of pesticides on highly weathered tropical soils is still poorly understood. In general, highly used compounds, very or poorly sorbed, high persistence and toxicity, should receive priority attention. The objective of this work was to evaluate the commercialized quantities of the atrazine ingredient in the municipality of Rio Verde in the year 2013, to apply the Gus and Goss indices to the preliminary assessment of the environmental contamination potential of atrazine and to study its dynamics in two soils of contrasting texture (9 and 55% of clay), coming from three depths (0-10, 10-20 and 20-40 cm). In the year of 2013, 283.43 tons of atrazine were commercialized, being this the second active ingredient more commercialized in the region, which resembles the Brazilian reality, where atrazine was third more commercialized. Regarding the Gus and Goss indices, atrazine is classified as medium transport potential. In the sorption studies the Kf coefficients ranged from 3.69 to 10.09 mL g^{-1} for atrazine in sandy texture soil and 8.02 to 9.30 mL g^{-1} in clayey soil. These values indicate that atrazine in these soils has a high potential for leaching and, consequently, potential for contamination of the water table. The values of the desorption coefficient ranged from 8.28 ml g^{-1} to 26.77 ml g^{-1}, and the highest value was observed in a sandy soil. The pesticide had a mineralization rate of only 4.71% of the initial concentration applied during 62 days of study. The mineralization was higher in clay soil. It was concluded that, atrazine presented low sorption and mineralization in both studied soils. These results suggest a high transport potential of the pesticide, and consequently a high potential for contamination of water courses.
Keywords: Soil contamination, pesticides, pesticide dynamics
Financial support:

C3.6 - Salt-affected soils

D3.6.2 - Salinity mapping and modelling salinization processes

(2122 - 1850) Methodological limits for characterizing the hydrostructural behavior of a saline clayey soil (Kairouan region, Central Tunisia)

Montoroi Jean-Pierre[1]; Zarai Bessma[2]; Aroui-Boukbida Hanane[1]; Hachicha Mohamed[3]

IRD, IESS-Paris, Bondy, France[1]; INAT-INRGREF, LRVENC, Tunis, Tunisia[2]; INRGREF, LRVENC, Tunis, Tunisia[3]

In the laboratory, the hydrostructural characterization of a given soil sample consists in measuring the variation of its volume as a function of its mass water content. Firstly, the sample is saturated per ascencum with deionized water, by placing it on a calibrated sand column under a low hydraulic head pressure ranging from -100 mm to -20 mm. Once saturation is reached, the sample is dried in an oven at 30°C. During the desiccation phase, its volume and mass are automatically recorded at a regular time step. The final sample is dried at 105°C, weighted and its final volume measured using the vacuum plastic bag method. The acquired data make it possible to obtain the shrinkage curve of the sample. The approach is based on the implicit assumption that we reproduce the soil moistening by a weakly mineralized rainwater and a soil drying. The same methodology applied to a saline clayey soil of Tunisia shows some singularities. During the moistening phase reaching the most complete water saturation of the soil, it is found that the salinity of the soil solution varies. The 1/5 electrical conductivity measurements ($EC_{1/5}$) made on the initial sample (air-dried before moistening) and the final sample (oven-dried at 105°C) show a significant decrease. In contrast, the $EC_{1/5}$ measurements in the sand column and the EC of the deionized water indicate an increase in values. The continuous changes in the salinity of the soil solution are due to the mineral dissolution of salts precipitated in the porosity and to cationic desorption by the clay minerals. The change in soil salinity will influence the soil structure and, consequently, the shrinkage curve. The interpretation of shrinkage curves, relating to soils with variable salinity, will be more debatable. In conclusion, it would be wise to adapt the saturation method with deionized water when applied to saline soils. The ideal would be to saturate the soil with a water of a salinity and chemical composition identical to the salinity and chemical facies of the soil solution. As soil salinity is usually very variable, there is the question of finding the "ideal" saturation water. A saline groundwater directly supplying a given soil could be suitable. Reconstituting in the laboratory a water of a given salinity and chemical composition is also feasible, but would greatly extend the experimental protocol. In any case, normalization is necessary to compare the hydrostructural behavior of a soil with various salinities.

Keywords: Soil structure, Shrinkage, Salinity, Semi-arid region, Tunisia

Financial support: INRGREF-IRD

D3.6.3 - Salinity management and remediation of salt-affected soils

(7541 - 646) Agricultural gypsum as material to improve physicochemical conditions of soils with excess sodium

Johana Ballestero[1]; Amabelia del Pino[1]; Mónica Barbazan[1]

Facultad de Agronomia. Universidad de la República[1]

An excess of sodium (Na) in the cation exchange complex produces a soil with low permeability and porosity that difficult the development of the root system. In Uruguay, the excess of Na in soils has a natural origin and frequently the Na increases with the profile depth. These soils coexist associated with fertile soils, remaining in general as unproductive areas, so they have been little studied. In order to improve the productivity of these soils, the effectiveness of the agricultural gypsum was evaluated under laboratory (microlysimeters) and under field conditions (with an implanted pasture). The Ap horizon of the selected soil was thoroughly mixed with two commercial sources of gypsum, at equivalent rates of 0, 3 and 6 Mg ha^{-1}, and placed in microlysimeters. The leached and interchangeable cations were determined periodically, with destructive soil sampling. In the field experiment, the gypsums were applied on surface, at equivalent rates of 0, 1, 2 and 3 Mg ha^{-1}, in implanted pasture of Festuca arundinacea. In the pasture were determined yield and nutrient absorption, and in the soil, chemical and physical properties were determined at different depth. In the treated soil of microlysimeters, the exchangeable Na decreased 11, 26 and 35%, while the exchangeable Ca increased 63, 70 and 71% at day 90, 180 and 360 after the application of the treatment, respectively. At the end of the study, a lineal and positive correlation was established between exchangeable Ca and total leached Na ($r = 0.72$). In the field experiment, the pasture yield in the treated plots was 50% greater than the control, and absorbed 54% less Na. No significant differences in yield were observed between rates or between sources of gypsum. The treated soils had higher exchangeable Ca and lower exchangeable Na than the control soil, and 37% more moisture content in the first 5 cm of the soil profile after 14 months of gypsum application. The soil pH tended to decrease in time and the difference remained at depth. The resistance to penetration decreased significantly in the treated soils. The agricultural gypsum was effective to improve the soil conditions at layer 0 – 5 cm the profile. More specific studies are needed that include the physical and chemical properties of the entire soil profile to give recommendations for the use of gypsum in our production conditions.

Keywords: sodic soils; microlysimeter; exchangeable calcium

Financial support: Partially Nidera and University of the Republic, Uruguay

(9953 - 807) Analysis on cultivated land low-carbon management countermeasure under World City Construction

Zhao Yongzhi[1]; Wang Shengtao[1]; Guo Ning[1]

Beijing Soil and Fertilizer Extension Service Station,[1]

With rapid progress urbanization in China,this paper discussed the great signification of low-carbon city and low-carbon civilization development for Beijing to be a world city.On the basis,suggested low-carbon agriculture was an important component of achieving low-carbon city construction.And proposed to promote cultivated land low-carbon management in Metropolitan could be a vital way toward low-carbon agriculture development. Analysis and discussion of cultivated land low-carbon management implementation methods, combined with urban agriculture characteristics and land resources.It provided references for metropolitan agriculture sustainable development,Eco-living and environmentally friendly urban construction under global climate change.

Keywords: global climate change; World City; cultivated land; low-carbon management; route

Financial support: Research and promotion of the Soil Testing and Formula Fertilization in Beijing

(1519 - 1253) Effects of Biochar and Wood Vinegar on Saline Soil Physical and Chemical Properties and Maize Yield

Zhongyi Qu[1]; Fan Wang[1]

Inner Mongolia Agricultural University[1]

Using biochar and wood vinegar as amendments, this study aimed to investigate the effect of soil amendments with different application amount on soil physical and chemical properties and maize yield, so as to provide theoretical references for improving saline alkali soil and rational utilization of biochar and wood vinegar. Field plot experiments were conducted by 7 treatments with 3 rounds

respectively, as follows: CK, WV(300L·hm^{-2}), T2:WV(450 L·hm^{-2}) ,T3: WV(300 L·hm^{-2})+B(15 t·hm^{-2}) ,T4: WV(450L·hm^{-2}) +B(15 t·hm^{-2}),T5: WV(300 L·hm^{-2})+B(30 t·hm^{-2}), T6:WV(450 L·hm^{-2})+B(30 t·hm^{-2}). The results showed that with biochar application amount less than 30 t hm^{-2}, biochar with wood vinegar compound fertilizer could reduce soil salinity and pH, inhibit the surface accumulation of soil salt. Salt content of T2 treatment reduced by 20.10% during the period from the seedling to jointing stage, and pH of T2 decreased by 0.35 units compared with CK treatment. Different treatments soil organic and nitrogen contentwith application of biochar was positively correlated. With the amount of biochar and wood vinegar dosage increasing, phosphorus and potassium content increased firstly and then decreased, which were all higher than the values in control group. The highest value of organic matter and nitrogen appeared in T6 treatment and increased by 54.91% and 41.63% compared with the values in CK treatment, respectively. Meanwhile the highest values of available phosphorus and potassium appeared in T3 treatment and increased by 44.80% and 42.88%. The highest yield in T3 treatment increased by 23.17% and showed significant correlation with soil nutrient index, while the correlation coefficient between yield and phosphorus reached to 0.923. In summary, With applying biochar of 15 t·hm^{-2} and wood vinegar of 300 L·hm^{-2}, the effect of soil improvement is optimal, and the yield was the highest. It can improve the efficient utilization of agricultural and forestry biomass resources, reduce the risk of environmental pollution

Keywords: Biochar ; Wood vinegar ; Saline alkali soil ; Soil physical and chemical properties ; Yield

Financial support: the National Key Research and Development Program of China (2016YFC0501301)

(3580 - 3041) Excessive use of potassium chloride in the banana cultivation: impacts on the vegetative development of the crop

Michele Xavier Vieira Megda[1]; Nayara Ellane Pereira Viana[1]; David Gabriel Campos Pereira[1]; Mickaelly Jordanya Guimarães Silva[1]; Matheus Magno Silva Damasceno[1]; Marcos Koiti Kondo[1]; Marcio Mahmoud Megda[1]; José Augusto dos Santos Neto[1]

Universidade Estadual de Montes Claros[1]

Potassium chloride (KCl) is the most widely used potassium source and, due to its continuous use, the accumulation of salts in soils and plants has been increasing. The excess of ions in the soil triggers a series of physiological disturbances to the plants. The objective was to evaluate the application of KCl associated to nitrogen fertilization in the vegetative development of 'Prata' banana. The experiment was conducted in a greenhouse in a Typic Hapludox. The experimental design was a randomized block with 10 treatments and 4 replicates, consisting of 5 doses of K_2O (50, 100, 200, 300 and 400 mg dm^{-3} as KCl) and 2 doses of N (200 and 400 mg dm^{-3} as ammonium sulfate), besides the control (without K_2O). The results were submitted to variance analysis and the significant interactions, within each dose of N, were performed by means of regression. The increase of the potassium doses increased the electrical conductivity of the soil. At 5 days after fertilization (d.a.f.). the values of electrical conductivity were higher due to the small root development of the culture and, after 120 d.a.f. the values decreased, suggesting that there was absorption of a great part of the salts applied. The salinity index represents the ability of the fertilizer to increase the osmotic pressure of the soil solution. Regarding KCl, for each unit of K, a salinity index of 1.93 is considered high when compared to other fertilizers. According to data in the literature, the banana crop is very sensitive to salinity, and its development is reduced in soils with electrical conductivity higher than 3.0 dS m^{-1}. The values of electrical conductivity are above the values considered adequate for the culture. There was a linear decrease in the production of dry mass of the shoot to the dose of 200 mg dm^{-3} of N, on the other hand, the dose 400 mg dm^{-3} of N promoted increase of production up to 200 mg dm^{-3} of K_2O, being this effect represented by a quadratic regression model. For both doses of N, the increase in the dose of K_2O resulted in a decrease in the production of root dry mass. The use of nitrogen fertilizers associated with potassium fertilization further aggravates the problems of salinization, and the use of ammonium sulfate is not recommended due to its high salinity (3.45). It is concluded that the increase of the K_2O dose associated to the N doses promotes excessive increase of soil conductivity and a significant reduction in the shoot and root development of the banana crop.

Keywords: Ion Chloride; Salinity; nitrogen fertilization; potassium doses

Financial support: Unimontes, Fapemig scholarship

(4147 - 740) Exploring the impact of polyhalite application on soil sodium

Lino Furia[1]; Annette Raffan[2]; Huoyan Wang[3]; Timothy D Lewis[1]

Sirius Mineral[1]; Institute of Biological and Environmental Sciences, University of Aberdeen[2]; Soil Fertility and Plant Nutrition, Institute of Soil Science, Chinese Academy of Science[3]

Soil salinization affects approximately 831 million ha of soil globally impacting the availability of land for crop production. Sodium can enter the soil system either naturally (through weathering, seawater intrusion or evapotranspiration) or as a result of human activity (water extraction, irrigation). Remediation is achieved by application of calcium to encourage flocculation of soil particles that lowers tensile strength enabling plant roots to penetration and facilitating soil water drainage. Polyhalite ($K_2SO_4.MgSO_4.2CaSO_4.2H_2O$) is an evaporite mineral that contains potassium (14% K_2O), magnesium (6% MgO), sulphur (48% SO_3) and calcium (17% CaO). The use of polyhalite in soils containing high levels of sodium could be beneficial as the introduction of additional cations should displace sodium. An initial lab based study investigated the effects of on soil physical properties using polyhalite at application rates of 0, 2.5, 5 and 50 t ha^{-1}. This study found changes in soil tensile strength was inversely related to polyhalite application depending on soil type with wastewater irrigated soils showing signs of remediation. Following this trial, a separate glasshouse study was setup in Nanjing, China to characterise the influence of polyhalite on sodium within the soil. Results found a positive relationship between polyhalite application and soil sodium content, indicating potential remediation benefits of polyhalite.

Keywords: polyhalite, flocculation, soil salinization

Financial support: Sirius Mineral

(4547 - 1283) Influence of Soil ESP and Salinity on Soil Atterberg Limits and Shrinkage

Hans Klopp[1]; Will Bleam[1]; Francisco Arriaga[1]

University of Wisconsin Madison[1]

Soil sodicity occurs from a breakdown of structure in the soil and an increase in swelling of the soil clay fraction. Little research has been conducted relating soil sodicity to the swelling clay fraction behavior of the soil under EC and ESP combinations. Three smectitic soils were treated to salt concentrations between 5 and 40 meq/l and ESP levels between 0 and 50 %. Soil Atterberg limits and shrinkage potential were measured on three soils of differing degrees of sodicity prior to treatment and after soils were treated to the same EC vs ESP combinations. Whole soil liquid limit, plasticity index and shrinkage potential increased for salt concentration of 5 meq/l at an ESP of 25 and 50% and 10 meq/l at an ESP of 50 % in all three soils. Whole soil

swelling behavior is expressed when soil ESP levels are high and salt concentrations are low as would be expected with the behavior of swelling clays. Whole soil swelling behavior and plasticity can be used to determine a soil that is sensitive to soil sodicity but will not show a change until an ESP of much greater than what is considered to be sodic by USDA classification. Some soils such as silty soils that have a low clay content may have a change in soil hydrologic properties due to sodicity but will not increase in clay swelling or plasticity.
Keywords: Soil Salinity Sodicity Salt Affected Soils
Financial support: USDA Hatch Grant

(5785 - 3219) Physi-chemical and microbial properties of coastal soils with different salinity classes under natural conditions in Jiangsu, China

Liu Guangming[1]; Zhang Xuecheng[1]; Wang Xiuping[2]; Shao Hongbo[3]
Institute of Soil Science, Chinese Academy of Sciences[1]; Institute of Coast Agriculture, Hebei Academy of Agriculture and Forestry Sciences[2]; Institute of Agricultural Resources and Environment, Jiangsu Academy of Agricultural Sciences[3]

Soil salinity is one of the major problems to overcome around the world, especially in arid and semi-arid areas. Many researchers studied effects of different salinities on soil properties by increasing salt concentration in laboratory, but little of which showed the real effects of salinity on microbial properties at the field. Situ salinity was not always constant and the same microorganisms in saline soil may adapt to different salinities. Therefore, the aim of our study was to investigate how a gradient in salinity under natural condition affected soil physical, chemical and microbial properties. Soil samples were taken from 10 sites with different salinities in Jiangsu province and these sites covered non-salinized (<1 g kg-1), slightly salinized (1-2 g kg-1), moderately salinized (2-4 g kg-1), strongly salinized (4-6 g kg-1) and saline soil (>6g kg-1). Electrical conductivity (EC) ranged from 0.112 to 2.818 dS m-1. The results showed that the pH did not show significant difference in values among 10 sites.Organic carbon (OC), NO3--N, NH4+-N and extractable phosphorus (P) were lower at heavy and saline soils, indicating that the increasing EC can limit the availability of nutrients. Microbial biomass and enzyme (urease, alkaline phosphatase and catalase) activities decreased with the increase of EC and they were all negatively correlated with EC. On the other hand, ions compositions were higher in sites with high salinity and showed positive relationships with EC.
Keywords: soil salinity; soil property; microbial biomass; enzyme activity; salt-soil quality evolution
Financial support:

(4952 - 304) Sodic-saline soil spatial variability characteristics and precision reclamation using farmland scale-based approach

zhiping yang[1]; qiang zhang[1]; haolin zhang[1]; chunhua gao[1]; dongsheng jin[1]
Institute of Agricultural Environment and Resources, Shanxi Academy of Agricultural Sciences[1]

Sodic-saline soil is a major type of saline-alkali soil in the inland regions of China and severely limits crop productivity. This study was designed to investigate sodic-saline soil spatial variability and precision reclamation on 1 ha farmland in Datong basin of Shanxi Province, China, using a RTK network sampling method. Under farmland scale, soil salinization and alkalization exhibited high variability on the surface layer of the sodic-saline soil. Correlations were found between distribution and spatial location of salinization parameters including EC, pH, and Ex-Na. Meanwhile, the level of these salinization parameters was negatively correlated with the biomass yield of maize grown on it. Based on classifications of EC and pH critical values, the optimum rates of chemical conditioners (desulfurized gypsum, weathered coal, and ferrous sulfate) were recommended for the farmland investigated, and precision reclamation was implemented. This approach reduced soil saline variation, increased crop biomass yield, and reduced amount of the chemical conditioners for the soil reclamation.
Keywords: sodic-saline soil, spatial variability, precision reclamation
Financial support: China's International Science and Technology Cooperation Fund (2015DFA90990)

(2181 - 420) Temporal-spatial features of soil salinity in coastal soil of East China over 3 years

Jianbin LAI[1]; Zhu Ouyang[1]; Lanfang Wu[1]
IGSNRR,CAS[1]

Salt-affected land varies spatially and seasonally in terms of soil salinity. "Bohai Granary" is a newly proposed national-level program which aimed to improve soil quality and mining the potential of grain production in the salt-affected land in east China. In this work, hundreds of soil samples were monthly taken at 11 sites within the Yellow river delta. The spatial distribution pattern of soil salinity were investigated and its seasonal variation over 36 months were discussed. Our findings indicated that the vertical distribution type of soil salinity was bottom-accumulating in the near coastal area while it gradually turned into a type of surface-accumulating for the soil profiles in inner land. The peak of the soil salinity along the soil profile alternately moved upwards and downwards during the growing seasons. However, there was no evidence for the increasing of the total salt amount within the upper 100cm of soil. Moreover, the salt was mostly accumulated in the upper soil (0-40cm) during the late spring and early summer season; and winter wheat was tend to be affected severely at this stage. Therefore, special field practices (e.g. regular irrigation to leach salt, good maintenance of drainage system) should be taken to minimize the threat of soil salinity.
Keywords: Soil salinity, Temporal-Spatial pattern, Yellow-river-Delta, Field sampling.
Financial support: The Bohai Granary project of Chinese Academy of Sciences (No. CXJQ120109)

D3.6.4 - Impact of land use change on soil and the environment in dry regions

(6667 - 1761) Sediment yield scenarios and water demands of the Bocaina dam, Brazil

Margarita M. López-Gil[1]; Suzana M. Gico de L. Montenegro[2]; J. C. de Araújo[3]
UESPI[1]; UFPE[2]; UFC[3]

In large water scarcity regions, dams are used to guarantee the necessary flow to different users. This kind of structure is also an artificial means of sediment retention, causing, over time, the lake silting and the reduction of its lifespan. Consequently, silting enhances the risk of not supplying the water demands. Reservoir operation generally disregards the updated silted lake morphology, using the initial (project-based) morphology. The objective of this study was to analyze the effect of a reservoir silting on the future water demands for the Bocaina Dam, located in the semi-arid region of Piauí, Brazil. Siltation was assessed using three land-use scenarios. In order to reach the proposed objective, we performed a bathymetric survey; and calculated sediment yield and associated sediment delivery ratio (SDR). Current and future water demand for the reservoir was computed for the period from 2015 to 2040. The erosive potential of the basin was estimated at 13.54 Mg.ha-1.yr-1; the sediment delivery ratio was 12.4%; and the sediment yield was 1.68 Mg.ha-1.yr-1. The low SDR, typical from the Caatinga biome, is probably due to low connectivity in the basin, caused by intermittent flows in the basin. The sedimentation rate estimated for the Bocaina dam was 0.12

hm3.yr-1, a value slightly below those found in other semi-arid regions. The sediment retained in the reservoir until 2040, according to the three simulated scenarios, resulted in useful volumes above 89% of the original reservoir capacity, which indicates that the demands will be only partially affected by the siltation in regular years. However, should reservoir levels be below 40% of their capacity, operation will have to be adapted to the siltation.

Keywords: Water availability. Water demands. Sediment yield. Bocaina Dam

Financial support: DINTER–UFPE/IFPI/UESPI in Civil Engineering. CNPq

(3217 - 2247) Spatial and temporal analysis of land use and soil occupation in a small town in the NEB

Luciana Mayla de Aquino França[1]; Rodrigo de Queiroga Miranda[1]; Josiclêda Domiciano Galvíncio[1]

Universidade Federal de Pernambuco[1]

The northeastern region of Brazil (NEB) is constantly in the science spotlight because of its harsh climate conditions. The most prominent characteristics that lead the NEB to be a hostile environment for many tropical species are its high temperatures and low rainfall indices. For this reason, its vegetation has become very adapted, looking mostly dry and thorny. However, in some places in the NEB, the environment may be different. It happens mainly because of high altitudes that makes climate milder. The municipality of Flores is located in the hinterland of the state of Pernambuco (PE), and although it is on a semi-arid zone, it is almost 500 m above sea level, which produces a milder and rainier climate than other municipalities of the region. Given our interest in such discrepant features, the objective of this study is to analyze the changes in land use and soil occupation that occurred over a period of 13 years in the Flores town, PE. For this purpose, two images from the MODIS sensor installed on the TERRA satellite were utilized. More specifically, we used data from the MCD12Q1 product for the years of 2001 and 2013, with which we produced maps and analyzed statistically the land use dynamics in the area. Once analyzed, the classes 6, 7, 8, 9, 12, 13 and 14 that correspond to closed shrublands, open shrublands, Woody savannas, savannas, urban and built-up, croplands and natural vegetation mosaic respectively, represented 98% of the area. The MCD12Q1 product stands out by presenting in a single image the annual average of land use and soil occupation based on images obtained daily by orbital sensors and classified according to the IGBP (International geosphere Biosphere Programme) method. The results showed that there was a decrease of 7% in class 6, 3% in class 8, and 12% in classes 12 and 14/ an increase of 22% in class 7, and 1% in class 9. The class 13 remained unchanged. Considering that the years of 2011, 2012 and 2013 were significantly dry for the countryside of Pernambuco, we suggest that the decrease that we have noticed in the classes 6, 12 and 14 may be related to a lack of rainfall. As the area is dominated by planosols and beans plantations, it causes impacts on the soil due to lack of water.

Keywords: Remote sensing; geotechnology; MODIS.

Financial support: Coordination for the Improvement of Higher Level Education (Bolsa de Doutorado CAPES/DS), Foundation of Support for science and technology of the state of Pernambuco (FACEPE IBPG-0906-9.25/16, APQ 0646-9.25/16)

C4.1 - Soils and the Environment

C4.1.1 - Soil ecosystem services

(7431 - 1348) An Approach to assessment soil ecosystem services in Atlantic Rainforest - Brazil

Gabriel Spínola Garcia Távora[1]; Vanessa Ingrid Carvalho Saraiva[1]; Antonio Soares Da Silva[1]; Luciana Maria Sousa Dos Santos[1]; Samuel Vitor Oliveira Dos Santos[1]; Patricia Quadros Gondim Leite[1]
UERJ[1]

The agro-ecosystems are expanding globally due to increasing human demand for provision. Because of this the different ecosystems are changing to agro-ecosystem. This process of landscape transformation has negatively affected the production of regulatory and cultural services. In the agroecosystems the soil management has directly effects in the ecosystem services provision. Thus, the main goal of this project is evaluate and models the provision of ecosystem services related to a soil in a river basin located in a mountainous region in Rio de Janeiro State. The study is justified because we need to evaluate the influence of agroecosystem for the provision of the ecosystem services. In addition the established hypothesis in the Pito Aceso river basin the soil ecosystem services, specially, regulation ecosystem services are not negatively affect by the agricultural activity. This occurs because the study area has a high degree of preservation and the agricultural management practices not so impacting the environment. For the same reason the provision ecosystem services are also benefited. The adopted methodology is based in a holistic approach and tries to correlate the provision of ecosystem services and soil natural capital. The methodology of this proposal is divided in five steps. The first step is determined the classes of land use and land cover and also identify the ecosystem services provided by the soil and the indicators of ecosystem services. The second part is related to the soil sample collection and the subsequent laboratory analysis. The third stage is rising of the information about the agricultural production in the municipality of Bom Jardim (RJ). The fourth stage is related to the statistical analysis of the collected data, the indicators validation and the evaluation of soil ecosystem services. The last step of this research will deal with the modelling of soil ecosystem services data.

Keywords: Watershed, Rural Landscape, Modelling Ecosystem services, Soil Ecosystem services.
Financial support: Coordenação de Aperfeiçoamento de Pessoal de Nível Superior- CAPES

(3283 - 3125) Ecological corridors proposal for interligation of the augusto ruschi biological reserve with the apa of goiapaba-açu, es, using geotechnologies

Utálice da Silva[1]; Alixandre Sanquetta Laporti Luppi[1]; João Luiz Lani[1]; Diogo Antonio da Silva[1]
Universidade Federal de Viçosa[1]

The Brazilian landscapes, in the majority, have remnants of vegetation that are isolated, composing environments different from the original one. Factors such as the reduction of natural vegetation areas and the degree of isolation affect the ecological relations between species, causing a negative impact on the size of the populations. The natural environment is the shelter for several native species and, especially, those species that are migratory. However, these areas are generally in a very fragile position, since the expansion of the agricultural and livestock frontier corresponds to a risk factor for the preservation of species. To know these environments is fundamental to understand the mechanisms of conservation and renewal of the fragments and to propose methodologies for the recovery of areas through biological and spatial elements, generating technical and scientific knowledge, and can be used as a basis for the interconnection between forest fragments. In this way, the establishment of Ecological Corridors is a necessity to extend environmental protection and biodiversity conservation, which is a great national wealth. This study aimed to propose routes for implementation of ecological corridors aimed at the interconnection of forest fragments in the municipalities of John Neiva and Fundão using geotechnology. Using the methodology of distance from the lowest cost four routes have been proposed for implementation of ecological corridors, corridor named A, B, C and D. After analyzing the images of APPs, use and coverage of the Earth and Slope and Land Use Conflict in the APP, was named the Corridor "A", with 2704.23 in length, width 270.42, as the best proposal for the deployment. An important factor for choosing this corridor was the existence of large area of vegetation and area regeneration, larger APPs preserved and have a great potential for tourism and agriculture. From the data obtained and analyzed, it was possible to conclude that: The methodology used by GIS to route routes to the Ecological Corridor proved to be efficient, generating routes with weights of lower cost and smaller path between two points.

Keywords: Protected Areas, Ecological Corridor, Permanent Preservation Area, Land Use, Geographic Information Systems.
Financial support:

(7737 - 3193) Ecosystem services of soil in Coffee Agroecosystem of Colombia

Liliana Bueno López[1]
Universidad Tecnológica de Pereira[1]

Coffee production represents 16% of Colombian agricultural GDP, making it the largest producer of soft washed Arabica coffee and the third largest producer in the world, a situation that It has arrived after an extensive and changing history of coffee production which has generated environmental transformations as a consequence, possibly due to the need of adaptation to achieve ownership of the territory, a situation that is evidenced by the presence of coffee in mountain ecosystems; the last time, most of the coffee farmers have opted for small planting areas in which it is not possible to show a homogeneous structure, nor a single management strategy; In the municipality of Belén de Umbría, the main coffee producer in the department of Risaralda (Colombia), it is possible to appreciate the dynamics described in the integrated management district "Cuchilla de San Juan", a figure that allows the presence of sustainable agroecosystems and an area of conservation. Soil Ecosistemic Services In this occasion, the role of soils in the provision of ecosystem services for coffee agroecosystems is considered important, and in this sense it is worth emphasizing the approach of soil study in a multifunctional way, since they are the various functions which support the delivery of services. For this research, the role played by the ecosystem services of the soils in coffee production of the Association of High Quality Coffee Producers "Cuchilla del San Juan", from the municipality of Belén de Umbría, was investigated, located in the center west of the country, constitute coffee agroecosystems located at the borders of the Cuchilla de San Juan Integrated Management District, an important area in the provision of water for the aqueducts of the surrounding rural and urban areas and the provision of ecosystem services fundamental for the development of their productive activities; despite the importance of this area, there has been a strong pressure on it, possibly due to the expansion of the agricultural frontier, generating changes in the functions of the ecosystem and consequently in the ecosystem services that there they could exist. The ecosystem services of the soil were identified based on some microbial functions and soil characteristics, it was also linked to the recognition of the ecosystem services of the soil, the traditional perception of the coffee grower, establishing strategies that allow sustainable management of the soil and the agroecosystem.

Keywords: agroecosistema cafe, suelo, conservacion
Financial support: UTP

(7808 - 611) Effect of the agrossilviculture of *Euterpe edulis* Martius on physical and chemical soil attributes

Fábio Martinho Zambonim[1]; Paulo Sérgio dos Santos Leles[2]; Paul

Richard Momsen Miller[3]; Milton da Veiga[4]
EPAGRI- Empresa de Pesquisa Agropecuária e Extensão Rural de Santa Catarina[1]; UFRRJ-Universidade Federal Rural do Rio de Janeiro[2]; UFSC-Universidade Federal de Santa Catarina[3]; UNOESC- Universidade do Oeste de Santa Catarina[4]

The agroforestry systems (AFSs) are recognized as sustainable production systems and they contribute to the natural resources conservation. The soil quality monitoring is an important tool for sustainability assessment of this production system. The aim of the current study is to verify the effects of the *Euterpe Edulis Martius* AFSs, performed by farmers from the northern coast of Santa Catarina, as for the physic and chemical soil properties in comparison with the soil properties under other forest uses. Five *E. Edulis* AFS areas (TRAT 1) have been selected, all located next to areas with other forest uses (TRAT 2). The experiment was arranged in full blocks with five replications. Three different depths of layers were used as physical and chemical soil factors indicators (0–5; 5–10 and 10–20 cm), pH rates; organic material levels, phosphorus, potassium, calcium; magnesium, aluminum; the CTC $_{pH\ 7,0}$ index, the base saturation CTC $_{pH\ 7,0}$ index, and CTC $_{pH}$ soil saturation by aluminum index, the bulk density (BD), the mean weight-diameter of aggregates obtained through dry sieving (DMPs), the mean weight- diameter of aggregates obtained through water sieving (DMPu) - and aggregate stability index (ASI). The *E. edulis* AFSs did not show different effects on most soil chemical properties indicators when compared to other forest cover composed primarily of native species of the Atlantic Forest. This result shows that the AFSs did not cause improvements in soil chemical properties and that some possible increases in nutrient exportation of agroforestry systems for bigger harvests may exhaust the natural reserves of soil nutrients. In order to provide increase and chemical fertility maintenance of soils under AFSs, a continuous and careful management of these fertilization systems is recommended. Soils under *E. edulis* AFSs showed a larger soil aggregate stability when compared to soils under other forest uses. The cultivation of *E. edulis* when intercropped with tree species effectively promotes the improvement of soil aggregate stability due to the characteristics of its root system.

Keywords: Juçara palm, agroforestry systems, açaí
Financial support: Fapesc; Acafruta

(3576 - 2481) Evaluation of environmental soil functions in avocado crops Michoacan, Mexico.

Alma Barajas[1]; Ángeles Gallegos[2]; Francisco Bautista[2]
Escuela Nacional de Estudios Superiores Unidad Morelia, Universidad Nacional Autónoma de México[1]; Centro de Investigaciones en Geografía Ambiental, Universidad Nacional Autónoma de México[2]

Mexico is the first producer of avocado. The 84% of the national surface of orchards is in the state of Michoacán. The crop of avocado has brought a series of consequences, positives and negatives; on one hand the economic spill and on the other hand deforestation for the establishment of avocado. The change of land usage can have negative repercussions on environmental services. It has not been evaluated yet the environmental functions of the soils. The objective of this work is evaluating the environmental soil functions with avocado crop in the municipality of Tacámbaro, Michoacán. The eleventh representative sampling points were selected based on the units of landforms, and also the presence of avocado cultivation was observed. A pit was opened at each site and the soil profile was described. Samples were taken from each soil horizon and analyzed in the laboratory. The soil profiles were classified with the WRB (2015), with the data of the field and the laboratory, were evaluated, four environmental soil functions with the software Soil & Environment: 1) Nutrient Cycle; 2) Site of Food and Biomass; 3) Water Cycle; 4) Content of Organic Carbon. Three soil groups were identified: Andosol, Umbrisol and Alisol. Andosols with avocado crop have an intermediate aptitude of water quality for recharging aquifers, so their filtration capacity is acceptable; about the water they infiltrate, all the Andosols evaluated have a good internal drainage, these also have a very high capacity as a component of the nutrient cycle, which indicates that they have excellent natural fertility and are suitable for agriculture. The evaluated Umbrisols present a natural fertility and a variability of filtration and infiltration capacity. The Alisol with avocado crop presented a good quality and quantity of water for the recharge of aquifers, however, the Alisols with forest cover infiltrated a low amount of water, therefore, contrary to what is known, a cover with crop of avocado allows this type of soil to improve its capacity to permeate the water to the subsoil. The capacity of soils like sites for food production, the results are mostly intermediate, this is due to the capacity of aeration. No significant negative impacts of avocado crop, were observed in the environmental services offered by the evaluated soils, considering their aptitude to perform the environmental functions, all the evaluated soils presented good characteristics for avocado crop, especially the Andosols.

Keywords: Software S&E; Andosols; Umbrisols; Alisols.
Financial support:

(3844 - 1895) Impacts of forest restoration on soil water infiltration: an overview

Sergio Esteban Lozano Baez[1]; Ricardo Ribeiro Rodrigues[1]; Silvio Frosini de Barros Ferraz[2]; Miguel Cooper[3]; Paula Meli[4]
Laboratório de Ecologia e Restauração Florestal, Department of Forest Science, "Luiz de Queiroz", University of São Paulo (ESALQ/USP)[1]; Laboratório de Hidrologia Florestal, (ESALQ/USP).[2]; Department of Soil Science, (ESALQ/USP).[3]; Laboratório de Silvicultura Tropical, (ESALQ/USP)[4]

Over last few decades, forest restoration initiatives have increased around the world. However, effects on soil to the current restoration efforts still require a better understanding, especially due to the potential benefits of restoring forest for ecosystem functions and human well-being. This is particularly important for soil water infiltration, a key hydrological process that influences groundwater recharge and soil erosion. Whether or not forest restoration can improve soil water infiltration is still unclear. We conducted a systematic literature review of restored forests world-wide to assess the impact of forest restoration on soil water infiltration. We selected peer-reviewed articles published in English, Spanish and Portuguese in ISI Web of Science and Scielo. Most studies reported an increase in soil water infiltration after planting native trees in degraded lands, in a wide variety of ecosystems in 11 countries. Nevertheless, in some cases forest restoration per se did not guarantee an increase in water infiltration. The majority of the studies did not report the land use history and usually comprised only a single measurement in time after plantation establishment. Moreover, the information is especially limited for the humid tropics and different restoration techniques. Our results highlight that time required to recover soil water infiltration to a reference condition (old-growth forest) differs considerably due to variations in forest, climate and soil type. We hope that presenting these gaps will encourage the scientific community to produce more information on soil water infiltration in restored forests and improve future research to assess forest restoration success.

Keywords: Soil properties; trees; soil recovery; forest restoration.
Financial support: FAPESP (processo nº 2013/50718-5)

(9227 - 765) Is leaf decomposition more accelerated in a Cerradão or Eucalyptus stand on Cerrado soils?

Karla Monique Silva Carneiro Valadão[1]; Marco Bruno Xavier Valadão[2]; Sarah Camelo da Silva[2]; Jonas Inkotte[2]; Alcides Gatto[2]; Reginaldo Sérgio Pereira[2]
Universidade do Estado de Grosso - UNEMAT[1]; Universidade de Brasília

- UnB[2]

Eucalyptus has been one of the main exotic species used in large-scale plantations and with the potential to recover degraded areas since it has a good tolerance for low fertility soils. Eucalyptus has high water and nutrient efficiency and great litter production, which allows the entry of carbon and nutrients with the maintenance of soil physical properties. The leaf fraction is the main material contributed in the soil contributing 50 to 80% of the total litterfall, and its decomposition regulates not only the litter accumulation but also the nutrient cycling. The new Forest Code published on May 25, 2012 (Law no. 12.651/ 012) allows the intercalation of up to 50% of exotic species with native species of regional occurrence in consolidated areas of legal reserve and permanent preservation. Thus, with the ecological role that the litter has the objective of this study was to evaluate the decomposition of eucalyptus leaf in the stand and Cerradão area. The study was carried out at Fazenda Água Limpa (FAL), Brasília - Federal District (15 ° 56'-15 59 'S and 47 ° 55'-47 58' WGr.). The methodology used was that of litter bags, which leaves a clonal hybrid of *Eucalyptus urophylla* x *grandis* with three years of planting were used in 3x3 m spacing. The soil of the eucalyptus stand was characterized as Red-Yellow Latosol (Oxisol), being limed followed by mineral fertilization, and Cerradão was classified as Red Latosol (Oxisol). In which litter bag was filled 20 g of leaves and installed randomly in eucalyptus stand and Cerradão being rescued after 30 and 60 days. To obtain the leaf mass was calculated by the difference between the initial and end of each period, by the equation: Remaining Mass (%) = (Final weight/initial weight) x 100. To evaluate the differences between areas we used independent samples t-Test. At 60 days after the beginning of the experiment, the Cerradão presented greater decomposition. The native area decomposed 27.46% in the stand this percentage was 23.18% ($p < 0.05$). Our results indicate a variation in the rates of leaf litter decomposition among the evaluated areas, which may be related to the forest type presented by Cerradão. This condition provides a more favorable environment with greater shading, greater soil moisture thus benefiting decomposing organisms in the litter layer. This more rapid decomposition can provide input of carbon and nutrients and provide favorable conditions in soils of areas to be recovered.

Keywords: forest stand, litter bags, degraded areas, Forest Code
Financial support:

(6360 - 2701) Key soil microbial-derived ecosystem services in Mediterranean native forests: to what extent are they affected by wildfires?

Claudia Rojas[1]; Juan Pablo Fuentes[2]; Marcia Ricci[3]; Felipe Sandoval[3]
Universidad de O'Higgins, Center for Applied Ecology and Sustainability (CAPES)[1]; Universidad de Chile[2]; Corporación Nacional Forestal (CONAF))[3]

Ecosystem services are the benefits society obtain from ecosystems, and soils are responsible for many of them. Soil microbial communities and their associated functions play key roles in a vast number of soil ecosystem services, as they are essential to maintain the capacity of soils to function as part of the environment and support aboveground life. Soil disturbances compromise the benefits microbes provide since they are very sensitive to changes, which explain why they are widely used as indicators of soil stress levels. Fires represent an important pressure to natural soil functioning worldwide, especially in regions with Mediterranean climates, where dry summers and elevated temperatures are common and where the effects of Climate Change can be more pronounced. The negative effect of fires on soil microbiota is well recognized globally, and the greater sensitivity of soil biological properties to disturbances (compared to abiotic factors) is also established. However, the effects of this pressure on microbial-derived benefits such as biological nitrogen fixation (BNF) and fungi composition/carbon sequestration potential is less understood. This work aims to elucidate the effect of wildfires on soil microbiota and associated key functions in native forests of the Mediterranean Region of Chile. In order to understand the effect of fires in these biological properties, prokaryotes, fungi, and members of the BNF functional group will be studied by high-throughput amplicon sequencing of the 16S rRNA, ITS, and *nif*H coding genes, respectively. Molecular assays will be complemented with litter decomposition and soil respiration studies. Moreover, soil physicochemical analyses including: aggregate stability (dry and wet sieving for macro aggregates/ dispersion rate for micro aggregates); pH (1:1 suspension of air-dried soil: deionized water) and EC (1:5 suspension of air-dried soil: deionized water); nutritional conditions comprising SOM (loss of ignition), SOC (chromic acid digestion), carbon fractions (sequential extraction), TN (Kjeldahl method), P(Olsen method), and Ca, Mg, K, and Na (ammonium acetate extraction) will be included. This work will shed light on the effects of wildfires in microbial-derived ecosystem services crucial for the sustainability and resiliency of sclerophyllous forests of Chile. Moreover, it will provide baseline information to be used in initiatives to restore and protect Mediterranean native forest after fires.

Keywords: microbial ecology, soil functional groups, restoration ecology, ecosystem functions
Financial support: Seed Grant program 2017, Institute of Agricultural and Veterinary Sciences, Universidad de O'Higgins

(7482 - 1138) Land degradation, ecosystem services and food security of the Astrakhan region, Russia

Lavrova Aisylu[1]
Lomonosov Moscow State University[1]

Astrakhan region is a unique territory combining high agricultural and recreational potential due to its agro-climatic resources and the presence of Volga River delta, one of the most important geographical elements of the country. However, many of the areas of this region are subjected to the negative effects of unsustainable farming; thus there is a need to outline optimal types of land use for the subsequent conservation of ecosystem services and food security of the area.We compiled a map of the dynamics of the vegetative index NDVI from 2000 to 2015, and selected the most representative reference sites. Field study of these sites was organized in August 2016. The resulting map clearly divided the region into three natural climatic regions: the Volga-Akhtuba floodplain (the vegetation index is insignificant), the northern part of the region located within the steppe zone with the maximum decrease in NDVI (up to 40%), and the southern part located in the semidesert zone with the largest increase in NDVI (up to 20%)., We included in the analysis of the situation the climatic data of three meteorological stations - Verkhniy Baskunchak, Astrakhan and Lagan. The aridity index sharply increased in all three weather stations from 2009 to 2011, but in the following years and in the previous ones, it fluctuated insignificantly 0.15 (Astrakhan), to 0.25 (Lagan).Also the economic indicators of agriculture were analyzed from 2008 to 2014. Most municipal districts have a certain orientation of the agrarian sector (crop or livestock sector). Areas with negative NDVI dynamics are engaged mainly in plant growing. During the review period, there was a negative trend in the productivity of agricultural crops, plant products, and the greatest reduction in the number of agricultural machinery, which indirectly indicated the abandonment of arable land. The growth zone of vegetation index is confined to cattle-breeding areas. During the review period, livestock numbers, livestock production and sales of products increased. Regional agriculture is highly prone to climatic factors, since the lands located in zone of risky farming. Lack of moisture is one of the most acute problems in the region which lead to plant sector concentration in the northern and livestock sector in the southern territories. Thus, climate change threatens the food security and the well-being of the regional population.

Keywords: NDVI, ecosystem services, productivity, land degradation, aridity index
Financial support: Russian Science Foundation, project No. 14-38-00023

(7076 - 763) Leaf decomposition in eucalyptus stands on Latosol (Oxisol) in the Brazilian Cerrado

Marco Bruno Xavier Valadão[1]; Karla Monique Silva Carneiro Valadão[2]; Jonas Inkotte[1]; Alcides Gatto[1]; Eder Pereira Miguel[1]

Universidade de Brasília - UnB[1]; Universidade do Estado de Grosso - UNEMAT[2]

Eucalyptus cultivation in Brazil is the result of decades of research and improvement of crop technologies. Nowadays, eucalyptus plantations are the main source of wood in the country. However, there are persisting doubts about the impacts of this monoculture forest. For this reason, the quality of the litterfall from stands can contribute to the studies about the transformations of vegetal organic matter occurring in the soil. In this work, we evaluated leaf decomposition in eucalyptus plantation 72 months of age in the Cerrado. The work was conducted in the Água Limpa Farm, which belongs to the University of Brasília, situated in the Distrito Federal - DF (15° 56'-15 59' S and 47° 55'-47 58' WGr.). The stand was comprised a total area of 3.29 ha and was established in 2010. The planting of I224 clone *Eucalyptus urophylla* x *Eucalyptus grandis* was performed in a 3x2 m spacing. The soils were described as dystrophic Red Latosol (Oxisol) with low base saturation (V<50%) and high aluminum saturation (m). Fertilization was practiced along the planting line by application of 100 g of super simple phosphate + 100 g of NPK (4-30-16); liming was not performed previously. A total of 40, 10x10 m plots were randomly marked for monthly monitoring the leaf decomposition in each plot. Leaf decomposition rate was verified by means of the confinement of freshly fallen leaves into litter bags (20 x 20 cm) made of 2 mm nylon mesh. Each litter bag was filled with 21.00 g of leaf material and placed on the ground in each of the 40 plots for monthly redemption during the year of study. Leaf decay was calculated as a function of mean biomass losses over time with the following equation: remaining mass (%) = (final mass/initial mass) × 100. The constant *k*, calculated for 30, 60, 120, 240 and 365 days after the start of the experiment (5 periods) and also monthly (12 periods), was obtained through the simple exponential equation; where $X_t = X_0.e^{-kt}$, (X_t= dry weight of material remaining after *t* days and X_0 = dry weight of material at t = 0). Half-life time was calculated by means of the equation $t^{1/2} = \ln(2)/k$. Data of decomposition were compared by analysis of variance, followed by Tukey´s test to identify significant differences between monthly means. The constant *k* was 0.0008, $T^{1/2}$ 866 days and the estimate of decomposed biomass 1.70 Mg ha^{-1}. The results showed great recalcitrance of eucalypt leaves.

Keywords: dystrophic soil, k decomposition constant, litter bags

Financial support:

(8618 - 539) Macro- and micronutrients in western Amazonian forests and their influence on palm (Arecaceae) communities

Kristiansen, Søren M[1]; Muscarella, Robert A[2]; Cámara-Leret, Rodrigo[3]; Balslev, Henrik[2]

Aarhus University, Department of Geoscience, Denmark[1]; Aarhus University, Department of Bioscience, Denmark[2]; Royal Botanic Gardens, Kew, United Kingdom[3]

The vegetation of tropical rainforests is shaped by soil and climate, but the response of individual species to soil nutrients remains poorly understood. As Amazonian rainforests sustain one of the world's richest floras, understanding the soil controls of plant community structure is critical for conservation and land-use planning. In this paper, our aim is to present soil chemical variability within and between geomorphological landscape types, and to demonstrate how this variability influences the assembly and composition of palm communities in western Amazonian rainforests. We compiled data from 382 Amazon lowland rainforest transects, each of 5 x 500m (0.25 ha), across four countries (Bolivia, Colombia, Ecuador, Peru). Based on satellite images and field observations, transects where placed within areas of homogeneous landscapes and forest cover in order to represent local soil variation. Three soil samples were collected at 0-10 cm depth below the organic layer at each transect. Geomorphological landscape units included: terra firme, flood-plains (varzeá including restinga, igápo), terraces, white-sands and pre-montane hills. Floristic data included counts and identifications of 619,281 palm individuals from all life history stages, corresponding to 110 Neotropical palm species. Soil analyses included pH, loss on ignition, exchangeable acidity, exchangeable Al, exchangeable bases (Ca, Mg, Na, K), phosphorus, as well as carbon, nitrogen and particle size. Soil macronutrients and micronutrients (B, Cu, Fe, Mn, Zn) were extracted in Mehlich-III solution and analysed using ICPMS. In addition, site topography, palm community composition and satellite images were used to predict palm community composition. This unparalleled palm-soil dataset can be used to explore the relative importance of soil macro- and micro-nutrients in controlling the assembly and composition of palm communities in the Amazon. We demonstrate that palm phylogenetic structure in western Amazonia is strongly influenced by edaphic factors, and that canopy and understory species have significantly different mean optima for soil P and greater mean niche width along Ca, K, Mg, P, and B gradients. Overall, our analyses advance ecological niche theory about palms, and reveals that the main environmental correlates for palm species distribution are soil nutrient levels and inundation (possible in combination with Al toxicity), while clay content surprisingly is of less importance.

Keywords: Palm soil Plant available nutrients Lowland rain-forest Macro- and micronutrients

Financial support: This work was supported by the Danish Council for Independent Research – Natural Sciences (grant no. 4181-00158)

(3807 - 1910) Meaning of soils and vegetation in the context of urban heat island and health challenges

Norra[1]

Karlsruhe Institute of Technology[1]

Urbanization is a global phenomenon directly linked to economical development. Since about ten years, more than half of the world's population is living in urban regions. This causes an enormous intensification of buildings and land development. Valuable soils are lost by this ongoing process. They become excavated, sealed, polluted or intensively disturbed. But not all soils will be affected by constructions, some will be used e.g. as parks, small lawns, roadside greenery, playgrounds, gardens or will be abandoned. During the last decades the need for such free areas became obvious. Intensive and dense development produce urban heat islands. The related health consequences will be intensified by the warmer temperatures caused by climate change. Decreased life expectancies for citizens are predicted. Furthermore, lack of green areas (including soils) in cities negatively influencephysiological, psychological and social health. Therefore, urban soils provide an enormous value regarding the ecosystem services for human beings. Nevertheless, urban development is extremely often not considering these benefits of soils in urban systems. To protect agricultural fields and nature, the urban development policy of some countries, such as Germany, follows a paradigm that prefers inner urban densification against urban spatial extension. A paradigm that produces health disadvantages in the city for the benefit of the non-urban areas. Here, the approaches of the assessment and montezation of soil's ecosystem services contribute arguments for the protection of open areas within the city's built-up area. The implementation and protection of fresh air lanes, cold air formation areas, green roofs and facades, the general support of evapotranspiration processes and the improved understanding of the meaning of soil water for the benefit of citizen's health is urgently needed to improve the living conditions in our cities. Examples for the interdependencies between soil and building structure with respect to the generation of specific micro-climates will be given for the cities of Karlsruhe and Mannheim in South-West Germany.

Furthermore, the challenges to protect and provide sufficient areas of open soils and vegetation in the urban development process are subject of discussion for the situation of those two cities that are located in one of the warmest regions of Germany that faces intensive urban development due to population growth and land use conversions.
Keywords: Ecosystem Services, Urban Planning
Financial support: ---

(6887 - 1873) Molecular identification of ectomycorrhizal fungi occurring in pecan orchards in Rio Grande do Sul / Brazil

De Andrade, Nariane[1]; Bevilacqua, Caroline B[1]; Sulzbacher, Marcelo A[1]; Antoniolli, Zaida I[1]; Jacques, Rodrigo J[1]
UFSM[1]

The culture of *Carya illinoinensis* (Wangenh.) K. Koch was introduced in Brazil at the beginning of the last century, and became commercially important after the 1960s, mainly in the southern region of the country. The pecan is proven to be an ectomycorrhizal symbiont, forming several mutualistic associations with mycorrhizal fungi. The main objective of this study was to identify the fungal isolates from commercial pecan plantations in the State of Rio Grande do Sul. For this purpose, the basidiomas were collected, which were photographed and described macroscopically still fresh and subsequently dehydrated to Microscopic analysis, according to traditional methodology in Mycology. Part of the isolated material was conserved in 2% CTAB (cetyltrimethylammonium chloride) at -20 ° C until DNA extraction, amplification and sequencing, using the ntDNA region primers ITS1 and ITS4 (ITS1-5.8S-ITS2). The extraction was performed by DNeasy® Plant Mini Kit (Qiagen). In order to detect the presence or absence of DNA in the sample, the electrophoresis of the PCR products in 1% agarose gel was performed. After the amplification, the presence of bands was verified by the electrophoresis of the PCR products in 1.5% agarose gel. For the purification of PCR products, KitGenElute PCR clean-up (Sigma, Saint Louis, USA) was used. After sequencing, Sequenced fragments were analyzed using the Staden Package 2.0.0b program for obtaining consensus sequences. After this, the consent sequences were deposited in the GenBank and a comparative search by means of BLASTn was perfomed. For the identification of fungus, all the sequences were aligned. The phylogenetic relationship of the specimens was reconstructed based on analyses of the ITS region, with the analysis of Maximum Likelihood (ML) in a total of 1000 replications for all reconstructions. The model of nucleotide substitution General Time Reversible model was estimated as the best model to solve the data, performed with Gamma distributed with Invariante sites and parameters for partial exemption (95%). The following potentially ectomycorrhizal fungi were identified: *Astraeus* sp., *Hymenogaster* sp., *Inocybe* sp., *Pisolithus arhizus*, *Russula* sp., *Scleroderma bovista* and *Scleroderma* spp. From these results, it is possible to continue with research aiming at the next stages of identification and phylogenetic analysis.
Keywords: symbionts, mycorrhizal, *Carya illinoinensis*
Financial support: CNPq, CAPES and UFSM

(7847 - 1891) Monitoring soil management to assess ecosystem services provision in Atlantic Forest, Rio de Janeiro

Joyce M. G. Monteiro[1]; Azeneth E. Schuler[1]; Rachel B. Prado[1]; Elaine C. C. Fidalgo[1]; Ana P. Turetta[1]; Alba L. Martins[1]; Aline P. de Oliveira[1]; Guilherme K. Donagemma[1]
Embrapa Soils[1]

Monitoring soil management to assess ecosystem services provision in Atlantic Forest, Rio de Janeiro. Joyce M. G. Monteiro[1], Azeneth E. Schuler[1], Rachel B. Prado[1], Elaine C. C. Fidalgo[1], Ana P. Turetta[1], Alba L. Martins[1], Aline P. de Oliveira[1], Guilherme K. Donagemma[1] Embrapa Soils, Rua Jardim Botânico, 1024. Jardim Botânico Rio de Janeiro, RJ Brazil, 22460-000 Soil conservation management includes practices that help to preserve the quality of soil, water and biodiversity, promoting sustainable agriculture and ecosystem services supply. In Rio de Janeiro state, Brazil, in the region of Atlantic Forest biome, some agriculture conservation practices have been reported as capable to provide soil ecosystem services (ES) and also to increase productivity and rural income. The monitoring of the conservation practices and related ecosystem processes is essential to understand and evaluate their impacts on ecosystem services provision, as well as to subsidize conservation policies and programs. This study highlights aspects to be considered in monitoring based on a review of researches on conservation management practices in the state such as minimal tillage, crop rotation, agroforestry systems, rotational grazing and fallow. A key point concerning the monitoring of agroecosystems and their potential to provide ES is to define indicators to evaluate the impact of soil management on ecosystem services. The selection of indicators to link agroecosystems and soil ES provision requires identifying key features that represent the compositional, structural, and functional components of the system important for ecosystem services provision. The monitoring must deal with the complex dynamics of land management and ES provision in order to quantify and model them connected to ecological and soil processes in multiple spatial and temporal scales. We found that major challenges of monitoring are related to the needs of: (i) multidisciplinary studies to understand how land management affects soil ES considering the set of biotic and abiotic parameters involved, (ii) a suitable approach to analyze these parameters together, and (iii) participatory monitoring skills to promote the exchange of local stakeholders' knowledge on the ecosystems and the impacts of land management on ES . The efforts to overcome these main challenges are mandatory in order to build gathered solutions to the communities' needs concerning to the agricultural management potential to provide soil ES.
Keywords: soil ecosystem services assessment, soil conservation practices, participatory approach and multidisciplinary criteria
Financial support:

(8633 - 1370) Overview of methods to assess the impacts of management practices on ecosystem services to control erosion and soil loss in Latin America.

Marllus Henrique Ribeiro de Paiva[1]; Dirlane de Fátima do Carmo[1]; Rachel Bardy Prado[2]
Pós-Graduação em Engenharia de Biossistemas - Universidade Federal Fluminense[1]; Embrapa Solos[2]

The land use and land cover dynamic, as well as soil and water management in agriculture can influence the amount of nutrients and sediments leached by erosion processes, jeopardizing the provision of the ecosystem services. This work aimed to identify the state of the art of methods applied in Latin America to assess management practices impacts on ecosystem services to control erosion and soil loss. For that, a bibliographic survey was done and data base was carried out, containing information on indicators and models currently used. 85 indexed articles were selected from 3.018 in the Scopus and Web of Science database (1990 to 2016). The keywords applied were: Esosion Control, Landscape, Methods, Land Use, Land Cover, Monitoring, Ecosystem Services, Indicators, Sedimentation and Latin America. The most used indicators in these studies were soil erodibility, rainfall erosion, precipitation, turbidity and flow. Among the models, there was a greater application of the USLE (30.6%), RUSLE (9.35%), MUSLE (8.5%), and SWAT (5.1%) to measure the rates of erosive potential and sediment generation (63%) under management practices. Few (6%) applied methods integrated indicators to evaluate the landscape. 75% of the studies were developed in agricultural areas. Most of them were developed in Brazil (65%), followed by Chile (5%), Costa Rica/Argentina (2.5%) and others (27.5%). This study concludes that the applied methods are similar and need to be addressed, taking into account landscape ecology, multiple scales and the provision of ecosystem

services.
Keywords: Erosive process, methodologies, models, indicators.
Financial support:

(1261 - 2441) Pedodiversity in Brazil: recognizing and valuation

Rosangela Garrido Machado Botelho[1]; Katia Leite Mansur[2]
Instituto Brasileiro de Geografia e Estatística, Diretoria de Geociências, Coordenação de Recursos Naturais e Estudos Ambientais[1]; Universidade Federal do Rio de Janeiro, Instituto de Geociências, Departamento de Geologia[2]

Geodiversity is a concept that has been increasingly discussed by the geoscientists in this millennium. In a few words it is the abiotic equivalent of biodiversity and has been defined as the natural variety of geological (rocks, minerals, fossils), geomorphological (landforms, processes), hydrological and pedological features, including their assemblages, relationships, attributes, interpretations and systems. However, mainly in Brazil, the soil features or pedodiversity has not been recognized and valued enough in spite of its great range in the territory. This work aims to point out the high diversity of pedological heritage (soil features with different values including the scientific one) in Brazil and the importance of identifying, mapping and conserving it for the future generations. The own existence of a wide and robust Soil Classification System reveals that diversity. Considering only up to the fourth level of this System, there are 880 different kinds of soils. The role of some types of soils (ex. Nitisols) in the occupation and development of regions in Brazil, as the coffee zone in South and Southeast, and soils originated by human activities (anthrosols) in Amazonia Region are examples of the meaning of soil to our history and economy. The paleosols also can tell about past environmental conditions, reflect former human environment interactions and can guide the society to sustainable use and management. Some areas are under intensive exploitation and negative impacts due to specific soil properties as high values of sand (ex. Arenosols) by the building sector. Others (ex. Gleysols) are used as raw material to ceramics, sculptures, jewels and different kinds of art products. Besides this, soils are a live system with interactions to biological processes that are essentials to ecosystems functioning. Thus, soils can have scientific, historic, economic, ecological, educating and cultural values that need to be recognized and protected. But in the inventory carried on by the Brazilian Committee of Geological and Paleontological Sites there are 116 geosites published from several categories but there are no pedosites. These ones are very significant for science development, teaching, geoturism and even recreation activities. So, it is mandatory that pedologists and soils institutes, universities and organizations gather efforts to identify soil heritage in Brazil and defend its protection.
Keywords: geodiversity; pedosites; geoconservation
Financial support:

(3873 - 1754) Physical and water attributes of the soil and the water production of in hydrographic basin

Hudson Carlos Lissoni Leonardo[1]; Miguel Cooper[2]
ITAIPU Binacional[1]; Universidade de São Paulo[2]

The adequate use and management of the soil associated to the mechanical practices of soil and water conservation improves the infiltration of water in the soil, instead of runoff and, consequently, contributes to the recharge of water table, processes present in the hydrographic basin, but are not linear according to the spatial scale of the basin. Among the benefits of this land use and management suitability, there is an increase in water availability for the electrical sector from the storage of water in the soils of the reservoirs contribution basins, the recharge of the water table and the regulation of the flow of streams and rivers from the drainage network that supplies the reservoirs. Thus, the objective of this work is to quantify the environmental services in terms of production and regulation of the water production, provided by an agricultural hydrographic basin under no-tillage since 1987, with the implanted terracing system and established riparian forest. It is a first-order basin with an area of 1.03 square kilometers, localized coordinates 24 ° 48 '59 "S and 53 ° 33' 09" W, in the region of the third plateau paranaense. The regional relief is predominantly slightly wavy to wavy. The representative topossequence of the basin consists mainly by Oxisols. In order to do so, will be characterized and quantified soil physical and water attributes (granulometry, soil water retention curve, soil density, particle density, micromorphometric analysis, hydraulic conductivity of the saturated soil, hydraulic conductivity of the unsaturated soil) and combined with the monitoring between 0 and 2 meters deep of the moisture and the total soil water potential, soil temperature and precipitation, will be characterized the subsurface vertical and lateral water flows in toposequence. The water table is also being monitored by means of wells along the toposequence and the flow of the basin by means of parshall gutter and radar type sensor. All the described variables are being monitored with a resolution time of ten minutes. To date, only partial data have been used, which indicated a time of concentration of the basin in the order of twenty minutes and the presence of subsurface flows, both vertical and lateral. For medium intensity rains there is a trend of infiltration values higher than the surface runoff.
Keywords: hydrographic basin; water production; environmental soil functions
Financial support: ITAIPU Binacional; Universidade de São Paulo, Escola Superior de Agricultura Luiz de Queiroz

(8465 - 715) Potential of agroecosystem services. The case of Slovakia.

Jarmila Makovníková[1]; Boris Pálka[1]; Miloš Širáň[1]; Beata Houšková[1]
National Agricultural and Food Centre/ Soil Science and Conservation Research Institute Bratislava, Slovakia[1]

Applying the mapping of agroecosystem services potential appropriately can help to show the possibilities of regional sustainable land use management as well as trade-offs between diferent ecosystem services. For evaluation of agroecosystem services potential in Slovakia, we have created a mapping unit by combination of four input layers (slope topography, climate units, soil texture and land use) with the use of tools offered by geographic information systems. In Slovakia 29.14% of agricultural land has very high potential for provisioning services, 27.47% of agricultural ecosystems has very high potential for water regime regulation of and 92% agroecosystems have a high to very high potential for water erosion regulation . Out of the total Slovak land used in agriculture 41.67% of ecosystems have very high potential for soil purification, they are mainly ecosystems of arable land with high carbonate content without anthropogenic and geochemical deposition. The percentage distribution results of various categories for climate regulations potential (sequestration of organic carbon in the soil) are significantly influenced by the ecosystems of arable land due to the high share of area of these ecosystems to the total area of agricultural land. The capacity of ecosystems to provide recreational services depends on the particular uniqueness of the site, its accessibility and the surrounding infrastructure. Agroecosystems of arable land have predominantly very low (50.7 %) to low potential (15.7%) and permanent grasslands have high and very high potential of natural conditions for recreation (53.82%). Ecosystem services are non-linearly linked and changes in one service influence the other in positive or negative way. High potential of provisioning service is linked to the high potential of water regime regulation, pollutants filtration and soil erosion. The opposite trend has the potential provisioning services to potential of climate regulation and potential of natural conditions for recreation. The synergistic effect is between the provisioning agroecosystem service, regulation of water regime and soil purification. Climate has the most significant impact on agroecosystem services. Warm, dry and lowland regions have higher potential of provisioning services, regulation of water regime, filtration of pollutants and control of soil erosion in comparison to moderately warm and cold regions.

Keywords: agroecosystem services, mapping, arable land, grassland
Financial support: The authors acknowledge the Slovak Research and Development Agency for the financial support via contract No. APVV-15-0160 Elimination of degradation processes in soil biodiversity and No. APVV-0098-12 Analysis, modelling and evaluation of agroecosystem

(6860 - 1455) Soil organic matter quality as indicator of ecosystem services

Ana Paula Turetta[1]; Etelvino H. Novotny[2]; Catarina Mendes Rebello[3]
Brazilian Agricultural Research Corporation - Embrapa[1]; Brazilian Agricultural Research Corporation[2]; Federal University of Rio de Janeiro State[3]

Soil organic matter (SOM), although a minor component in most soils, is primarily responsible for structure, function and sustainability of the ecosystems. Regarding the effects of soil degradation, those associated to SOM have importance and complexity, since changes in the quantity and quality of SOM may occur as a function of agricultural management practices. Ecosystem services (ES) are the benefits that humans obtain from ecosystems and so is necessary to develop methodologies capable to assess the potential of agroecosystems to provide ES; to subsidize public policies that encourage the adoption of conservationist agricultural practices and; consequently, the payment of ecosystem services (PES). For this, is necessary to identify parameters that can act as indicators of such services. Since SOM is a key component in soil ES provisioning, its characterization is mandatory to this discussion, and ^{13}C nuclear magnetic resonance (NMR) spectroscopy is one of the most powerful tools for this purpose, making possible, with the aid of multivariate analysis, to compare different soil management practices for ES evaluation. For the evaluation of a new management model, tested in Pito Acceso watershed, in Bom Jardim/Rio de Janeiro State, Brazil, with typical soils of mountain environment under the Atlantic Forest cover, we analyzed soil samples from four land uses/soil management: forest; permanent conventional crop; annual conventional crop and annual implemented crop, in two depths: 0-5 and 80-100 cm. Three pseudoreplicates from each area were collected. The extraction of the humic acids (AH) was carried out according to the method suggested by the International Humic Substances Society. The HA were analyzed by solid state NMR in a Varian INOVA (11.74 T) spectrometer. To help in data interpretation, the technique "Multivariate Curves Resolution" was used. The superficial layer (0 – 5 cm), the implemented crop presented AH similar to those obtained from the forest, with predominance of aliphatic structure. In depth (80 - 100 cm) there is a relative accumulation of aged (partially oxidized) pyrogenic C and carbohydrates, which probably percolated through the soil. The HA composition, determined by NMR, proved to be efficient in the evaluation of the soil potential to provide ES and can be used as an indicator of ES or as a reference method for the validation of other low-cost indicators.

Keywords: Humic acids, multivariate analysis, Nuclear Magnetic Resonance, Ecosystem Services Indicators
Financial support: EMBRAPA; CNPq; CBPF

(9678 - 1127) Spatial Bayesian belief networks: A participatory approach for mapping soil vulnerability at the Itatiaia National Park, Brazil

Elias Mendes Costa[1]; Laura Poggio[2]; Helena Saraiva Koenow Pinheiro[1]; Robson Altiellys Tosta Marcondes[1]; Lúcia Helena Cunha dos Anjos[1]
Federal Rural University of Rio de Janeiro[1]; The James Hutton Institute[2]

The Itatiaia National Park (INP) is a conservation unit, with a multitude of species of the Brazilian fauna and flora, some endemic. The INP is the origin of 12 watersheds that contribute to the rivers Rio Grande and Paraíba do Sul, important rivers in southern and south regions of Brazil. It is one of the parks that receive most visitors in Brazil due to the landscape and biodiversity characteristics. The aim of this study was to assess the soil vulnerability in the INP by integrating the information of physical environment with knowledge of experts, to reconcile demand for public use and of ecosystems conservation. The method used was spatial application of a probabilistic model known as Bayesian Belief Network (BBN). Soil data (such as carbon content, texture, depth, and capacity to store water) were integrated with data derived from remote sensing (e.g. land use) and relief (elevation and slope) and with the expert opinion of land managers, decision makers and researchers that work with the INP or surrounding areas. Integrating environmental factors and expert opinion is a suitable approach to assess the soil vulnerability in INP. The most fragile areas were identified with soils with high levels of carbon, profiles less developed (shallow), with accentuated slopes, and a vegetation cover with herbaceous graminoid plants, with a predominance of Cyperaceae and Poaceae (high altitude fields). This approach will help decision makers to identify priority areas for intervention, in order to reduce soil degradation in the areas with high vulnerability. The results could also be used as a basis to support the INP management plan, as well as to contribute to other researches, especially those related with ecosystem services in the Atlantic Forest Biome.

Keywords: Ecosystem services; soil degradation; soil functions; soil security
Financial support: National Council For Scientific And Technological Development (CNPQ), Coordination For The Improvement Of Higher Level Education (CAPES)

(7195 - 1946) Sugarcane straw removal for bioenergy production in Brazil: short-term effects on soil functions and plant yield

Maurício Roberto Cherubin[1]; Izaias Pinheiro Lisboa[2]; Lucas Santos Satiro[2]; Aijânio Gomes de Brito Silva[2]; Brigitte Josefine Feigl[3]; Carlos Eduardo Pellegrino Cerri[2]
University of São Paulo, "Luiz de Queiroz" College of Agriculture, 11 Pádua Dias Avenue, Piracicaba, SP 13418-900 Brazil (cherubin@usp.br) / University of São Paulo, Center for Nuclear Energy in Agriculture, Piracicaba, SP 13416-000 Brazil[1]; University of São Paulo, "Luiz de Queiroz" College of Agriculture, 11 Pádua Dias Avenue, Piracicaba, SP 13418-900 Brazil[2]; University of São Paulo, Center for Nuclear Energy in Agriculture, Piracicaba, SP 13416-000 Brazil[3]

Brazil is the largest sugarcane producer in the world, accounting for about 40% of the global production. Despite that, growing demands for bioenergies and market opportunities have raised the industry's interest for removing the sugarcane straw left on the field during stalk harvesting to produce bioelectricity and/or cellulosic ethanol. However, the straw maintenance in the field has a key role for preserving or improving soil functioning and plant growth. Therefore, indiscriminate straw removal management can deplete soil quality, decreasing its capacity to sustain suitable biomass production over time. In light of that, a multi-local study has been conducted since 2014 across central-southern Brazil. We investigated the impacts of sugarcane straw removal rates on soil and plant growth aiming to produce a useful scientific base to the sector for supporting decision-making. In nine study sites, we assessed straw decomposition, multiple soil properties (chemical, physical and biological) and sugarcane biomass production under increasing amount of straw that representing 100, 75, 50, 25 and 0% of removal straw. After two years of study, the short-term effects indicated that indiscriminate (total) removal of sugarcane straw from the field induced negative impacts on key soil functions, such as cycling and storage of C and nutrients, thermal regulation, plant-available water storage and resistance to structural degradation, especially in the surface layers (up to 10 cm). Soil functions were little or no impacted by moderate straw removal (~50%). In terms of plants, straw removal affected positively plant sprouting, but it had none or a slight negative effect on the sugarcane yield. Both, soil and plant responses varied according site-specific conditions of soil, sugarcane variety and climate, confirming that

these factors have to be taken account for more sustainable straw management. Our findings indicated that in high straw-producing fields, partial straw removal seems to be (at least in the short term) a sustainable strategy to increase Brazilian bioenergy production with minimal degradation of soil functions and negative impacts on biomass production.
Keywords: Crop residue; soil ecosystem services; sugarcane yield
Financial support: The Brazilian Development Bank (BNDES) and Raízen Energia S.A (Project Number #14.2.0773.1); Fundação de Estudos Agrários "Luiz de Queiroz" (Project #67555); CAPES; CNPq.

(3628 - 989) The activity of earthworms and their influence on the soil of an Atlantic Plateau hillslope in São Paulo State under primary forests

Geraldo José Diogo Filho[1]; José Pereira de Queiroz Neto[2]
Escola Superior de Agricultura[1]; Universidade de São Paulo[2]

Very little is known of the impacts of topography on soil faunal communities. Therefore, the focus of this research is the activity of earthworms and their influence on the soil of an Atlantic Plateau hillslope in São Paulo State. Our area of study is surrounded by environmental preservation areas, it has primary forests in good conditions, warm climate and precipitations above 2,000 mm per year. Three different extraction techniques were used for the survey of annelid communities. Twenty seven monoliths of 25 cm x 25 cm x 30 cm depth were sampled, using the Tropical Soil Biology and Fertility (TSBF) method. Qualitative samples were taken by digging ten holes of 50 cm x 50 cm x 50 cm deph and worms hand sorted. We also used a behavioural extraction technique that induces earthworms to emerge from the soil (onion extract solution) in twelve sites. The collected organisms were weighed, counted and identified at the species level and its distribution was analyzed along the topography. We found a variation of earthworm populations in the three sectors of the slope, with the highest densities in the foothills and lower densities in the top. The density of these invertebrates was influenced by the type of soil along the topography. There is an intense activity of these organisms in the soil and they are not equally distributed in the vertical profile, concentrating on a few layers, sometimes in topsoil, sometimes in subsoil. We also observed the presence of exotic species in disturbed areas. The activity of oligochaetes changes the morphology (bioaggregation), the physical (macroporosity), and chemical (P, K^+, Ca^{2+}, Mg^{2+} and organic matter dynamics, sum of bases and cation exchange capacity) attributes of soil, affecting many pedological processes and soil formation. With their feeding and builder ecological behaviors, worms create galleries, channels and produce casts, helping in soil aeration, the water dynamics and nutrient cycling processes. Despite the role they play in the formation of soil mantle, most of the ground surveys does not include the biogenic aggregates, therefore, we gave special emphasis on the descriptions of such morphologies.
Keywords: topography, pedological coverage, oligochaetes, biogenesis, bioturbation.
Financial support: CAPES

C4.1.2 - Climate change and adaptation of soil functions

(1588 - 1399) Assessing the potential of a Ferric Luvisol in climate change adaptation.

Daniel Okae-Anti[1]; Pane Jeanne D'arc Coulibaly[2]
University of Cape Coast[1]; INERA[2]

Luvisols are considered productive soils because of their moderate stage of weathering and high base saturation. Soils at the study site had developed from granite rock as parent material. These soils have upper horizons of sandy loam texture to sandy clay and generally continuous and massive structure. The study was conducted at Saria in the Central region of Burkina Faso, where contrasting climatic conditions were prevalent, to assess the genotypic performance of two Sorghum varieties, *Kapelga* and *Sariaso 14*, local and improved varieties respectively. Three experiments were carried out under three climatic conditions of a hot dry, cold dry and rainfed seasons. The design was a split-plot. Physico-chemical characterization was done on soils at the 0-20 cm and 20-40 cm depth for particle size distribution, pH, N, P, K, Org C, Ca, Mg, CEC. The crops were evaluated for root growth, reproductive cycle, yield and yield components. Results indicated that yield of sorghum declined with variations in climate. However, the dry cold season was found to be the most productive giving a shortened reproductive cycle with *Sariaso 14*. The soils were sandy loams, slightly acidic and low in N, P, K, Ca, Mg and CEC. Productivity of the soils can be boosted with nitrogen fertilization and some irrigation.
Keywords: Climate change, Sorghum genotypes, Luvisols, Hot dry, Cold dry and Rainfed seasons.
Financial support: FULLY SELF FINANCE

(3687 - 2189) Biometric variables in young plants of Khaya ivorensis A. Chev. under phytoremediation of Cadmium.

Vitor Resende do Nascimento[1]; Cândido Ferreira de Oliveira Neto[1]; Josilene do Carmo Mescouto de Sousa[1]; Thays Correa Costa[1]; Jessica Taynara da Silva Martins[1]; Liliane Correa Machado[1]; Denilson Pontes Ferreira[1]; Susana Silva Conceição[1]; Diana Jhulia Palheta de Sousa[1]; Jessica Suellen Silva Teixeira[1]
Universidade Federal Rural da Amazônia (UFRA)[1]

Soil contamination by cadmium represents a potential agricultural, food-producing, and environmental hazard throughout the world. Faced with the problems caused by this and other metals it is necessary to remove or stabilize the same of the soil, so that there is no contamination of the ecosystems. One of the options for recovering the activity and the diversity of these environments is phytoremediation. With this, the objective of this work was to evaluate the biometric responses in plants of Khaya ivorensis A. Chev. submitted to different doses of $CdCl_2$. The experiment was conducted at the Federal Rural University of Amazonia (UFRA), Belém campus, from December 2015 to April 2016. A completely randomized experimental design with 5 treatments (Control, 10 $ClCd_2$ mg/L^{-1} , 20 $ClCd_2$ mg/L^{-1}, 30 $ClCd_2$ mg/L^{-1}, 40 $ClCd_2$ mg/L^{-1}) and 7 replicates. With the increasing doses of the metal, the plants of Khaya ivorensis A. Chev., presented in response a decline in the biometric parameters, but did not cause the death of the plants. The Khaya ivorensis A. Chev species proved to be an excellent alternative for the phytoremediation method in areas contaminated with cadmium.
Keywords: Ecophysiology, toxicity, African mahogany
Financial support: CAPES and Federal Rural University of Amazonia (UFRA)

(7004 - 3101) Deep Soil Carbon in the Critical Zone: climatic controls on the amount and turnover of carbon in weathered bedrock

Kimber Candice Moreland[1]; Zhiyuan Tian[2]; Asmeret Asefaw Berhe[1]; Anthony O'Geen[2]; Karis McFarlane[3]
University of California-Merced[1]; University of California-Davis[2]; Lawrence Livermore National Lab[3]

Up to 60-80% of the Carbon (C) stored in soils is found below 30cm and deep CO^2 efflux changes seasonally showing the direct connection between atmospheric conditions and deep soil C dynamics. Despite this link there is very little data on C storage and stability in weathered bedrock or saprolite. The overall objective of this research is to investigate how climate regulates organic matter (OM) storage, composition, stability, and stabilization mechanisms. Expecting that the amount of OM stored in deep soil and the stability are a function of soil thickness and availability of weathering products (i.e. reactive minerals),

the stock and stability of deep SOM is expected to follow a similar relationship with climate, as does the intensity of weathering. This research is conducted in the NSF funded Southern Sierra Critical Zone Observatories that is located along a climosequence, the western slopes of the Sierra Nevada Mountains of California. Here we will present results derived from characterization of soils and weathered bedrock using elemental and stable isotope elemental analysis, Fourier Transformed Infrared Spectroscopy as a proxy for decomposition of bulk OM, and Accelerator Mass Spectroscopy to determine the turnover time of C from the topsoil down to 10 meters deep. Our findings show that adding in subsoil and weathered bedrock C stocks increases estimates of soil C stock by 23-29%, that weathered bedrock is an active cycling pool of C, and that the turnover time generally increases with depth and responds to climate regime.

Keywords: C stocks, turnover
Financial support: UC Merced, UC Davis, Critical Zone Observatory, Lawrence Livermore National Lab

(4805 - 784) Effect of temperature and soil moisture on soil: atmosphere greenhouse gases exchange on an aridity gradient

Everaldo dos Santos[1]; Luciana Mayara Mendonça de Almeida[2]; Alexandra Rodríguez[3]; Jorge Durán[3]; Laura García-Velázquez[4]; Fernando T. Maestre[5]; David Fangueiro[6]
Instituto Federal do Paraná[1]; Universidade Federal de Alagoas[2]; Centre for Functional Ecology Coimbra University[3]; Universidad Pablo de Olavide[4]; Universidad Rey Juan Carlos I[5]; Instituto Superior de Agronomia Universidade de Lisboa[6]

Climatic models project an increase of temperature and aridity in many regions of the planet. Soil responses to these changes in drylands are still poorly understood, especially regarding the release and uptake of greenhouse gases (GHGs) by soil microorganisms. In this context, we evaluated the effect of temperature and humidity on the exchange of methane (CH_4), carbon dioxide (CO_2) and nitrous oxide (N_2O) between the soil and the atmosphere in a natural aridity gradient. To do so, we selected and surveyed 24 stabilized dunes located along a natural aridity gradient in the Iberian Peninsula. Collected soil samples were subjected to 10-day laboratory incubations following a full-factorial design with two temperature (25ºC and 30ºC) and two moisture (30% and 60% Water Holding Capacity - WHC) levels. We calculated potential rates of nutrients transformation and GHGs exchange for each combination of temperature and soil moisture. Preliminary results of this experiment show a significant effect of temperature on the soil: atmosphere exchange of all the studied gases ($P < 0.001$). Interestingly, whereas we did not find a significant effect of soil moisture on the GHGs exchange (CH_4: $P = 0.366$, CO_2: $P = 0.781$, N_2O: $P = 0.836$), we found a significant interaction between temperature and soil moisture for soil CO_2 emissions ($P < 0.05$). These results suggest that soils from this gradient can maintain similar levels of functioning under different levels of soil moisture. However, increases in temperature are likely to lead to increased GHGs emissions, which represents a positive feedback to climate change.

Keywords: climate change, biological feedbacks, methane, carbon dioxide, nitrous oxide.
Financial support: FCT - Fundação para Ciência e a Tecnologia Portugal - Instituto Federal do Paraná – IFPR

(1285 - 561) High temperature and water stress affect the plant nutrient levels of *Panicum maximum* under future climatic changes

Dilier Olivera Viciedo[1]; Renato de Mello Prado[1]; Carlos Alberto Martinez[2]; Eduardo Habermann[2]; Kolima Peña Calzada[3]; Alexander Calero Hurtado[1]; Rodolfo Lizcano Toledo[1]
São Paulo State University (Unesp), School of Agricultural and Veterinarian Sciences, Jaboticabal, SP- Brazil.[1]; University of São Paulo, Department of Biology, FFCLRPRibeirão Preto, São Paulo, Brazil, 14040–901[2]; University of Sancti Spiritus Jose Marti Perez, Sancti Spiritus, Cuba[3]

Panicum maximum Jacq. 'Mombaça' (C4) was grown in field conditions with sufficient water and nutrients to examine the effects of warming and water stress (Ws) on the growth, accumulation and efficiency of nutrients in the metabolism of tropical grass C4, from November 6th to 27th, 2016. Plants were exposed to both the ambient temperature and good soil moisture (Control); water stress (Ws); canopy warming (+2°C above regular canopy temperature, eT); or water stress and canopy warming (Ws+eT). The temperatures in the field were controlled by temperature free-air controlled enhancement (T-FACE). The plots with normal moisture were irrigated frequently to maintain soil moisture at 80%. Soil of the experimental area was an Oxisol clayey. The temperature increase with adequate humidity (eT) significantly influenced the nutrients accumulation N, K, Ca, B and Cu with relation the control treatment (C). The treatment under water restriction (Ws) presented the worst performance, with the absorption of nutrients being limited. In relation to the nutrient use efficiency (NUE) a behavior similar to the nutrient accumulation could be verified, being the (eT) treatment the one that stimulated a greater nutrients use efficiency N, P, K, Cu, Fe, Mn and Zn in relation to the control treatment (C). This behavior can be explained because the higher temperature promoted a higher photosynthetic, improving the efficiency of water use, nutrients, being reflected in the greater production of dry matter. Therefore, with sufficient water and nutrients in this forage, the accumulation and nutrient use efficiency could be partially offset by elevated temperatures, achieving a greater production of P. maximum foliage and decreasing the fertilization costs under the future effects of climate change. Dry matter was also favored with the increase of temperature and adequate humidity (eT) presenting an increase of 20% in relation to the control treatment (C), 16% with the (Ws + eT) treatment and 33% with the water stress (Ws) respectively. Interesting result how the treatment subjected to water stress and high temperature (Ws+eT) presented a better performance than the one subjected to water stress in an isolated form, which is probably influenced by a better use of water as well as stomatal opening and closing.

Keywords: Nutritional efficiency, nutrient absorption, environment, climate.
Financial support: This work was supported by the Sao Paulo Research Foundation (FAPESP), Thematic Project (Grant 2008/58075-8) and by The Brazilian National Council for Scientific and Technological Development (CNPq).

(8649 - 1088) Relationship of Nitrous Oxide Production and Consumption By Collapsed Palsa

Yuta Takatsu[1]; Nako Achiwa[1]; Leo Vainio[1]; Teemu Tahvanainen[2]; Yasuyuki Hashidoko[1]
Hokkaido Univ[1]; University of Eastern Finland[2]

Nitrous oxide (N_2O) is known to be one of the strongest greenhouse gases, which is 300-times stronger than CO_2. N_2O is also recognized as a disrupter of the ozone layer. Now-a-day, the permafrost including the palsa mire in subarctic tundra has been melting due to global warming. After this topogeological collapse of palsa hills, active N_2O emission was predicted in this area. Generally, N_2O is emitted in acidic conditions, but in the palsa, N_2O emission is accelerated in weak alkaline conditions. Stable palsa mire generally sustains acidic conditions in soil, water, and heathy vegetation. In the culturing system, N_2O emitters isolated from the ombrotrophic ecosystems indicated similar tendency. Furthermore, consumption of N_2O that had been produced by N_2O emitters was implied in varying conditions and we predicted that N_2O-consuming

bacteria are present and act as an N_2O quencher in the palsa soil. We attempted to find the N_2O emitting bacteria and N_2O consuming bacteria in the degraded palsa soil, Finland, Kilpisjärvi. A 10 mg potion of the soil was suspended in 10 ml Milli Q water and 100 µl of the resulting supernatant was inoculated into a gellan gum medium for N_2O production assay, allowing culturing at 25°C for 14 days. Headspace gas (22.6 mL) in the vials was then analyzed by ECD-gas chromatography to search for hyperactive N_2O emission bacteria, and some of the highly N_2O emitting bacteria were confirmed as the community members in the soil. These cultures were analyzed by the next generation sequencer together with the soil itself to reveal intact or biased bacteria community structures, including those N_2O emitting bacteria. The result of the microfloral analysis administered prediction that *Chitinophpaga* sp., which has been found in reclaimed tropical peatland, in Sarawak, Malaysia, and andisol farmland in Hokkaido, Japan, was also confirmed in the collapsed place of subarctic palsa soils, in Lapland, Finland. The proportion of *Chitinophaga* spp. at the low N_2O emitting soil tended to be large. These results strongly suggested that N_2O quenching system by *Chitinophaga* sp.is distributed in global scale throughout tropic to subarctic zones. Currently, we are attempting to elucidate mechanisms of this N_2O quenching process.

Keywords: Nitous oxide quencher, collapsed Palsa, soil bacteria
Financial support:

(7160 - 2223) Response of soil microarthropods assemblages to different precipitation patterns

Bruna Raquel Winck[1]; Felicia Fischer[1]; Ricardo de Alencastro[1]; Daniela Hoss[1]; Bruna Claudia da Silva Jorge[1]; Valério D. Pillar[1]

Universidade Federal do Rio Grande do Sul[1]

Soil fauna assemblages can influence several ecosystem services related to organic matter decomposition and nutrient availability. Previous studies suggest that soil biota is very sensitive to impacts such as climate change and can be indicator of environmental disturbance. One of the effects of climate change is on precipitation patterns, causing extreme weather events such as drought and intense rainfall. Here we investigate how extreme weather events can influence epigeic soil fauna community in natural grassland in southern Brazil. We simulated two extreme weather conditions: drought (93% rainfall reduction with rainout shelters) and excessive rainfall (93% rainfall addition with irrigation). Two additional controls were used: natural rainfall and upside down rainout shelter (simulating only the microclimate under shelter). We focused our attention on collembolan community (a representative microarthropod of soil) as proxy for soil biodiversity. We measured: community composition (MANOVA), abundance, richness, taxonomical diversity, dominance, evenness, functional diversity and functional redundancy. Our findings showed that collembolan composition (P = 0,0001), abundance (P = 0.025), richness (P = 0.05) and functional diversity (P = 0.04) were significantly affected by rainfall treatments. MANOVA revealed that drought (93% rainfall reduction) was strongly different from the other treatments, indicating that soil moisture reduction and temperature increases caused by precipitation reduction can affect species composition. Collembolan abundance was high in rainfall addition and in natural conditions (77 and 90 individuals, respectively), possibly due the better habitat conditions (higher soil moisture and lower temperature). Species richness was also higher in rainfall addition and natural conditions (both with 12 species) when compared to drought conditions (9 species). Higher species richness can explain the higher functional diversity (0.41 and 0.40) in these treatments when compared to drought and control with shelter (0.38 and 0.36). Comparing the treatment of drought and control with shelter, we observed that abundance, richness and functional diversity were statistically similar, suggesting that the microclimate can also influence Collembola community. Even so, our findings revealed that changes on soil habitat caused my climate changes, mainly drought, can strongly affect fauna communities and consequently ecosystem services they provide.

Keywords: climate changes collembolan community soil biodiversity ecosystem services
Financial support: Conselho Nacional de Desenvolvimento Científico e Tecnológico

(6091 - 1880) Soil organic carbon store in Honduras

Arévalo Gloria[1]; Manueles Alexandra[1]; Guevara Mario[2]; Olmedo Guillermo[3]

Zamorano University, Honduras[1]; 2University of Delaware, Department of Plant and Soil Sciences, Newark DE, USA. 19713[2]; 3INTA EEA Mendoza, San Martín 3853, Luján de Cuyo, Mendoza, Argentina, M5507EVY and FAO-Global Soil Parthership, Viale delle Terme di Caracalla, 00153, Rome, Italy.[3]

Soil organic carbon (SOC) and also Soil Organic Matter (SOM) buffers the impact of climate extremes on soils and crops by regulating water supply to plants, reducing erosion by decreasing runoff, and providing sites for nutrient retention and release (FAO and ITPS 2015). The SOC map was building on basis for the preparation of the Global SOC Map of the Global Soil Partnership (GSOCMap-GSP). Honduras is located at the middle of Central America. It has 112,492 km² and about 70% of irregular landscape. Intermountain rivers give origin to alluvial valley of various shapes and extensions. This conditions generates a great variability of landscapes, subjects to common cycles of soil erosion and flooding. Since the country is located 16 degrees North of the Equator, with various thermal levels in the soils as well as in the atmosphere. Rainfall has a very strong effect in (SOC). More than 2200 soil profiles were collected and reviewed from various sources. It was necessary to locate the each information point: master horizons and their depth, color, texture and coarse fragments volumes. Bulk density was calculated on basis of this information. With these parameters (SOC) were calculated end extrapolated by the Kriging Method. Therefore, the genesis and content of SOC varies across the country, mainly taking into consideration a very distinct climatic patterns between The Caribbean and The Pacific Ocean Coast. It can be predicted that Climate Change will have a decrease on SOM of the soils, punctuated by years of heavy rainfall with signicant with draughty ones which result in SOM losses in the soils. The work was presented as a major effort of the Republic of Honduras to mitigate Climate Change and to improve soil sustainability. Highest correlations of available SOC data and were found with temperature across Honduras. Terrain slope and temperature are the best correlated variables with available data. Higher uncertainty and a relatively low density of SOC per unit of area was found in Honduras.

Keywords: Climatic change, organic matter storage, soil degradation
Financial support: FAO and Zamorano University, in collaboration with SAG/DICTA of the Honduras Republic Goverment.

(5942 - 1631) Soil organic carbon turnover rate prediction in the framework of global warming: an approach to determine the role of climate and geochemestry.

Marcela Hidalgo[1]; Manuel Casanova[2]; Cristina Muñoz[1]; María de los Ángeles Sepulveda[1]; Erick Zagal[1]

Universidad de Concepción[1]; Universidad de Chile[2]

The role of soil as a sink or source of atmospheric CO_2 is not sufficiently elucidated. As well as the knowledge of geochemistry and climate influences in the stabilization and decomposition process of organic matter. This knowledge is needed to improve prediction of carbon (C) storage under the new sceneries of global warming. Thus, the main goal of the research is to evaluate the organic matter mineralization rate through soil profile in order to understand geochemical and climate interaction as control factors in the soil C feedback to climate change. By the determination of $\Delta\delta^{13}$ using NIRS as a tool to predict the C turnover

rates in a latitudinal climatic gradient. The gradient includes 38 different sites across Chile (between 32°-47°S, 4000 km) with different climate zones as hot, temperate and cold as well as humid and arid zones. Soil samples were collected in 40 different sample sites at three different soil depth (0-10; 10-30; 30-60 cm). Geochemistry parameters will be analysed as well as SOC turnover rates by soil respiration until 70 days of soil incubation, relating these results to $\delta^{13}C$ values ($^{0}/_{00}$) obtained through NIRS method. Our study will help unravel climate and geochemistry effects on patterns of vertical $\delta^{13}C$ leading to a better understanding of SOC turnover both for the top and sub-soils. And consequently to improve CO_2 prediction in a changing climate. Currently measurement are been performing on $\delta^{13}C$ values ($^{0}/_{00}$) from soil incubations using NIRS technique, and these results will be available by May 2018.
Keywords: δ13Carbon , Geochemistry , Carbon stabilization
Financial support: Fondecyt Regular 1161492 Gobierno de Chile

(1698 - 632) The heat on the surfaces of the Federal Rural University of Rio de Janeiro

Thallison Rodrigues de Oliveira[1]; Adriana Soares de Schueler[1]
Universidade Federal Rural do Rio de Janeiro[1]

The solar irradiation when focuses on Earth provides five physical phenomena: reflection, transmission, scattering, absorption and emission. Find out how these phenomena work is important for determining the reflectance of the waves and consequently the balance of the short waves. Among these physical phenomena the scattering which is called the albedo or coefficient of reflection which may vary according to the conditions of the Earth's surface. In this paper were collected soil samples from specific locations on the Campus of the Universidade Federal Rural do Rio de Janeiro, located in SeropeFRRJdica-RJ. By means of a thermal imager equipment (Flir-E63900) solar emissions of samples of soil were measured and compared with the values obtained in the literature, concerning the texture characteristics obtained in the laboratory. This way you can know the temperature difference obtained in the literature and in the field. It is observed that Seropedica was considered a rural and planting area, today it has a feature of urban rural fringe, what may be observed by it new soil uses and what interferes interferes in the urban temperature. Notes that in recent years have increased the urban agriculture initiative that contributes to the reduction of the effects of heat islands and the improvement of air quality.
Keywords: albedo; soil texture; climate
Financial support: Scholarship CNPq, Faperj Project Number E-26/210.242/2014

(4479 - 781) Use of adaptive legumes genotypes to constraint factors in soil as strategy to improve agricultural sustainability in different cropping system

Luis A. Gomez Jorrin[1]
Soil Institute of Cuba[1]

Use of “adaptive” legumes genotypes to constraint factors in soil and effective *Rhizobium* strain as strategy to improve agricultural sustainability in different cropping system. Luis A. Gomez[1]; Tomas Shagarodsky[2]; Vincent Vadez[3]; Graciela Dueñas[1]; German Hernandez[1]; Amalia N. Morales[1]; Helene Valhe[4]; Catherine Pernot[4]; Jean J. Drevon[4]. Soil Institute, MINAG, Havana, Cuba; 2. INIFAT, MINAG, Havana, Cuba; 3. ICRISAT, Patancheru, Andra Pradesh, India; 4. URM 1222 Eco & Sol. INRA-IRD-SupAgro, Montpellier; France. E-mail address: gomezjo@isuelos.cu Legumes are main protein source of Cuban´s peoples, but at the present Cuban Agriculture faces fertilizer deficit with the consequences negatives impact upon the agricultural production and the soil fertility. Soils nutrient deficiencies *(nitrogen and phosphorus), drought* and *salinity* mainly in small farmer agricultural areas are the principal constraint factors that limit crop production. One solution way to these problems is use of “adaptive” genotype to theses adverse conditions. In this context, several experiences were developed under controlled conditions and field, where agronomy response of 110 common bean (*Phaseolus vulgaris L.*), 48 cowpea (*Vigna unguiculata L. Walp*), 42 chickpea (*Cicer arietinum* L.) and 12 mungbean (*Vigna radiata (L) Wilzeck*) genotypes were evaluated. “Superior genotypes” in interaction with specific Rhizobia were selected on basis of grain, shoot and nodule biomass production, efficiency of utilization of rhizobia symbiosis, proportion N_2 derived from air (%Ndfa) using isotopic techniques, root traits, phosphorus use efficiency and adaptation to salinity. The strategy the use of effective Rhizobium strains in combination with “superior genotypes” in fourth different agro-ecosystem (Pinar del Rio, Artemisa, Mayabeque and Holguin) showed that it is possible to i) obtain average %Ndfa between 40 and 60 % , ii) to increase grain production, iii) incorporation of biomass residues and nitrogen to soil in farming cropping system. It was recognized by Cuban agricultural authorities that this strategy improved the agricultural sustainability of the legumes cropping system and it allowed obtaining earnings of 173 $USDha^{-1}$ with regard to the conventional systems. Keywords: genotypes, phosphorus, salinity, sustainability Financial support: Soil Institute of Cuba
Keywords: genotypes, phosphorus, salinity, sustainability
Financial support: Soil Institute of Cuba

C4.1.3 - Soil in the Anthropocene

(8196 - 1713) Soil Habitat Characteristics for a Rare Cactus Can Guide Energy Development, Soil Reclamation, and Plant Reintroduction

Janis Boettinger[1]; Eugene Schupp[1]; Jeanette Norton[1]; Jeremiah Armentrout[1]; Kourtney Harding[1]
Utah State University[1]

Sclerocactus wetlandicus, a rare cactus endemic to northeastern Utah, USA, is threatened by non-renewable energy development. While we have a basic understanding of vegetation characteristics of *S. wetlandicus* habitat, there are no data quantifying soil characteristics of occupied habitat, whether these characteristics differ from those of unoccupied habitat, and how closely reclaimed well pads resemble undisturbed sites in these characteristics. An understanding of soil characteristics of *S. wetlandicus* will help: 1) guide energy development compatible with conservation, 2) identify areas suitable for introduction of additional populations, and 3) determine the suitability of reclaimed well pads for cactus reintroduction. The objectives of our study were to determine: 1) Soil properties of cactus-occupied vs. cactus-unoccupied sites, 2) Whether *S. wetlandicus* is associated with mycorrhizae, and 3) If soil properties of reclaimed well pads are similar to cactus-occupied sites. Five populations were identified and occupied sites were created around them. These were paired with unoccupied sites with similar geologic features. We also selected unoccupied sites far away from known cactus populations. Lastly, 18 reclaimed well pads were selected. We excavated soils to describe and sample material for laboratory analyses. We sampled and analyzed cactus roots for mycorrhizal analysis. The cactus was associated with vascular arbuscular mycorrhizae (VAM). Properties of undisturbed soil at occupied sites were not significantly different from undisturbed soils at unoccupied sites. However, properties of undisturbed soils at both occupied and unoccupied sites differed significantly from the soils of well pads ($p<0.05$). Well pad soils were significantly higher in available P, electrical conductivity, and soluble B, S, Na, Mg, and K; and contained human transported/altered materials. Compared to undisturbed sites, well pads had significantly lower slopes because they had been excavated/constructed to be a level surface. Bare soil cover was much higher and biological crust cover was much lower on well pads than on

undisturbed soils. In conclusion, soils of occupied and unoccupied undisturbed sites are indistinguishable, and reclaimed well pads do not resemble undisturbed soils. Also, cactus association with VAM could help in plant reintroduction.

Keywords: Rare endemic plant, Non-renewable energy development, soil reclamation, plant reintroduction

Financial support: National Fish and Wildlife Foundation, Utah Agricultural Experiment Station, USU Ecology Center

C4.1.5 - Carbon sequestration potential of soils

(2876 - 2736) A preliminary study of soil respiration from a semiarid ecosystem of Caatinga at northeast Brazil

Renato Francisco da Silva Souza[1]; Victor Junior Lima Felix[1]; Emanoel Lima Martins[1]; Vânia da Silva Fraga[1]; Bruno de Oliveira Dias[1]; Borja Ruiz Reverter[1]; Antonio Celso Dantas Antonino[2]

UFPB[1]; UFPE[2]

Soil respiration from semiarid ecosystems plays an important role in the interannual variability of the global carbon cycle, but the drivers that control such variability are still under debate since studies of this kind on semiarid ecosystems are scarce in the literature. In our preliminary work, we quantify the CO_2 efflux from a Caatinga located in northeast Brazil and study the influence of soil temperature and soil moisture on it. For that we used a LI-8100 chamber measuring on 12 points along a straight transect of 360 m. Measurements were taken bimonthly from August to October 2017. Overall, we found that soil respiration varied between 4.78 and 0.38 µmol m^{-2} s^{-1}, with a standard deviation of 1.86 µmol m^{-2} s^{-1}. Averaging each field campaign, the highest CO_2 efflux was 2.49 µmol m^{-2} s^{-1}, which coincided with the highest soil moisture (0.18 m^{-3} m^{-3}). On the other hand, the least averaged CO_2 efflux values (0.72 µmol m^{-2} s^{-1}) were associated with the least soil moisture (0.09 m^{-3} m^{-3}). Soil temperatures showed little variation during the measurement period as they remained tightly between 25.8 °C and 30.3 °C. We therefore conclude that soil moisture and not temperature is the main driver of the soil CO_2 emissions, which is in fact characteristic of semiarid ecosystems.

Keywords: Keywords: CO_2 efflux; closed chamber; Caatinga.

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(9213 - 1316) Beyond infrared spectroscopy and spatial analysis: SOC stocks mapping in volcanic soils of Reunion Island.

Allo Myriam[1]; Todoroff Pierre[1]; Jameux Magali[1]; Stern Mathilde[1]; Rosies Blandine[1]; Ramos Marion[1]; Quero Solene[1]; Albrecht Alain[2]

CIRAD[1]; IRD[2]

As high carbon content soils with high human carrying capacity, volcanic soils of Reunion island highlight the importance of “carbon hotspots” to face the challenges of climate change and food security trough carbon sequestration. In addition, the ‘4 per mille’ initiative demonstrated that agricultural soils can play a crucial role for these global issues but knowledge on soil organic carbon (SOC) stocks of agricultural soils is still needed in tropical areas. Reunion is a young tropical volcanic island in the Indian Ocean, 700km east of Madagascar, with three major agricultural land uses (sugarcane crops, pastures and gardening) on a volcanic rock weathering gradient from Andosols to Ferralsols. A stratification method has been used to map SOC stocks in Reunion. First, 1000 soil samples (0-30cm depth) on the major agricultural land uses across the island from a huge database containing more than 45 000 soil analyses since 1993, have been selected. Mid-infrared spectra were acquired on these dried and thieved 1000 soil samples using a portable spectrophotometer. Spatially homogenous soil units have been defined by a clustering method (K-means) from laboratory analyses (SOC content, CEC, N, …) and mid-infrared spectra of these 1000 soil samples. Secondly, since 2016, soil samples have been collected in the field on the major agricultural land uses per spatially homogenous soil units to developed a mid- and near- infrared (MIR and NIR) spectroscopy method, both in the field (fresh soil samples) and in the laboratory (dried and thieved samples) to predict SOC stocks on 0-30 cm depth. Overall, SOC stocks can be predicted with satisfactory accuracy and directly by NIR and MIR spectroscopy in volcanic soils. In order to spatialize these results, an average SOC stock has been calculated for each combination of soil unit and agricultural land use. Then, each average SOC stock has been attributed to every agricultural field to map SOC stocks of the whole agricultural area in Reunion. The proposed methodology will produce a strong spatial baseline that will enable simulations of impacts of land use changes on SOC stocks at the island scale.

Keywords: Soil organic carbon (SOC) stocks, infrared spectroscopy, volcanic soils, spatial analysis, clustering.

Financial support: CIRAD/IRD

(3270 - 777) Cacao agroforestry system as a strategy for soil carbon sequestration

Emanuela Forestieri Gama-Rodrigues[1]; Paulo Henrique Marques Monroe[2]; Gerbeli de Mattos Salgado[3]; Antonio Carlos Gama-Rodrigues[1]

Soil Laboratory, North Fluminense State University[1]; Soil Laboratory, UESB[2]; UEMASUL[3]

Cacao (Theobroma cacao L.) is the main agricultural commodity in many tropical countries. In Brazil, southern Bahia is the largest planted area and is in the central corridor of the Atlantic Forest, one of the main centers of endemism of this biome, which has gone through a continuous elimination and fragmentation process. Two typical cacao production systems are used by both smallholder (5–8 ha) and large farmers (approximately 300 ha) in this region: (1) traditional cultivation system, wherein the cacao plantations are implanted under natural forest; and herbaceous, shrub and individuals of the upper canopy are eliminated to provide increased light input, resulting in extensive agroforestry called ‘cabrucas’ with 600 cacao ha^{-1}; (2) cacao plantations are established in areas where all native forest has been removed; cacao plants, in a density of 1100 cacao ha^{-1}, are shaded with banana and *Erythrina glauca* or *Hevea brasiliensis*. Agroforestry systems (AFS) based on cacao may play an important role in capturing carbon (C) aboveground and storing it belowground (soil) through continuous deposition of plant residues. C occlusion in soil aggregates could be a major mechanism of C protection in these soils. Therefore, it is important to know the amount of soil C storage across different soil aggregate classes at different soil depths and identify the extent of the sequestered C that is occluded in the soil aggregates. A range of shaded cacao systems and an adjacent natural forest and pasture were selected in different soil classes in Bahia, Brazil. Soil samples were collected from five depth classes up to 1 m depth and separated by wet-sieving into three fraction-size classes (>250 µm, 250–53 µm, and <53 µm)— and analyzed for C content. The SOC stock ranged from 300 to 200 Mg ha^{-1}. In some cases, converting secondary forests into AFS did not decrease the SOC stock up to 1m. However, in other cases this conversion showed a decrease from 34 to 72 Mg ha^{-1} compared to secondary forest. Macroaggregates were the most abundant fraction with great contribution of occluded C storage in the upper soil. The reduced amount of micro-size fraction is probably a result of slow macroaggregate turnover, induced by low tillage, in these AFS. Around 50% of the SOC accumulated under AFS were occluded in the aggregates up to 1 m depth, which is a favorable strategy to C accumulation and will contribute to reduction of CO_2 emissions.

Keywords: soil aggregates, C stabilization, Atlantic Forest, rubber tree
Financial support: CNPq, FAPERJ

(6259 - 1999) Carbon sequestration in agroforestry systems in the south Peruvian Amazon

Joel Peña Valdeiglesias[1]; Julio Alegre Orihuela[2]

Universidad nacional Amazonica de madre de Dios[1]; Universidad Nacional Agraria La Molina[2]

In the South Peruvian Amazon, there is a risk of degradation of the Brazilian nut (*Bertholletia excelsa*) due to illegal extraction of wood and mining. The study was conducted in 40 farmer's plots with agroforestry systems (AFS) of different ages in the south Peruvian Amazon in Puerto Maldonado to measure C sequestration in order that associated farmers have the option of to get environmental services and reduce gas emissions and maintain the productivity of Brazilian nut. Most AFS are base on several prototypes with Brazilian nut as main component in different associations with cacao (*Theobroma cacao*), copoazu (*Theobroma grandiflorum*), naranja (*Citrus sinensis*), plátano (*Musa paradisiaca*), piña (*Ananas comosus*), araza (*Eugenia stipitata*), achihua (*Jacaranda copaia*), pashaco (*Schizolobium amazonicum*), lupuna (*Cavanillesia umbellata*), caoba (*Swietenia macrophylla*), cedro (*Cedrela odorata*), guaba (*Inga sp*), sapote (*Matisia cordata*), tornillo (*Cedrelinga catenaeformis*), teca (*Tectona grandis*), caucho (*Hevea brasiliensis*), cetico (*Cecropia sp*), tahuari (*Tabebuia serratifolia*), pijuayo (*Bactris gasipaes*), aguaje (*Mauritia flexuosa*), capirona (*Calicophyllum megistocaulum*) and shimbillo (*Inga sp*). To measure above ground carbon (C) was used allometric equations and soil C was measured in the layers of a pit of one-meter depth and each soil layer was analyzed the C concentration with the Walkey and Black method. Carbon in above ground biomass including roots fluctuated from 8.37 to 142.24 t/ha and the systems that accumulated more C was the Brazilian nut associated with the species of copoazu, piña, pijuayo, and achihua. The average C in soil at one meter depth was 54.91 t/ha and the average total C in above ground and soil at one-meter depth was 94.35 t/ha. There was a high correlation between the aboveground C, soil C and the age of the prototype AFS.

Keywords: amazon, Brazilian nut, agroforestry systems, allometric equation
Financial support: The authors are grateful to Universidad Nacional Amazónica de Madre de Dios for laboratory and logistic support

(5047 - 2711) Carbon storage capacity in natural and intervened land covers in the Andean zone of Southern Colombia.

Felipe Zúñiga[1]; Jenny Huertas[2]; Gabriela Guerrero[2]; José Dörner[3]; Jairo Sarasty[4]; Hernán Burbano-Orjuela[5]

Doctorado en Ciencias Agrarias, Escuela de Graduados, Facultad de Ciencias Agrarias, Universidad Austral de Chile, Valdivia, Chile[1]; Programa de Ingeniería Ambiental, Facultad de Ingeniería, Universidad Mariana, San Juan de Pasto, Colombia[2]; Instituto de Ingeniería Agraria y Suelos, Facultad de Ciencias Agrarias, Universidad Austral de Chile, Valdivia, Chile[3]; Facultad de Ciencias Agrícolas, Universidad de Nariño, Torobajo, San Juan de Pasto, Colombia[4]; Centro de Investigación en Ciencias Agrarias, Facultad de Ciencias Agrícolas, Universidad de Nariño, Torobajo, San Juan de Pasto, Colombia[5]

FAO projections indicate that Latin America has potentially around 800 million hectares available for cropland expansion. The conversion of natural ecosystems to ecosystems to agro-ecosystems, is one of the main sources of increasing GHG (e.g. CO_2). Since soils are considered to be a potential carbon sink they play a key role in the regulation of the carbon dynamics of terrestrial ecosystems. This research evaluates the carbon storage capacity (OC_{mass}) along altitudinal gradient of land cover change in Nariño, the Andean zone of Southern Colombia. Nine sampling sites were selected, ranging from natural ecosystems (e.g. páramos and native forest) to agro-ecosystems (e.g. grasslands and croplands). From each site, disturbed material in each soil horizon (z) was collected to measure their chemical properties using specific dissolution extractions (ammonium oxalate, pyrophosphate extractions, NaF pH), cation exchange capacity (CEC) and total organic carbon (C). Undisturbed material was collected to measure bulk density (dB). i) the organic carbon mass, which was calculated as: OC_{mass}= C [%]*dB*z*100, varied between 697 to 173 Mg ha^{-1} for native forest and croplands, respectively. ii) the highest values of C were found for páramo azonal [21.5%] but because the dB was low [0.18 Mg m^{-3}] the OC_{mass} sampled is not the highest. iii) a significant correlation (r= 0.64) was found between NaF pH vs. Al_o+½Fe_o (y= $9.78x^{0.07}$; R^2 =0.35). iv) 50% of the soils investigated had Al_o+½Fe_o ≥; 61% dB < 0.9 Mg m^{-3} and 66% had NaF pH values > 9.4. These indicators suggest that andic properties, dominated by amorphous colloidal material, especially the colloidal organic fraction, are related to iron linked with soil organic matter [Fe_p/Fe_o >0.5 = 82%]. 25% of Al_o-Al_p presented negative values, in grassland and croplands, suggesting that these soils have mainly crystalline clays. This is reflected in low values of CEC [23 $cmol_{(+)}$ kg^{-1}] compared with native forest and páramo azonal which reached CEC 82 and 76 $cmol_{(+)}$ kg^{-1}, correspondingly. These results suggest that the OC_{mass} accumulation in these soils depends on land cover and is regulated by colloidal properties such as clay type and soil organic matter.

Keywords: Carbon sink; Páramos; Andisols
Financial support: Student and Academic Mobility Platform of the Pacific Alliance, the Vice-Rectory for Research, Postgraduate and International Relations (VIPRI), Botana Experimental Farm, Specialized Laboratories of the Nariño University and Mariana University.

(6199 - 694) Climate determines the response of soil carbon to no-till

Denis Angers[1]; Murilo Veloso[2]; Cimelio Bayer[2]

Agriculture and Agri-Food Canada[1]; Federal University of Rio Grande do Sul[2]

Adopting no-till (NT) in agro-ecosystems has been widely recommended as a measure to sequester soil organic C (SOC). However, ranges of positive and negative results have been obtained, and the reasons for this variability are still unclear. A data set of long-term tillage studies was compiled from a survey of the scientific literature worldwide, including studies from previous meta-analyses. Studies were included in the data set if the following criteria were met: (i) studies compared NT and conventional tillage (CT) systems; (ii) studies were replicated experimental designs; (iii) SOC was sampled to 0-5 ±2.5 cm soil layer and 0-30±2.5 cm soil layer, and (iv) tillage treatments were applied for at least 5 yr; (v) soils with clay content between 150 and 350±20 g kg^{-1} were considered. For each study, we calculated the relative response of SOC to NT compared to CT, and investigated its relationship with climate variables. A total of 28 studies were included in the analysis from four continents. In all cases, there was a positive effect of NT on SOC in the 0-5 cm soil layer where the relative SOC accumulation under NT was best fitted to mean annual precipitation (MAP) using a hyperbolic curve (R^2 = 0.59; p<0.002). When the 0-30 cm soil layer was considered, the SOC response to NT followed the same tendency, and was still dependent on MAP. High accumulation at high MAP was possible only with increased input or reduced decomposition under NT, whereas high accumulation at dry sites (< 500 mm $year^{-1}$) was also possibly due to the mulch effect; i.e. leaving the residues at surface slows down their decomposition. At around 800 mm $year^{-1}$, the relative SOC accumulation under NT was around zero, which is attributable to the higher SOC in deeper soil layers under CT, which compensates for the gains in the surface layer under

NT. We conclude that at the global scale the response of SOC to NT is highly dependent on climate, especially precipitation. However, the mechanisms explaining these effects are still not fully understood and generally not well represented in our predictive models.
Keywords: soil tillage carbon sequestration climate
Financial support: CAPES (Brazil) and AAFC (Canada)

(1456 - 354) Effect of designer acidic biochar on coastal saline-sodic soil properties and okra growth

Zhenyu Wang[1]; Le Yue[1]; Lin Fu[1]; Zhenggao Xiao[1]
Jiangnan University[1]

Soil health is essential and irreplaceable for plant growth and global food production, and has been threatened by climate change and soil degradation. Degraded coastal soils are urgently required to reclaim using new sustainable technologies including biochar technology promotion, but the modification of original biochar is still needed due to the intrinsic alkalinity and available nutrient deficiency. In present study, the acidic phosphorus-rich biochar was prepared by using 2 acidified methods. The response of Okra (*Abelmoschus esculentus*) to the application of the modified biochar into a coastal soil was also investigated using a pot experiment. The 3 acidified biochars showed the pH of 2.81, 3.02, and 2.71, respectively (original biochar, 8.19), and the phosphorus acid pre-modified biochars showed a specific surface area of 17.99 m^2g^{-1}(approximately treble the area of original biochar), whereas a slight reduction in the surface area was found with monocalcium phosphate modified biochar. The phosphorus acid post-modified biochars contained a significantly higher amount of water-soluble cations (e.g., K^+ and Ca^{2+}) compared to other biochars. The 3 acidified biochars significantly decreased the pH of saline-sodic soil by 0.729-0.225, while increased soil Olsen- phosphorus content, EC and CEC by 38.3-387.8, 8.89-22.3% and 7.29-22.2%, respectively. The 3 acidified biochars significantly elevated the root length and surface area of okra by 143.7-165.4% and 38.2-135.3%, respectively, while the original biochar showed no obvious effect on okra root development. The monocalcium phosphate modified biochar significantly enhanced the shoot biomass of okra by 38.2%, and all the biochars increased the okra yield by 24.0-151.4%. Moreover, the monocalcium phosphate modified biochar showed the best okra growth and yield performance, which led to an increase of 28.59-39.56% and 90.3-104.1% in okra biomass and fruit yield, respectively. This was mainly attributed to the enhanced phosphorus availability, resulting from the biochar-improved soil quality and fertility. Additionally, the elevated bacterial activities and abundances of the bacterial taxa responsible for phosphate solubilizing and C-stabilizing also contributed to the enhanced primary productivity. The study proposed a promising method to design biochars by phosphorus and monocalcium phosphate modification to reclaim the degraded coastal soil and benefit in soil and food security.
Keywords: climate change; food security; salinity; plant growth; rhizosphere; monocalcium phosphate
Financial support: Research Funds

(7465 - 1340) Impact of sugarcane cultivation on soil carbon dynamics in a semi-arid Brazilian Vertisol

Leandro Reis Costa Santos[1]; Adriana Bezerra dos Santos[1]; Andressa Silva de Oliveira[1]; Pablo Acácio dos Santos Souza[1]; Everardo Valadares de Sá Barretto Sampaio[2]; Ana Dolores Santiago de Freitas[1]; Sueide Karina da Silva[1]
Universidade Federal Rural de Pernambuco[1]; Universidade Federal de Pernambuco[2]

Changes in land use can alter soil carbon stocks, increasing carbon dioxide (CO_2) emission, aggravating the greenhouse effect. The impact of irrigated sugarcane (*Saccharum* spp) cultivation on C dynamics in soils of semi-arid regions, where conditions favor the rapid degradation of soil organic matter, is little known. The stock, origin and mean residence time of C in a soil under native vegetation (caatinga) and cultivated with irrigated sugar cane after 10, 20, and 30 years of caatinga removal were determined in Juaziero municipality, Bahia state, Brazil. Three trenches 60 cm deep were opened for each situation, and disturbed and undisturbed samples were collected in the 0-10, 10-20, 20-40 and 40-60 cm layers for physical and chemical characterization. Due to the similarity of the sampled environments, the experimental was established as a completely randomized design. The data were submitted to analysis of variance and the means compared by the Tukey test, at 5% probability. Cane cultivation for 30 years promoted a significant increase in the amount of soil C, with an increase of approximately 84.4 Mg ha^{-1}. The C mean residence time is relatively low, about 19 years in the 0-10 layer and 82 years in the 40-60 cm layer. This rapid C degradation becomes clear analyzing the contributions of the two different C sources to the stock in the cultivated areas. There was enrichment of ^{13}C in the cultivated areas, resulting in more than 90% of C from plants with C4 photosynthetic cycle in the superficial layers. The soil C dynamics is very fast, and the C from the native vegetation decreases rapidly after conversion of caatinga to sugarcane. However, the input from the cane straw and roots more than compensates for this loss.
Keywords: Caatinga. Carbon dioxide. Greenhouse effect. Isotope ^{13}C. Soil organic matter.
Financial support: Federal Rural University of Pernambuco, National Council of Scientific and Technological Development.

(3121 - 1934) Lithology controlled soil organic carbon stocks and stabilization processes in Paramo grasslands of the Peruvian Andes.

Songyu Yang[1]; Erik Cammeraat[1]; Boris Jansen[1]
UvA-IBED[1]

Paramo grasslands of the Neotropical Andes have high soil organic carbon (SOC) stocks. Most studies on SOC in these alpine grasslands focus on volcanic-ash soils, while non-ash soils, which also cover large areas in the highlands of the Andes, are far less studied. Our objective was to compare SOC stocks for two sites with a non-ash lithology, and also to study their stabilization processes in paramo grasslands in Cajamarca, Peru (7°11"S, 78°35"W). We sampled soils developed on limestone and granite, on stable, non-disturbed locations at about 3700 m altude. We analyzed SOC stocks and researched organic matter (OM) stabilization mechanisms, using ammonium oxalate, sodium pyrophosphate and citrate-dithionite extracted Fe, Al and C fractions, exchangeable cations and soil aggrgegation. Our results showed that organic carbon (OC) in limestone soils (405±42 T ha^{-1}) was significantly higher than in granite soils (226±6 T ha^{-1}). Both values are much higher than reported in literature. For OM stabilization, we found (i) positive correlations between pyrophosphate fractions and OM related variables in both limestone soils and granite soils, (ii) high ratios of C to pyrophosphate extracted metals and robust correlations between exchangeable Ca and OC in limestone soils only, and (iii) clear differences in soil macro- and micro-aggregation. Our results suggest that the formation of organo-metallic complexes plays a key role in the high OM stabilization rates in both limestone and granite soils, and we found strong indications that OM-mineral association and/or aggregate is an important stabilization mechanisms in limestone soils only. Furthermore, we found no evidence to support that OM is stabilized by non-crystalline Fe and Al (hydr)oxides, crystalline Fe (hydr)oxides or Al toxicity.
Keywords: soil organic matter, granite, limestone,
Financial support:

(7782 - 2644) Litter Decomposition and Microbial Biomass in Clonal Teca Plantation

Luisa Carla Cotta[1]; Valéria Santos Cavalcante[1]; Juana Amaral figueira[1]; Júlio César de Lima Neves[1]; Caroline Moreira Análio[1]; Emanuelle Mercês Barros Soares[1]
Federal University of Viçosa[1]

Deciduous and evergreen forests present distinct biogeochemical cycling of nutrients. This phenomenon is closely related to the dynamics of carbon (C) present in soil organic matter (SOM). The objective of this study was to evaluate the dynamics of the SOM decomposition in 5 years old Teca (Tectona grandis) plantations. The experiment was set up in an area near to the city of São José do Rio Claro, Mato Grosso state, following a systematic design with four replications. In each plot, 72 litter bags filled with litter, previously collected (during the dry period), were distributed directly on the soil. Six litter bags were collected in each time (August / 2015, November / 2015, March / 2016, May / 2016 and July / 2016) for total organic carbon (TOC) determination. At the same time, soil samples were collected (0-20, 20-40 and 40-60 cm) below the litter bags for C (CMB) and nitrogen (NMB) microbial biomass determination. The half-life ($t_{1/2}$) of the litter was approximately 9.12 months. During the experimental period, TOC levels increased approximately until 7 months. CMB and NMB (0-20 cm) showed a marked decrease in the first three months, increasing again at 9 months, respectively. These results indicate that the litter deposited by Teca is difficult to decompose by soil microorganisms. Also, the higher CMB and NMB values at the beginning and end of the experiment indicates a specific microbiota to decompose the C present in the organic residues deposited by clonal Teca trees.
Keywords: Tectona grandis, soil organic matter, carbon
Financial support: CNPq; CAPES

(1632 - 828) Long-term effects of different organic and inorganic fertilizer treatments on soil organic carbon sequestration and crop yields on the North China Plain

Nan Zhao[1]; Zhichen Yang[2]; Yizhong Lv[3]; Rongliang Qiu[4]
College of Resources and Environment, China Agricultural University, Beijing, 100193, China (zhao.nan.466158602@163.com);School of Environmental Science and Engineering, Sun Yat-sen University, Guangzhou, 510006, China[1]; College of Resources and Environment, China Agricultural University, Beijing, 100193, P.R. China;Institute of Agricultural Integrated Development, Beijing Academy of Agricultural and Forest Science, Beijing,100097, China[2]; College of Resources and Environment, China Agricultural University, Beijing, 100193, China[3]; School of Environmental Science and Engineering, Sun Yat-sen University, Guangzhou, 510006, China[4]

The aim of the study is to analyze the effects of different fertilization of organic and inorganic fertilizers on soil organic carbon (SOC) sequestration and crop yields after a 22 years long-term field experiment. The crop yields and SOC were investigated from 1981 to 2003 in Dry-Land Farming Research Institute of Hebei Academy of Agricultural and Forestry Sciences, Hebei Province, China. The dominant cropping systems are winter wheat - summer corn rotation. There were totally sixteen treatments applied to both wheat and corn seasons: inorganic fertilizers as main plots and corn stalks as subplots and the main plots and subplots all have four levels. The results revealed: after 22 years, mixed application of inorganic fertilizers and crop residuals, the SOC and crop yields substantially increased. Higher fertilizer application rates resulted in greater crop yields improvement. In 2002–2003, wheat and corn for the highest fertilizer inputs had the highest yield level, 6,400 kg ha-1 and 8,600 kg ha-1, respectively. However, the SOC decreased as the excessive inorganic fertilizer input and increased with the rising application of corn stalks. The treatment of the second-highest inorganic fertilizer and the highest corn stalks had the highest SOC concentration (8.64 g C kg-1). Pearson correlation analysis shows that corn and winter wheat yields and the mineralization amount of SOC have significant correlation with SOC at $p < 0.05$ level.
Keywords: Wheat; Corn stalks; Long-term experiment; Soil organic carbon sequestration; Crop yields.
Financial support:

(8537 - 2818) Panoramic view of the soil carbon stocks of Zona da Mata region, Minas Gerais state, southeast Brazil.

Geraldo Cesar Rocha[1]
Universidade Federal de Juiz de Fora[1]
It is well known that soils are important carbon reservoirs, containing more of this element than the atmosphere and terrestrial vegetation combined. Otherwise, climate change, land use/degradation and biodiversity loss, have put soils as one of the most vulnerable resources in the world. The protection and monitoring of carbon stocks at national and global levels still face complicated challenges, including, in the case of Brazil, the knowledge of the carbon stocks of the various soil types and even the geography of its distribution. In a way to contribute to enhance the knowledge and to fill this gap of scientific information, this work shows a view of the soil carbon stocks of the called Zona da Mata region, located at the state of Minas Gerais in southeast Brazil. The data was compiled from researches of the author, as well as from other literature works. First of all, it is important to consider the diversity of land use in the region, as well as the predominance of oxisols (latossolos in the brazilian soil classification system). Some researches show that the carbon stock is higher at the soil surface horizons; meanwhile, the author noted that this is not a general rule, finding increment in the carbon stock in B horizons of oxisols of the region. In general, it is agreed that the carbon stock is higher in forest soils, but that do not always occurs, as can be seen in a research by the author comparing soil carbon stocks from a forest, eucalyptus plantation and a natural grass field. It is recommended more works comparing different kinds of soils, types of land use and also a standardiization of methodological procedures.
Keywords: soil carbon stocks; Zona da Mata region; soil carbon
Financial support:

(4471 - 2885) Potential global climate, soil and food security via enhanced weathering of rocks applied to croplands

Binoy Sarkar[1]; Michael E Kelland[1]; Jonathan R Leake[1]; Mark E Hodson[2]; David J Beerling[1]
Leverhulme Centre for Climate Change Mitigation, Department of Animal and Plant Sciences, The University of Sheffield, Sheffield, S10 2TN, UK[1]; Environment Department, Wentworth Way, University of York, Heslington, York, YO10 5DD, UK[2]

Limiting future climate change requires urgently decreasing CO_2 emissions and developing approaches for carbon dioxide removal (CDR) from the atmosphere. Both IPCC and the US National Research Council have called for research effort into effective CDR strategies. Enhanced weathering (EW) is a CDR option achieved by amending the soils of managed croplands with crushed fast-reacting silicate rocks. EW increases C capture by locking up C in soils as aqueous CO_2 reacts with the silicate minerals, and eventually deposit C in the oceans. An additional pathway is that the cations (e.g., Ca^{2+}, Mg^{2+}, $Fe^{2+/3+}$) released during EW attract both inorganic and organic C compounds in soils and lead to carbonate precipitation, organic polymerization, coating of rock grains with highly stable organo-mineral complexes, formation of stable particulate organic matter, secondary minerals, and ultimately soil aggregates. EW also has potential co-benefits for sustainable soil and food security by replenishing eroded soils, decelerating soil erosion, ameliorating soil acidity, increasing yields via Si and other nutrients uptake by crops, conferring crop protection from pests and diseases, and reduced uptake of toxic heavy metals in crops' edible parts. Similar to any other CDR approaches, EW also warrants field-scale trials across the continents in order to evaluate its global CO_2 sequestration potential and plausible co-benefits, and thus make the

technology socially and environmentally acceptable. This requires detailed risk assessment of the technology, wider public participation and transparency in communication. References: Beerling, D.J. et al., 2018, Nature Plants, doi: 10.1038/s41477-018-0108-y Singh, M. et al. 2018, Advances in Agronomy, doi: 10.1016/bs.agron.2017.11.001 Taylor, L.L. et al. 2016, Nature Climate Change, 6: 402–406

Keywords: Enhanced weathering, Carbon capture, Soil carbon, Food security

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(1170 - 515) Soil Analyses after Growth of Six Winter Cover Crops

O.W. Freeman[1]; M.B. Kirkham[2]; K.L. Roozeboom[2]; A.J. Schlegel[3]; S.A. Staggenborg[4]

Central State University, Wilberforce, Ohio 45384 USA[1]; Kansas State University, Manhattan, Kansas 66506 USA[2]; Southwest Agricultural Research-Extension Center, Tribune, Kansas 67879 USA[3]; Chromatin, Inc., Lubbock, Texas 79424 USA[4]

Little information exists concerning the appropriate cover crop to grow during the winter in the Great Plains of the USA. Therefore, we compared legume and non-legume winter cover crops grown at two locations in Kansas: Manhattan, in the northeastern part of the state, and Hutchinson, in the south-central part of the state. The cover crops were planted and terminated at times corresponding to how they might be used in a corn (*Zea mays* L.) or forage sorghum [*Sorghum bicolor* (L.) Moench] rotation. At Manhattan, the soil was a Bismarckgrove-Kimo complex, and, at Hutchinson, the soil was a Funmar-Tarver loam. Here we report the soil analyses after one year's growth of the winter cover crops (2010-2011). The soil was analyzed for pH, organic matter (OM), total nitrogen (N), and total carbon (C) in the fall before the cover crops were planted and in the spring after the cover crops were terminated at times to correspond with the corn and sorghum rotations. The residue of the cover crops was left on the ground after termination. Analyses of soil growing the leguminous cover crops were similar to those growing the non-leguminous cover crops. The pH's of the two soils were similar, but the OM, N, and C were higher in the soil at Hutchinson than in the soil at Manhattan. At both Manhattan and Hutchinson, the OM and N before planting the cover crops and after their termination were similar. However, C increased in the soil after planting the cover crops. At Manhattan, the average value (with standard error) before planting was 0.43±0.02% C; for the cover crops terminated at sorghum planting time, the average value was 0.50±0.01%, and for the cover crops terminated at corn planting time, it was 0.48±0.02% C. At Hutchinson, C increased only in the sorghum rotation (1.17±0.02% C before planting the cover crops; 1.21±0.01% C after termination). The results showed that winter cover crops increased C in the soil after one season's growth. The increase in soil C at Manhattan was 0.07% for the sorghum rotation and 0.05% for the corn rotation; at Hutchinson the increase was 0.04% in the sorghum rotation. The United Nations Paris climate accord, signed in December 2015, included a commitment to increase soil C by 0.4 per cent each year. Thus, the increase we observed in the soil carbon after one season's growth of winter cover crops would satisfy about 0.1 to 0.2 of this commitment.

Keywords: winter cover crops, organic matter, nitrogen, carbon

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(4750 - 339) Soil carbon stocks under integrated crop-livestock-forest system in the Brazilian Atlantic Forest region

Alberto C. de Campos Bernardi[1]; Sergio N. Esteves[1]; Jose Ricardo M. Pezzopane[1]; Teresa C. Alves[1]; Alexandre Berndt[1]; Andre F. Pedroso[1]; Paulo H. Mazza Rodrigues[2]; Patricia P. Anchao Oliveira[1]

Embrapa Pecuária Sudeste[1]; VNP / FMVZ / USP[2]

Integrated crop-livestock-forest systems (ICLFS) are one of the leading strategies of the Brazilian government program "Low-Carbon Agriculture" to reduce or compensate the carbon emissions, with simultaneous improvement in harvest efficiency. ICLFS provide a strategy for sustainable agricultural production which integrates annual crops, trees, and livestock activities on the same area, and in the same season. The system is based on crop rotations and no-tillage practice that contributes to the quantity and quality of residues input and increasing soil organic matter content. Farmers are adopting ICLFS, but there is still a lack of quantitative data on C stock primarily for the integrated systems. This research aims to address the soil carbon stocks under different management systems in Atlantic Forest biome. Soil carbon stocks were estimated to a depth of 100 cm in a 30-ha ICLFS in São Carlos-SP, Brazil (21°57'S, 47°50'W, 860m alt). The soil classified as a sandy-clay-texture dystrophic Red-Yellow Latosol and climate is Cwa. The experimental area included: i) intensive (INT) grazing of palisade grass; ii) crop-livestock (CLS), one-third of the area is renovated with corn intercropped with palisade grass; iii) crop-livestock-forest (CLFS), CLS planted with *Eucalyptus urograndis* (333 trees per ha); iv) livestock-forest system (LFS), with palisade grass and *Eucalyptus*; v) extensive pasture (EXT) of signal grass, and the control of vi) natural Atlantic forest. After five years soil C stocks (in Mg ha^{-1}) were: LFS, 179.9; INT, 173.1; CLFIS, 160.2; LFIS, 136.4; and EXT, 121.0 Mg ha^{-1}. LFS, INT, and CLFIS stocks were significantly ($p<0.001$) higher, and EXT significantly lower than C stocks under natural Atlantic Forest (129.7 Mg ha^{-1}). Results indicated that under the local edaphic and climatic conditions of the study both agroforestry systems (CLFIS and LFS) and intensive managed pasture (INT) lead to high SOC accumulation even in the short term such as five years study. Land use change, based on adequate farm and soil management strategies, such balanced nutrient management, improved grazing, no-till farming and crop rotation increased soil carbon accumulation.

Keywords: Soil organic matter, ICLFS, carbon sequestration, land use change, Red-Yellow Latosol

Financial support: Embrapa

(9068 - 2805) Soil CO_2 emission in no-tillage areas with residues from summer and off-season crops

Clariana Valadares Xavier[1]; Mara Regina Moitinho[1]; Gustavo André de Araújo Santos[1]; José Eduardo Corá[1]; Newton La Scala Júnior[1]

São Paulo State University, Campus of Jaboticabal[1]

Soil CO_2 emission (FCO2) in agricultural areas is a dynamic and complex process resulting from different edaphoclimatic factors. This study aimed to quantify and characterize the relationship between FCO2 and soil physical and chemical attributes at the end of the agricultural year in no-tillage areas managed with the same arrangement of summer and off-season crops for more than 15 years. Sixteen assessments of FCO2, soil temperature, soil moisture, and soil physical and chemical attributes were carried out over a period of 51 days. We used the remaining straw from the combination of three summer crop sequences (corn monoculture, soybean monoculture, soybean-corn rotation) with five off-season crops (corn, millet, pigeonpea, grain sorghum, and crotalaria). For FCO2, soil temperature, and soil moisture, analysis of variance was performed in a randomized block design and observations were repeated over time. Multivariate exploratory analyses of hierarchical clustering and factors were carried out to verify the interdependence relationships between FCO2 and soil attributes as a function of the assessed managements. FCO2 was related to the quantity and C/N composition of remaining residues on the soil surface

in the assessed systems. In this case, grain sorghum grown off-season after corn monoculture was the management that presented the lowest FCO2 values. The highest values of FCO2, clay content, organic matter, macropores, sum of bases, as well as the lowest values of soil bulk density contributed to characterize FCO2 process in soils managed with residues from summer and off-season crops in no-tillage areas. The sequences soybean-corn rotation and corn monoculture differed from each other only in relation to the off-season crop, with a distinction between grasses and legumes. Soybean monoculture differed from the other managements regardless the off-season crops under study. When analyzing the behavior of the variables related to CO_2 production, a significant difference was observed between managements, evidencing that the soil attributes retained in the exploratory analysis, when analyzed separately, respond differently as a function of the transport and gas production processes, demonstrating the complexity of FCO2 dynamics under this no-tillage system.

Keywords: conservationist management, soil respiration and soil moisture.

Financial support: São Paulo Research Foundation (FAPESP). Process No. 2015/26289-2.

(7321 - 1184) Soil organic matter formation under different plant species mixture during 50 years in a temperate region

Karin Kauer[1]; Rein Viiralt[1]; Kerttu Tammik[1]; Henn Raave[1]; Alar Astover[1]
Estonian University of Life Sciences, Institute of Agricultural and Environmental Sciences, Kreutzwaldi 1, Tartu, 51014, Estonia[1]

Soil organic matter (SOM) formation is a long-term process depending on the amount and quality of organic matter input. For evaluation of the effect of various plant species on the SOM formation, long-term field experiments are of vital importance. The long-term experiment was established in 1964 close to the city of Tartu in Estonia (N 58°22'04.09", E 26°39'41.47"). The initial soil originating from the BC horizon from a nearby field was almost free of SOC (1.28 g kg^{-1}) and total nitrogen (N_{tot}) (0.18 g kg^{-1}). The soil texture was sandy loam (61.1% sand, 24.8% silt and 14.1% clay). The aim of the trial was to study the SOM formation under different plant species and species mixtures. There were five treatments with different plant species (barley, grasses, clover-grasses, galega, hybrid lucerne) and one bare fallow treatment that have been without vegetation at the start of the experiment. In autumn 2014, soil samples were collected from three depths: 0-5, 5-10 and 10-20 cm in each plot. The SOC and N_{tot} contents were measured. The stock of SOC was calculated separately for each layer (0-5, 5-10, 10-20 cm) and for the 0-20 cm soil layer, the SOC stocks were summarized. The aboveground biomass was monitored during 1981-2014. Using aboveground biomass crop-specific C allocation coefficients based on Bolinder et al. (2007) the C inputs were calculated. The SOC and N_{tot} contents were significantly affected by the plant cover and increased up to average of the treatments with plant cover 7.2 and 0.47 g kg^{-1} (average of the treatments with plant cover), respectively. During 1964-2014 the annual SOC stock change in 0-20 cm soil depth varied by 0.11-0.46 t ha^{-1} y^{-1} and the highest increase was in the treatment with hybrid lucerne. In 2014 the SOC stock of 0-20 cm soil depth was 9.4-27.2 t ha^{-1}. The lowest SOC stock was in bare fallow treatment. The SOM was accumulated mainly in the upper soil layer, 41-47% of the 0-20 cm SOC stock was in 0-5 cm soil layer depending on treatments, averagely 29% was in 5-10 cm and 29% in 10-20 cm layer. Also in barley treatments where tilling of plots (mixing of soil layers) takes place every year the SOC stock declines in the lower soil layers. There was positive relationship between average C input into soil and SOC stock change. SOC sequestration efficiency was higher in treatment with annual crop (barley) and lower in treatment with perennial grasses.

Keywords: SOC stock, long-term experiment, plant species
Financial support:

(8991 - 1172) The effect of biosolids application on organic carbon dynamics in soil

Hasintha Wijesekara[1]; Nanthi S. Bolan[1]; Ramesh Thangavel[2]; Peter Matthews[3]; John Bennett[4]; Aravind Surapaneni[5]; Balaji Seshadri[1]; Christopher Saint[6]

Global Centre for Environmental Remediation (GCER), Advanced Technology Centre, Faculty of Science, The University of Newcastle, Callaghan, NSW, 2308, Australia[1]; Indian Council of Agricultural Research (ICAR) Complex for North-eastern Hill Region, Umiam, Meghalaya, 793103, India[2]; Cleanaway Organics, 390 Princes Highway, Bomaderry, 2541, NSW, Australia[3]; National Centre for Engineering in Agriculture, Toowoomba Campus, University of Southern Queensland, Darling Heights, QLD, 4350, Australia[4]; South East Water, 101 Wells Street, Frankston, Victoria, 3199, Australia[5]; Natural & Built Environments Research Centre (NBERC), University of South Australia, Mawson Lakes, South Australia, 5095, Australia[6]

Biosolids produced at wastewater treatment facilities have been extensively applied to agricultural land and degraded mine sites to improve soil health, and increase soil organic carbon (SOC) stocks. The relationship between biosolids application and carbon retention or CO_2 fluxes however has not been studied in detail under the field scale for Australian soils. Thus a field study was conducted on two texturally different soils to determine the influences of biosolids application on selected soil chemical properties and CO_2 fluxes. Two sites, located in Manildra (clay loam) and Grenfell (sandy loam) in New South Wales, Australia were selected for this study. Each site was treated at a single level of 70 Mg ha^{-1} biosolids. Over the four months study period, soil samples were analyzed for SOC fractions including total organic carbon (TOC), labile and non-labile carbon, humic acid contents and carbon stocks. Liquid-state ^{13}C and ^{1}H NMR spectroscopy was applied in order to understand the major constituents present in the humic acid fraction. The natural abundances of soil $\delta^{13}C$ and $\delta^{15}N$ were also measured as isotopic tracers to determine the fate of carbon in biosolids and native carbon in soil. An automated soil respirometer (LICOR LI-8100A) was used to measure in-situ diurnal CO_2 fluxes, soil moisture and temperature. Application of biosolids increased the surface (0 – 15 cm) soil's non-labile and labile organic carbon fractions. For example, TOC was increased by > 45 % at both sites and was attributed to the direct contribution from residual carbon in the biosolids as well as from increased biomass production. Humic acid content increased by 66 % in biosolids amended soils at the Grenfell site. The NMR results revealed strong alkyl carbon peaks in biosolids treated soils comparative to the control soils. Soils amended with biosolids showed depleted $\delta^{13}C$, and enriched $\delta^{15}N$ indicating the accumulation of biosolids residual carbon in soils. The in-situ respirometer data demonstrated enhanced CO_2 fluxes at the sites treated with biosolids, indicating limited carbon sequestration potential. Decline trends were also observed in the carbon stocks on both sites. The application of biosolids on both the clay loam and sandy loam soils however was found to be effective in building SOC rather than reducing it; indicating potential sequestration of carbon in soil.

Keywords: Sewage sludge, Soil carbon fractions, Carbon sequestration, Climate change mitigation
Financial support: The research project on "Carbon sequestration from land application of biosolids", Australia. Partners of the project: South East Water, Western Water, Gippsland Water, City West Water, Yarra Valley Water and Cleanaway Organics

(8165 - 2842) The state of the art of the negative impacts in Brazillian carbon stocks due to bad practices

Lucas Henrique Ribeiro Reis[1]; Rodrigo de Queiroga Miranda[1]; Josiclêda

Domiciano Galvíncio[1]; Valéria Sandra de Oliveira Costa[1]
Universidade Federal de Pernambuco[1]

Brazilian soils accumulate an average of 0.5 mg C ha-1 year-1. The soils are considered as the main reservoir of carbon in the world, presenting 4.5x more carbon than our biota and 3.3x more than the atmosphere. However, this reservoir is controlled by a delicate process, in which any modification, as poor use of the soil, can produce an imbalance in nature. In Brazil, 46.4 million tons of carbon dioxide were emitted in the period between 1975-1995. Brazilian studies on the subject have been showing that carbon stocks, mainly in form of gas, are concentrated on layers with 0-30 cm of depth. Therefore, planting systems that were poorly developed can result in a dispersion to the atmosphere of the gas found in the soil, which would contribute negatively to the greenhouse effect, leading to serious future climate problems. In order to mitigate this emission by up to 33 million tons annually, it would be interesting to adopt conservation practices (no-tillage system). That would promote the addition of organic matter in the soil, and then, retention of organic carbon in it. In addition, worldwide studies have been indicating that, for temperate soils, just the conversion of natural areas to agriculture may correspond to more than 60% of carbon losses in the organic matter reserve; and more than 75% for tropical soils. In Brazil, the well-known soil control systems based on conventional tillage is promoting big losses in the reserve of organic matter in the soil, affecting even nearby natural forest. These kind of damages contribute to the intensification of negative effects in the atmosphere, which in turn, might worsen climate changes.

Keywords: Carbon stocks; Impacts; State of the Art.
Financial support: Coordination for the Improvement of Higher Level Education, Foundation of Support for science and technology of the state of Pernambuco, National Council for Scientific and Technological Development.

(3107 - 1171) The use of plant lipids as molecular proxies to trace the origin and dynamics of soil organic carbon

Boris Jansen[1]; Guido Wiesenberg[2]
University of Amsterdam[1]; University of Zürich[2]

The use of plant lipids as molecular proxies to trace the origin and dynamics of soil organic carbon *Boris Jansen and Guido Wiesenberg* Tracing the origin and dynamics of soil organic matter is an important tool to unravel mechanisms that lead to (de)stabilization of soil organic carbon (SOC). A very hot topic indeed given its direct link to climate change on the one hand (1), and the ongoing scientific debate on what drives SOC (de)stabilization and sequestration (2). Plant lipid based molecular proxies are (groups of) specific lipid molecules that can be linked to (groups of) specific plant species or plant parts. The last decade has seen a dramatic increase in their application to study SOC dynamics through time (3). However, the use of molecular proxies to trace the origin and dynamics of soil organic carbon is also subject of fierce scientific debate. On the one extreme end there are those colleagues who see biomarkers as a cure-all solution to all organic matter tracing problems. On the other end of the spectrum there are experts who claim that the concept of molecular studies is so intrinsically flawed that it can never yield meaningful information about carbon transformations except in the most specific cases. We believe that neither vision is correct. In our presentation we will discuss the merits and drawbacks of using molecular proxies to study SOC dynamics based on our recently published review article (2), and examples of the application of molecular proxies from our own research focusing on the link between molecular SOC dynamics and C sequestration in plaggen soils in Northwest Europe and volcanic ash soils in the South American Andes. S.D. Keesstra, J. Bouma, J. Wallinga, P. Tittonell, P. Smith, A. Cerdà, L. Montanarella, J. Quinton, Y. Pachepsky, W.H. van der Putten, R.D. Bardgett, S. Moolenaar, G. Mol, B. Jansen, and L.O. Fresco, 2016. The significance of soils and soil science towards realization of the United Nations Sustainable Development Goals, *SOIL*, 2: 111-128. J. Lehmann and M. Kleber, 2015. The contentious nature of soil organic matter, *Nature*, 528: 60-68. B. Jansen and G.L.B. Wiesenberg, 2017. Opportunities and limitations related to the application of plant-derived lipid molecular proxies in soil science, *SOIL*, 3: 211-234.

Keywords: carbon sequestration, soil organic carbon, biomarkers, molecular proxies, C
Financial support: None

(6317 - 2289) When the forest drops acid: threshold behavior in carbon cycles upon acidification

Karen Vancampenhout[1]; Bart Muys[2]
KU Leuven[1]; [2]

Soils hold the largest terrestrial carbon pool, essential to a multitude of ecosystem services. Forest soils are particularly relevant, containing about 40% of the global soil carbon stocks. The drivers and mechanisms of soil carbon storage in forests therefore are particularly relevant in the context of climate change and soil-based mitigation solutions. In current models, the soil carbon cycle is projected as a continuous microbial funnel where decomposition follows a consistent and predictable path of chemical change. Molecules are exempt from this funnel only if occluded in aggregates or adsorbed on mineral surfaces, while substrate quality and chemical properties of organic matter are no longer regarded as relevant. Environmental and edaphic challenges on decomposer communities are described via static, linear relationships and soil organisms are largely perceived to have redundant functionality. We argue that soil carbon turnover may be much less deterministic than currently assumed. Based on data from several forest experiments in Europe, we evidence that ecosystems adapt their carbon decomposition strategies in a non-linear way to the constraints imposed by their environments, in casu acidity, nutrient imbalances and aluminum toxicity. For forest soils near the pedogenic threshold between the cation and the aluminum soil process domain, small increases in soil acidity have the potential to dramatically shift soil communities to a point where decomposition is forced to switch to alternative pathways. Edaphic and biological feedback loops further substantiate the new, acidic state. Carbon accumulates in particulate fractions that are poorly mixed with soil minerals and devoid of lignin, making carbon dynamics in acid soils upon anthropogenic change particularly difficult to predict. Furthermore, we explore if choice of overstory species can amplify or mitigate soil acidification and we assess if non-linear behavior can also be applied in a positive trajectory, i.e. to increase the efficiency of restauration efforts. As a large part of the European forest soils are close to a pedogenic threshold, our results have important implications for climate-smart forest management. Moreover, acknowledging non-linearity and threshold behavior in the soil carbon cycle implies recognizing that uncertainty, resilience and resistance may be just as important for managing environmental change below-ground as they are above-ground

Keywords: forest soils; non-linearity; acid soils; feedback loops; resillience
Financial support:

C4.2 - Soils, food security, and human health

C4.2.1 - Soil and Human Health

(9781 - 1468) A brief history of soils and human health studies

Eric C. Brevik[1]; Lily Pereg[2]; Thomas J. Sauer[3]
Dickinson State University, USA[1]; University of New England, Australia[2]; UDSA-ARS, National Laboratory for Agriculture and the Environment, USA[3]

The idea that human health is tied to soils is not a new one. As far back as circa 1400 B.C. the Bible depicts Moses as understanding that fertile soil was essential to the well-being of his people. In 400 B.C. the Greek philosopher Hippocrates provided a list of things that should be considered in a proper medical evaluation, including the properties of

the local ground. By the late 1700 and early 1800s, American farmers had recognized that soil properties had some connection to human health, and in the early 1900s scientists worldwide were recognizing the importance of soils to human health. However, by the end of the 1900s there was still a need for well-designed scientific studies into soils and human health. In the modern world, we recognize that soils have a distinct influence on human health. We recognize that soils influence 1) food availability and quality (food security), 2) human contact with various chemicals, and 3) human contact with various microorganisms (both pathogenic and beneficial). Soils and human health studies include investigations into nutrient supply through the food chain and routes of exposure to chemicals and pathogens. We now know that healthy soils make for healthier people and that soil biodiversity is important to soil health. Therefore, the study of soil organisms has taken on an increasingly important role, and it is recognized that climate change and how it will affect the soil environment/ecosystem going into the future is another variable affecting the relationship between soils and health. The tools to conduct studies, including laboratory and field equipment as well as computers and statistical techniques, have improved dramatically. Inter- and transdisciplinary studies have become more common, and academic disciplines that have not worked together in the past are now seeking to do so. However, making strong, scientific connections between soils and human health can be difficult. There are multiple variables to consider in the soil environment, meaning traditional scientific studies that seek to isolate and manipulate a single variable often do not provide meaningful data. Future successes in soils and human health research will require effectively addressing difficult issues such as these.

Keywords: soils and human health; soil science history; future needs
Financial support:

(7228 - 2340) Agronomic biofortification of potato (*Solanum tuberosum* L.) through foliar and soil fertilization with zinc and its interaction with cadmium

Pedro Pablo Gutierrez Vilchez[1]; Ruby Vega Ravello[1]; Rolando Egúsquiza Bayona[1]; Peter Kromann[2]

Universidad Nacional Agraria La Molina[1]; Centro Internacional de la Papa[2]

Agronomic biofortification is the application of mineral micronutrient fertilizers to increase the micronutrient content in edible crops. Zinc (Zn) is one of the most important micronutrients for human health. Its deficiency in population has been considered a limiting factor for the normal growth of children, especially in developing countries. In addition, Cadmium (Cd) uptake by plants is a risk for living beings. Generally, there is a competitive interaction between Cd and Zn into plants, where Cd uptake and accumulation are reduced by Zn. Therefore, agronomic biofortification in agriculture is being considered as the most accessible way to increase the amount of zinc in food; also, it could be an alternative to reduce Cd in plants. During 2017 cropping season, experimental fields were installed in moderately alkaline soils of the Peruvian coast to study the response of potato crop (Solanum tuberosum L.) to zinc fertilization. The plots were distributed in a randomized complete block design (RCBD) with four replicates. The treatments considered applications of zinc to the soil in rates of 0, 20 y 40 kg Zn ha^{-1}, and in some cases application of Zn to the foliage (5 kg Zn ha^{-1}). The response variables were yield (t ha^{-1}) and concentration of Zn and Cd in leaves and tuber (skin and pulp). The statistical analysis did not reveal significant effects in the Zn soil fertilization for potato production. However, concentration of Zn in leaves and tuber was greater with foliar Zn application. In the treatments with foliar application, the Zn concentrations in the leaves, skin and pulp were 166.0, 49.3, and 24.6 mg Zn kg^{-1}, respectively; while the values in treatments without Zn foliar were 69.7, 41.4, and 18.5 mg kg^{-1}, respectively. Statistically, there no was evidence Zn application reduced Cd.

Keywords: biofortification, zinc, potato, cadmium
Financial support:

(8391 - 2654) Detection of *amp*C beta-lactamase from agricultural and forest soils in Nova Friburgo, Rio de Janeiro, Brazil

Eliene dos Santos Lopes[1]; Camila Costa de Oliveira[1]; Ramon Loureiro Pimenta[1]; Daniele Rodrigues Barbosa[1]; Shana de Mattos de Oliveira Coelho[1]; Miliane Moreira Soares de Souza[1]; Irene da Silva Coelho[1]

Universidade Federal Rural do Rio de Janeiro[1]

Beta-lactams represent the first class of antimicrobial agents discovered, and include penicillin derivatives (penams), cephalosporins (cephems), monobactams and carbapenems. These antimicrobials are a class of broad-spectrum antibiotics, consisting of all antibiotic agents that contain a beta-lactam ring in their molecular structure. They are among the main antibiotics prescribed in clinical practice because of their efficacy and low toxicity. In addition, beta-lactams are often associated with preventive veterinary drugs or as zootechnical additives in animal production, especially in aviculture, in order to enhance performance. Most of them act by inhibiting the synthesis of the peptidoglycan layer of bacterial cell walls. A mechanism of bacterial resistance to these antimicrobials is associated to hydrolysis of beta-lactam ring by beta-lactamase enzymes, encoded, for example, by the *amp*C gene. In this perspective, the present study aims to detect the *amp*C gene in soil from agricultural and forest areas in Nova Friburgo, Rio de Janeiro, Brazil. Soil samples from 10 agricultural and 10 forest areas were collected at 0-20 cm depth. Total DNA extraction was performed, followed by amplification of *amp*C gene by PCR (Polymerase Chain Reaction). The *amp*C gene was detected in most soil samples, where poultry manure was used as organic fertilizer and also in forest areas. The presence of this gene even in forest soils is justified because bacterial resistance is not a recent phenomenon. Beta-lactamases can be encoded by chromosomal genes or genes present in plasmids, and they have been identified before the use of penicillin in large scale. It is believed that bacterial resistance evolved from the selective pressure made by microorganisms that produce beta-lactam compounds present in soils, but the use of these antibiotics in large scale has been contributing to increase the selection and to spread resistance genes. These finding reinforces the importance to study the antimicrobial resistance in a one health approach, that recognizes that the health of people is connected to the health of animals and the environment.

Keywords: Antimicrobial resistance, beta-lactams, one health, Polymerase Chain Reaction (PCR)
Financial support: CAPES, CNPq and FAPERJ

(1053 - 2583) Detection of the colistin resistance gene (*mcr*-1) from agricultural and forest soils in Nova Friburgo, Rio de Janeiro, Brazil

Camila Costa de Oliveira[1]; Eliene Santos Lopes[1]; Daniele Rodrigues Barbosa[1]; Ramon Loureiro Pimenta[1]; Shana de Mattos de Oliveira Coelho[1]; Miliane Moreira Soares de Souza[1]; Irene da Silva Coelho[1]

Universidade Federal Rural do Rio de Janeiro[1]

Antimicrobial resistance has emerged as one of the principal global public health problems. Increasing number of infections caused by multiresistant gram-negative bacteria has reduced therapeutic options commonly used. Colistin, which is a member of the polymyxin family, is currently the last-resort antimicrobial for treatment of infections caused by these pathogens. Its mode of action involves inducing changes in the permeability of the cell membrane by binding anionic lipopolysaccharide molecules and displacing calcium and magnesium, thus causing cell leakage and death. One of the polymyxin resistance mechanisms is mediated by the enzyme phosphatidylethanolamine transferase, encoded by the *mcr-1* gene. The enzyme transfers a phosphoethanolamine residue to the lipid A present in the cell membrane of gram-negative bacteria. The altered lipid A has much lower affinity for colistin and related polymyxins resulting in reduced

activity of the antimicrobial. Therefore, the present study aimed to detect the *mcr-1* colistin resistance gene in agricultural and forest soils in Nova Friburgo, Rio de Janeiro, Brazil. Twenty soil samples with known physical-chemical characteristics were collected at 0-20 cm depth, including 10 from agricultural areas and 10 from forest areas. Total DNA was extracted, and the detection of the *mcr-1* gene was performed by Polymerase Chain Reaction (PCR). The *mcr-1* resistance gene was detected in agricultural soils. The addition of poultry manure as organic fertilizer can contribute to an increase of this gene in soils. However, the *mcr*-1 gene was also detected in forest soils. Although the emergence of antimicrobial resistant strains is often interpreted as a modern phenomenon, these findings reinforce it is a natural phenomenon that precede the antibiotics era. Nonetheless, the excessive use of antibiotics in animal production and the use of manure from these animals in soil can increased the dissemination, selection and spread of resistance genes. These results further support the role of soil as source and reservoir of antimicrobial resistance and the need to addressing the rising threat of antimicrobial resistance in a One Health approach that recognizes that the health of humans is connected to the health of animals and the environment.

Keywords: antimicrobial resistance; One Health; polymixin; Polymerase Chain Reaction (PCR); poultry manure
Financial support: CAPES, CNPq and FAPERJ

(3507 - 210) Eastern European Pollution Assessment via Portable X-ray Fluorescence Spectrometry: Soils and Vegetation

Laura Paulette[1]; David C. Weindorf[2]; Somsubhra Chakraborty[3]; Bogdan M. Duda[2]

University of Agricultural Sciences and Veterinary Medicine[1]; Texas Tech University[2]; Indian Institute of Technology - Kharagpur[3]

Toxic metals released into environment from anthropogenic sources accumulate in soils and pose serious risks to organisms and human health. Elevated environmental concentrations of toxic metals and other chemicals have been linked to many acute and chronic health conditions including poisoning, allergies, neurological/dermatologic/respiratory problems, and cancer, accelerating mortality. Environmental exposure to toxic metals is concerning but also presents a remediation serious challenge. Soils featuring toxic metals pose a threat both for vegetative uptake of metals or via metal-laden dust deposited on plants, either of which may be inadvertently consumed. In Romania, soils in many localized areas are known to be polluted with toxic metals from former smelters in Zlatna, Copşa Mică, Baia Mare, and other locations. However, few data exist regarding the spatial extent of pollution and the potential impacts toxic metals are having on the health of local residents. As such, we used portable X-ray fluorescence (pXRF) spectrometry to scan multiple elements in-situ. Surface soils (0-2 cm) were scanned with kriging interpolation applied for rapid soil pollution hotspot mapping. Also, various vegetation types were scanned (e.g., bark, deciduous leaves, grasses, herbaceous materials, organic thatch) to identify potential vegetative pathways to human exposure. In each area evaluated, the spatial extent of certain metals exceeded the Romanian action limits. For example, the spatial area in which Pb exceed Romanian action limits was 99% in Zlatna, 100% in Copşa Mică, and 91.09% in Baia Mare; As, Cu, Zn, Co, and Cd exceeded limits in >50% of the areas scanned. Hotspots were easily and rapidly identified by kriging interpolation. In vegetation, thatch and bark showed the highest toxic metal concentrations. In conclusion, pXRF was shown to be a valuable tool for rapidly assessing smelter pollution in soil and vegetative matrices. Even newer research is investigating its efficacy in for liquid matrix analysis in support of comprehensive environmental quality assessment.

Keywords: portable XRF; environmental quality assessment, spatial variability, metals, health
Financial support: BL Allen Endowment in Pedology - Texas Tech University

(9886 - 1141) Metal and metalloid contaminated soil from an ancient gold Mine - Mina de Chico Rei – Ouro Preto/MG – Chemical extraction studies

Alcylane Caldeira Santos[1]; Mônica Cristina Teixeira[1]

Universidade Federal de Ouro Preto[1]

Soil contamination by metals and metalloids is of environmental concern since even very small amounts of some those elements could be hazardous for human beings. In Ouro Preto, some underground ancient gold mines are actually located at residential neighbourhoods. Chico Rei, Santa Rita and Mina Velha mines are some good examples of the aforementioned. Arsenic content in their soils may vary from 465.0 to 1829 $mg.kg^{-1}$ (Lopes, 2014). However, according to legislation, the maximum recommended As soil content for residential areas is 55 $mg.kg^{-1}$ (BRASIL, 2009). As contents above that should be investigated. Besides As, also other potentially toxic elements (PTE) like Cd, Pb, Co and Cr were found. During this study, chemical extraction efficiency in removing metals and metalloids from Chico Rei mine soil samples was tested. Extractant solutions tested were organic acids (0.1 M); $CaCl_2$ (0.2 mM) and distilled water (negative control). For each test, a 5g solid sample was soaked with 25 ml of the extractant (1:5). Samples were agitated (150 rpm) and kept at constant temperature (30ºC) for 1h, 24h or 48 h. Samples were centrifuged (5000 rpm, 15 min), liquid fraction was recovered, filtered and acidified with HNO_3 prior to ICP-OES chemical composition analyses. As maximum extraction achieved was 28.0062 $mg.L^{-1}$ (after a 48h contact time with organic acid solution). This result corresponds to an extraction efficiency of 7.3%. Additionally, elements like Al, Fe e Mn were largely extracted, metal solubility was higher than the equipment detection limits (i.e. 10ppm), even after dilutions. Cd, Cr, Pb, Cu e Zn were also solubilized with extraction efficiencies of 9.33, 1.62, 26.0, 14.0 and 51.5%, respectively. $CaCl_2$ extraction efficiency was not relevant when compared to organic acid solution, only the easily exchangeable elements were extracted from soil. Nevertheless, even a diluted acid solution was efficient in removing PTE from a contaminated soil sample. This feature demands further investigations relative to bioaccessibility and bioavailability of those potentially hazardous elements, mainly As, since the studied material was obtained from a densely populated residential area were the deposition of organic waste material is likely and may causes organic acids generation which by it turns, decreases soil pH, thus facilitating metals and metalloids solubilization.

Keywords: Soil, contamination, extraction, metal and metalloid. mobility
Financial support:

(2809 - 3016) Soil and house dust as environmental media of human exposure to trace elements in an historically contaminated area of central Chile

Maite Berasaluce[1]; Pedro Mondaca[1]; Alexander Neaman[1]

Pontificia Universidad Católica de Valparaíso[1]

The Puchuncaví valley has been exposed to a large amount of contamination caused by the emission of trace element (TE) rich particulate matter from the Ventanas copper smelter into the local atmosphere. Pollution in mining areas can expose the local population to TE. However, biomarkers as a tool to confirm health risk have not been considered as a possible monitor of this problem in Puchuncaví. While, it is known that incidental ingestion of both soil and dust are exposure routes of TE, the contribution of each media is not yet known. Consequently, the present study aims to (1) determine the relationship between TE in environmental media (soil and dust) and TE in human samples (hair and toenails), and (2) characterize the contribution of different environmental media to human exposure to TE, through determination of chronic daily intake (CDI). A total of 100 households from three areas (highly contaminated, moderately contaminated, and

not contaminated) were studied. For each household, the following samples were collected: outdoor dust and/or soil, indoor house dust, and hair and toenail samples from the residents. Additionally, exposure factors associated to the behavior of the residents were obtained by surveys. This information was used to estimate the chronic daily intake as an index of exposure. Trace element concentrations of As, Pb and Cd in environmental media were determined using AAS; biological samples were analyzed via ICP-MS. Moreover, the CDI was calculated to characterize the health risk of each environmental media. TE concentrations in our samples are broadly consistent with previous studies, showing a higher concentration of TE near the copper smelter. In addition, results show that TE concentration of samples depends on the environmental media, as indoor house dust consistently showed higher concentrations of TE, followed by outdoor dust and soil. Despite these results, no significant correlation was found between TE in biological samples and TE in environmental media. However, exposure estimation of TE through CDI demonstrated a significant correlation with TE in biological samples. As-CDI is correlated with As concentration on hair and toenail samples; furthermore, Pb-CDI and Cd-CDI demonstrate a correlation with Pb and Cd in toenail samples, respectively. In addition, our results indicate that As is the TE of concern for human health in this province, specially for populations under 18 years old living near the smelter.

Keywords: Chronic daily intake, trace elements, health risk, biomarker
Financial support: FONDECYT project 1160018

(7048 - 2932) Spatial distributions of soil lead across scales in the Twin Cities Metropolitan Area, United States

An-Min Wu[1]; Ashley Hansen[2]; Kat LaBine[2]; Nic Jelinski[2]
University of Southern California[1]; University of Minnesota[2]

Soil lead (Pb) in the urban environment has been linked to elevated blood Pb levels with long-term health effects to young children. Urban soil Pb levels are generally higher than background levels (10-50 ppm) due to historical usage of lead paint and leaded gasoline (Mielke and Reagan 1998). Because Pb is a legacy contaminant that accumulates on the soil surface, lead-contaminated soil continues to pose a high risk to children in some urban areas (Laidlaw and Flippelli 2008). In the Twin Cities metropolitan area in Minnesota, U.S.A., urban soils typically have Pb levels in 1-2 orders of magnitude higher than those in rural areas (Mielke et al. 1984). Understanding soil Pb distributions throughout the Twin Cities over time are thus crucial for researchers in identifying population and health relationships with Pb contamination in this urban environment and for city officials in land use planning and regulations. The objectives of this project are to: 1) Build spatially-explicit models for soil Pb in the Twin Cities metropolitan area; 2) understand the spatial relationships between soil Pb and social environmental parameters related to urban lead sources including traffic volume, housing density, and age of houses; and 3) Identify whether samples collected in various time and spatial scales provide matching results about soil Pb levels in the Twin Cities area. Various spatial modeling methods (i.e. general linear model, random forest, and support vector machine) will be tested for mapping soil Pb levels from samples collected in the community engagement and citizen science projects (2015-2016). A set of legacy soil Pb data for the city of St. Paul (1997-1998) will also be modeled with these methods. The predictor variables for soil Pb models will consist of urban environmental parameters related to Pb contamination sources (e.g. traffic volume, building density and housing age). The modeling results from different methods will be compared and reported. We will also georeference and digitize an old soil Pb map from mid-1980s in the Twin Cities area (Mielke et al. 1989). Our intention is to know whether the three sets of samples collected in different scales and time show matching results, and whether urban environmental parameters related to Pb contamination can be used to predict the soil Pb levels in the Twin Cities. The results will help house siting and land use planning for protecting human health in the urban environment.

Keywords: soil lead, urban health, GIS, spatial interpolation
Financial support:

C4.2.2 - Soil quality and food security in the tropics

(1948 - 2427) Accumulation and translocation of cadmium in cacao production systems of the Colombian central Andean region

Martha Cecilia Henao-Toro[1]; John Fernando Soler-Arias[1]
Universidad Nacional de Colombia[1]

Cadmium is a toxic heavy metal that is not essential for plants, but can be absorbed by them, through soils. A preliminary study showed high levels of Cd in cocoa beans in some areas of Colombian central Andean region, in crops seeded in stony soils developed from sedimentary rocks with relatively high levels of Cd. In order to determine the potential Cd accumulation in different tissues of cacao plants, 95 crops were selected and in each one a plant with mature fruits was sampled. The Cd in leaf and fruit tissues (shell, bean and pod husk) was analyzed by AAS after sample calcination and dissolution in HCl-HNO_3. Cd in soil and cacao leaf litter around trees was also determined. Bioaccumulation factor (BF) was calculated as the ratio of Cd in leaf or bean to that in soil, and Translocation factor (TF) as the ratio of Cd in leaf to that in fruit tissues. It was found statistical differences between Cd levels in leaf and fruit tissues, Cd in leaf being higher ($P<0.01$). Among the other fruit tissues there were no statistical differences. Cd means levels found were 7.18, 4.42, 3.36 and 2.88 mg/kg in leaf, bean, pod and shell respectively. Except for pod, levels in other tissues showed a high correlation with each other ($r> 0.6$, $P<0.01$), Cd in leaf was an acceptable estimator of Cd in bean ($r=0.67$, $P<0.01$). FB indicated that plant can be considered as accumulator since all values were higher than 1, and 10% even were higher than 50. FT suggests that mobility of Cd between leaves and fruits is low, with values generally lower than 1, which would exclude cacao as hyperaccumulator plant. Cacao leaf litter had the highest levels of Cd in all types of plant tissue evaluated ($P<0.01$), with a ratio Litter/Leaf of 2.3 on average. The risk of Cd cycling in crops of the study area can be high, as litter is a direct product of foliar abscission of cacao during all year, and leaf is the organ with the highest concentration of Cd. An estimate of maximum possible addition to soil of Cd by litter was of 1 kg/ha/year, calculated with the highest Cd concentration found in litter in this study and a dry biomass production of 21 Mg/ha/year of litter, reported for similar production systems. The cycling could also occur due to use of pod husk in compost production for cacao fertilization, since, along with FT, pod can accumulate 58% of Cd present in the leaf. A strategy of litter and crop residues management should be applied for reducing Cd recycling in cocoa production systems.

Keywords: Heavy metal, soil Cd, leaf litter, cacao pod
Financial support: Subproject of the project

(2325 - 927) Achievements and Challenges of the Regional Soil Partnership for Central America, Mexico and The Caribbean

Olegario Muñiz[1]
Soil Institute. Autopista Costa Costa y carretera de Vento. Boyeros. CP. 10800. La Habana, Cuba. Email: olemuni7@gmail.com[1]

In 2012, FAO members approved the establishment of the Global Soil Partnership (GSP), an initiative aimed for improving the governance of natural resource soil and raising awareness of its importance on a global scale. The GSP is directed to stop and reversing the soil degradation process through the establishment of regional strategies based on Sustainable Soil Management. In October 2013, it was launched in Havana for the region of Central America, Mexico and the Caribbean with the participation of soil officials from 15 of the countries in the area; as well as international institutions and NGOs. Thus, it was established the Regional Soil Partnership (RSP), in front of which was an Steering Committee conformed by specialists of seven of the countries present. An Implementation Plan of activities for the region was approved for the following 5 years, as a contribution to the Food Security, the adaptation

and mitigation to the Climate Change and the provision of ecosystem services. Recently, the Third Workshop of our RSP was carried out at Panama City. In present paper, the achievements, shortcomings and challenges are discussed.

Keywords: Regional Soil Partnership, Soil Sustainable Management, Food Security.
Financial support: Global Soil Partnership, FAO, Rome.

(6207 - 1148) Agronomic fortification of Zinc and Iron nutrition on productivity and quality of wheat

Sudha T[1]; Pallavi V[1]
University of agricultural sciences Dharwad[1]

field experiment was carried out during *rabi* season of 2015-16 and 2016-17 to study the effect of agronomic fortification of Zinc (Zn) and Iron (Fe) nutrition in irrigated wheat at Main gricultural Research Station, Dharwad, Karnataka, India. The experiment was laid out in a Randomized complete block design (RCBD) having 15 treatments and replicated thrice. A common dose of 100 N : 75P_2 : 50 kg K_2O kg/ha was applied to all the treatments. $ZnSO_4$ and $FeSO_4$ was applied to the soil alone and in combination with foliar application (0.5%) at the rate of 20 kg/ha each. Foliar application of $ZnSO_4$ and $FeSO_4$ each were made at heading and milky stage @ 0.5%. The higher number of earhead / m^2 (277), grain yield (41.3 q/ha) and biomass yield (106 q/ha) were recorded with combined soil (20 kg/ha) and foliar (0.5%) application of $ZnSO_4.7H_2O$ during heading and milky stage as compared to all other treatments and found on par with soil and foliar application of $ZnSO_4.7H_2O$ heading stage. Soil and foliar application of $ZnSO_4.7H_2O$ at heading and milky stage recorded higher gross returns (Rs. 74 x 10^3), net returns (Rs. 37 x 10^3) and B:C ratio (2.02) and found on par with soil and foliar application of $ZnSO_4.7H_2O$ at heading stage. Quality parameters like protein (14.2%), sedimentation value (37.6 ml) was significantly higher with soil and foliar application of $ZnSO_4.7H_2O$ at heading and milky stages compared to all other treatments and found on par with soil and foliar application of $ZnSO_4$, $7H_2O$ at heading stage. The soil of the experimental site showed high in Iron (Fe) content (3.56 ppm) the response of $FeSO_4.7H_2O$ is not noticed in the grain concentration.

Keywords: wheat, agronomic fortification, productivity quality
Financial support: AICRP Wheat, ICAR, India

(9958 - 2123) Assessment of chemical quality of soils of horticultural areas of the Federal District

Lucas Soares Mendes[1]; Rafaella Russolyne Marques Silva[1]; Carlos Eduardo Pacheco Lima[2]; Juscimar Silva[3]
ICESP Promove[1]; Embrapa Vegetables[2]; Embrapa Vegetables, BR 060, km 09, Brasília/Anapolis, 70275-970 (juscimar.silva@embrapa.br)[3]

The cultivation of vegetables requires intensive soil management, in particular regarding the addition of high doses of fertilizers. Such doses when applied without proper guidance may lead to loss of chemical quality of soils with direct effects on crop yield. The objective of this work was to evaluate the chemical quality of soils from vegetables areas of the Federal District, Brazil. It was analyzed 160 samples of top soils (0 – 20 cm depth) collected from the major administrative regions. Chemical quality was defined as function of fertility level of the soils, content of soil organic matter (SOM) and trace elements. The results showed that, in average, the levels of soil nutrients presented different behaviors. Phosphorus and potassium were below the critical level (nutrient status that correlates with maximum yield) in 51.8% and 59.2.7% of the samples, respectively. Potential acidity (56.1%) and CEC (60%) presented same pattern. The content of SOM was adequate for most of the soils and ranged from 10.6 up to 79.8 g/kg with the highest values observed on soils from organic farming. Available micronutrients were excessively high, reaching up to 10 folds the content considered adequate for vegetable growth especially for Fe, Mn, and Zn. Total content of Ag (< 44,18 µg/L), Cd (< 7.67 µg/L), and Pb (< 205.5 µg/L) were below de detection limit. Some samples presented the content of Cr (79%), Cu (10%), Ni (17.5%), and Mo (28.1%) above the Quality Reference Values (VRQ) for soils according to Brazilian regulation (CONAMA, 2009) and their monitoring are needed.

Keywords: Soil Health, Nutrient Status, Organic Matter, Trace Elements
Financial support: Cnpq, FAPDF and Embrapa Vegetables

(4206 - 291) Biological indicators and soil quality indices for red soils under subtropical rainforest and under *Pinus sp.* plantation

Toledo Diana Marcela[1]; Arzuaga Silvia Amanda[1]; Galantini Juan Alberto[2]; Vazquez Sara[1]
Universidad Nacional Del Nordeste[1]; Universidad Nacional Del SUR-CERZOS-CONICET[2]

Over the last decade, massive forest-clearing, coupled with agricultural and forestry expansion in the province of Misiones (northeast of Argentina), has resulted in the loss of 500,000 hectares of subtropical rainforest, accounting for the highest annual deforestation rate in the country (1.3%, i.e. 60,000 ha $year^{-1}$). Rainforest areas are becoming smaller as a consequence of land-use changes for planting fast-growing exotic trees such as *Pinus sp.* (83% of forest area). The objective of this research was to assess the changes induced by subtropical rainforest-clearing and the subsequent plantation of *Pinus sp.* through biological indicators and functional indices of soil quality. The assay was carried out in Oxisols in the department of Oberá (Misiones). A completely randomized design was used and two treatments were included: rainforest (S) and 20-year-old *Pinus sp* (Pi) plantations. The soil was sampled from 12 plots under Pi and from 12 under S. Composite samples were collected from each plot to the 0 - 0.10; 0.10 - 0.20 and 0.20 - 0.30 m depths. The following soil properties were determined: total organic matter (MO), particulate organic matter (MOP), total nitrogen (Nt), potentially mineralizable nitrogen (NMP) and soil respiration (RES). The NPM/Nt, NPM/MOP, MOP/MO, MOP/RES and NPM/RES indices were calculated. The results were analyzed through an ANOVA, an LSD test ($P \leq 0.05$) and a Pearson's correlation test ($P \leq 0.05$). Clearing subtropical rainforests and the subsequent forest plantations resulted in lower MO (37%), MOP (41%), Nt (52%) and NPM (70%). The correlation of NPM with MO, MOP and Nt, as well as with the NPM/Nt, NPM/MOP, MOP/RES and NPM/RES indices, were shown to be positive and significant across the three depth levels. Land-use changes resulted in a negative organic balance and affected MO dynamics, as shown by the MOP/RES and NPM/RES indices, indicating a lower turnover rate for soils under forestry.

Keywords: Soil quality; index; changes land-use; Oxisols
Financial support: UNIVERSIDAD NACIONAL DEL NORDESTE

(2400 - 2611) Comprehensive study of soil physical and chemical properties under no-tillage systems in Brazil

Rhuanito Soranz Ferrarezi[1]; Ondino Cleante Bataglia[2]; Camilo Lázaro Medina[2]; Pedro Roberto Furlani[2]; Fernando Penteado Cardoso[3]
University of Florida[1]; Conplant Consultoria, Treinamento Pesquisa e Desenvolvimento Agrícola[2]; Fundação Agrisus Agricultura Sustentável[3]

The 2009 Brazilian Crop Tour (known as Rally da Safra) visited the main row crop producing regions in Brazil to determine the state of the art of intensive farming in Brazil. During this endeavor across the country, soil samples were taken to perform a comprehensive study of soil physical and chemical properties of no-tillage systems in soybean and corn summer crops. 1,171 soil samples were collected in two layers (0-5 and 5-10 cm), totaling 2,342 samples. We determined soil texture, soil cover, cation exchange capacity, pH, base saturation, P and total exchangeable

bases (Ca, Mg, K, Na). In addition, soybean and corn crop yield were estimated. Data were grouped into climatic regions and states: Region 1) cold and humid winter, wheat and oat cultivation (RS, SC, PR); Region 2) mild and wet winter, unpredictable weather changes, and wheat, oat, sorghum and winter corn production (MS, PR, SP); Region 3) warm and humid winter, corn and sorghum cultivation (MT, RO, SP, MG, GO); and Region 4) warm and dry winter, with corn, soybean and cotton production (MA, PI, TO, BA, GO). The sampled soils presented variable texture, soil cover and cation exchange capacity, and were predominantly formed by clay soils in the southernmost regions of the country – which presented the longest time under no-tillage cultivation. Sandy soils prevailed in the northeastern regions, where no-tillage systems are more recent. The surface lime addition was adopted by most corn and soybean producers in Brazil, as pH >5 in 74% of soils and base saturation >50% in 82% soils. We developed an interpretation range based on P levels and soil depth, which revealed the predominance of samples with high P levels for corn and medium for soybean in the 0-5 and 5-10 cm layers. The P concentration, extracted using ion exchange resin method from the Agronomic Institute of Campinas, indicated the presence of high P levels in 41% of 0-5 cm samples and in 36% of 5-10 cm samples. When considering the two sampling layers pooled, results showed the existence of high P in 51% of the samples. Clay soils had more samples with higher P, which coincides to regions with older, consolidated no-tillage systems. Cornfields tended to present higher soil fertility compared to soils cultivated with soybean. In regions 1 and 2, high levels of K prevailed, as opposed to regions 3 and 4. K increased with soil cover due to higher nutrient recycling by cover crops, with greater soil surface organic matter accumulation.

Keywords: Fertilization, soil cover, soil fertility, sampling depth, soil texture, Crop Tour, Rally da Safra.

Financial support: Fundação Agrisus Agricultura Sustentável (award PA 541/09 and PA 707/10)

(2092 - 2578) Fertility and metal concentrations in soils of tropical *Eucalyptus* plantations under residual application of sewage sludge: indication of soil quality

Cassio Hamilton Abreu-Junior[1]; Antonio Leite Florentino[2]; Alexandre V. Ferraz[2]; Josè Leonardo M. Gonçalves[2]; Fábio Poggiani[2]; Verónica Asensio[2]; Takashi Muraoka[1]

USP/CENA[1]; USP/ESALQ[2]

The management of sewage sludge (SS) in agricultural areas increase soil fertility, nutrient cycling and crop yield. However, soil and plant contamination with metals is a great concern. In the case of São Paulo state, Brazil, the Environmental Company of São Paulo State (CETESB) defines three key values: quality reference values (QRV), prevention values (PV) and intervention values (IV) for soils as function of the concentration of metals. In this study, the objectives were: to assess the concentration of As, Ba, Cd, Co, Cr, Cu, Mo, Ni, Pb, Se and Zn in soils; to evaluate the soil fertility status; and to investigate the quality standards of tropical soils for *Eucalyptus* plantations as affected by residual application of SS. The study was carried out in four experimental sites at São Paulo state, Brazil: 3 experiments at Itatinga city (3 Typic Hapludox soils, TH, with texture varying from sand to loamy) and 1 at Angatuba city (TH, sand texture). The SS came from the sewage treatment plants of Jundiaí, Barueri and São Paulo cities. The sludges were applied only once at 10-17 years ago (before soil sampling for this study). For each site, treatments were SS doses (from 8 to 40 t ha^{-1}, dry base), conventional mineral fertilization (MF) and control (without sludge and mineral fertilizer). The experimental designs were randomized block, with 5 treatments and 4 replicates for three sites, and 3 replicates for one site. Analytical determinations were performed by ICP-OES after sample acid digestion (HNO_3+HCl), USEPA method 3050b. There was a residual effect of SS on the concentration of metals and soil fertility, in comparison with the MF, especially in the treatments with the highest doses (i.e., 30 t ha^{-1} and/or 40 t ha^{-1}). Notwithstanding, the metal concentrations in the soil were generally lower than the prevention values, except for Se. There was a relationship between the dose of sludge and the concentration of metals and soil fertility, i.e., the higher the effect of the doses, the higher the increase in the sandy texture soils. We concluded that there is a residual effect of the application of SS in comparison with the mineral fertilizer application, with an increase in the metal concentrations as soil fertility was improved. There is no soil contamination by metals as a residual effect of the application of sewage sludge. Conversely, the soil fertility and quality were improved for fast growing *Eucalyptus* plantations under tropical climate.

Keywords: Forestry, Mineral fertilization, Trace elements

Financial support: São Paulo Research Foundation (FAPESP), grant #2004/15097-0, and National Council for Scientific and Technological Development (CNPq), grant #485205/2012-2.

(4072 - 1230) Fertilizer application alters temporal dynamics of soil inorganic nitrogen and its availability to maize in two soil types in the Tanzanian highlands

Jinsen Zheng[1]; William N. Mmari[2]; Tomohiro Nishigaki[3]; Method M. Kilasara[4]; Shinya Funakawa[1]

Kyoto University[1]; Uyole Research Institute, Mbeya, Tanzania[2]; Japan International Research Center for Agricultural Sciences[3]; Sokoine University of Agriculture[4]

Regional and national efforts are underway to increase fertilizer use (especially nitrogen, N) in Sub-Saharan Africa (SSA), yet the fate of added N and the crop response are poorly understood. For two consecutive cropping seasons (2013–2015), we monitored the fluctuation of soil inorganic N and its availability to maize in the Tanzanian highlands. Four urea-N rates (0, 50, 100, and 150 kg N ha^{-1}) were applied to two types of soils (TZi, sandy Alfisols; and TZm, clayey Andisols). Seasonal variations in soil inorganic N availability coupled with plant N uptake revealed that, regardless of soil type, soil mineralized N at the early growing season were largely exposed to the risk of leaching due to small crop N demand. Shortly (10–12 days) after urea application, soil inorganic N availability (0–30) increased significantly with urea-N rate at TZm ($P < 0.001$) but not at TZi ($P = 0.17$), indicating that higher rate of urea-N applied at TZi was accompanied by more N loss. Fast depletion of applied urea-N at TZi, especially at higher N rate, was likely a result of substantial N loss through ammonia volatilization, as supported by the poorly pH-buffered soil with low cation exchange capacity at TZi. By contrast, a large fraction of applied urea-N was retained available to crop at TZm. Accordingly, yield at TZi was low (up to 2.6 Mg ha^{-1}) compared to TZm (up to 4.4 Mg ha^{-1}) under the same N rate. The best-fitted linear-plateau model indicated that the soil inorganic N availability in the top 30 cm at the tasseling stage (i.e., 68–71 days after planting) largely determined maize yield. Further, yields at TZi were still limited by N availability at the tasseling stage due to fast depletion of applied-N, whereas yields plateaued at TZm once N availability was above 67 kg N ha^{-1}. Our results provided a valuable reference for N management to increase yield, while minimizing the potentially adverse losses of N to the environment, in different agro-ecological zones in SSA, where N application is poised to increase.

Keywords: Seasonal variation; N leaching; N retention; Plant N uptake; Maize yield; Sub-Saharan Africa

Financial support: the Japan Society for the Promotion of Science KAKENHI (Grant No.: 24228007); the Inter-Graduate School Program for Sustainable Development and Survivable Societies at Kyoto University

(5485 - 1452) High resolution soil functional maps for Central America and Oaxaca using Digital Soil Mapping

Phillip R. Owens[1]; Axel Schmidt[2]; Zamir Libohova[3]; Minerva Dorantes[4]

USDA ARS[1]; Catholic Relief Services[2]; USDA NRCS[3]; ORISE Research Scientist[4]

Some of the current problems related to food security, drought and ecosystem degradation are rooted in the lack of information on soil function and soil resource linkages within landscapes. Additionally, the problem is coupled with (i) lack of detailed soil information; (ii) access to existing soil data; and (iii) investment in detailed soil surveys. As a result, a paradoxical situation has been created with soil being an overlooked national infrastructure resource, yet constituting the biggest freshwater reservoir. More than 70% of the agriculture in Central America is rain fed thus its dependence on the amount and distribution of water is critical. Recent government investments on subsidizing seed and fertilizer for the farmers in some of the countries while ignoring proper soil conservation and management has led to further degradation of soils and crop failures. Climate change and associated uncertainties have led to persistent and prolonged droughts in Central America especially in the so called "dry corridor". As part of the Water-Smart Agriculture project, sponsored by the Howard G. Buffett Foundation to improve food security in Central America, Catholic Relief Services (CRS), and United States Department of Agriculture (USDA), Dale Bumpers Small Farm Research Center - Agriculture Research Service (ARS) and Soil Science Division - Natural Resources Conservation Service (NRCS) have launched a Soil Mapping Initiative project aimed at creating detailed soil property maps by combining legacy data, local tacit knowledge, and new digital soil mapping (DSM) techniques as well as building capacity for sustainable future soil surveys efforts. The Soil Mapping Initiative project is focusing on generating detailed soil maps of properties that are directly related to soil water dynamics such as soil depth, texture, permeability and available water capacity. The property maps and interpretative maps will also be made freely available to users to help their management decisions from the field to watershed scale. We highlight some of the achievements and challenges of the DSM efforts.

Keywords: Digital Soil Mapping; soil functional maps, Water Smart Agriculture

Financial support: Howard G. Buffett Foundation and Catholic Relief Services

(1206 - 2526) Influence of soils and micro-environment on the biomass and bioactive concentration of plantation grown E*urycoma longifolia*

Wan Rasidah Kadir[1]; Mohamad Fakhri Ishak[1]; Rosnani Abdul Ghani[2]

Forest Research Institute Malaysia[1]; Malaysian Agriculture Research and Development Board[2]

Differences in environmental parameters can significantly influence growth performance and quality of plants growing on such sites. This study examined the influence of soils, micro-climate and stand management on the growth, biomass production and the quantity of bioactive compounds that can be extracted from tongkat ali (*Eurycoma longifolia*) plants. Data collection and sampling were carried out for the Peninsular Malaysia, separated into five zones assumed to differ in micro-climate and environments, rainfall distribution as well as soil quality. Our discussion with plantation owners revealed that there was no standard or uniform plantation management regime and it differs for each organization. Thus we have to resolve with *E. longifolia* plantations of age range between 8-13 years for data collection and biomass sampling. Out of five sampling zones, two sites gave high biomass yield, one in the Northern zone (Perlis) and the other in the Southern zone (Johor). However, eurycomanone concentrations in plant sample collected from Perlis were rather inconsistent and not as much of identifiable pattern. Plants at open area have the highest eurycomanone concentration for the leaves part, probably due to the influence from soil and micro-environment. From the six plants harvested, only two plants have detectable eurycomanone in stem, and no eurycomanone was traceable in leaf stalk. For samples taken from Southern zone, the presence of eurycomanone was comparatively higher especially in roots and leaves. The other two zones i.e. the Eastern and Middle zones, eurycomanone were detected in roots, stem and leaves with concentration higher than those samples from shaded site in the Northern zone even though their biomass yields were much lower. On the whole, for all samples chemical analysis showed that eurycomanone was present in roots and leaves. We are not able to conclude on plantation management such as management during planting, fertilization and stand management due to scarcity of information. Nevertheless, from field observation we can roughly presume that stands management practiced by MARDI Kluang could be the option as three out of the four sites gave the highest biomass and eurycomanone yields. The site with low yield was planted on shallow soil. There is no issue with heavy metals content as the concentrations for all sites were below the permissible levels

Keywords: Agroecological zone, medicinal plants, soil differences, plant yield, bioactive

Financial support:

(7240 - 2693) Influences of culturing eels in paddy fields on soil nutrients and rice's resistance to pests and diseases

Guo-jun Lan[1]; Xue-feng Hu[1]; Jing-long Zhao[1]; Si-wen Lu[1]; Fan Luo[1]

Shanghai University[1]

Excessive applications of chemical fertilizers and pesticides under the conventional rice farming system have already caused many environmental problems in China. In recent years, artificially ecological agricultural systems, called ecological planting-breeding coupling models, are introduced and gradually implemented in Shanghai and other areas in China. Rice-eel integrated farming is one of the important ecological coupling models, which means culturing eels in paddy fields during the rice growing season. The fields provide natural food, sufficient water and habitats for eels, and, on the other hand, eels improve rice growth through loosening soils, preying on rice pests and raising soil fertility. Our field experiments indicated that the rice pants for the eels treatment was 6.6% higher than the control, and the content of aliki-hydrolyzable N in the soil for the eels treatment was 3.1% higher than the control. Moreover, the incidences of rice leaf rollers, plant hoppers and blast for the eels treatment during the rice growing season were reduced by 46.6%, 39.5% and 33.4% on average, respectively. In short, the culture of eels in the fields can improve soil aeration, nutrients and biodiversity, thus stimulating rice growth and reducing the incidences of rice pests and diseases. The promotion of the rice-eel integrated farming system is beneficial to lessening the amounts of application of chemical fertilizers and pesticides during the rice growing season and reducing agricultural diffuse pollution effectively.

Keywords: paddy fields, eels, soil fertility, agricultural diffuse pollution, incidences of rice pests and diseases

Financial support:

(6990 - 696) Knowledge management and technology transfer by the use of scrap farm for soil improvement via mushroom cultivation and inducing mushroom growing in the nature

Dr.Orathai Sukreeyapongse[1]; Dr.Thaworn Vinitsanan[2]; Dr.Weerasak Saksirirat[3]; Mr.Surachet Narabhat[1]; Ms.Prapatsorn Polwong[1]

Office of Science for Land Development[1]; Mahidol University[2]; Khon Kaen University[3]

In Thailand, some farmer in the northeast rural area, have free time after harvesting rice but they cannot grow any plant. They still need to expend for their family living. They want to do something but cannot due to lack of knowledge and experience. Therefore 3 objectives had been set to solve these problems. 1) To survey the need of the community and gathering knowledge for them. 2) To do knowledge management for soil improvement via mushroom cultivation by the use of scrap farm. 3) To transfer technology by the use of scrap farm for soil improvement via mushroom cultivation and induce mushroom growing in the nature. The results show that soil at the studied sites were low fertile, the pH were in the range of severe acid to medium. Plant nutrient of N, P and K were low. Soil properties need to be improved. The farmer want to learn

about mushroom cultivation which they can use scrap farm as a growing media. The trainees learned to grow mushroom in complete steps. They can separate mushroom pure culture, they can grow mushroom in PDA and in whole grains. They can produce mushroom bag and growing and harvest it in farmhouse. They can make compost from used growing media to amend and improve soil fertility. Average soil pH increased from 4.8 to 6.3, OM increased from 1.1 % to 1.6%, avail.P and extr.K increased from 4.3 and 65 to 27 and 163 mg/kg, respectively. They can induce Barometer Earthstars (*Astraeus hygrometricus*), Bolete (*Thaeogyroporus porentosus* (berk. ET. Broome) and Mouthpiece (*Tricholoma crissum*, Macrocybe Crassa (Beak)) to occur in the nature. They grew 700 Barometer Earthstars, 500 Boletes and 500 Mouthpieces in the studied area. 94.39% of the trainee was most satisfied the course, all of them (100%) will use the knowledge to improve their soil quality, to create job and produce mushroom as a community enterprise product. Soil quality in the studied area have been improved and the poverty of the farmers have been eradicated by this project.

Keywords: mushroom; scrap farm; soil improvement; soil quality
Financial support: National Research Council of Thailand

(4875 - 1813) Large-area soil assessments for agriculture development in tropical Northern Australia

Mark Thomas[1]; Elisabeth Bui[1]; Seonaid Philip[1]; Ross Searle[1]; Ian Watson[1]; Peter Wilson[1]
CSIRO[1]

There is a need to develop new land to meet the world's rising demand for food. As the population grows, conflicts arise for precious land and water resources while the quality of much farm land (and yields) declines from poor management (e.g. nutrient imbalances, erosion, salinisation, etc.). Furthermore, many countries recognise the strategic importance of hedging against climate uncertainty for food security, and the desire to boost exports. Australia's pattern of soil and land evaluation - the precursor to agricultural expansion - since European colonisation in 1788 was initially *ad hoc* and centred on the settled hinterlands. Since World War 2 it has been more strategic supported by government investments, which in cases extended to the sparsely populated remote areas and producing coarse scale soil and land assessments (i.e. 1:250,000 – 1:2M scale mapping products). The sentiment to expand Australia's agricultural land persists, and there has been renewed interest in assessing opportunities in remote tropical Northern Australia where land and water are considered abundant. This paper describes experience in mounting large-area soil survey and mapping campaigns in the region under substantial operational constraints. Experience is drawn from two projects, each simultaneously assessing soils from multiple catchments, including the Flinders and Gilbert Agricultural Resource Assessment (155,000 km^2) and the Northern Australia Water Resource Assessment (196,000 km^2). Constraints include: short and fixed project timelines, each three years and catering for field access determined by unreliable but distinct wet/dry season breaks; a scarcity of suitable legacy data to draw upon, including soil survey and mapping of appropriate scale and themes; shortage of national soil survey capacity (personnel, equipment), and; remoteness and difficult field access, including a sparse transport networks. The paper presents pragmatic adaptations to these constraints allowing project objectives to be fully met. Adaptations include: adoption of digital soil mapping (drawing on past investments in digital terrain and geophysics data), statistically-based survey design, and rapid soil analysis; use of legacy soil survey data (after robust data evaluation) from government databases, and; inter-government agency partnerships to address short-falls in field skills and equipment. The approach can be modified in other countries where similar circumstances occur.

Keywords: soil land assessment tropics Australia
Financial support: Government of Australia

(3421 - 866) Measurement of biological N_2 fixation in field-grown common bean cultivars in Brazilian Cerrado soil using ^{15}N natural abundance method

Rafael Sanches Pacheco[1]; Bruno José Rodrigues Alves[1]; Robert Michael Boddey[1]; Enderson Petrônio de Brito Ferreira[2]; Rosângela Straliotto[3]; Adelson Paulo Araújo[4]
Embrapa Agrobiologia[1]; Embrapa Arroz e Feijão[2]; Embrapa Solos[3]; Universidade Federal Rural do Rio de Janeiro[4]

The ^{15}N natural abundance method (NA) can be used for distinguishing among the N from soil and air in N_2-fixing plants and thus to estimate the contribution of biological nitrogen fixation (BNF). The aim of this study was to estimate the BNF contribution for plant N nutrition by NA method in eight common bean cultivars with different agronomical traits at field conditions. Two field experiments were carried out in an Oxisol at Brazilian Cerrado biome, with eight common bean cultivars inoculated with *Rhizobium*. The NA method was used to estimate BNF in plant shoots at mid-pod filling and in grains at physiological maturity. Three non-fixing plants were used as reference and the assumed B value was -1.2. The same bean cultivars grew under mineral N (90 kg ha^{-1} as urea) to estimate their yield potential without N limitations. Averaged grain yield was 1614 and 2942 kg ha^{-1} in the Experiment I, and 3284 and 3919 kg ha^{-1} in the Experiment II, respectively, under inoculation or mineral N. None cultivar under rhizobium inoculation surpassed the grain yield provided by mineral N in both experiments. The ^{15}N natural abundance ($\delta^{15}N$) in non-fixing reference plants was 5.49‰ in the Experiment I and 4.88‰ in the Experiment II. In Experiment I, the contribution of N derived from atmosphere (%Ndfa) reached a maximum of 25% in shoots at mid-pod filling, while varied from 18 to 35% in grains at maturity. In Experiment II, the %Ndfa ranged from 7 and to 50% in shoots and 29 to 51% in grains. In Experiment I, the N_2 fixation was estimated as 6.7 kg ha^{-1} in shoots, averaged across all cultivars, and ranged from 6.42 to 17.89 kg ha^{-1} in grains. In Experiment II, the lowest amount of N_2 fixed in shoots was 2.5 kg ha^{-1} and the highest 31.3 kg ha^{-1}. The cultivar that accumulated less N from BNF in shoots was also the same that accumulated less N in grains, whereas the greatest accumulation of N derived from BNF in grains was 69.7 kg ha^{-1}. In Experiment II, the average grain yield of the inoculated cultivars was double of Experiment I and the average of the amount of N_2 fixed was 3 to 4 times higher in shoots and grains, respectively, indicating that a higher contribution of N from symbiosis occurred when the bean crop achieved its optimum yield potential. The ^{15}N natural abundance method allowed to detect phenotypic capability to acquire N from BNF among field-grown common bean cultivars.

Keywords: *Phaseolus vulgaris*; rhizobia inoculation; $\delta^{15}N$; biological N fixation.
Financial support: EMBRAPA; CNPq.

(1884 - 1443) Pineapple mineral nutrition profile and diagnosis of nutritional status

Marco V. Gutiérrez-Soto[1]; Esteban Loría-Solano[2]
University of Costa Rica, Dept Agronomy, Fabio Baudrit Exptl. Stn.[1]; Agrocontrol, Guápiles[2]

Pineapple nutritional requirements, particularly K and N, are superior than most tropical crops, but only a small fraction is retained in the fleshy fruits. In the field, most of the uptake occurs during vegetative development, when nutrients are applied mostly to the foliage. It is important to know the content and distribution of nutrients in the whole plant to improve fertilizer use and to produce well-nourished plants

capable of sustaining higher fruit yields. Here we present the content and distribution of essential nutrients in all organs of whole vegetative and reproductive MD-2 pineapple plants grown in a greenhouse in Costa Rica (10^{o}N, 840 m elev.), under optimal nutrient and water supply. We also characterized the mineral profile of different leaf strata and leaf segments, with emphasis on the utility of the D leaf as a diagnosis organ. Our results revealed that substantial amounts of nutrients are removed by a pineapple crop especially after 4 months, and point to stems and roots, in addition to leaves, as major sinks of Ca and P, and micronutrients respectively. Large amounts of K and N were contained in succulent leaves, but substantial nutrient uptake was observed during fruit and crown development. Nutrient content of fruit peel and pulp was quite low compared to vegetative organs, and do not support the application of copious amounts of K and Ca during fruit development. The root system was extensive, fragile, with abundant root hairs, and was the main route for mineral uptake. Plants fed *via* the root were larger, heavier, greener, and produced higher yields in shorter periods than plants growing in the field. The number and quality of slips was also superior. K and N use efficiency and nutrient content and balances increased significantly. Several young, fully expanded leaves exposed to full solar radiation could be used for diagnosis purposes, and no support for the use of basal leaf segments was obtained; instead, we recommend to periodically sample and nutritionally analyze whole plants for fertilizer needs determination, and conclude with suggestions regarding the routes for mineral uptake in pineapples, the role of the root system and the stem in nutrient budgets, and the intervention of on-farm biogeochemical cycles to improve fertilizer and water use efficiency using soils covers, timely irrigation and incorporation of crop residues, and to fine-tune protocols for sampling and diagnosis of the pineapple plant nutritional status

Keywords: D-leaf, CAM, nutrient use efficiency
Financial support: Agrocontrol, Guápiles, Limón, Costa Rica

(9990 - 616) Soil analysis and use of the calcary as an efficient public management in family agriculture in the municipality of Jeceaba, Minas Gerais

Leandro Marciano Marra[1]; Marcelo Zózimo da Silva[2]; Lindayane Cardoso Chaves Marra[3]; José Silva Soares[4]; Wilton Fernandes Monteiro da Mata[5]; Selene Cristina de Pierre Castilho[1]; Jean Sérgio Rosset[1]; Gledson Martins[6]
Universidade Estadual de Mato Grosso do Sul - Unidade de Mundo Novo[1]; IFET-MG[2]; Escola Adventista - Mundo Novo - MS[3]; Deputado Federal / Emater - MG[4]; Produtor Rural / Jeceaba - MG[5]; Graduating UEMS[6]

Jeceaba - MG has an area of 236 km^{2} located in the region of Alto Paraopeba, an average altitude of 850 m. The rural area is composed of 22 localities with 2,417 inhabitants (44.79%). The number of agricultural establishments reaches 345 that employ 756 men and 266 women. By the year 2013, a family agricultural era exercised very empirically and semi-technical support. Only 8% knew what a soil test was and 3% used limestone. Thus, as a form of support and promotion of rural development were implemented in 2013, Pro-Analysis and Pro-Calcary projects with the aim of enabling, encouraging and introducing a chemical and physical soil analysis and a correction of soil acidity. A partnership was signed with IFET-Campus Barbacena-MG for a soil analysis and created the Municipal Law of Family Agriculture that allows the subsidization of agricultural inputs to family farmers. As results, 150 soil analyzes were performed for 78 establishments. Of these, 65% had high acidity. Regarding phosphorus, 94% of the areas sampled had very low and low levels. As for potassium, sulfur, calcium and magnesium, in general, presented low levels. The organic matter content showed that 99% is not an ideal for soil conservation. As for the micronutrients copper, iron, manganese and zinc as samples presented medium to high level, exception was found at low lows. A textural analysis evidenced that 98% of the known areas of the medium or clay texture. 285 tons of dolomitic limestone were subsidized for the crop year 2013/2014, which resulted in an investment of R$ 38,990.00, which represents 0.15% of the municipal collection in the year 2013. In addition, a public management practice granted the award for the best public project developed in Minas Gerais. As well as its application as a management practice that is the project, there is not a technological innovation, but rather in its application as a management practice that is the odd project, when articulating partnerships with research centers and public power, promoting an approximation of science with the rural man and the greater contribution of resources to family agriculture.

Keywords: Food security, rural exodus, casa do agricultor de Jeceaba, soil conservation, sustainability
Financial support: County of Jeceaba-MG. Fundect/UEMS PAPOS n° 25/2015.

(2888 - 1077) Soil quality under no-till: challenges and opportunities for food security in the tropics

Abhas Sinha[1]; Arunava Ghosh[1]; Tapamay Dhar[1]; Prateek Bhattacharya[1]; Kulanand Mishra[2]; Prakash Paneru[2]; Bedanand Choudhary[2]; Shurra Raj Shrestha[2]; Sarita Manandhar[2]; Neal Menzies[3]
Uttar Banga Krishi Viswavidyalaya[1]; Nepal Agricultural Research Council[2]; University of Queensland[3]

No-till (NT) is an essential component of conservation agriculture, which includes crop residue retention and crop rotation as other components. No-till and crop residue retention practices were initiated in the 1960's for soil erosion control. Besides water and resource conservation, these practices may improve soil quality over time, for example by increasing soil organic matter, which provides physical, chemical and biological functions in soil, and hence contributes to long-term food security from agricultural soils. To ensure food security in the tropical environment of the Eastern Gangetic Alluvial Plains (Bangladesh, India and Nepal), a project was initiated in 2014 on sustainable and resilient farming systems intensification. We monitored soil quality in 2016-17 period to assess the changes in soil organic carbon and soil pH in the top <15 cm depth, and partial nutrient balance in either rice-maize or rice-wheat systems grown under NT versus tillage systems in the 1000 -2500 mm annual rainfall region. The alluvial soils of the region vary in texture from sandy loam to clay loam and are mostly classified as Inceptisols and Entisols. Soil organic carbon varied from 0.35 % to 1.65 % and generally followed rainfall gradient; as the annual rainfall increased organic C concentration increased. At all sites the soil under NT had higher organic C than under conventional till. Soil pH_{H2O} varied from 5.8-7.1 across the region. At all sites, soil pH decreased under NT compared to under conventional till at some sites up to pH 0.4 units, the lower the initial soil pH the higher the decrease in pH under NT practice. Partial nutrient balance for N, P and K in rice-wheat and rice-maize systems was positive for P (>50 kg ha^{-1}) but negative for K (->100 kg ha^{-1}) under both tillage practices. Soil quality changes under NT and farming systems intensification in the tropics have provided the opportunity to increase soil organic C benefits. However, NT and intensification also presents challenges including acidification through increased product removal and as a result of increased application of urea-N fertilizer, and of imbalances in nutrients applied as fertilizer relative to crop removal resulting in soil nutrient exhaustion. Legumes in rotation should reduce N requirement but increasing acidification may be an ongoing constraint to sustainable and resilient farming systems in the tropics unless remediation measures are included in the farming practice.

Keywords: Eastern Gangetic Plains, soil organic carbon, soil pH, partial nutrient balance, rice, maize, wheat, legume
Financial support: Provided by ACIAR through CIMMYT, project number CSE/2011/077

(2815 - 2293) Use of effluent from a pharmaceutical industry as fertilizer for seedlings of a native tree species

Carina Aline Prado[1]; Mariana Paiva Batagini Giron[1]; Fernanda Gonçalves Mendes[1]; Marco Aurélio Kondracki de Alcântara[1]; Hélcio Izário Filho[1]
EEL-USP[1]

Sustainability involves many aspects. Among them, the utilization of nutrients present in effluents generated by antropic activities. A destination that has been studied is the application of these materials to the soil for agricultural purposes. In recent years, some environmental damage has been detected resulting from the incorrect dumping of effluents from the pharmaceutical industry. The pharmaceutical industry generates a large number of residues with high organic content. Residues resulting from the production of antibiotics are an example of such compounds, which may contain high recalcitrant and high molecular weight components. In order to reduce this kind of environmental damage, a fertilizer was developed from the chemical precipitation (pretreatment) of an effluent generated by a pharmaceutical industry. This fertilizer was tested for Schinus molle, popularly known as aroeira-salsa. This species has been used in reforestation activities and in some other agroforestry systems. The plants were grown in an Ultisol, medium-textured, with high aluminum contents, under a greenhouse experiment. The occurrence of this soil is common in the region of the Vale do Paraíba, São Paulo State, Brazil ($22^{o}47'26"S$; $45^{o}66'11"W$). The application of the fertilizer to the soil improved its characteristics in relation to the contents of C, N, P, K, Mg, Ca, base saturation, pH, Al and density. Also, nutrient absorption and plant growth benefited from this fertilizer application.
Keywords: Tropical Soil; Pharmaceutical industry effluent; Fertilizer; *Schinus molle*
Financial support: Capes and Fapesp

(6888 - 1020) Vegetation tillering of Brachiaria ruzizienses in response to different doses of phosphorus

Ramaiany Lohanny Sousa Cremer[1]; Lucas Vinícius Albuquerque de Oliveira[1]; Pablo Rogério Ciechorski[1]; Renan Marré Biazatti[1]; Rogério Gonçalves Teixeira[1]
Federal University of Rondônia Foundation[1]

Grassland is the basis of animal feed, the choice of forage and the correct fertilization in pasture formation, are the main ways to maintain high productivity livestock. In this context, the *Brachiaria ruziziensis*, has gained great space in Brazilian livestock, because it has a characteristic to be quite palatable and well accepted by the animals. Its nutritional requirement and something limiting the productivity, especially in poor phosphorus soils. For several reasons the tillering of forages has been considered fundamental to maintain the high productivity of the plants, with this, the research identified the best dose of phosphate fertilizer that increases the greater tillering of the forage studied. There were five different dose treatments (0, 100, 200, 400 and 800 $Kg.ha^{-1}$) with five replicates each, conducted in polyethylene pots of 8 dm^{-3}, in a greenhouse and distributed in a completely randomized design. The till number was counted at 30 and 60 DAE. At 30 (thirty) and 60 (sixty) days, the fertilization efficiency was linearly increased, where the highest tillering was 800 $Kg.ha^{-1}$. The results were justified by phosphorus being a determinant in the energy production, and a helper in the initial start of the plants, limiting the growth of the plant in its absence, as demonstrated in the experiment, the increasing dose allowed an increase of up to 800% in the number of grassy tillers so greater number of leaf area and fresh mass available to the animals. It is concluded that the phosphorus is fundamental in the establishment of *Brachiaria ruziziensis* and with this, it reduces the use of phosphate minerals for animal feed without losing quality and that the absence of this hinders the management of a high production livestock.
Keywords: forage; phosphate fertilizer; productivity.
Financial support: Federal University of Rondônia Foundation, Rolim de Moura – RO

C4.2.3 - Soil quality to secure human and environmental health

(5814 - 1461) Are protected areas a source of quality of life?

Laiz Coutelle Honscha[1]; Roberto Martins Baisch[1]; Manoel Rodrigues da Silva Júnior[1]
Universidade Federal do Rio Grande, FURG, Rio Grande, CEP: 96203-900, Brasil.[1]

The interaction of water, soil and air compartments through physical, chemical and biological characteristics directly influence the quality of life of organisms. An ecosystem is healthy where all its members are in balance generates a favorable environment for life. Environmental changes through anthropic actions imply environmental contamination, being these actions coming from industrial areas, agropastoral, mining, etc. The soil is considered a geochemical deposit of chemical substances, which are capable of altering its natural composition, which can lead to damage to living beings. Exposure of populations to contaminated soil may pose a risk to human health. Environmental Protection Areas are legally envisaged by law to protect the natural environment, having the function of preserving water resources, landscape, geological stability, biodiversity, the genetic flow of fauna and flora, protecting the soil and ensuring the well-being of human populations. Based on the assumption that legally protected areas were created to maintain environmental quality and that this is indispensable for life quality, the aim of this study was to evaluate the soil conditions of Protected Areas located near urban areas using ecotoxicological assays and chemical analysis. The study was carried out with surface soil samples from seven protected areas collected in southern Brazil. For the protected area to be considered "clean" the results of the ecotoxicological tests should be within the criteria accepted for the negative control according to standardized protocols, while the concentration of the chemical elements should be below the maximum levels allowed in the Brazilian laws. Based on the criteria adopted for ecotoxicological assays and chemical analysis, only 3 of the 7 protected areas (43%) met the criteria for being considered "clean" soils. This probably reflects the influence of anthropic activities within protected areas, showing fragility in delimitation and management. The strategy used in this study should be used in other parts of the world to assess the anthropic impact in protected areas.
Keywords: soil contamination, soil quality, ecotoxicity, metals.
Financial support: CNPq, Edital Universal, 2014, Grant 442381/2014-0 and Fapergs Edital ARD, 2014, Grant 16/2551-0000353-0.

(9644 - 514) Assessment of Heavy Metal(loid)s Pollution Status in Agricultural Land near Industrial Complex in Korea

Hyun Uk Kim[1]; Byeong Hwan Seo[1]; Kwon Rae Kim[1]
Department of Agronomy & Medicinal Plant Resources, Gyeongnam National University of Science and Technology, Jinju 52725, Republic of Korea[1]

Some soil and water near industrial complexes are polluted due to rapid industrialization and it has drawn much attention to environmental pollution issues. Consequently, various projects and studies have been conducted to evaluate the current status of environmental pollution. As of 2014, there are 1,009 industrial complexes in South Korea and 447 of them are operated as agricultural industrial complexes. Since the agricultural land near an industrial complex has a potential to be contaminated by pollutants such as heavy metals, which can be discharged from the industrial complex, it is necessary to manage the hazardous materials of the agricultural land and conduct a safety assessment for the area. This study was conducted to evaluate the heavy metal contamination level of agricultural lands near industrial complexes located in Gyeonsangbuk-do province, Korea. Fifteen industrial complexes were selected and the concentrations of heavy

metals in soil were measured in nearby agricultural lands. Ten land lots were selected for each industrial complex: five within 500 m from the boundary line of the industrial complex and five between 500 m and 1,000 m from the boundary line of the industrial complex. Three samples were taken at regular interval from each lot by using auger and these samples were composited and mixed. The collected samples were air-dried and sieved with a 2 mm sieve. These samples were acid-digested by using aqua regia and the concentrations of As, Cd, Cu, Ni, Pb, and Zn were analyzed by ICP-OES (8300DV, Perkin Elmer, USA) and that of Hg was analyzed by a Hg analyzer (DMA80, Milestone&T CI, Ltd). The results of analysis showed that only one sample exceeded the concern level of arsenic (25 mg kg^{-1}) among the determined seven heavy metal(loid)s (i.e., As, Cd, Cu, Hg, Ni, Pb, and Zn) and the seven heavy metal(loid)s in all other samples were below the concern level. This study used the integrated pollution index (IPI), which is one of the methods for evaluating heavy metal pollution in soil. The reference concentration was the heavy metal(loid) mean content proposed by the soil measurement network of the Ministry of Environment in 2014. IPI of 15 industrial complexes ranged from 0.07 to 2.86 and the results indicated that only three of them were polluted.

Keywords: Agricultual land, heavy metals, industrial complex, and pollution index
Financial support:

(8489 - 2748) Brazilian Family Agriculture: a small guide family from farmers to researchers

Carlos Victor Dourado Batista[1]; Júlio Iglesias Guerreiro[2]; Fábio Branco da Cruz[3]; Mônica Santana Vianna[2]; Joao Paulo Machado Torres[2]
UFRJRadioisotope Laboratory Eduardo Penna Franca, Institute of Biophysics, Federal University of Rio de Janeiro (UFRJ), Brazil[1]; Radioisotope Laboratory Eduardo Penna Franca, Institute of Biophysics, Federal University of Rio de Janeiro (UFRJ), Brazil[2]; Company of Agricultural Research of the State of Rio de Janeiro (PESAGRO-RIO)[3]

Brazilian Family Agriculture has been recognized as a force economic and social. Because of this, several academic works in different areas (mainly in health and environmental sciences). Therefore, the State Center for Research in Vegetables is reactivating its experimental field, laboratory and extension actions. This region has priority for the concentration of teaching and research agencies and the target of numerous researches of a decade of 1990. However, as local micro-basins as a target of scientific and international speculation. This situation shows the violation of ethical issues that weaken the strategies of implementation of agroecological transition systems or of Good Agricultural Practices. They are strategic as effective partnerships between scientific research and family farmers for the strengthening and efficiency of activities constructive relations. This work presents the preparation of a guide for researchers, through the experience and perspectives of the producers. This guide intends to support professionals, especially research, with an interest in developing studies in a participatory way in these communities. Purpose of this extension activity is to support the training of young professionals on the problems of family farming and their complexities. Results are intended to guide the preparation of research proposals in an effective partnership with rural communities. In this first stage we are making visits to the rural property to follow the routine of the producers in their activities in the fields, such as commercial transactions, such as meetings of associations of farmers. In the sequence, we have interviewed extension workers, health agents and doctors. Surveys of the scientific and technical publications related to the studies developed in the region. It is observed that the theme most discussed by the researchers is related to the use of pesticides and health. Tomatoes, zucchini, coriander, parsley and chives are the most grown by farmers. Biodiversity is longer because the investment focuses on foods that are more profitable. It is evident the absence of an appropriated support for property management and pesticide use. However, farmers know about the poor management of the soil and about the risk of their health and pockets. This information represents a challenge to achieve a sustainable environment and soil health.

Keywords: The socio-economic-cultural dynamics of rural life. Agroecology. Agrochemicals and Health. Producer participation. Extension.
Financial support: UFRJ and FAPERJ

(7084 - 2659) Cadmium, copper and chromium, pseudo-total concentration and available to soil in long-term experiment

Iolanda Maria Soares Reis[1]; Suelen Cristina Nunes Alves[2]; Wanderley José de Melo[2]; Eliandra de Freitas Sia[1]; Ianna Bizerra Barros[3]
Universidade Federal do Oeste do Pará[1]; Universidade Estadual Paulista Júlio de Mesquita Filho/Faculdade de Ciências Agrarias e Veterinária[2]; Universidade Federal de Viçosa[3]

Knowing the distribution of heavy metals in the soil as its pseudototal and available contents is of paramount importance for the evaluation of environmental impacts, as well as knowing the contents associated with soil particles. The objective of this work was to evaluate the pseudototal and available soil content of the cadmium, copper and chromium metals in eutrophic Red Latosol fertilized with sewage sludge for fifteen consecutive years at three depths. The experiment was installed in field conditions, in randomized blocks, in a Red Latosol eutroferric submitted to four treatments with different dosages of sewage sludge (dry base) in five blocks. Soil samples were collected from the superficial layer, 0.00-0.05; 0.05-0.10 and 0.10-0.20 m, and the pseudo-determinations were made and available for determination of the cadmium, copper and chromium contents. The analyzed cadmium, copper and chromium contents did not present variations in the analyzed depths. The concentration of cadmium was higher in the treatment with mineral fertilization when compared to the treatment fertilized with different doses of sewage sludge, this can be attributed to the chemical constitution of the minerals. On the other hand, copper and chromium metals presented higher levels in the treatments with 10 and 20 Mg ha, at depths 0 to 5 and 10 to 20 m, it is important to note that the sewage sludge used in the 15th year experiment did not have high concentrations of these metals , this shows that the contents presented may be associated with the quantity of metals remaining from another year, that is, residual quantity.

Keywords: Availability, determination, heavy metals
Financial support: CAPES

(3623 - 2712) Can the Quick Diagnosis of Soil Structure (DRES) method describes the soil quality of Brazilian pastures?

Thamires Rodrigues de Sá Valle[1]; Renato de Aragão Ribeiro Rodrigues[2]; Fabiano de Carvalho Balieiro[2]; Ademir Fontana[2]; Marcella Leal Santos[1]; Guilherme Kangussú Donagemma[2]
Universidade Federal Fluminense[1]; Embrapa Solos[2]

Soil structure is related to many soil ecosystem services and has been used as manageable property in evaluating soil quality in agricultural areas. From this perspective, Quick Diagnosis of Soil Structure (DRES) shows up as an efficient soil structure assessment in field. It was first developed to no-tillage crop systems but it may be well fit to others productive systems such as pasturelands. Brazilian cattle herd is one of the largest in the world, occupying around 159 million hectares. However, about 50% of this area is estimated being under some degradation level. Hence, strategies to pasture recovery demand previous diagnosis to stablish appropriated rehabilitation technics and pasture management. This work intends to distinguish pastures degradation levels by visual evaluation of soil structure (DRES), soil surface cover (forage and weed vegetation characteristics) and the following soil attributes: mean weight diameter, soil C concentration and stocks. The experimental area are rural farms, in Valença Municipality, Rio de Janeiro State, Brazil. The region is known as “Mar de Morros” due

its rugged relief, and the local soil is classified as Cambisols. A previous visual classification of degradation levels reaches four treatments defined as N1-light, N2-moderate, N3-severe, and N4-very severe degradation. Three areas of each level were selected and soil samples were collected in 0.0-0.2 meters depth. The Spearman correlation was applied ($p < 10\%$). Previous results confirmed pastures degradation levels since worse soil structure described by lower DRES grades (N3= 2.4; N4= 2.7) were associated to lower soil C concentration and C stocks, smaller aggregates and higher occurrence of exposed soil. The opposite occurs to N1 and N2 (N1= N2= 3.9). Results show positive correlations between the DRES index and soil C stocks (r= 53.1%, p= 0.079) and concentration (r= 40.6%, p= 0.193), mean weight diameter (r= 56.6%, p= 0.0059) and soil cover percentage during rainy season (r= 79.0%, p= 0.004). Negative correlation between DRES index to exposed soil percentage during rainy season (r= -79.0%, p= 0.004) were estimated. Thus, results reveal the DRES as a feasible assessment method to soil quality in pasture, able to distinguish degradation levels. Well manageable pastures got higher DRES grades and better soil quality, due to higher biomass production (above and belowground) and soil protection.

Keywords: Soil structure, DRES, pastures degradation.
Financial support: CAPES, Rural Sustentável, Rede ILPF.

(1295 - 1087) Changes of soil chemical quality index in according to time in paddy soils by long-term application of soil amendments

Myungsook Kim[1]; Seokcheol Kim[1]; Seongjin Park[1]; Changhoon Lee[1]
NAS[1]

The changes of soil chemical quality index in paddy soils applied of soil amendments were assessed from data of long-term experiment plots which were operated from 1969 to 2016 by the National Academy of Agricultural Science, Suwon, Korea. The treatments were inorganic fertilization (NPK), inorganic fertilizer plus soil amendments(rice straw compost, NPK+C; silicate fertilizer, NPK+S; lime, NPK+L; mixing rice straw compost and silicate fertilizer, NPK+CS). The quality index of soil for chemical properties was analysed by method suggested by Yoon et al.(2004), and divided into by 4 periods(Period Ⅰ: 1969 ~ 1978, Period Ⅱ: 1979 ~ 1985, Period Ⅲ: 1986 ~ 2001, Period Ⅳ: 2002 ~ 2016). The order of magnitude of soil chemical quality index was NPK+CS > NPK+S > NPK+L > NPK+C > NPK. The quality index of soil chemical properties of NPK, NPK+C and NPK+S treatments ranged from 70 to 74 in period , from 64 to 71 in period Ⅱ, and to 75 to 82 in period Ⅲ and Ⅳ. Especially, the decrease of the chemical quality index value of NPK, NPK+C and NPK+S treatments in Period Ⅱ was attributed to the decrease of the soil pH value below the optimum range of rice growth due to irrigation water. NPK+L treatment increased from 71 ~ 72 to 76 during the period Ⅰ, Ⅱ and Ⅲ due to the increase of pH by the lime application. The NPK + CS treatment increased to the highest value from 82 to 82 in period, but tended to decrease at period Ⅲ and Ⅳ. It showed that this was caused by the accumulation of silicate fertilizer, resulting in a decrease of the chemical quality index value of the soil. When a constant amount of soil amendments was continuously applied for 48 years, the soil chemical quality indexes were improved. But after that period, the soil chemical quality index was decreased because of excess accumulation of soil amendments. In order to determine the quality of paddy soils that meet the agricultural environment conditions in Korea, the soil quality including physical and microbial properties as well as chemical characteristics should be evaluated at a later stage.

Keywords: Long-term application, paddy soil, soil chemical quality index, rice straw compost, silicate fertilizer, lime
Financial support: This study was conducted by support of NAS research and development project

(7234 - 1796) Characterization and valuation of soils with potential investigative and productive in the Bogota's Savannah, Colombia.

Gabriela Sepúlveda Prieto[1]; Melissa Lis-Gutiérrez[1]
Universidad de Ciencias Aplicadas y Ambientales[1]

Latin America is considered one of the most diverse regions in relation to natural resources. This area offers 31% of the world's fresh water, and has approximately 23% of land considered high productive potential. Rapid population growth has increased the demand for ecosystem services offered by soil. This is causing greater anthropogenic intervention, reflected mainly in the conversion of natural ecosystems to agricultural soils, which affects their quality. In recent decades, productive activities have been directed towards sustainability, ratifying the need to guarantee food security at a global level. In this context, agriculture faces the challenge of producing food and raw materials in a sustainable manner, which favors the reduction of pollutant emissions, in order to maintain soil quality and face the threats posed by climate variability and change. In Colombia, a large percentage of agricultural activity takes place in the central zone of the country, where the department of Cundinamarca occupies the seventh place, producing vegetables, fruits, potatoes, flowers, among others. These crops, in many cases, are produced intensively, without considering the impact they can have on the productive capacity of the soil. Hence the importance of the participation of future professionals in the discipline in relation to sustainable production. The purpose of this work was to characterize and evaluate the current state of the soil at free exposure (1218 m^2), in the investigative and productive unit El Remanso, which is located at coordinates 4° 47'58.93''N and 74°2'48''W, in the savannah of Bogotá, Cundinamarca, Colombia. For this, we use quality indicators, following the standard USDA methodologies, such as apparent density, real density, porosity, texture, humidity and pH. The results obtained, led to establish that the evaluated soils have influence of volcanic ash, which improves some properties such as moisture retention, accumulation of organic matter, among others. Likewise, they have textures C, SiC, CL SCL, SiCL and SiL, pH between slightly acid and moderately alkaline (6.5-8.2), average apparent density of 0.73 g/cm^3. The surface horizon allowed identifying two activities that can influence the loss of soil quality. Otherwise, the loss of structure is associated with conventional tillage practices, a condition that makes compaction probable. On the other hand, the loss of nutrients, structure and humidity is related to intensive production.

Keywords: Soil health, sustainable production, tropical soil, soil quality.
Financial support: Universidad de Ciencias Aplicadas y Ambientales

(3712 - 1503) Chemical characterization of soils adjacent to a wastedump of the Stella Maris polymetallic mine Paso de Indios, Chubut. Argentina.

RacK, M.G.[1]; Valenzuela, M. F[2]; Nillni, A. M.[3]; Ferro, L. F.[4]
Universidad Nacional de la Patagonia San Juan Bosco (UNPSJB), Ruta Nº 1 Km 4, S/N, Comodoro Rivadavia, (9005), Argentina (monirack@yahoo.com.ar)-Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET)[1]; Universidad Nacional de la Patagonia San Juan Bosco (UNPSJB), Ruta Nº 1 Km 4, S/N, Comodoro Rivadavia, (9005), Argentina -Universidad Nacional de la Patagonia San Juan Bosco (UNPSJB). Ruta Nacional N° 259 km 16,41(9200), Esquel, Argentina[2]; Facultad de Ciencias Naturales. Universidad Nacional de la Patagonia San Juan Bosco (UNPSJB), Ruta Nº 1 Km 4, S/N, Comodoro Rivadavia, (9005), Argentina[3]; Universidad Nacional de la Patagonia San Juan Bosco (UNPSJB). Ruta Nacional N° 259 km 16,41(9200), Esquel, Argentina[4]

The main environmental problem associated with the exploitation of metallic deposits is related to the presence of polymetallic waste dumps. If they are not managed properly, once the exploitation is finished, they become environmental liabilities. Depending on the mineralogy of the exploted deposits and the climate of the region, they can produce acid drainage and as a result, they will affect the properties of the surrounding soils. The objective of this work is to characterize the chemical properties of the soils adjacent to a Stella Maris polymetallic

mine, located in an arid climate, such as the Paso de Indios area, Chubut. The mine stopped working approximately 30 years ago and consists of a group of vein-shaped structures hosted by a small intrusive and volcaniclastic rocks around it. The mineralogy of the dump consists of sphalerite, galena, pyrite, chalcopyrite and marcasite, with barite, calcite and quartz gangue. Its pH is moderately alkaline and the contents of Cu, Zn, As, and Pb exceed the guideline levels of soil quality established by National Law of Hazardous Waste N° 24,051 (Regulatory Decree N° 831/93 - Argentina). Two sites of interest were considered for the soils study: one of control (PI1), which was considered as an adjacent area not impacted by the exploitation, and another located at the base of the dumps (PI2), which has been impacted for the mentioned activity. The morphological properties of the soils were described and a sampling was made in each horizon to carry out chemical analysis and determination of Cu, Pb, As and Zn contents. Both studied soils, which have an eolic origen, were transported. They present a sequence of A-C horizons. The electrical conductivity, the content of organic matter, the cation exchange capacity and the bases contents (Ca, Mg, Na and K) are similar in both profiles. However, the PI2 profile shows an increase in pH in depth, being similar to the pH of the dump. On the other hand, there are higher Pb contents in the surface horizon than in the PI1 profile. Although the Pb exceeds the guideline levels of soil quality, the enrichment in this horizon is nine times less than that of the waste dump. The presence of calcite in the dump and the arid climate would not facilitate the mobilization of heavy metals and the generation of acid mine drainage in the deeper horizons of the PI2 profile. The Pb content of the surface horizon could be product of theeolic dispersion, which requires a more detailed study.

Keywords: extractive activity, heavy metals, arid climate
Financial support: Financial support: Project PI 1252: "Effects on the soil of polymetallic extractive activities in the Andean Region of Chubut province". Funded by the National Univesity of Patagonia San Juan Bosco

(5267 - 2047) Comet assay in *Eisenia andrei* coelomocytes as a tool for assessing the genotoxicity of urban soils

Ronan Adler Tavella[1]; Laiz Coutelle Honscha[1]; Caroline Lopes Feijo Fernandes[1]; Flávio Manoel Rodrigues Da Silva Júnior[1]

Universidade Federal do Rio Grande[1]

Urban soils quality is an indispensable condition for maintaining of well-being and life quality. On the other hand, studies have shown an increasing number of contaminated sites in urban clusters. This condition is aggravated when there are industrial zones adjacent to urban areas, exposing populations to the two types of contamination. Rio Grande is a city in the extreme south of Brazil with more than 200,000 inhabitants and located in the estuary of Lagoa dos Patos. It is a city with intense urban flow, allied to industrial complex and port activities. Lethal toxicity studies conducted in the study area in soil organisms have shown little sensitivity to detect this toxicity, with biomarkers being a promising alternative for detecting toxicity in an early manner. Thus, this study aimed to evaluate the use of the comet assay in *Eisenia andrei* coelomocytes as a sensitive tool for detecting genotoxins in soil samples from urban areas, using soil samples collected in environmental protection areas as a control. Soil samples from two sites were collected: one influenced mainly by the oil industry and the other influenced by the oil industry and a complex of fertilizer industries. As control, soil samples from two environmental protection areas of the same city were used. For chemical monitoring of these soils were measured concentrations of arsenic, cadmium, copper, lead and zinc. The exposure (14 days) of *Eisenia andrei* worms to the soil samples was performed according to ISO 11268-1: 2012 and subsequently, extraction of the worms' cells (coelomycetes) was performed using 10% alcohol solution, followed by centrifugation and addition of buffer. Aliquots of this solution were used to perform the comet assay on the coelomocytes and 100 nucleoids were counted per animal and ten animals per site. The results obtained showed a significant increase in the DNA damage of the cells of the organisms exposed to urban soils when compared to control soils. Urban soils presented a higher concentration of all analyzed elements compared to protected area soils, except for lead. Thus, it can be concluded that the presence of industrial activities in urban soil could compromise soil quality, causing the deposit of the soil genotoxins. Among these harmful genotoxins for soil organisms are arsenic and metals such as cadmium, copper and zinc.

Keywords: soil contamination, ecotoxicity, comet assay, earthworm.
Financial support: CNPq, Edital Universal, 2014, Grant 442381/2014-0 and Fapergs Edital ARD, 2014, Grant 16/2551-0000353-0.

(3150 - 1993) Competitive adsorption of Pb(II), Cu(II), and Zn(II) ions onto hydroxyapatite-biochar nanocomposite in aqueous solutions

Yu-Ying Wang[1]; Yu-Xue Liu[1]; Hao-Hao Lu[1]; Li-Li He[1]; Rui-Qin Yang[2]; Sheng-Mao Yang*[3]

Institute of Environment, Resource, Soil, and Fertilizer, Zhejiang Academy of Agricultural Sciences, Hangzhou, 310021, P. R. China[1]; Zhejiang Provincial Collaborative Innovation Center of Agricultural Biological Resources Biochemical Manufacturing, Zhejiang University of Science and Technology, Hangzhou, 310023, P. R. China[2]; Institute of Environment, Resource, Soil, and Fertilizer, Zhejiang Academy of Agricultural Sciences, Hangzhou, 310021, P. R. China 2 Engineering Research Center of Biochar of Zhejiang Province, Hangzhou, 310021, P. R. China[3]

A hydroxyapatite-biochar nanocomposite (HAP-BC) was successfully fabricated and its physicochemical properties characterized. The analyses showed that HAP nanoparticles were successfully loaded on biochar surface. The adsorption of Pb(II), Cu(II), and Zn(II) by HAP-BC was systematically studied in single and ternary metal systems. The results demonstrated that pH affects the adsorption of heavy metals onto HAP-BC. Regarding the adsorption kinetics, the pseudo-second-order model showed the best fit for all three heavy metal ions on HAP-BC. In both single and ternary metal ion systems, the adsorption isotherm of Pb(II) by HAP-BC followed Langmuir model, while those of Cu(II) and Zn(II) fitted well with Freundlich model. The maximum adsorption capacity for each of tested metals by HAP-BC was higher than that of pristine rice straw biochar (especially for Pb(II)), and also exceeded those of other reported adsorbents. Therefore, HAP-BC can be explored as a new material for future application in heavy metal removal.

Keywords: Biochar, Hydroxyapatite, Nanocomposite, Competitive adsorption, Heavy metal
Financial support: This work was supported by National Key Science and Technology Project (2014ZX07101-012), Natural Science Foundation of Zhejiang (LQ17D020002, LY16D010004), Key research and development projects in Zhejiang Province (2015C03020), Zhejiang Provincial Colla

(5936 - 2883) Effect of commercial insecticides used for the control of the western corn rootworm (*Diabrotica virgifera* ssp. *virgifera*) on the nematode community

Ludovit Cagan[1]; Andrea Cerevkova[2]; Dana Miklisova[2]

Slovak Agricultural University in Nitra, Slovakia[1]; Institute of Parasitology, Slovak Academy of Science, Košice[2]

Soil health and quality can be assessed through the investigation of physical and chemical soil properties and/or by studying the communities of living soil organisms, e.g., bacteria, springtails, or nematodes. The present study assessed the effect of commercial insecticides used for the control of the western corn rootworm (*Diabrotica virgifera* ssp. *virgifera*) on the nematode community. Three different insecticide variants were used in the experiment: a granular application of tefluthrin, seed treatment of clothianidin and granular application of clothianidin. This study concludes that soil nematode communities are very sensitive to climatic conditions or any environmental change. Within the same environmental conditions, it was found that nematode communities were also affected by the

chemical control of insects with clothianidin or tefluthrin. For many parameters of nematode communities, the effects of year and sampling date were more pronounced than the effects of insecticide application.
Keywords: Soil nematode communities, chemical control, soil disturbance, maize pests
Financial support: This study was supported by project Slovak scientific agency VEGA (Grant No. 1/0849/18 and Grant No. 2/0013/16)

(9768 - 573) Effect of different immobilizing agents on soil quality and metal uptake by plant in heavy metal contaminated soilEffect of different immobilizing agents on soil quality and metal uptake by plant in heavy metal contaminated soil

Byoung Hwan Seo[1]; Hyun Uk Kim[1]; Kwon Rae Kim[1]
Department of Agronomy & Medicinal Plant Resources, Gyeongnam National University of Science and Technology, Jinju 52725, Republic of Korea[1]

This study examined the performance of different immobilizing agents on the quality of soil affected by heavy metals through determination of selected soil biological and physiochemical parameters together with metals availability to Chinese cabbage over long period of pot incubation. The immobilizing agents used in this experiment included: lime (L), gypsum (G), fly ash (F) and livestock manure based compost (C). All immobilizing agents were applied to the soil on the dry weight basis of soil at 3% for all agents while lime was treated at 1%. These immobilizing agents were either applied in isolation and complex mixtures as lime+ gypsum (LG), lime+ compost (LC) and gypsum+ fly ash (GF). As expected, all the immobilizing agents tested increased soil characteristics (i.e., organic matter content, cation exchange capacity, total nitrogen content, available P, soil porosity and stability of soil aggregates). The greatest increase on these soil quality parameters was obtained with compost treatment, followed by mixed treatment of LC. The organic immobilizing agent, compost was good in its capacity to supply essential macronutrients and organic matter content. With the exception of F, microbial biomass carbon and dehydrogenase enzyme activity (DHA) was also enhanced by all immobilizing agents in particular with LC treatment. All immobilizing agents used decreased phytoavailability of As, Cd, Cu, Pb and Zn as determined by the corresponding metal concentration in Chinese cabbage. Therefore, these immobilizing agents can be used successfully in the remediation of metal-contaminated mine soil. Over all, the result obtained in this study suggests that among immobilizing agents, compost was effective in both the *in situ* immobilization of metals, and improving soil properties leading to a large increase in plant biomass.
Keywords: immobilization, heavy metal, phytoavailability, remediation, soil quality,
Financial support:

(6697 - 276) Genotypic variation of rice plants exposed to cadmium in tropical contaminated soil

Thiago Assis Rodrigues Nogueira[1]; Takashi Muraoka[2]; Zhenli He[3]; Jamille Santos da Silva[2]; Laís Karina Silveira[2]; Milena Emi Nishikawa[2]
São Paulo State University, Avenida Brasil 56, Ilha Solteira, 15385-000, Brazil[1]; University of São Paulo, Piracicaba, SP, Brazil[2]; Indian River Research and Education Center, Institute of Food and Agricultural Sciences, University of Florida, Fort Pierce, FL, USA[3]

The dry matter yield, Cd concentration and the daily intake of Cd from rice cultivars in a tropical contaminated soil was evaluated in order to identify Cd-tolerant genotypes that exhibit a lower potential for Cd accumulation in the grain. A greenhouse experiment was carried out in Piracicaba, Brazil. Three rice cultivars with characteristics of low (Cateto seda), medium (BRSMG Talento) and high (BRSMG Caravera) capacity of Cd uptake were used and cultivated in pots filled with 4 kg of Oxisol samples. Pots were arranged in a completely randomized block in a factorial scheme (6 x 3) with four replications. The cultivars were exposed to six levels of Cd (0.0, 0.65, 1.3, 3.9, 6.5, and 11.7 mg kg^{-1}, added as $CdCl_2.H_2O$), based on the guideline established by CETESB. Daily Cd intake from rice was calculated by the Cd content in rice grains (for the level of 1.3 mg Cd dm^{-3}) multiplied by the average of daily rice consumption in Brazil (160 g, fresh weight). Based on the WHO/FAO provisional tolerable weekly intake (PTWI) of 8 µg kg^{-1} of body weight, the daily intake of Cd considering the average human body weight (70 kg) of the Brazilian population was calculated. Dry matter yield of the shoot and grain of rice plants decreased with increasing Cd supply levels linearly. Cd concentrations in shoot and grain significantly increased with external Cd loading rate. Grain Cd concentrations ranging from 0.01 to 1.61 mg kg^{-1} in the cv. Cateto seda, from 0.01 to 1.70 mg kg^{-1} in the cv. BRSMG Talento, and from 0.02 to 4.45 mg kg^{-1} in the cv. RSMG Caravera. Grain Cd concentration for the cv. Cateto seda (0.35 mg Cd kg^{-1}) and the cv. BRSMG Talento (0.63 mg Cd kg^{-1}) did not exceed the critical levels of Cd (1.0 mg kg^{-1}) for human consumption (according to Brazilian legislation) when Cd was applied up to 1.3 mg kg^{-1} (alert value for Cd in Brazilian soils). However, grain Cd concentration for cv. BRSMG Talento was not in the acceptable range for human consumption (0.4 mg kg^{-1}) according to the Codex Alimentarius Commission of WHO. Daily intakes of Cd in rice cultivars were higher than the PTWI when the daily rice consumption was 160 g. The results suggest that human Cd intake can be reduced by selecting low-Cd rice cultivars. There is clear necessity for continuous monitoring so as to ensure that the food supply and diet of the Brazilian population is safe.
Keywords: *Oryza sativa L.*; food safety; soil pollution.
Financial support: To the State of São Paulo Research Foundation – FAPESP (process # 2012/07158-6) and National Council for Scientific and Technological Development – CNPq (process # 484928/2013-9) by the postdoctoral fellowship and the financial support.

(5083 - 521) Heavy metal sorption indexes in urban soils

Francisco Bautista[1]; Elsy Campuzano[1]; Carmen Delgado[1]; Avto Gogichaichvili[1]
Universidad Nacional Autónoma de México[1]

The growth of populations in urban areas increases anthropic activities derived from industry, vehicular traffic and the generation of solid waste that releases into the environment large amounts of particulates containing heavy metals that when breathed or inhaled are of high risk for human health. Particulate materials are deposited on urban surfaces such as plants, streets and soils, thus contributing to the pollution of urban soils. Pollution in urban areas is increasing and has become a study of interest, however, the capacity of the soil to incorporate heavy metals has been little studied. The aim of this study was the evaluation and development of three heavy metal sorption indices and their mathematical validation using decision trees for classification purposes. The study started from the analysis of the Lehmann index that considers the pH and the predominant structure (type of aggregate). The investigation was carried out in the urban area of the city of Morelia, Michoacán, Mexico where a systematic sampling of 100 surface soil samples was carried out; the content of organic matter, pH, cation exchange capacity, percentage of clays, structure, stoniness and bulk density were determined. The Lehmann index was evaluated and two new indices were developed: the modified Lehmann index and the Bautista-Campuzano index. The mathematical validation of the three indexes was carried out by the elaboration of decision trees for classification with the WEKA software. In the Lehmann index the percentage of clays, structure and stoniness was mainly considered; in the modified Lehmann index the capacity of cation exchange, organic matter, stoniness and pH was used; and in the Bautista-Campuzano index, pH, organic matter, clays, stoniness and bulk density were considered of greater importance. The three indices showed congruence

between the soil properties and the heavy metal sorption classes with a Kappa coefficient> 0.7. However, the Bautista-Campuzano index showed greater theoretical congruence according to the decision tree for classification, which is why it is proposed to use this index in urban land management plans. This study reveals the importance of the mathematical and theoretical evaluation of the indices by means of decision trees for classification. The city center of Morelia, was the one that presented the low capacity class of adsorption of heavy metals, so it is considered urgent to make decisions and take actions to protect the population

Keywords: Soil Pollution; Cities; Top soils; urban soils
Financial support: Consejo Nacional de Ciencia y Tecnología

(8069 - 1647) Heavy metals in soils impacted by the alluvial gold mining in the Peruvian Amazon

Velásquez Manuel[1]; Guerrero B. Juan[2]; Gamarra Alfredo[2]; Bazán Rubén[2]; Nazario Julio[2]; Tello Lily[2]

Instituto de Investigaciones de la Amazonía Peruana (IIAP)[1]; Universidad Nacional Agraria – La Molina (UNALM)[2]

Nowadays the Peruvian Amazon is being impacted by the alluvial gold mining which is the most important source of mercury pollution worldwide. Its main process consists in slash and burns trees, sediment extraction, goldy gravel pick up, amalgamation with mercury and gold recovery. According to Asnner (2016) every year 6,000 ha are deforested. Fish and hair of children sampled showed up to 1.5 and 2.1 ppm of mercury, were maximum limited established by USEPA are 0.3 ppm and 1 ppm respectively. Furthermore, approximately 3,000 t of mercury were thrown to the Amazonian rivers since 1980 up to 2000 year. A healthy soil is essential to warrant health for humans and for the environment so the main objective was to evaluate the degree of heavy metals pollution in soils to measure and value its quality and prevent environmental and human risk. Through multivariate and geostatistical analysis a research was carried out at an alluvial gold mining concession in the Peruvian region, Madre de Dios. In 13 ha it was determinate three types of areas: recently impacted, impacted (6 to7 years ago) and non-impacted; 93 topsoil samples (0-20 cm depth) were taken in order to characterize it and determinate heavy metal content. According to Peruvian and Canadian environmental quality standards, there was no pollution detected except for Cd. As, Ba, Pb, Cu, Cr, Ni, V and Zn mean concentration was 1.90, 29.80, 4.60, 12.68, 7.90, 7.93, 12.67, and 26.65 mg kg^{-1} DM respectively. Cadmium mean concentration in impacted areas was 2.22 mg kg^{-1} DM in contrast to environmental standards which maximum limit is 1.40 mg kg^{-1} and in non-impacted areas is 6.6 mg kg^{-1} DM; so its origin might be geochemical. There was no pollution caused by mercury in non-impacted areas and impacted areas; it was not detected because intense volatilization and leaching caused mainly by pluvial precipitation. According to multiple correlations, 82% of the variability of heavy metal was explained by soil pH (4.24 to 5.19), cation exchange capacity (7.82 to 19.43 cmol(+)kg^{-1}), clay particle (1.44 to 21.44%) and organic soil matter (0.03 to 0.24%). In spite there was no pollution registered, contaminated sites evaluation is important to warrant any ecological restoration management. According to Minamata convention on mercury, every country needs to assess its contaminated sites in order to prevent environmental and human risk, so this research provides a guideline to evaluate contaminated sites in the Amazonia.

Keywords: Pollution; human risk; gold mining; mine impacts
Financial support: NGO Solidaridad – Project Responsible Gold In Madre de Dios

(4112 - 761) Legal and ilegal deforestation actions in Ceará state in 2015 and 2016

Ana Leônia de Araújo Girão[1]; Rodrigo de Oliveira Girão[1]

SEMACE[1]

Deforestation is one of the actions related to economic development of a region, besides the environment impact of vegetation supress afects the soil functions, mainly in regions with dualistic climatic conditions, as Ceará state. The state environment agency (SEMACE) is responsible for licensing and supervising the deforestation actions performed in Ceará. Aiming to analyze the deforestation actions licensed, comparatively with the supervised areas related to deforestation, we observed the deforestation requisitions filed in SEMACE and the fines related to flora infractions in the years 2015 and 2016. It was observed also the soil classes in the areas deforestated and its environment fragility. In 2015 were requested 268 licences to deforestation, representing 9.500 ha. It was identified 35 fines representing 195 ha of irregular areas related to infractions against flora. In 2016 were requested 172 licences to deforestation, representing 3.000 ha. It was identified 23 fines representing 61 ha of irregular areas related to infractions against flora. Analyzing the spacial distribution of deforestated areas we identified that they are concentrated in the regions of Baturité, Sertão Central, Sobral-Ibiapaba, Litoral Oeste e Região Metropolitana de Fortaleza – RMF, confirming the relation with economic activity whereas these areas have high urban densities and agricultural production, partially with irrigation. The soil classes from these regions are mainly the Argissolos vermelho-amarelos that are characterized as deep soils with low obstruction due to a horizon with clay accumulation, and can be eutrophic or distrophic. Due to deforestation, the soil from these regions may be impacted from erosive processes, specially if they occur in sloping areas, reduction of natural fertility, surface sealing, moreover, other general impacts as biodiversity reduction. Comparatively, in a study promoted by the Environment Minister disclosed in 2011 informs that Ceará had 48% of the state area deforestated. According to the Forest inventory of Ceará, disclosed in 2016, the state has around 43% of areas without forest (including urban areas, rural and water bodies). The area identified in the present study represents 0,08% of the deforestated area of the state. We can conclude that the situation of deforestation in the state is threatening and actions of monitoring and supervising must be enlarged to assure the real situation of deforestation in the Ceará state.

Keywords: Soil classes; Environment; Forest.
Financial support:

(2578 - 2946) Mercury bioextraction using earthworm (E*isenia foetida)* in degraded soils by mining in the choco department (Colombia)

JUAN CARLOS MONTOYA SALAZAR[1]; John Fredy Betancur[2]; Tatiana Mosquera–Córdoba[3]

Caldas University[1]; Manizales University[2]; independent[3]

Among the less desirable effects of mining is the contamination of soils and subsoils by Mercury, the goal os studies being the search for different strategies and methods that could help to mitigate this problem. This investigation evaluated the bioremediation process through vermicomposting in a soil contaminated with mercury (Hg), from open-mining in the Union Panamericana municipality (Chocó-Colombia). Field work was carried out exsitu on a pilot scale, with a design of complete blocks at random with three repetitions. Treatments were: T1: Contaminated Soil with mercury (SC-Hg) + earthworm (Eisenia Foetida), T2 (50% SC-Hg-50% Compost + earthworm), T3 (Contaminated Compost with mercury + earthworm) and T4 (Compost + earthworm) established as a control. The soil samples were collected at 0-20cm depth, obtaining 15 subsamples. There were determined in all treatments: Hg, pH, organic carbon, CEC (Cation Exchange Capacity), Texture, Bulk Density and Soil Moisture. The population and size of the earthworms were also evaluated. The initial values of the parameters in the soil were: organic carbon of 1.63%, pH of 5.58, CEC 10.67 cmol(+)/kg, and 1980 ppm of Hg. The process showed mercury extraction by the earthworm, and highly significant differences in Hg contents were observed among treatments with respect to the initial values. T3

had the highest removal rate (65%), followed by T2 (43%) and T1 (28%). The values of pH, organic carbon, and CEC showed significant differences between treatments. The final population and the size of the earthworms were only affected in the T1 treatment, where they increased by 20% and 5% respectively. The other treatments had an increase in the population and size up to 50% more. The results show that the combined use of earthworms and compost is an efficient alternative for bioremediation of contaminated soils.

Keywords: Bioremediation, Bioremediation, Mercury (Hg), earthworm
Financial support: Caldas University and Manizales University

(5841 - 2038) Phyto-microbe remediation of heavy metal and organic pollutant co-contaminated farmland soils

Xiaoe Yang[1]; Zhenli He[2]
Zhejiang University[1]; University Of Florida[2]

Soil pollution has become a world-wide environmental issue for food safety and human health. In most cases soil co-contaminated with both heavy metals and organic pollutants like pesticides and persistent organic substances. How to remediate heavy metal and organic pollutant co-contaminated soils has become a hot research spot in recent years. This paper provided a brief review regarding the progress of phyto-microbe remediation of co-contaminated soils in the last decade. Systematic studies on the processes and effectiveness of phyto-microbe remediation of soils co-contaminated by cadmium (Cd), combined with DDT, PAHs, or nitrate in vegetable-producing farmlands. The results from our research showed that planting Cd hyperaccumulator *Sedum alfredii* with application of DDT degrading special microbe (DDT-1) for one year, soil Cd was removed by 26%, and DDT was degraded by 28% under subtropical climate conditions in Southeast China. For Cd-PAHS co-contaminated soils in Northeast China, planting Cd high accumulator combined with application PAHs degrading microbe (P-1) and metal extraction promoters for one year, soil Cd was reduced by 11%, and PAHs content decreased by 26%. The results showed that phytoremediation integrated with special microbes is effective for remediating complex contaminated soils. The mechanisms of phyto-microbe co-remediation for complex polluted soils are discussed.

Keywords: Agricultural soils, bioremediation, cadmium, co-contamination, food safety
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(8558 - 1391) Potential of urban agriculture in Moscow and its effect on soil

Anna Buyvolova[1]; Alexandre Rappoport[2]; Tatiana Prokofieva[2]; Anna Rakhleeva[2]; Lyudmila Lysak[2]; Ekaterina Morachevskaya[2]; Marina Rozanova[2]; Alexey Kiriushin[2]
Lomonosov Moscow State University, the World Bank[1]; Lomonosov Moscow State University[2]

Urban farming has a positive effect on urban environment. Currently, over 800 million people around the world are engaged in urban agriculture. However in Russia neither urban farming nor roof gardening are common. Researchers have just started studying the potential of the development of urban farming in Russian cities. The present study aims to help fill the existing knowledge gap by analyzing how urban farming affects soil properties in Moscow and providing an estimate of the rooftop gardening potential in Moscow. Unfortunately, no research on soil in the context of urban agriculture is presently conducted. In this study, soils from three plots in Moscow gardens used for farming and gardening during different periods of time are analyzed. The authors conclude that urban farming has the most positive effect on urban soils: humus reach topsoil (Corg 2,2%), high biological activity (both micro- and macrofauna). The level of heavy metals exceeds Russian standards on two of the plots with a high level of total Pb (up to 192 mg/g) and Zn (up to 68.7 mg/g). Because urban farming has a positive impact on urban soil properties the potential for urban agriculture in Moscow is estimated as high, however the risk of food and soil pollution is also high. This should be taken into account when growing food in the city. An analysis of the production capacity of roof gardens reveals that 4000 ha are available for roof gardening. The potential of growing vegetables on rooftops is estimated as high: up to 30% of tomatoes consumed by Muscovites can be grown on the roofs using special technologies. However, before green roof technology can be applied to urban farming on a larger scale, necessary management practices have to be developed. This will ensure that the citizens will benefit from green roofs: rainwater will be disposed in a more cost-effective manner, the service life of roofs will increase and the thermal insulation of the upper floors will improve. The research provides evidence that urban farming can be developed in Moscow, and that it has significant environmental benefits for the city.

Keywords: rooftop gardening, urban farming
Financial support: Russian Foundation for Basic Research #15-04-04702, RF

(4368 - 1189) Response of soil chemical and microbiological attributes to different ages of riparian forest restoration in Paraná River

Gabriela S. Machineski[1]; Andrea S. Scaramal[2]; Amanda C. Gil[2]; Karina L. Alves[2]; Gabriel E. Freitas[2]; Pablo H. N. Severino[2]; Breynner G. P. Bertagnoli[2]; Arnaldo Colozzi Filho[2]
State University of Londrina, Rod. Celso Garcia Cid, km 380, Zip code 86.057-970, Brazil[1]; Agronomic Institute of Paraná, Rod. Celso Garcia Cid, km 375, Zip code 86047-902, Brazil.[2]

The riparian forest plays an important role in soil and water protection and it is of utmost importance to maintaining the ecological balance. The objective of this study was to evaluate the effect of different ages of riparian forest restoration in soil chemical attributes and microbial biomass and activity. We selected six areas around the Paraná River: 1. an undisturbed riparian forest; 2. a restored riparian forest of 30 years of age; 3. a restored riparian forest of 19 years of age; 4. a restored riparian forest of 3 years of age; 5. an initial riparian forest restoration and 6. an agricultural crop area. At each area, soil samples were collected in five points, one central point and four points directed at north, south, east and west. In each point, five subsamples were collected from 0-0.1 m topsoil layer to compose one sample. Soil chemical attributes determined were: carbon (C), phosphorus (P), potassium (K^+), calcium (Ca_2^+), magnesium (Mg_2^+), aluminum (Al_3^+), pH and organic matter. Microbial biomass was estimated by microbial carbon biomass and the enzymes: acid and alkaline phosphatase, arylsulfatase and β-glucosidase were measured to estimate microbial activity. The P content was higher in agricultural crop area, which was expected due to annual fertilizations. However, that was no pattern to other chemical attributes. Microbial carbon biomass was higher in the undisturbed riparian forest and in restored riparian forest of 3 years of age and acid and alkaline phosphatase and arylsulfatase were greater in undisturbed and restored areas than agricultural crop area. Agricultural crop area and initial riparian forest restoration presented higher β-glucosidase activity. In several chemical and microbiological attributes, only the samples of restored riparian forest of 30 and 19 years of age were similar to undisturbed riparian forest, which shows that restoration of riparian forest can be a slow process and lead to ecological restoration.

Keywords: Afforestation; Microbial carbon biomass; Microbial activity.
Financial support: Agronomic Institute of Paraná, Brazil; ITAIPU Binacional.

(3007 - 2603) Soil enzymatic activity as soil quality indicator of metal(loid) contaminated soils: a meta-analysis

Humberto Aponte[1]; Pablo Cornejo[1]
UFRO[1]

Enzymatic activities (EAs) are good indicators of soil quality due to their sensitivity and fast response under changes and perturbations. They can response in several ways depending on the chemical form and concentration of metal(loid)s, and some soil factors such as pH and total organic matter. Therefore, an assessment of which EAs are the potentially better indicators of soil quality under metal(loid) contamination is required. The aim of this work was to determine if EAs are good indicators in metal(loid) contaminated soils. Additionally, we evaluated which EAs are the most negatively affected under metal(loid) contamination through a meta-analysis. A bibliographic search was performed through the Thomas Reuters Web of Science using keywords such as “soil enzymes”, “enzymatic activities”, and “heavy metal”. The search was limited to the last ten years. A total of 115 articles were obtained, among which 15 showed the needed data for the meta-analysis. Values of means, number of replicates, and standard deviations of EAs were manually extracted from text, tables, and figures. These values were classified in observations of EAs for: 1) metal(loid) contaminated soils, and 2) non-metal(loid) contaminated soils. Data whose physic-chemical characteristic were not different were taken per study. This resulted in 195 observations partitioned in seven EAs, which were used to quantify the magnitude of the effect of metal(loid) contamination on these biochemical properties as the response-ratios. The meta-analysis was made with the package “meta” of R version 3.4.1. The result was a significant less activity in metal(loid) contaminated soils for the enzymes dehydrogenase, urease, acid and alkaline phosphatase, catalase, and arylsulfatase. Dehydrogenase was the most negatively affected. This can support the idea that intracellular oxidoreductases can be more vulnerable to metal(loid) contamination, due to extracellular enzymes might be stabilized in clays or humus-clay-enzyme complexes, which give them more tolerance against soil changes.
Keywords: Soil enzymes, heavy metals, response-ratios
Financial support: Beca de Doctorado Nacional 21160049, CONICYT

(8953 - 2311) sSil structural quality in pasturelands in the city of buritis (RO), Brazil

Carlos Henrique dos Santos Zebalos[1]; Vanessa Gretzler Monteiro[1]; Luis Gustavo Lima Fogaça[1]; Ana Paula Duarte de Lima[1]; Everton Gonçalves Leite[1]; Edimar Rodrigues Soares[1]; Adriana Ema Nogueira[1]
Faculdade de Educação e Meio Ambiente - FAEMA[1]

Localized within the Amazonian Region, the state of Rondônia ranks eighth for cattle herd in Brazil. Livestock production in that state takes large portions of land with low technologic level. As a result, a considerable part of the pasturelands has become deteriorated. This study aims to evaluate the soil structural quality of pasturelands in the city of Buritis (RO), Brazil. The analysis took place at Boa Esperança and Boa Sorte farms, in November 2017. Three areas at Boa Esperança were evaluated: 1 – cultivation of *Panicum maximum* cv. Mombaça planted for 19 years; 2 – cultivation of *Panicum maximum* cv. Mombaça planted for two years; and 3 – cultivation of *Brachiaria brizantha* cv. Xaraés planted for a year and a half. The area 4 was evaluated at Boa Sorte, having *Brachiaria decumbens* cultivated for two years. For structural evaluation purposes, the visual examination method was deployed and grades from 1 to 6 for Soil Structural Quality Index were attributed. The average of indexes in each area was: area 1 – 4,87 (good structural quality); area 2 – 3,64 (regular structural quality); area 3 – 4,67 (good structural quality); and area 4 – 3,36 (regular structural quality). The obtained grades for areas 2 and 4 show that land use in such areas should be treated with conservationist techniques to improve overall soil structural quality over time. The good quality shown in area 1 points out that keeping fodder plants for large periods of time does not compromise overall structural quality. In this scenario, for better production results, it is only needed to improve chemical factors by fertilizing and correcting soil acid levels. The evaluation of soil structural quality is proven to be useful to help producers enhance their methods of land use, also contributing to a sustainable livestock production.
Keywords: KEYWORDS: *fodder plants*; *land use*; *rapid soil structural quality diagnosis*
Financial support: Faculdade de Educação e Meio Ambiente – FAEMA

(6455 - 3084) Strategies for phytoremediation in soils contaminated with As, Cd, Pb, and Zn by slag disposal

William Ramos da Silva[1]; Clístenes Williams Araújo do Nascimento[1]; Fernando Bruno Vieira da Silva[1]
Universidade Federal Rural de Pernambuco[1]

The generation of waste through mining poses a potential risk of contamination of soil, water resources, plants and animals. For decades, the municipality of Santo Amaro da Purification - BA has suffered the impacts caused by improper and inadequate release of thousands of tons of steel slag, contaminated mainly by Cd and Pb, and by the exposure of these contaminants to the population through the distribution of this material for landfills in squares, streets and residences. The city today is known to present the highest human contamination per Pb in the world. The objective of this study was to evaluate the use of corn (Zea mays) and castor bean (Ricinus communis) for phytoextraction induced by chelating agents or phytostabilization. For this, a greenhouse experiment was carried out with the use of both plant species and phytoextraction inducers (citric acid and NTA). After the cultivation period, the contents of As, Cd, Pb and Zn were evaluated in soil and plant to evaluate the potential of the remediation technique. The data demonstrated that the environmentally available concentrations of As, Cd, Pb and Zn in the soils surrounding the Pb smelting plant are among the highest that have been reported. The application of the chelating agents citric acid and NTA increased the absorption of heavy metals by corn and castor bean. Although the removal of the metals with citric acid application is lower, it is more indicated because it presents greater degradability and helps in the inhibition of the phytotoxicity of the metals. Corn showed better phytoextractive capacity for As, Cd, Pb and Zn in the soil under study. The castor bean, although it did not translocate high concentrations of the metals, presented accumulation in the roots, being able to be used as phytostabilizing plant and generating economic benefits for the production of inedible vegetable oil. The mean estimated time for remediation of the area using phytoextraction was *high*, ranging from 76 to 259 years; therefore, this is not a viable alternative for remediating soils in the studied area. However, good development in the contaminated soil along with restriction of the metal(oid) translocation to shoots enables castor bean to phytostabilize metal(oid)s. Additionally, castor bean cultivation may be an alternative for an economic return because of biofuel production.
Keywords: contamination, heavy metals, chelating agents
Financial support:

(6862 - 903) Structural quality of the soil according to management in an integrated system of livestock and agricultural production

Matheus Henrique Martins Silva[1]; Raiane Maiara Gonzalez Frantz[1]; Eliza Fernanda Oliveira dos Santos[1]; Augusto Vicente Fortes Júnior[2]; Karen Andressa Ribeiro Artner[1]; Edimar Rodrigues Soares[1]; Adriana Ema Nogueira[1]
Faculdade de Educação e Meio Ambiente[1]; Universidade Federal de Pelotas[2]

The present essay evaluates the structural quality of soils according to their management in an integrated system of livestock and agricultural production in the city of Rio Crespo (RO), Brazil. This study took place at Esperança farm in September 2017. The following managements were analyzed: area 1: crop-corn-grain/winter crop-soy (2015/2016); crop-

soy/*Bracharia ruziziense*s/pasture – 60 days – 3,87 UA/ha (2015/2016); crop-soy/winter crop-corn-silage/*Bracharia ruziziense*s/pasture – 60 days – 3,39 UA/ha (2016/2017); area 2: crop-corn-grain/winter crop-soy (2015/2016); crop-soy/*Bracharia ruziziense*s/pasture – 60 days – 3,39 UA/ha (2015/2016); crop-soy/winter crop-corn-sillage/*Bracharia ruziziense*s/pasture – 60 days – 4,22 UA/ha (2016/2017); area 3: *Crotalaria*/crop-corn-grain/*Bracharia ruziziense*s without pasture; area 4: *Crotalaria*/crop-corn-grain/winter crop-soy (2015/2016); crop-soy/winter crop-corn-grain/*Bracharia ruziziense*s/pasture – 60 days – 3,20 UA/ha (2015/2016); crop-soy/winter crop-corn-grain/*Bracharia ruziziense*s/pasture – 60 days – 4,22 UA/ha (2016/2017); and area 5: native wilderness. The evaluation of the soil quality was made visually through the Rapid Soil Structure Diagnosis method, with grades for Soil Structural Quality Index ranging from 1 to 6. The indexes for each area were: area 1 – 5,67 (great structural quality); areas 1 and 4 with indexes of 4,12 and 4,05 respectively (good structural quality). Areas 2 and 5 were ranked with index values of 2,77 and 2,54 respectively (poor structural quality). The deployment of integrated systems improves the overall soil structure quality. The best structure is achieved when no animal pasture is used. In areas with animal population over 4,0 UA/ha, there is the need to constantly monitor the soil structure quality, and to observe the homogenic distribution of animals throughout the area.

Keywords: *livestock/agriculture integration*; *conservationist management*; *rapid soil structure diagnosis*.
Financial support: Faculdade de Educação e Meio Ambiente

(1196 - 2487) Structural quality of the soil in an integrated system of livestock and agricultural production in the city of ariquemes (RO), Brazil

Lucas Pedro Cipriani[1]; Julyana Corrêa de Ávila[1]; Rogério Carlos de Souza[1]; Edneia Maria Sobrinho Rodrigues[1]; Edimar Rodrigues Soares[1]; Adriana Ema Nogueira[1]
Faculdade de Educação e Meio Ambiente[1]

This study evaluates the structural quality of the soil in an integrated system of livestock and agricultural production at Esperança farm, in Ariquemes (RO), Brazil, in August 2017. Three areas belonging to the integrated system and one single area of extensive pasture were analyzed. Area 1 has a history of previous successive cultures of corn/*Brachariaruziziense*s (no pasture) in the agricultural year of 2015/2016 and soy crop in 2016/2017. Area 2 was previously cropped with soy/corn/*Brachariaruziziense*s (with pasture) in the agricultural year of 2014/2015, with one crop of soy in 2015/2015 and once more with soy in 2016/2017. Area 3 experienced crops of *Brachariaruziziense*s/soy (no pasture) in the agricultural year of 2014/2015, followed by one single culture of soy in 2015/2016 and once again soy/*Brachariaruziziense*s in 2016/2017. Area 4 was essentially formed by deteriorated pasture. The structural quality of the soil was evaluated visually through the Rapid Soil Structure Diagnosis method, with grades for Soil Structural Quality Indexes ranging from 1 to 6. The management used in areas 1, 2 and 3 had better structural quality compared to area 4 (deteriorated pasture), with indexes equal to 4,87; 4,67; 5,67 and 2,57 respectively. The succession of *Brachariaruziziense*s/soy (no pasture), soy and soy/*Brachariaruziziense*s showed the best structural quality, whereas the area with deteriorated pasture had poor quality.

Keywords: *conservationist technologies*; *soil management*; *direct seeding*; *rapid soil structure diagnosis*.
Financial support: Faculdade de Educação e Meio Ambiente

(6425 - 2327) Which pesticides are contaminating Brazilian soils?

Caroline Lopes Feijo Fernandes[1]; Lisiane Volcão[1]; Flávio Manoel Rodrigues Da Silva Júnior[1]
Universidade Federal Do Rio Grande[1]

Soil is an indispensable natural resource for the maintenance of life on the planet, however, agricultural production techniques have introduced a variety of synthetic substances in this compartment, with pesticides being the main example of these xenobiotics. Brazil is the world leader in the pesticide consumption market. However, these agrochemicals are recognized as an environmental, social and public health risk and constitute the main class of pollutants in agricultural soils. These factors motivate a need to monitor and control soil contamination by pesticides in Brazil. Thus, the objective of this work was to verify in the literature the diversity of pesticides found in soil samples within the Brazilian territory. The literature review was done in a systematic way, using the keywords pesticide, pesticide residues, soil, Brazil and Brazilian. The databases used were PUBMED, Web Of Science, TOXINET, SCIELO and Google Scholar (to grey literature). The sum of articles obtained in the search in all databases was 2.769 articles, but only 13 were included because they were related to the research theme (pesticides in Brazilian soils). In the 13 articles that were included in this review, 38 types of pesticides were found. Of these, 80% comprise the class of organochlorines, 5% the class of pyrethroids and the remaining 15% are equally divided into the classes imidazoles, imidazolylcarboxamide, triazoles, dinitroaniline and organophosphates. Organochlorine pesticides were reported in 12 articles, while the other classes were in only 1 study. However, the number of pesticides found is extremely small compared to the 504 marketed in Brazil. From this, it is possible to conclude that there is a need for new studies that contemplate chemical analyzes of real soil samples, with or without agricultural history, so that environmental risk can be predicted, diagnosed and reversed.

Keywords: review soil, pesticide quantification, residue pesticide, Brazil.
Financial support:

C4.3 - Soils and land use change

C4.3.1 - Ecological soil management systems and soil quality

(6043 - 1990) Acute toxicity in earthworms by the use of forest pesticides

Isabela Aparecida Giordani[1]; Carolina Riviera Duarte Maluche Baretta[1]; André Junior Ogliari[1]; Elizeu Moizés Bonfim[1]; Patrícia de Oliveira[1]
Universidade Comunitária da Região de Chapecó[1]

Pesticides are used indiscriminately throughout the world and the true impact of these products on the terrestrial biota is unknown. It is estimated that 0.1% are of specific action, reaching only the target pest, and the others reach other organisms too (CARRIGER et al., 2006), including species that play important roles in soil quality such as earthworms, which are important in maintaining the structure and decomposition of organic matter (GILL & GARG, 2014). The present study aimed to evaluate the toxicological potential of a pesticide used in forest system on the survival of *Eisenia andrei*. The experiment was conducted in a completely randomized design, with six replicates for each concentration of the Comet^{TM} herbicide (pyraclostrobin), based on the application recommendations for forest species (0, 58, 140, 350, 525 and 875 µL). For the tests, earthworms of *Eisenia andrei* species were used, following the recommendations of ISO 11268-2 (1998). Tropical Artificial Soil (TAS) was used for the tests, a standard soil for ecotoxicological testing, composed of sand, coconut fiber and kaolin. Each experimental unit received 500 g of contaminated soil and ten adult individuals with clitellum, weighing between 250-600 mg. The tests were maintained at 20±2 °C temperature and 12:12h photoperiod (light/dark). Survival evaluation was performed at 28 days. The results were subjected to analysis of variance (One-way ANOVA), followed by the Dunnett test ($p<0.05$). The test met the validation criteria in accordance with the respective ISO guideline. The mortality rate in the control did not exceed 10% of the total of individuals (average of 100% survival), with a coefficient of variation lower than 30%. The mortality of organisms of *E. andrei* species was not significantly affected by the

application of the Comet™ concentrations tested. There are currently no studies testing the toxicity of pyraclostrobin to terrestrial organisms. Toxicological assays with *Danio rerio* fish indicate a highly toxic potential of this fungicide for the species (ZHANG et al., 2017). We suggest further studies evaluating the toxicological potential of the substance pyraclostrobin. It is concluded that the Comet™ product, based on pyraclostrobin, was not able to cause toxicological effects on the lethality of *E. andrei* species at the concentrations tested

Keywords: Terrestrial ecotoxicology; *Eisenia andrei*; pesticides.
Financial support: Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES), Universidade Comunitária da Região de Chapecó (UNOCHAPECÓ).

(4500 - 1604) Baby corn and biomass production for green manure in organic production system

Ana Amélia dos Santos Cordeiro[1]; José Guilherme Marinho Guerra[2]; Ednaldo da Silva Araújo[2]
Post-Graduation Student - Soil Science, UFRRJ[1]; Researcher, Embrapa Agrobiology[2]

The baby corn exports small amounts of nutrients from the system and when grown in consortium with other species of green manure has the possibility to pay the investment of the planting and still guarantee an extra gain with its commercialization. The objective of this study was to evaluate baby corn productivity and amount of aerial phytomass produced by green mucuna (*Mucuna pruriens* (L.) DC. Var. Utilis (Wall ex Wight) Baker ex Burck) and corn,). The experiment was installed in Fazendinha Agroecológica Km 47 (Embrapa Agrobiologia, Seropédica, RJ). A randomized complete block design was used, with three treatments and eight replications: a) corn at the density of 100,000 ha^{-1} plants; b) green mucuna at the density of 100,000 ha^{-1} plants and c) maize and green mucuna consortium at densities of 100,000 and 50,000 ha^{-1} plants, respectively. In the monocultures, sowing was carried out on the same date and, in the consortium, the corn was sown 20 days after planting the corn. The baby corn harvest was started at 57 days after sowing, being performed three days after emergence of the stigmas and repeated every three days, totaling five harvests. The cut of the aerial part of the species had as reference the flowering of the green mucuna in monoculture, at 156 days after sowing. The results were submitted to statistical analysis using the F-test, with the help of the SAEG Program and the means were compared by the Scott-Knott test at the significance level of 5% probability. No differences were observed in relation baby corn productivity when it was compared to corn monoculture and intercropped with green mucuna. The amount of aerial phytomass produced differed among the treatments, being the highest value observed in intercropping, which shows that this consortium strategy, with a view to green fertilization, has a high capacity of soil cover and phytomass production "*in situ*", Associating species with different C/N ratios, in addition to replacing the system with N derived from the atmosphere, and allowing the farmer to generate monetary income with the production of mint.

Keywords: agroecology; agroecological management; soil fertility
Financial support: CAPES and Embrapa Agrobiology

(7586 - 2846) Carbon and nitrogen soil in different management of long term pastures in the region of Mata Atlantica - Brazil

Mirelly Mioranza[1]; Renato Campello Cordeiro[1]; Renato de Aragão Ribeiro Rodrigues[2]; Fabiano de Carvalho Balieiro[2]; Ademir Fontana[2]; Guilherme Kangussu Donagemma[2]; Marcella Leal Santos[3]; Thamires Rodrigues de Sá Valle[4]; Pedro Augusto Dias de Oliveira[5]
Universidade Federal Fluminense, Outeiro de Joao Batista s/nº, Niterói – RJ, Brasil[1]; Embrapa Solos, Rua Jardim Botânico, Rio de Janeiro – RJ, Brasil[2]; Universidade Federal Fluminense, Rua Passos da Pátria, Niterói – RJ, Brasil[3]; niversidade Federal Fluminense, Rua Passos da Pátria, Niterói – RJ, Brasil[4]; Universidade Federal Fluminense[5]

Changes in land use can result in an important source or sink of carbon (C) from the atmosphere, depending on the management applied. The most important examples of land use changes in Brazil are the conversion of native vegetation to pasture and agriculture, and more recently the conversion to integrated systems. The objective of this work was to determine the carbon and nitrogen content and soil content in pasture areas under different managements. Samples were collected in the experimental field of Embrapa Cattle of Milk, in the municipality of Coronel Pacheco - MG, in pasture areas under Silvopastoral System (SSP) – composed of *brachiaria decumbens*, *Eucalyptus grandis* e *Acacia mangium*; Monoculture of Managed Pasture (PM); Degraded Pasture (PD) and Native Forest (NF) established for 20 years on a clayey red-yellow latosol in mountain topography. The samples for determination of total and labile C and N contents and stock were collected at depths of 0-100 cm and 0-30 cm respectively. The total and labile C content was influenced by the handling in the 0-10 cm layer, in the following order: PM (34.37 and 2.04 $g.kg^{-1}$), SSP (25.77 and 1.94 $g.kg^{-1}$), MN (21.90 and 1.49 $g.kg^{-1}$) and PD (19.20 and 1.37 $g.kg^{-1}$), in which the PM presented the same tendency of accumulation of carbon in depth. In this way, the largest stock was obtained in PM (121 $Mg.ha^{-1}$), SSP (108 $Mg.ha^{-1}$), NF (99 $Mg.ha^{-1}$) and PD (98 $Mg.ha^{-1}$). As for N, the total contents were similar in the different managements, whereas the labile N in the first layer was higher in the SSP (0.13 $g.kg^{-1}$), decreasing the depth content. This result is probably due to the presence of legumes (*Acacia mangium*) in the SSP that may have influenced the lower nitrogen availability, due to the higher uptake by the roots. The obtained stock was: PM (9.7 $Mg.ha^{-1}$), SSP (7.9 $Mg.ha^{-1}$), NF (8.5 $Mg.ha^{-1}$) and PD (8 $Mg.ha^{-1}$). It is remarkable the contribution of carbon by the well managed pasture in relation to degraded pasture and forest. These results can be attributed to the more developed, voluminous and well distributed root system of the grasses, which favors the high deposition of C to the soil in the form of roots. The apparent efficiency of the root system in contributing organic C to the soil probably results from the fact that they are not exposed to climatic factors and are in direct contact with the soil.

Keywords: Integrated systems, organic matter, soil management
Financial support: BID, EMBRAPA, REDE ILPF, CAPES

(1171 - 1763) Carbon stock in a sandy soil of the southwestern Amazonia

Falberni de Souza Costa[1]; Marcelo André Klein[1]; Erbesson de Souza Brito[2]; Manoel Delson Campos Filho[1]; Daniel Moreira Lambertucci[1]; Deborah Pinheiro Dick[3]; Itauane Oliveira de Aquino[3]; Leonardo Barreto Tavella[2]
Embrapa[1]; Ufac[2]; UFRGS[3]

Soil conservation management (SCM) system with no-till (NT), cover crops and cash crops in rotation and/or succession, limestone and fertilizers can recover and/or maintain soil quality in terms of its carbon (C) stock in comparison to the slash-burn system with or without conventional tillage (CT). The objective of this study was to determine the effect of SCM system on temporal variation of soil carbon stocks in its natural state (native forest – NF) and under different tillage/cropping systems. The experiment was conducted in an Acrisol of the smallholder property, Mâncio Lima municipality, Acre state, Brazil, in split-plot design in a randomized complete block design with three repetitions, for NT and CT (main parcels), and the succession manioc (*Manihot esculenta*)/cover crops (green manure)/maize (*Zea mays*). The sub parcels were: (1) control: slash and burn (C); (2) cover crops (*Mucuna aterrima* or *Canavalia ensiformes* or *Sorghum bicolor*) among cash crops (CC); (3) CC with addition of P-fertilizer (CCP); (4) CC with addition of

limestone (CCL); and (5) CC with addition of P-fertilizer and limestone (CCPL). Disturbed and undisturbed soil samples were collected (0-1.0 m) in the Amazonian summer of 2006 (beginning of the experiment), 2012, 2016, and analyzed for total organic carbon (Walkley-Black), and physical and chemical properties. In this study are presented only soil C stocks in NF, C and CCPL both under CT and NT. The C stock is presented for the 0-0.3 m because more than 50 % of the total C stock are located in this layer. The greatest C stock was observed under NF (46 Mg ha^{-1}) that ranged from 18.3 Mg ha^{-1} (0-0.05 m) to 14.2 Mg ha^{-1} (0.20-0.30 m). The others land use reduces an average of 26 % of the C stock under NF. C stocks did not differ among land uses investigated in this study.
Keywords: Embrapa Acre; No-till; conservation agriculture.
Financial support: Embrapa

(8060 - 2705) Chemical composition differences of mountain soil at natural regeneration areas (Nova Friburgo-RJ)

Matheus Dias Nideck[1]; Pedro Longo Guerra[1]; Thalita de Lima Adame[1]; Monica Santana Vianna[2]; João Paulo Machado Torres[2]; Ricardo Finotti Leite[1]
UNESA[1]; UFRJ[2]

Nova Friburgo (Rio de Janeiro State) was affected by extreme climatic events on January 2011. These events resulted in many landslides in mountain slopes that created many degraded areas where all the plant cover and superficial soil layers were removed. Many of these areas are under natural regeneration but plant growth still incipient. Evaluate and monitor soil characteristics and changes through space and time can furnish important insights about the successional pathways of soil regeneration and it constrains, furnishing insights for restoration projects. We sampled three degraded slopes surrounded by agricultural properties and a forest fragment on Barracão dos Mendes (Nova Friburgo – RJ). We collected eighteen soil samples along each degraded hill declivity and adjacent forest portions, making 54 samples for degraded areas and 54 samples for forest areas and 18 samples at each slope segment: 20 to 70 m, 70 to 140 m and upper portion 140 to 210 m. The concentrations of expressive elements for the soil fertility profile Al^{3+} and Ca^{2+} and pH was initially considered. These parameters were compared between the areas and between the different slope segments. Comparisons were made using Mann-Whitney (U test) with Bonferroni correction. Degraded areas presented significant lower Ca^{2+} concentrations (0,53 $cmol.dcm^{3}$) and lower pH (4,54) compared with forest areas (1,33 $cmol.dcm^{3}$) and (5,13) (U=3,55, p=0,0003 and U=2,54, p=0,01, respectively). Inversely, degraded areas presented significant lower Al^{3+} concentrations (than forest areas (0,73$cmol.dcm^{3}$) than forest areas (0,49$cmol.dcm^{3}$) (U=2,39, p=0,01). Slope portions did not differed in relation to all parameters at forest areas (U=0,39, p=0,65 for all comparisons) and at degraded areas (U=0,25, p=0,76 for all comparisons). Preliminary results indicates that soil of degraded slopes under natural regeneration are nutritionally poorer and more acid than the forest areas what can explain the difficult of plant settlement at these areas. However, values did not differed between slope segments indicating that differences found for plant settlement between slope portions are not being influenced by these parameters. The results indicate that restoration actions should consider the soil fertility pattern to evaluate the natural regeneration process. Subsequently, we intend to correlate soil fertility to the nutritional requirements of the species and the levels of pesticides found in the soil and organic matter.
Keywords: natural regeneration, soil conservation, restoration.
Financial support: FAPERJ, UNESA

(1020 - 3067) Comparison of soil carbon stock in conventional and organic palm plantation in northeast Amazon

Arianne Flexa de Castro[1]; Manoela Sena Avelar[1]; Richardson Sandro dos Santos Freitas[1]; Fabio Alexandre Oliveira Teixeira Filho[1]; Sílvia Fernanda Mardegan[1]
Federal University of Para[1]

Amazon is target of degradation and deforestation. Land use changes after deforestation cause several effects in ecosystems processes. In this context, oil palm (*Elaeis guineensis* Jacq., Araceae) plantation is in expansion process and its effects on nutrient cycling and storage, as well as carbon stock in Amazon soil are so far misunderstood. Here we investigated how land use change affects soil physical-chemical properties and organic carbon (C) stocks in northeast Amazon. The study was carried out at Agropalma agroindustry complex, Tailândia-PA, Brazil, in a typic dystrophic Yellow Argisol. We sampled in organic (OP) and conventional (CP) oil palm plantation, which we separated into frond piles, inter rows and oil palm rows. At each site, we collected three depth intervals (0-10,10-20, and 20-30 cm) to quantify soil C content and stock, as well as to determine its physical-chemical properties. A terra firme forest (TF) nearby was collected as reference. Soils from forest and oil palm plantations are highly sandy (60% sand; 27% clay) and have low fertility. TF had lower fertility than oil palm plantations. Among plantation types, fertility at OP is higher than at CP, while among treatments, frond piles are more fertile than inter rows. Soil acidity was high (pH around 4) and similar among sites. Soil C:N ratio was low and variable, with no differences among plantation types and depth. Soil C content and stock in TF were lower than in both OP and CP plantations. Soil C content in oil palm row at OP was 7% higher than at CP. Comparisons within palm plantations indicated that soil C stock in frond piles was higher at both OP and CP (17.41, and 16.93 Mg C ha^{-1}, respectively) than at inter rows and oil palm rows. The higher soil C stocks in frond piles and oil palm rows are likely related to the presence of oil palm roots, and to higher inputs of organic matter. Conversely, the lower C stocks at inter row soils are likely to be related to poor drainage system and soil compaction. Our previous results suggest the enhanced potential of organic oil palm plantations to storage C in soil. This is probably due to the use of oil palm empty fruit bunch as fertilizer, rising soil organic matter content. Altogether, our results point that the conservative management of oil palm plantation has the ability to enhance organic C sequestration in Amazon soils.
Keywords: Agroecosystems; carbon stock; land use change; soil physical-chemical properties.
Financial support: Conservation International; Agropalma agroindustry complex.

(2766 - 894) Ecological farming - soil awareness in praxis

Houšková Beata[1]; Makovníková Jarmila[1]; Šlinský Ján[2]
National Agricultural and Food Centre – Soil Conservation and Research Institute, Gagarinova 10, 827 13 Bratislava, Slovakia[1]; EKOplod, Pavlovce nad Uhom, Slovakia[2]

Soil, alongside with air and water is the basis for life on the Earth. For many years, the function of soil has been understood only as a mean for production. Nowadays the soil is perceived as an integral part of environment which must be preserved for future generations. This shift in human thinking is also due to the increase in soil awareness. We cannot be satisfied with present situation as it still needs a lot of work in soil issues promotion in the society, but because soil is considered as non-renewable resource according to several soil protection documents, soil awareness is becoming stronger. One, very effective way, how to contribute to soil protection is ecological farming. Soil is subjected to several external factors which can influence its properties. The cause of soil degradation directly lies in the way of soil use, which affects its ecological functions and consequently the stability of the land. Sustainable soil use must keep equilibrium with the other parts of environment and ecological farming is also the way to realize it. Example can be soil cultivation in spirals where individual fields have circle shape. Such cultivation is based on low soil surface disintegration without

turning the soil layers and without heavy machinery and fertilizers. It is realized by a rotating arm fixed in the middle of the field. Soil cultivating tool is mounted on a chain and is guided along the arm. It is possible to fix interchangeable tools that can serve as a spade, rotary tiller, and seeder or for drip irrigation. The circular fields are located side by side and one working arm can be easily moved to an adjacent field. In these fields it is already possible to see the change of soil properties. This is noticeable in the amount of stable soil aggregates proportion in comparison with fields cultivated in traditional way. Due to low soil disturbance also amount of earthworms is higher in circle fields. Improvement in soil structure tends to grow from the fields with 1 year to the fields with 5 years of ecological cultivation, thus with years the effects are more and more visible. Ecological farming is soil awareness in praxis and can significantly contribute to soil protection and sustainable use according to A2030 SDG's, especially goal 15 which aims to: protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.

Keywords: soil awareness, ecological farming, field's shape, soil structure, SDG's

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(2139 - 732) Effect of rangland management on soil properties in South Africa

Elmarie Kotzé[1]; Hennie Snyman[1]; Chris Du Preez[1]

University of the Free State[1]

Rangeland management can affect soil in various ways. Direct effects are related to animal trampling and excretion, while indirect effects are involved with changes in vegetation structure and function, like defoliation, burning and drought. Both beneficial and detrimental effects of rangeland management on soil properties have been found in several studies in South Africa. Livestock grazing are known to significantly change almost every aspect of soil structure and function, including soil porosity, chemistry, microbiology, nutrient cycles, productivity, and erosion rates. It has been reported that high grazing intensity increases soil compaction and erosion, while reducing soil aggregate stability, and decreasing soil nutrient and organic matter levels. Drought and fire in arid and semi-arid rangelands in South Africa, generally reduce soil organic matter content and the soil seed bank which can lead to reduced porosity and increased bulk density, causing further soil compaction. However, the decrease in root mass due to drought can also add organic matter to the soil. These effects, especially when combined, leads to rangeland degradation in the form of compaction or erosion. Soil degradation (erosion and compaction) due to rangeland management in South Africa is substantially higher in communal than in commercial rangelands, with areas mostly affected in steep sloping land in the eastern parts of South Africa primarily used for grazing, with KwaZulu-Natal, Northern and Eastern Cape Provinces being badly affected by soil degradation. Rangeland degradation seems to be highest in KwaZulu-Natal and the Northern Province of South Africa. Whereas the eastern Karoo is no longer seen to be severely degraded by agricultural experts, as it appears to have benefitted considerably from rangeland management strategies. The rate of rangeland degradation is decreasing in commercial areas, largely due to state intervention, strategies and schemes, while it is perceived to be increasing in communal districts. Rangeland management should include strong, effective, and specific measures to prevent degradative effects or to repair soil damage where it has already occurred. Changes in rangeland management, especially applying long enough resting periods, can be very effective in controlling soil compaction, infiltration and erosion.

Keywords: degradation, grazing, soil quality

Financial support:

(8603 - 1231) Epiedafic fauna in a long-term integrated crop-livestock system at different grazing intensity

Daiane Dalla Nora[1]; Ângela Denise Hübert Neufeld Vieira[1]; Hazael Soranzo de Almeida[2]; Juliane Schmitt[1]; Paulo César de Faccio Carvalho[2]; Rodrigo Josemar Seminoti Jacques[1]

Universidade Federal de Santa Maria[1]; Universidade Federal do Rio Grande do Sul[2]

The integrated crop-livestock system representing a production model that seeks sustainability of agricultural systems and increase the productivity, reconciling animal and agricultural production. This system has a direct and indirect effect on soil fauna, which undergoes rapid changes by changing the management. Evaluating these effects is essential, because edaphic invertebrates are directly related to soil quality. This work aimed to determine the frequency of epiedafica soil fauna at different intensities of grazing in a long-term integrated crop-livestock system, conducted with different grazing intensities. The study was carried out in an area of 22 hectares located in the municipality of São Miguel das Missões / RS / Brazil, cultivated under tillage system. The soil is classified as typical Rhodic Hapludox. In winter, the consortium black oats plus ryegrass is used for animal grazing and in the summer the soybean crop for grain production. The area was divided into 14 plots and the treatments are the four grass heights 10, 20, 30 and 40 cm and control without grazing. The experimental design was complete randomized blocks with three replications, and areas between blocks without grazing. Sampling was carried out in 2014-2016, using traps in two seasons: after grazing of the animals (October / November) and post harvest of the soybean (April / May). Nine traps were installed in each plot, totaling 27 per treatment. The traps were installed with 70% (v / v) ethanol solution for preservation of organisms, since they stayed in the area for 7 days. The captured organisms were identified at the level of order and the frequency of the taxon was calculated. Among the 13 orders collected, Araneae, Coleoptera and Heminoptera presented higher frequency and lower variation among different pasture heights after animal grazing. After the soybean harvest, these organisms were also the most expressive; however, they behaved in different ways among the grazing intensities. The orders Araneae and Coleoptera presented higher frequency in the plots without grazing. This behavior indicates that the different intensities of grazing affect the frequency of the organisms in the soybean crop, however, this influence was not expressive after animal grazing.

Keywords: Invertebrates, ICLS, soil arthropods, soil quality.

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(1612 - 1290) Evaluation of Microbial Activity in Soil under Different Management Methods, with Addition of Organic Material with Deep or Conventional Amendment

Juliana Zucolotto[1]; Roberto Stefani Takahashi[1]; Paulo Cesar Tavares de Melo[1]; Elke Jurandy Bran Nogueira Cardoso[1]; Gustavo Scardazzi Lago[1]; Renato Manzini Bonfim[2]

Escola Superior de Agricultura Luiz de Queiroz[1]; EMBRAPA[2]

The conventional system of potato production has proven to be unsustainable due to the high inputs and the high incidence of pathogens that prevent consecutive crops in the same area. The deep tillage system for potato, developed by the study group PACES (Designing Sustained Agriculture in Sustainability) located at Escola Superior de Agricultura "Luiz de Queiroz" (ESALQ/USP) in Piracicaba (São Paulo – Brazil) , aims to improve the chemical, physical and biological soil properties, making it appropriate for cultivation in tropical conditions. The soil microbial activity is an indicator of the intensity of microbiological processes, which are essential for the maintenance of

soil biological quality. This work evaluated the microbial activity of soil under different forms of soil management. The five treatments were: 1. Deep Tillage and amendment of Panicum maximum 2. Deep tillage and amendment of Brachiaria brizantha 3. Deep Tillage and amendment of Zea mays; 4. Conventional tillage and amendment of Zea mays; 5. Control - conventional tillage with no amendment. The samples were collected at the depths of 0-20 cm and 20-40 cm and at 5 periods within the potato (Solanum tuberosum L. cv. Atlantic) cycle, being : twenty-three days before planting (T0), 1 day before planting (T1), 24 days after planting (T2), 45 days after planting (T3) and 80 days after planting (T4) and the samples were sent to the Soil Microbiology Laboratory of the Department of Soil Science of ESALQ, where they were submitted to respirometry analysis by the method of Alef (1995).For statistical analysis a randomized block design with five treatments and six replications was randomized. For respirometry, the analysis of the variables of time and treatments were submitted to analysis of variance and for the comparison of means, the Tukey test (P <0.05) was used for each depth (0 to 20 and 20 to 40 cm). All analyzes were performed using software R version 2.15.3. The conventional tillage productivity of potato was shown to be lower than in the deep tillage treatments, and this difference could be an effect of soil tillage that was done differently for both systems. The treatment with deep tillage and amendment with Panicum maximum presented the best potential to keep the microbial activity high during the whole potato cycle, but there was no significant difference between the amendment with Panicum and Brachiaria

Keywords: Sustentabily, soil profile, Poaceaes
Financial support: Escola Superior de Agricultura

(5962 - 2586) Evaluation of substrates and temperatures for germination of *Dalbergia nigra* (Vell.) Fr. All.

Ana Paula Braido Pinheiro[1]; Adriele dos Santos Jardim[1]; João Vitor Garcia Silva[1]; Adriano Alves Fernandes[1]; Fábio Ribeiro Pires[1]; Sara Dousseau Arantes[2]; Luis Fernando Tavares de Menezes[1]
UFES[1]; INCAPER[2]

Known locally as the *jacaranda-da-bahia*, *Dalbergia nigra* is native species of the Atlantic Forest with characteristics of late secondary to climax. It is a tough species to regenerate in nature and threatened of extinction, but has a great potential for the recovery of degraded areas as it adapts well to soils with low fertility. There are few studies about germination of this species, so it is fundamental to define the optimum conditions for the evaluation of the physiological quality of the seeds, mainly regarding temperature and substrate. The objective of this work was to evaluate the influence of different temperatures and substrates on the germination and vigor of *jacarandá-da-bahia* seeds, aiming at the establishment of a protocol for the evaluation of their physiological quality. The experiment was carried out at the Universidade Federal do Espírito Santo (UFES/CEUNES), the experimental design was completely randomized with four replicates of 25 seeds, in factorial scheme with three temperatures and four substrates. The sowing was done between sand, vermiculite and commercial organic (Tropstrato®), and on the paper, placed in gerbox boxes, and the test was conducted in Biochemical Oxigen Demand (BOD) germination chambers for 14 days at constant temperatures of 25 °C, 30 °C and 35 °C and 12 h photoperiod. The percentage of germination and the rate of germination were evaluated through daily evaluations of root protrusion. After the formation of the normal plant, the lengths of the root system and of the aerial part were evaluated. There was no interaction between the factors studied, therefore, they were independent. Means were compared by Scott-Knott test at 5% probability. The percentage of germination was statistically equal in the three temperatures. The temperature of 25 °C showed a higher rate of germination. The highest root length was observed at temperatures of 25 °C and 30 °C, and shoot growth was favored at 30 °C. Regarding the substrates used, the paper and the commercial organic showed a higher percentage of germination and a higher rate of germination. For the root growth the vermiculite and commercial organic substrates stood out, and as for the length of the aerial part all the substrates were statistically equal. For *Dalbergia nigra* it is recommended to evaluate the percentage of germination at 14 days, but a maximum value of 34% was observed. This low percentage may be related to the low physiological quality of the seeds.

Keywords: *jacarandá-da-bahia*, native species, recovery of degraded areas
Financial support: Petrobras

(5082 - 2650) Litterfall production and nutrient cycling on Caatinga woody leguminous.

Anacláudia Alves Primo[1]; Maria Diana Melo[2]; Graziella de Andrade Carvalho Pereira[2]; Ivanderlete Marques de Souza[2]; Henrique Antunes de Souza[3]
Universidade Federal do Ceará[1]; Universidade Estadual Vale do Acaraú[2]; Embrapa Meio-Norte[3]

The knowledge on nutrient cycling through litter is important for the management of the species in agroforestry systems (SAFs), since the litter is an important way of making plant nutrients available to soil. The aim of this work was to evaluate the litterfall production and nutrient cycling of woody species in an agroforestry system of Caatinga. The study was developed in SAF belonging to Embrapa Goats and Sheep, located in the county of Sobral-CE, Brazil. The evaluated species were four native leguminous from Caatinga: *Mimosa caesalpiniifolia* (sabiá), *Mimosa tenuiflora* (jurema-preta), *Libidibia férrea* (jucá) and *Poncianella piramydalis* (catingueira). To collect the litter, collectors were installed under the tree canopy, using six replicates for each species evaluated. The samples were collected monthly during the year 2015. After each collection, the materials were oven dried at 60 °C with circulation, to quantify the total litter production of each species, followed by macro and micronutrients analyzes of the residues of each collection. The period of greatest litter production occurred at the end of the rainy season and at the beginning of the dry period, between June and August. Thus showing an influence of rainfall regime on the production of litterfall. The jucá species presented higher production, followed by catingueira, sabiá and jurema-preta, with 925.8, 332.2, 259.3 and 221.9 g m^{-2} of dried mass. Calcium (Ca) presented greater accumulation of litter in the sabiá and catingueira species: nitrogen (N) was higher in the jurema-preta and jucá species; iron (Fe) was the micronutrient with the greatest accumulation in the litter in all species evaluated. It was observed that not all leguminous plants were Ca element superior to N as generraly occurs. In this study two out of five species showed higher N compared to Ca. This predominance of Ca in the residues can be due to the fact that it is a structural component of the cells of the vegetal tissue, thus tending to be one of the last to be released to the soil via litter decomposition. Overall, the elements P, K, Mg and S presented low accumulation during the one-year period evaluated. The leguminous on Caatinga greatly contribute with the soil residues accumulation. The adoption of SAFs in Caatinga as a soil conservation system maintain the recycling of nutrients within the agroecossystem, as well as in natural ecosystems, thus avoiding the expansion of areas in the process of degradation.

Keywords: semiarid; agroforestry systems; conservationist system.
Financial support: CNPq; Embrapa Caprinos e Ovinos

(9111 - 684) Measuring changes in soil carbon stocks in western Japan as influenced by land conversions from forest land to cropland

Nobuhisa Koga[1]; Takashi Kusaba[1]; Hiroshi Niimi[1]; Takeo Shima[1]; Tsuyoshi Yamane[1]
Kyushu Okinawa Agricultural Research Center, NARO[1]

In National Greenhouse Gas Inventory Report, CO_2 emissions from soil carbon stock changes resulting from land use conversions are the object of the report. However, those emissions from land use conversions between forest land and cropland are not fully investigated in Japan. In

this context, we measured changes in soil carbon stocks resulting from past land use conversions from forest land to cropland in western Japan. In the present study, we selected 8 sites from western Japan, and soil carbon stocks at both forest land and cropland (including grassland) converted from the forest land were measured at each site. The croplands at the 8 sites included 4 upland fields, 3 grazed meadow lands and 1 citrus orchard. The soil types were Andosols (volcanic ash-derived soil) for 4 of the croplands and Red-Yellow soils for the reminder. Elapsed times after land conversion from forest land to cropland ranged from 23 to 76 years (mean of 43 years). At both forest land and cropland, 3 soil profiles were created each land, and soil sampling was duplicated at each soil profile (six-replicated soil samples were taken from each land). For forest land soil (0-50cm) and cropland soil (0-30cm), soils were divided into several layers, based on the color and hardness of the soil. Then, soil samples for determining dry bulk density and carbon content of the soil were taken layer by layer. The comparison between forest land and cropland in terms of soil carbon stocks was made on an equivalent soil mass basis; namely, the soil depth considered for forest land was adjusted in order that the soil mass considered for forest land equaled that for 0-30cm in croplands. The soil masses were calculated by subtracting soil organic matter weight (carbon content x 1.724) from dry soil weight. Of the study sites, analyses of samples from 5 sites (3 Andosol sites and 2 Red-Yellow soils sites) were completed. For 4 of the 5 sites, soil carbon stock in forest land was greater than that in cropland. The mean ratio of soil carbon stock in cropland to that in forest land for the 5 sites was 0.80 (range: 0.36 to 1.09). It seemed that the ratios of soil carbon stock in cropland to that in forest land decreased with elapsed times after land conversion from forest land to cropland. We are still accumulating further data to derive the country-specific soil carbon stock change factor for land conversions from forest land to cropland.

Keywords: greenhouse gas inventory; soil carbon stock; land conversion; forest land; cropland

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(2084 - 2140) Monitoring restoration success of soil's quality in forested ecosystems: A global meta-analysis

Adriana Allek Litaiff[1]; Agnieszka Latawiec[2]; Renato Crouzeilles[1]

Programa de Pós Graduação em Ecologia, Departamento de Ecologia (UFRJ); Centro de Ciências para Conservação e Sustentabilidade do Rio; Instituto Internacional para Sustentabilidade[1]; Centro de Ciências para Conservação e Sustentabilidade do Rio; Instituto Internacional para Sustentabilidade[2]

The ecological restoration process and its success depend to a large extent on the soil's integrity and functionality. Recent global meta-analysis have been carried out to understand the effects of restoration success for biodiversity and vegetation structure, yet understanding restoration success of soil's quality in forested ecosystems remains unclear. Aiming to quantify how does restoration success varies for different soil's quality indicators (soil organic matter, biological, chemical and physical), we conducted a global meta-analysis encompassing 432 quantitative comparisons between restored and reference (e.g. old-growth forests) forest systems. As expected, we found that all indicators were more depleted in restored than in reference systems. Using the response ratio's metrics we found that biological indicators (-0.55) were more depleted than soil organic matter (-0.38), physical (-0.19), and chemical (-0.02) indicators. Our study shows that restoration practitioners should focus more effort on restoring biological soil fauna since it showed the most contrasting difference between restored and reference systems. This global meta-analysis provides insights not only in the trends of restoration success of soil quality, but also into which indicators are more critical to be restored and monitored in order to achieve more cost-effective restoration of soil's quality.

Keywords: ecological restoration, soil indicators, restoration success.

Financial support: Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq)

(9150 - 2122) Review of existing knowledge on soil crusting in South Africa with an appraisal of some specific case studies and possible solutions

G.P. Nortje[1]; M.C. Laker[2]

University of South Africa[1]; University of Pretoria[2]

Review of existing knowledge on soil crusting in South Africa with an appraisal of some specific case studies and possible solutions M.C. Laker[1]; G.P. Nortjé[2] [1]Professor Emeritus of Soil Science, University of Pretoria, Pretoria, South Africa; [2]Senior Lecturer of Environmental Soil Science, University of South Africa, South Africa (nortjgp@unisa.ac.za) Soil crusting (surface sealing) is a widespread and serious problem throughout all nine provinces of South Africa and in neighbouring countries, like Botswana, Namibia, Swaziland, Zimbabwe, Malawi and Tanzania. Unlike subsurface soil compaction, human-induced soil crusting is not confined to cultivated or irrigated areas (rainfed and irrigated), but it is also a widespread problem in overgrazed rangelands and overgrazed areas in game parks and National Parks. Both mineral and biological soil crusts are problems. Extreme crusting is found on soils where sub-tropical fruit crops i.e. avocado and macadamia nuts are grown in three of South Africa's main production areas namely, KwaZulu-Natal, Limpopo and Mpumalanga. Various research methodologies are used to study soil crusting. Soil factors determining the susceptibility of a soil to crusting include soil organic matter, sesquioxides, particle size distribution, exchangeable sodium percentage, magnesium:calcium ratio and parent material. Negative impacts of soil crusting include the reducing of water infiltration, leading to increased runoff and erosion and induced drought; inhibiting soil aeration; inhibiting germination and seedling emergence; inhibiting root functioning and development. Management practices that lead to the development of bare areas on crusted soils or are aimed at deliberately maintaining bare areas, e.g. under drip and micro irrigation, or off-road driving in game parks, aggravate soil crusting and its negative impacts. Crusted soils often do not recover even after several decades. In this paper the existing knowledge on soil crusting (surface sealing) in South Africa is reviewed, as well as viable practical solutions to prevent and alleviate soil crusts for example: changes in management practices, and amelioration by means of mulching, the application of gypsum (or phosphogypsum) or organic soil conditioners, such as polyacrylamide (PAM).

Keywords: Soil crusting, clay mineralogy, parent material, mulching, soil conditioners

Financial support: University of South Africa, Department of Environmental Sciences

(3191 - 1541) Sand encroachment and land degradation in an agropastoral area restored in the southern region of Sétif (Algeria)

Salah Belghemmaz[1]; Mohammed Fenni[1]; Yacine Louadj[2]; Afrasinei Gabriela M.[3]

UFA Sétif-1, Laboratory of Valorization of Biological and Natural Resources, Faculty of Life and Natural Sciences, Ferhat Abbas University, Sétif-1, 19000 Algeria[1]; UFAS Sétif-1, department of agronomic sciences, Faculty of Life and Natural Sciences, Ferhat Abbas University, Sétif-1, 19000 Algeria[2]; Remote Sensing and GIS TeleGIS Laboratory, Department of Chemical and Geological Sciences, University of Cagliari, Italy[3]

This study allowed us to establish a preliminary assessment of the state of degradation of the steppe ecosystem in the southern region of higher plain of Sétif (Hammam Sokhna). Soil sampling was done on the southern boundary of the sebkha and headed west to the north east a distance of about 15 km. The pedological evaluation had allowed us to complete our field observation. The high soil salinity, and high pH, low

soil organic matter, and low vegetation density, are all the sign of the predisposition of the soil to sand encroachment. Bad tillage management and overgrazing weaken the soil, make it susceptible to deflation. The Wind is the driving force behind sand encroachment. The accumulation of sand increases from the upstream to downstream of the toposequence. The presence of dune landscape testifies the sand encroachment phenomena. In summary, the degradation of this steppic environment due to sand encroachment is a reality. The agropastoral vocation of this region is threatened by the sand dynamic. The fight against this phenomenon must be included in a rehabilitation project. Dune fixation by atriplex must be revived and also, the restriction or controlled agricultural activity where the areas are more sensitive to degradation must be taking into account in the rehabilitation project of this steppic ecosystem.

Keywords: Steppic- Ecosystem, sand encroachment, degradation, Hammam Sokhna
Financial support:

(7424 - 3168) Soil CO_2 efflux in conventional and agroforestry-based oil palm production systems

Alessa Nayhara Mendanha Costa[1]; Steel Silva Vasconcelos[1]; Saime Rodrigues[2]; Helen Ramos[3]; Lilianne Cunha[4]; Osvaldo Kato[1]; Débora Castellan[5]

Embrapa Eastern Amazon[1]; Federal Rural University of Amazon[2]; World Agroforestry Centre[3]; Federal University of Para[4]; Natura Inovação e Tecnologia de Produtos Ltda[5]

The oil palm is an oilseed of great economic importance. In Brazil, the state of Pará is the biggest producer of this crop. Oil palm cultivation in agroforestry systems (AFS) is considered an alternative more sustainable of expansion of this crop. However, spite of its carbon accumulation potential, there are still many gaps in research on CO_2 production from soil respiration in these systems. The efflux of carbon dioxide (CO2) from the soil, a result of autotrophic and heterotrophic respiration, is a sensitive indicator of the crop impact on soil carbon cycling. From March 2016 to March 2017 in the region of Tomé-Açu, Pará, eastern Amazon, three systems were evaluated: (a) an eight-year-old agroforestry-based oil palm system (AFS P); (b) an eight-year-old conventional- based oil palm system (oil palm monoculture); and (c) a 40-year-old secondary forest. Soil CO_2 efflux was monthly determined with a portable photosynthesis measurement system (model LI-6400, LI-COR, Lincoln, NE, USA), connected to a soil breathing chamber (LI-6400-09). The experimental design was completely randomized. The effect of the systems on soil CO_2 efflux was tested with ANOVA; Tukey at 5% was used to compare the averages. The soil CO_2 efflux was significantly higher in the 40-year-old secondary forest (secondary forest = 5.89 ± 0.10 µmol CO2 m^{-2} s^{-1}) than in oil palm systems (AFS P = 3 , 75 ± 0.05 µmol CO2 m^{-2} s^{-1}, oil palm monoculture = 2.22 ± 0.04 µmol CO2 m^{-2}, s^{-1}). The litter stock of these systems and annual carbon efflux (data not shown) follow the same pattern of CO_2 efflux (secondary forest > AFS P > oil palm monoculture).The greater diversity and density of species present in the secondary forest and in the agroforestry-based oil palm system, associated to the higher litter stock of these systems, favors the accumulation of organic matter and microclimatic conditions, which can stimulate the root development and rate of decomposition, contributing to the autotrophic and heterotrophic respiration, and consequently, for the greater soil CO_2 efflux in these systems. Although "soil metabolism" in AFS is not the same as forest metabolism, the more diversified oil palm cropping system (AFS P) is, more akin to a more ecologically integrated system (secondary forest).

Keywords: Keywords: Oil palm, soil CO2 efflux, agroforestry
Financial support: Coordination of Improvement of Higher Level Personnel (CAPES), National Council for Scientific and Technological Development (CNPq), Brazilian Agricultural Research Corporation (EMBRAPA), USAID (United States Agency for International Development).

(7872 - 312) Soil compaction by livestock in selected communally grazed semi-arid savanna rangelands of South Africa

Simeon Materechera[1]
Faculty of Natural & Agricultural Sciences, North-West University, p/b X2046 Mmabatho, 2735, South Africa[1]

Although soil compaction from livestock traffic is known to be a serious problem, its extent in communally-grazed semi-arid rangelands of South Africa has not been well assessed. This study quantified the impact of grazing animals (Cattle, goat, sheep) on soil compaction in three communal grazing rangelands located within the vicinity of the city Mafikeng in the North West Province. The rangelands represented the major grazing practices employed by smallholder farmers (uncontrolled annual stocking densities of over 300 AU ha^{-1}). A controlled grazing plot (20 AU ha^{-1}) at the North-West University Research Farm was used a control. Livestock in communal lands are herded to graze during the day but are confined in kraals overnight. Measurements were made in summer (July to October) of 2015. The profiles of all grazing lands displayed a compacted surface (1-5 cm) layer with an average penetrometer resistance of 2.35 vs 1.61 MPa (communal vs controlled) grazed lands. The average soil bulk density was significantly higher ($p<0.05$) in the communal than controlled grazed lands (1.51 vs 1.28 Mg m^{-3}). The former lands had consistently lower gravimetric water contents than the latter at all depths. Soil compaction significantly reduced ($p<0.05$) the infiltration rate of water in the surface soil of communally grazed lands compared to the control (0.93 vs 2.45 mm h^{-05}) implying a reduction in large soil pores. This could explain the localised ponding widely observed in these rangelands during rainy seasons. In sloppy areas, the waterlogging contributed to water erosion which could lead to transfer and redistribution of soil sediments and nutrients into nearby surface water sources thereby posing the risk of siltation and eutrophication. Loss of vegetative grass cover due to overgrazing in the communal lands was visible and could increase the compaction. There was less variation in soil properties across communal lands. Soil compaction in the grazing lands could also be exacerbated by the predominantly sandy soils which are poorly aggregated due to low clay and organic matter contents. The study concluded that both the uncontrolled number of animals and time of exposure to grazing in communal lands contributed to soil compaction. It was recommended that rotational grazing schemes need to be improvised and hoof traffic needs to be kept off the land as much as possible especially when the soils are wet in order to reduce the susceptibility of the soil to compaction.

Keywords: Soil physical properties; livestock treading; land degradation; overgrazing; animal stocking rate
Financial support: NRF Project Number IFR 80999

(7911 - 2100) Soil organic carbon labile fractions as indicator to manage tropical soils with different land use systems of the Peruvian Amazon

Ceila Lao[1]; Julio Alegre[1]; Sady García[1]; Eddie Shrevens[2]
Universidad Nacional Agraria La Molina[1]; Leuven University[2]

Soil organic matter is a very complex and important indicator to improve soil fertility and soil physical properties in the tropical regions, but will depend of many factors to keep it available and efficient in nutrient cycling and soil stability. Actually the physical and chemical analysis of organic soil fractions matter (OSFM) has become more relevant because of their different mineralization rates and their contribution of carbon to the soil. The OSFM become the most important indicator of soil quality especially at the Peruvian Amazon where we have a diversity of land uses and very few information exist about this fractions. In this

study we have evaluated the effect of soil management on OSFM under 10 different production systems in the Peruvian Amazon based in forest and secondary forest, pastures, woody trees, fruit trees and mix of woody and fruit trees. It was evaluated the content of dissolved organic carbon (DOC), particulate organic matter (POM), microbial biomass (MBS) and oxidizable carbon in permanganate (POXC) in the 10 different land uses systems. Soil samples were taken at two depths (0 - 15 cm. and 10 - 30cm.) during the dry season. The results showed that the carbon contained in the soil microbial biomass was higher in the multistrata system (221.2 mg C kg^{-1}). The higher oxidizable carbon content in soil permanganate resulted in the peach palm (*Bactris gasipaes*) system associated with *Pueraria phaseoloides* (417.5 mg C kg^{-1}) and the primary forest system had the highest content of dissolved organic carbon (12.46 mg C kg^{-1}) as well as the content of particles of organic matter (11891.7 mg C kg^{-1}). At the same time with the hierarchical analysis by clusters, we obtain 4 groups formed by A: Peach palm, improved pasture, degraded pasture, heart palm (*Bactris gasipaes*) and oil palm *(Elaeis guineensis*); B: Multistrata sytem 2 (10% clay) with *Cedrelinga catenaeformis* and other timber and fruit species, Brazilian nut (*Bertholletia excelsa*) and secondary forest; C: Multistrata 1 (5 % clay) and D: Primary forest. It is concluded that efficient soil management with different land use systems in tropical regions contributes to the preservation of fractions of soil-labile organic carbon.

Keywords: Microbial biomass, oxidizable permanganate carbon, dissolved organic carbon and particulate organic matter.

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(6855 - 2554) Soil quality index, a tool for monitoring and conservation of Chilean sclerophyll forest

Martínez-Herrera, E.[1]; Magni, C.[1]; Grez, I.[1]; Rubio, R.[1]; García-Chevesich, P.[1]; Romero, F.[2]; Morales L.[3]; Soto G.[3]; Neira, J.[3]
Universidad de Chile, Facultad de Ciencias Forestales y Conservación de la Naturaleza, Casilla 9206, Santiago, Chile[1]; Reserva Natural Altos de Cantillana, Paine, Chile[2]; Universidad de Chile, Facultad de Ciencias Agronómicas, Departamento de Recursos Naturales, Santiago, Chile[3]

Soil quality must be expressed through a function such as the productive capacity of the soil or environmental protection. Soil quality is dynamic and can change in short term, according use and management practices. The aim of this work was to evaluate a SQ index to support growth and sustainability of sclerophyll forest of central Chile. Three sites (A, B and C) located in the foothills of the Andes mountain range, all with sclerophyll forest in a conservation - degradation gradient, were selected. Cattle activity and litter removal is practiced on site A, occasional cattle on site B, and site C is maintained for more than 20 years without any production activity. A SQ function was computed as a linear combination of hierarchically organized indicators. The indicators used were physical properties (cone index, shear strength), chemical properties (pH, N, P and K available, B, Fe, Mn, Zn and Cu, exchangeable cations and cation exchange capacity) and biological properties (litter depth and soil organic carbon). A score for each of these properties was computed using measurements (indicators) that were normalized (0-1) with one of the three (more is better, optimum, or worse) scoring functions, according to their relative importance. The SQ index obtained was 0.19 in site A, 0.36 in B and 0.55 in C, indicating that the site with the highest anthropogenic activity had the lowest soil quality, while the site with 20 years of exclusion reach the highest soil quality.

Keywords: Soil health, Mediterranean forest, forest sustainability.

Financial support: Project Propuesta de protocolo para la definición de créditos por ganancias en biodiversidad en ecosistemas mediterráneos de Chile central, 2015. PROYECTO GEF Nº 59602.

(1720 - 1617) Soil quality index: evaluating reclamation of bauxite mined-soils under coffee cultivation

Rafael Silva Santos[1]; Silvano Rodrigues Borges[1]; Dener Márcio Silva de Oliveira[1]; Ivan Francisco Souza[1]; Ernst Eduard Jan Verburg[1]; Laisa Gouveia Pimentel[1]; Rogério Santana da Cruz[1]; Ivo Ribeiro da Silva[1]
Universidade Federal de Viçosa[1]

Mining activities cause severe impacts to the soil, and reclamation requires monitoring and proper evaluation of the processes involved. In this study, our objective was to develop a soil quality index (SQI) for monitoring the reclamation of bauxite-mined lands for coffee production. Fertilizer treatments (no fertilizer, poultry litter, chemical fertilizer, chemical fertilizer + poultry litter) and intercrops (no intercrop, grass [*U. brizantha*], legume [*S. capitata + S. macrocephala*], and grass + legume) planted between the coffee plants (*Coffea arabica*) were used as rehabilitation techniques. Soil attributes grouped into organic, chemical, physical, and microbiological properties were evaluated at pre-mining (native forest and 10-year-old coffee plantation), post-mining (reference sites), and at 19 months after the start of the experiment. Labile organic carbon, total exchangeable basis, bulk density, and acid phosphomonoesterase activity were selected for calculation of the SQI. Mining reduced the SQI by approximately 65% compared to the undisturbed site under coffee cultivation (pre-mining). However, reclamation involving intercrops fertilized with poultry litter—alone or in combination with chemical fertilizer—resulted in a 23% increase in the SQI after only 19 months. Whereas fertilization alone produced a modest increase in the SQI, intercropping alone (i.e., without fertilization) resulted in no improvement of the SQI. The proposed SQI had a high sensitivity to reclamation practices and can provide a useful tool for monitoring the reclamation of bauxite-mined sites.

Keywords: Poultry litter; Land restoration; Coffee cultivation; Cover crops; Soil organic matter.

Financial support: Companhia Brasileira de Alumínio - Votorantim Metais, CNPq, and FAPEMIG

(1579 - 2696) Solubility of different residue from the benefit of marble and agricultural liming materials

Luis Paulo Patente Tanure[1]; Maria Maiara Cazotti[2]; Liovando Marciano da Costa[2]; Paulo Roberto Cecon[2]
Produquimica[1]; Universidade Federal de Viçosa[2]

Brazil stands out among the world's largest producers and exporters of ornamental stones. Advice on natural resources, such as soil degradation, water contamination, atmospheric and visual pollution, besides the generation of fine residues, mainly in the beneficiation process. In this context, the objective was to evaluate the solubility of cutting (RS) and polishing (RP) of the marble and compared to the agricultural liming (CC). After a granulometric standardization of the 0.053 mm sieve samples, 1 g of sample was added to 50 mL of HCl at concentrations of 0.01; 0.10; 0.50; 1.00 and 2.00 mol L^{-1}, with four replicates. The reaction time was 12 hours, as samples were shaken hourly for 15 minutes at 200 rpm. After a reaction, as solutions containing as limestone samples, they were filtered on slow filtering quantitative filter paper. In the filtrate the contents of Ca and Mg were determined by atomic absorption spectroscopy. After filtering, the filter papers containing the residues were brought to the muffle at 500 ° C for one hour. By mass difference before acid attack and post muffle was found to determine the limestone residue. Data were submitted to analysis of variance and as means compared by the Turkey test ($p < 0.05$). It was observed that the RP presented higher solubility along the increase of the HCl concentration, following the RS and later the CC. Possibly due to the specific RP surface of 2.68 $m^2 g^{-1}$ in relation to 1.53 of the CC and 1.68 of the RS, which confirms the importance of the granulometry in the solubility of the agricultural liming materials. The residuals generated with the solubilization of the limestones were

adjusted as a function of the HCl concentration, it was observed that the carbonate consumption present in the RP occurred until the concentration of 0.36 mol L^{-1} HCl, RS up to 0.39 and CC up to 0.29. The higher consumption of the carbonates in the CC is related to the lower concentration of Ca and Mg oxides present in the sample. The materials CC, RP and RS presented 26, 33, 33% of oxides of Ca and Mg, respectively. Besides the granulometry, the chemical composition of the residues was also important in the solubility of the evaluated materials. The residues present great potential agricultural liming materials, mainly in the regions close to the production of ornamental rocks, reducing costs with freight, solving an environmental embarassment and improving the conditions of the soils.

Keywords: agricultural liming materials; residue management; ornamental rocks
Financial support:

(3644 - 3049) Technique of Restoration of Degraded Soils by Extractive Activities in the Peruvian Jungle

Gladys López[1]

Forestsoil Consultoria Ambiental[1]

The present research tackles the technique used in the recovery of areas deteriorated due to the impact caused by the exploration and exploitation of hydrocarbons in the tropical forests of the Peruvian jungle. These generate loss of vegetation cover, erosion, compaction, loss of fertility, pollution, modification of the water regime and alteration of biodiversity. The restoration of these areas has traditionally been carried out through woody forest plantations, without taking into account soil management and the adequate selection of plant species, thus extending the time and effectiveness of the restoration procedure. The objective of the study was to recover a degraded area of 9.30 ha with the appropriate technique in a shorter time to comply with the environmental commitment of the Total Abandonment Plan (TAP) according to the Peruvian regulatory framework for these activities. The technique used for the restoration of the area consisted of applying an adequate soil management (decompaction, incorporation of organic amendments fertilization and improvement of drainage) and an assisted reforestation prioritizing the use of native legume species and nitrogen fixers of the genus *Inga sp, Ochroma sp* and *Guazuma crinita* with appropriate characteristics for their development under these conditions. Likewise, maintenance and monitoring of the area by evaluating parameters of soil quality, composition, structure and diversity of the vegetation with the modified Whittaker method was carried out. As a resulting effect, there was an increase in soil pH from 3.8 to 4.72, organic matter from 0.68 % to 4.60%, potassium levels from 22 to 188 ppm, and phosphorus levels from 0.9 to 4.1 ppm. Forest species, as well, presented a growth in average height of 9.5 m, with an average basal area DCH of 132.70 cm and a better coverage and vigor of the revegetated plants which favored the increase of natural regeneration achieving 100% of plant coverage in a period of 24 months. The results of this technique's design show that the development of vegetation, water and nutrients retention, soil loss reduction, natural regeneration and biodiversity recovery can meet the environmental commitments in a short period of time, thus providing an alternative technique to the traditional method used to restore areas impacted by extractive activities in tropical forest areas.

Keywords: restoration, degraded soil, reforestation, tropical soil
Financial support: Forestsoil E.I.R.L

C4.3.2 - Assessment and inventory of land use change under the SDG´s perspective

(1090 - 725) Carbon storage dynamics in sugarcane, pastures, eucalyptus, coffee and citrus in the mogi guaçu and pardo watersheds, Southern Brazil

Carlos Cesar Ronquim[1]; ivan André Alvarez[1]

Embrapa[1]

In the context of climatic changes, the observation of land use change scenarios is important to inform land use policies and also to evaluate the contribution of fitomass in carbon storage. However, information about the importance and potential for carbon sequestration by agrosystems is still scarce. Thus, assessments such as those proposed by this research are important for the scientific progress in this area. This study presents the evaluation of carbon storage dynamics in sugarcane, pastures, eucalyptus, coffee and citrus agroecosystems. The land use change and occupation was based on satellite images interpretation in the Mogi Guaçu and Pardo watershed of São Paulo state, southern Brazil and carried in two different times: 1988 and 2016. The results revealed that the sugarcane is on average capable of accumulating nine times more carbon in $t.ha^{-1}.yr^{-1}$ than other agrosystems. Sugarcane, pastures, eucalyptus, coffee and citrus has a potential to store 107.2; 11.7; 11.1; 10.3; 8.5 t CO_2 $ha^{-1}.yr^{-1}$ into biomass respectably. The expansion of the cultivated area with sugarcane, with efficient accumulation of CO_2 for area unit and time possibilited to remove of the atmosphere 128.7 million t. CO_2 in twenty six years. The results obtained can be relevant for the generation of environmental indicators and producing positive impacts on the environmental valuation of the production agrosystems.

Keywords: agrosystems, environmental valuation, fitomass, land use change.
Financial support: Embrapa, FAPESP

(4845 - 976) Land use change in the farm settlement umari, lábrea, in the period of 1996 to 2011

Mariano Vieira dos Santos[1]; Heron Salazar Costa[2]; Miqueias Lima Duarte[3]

Universidade Federal do Amazonas - Grupo de Pesquisa Agricultura & Ambiente, Humaitá, 786, Brasil (mariano_vieira@hotmail.com)[1]; Universidade Federal do Amazonas - Grupo de Pesquisa Agricultura & Ambiente, Humaitá, 786, Brasil (hescosta@ufam.edu.br)[2]; Universidade Federal do Amazonas - Grupo de Pesquisa Agricultura & Ambiente, Humaitá, 786, Brasil (miqueiaseng@hotmail.com)[3]

Deforestation in the southern region of Amazonas was been increasing expansion over the past few years. This is mainly due to the expansion of agricultural projects and deployed by improper occupation areas located in the vicinity of farm settlements and roads. This study aimed to characterize the soil use change in Farm Settlement (FS) Umari, on 1996 at 2011 period. It is a farm settlement located in the municipality of Lábrea (Purus Amazonas-South Middle), created by the National Institute of Agrarian Reform-INCRA, having currently 46 family units settled, which develop traditional agricultural activity and also act in extractive production. To characterize the dynamics of land use were used pictures Landsat 4 and 5, obtained from the database of the National Institute for Space Research (INPE). The images were processed with the aid of the QGIS 2.8 software, from the supervised classification using the Semi-Automatic Classification Plugin-SCP. Also was to do a statistical analysis for the estimation of accuracy and Kappa index of classification. Than quality of the data, it was found an average of 93.56% for accuracy and 0.80 for the Kappa index. Taking the total area of the farmer settlement (9,730.80 ha), at intervals of three years, it was found the following percentage of deforested area: 14.2% (1996-1999); 15% (1999-2002); 19.7% (2002-2005); 21.4% (2005 – 2008); 24.5% (2008 – 2011); 31.4% (2011-2014). Over the period of 15 years analyzed, the increase was of 221%, being that this increase was not linear, having the following variation: 0.8%; 4.7%; 1.7%; 3.1%; 6.9%. It was not possible to correlate the deforested area increase with the increase in production, however, on the basis of March 2017, provided by the Institute of agricultural and Forestry Sustainable Development State of Amazonas-IDAM found low productivity in relation to secondary vegetation

(18.01%). Despite the FS Umari have most of your areas still covered by original vegetation; it was observed an increase in acceleration of deforestation over the last six years. Such acceleration is attributed to the opening of highways, local roads associated with the economic moment of each period. The small agricultural productivity observed does not seem to justify the increased deforestation occurred.
Keywords: Land use, Sustainability, Amazon, Rural Settlement.
Financial support: Fundação de Amparo à Pesquisa do Estado do Amazonas - FAPEAM.

(1635 - 3176) Soil, Agricultural Suitability and Use at Rural Properties in the State of Mato Grosso.

Angelo Mansur Mendes[1]; Gisele Freitas Vilela[1]; Osvaldo Tadatomo Oshiro[1]
Embrapa Territorial[1]

Agriculture is the main source of welfare in Brazil. The state of Mato Grosso is probably the best example for it, with its 903 thousand km^2 covered by 3 biomes. The New Brazilian Forest Code (Brazilian Federal Law nº 12.651 - May 25, 2012) created a *Cadastro Ambiental Rural* (CAR) hosted at *Sistema Nacional de Cadastro Ambiental Rural* (SICAR), with the aim of creating a database for controlling, monitoring, environmental and economic planning, and for fighting against deforestation. The aim of this work is to identify, using a geographic information system (GIS), the soil and agricultural suitability and the land use at rural properties larger than ten 'rural modules' in the State of Mato Grosso accross its different biomes. We used ArcGIS 10.5 to geoprocess the databases on: soil and agricultural suitability by the Planning Department of the State of Mato Grosso; biomes by the Brazilian Ministry for Environment; soil use by the Brazilian National Institute for Space Research; and CAR, made available by SICAR. We considered only the properties larger than 10 fiscal modules, i.e. 16,669 rural properties registered under SICAR. The largest biome portion, Amazônia, occupies approximately 53% of the state's territory, and has 8,065 properties. The predominant soil classes in this part of the state are Oxisols and Ultisols, the main agricultural suitability classes in the management level C for agriculture use were good (23.3%), regular (39.7%), and land not recommended (20.6%), and the main land uses in 2014 were forestry (44.8%) and planted pasture (22.6%). The Cerrado biome portion occupies almost 40% of the state of Mato Grosso, has 7,910 properties where the predominant soil classes are Oxisols and Entisols, the agricultural suitability classes in the management level C for agriculture use were good (21.6%), regular (25.5%) and land not recommended (51.5%), and the main land uses were not forestry (78.2%). Whereas at the Pantanal biome portion occupies nearly 7% of the state and has 817 registered properties where the predominant soil classes were Plinthic subgoups and Alfisols, agricultura suitability were regular for native pasture and silviculture (43.3%) and good for planted pasture (19.6%), and the main land uses were not forestry (86.7%). The GIS tool enables the characterization of the large properties and may additionally serve to direct the farmers towards the best choices for areas based on the soil and agricultural of their farms.
Keywords: Biome; Geographic Information System (GIS); rural environmental registry (CAR).
Financial support: EMBRAPA

C4.4 - Soil education and public awareness

C4.4.1 - Soil science education in the 21st century

(5195 - 986) An Ecuadorian case study on the relationship between student's learning styles and academic performance in soil science

Pablo Quichimbo[1]; A. Javier Aguirre[2]; Michelle Chérrez[3]; Ute Hamer[4]; Leticia Jiménez[5]
Carrera de Ingeniería Agronómica, Facultad de Ciencias Agropecuarias, Universidad de Cuenca, Av. 12 de Octubre y Diego de Tapia, Cuenca, 0101168, Ecuador; Institute of Landscape Ecology, University of Münster, Heisenbergstraße 2, Münster , 48149, Germany.[1]; Proyecto PROMETEO, Secretaría de Educación Superior, Ciencia, Tecnología e Innovación (SENESCYT), 9 de Octubre y Gil Ramírez Dávalos, Quito, 170526, Ecuador.[2]; Carrera de Ingeniería Agronómica, Facultad de Ciencias Agropecuarias, Universidad de Cuenca, Av. 12 de Octubre y Diego de Tapia, Cuenca, 0101168, Ecuador[3]; Institute of Landscape Ecology, University of Münster, Heisenbergstraße 2, Münster , 48149, Germany[4]; Departamento de Ciencias Biológicas, Universidad Técnica Particular de Loja, San Cayetano Alto s/n, Loja, 1101608, Ecuador[5]

Nowadays, there is a challenging debate about the soil science's future in education. However, several studies have only paid attention in teaching aspects of this science, while the student's learning aspects have been neglected. Under this context, if learning can be defined as a relative permanent change in the behavior resultant from the experience, then learning styles can be referred as the ways that people learn and it is a part of the broader concept of personality of each individual. Thus, having an audience of learners with a range of different learning styles and characteristics, learning tools should be designed considering the diversity of knowledge, gender, age and development of individuals. Regarding research on learning styles applied to specific sciences in institutions of higher education, there are several studies but there is no information for soil science. Consequently, this study aimed to know the differences in preferences in learning styles of students who receive introductory courses of soil science in an Ecuadorian university and to study the effect of learning styles on students' academic performance. Thus, this work can contribute to know about learning's aspects under the typical environment of Ecuadorian students, this in turn can contribute to plan future strategies to reach the best development and achievements of students and teachers. For this purpose a study based on the application of the Honey-Alonso Learning Styles (CHAEA) questionnaire was carried out to identify and relate the learning styles with the academic scores in a group of students who received introductory courses of soil science at the Faculty of Agricultural Science in the University of Cuenca from March 2015 to February, 2016. The results of this study showed that there is a general preference in students towards pragmatic and activist styles. Furthermore, there are marked differences by gender, being men more pragmatic than women, while women are more active than men, and also women showed a tendency to be more theoretical and reflective than men. Academic performance was not influenced by the learning styles, however in students who showed multimodal preferences in learning styles the academic performance was increased. These results highlight that teaching plans of soil science have to take into account the diversity of students based on their learning style preferences.
Keywords: academic score; CHAEA questionnaire; education
Financial support: Facultad de Ciencias Agropecuarias-Universidad de Cuenca and SENESCYT. Project: "Estilos de aprendizaje en estudiantes de la Ciencia del Suelo: un caso de estudio en la Universidad de Cuenca".

(5891 - 2354) Digital 3d elevation model and augmented reality in the study of the soil/landscape relationship in Roraima, northern Amazonia.

Marcelle A. Urquiza[1]; Valdinar F. Melo[1]; Márcio R. Francelino[2]; Luciana S. Barros[1]; Ariecha V. R. Tibiriçá[2]; Marcelo M. Santiago[2]
Federal University of Roraima[1]; Federal University of Viçosa[2]

Challenges for teaching in the classroom, in the field and in research laboratories that address the relationship between soils/landscape and their representations are a constant, due to the complex nature that permeates the environmental relations, which have spatial expression and can be modeled according to their territorial distribution. The scale in which a landscape is organized is much superior to the field of vision and perception of humans, which hinders the mental and visual conception of the observed environment, and in areas with great

territorial extension more detailed observations and nuances are naturally diminished , due to the complexity of terrain and difficulties of access, like in the Amazon environments. The aim of this work was the creation of a 3D model and the integrated use of Augmented Reality (AR) resources, in order to foster the development of teaching practices with geotechnological tools that allow the view of environmental scenarios with a different approach, specifically in the spatial distribution of land use in the area of Tepequém settlement, State of Roraima, extreme north of Amazonia. As a result, a 3D model was built in ABS-M30 material representing 370 km², in the planimetric dimensions (48x50) cm with an altimetric difference of 2.65 cm in the elevations represented by the Digital Elevation Model (DEM) processed. The Land Use and Coverage Map (LUCM) and the MDE were recreated as Virtual Objects (VO) in the ArcScene software, and then animated. These materials were associated to graphic codes (QRcodes) that provided the experience of AR, virtually overlapping the VO generated on the prototype of the printed model. The QRcodes associated with the videos allowed a virtual tour of the features generated by the MDE and LUCM, and the integrated effect of other morphometric variables and hydrography, recovering the character of innovation to the visualization of these information plans, and the incentive to teaching practices that integrate the technological bias in everyday academic life. The changes in the learning process enriched by the use of AR that allow observations with different perspectives can establish a different understanding level of the soils relation and their uses in the landscape, in a technological and playful way.

Keywords: Virtual objects; land use; environmental education; qrcodes.
Financial support: INDT - Institute of Technological Development - Nokia / Microsoft Project: GEOMA / DIGITAL CITY, MANAUS - AM, 2014

(1040 - 1684) Digital game in soil education

Josiane Pacheco Menezes[1]; Fabrício de Araújo Pedron[1]; Fábio Franciscatto[1]; Rafaela Toaldo Happke[1]; Viviane Sebalhos Dal Molin[1]; Rosamari Piaia[1]
UFSM[1]

Educational software, including digital games, are important tools in education, since they present different pedagogical aspects, enhancing the learning of concepts, contents and skills, as well as promoting the development of reasoning and learning for the target audience. This research aimed to create and evaluate the performance of a computer application (digital game) on soils designed to the undergraduate and graduate students. Students of the course Integrated in Computer Science for Internet of the Industrial Technical College of Santa Maria (CTISM) and the Soil Museum of Rio Grande do Sul, both from UFSM, developed the digital game in the program Netbeans, using the language PHP, the database SQL and CSS styling. The game database has more than 250 questions in the areas of morphology/genesis, classification, mineralogy, fertility/chemistry, physics and soil biology/microbiology. The game was evaluated by undergraduate and graduate students and some teachers in the area of soil science. After this evaluation, the results indicated that the game helped the learning process, receiving a grade 8 in the importance for the professional formation of this public. In order to improve the quality of the game as well as its applicability, the public suggested the inclusion of images, score, explanations for the wrong answers as well as enabling the game for android system. The next step will be the improvement of the game for the launch of the first official release to the target audience.

Keywords: educational software; transdisciplinarity; education
Financial support: CTISM; Soil Museum of Rio Grande do Sul (UFSM)

(6136 - 3066) Knowledge building in undergraduate soil course: alternative methodologies during the teaching-learning process

Caroline Jardim da Silva Lisboa[1]; Aline dos Passos Silva[2]; Clécia Cristina Barbosa Guimarães[2]; Antônio Carlos de Azevedo[2]
Universidade Estadual do Maranhão[1]; Escola Superior de Agricultura Luiz de Queiroz[2]

The debate about the undergraduate teaching usually address the need of rethinking pedagogic methodologies as part of the path to better learning. The present study evaluated alternative strategies to the traditional soil science teaching method (lecturing) in undergraduate level, from a qualitative perspective. Four parallel classes, 23 to 28 students each, in Agronomy and Forest courses (freshman, 2o. semester), in Luiz de Queiroz College of Agriculture (ESALQ), at the University of São Paulo (USP), participate in classes in which seven teaching strategies: diagnostic evaluation, dialogued lecture, neighborhood exploration, concept mapping, two workshops (identification of minerals in sand fraction, and Cation Exchange Capacity with dies) and guided study. The students and the professor evaluate and were evaluated regarding the potential of such methodologies in the teaching-learning process. Among the strategies, the conceptual map was highlighted by the students as the one in which they became aware of the how fragile their understanding of basic concepts that they should mastered by that step of the course, mainly regarding sedimentary and metamorphic rocks. After a few classes, they were allowed to review the first version of their maps, and draw a new version, and this time the maps were much more detailed and richer in connections among the subjects. The study showed the need to better address and qualify the teaching learning process, both by the professor and students, and take advantage of the great variety of teaching methodologies available. In this sense, the professor should act at the interface student-science-knowledge and the student be proactive in constructing and transforming his/her knowledge.

Keywords: University teaching; soil teaching; conceptual map; teaching strategies.
Financial support:

(9377 - 1308) Learning to learn the soils: existentialist phenomenology as the foundation of a libertarian and innovative teaching.

Débora Jurado Ramos[1]; Jeani Delgado Paschoal Moura[1]; Douglas Vitto[1]; Estevão Conceição Gomes Junior[1]; Clarissa Gaspar Massi[1]
State University of Londrina[1]

In modern society, man's familiarization with the environment is done vertically, in order to enjoy it for the maintenance of unprecedented human life, denying that we, Homo sapiens, are part of nature. Unfortunately, regular education has little progress in encouraging a harmonious relationship between man and natural resources. In this sense, it was sought, in the activities described in this study, a methodology that would meet the construction of an individual who is active in his own learning, aware of his inalienable freedom and responsible for his choices. For this, the existentialist philosophical current is evoked through Sartre (1987, 2002), to understand human freedom, which according to this philosopher is a natural and inseparable attribute of men. Phenomenology complements existentialist thinking by providing us with an understanding of the lived world, showing us that harmonious living in a place, socially, ecologically and even spiritually, is intrinsic in its habitation. Thus, phenomenology allows individuals to approximate a supportive cycle by situating them in their space-times and showing them how their individual choices influence the world, and, moreover, snuggles humans back to the place. An educational model inspired these practices, the Escola da Ponte, created in Portugal, widely discussed by Pacheco (2015), which allows the student to command his learning, the organization of his educational space and the freedom to think and act. As part of the pedagogical practice, facing the structuring content Beginning, location and exploitation of natural resources, the Geography teacher asks the students: What natural resources do we enjoy? The lack of reference to the natural resource alone led to the elaboration of this study. There was no class in the conventional format, there was no adult rule, no content imposition. Gathered in groups determined by the affinity of interests about the soils, the students established their calendars of studies,

contents approached, activities, that is, they were free. The results were impressive, autonomous students, involved in the learning process, concentrated and applied. His scientific and human acquisitions have been immeasurable, which proves that it is time for a revolution in teaching towards learning to learn.
Keywords: Escola da Ponte; Bridge's School; libertarian education; soil education.
Financial support: Coordination of Improvement of Higher Level Personnel (CAPES).

(3332 - 1107) Project-based learning and soil judging: approaches to teaching the "hidden skills" in Soil Science

Carol Smith[1]; Henry Chau[1]; Helen Gilmore[1]; Judith Van Dijk[1]; Sam Carrick[2]
Lincoln University[1]; Landcare Research[2]

Soil scientists are increasingly working in a multidisciplinary world where they interact with professionals from different disciplines; stakeholders and diverse end user groups. Successful professional interactions and positive outcomes require more than an academic knowledge of soil science. The ability to communicate; critically appraise; problem solve; and to be an effective team player are all important skills. Allied to this are the practical field skills, unique to soil science such as the ability to describe soil profiles. For the latter, the kinaesthetic approach embodied in soil judging allows the student to also connect with pedological theory; we posit that it is a pedagogically-aligned style of learning. At Lincoln University, we have adopted two approaches to address these issues. Firstly, we have developed a 300 level course which utilises a project-based learning approach. This course is based on advanced field research, whereby the students form multidisciplinary groups who choose a real world environmental "problem", and design a research project to answer the problem. Group work involves experimental design, data collection and analysis, through to communication of their findings. The groups "learn by doing". Students are assessed using a range of approaches from practical skills testing, report writing, reflective journal and presentation / communication skills. Students reported an increase in a diverse skill set: communication, critical reflection, teamwork and problem-solving skills. Secondly, soil judging has become part of the wider soil science skills which students have been encouraged to acquire at Lincoln University. While soil judging in New Zealand is in its infancy compared to other countries, the undergraduate student soil science society and academic staff members have been enthusiastic in practicing soil description skills and have participated at a range of soil judging contests. Students report that they have become more confident in soil description and that it has stimulated their interest in learning about soil science. It may also be an effective recruitment pipeline into the discipline: offering students with a practical and kinaesthetic aptitude who perform well at soil judging an insight into the academic side of the soil science discipline. Both project based learning and soil judging are effective tools for students to acquire a valuable range of skills to a professional career in soil science.
Keywords: soil science project-based learning soil judging education
Financial support: Lincoln University

(4049 - 1143) Soil Expert Systems need On Ground Extension Experience

Packer I J[1]; Lawrie J[1]; Chapman G A[1]; Lawrie R A[1]
Soil Knowledge Network NSW[1]

The New South Wales (NSW) Soil Knowledge Network (SKN) is a small group of retired and semi-retired soil conservationists, scientists, soil surveyors and soil extension officers. The broad aims of SKN are to improve soil management and reduce or eliminate land degradation. We work as an independent partner with government and industry, largely on a voluntary basis. Among our other activities we provide soil training and workshops, produce soil videos, help formulate soil policy and support the use of legacy soil data and historical soil information. To help meet our objectives we support NSW government action on soil mapping and recording soil descriptions and data in databases. Widespread feedback from our training courses and field days indicates strong demand for practical and independent soil management advice. Despite soil electronic data/information being freely available, many land managers as well as government and professional advisors often have difficulties translating existing soil data into relevant land management decisions to meet landholder circumstances. Experienced persons in the soil extension network are growing older and few new soils staff, either in private or government agencies, are arriving to bridge the gap between often complex but essential data and useful knowledge. In these circumstances we propose that it is an ideal time to apply the knowledge of experienced extension workers to the development of expert soil management and extension systems. Given both the fundamental importance and the essentially non-renewable nature of the soil, should society continue to expand the investment in expert electronic systems, or should extension service capacity and training just be permanently increased? We argue both are synergistic and both are urgently needed.
Keywords: Soil Knowledge Network, soil expert systems, training courses, soil extension.
Financial support:

(7913 - 2567) Soil sampling and spatial statistics - a multi-level education experience

Guido Lorenz[1]; María Eugenia Figueroa[1]; Marcia Mabel Acosta[1]; Cecilia Zurita[1]
Facultad de Ciencias Forestales, Universidad Nacional de Santiago del Estero, Argentina[1]

Spatial variation of soils and its relevance for sampling designs are fundamental aspects for soil-related investigation or monitoring programs. Sophistication of statistical procedures during the last decades allows today for a very detailed and concise description of spatio-temporal variation of natural phenomena. In order to address these aspects in higher education, an educational project was created with the objective to get insights in concepts of spatial variation and to acquire capacities to deal with it, at under-, postgraduate and teacher level. The methodology consisted in (i) a systematic sampling of surface soil under sparse vegetation, in a 10 m x 10 m square with grid resolutions of 1 and 0.2 m, executed by undergraduate courses in Soil Science and Experimental Statistics; (ii) obtaining of fine-scale aerial photographs of the study unit, by means of a drone (Phantom 4, camera DJI FC330); (iii) analyzing of soil pH and electric conductivity in laboratory, as undergraduate activity, (iv) processing of soil and image data by means of spatial statistics, using R statistical environment; (v) training of the group of teachers in theory and techniques under R, and generation of educational material, using R markdown and the Moodle platform; (vi) continuing the undergraduate activities with class projects about soil sampling and basic concepts of geostatistics and finally, (vii) creating a postgraduate course, to be implemented in the first semester of 2018. Based on a real field experience, the undergraduate students could learn about sampling strategies and its execution, complemented by laboratory analysis of soils and interpretation of soil data. Respect to statistics, the following aspects were addressed: normality of data, treatment of non-normal data, spatial trends, spatial dependency and semivariogram, kriging procedure and causal modeling. The postgraduate course encompasses a detailed treatment of the mentioned concepts, with instruction in data processing with R statistics environment, accompanied by the reading of papers on essential topics. Due to its openness and the multi-level focus, this educational project has to be understand as a continuous, reciprocal teaching-learning process, allowing for adaption and broadening in the future.
Keywords: spatial variation, soil maps, R statistics
Financial support: Facultad de Ciencias Forestales, Universidad Nacional de Santiago del Estero, Argentina

(9364 - 341) Soil Science education in the 21st century to generate conscience and to accomplish the sustainable development goals, and arrive to the XXII century.

Reyes-Sánchez Laura Bertha[1]

Universidad Nacional Autónoma de México.[1]

The educational projects and the Education itself depend on the public policies generated by the governments as well as on the amount of money that the governments and societies destine to educate. Nevertheless, the possibility of having public policies and investment for the preservation of the natural resources and of the life on Earth, does not depend of the government; such possibility depends on a type of education that allows the citizens to understand the need to build, boost and request that their governments create preservation policies and invest on it. Due to these facts, an education which main value is the accumulation of concepts doesn't generate governments capable of creating preservation policies, nor citizens able to boost, demand, or invest on them. Teaching doesn't mean to educate, instruction is only a part of the education, but it is not the same. Educating involves forcibly the explicit formation of values that ingrain emotionally and cognitively all the information transmitted; in this way it is possible to progressively form consciousness that will build a preservation culture in the medium and long term. When we teach sciences we transmit basic and specialized information in various levels, we teach how to use that knowledge in theory and in the practice and we teach how to use that information to do interpretations, corrections, and projections; unfortunately this doesn't create an environmental consciousness nor builds a preservation culture that supports sustainability for our planet. If we want to create a knowledge that has a citizen culture within and that reflects in a culture of preservation of the natural resources as a building block for development, we do not need to instruct the citizens on the science of natural resources; what we need is to educate them to preserve those natural resources as indispensable elements for life itself. The really important is to explain to each citizen why the natural resources are important for them and why its loss affects us all without importance of the social class where we belong. The main idea is then that the knowledge that is taught has the purpose of PRESERVATION for the achievement of the SDGs. The Education is, as explained, the most important public policy in order to preserve the soil and all the natural resources and thus the life on Earth. The question of how we pretend to educate with this purpose and through what strategies? will be addressed during the presentation.

Keywords: Soil; sustainability; education.

Financial support: Own financing.

(5988 - 1923) Trump Cards: Super Soil – a tool for teaching about the classification and use capacity of soils

Larissa Pinto Seiberti[1]; Amanda Duim Ferreira[1]; Fábio Ribeiro Pires[1]; Graziela Evencio de Oliveira[1]; Kerwin Araújo Costa[1]

Universidade Federal do Espirito Santo[1]

Soils are an essential component of the biosphere, performing key ecosystem functions and providing the foundation and nourishment for terrestrial food, fiber, and biofuel production. The challenge of the soil education in the soil science is create tools that promote children's interest in the type of soil on their feet and also create awareness that each type of soil has adequate capacity for use and management. Our objective with the cards game Super Soil is exactly it: to promote the capacity of discern which soil attributes result in soils suitable for each use. The trump card game model is perfect for this use as it encourages comparison and has the potential to transmit ground science concepts in a simplified way, which makes learning intuitive. Top Trumps® is a card game traditionally played between two or more people. Each card lists numerical data that players compare with the aim of 'trumping' their opponent by having a greater value. The winner gains the opponents card(s) with the game continuing until only one player holds all the cards. The trump card game has already been used for educational purposes with various themes: trumps game "Plants, drugs and medicines" was produced as a result of a Science and Plants for Schools (SAPS) award; "Bacteria, virus and cell trump cards" was produced by Centre of the Cell and "Micro Trumps", a microbial card game, by the Chilled Food Association. In Brazil, the authors of this abstract found little use of the trump card for educational purposes, an example being the adaptation of Grow's Super Trunfo® game, developed by Gonzaga et al (2017), that compares chemical elements based on the periodic table. The game Super Soil was developed for the 1st Soil Education Week, held in 2015 at the São Mateus Campus of the Federal University of Espírito Santo, where 353 students from the municipal school system attended. Our game has 30 cards and shows all 13 class of soil that occur in Brazil, according to the third edition Brazilian System of Classification of Soils (SiBCS, 2013). We chose to present the soils up to the second level (order) in the classification to show that even within a single class the soils are different and leave the presentation of the game, especially the nomenclature of the soil, less heavy. Soil science, especially the soil classification, is a very academic and scientific discipline, so we propose with this game make learning about soil classification more dynamic and interactive.

Keywords: Soil education, game, pedology

Financial support:

(4343 - 649) Very Low Competence of Scientists and Technical Personnel in Central America is a Critical Limitation to Advance in Soil and Plant Nutrition

Armando Tasistro[1]; Axel Schmidt[2]

Soil Science Advisor, Catholic Relief Services, Watkinsville, Georgia, USA[1]; Catholic Relief Services, Latin America and Caribbean Office, La Molina, Lima, Peru[2]

Restoring soils' health and advancing more sustainable agricultural systems demands highly competent technical personnel with effective holistic visions of the systems. In large parts of Mexico and Central America, however, the level of expertise in soil science and agronomy is extremely low, virtually at all levels: public or private sector, national or international, educational, research or extension. The seriousness of this situation has been largely neglected, particularly by decision-makers. Most of the time perceived educational needs are intended to be fixed with short courses taught by whoever is available, with erratic results at best. This state of affairs is specifically grave in soil science, which has been affected by a global decline since the 1980s. The number of qualified active soil scientists in the region has been reducing steadily compared to other professions. Thus, many key positions in education, research, and technology transfer are in the hands of staff without specific formation in soil science, which might explain the inability to realize the tremendous shortcomings that we are facing. Catholic Relief Services (CRS) has been working for the last three years in the Program "Agua y Suelo para la Agricultura (ASA)" (Water and Soils for Agriculture) in Guatemala, El Salvador, Honduras, and Nicaragua, and more recently in Oaxaca (Mexico), to promote increased sustainability in agro-ecosystems, restore soil health, and improve water use efficiency. Technical staff are continuously involved in in-service educational activities, so that in addition to the inherent value of their work for the Program, they can learn the practical application of taught theoretical concepts. This valuable link between theory and practice, is sorely missed by our agronomy graduates. The big challenge is clearly how to improve the integral formation of our agronomists, which implies reinforcing science-based instruction throughout all the educational system. Graduates need to be able to think critically using evidence-based methods in order to identify and prioritize problems, as well as their possible causes and solutions by means of hypothesis testing. This must go along with the teaching of the right contents, which is normally assumed to be the case, but not supported by the evidence. One way that CRS is supporting these efforts involves a regional MSc Program in

Soil Science with key universities in Guatemala, El Salvador, Honduras, and Nicaragua.
Keywords: Education, competences, science-based instruction, Central America, soil science
Financial support:

C4.4.2 - Soil education and public perception of soils

(6566 - 3002) Comprehensiveness in the forms of soil perception through educational institutions, traditional peoples and family agriculture in certain regions of Mato Grosso, Brazil.

Willian Marques Duarte[1]; Fernanda da Silva Ferreira[2]
Escola Técnica Estadual de Educação Profissional e Tecnológica de Diamantino[1]; Universidade do Estado de Mato Grosso[2]

The work is inserted in a national context where the education focused on the areas of agrarian and biological sciences perpasses by the study of the soil, and how this is fundamental for the survival of the living beings of planet earth. For it is from him that we extract the natural resources like: water, forest, ores, oil among others. Thinking about academic centrality and the importance of Soil in food production is that it is necessary to reflect on educational aspects arising from studies done by Soil Science. In this sense, the present work starts from activities developed since 2012. The objective was to verify the perception about the meaning and importance given to the Solo in this context. The methodology used included the insertion of learning activities (workshops, courses, lectures, studies, data surveys, reflections, mutirões, local research) that could address topics such as environment, soil degradation, burnings, soil cover, enrichment with organic matter, consortium, cultivation of vegetables, agroecological vegetable garden, medicinal plants, soil preparation, creole seeds, green fertilization, biological nitrogen fixation, protection of springs and rivers, among others. These activities were developed in the Agronomy courses, Federal Institute of Mato Grosso-2012 and in the State University of Mato Grosso-2013-2016, Civil Engineering (University of the State of Mato Grosso-2013), Technologist in Agroecology (University of the State of Mato Grosso-2016). And classes of Agricultural Technical Courses (Technical State School of Professional and Technological Education of Diamantino-2017) and Agricultural Technician (Federal Institute of Mato Grosso-2012), for these the soil has as main proposition the scientific production, research, development of technologies and inputs, being a resource that can make a profit and a substrate for food production. In the perception of the indigenous peoples (Tangará da Serra, Campo Novo do Parecis, Sapezal), family farmers and settlers (Caceres, Tangará da Serra, Diamantino, Cláudia, Sinop, ribeirinhos (Cáceres), quilombola people (Barra do Bugres) It is important to note that the two perceptions are extremely important, the line of thought of educational institutions is aimed at more efficient technologies in the food production and profit, and traditional people and family farmers see the soil as a place of living and food production for sustenance.
Keywords: Teaching; soil; production.
Financial support:

(1088 - 2043) Demonstration of the magnetic characteristic of Perferric Rhodic Oxisols for educational purposes

Clarice de Oliveira[1]; Maria Lídia Novaes Correa[1]; Gilberto Silva Rocha[1]; Marcos Bacis Ceddia[1]
Universidade Federal Rural do Rio de Janeiro[1]

Magnetism is a characteristic of soils associated with the presence of ferromagnetic minerals, being important for the indirect quantification of chemical, physical and mineralogical properties of the soil. In Brazil, magnetic soils occupy a significant area, estimated at about 5% of the surface of the country and, in most cases, they are of great economic importance, considering the relatively high potential for agriculture. The objective of this work is to demonstrate, in a didactic way, the magnetic properties of a Perferric Rhodic Oxisol by means of magnetic soil boards, made from a sample of the Bw horizon of a Perferric Rhodic Oxisol. The soil was collected in the municipality of Nova Lima, Minas Gerais State, Brazil, with a Fe_2O_3 content of 480 g kg^{-1}. In the laboratory, the soil sample was air dried, gently ground and sieved to 4 mm to be used for the preparation of the magnetic board. The wooden board(50 cm x 40 cm) was covered with cotton cloth and a thick layer of PVA glue was applied to the surface. A soil sample was evenly distributed on to the surface of the glue. After drying, this procedure was repeated until a soil sample layer of 0.7 cm thickness was obtained on the board. Then to reinforce the cohesion of the soil sample to the board more glue was applied weekly ; 100 ml of glue diluted in water, at a ratio of 1: 5, for a period of two months. In these soil board neodymium magnetic discs (10 X 1 mm N35) were positioned and adhered to the board demonstrating the magnetism of the soil. These materials are part of the didactic collection of the Museum of Soils of UFRRJ.
Keywords: Magnetism; Museum of Soils; magnetic susceptibility of soils
Financial support: FAPERJ; UFRRJ

(8867 - 3072) Evaluation of geography and agronomy students on pet didactic materials presented in the science of the earth office of pet solos

Amanda Dias dos Reis[1]; Aline Roma Tomaz[1]; Maíra do Carmo Neves[1]; Ana Maria S. S. Moreau[1]
Universidade Estadual de Santa Cruz[1]

Environmental Education has as one of its aspects the Education in Soils, which has the fundamental role of raising and consolidating awareness on this resource. Therefore, based on the assumption that the task of soil education is not always easy, and since it is composed of a highly complex content, the implementation of teaching materials is fundamental as one of the tools to stimulate in students the importance of this knowledge and make them more aware of the need to review and re-establish the values and attitudes attributed to this resource. In this way, this paper aims to evaluate the efficiency of didactic materials presented at the Earth Science Workshop by PET Solos, through the Agronomy (AGR) and Geography Degree (GL) students of the State University of Santa Cruz - UESC. To obtain the data, a questionnaire was developed and applied to a sample of 18 students in Geography Teaching major and 12 students in Agronomy major, who participated in the Earth Science Workshop, presented by the PET Solos students. This workshop was divided into the following thematic axes: Origin of the Earth, Petrology (rocks), Formation of the Soil and Use and Conservation of Soil. Among the GL and AGR students, 94% and 83%, respectively, stated that the way the contents were approached in the workshop allowed them to understand the sequencing of the subjects covered in Earth Science. Among these same students, 100% stated that the didactic materials made it possible to understand the contents covered in each of the thematic axes. The models are one of the most cited materials: mentioned by 37% of the students in GL and 44% of those of AGR. According to reports of GL students, 37.5% agreed that didactic materials such as Earth globe, model of tectonic plates, experiments of convection current and volcanic eruption were the ones that most aided in understanding the thematic axis Origin of the Earth. Meanwhile, 43.4% of AGR students stated that mineral samples, rocks and weathering experiments contributed the most to understanding the thematic axis Petrology (rocks). In summary, it was possible to understand that the use of didactic materials in the Earth Science Workshop, contributed to the understanding of soil contents to students of Geography and Agronomy Degrees.
Keywords: Soil Education; Teaching materials; Earth Science Workshop;
Financial support: Universidade Estadual de Santa Cruz ; FNDE

(6567 - 3055) Evaluation of the level of knowledge in pedology of the concluding students of the agronomy degree of the state University of Santa Cruz

Maíra do Carmo Neves[1]; Aline Roma Tomaz[1]; Amanda Dias dos Reis[1]; Ana Maria S. S. Moreau[1]
Universidade Estadual de Santa Cruz[1]

Bachelor's degrees in Agronomy or Agronomic Engineering must qualify their graduates so that they can make a reasonable and rational use of the resources available, with respect to the environment, promoting a balance between the production of food and the use of these resources. Within the curriculum frameworks of these degrees, the study of Soil Science comprehends a set of subjects that represent fundamental importance for the formation of the students, seeking to demonstrate the usefulness of the soil and its relationship with man. Pedology is understood as a branch of soil science that deals with studies related to different contents and is based on multidisciplinarity, studying the soil in its natural environment, and its interaction with the environment. The syllabus aims on the training of professionals with the potential to conceptualize soil in the pedological vision, identifying its different components and interpreting its diagnostic attributes; explaining how each factor and process contribute to the formation of soils in different environments, classifying them according to the Brazilian Soil Classification System (Embrapa, 2013) for environmental and agricultural planning and use. Therefore, this research aimed to evaluate the importance and the level of knowledge in Pedology of students graduated in Agronomy of the State University of Santa Cruz. Data were collected through the application of a questionnaire, composed of ten objective questions, to 10 students, which addressed the importance and application of several concepts related to Pedology. This is a quantitative approach, with a descriptive character, with the main objective, according to the literature, describing the characteristics of a given population. The analysis of the answers showed that 100% of the students consider Pedology knowledge important for their academic formation. Amongst these, 83% can identify the inherent aspects of soil formation factors, but 50% have difficulties in differentiating formation processes and diagnostic horizons, which may complicate soil management activities. Despite this, 100% of the students have high knowledge about the environmental problems resulting from the inadequate management. With this, we can conclude that the students have a small perception about the different diagnostic horizons of the soil, and that Pedology constitutes an important subject for the Agronomy degree.

Keywords: Keywords: Soil education; Pedology; Agronomy;
Financial support: UESC; FNDE

(9798 - 2687) Perception regarding the importance of soil by middle and high school students from public schools in Northeastern Brazil

Carolina Malala Martins Souza[1]; Daniely Formiga Braga[1]; Lunara Gleika da Silva Rêgo[1]; Francisca Elisângela Maniçoba[1]; Gilson Dias Costa Filho[1]; Rodolfo Martins Formiga Fernandes[1]; Matheus Rodrigues de Oliveira[1]; Priscilla Ribeiro de Oliveira[1]
UFERSA[1]

Public perception in Brazil about soils and its importance as an essential mean to support the life on Earth has increased when compared to a few decades ago. Combined with the traditional and recognized soil functions, such as food, fiber and energy production, especially in a country with an agricultural vocation such as Brazil, this increased comes from the work on soil education that is being developed in the country. The objective of this work was to establish a constructive dialogue about soil science knowledgements with middle and high school students from public schools in the municipalities of Governador Dix-Sept Rosado and Caraúbas, Rio Grande do Norte state, Brazil. Students from all urban and rural schools of each municipality were selected, with a total of 60 students. The work consisted of three steps: 1st) application of a questionnaire with general questions about soil science; 2nd) theoretical and practical explanation on the main concepts and functions of the soil; 3rd) reapplication of the same questions that were applied during the first step. Most of the students were not able to respond satisfactorily the questions on the first step. Misconceptions about the soil formation were common for both municipalities. After the theoretical and practical explanation and reapplication of the same questions, the answers came to include the basic concepts that were commented during the presentations, such as: "the soil has O, A, B and C horizons" or "the soil is composed by sand, silt, clay and organic matter". When questioning about the importance of soil, the answers indicated an understanding about the importance of soil as an essential component for the life in the Earth since the first questionnaire was applied. Statements such as: "soil is important for all of us" and "soil is important for the survival of animals" were given both in the first and third step. When confronting the answers of the initial and the final step, the greatest change occurred in relation to the knowledge about the concept of soil. This indicates that despite not having more specific knowledge about soil, it is understood that soil is important for life. After the explanation the students were able to write what was approached about soil science in a clear and logical way, making it possible to understand that the initial construction of knowledge was accomplished. More actions are needed to strengthen the basic concepts of soils and their importance for the life.

Keywords: Soil education; Public perception of soils; Environmental education.
Financial support: Universidade Federal Rural do Semi-Árido (UFERSA)

(9533 - 2997) Soil Education in Northeastern Brazil, "Maciço de Baturité" Region: instruments and awareness

Susana Churka Blum[1]; Rosemery Alesandra Firmino dos Santos[1]; Smaiello Flores da Conceição Borges dos Santos[1]
Universidade da Integração Internacional da Lusofonia Afro-Brasileira[1]

Compared to other ecosystem components, soils are a natural resource that still had received little attention from general population. Primary and secondary schools are important resources for public awareness, reinforcing the role of universities in extension programs. From Agronomy students at UNILAB (Universidade da Integração Internacional da Lusofonia Afro-Brasileira), less than 5% had already had contact with the topic soil, supporting the importance of this work. During August 2016 to December 2017 we conducted a project aiming to produce and collect several didactic materials such as banners, experiments, lectures and workshops and to visit primary and secondary schools to talk about soils and their role in ecosystem and how its use affect our daily lives. Eight schools were visited in the municipalities of Redenção/CE, Barreira/CE and Acarape/CE, reaching a total audience of 345 students in ages varying from 8 to 20 years old. All schools visited were marked by a participative lecture and the development of simple experiments about soil formation, soil composition and soil conservation. In all visits, we applied a survey to verify the effectiveness of the process. We also conducted an exhibition to celebrate the National Day of soil Conservation (15/04/2017) at UNILAB. The visits were successful for student's awareness mostly about soil conservation and soil pollution. The State of Ceará in Northeastern Brazil and the "Maciço de Baturité" region still uses few conservation practices for soil management, being slash and burn a very common practice for land preparation. In urban areas, we still lack sewerage systems and proper waste disposal. Some challenges faced during the course of the project were the lack of interest from teachers in schools, since often the teachers responsible for environment-related topics have no specific formation for that. In the next project phases, we will focus on short courses to attend these issues.

Keywords: Ecosystem, primary schools, soil management, soil conservation, soil and society.
Financial support: PROEX/UNILAB

(8681 - 596) Soil in Environmental Education and the implementation of sustainable practices in Public Education of Belém, Pará.

Regilene Angélica da Silva Souza[1]; Dênmora Gomes de Araújo[2]; Selena

Mara Jesus Dias[2]; Maria Goreth Soares Teles[2]; Herika Gonçalves Soares[2]; Lia Rosa Cardoso de Loureiro[2]
Universidade Federal Rural da Amazônia, 2501 Avenida Presidente Tancredo Neves, Belém, 66077-830, Brasil (regilenesouza@yahoo.com.br)[1]; Universidade Federal Rural da Amazônia, 2501 Avenida Presidente Tancredo Neves, Belém, 66077-830, Brasil[2]

Soil is an important natural resource for life on earth, but misuse has caused serious impacts by compromising its functions in the environment. One of the ways to sensitize and raise awareness of its importance is through soil education, mainly in basic education. The objective of this study was to verify the knowledge of elementary school students about the concept, importance and functions of soil in the environment, as well the implementation of sustainable land use practices. The study was developed at the State School Virgílio Libonati and is part of "A Prática da Educação Ambiental no Ensino Público de Belém – PA" Project. The methodology adopted was the use of lectures with didactic materials and painting workshops, construction of gardens, vegetable gardens and seed planting. The classes were taught throughout the year of 2017 and integrated the discipline Natural Sciences. The work was carried out in the 1st to 5th grades of elementary school, formed by children and teenagers of low income. As result, students' interest in the soil theme was observed, which was demonstrated by participation with questions and answers. The presented didactic materials facilitated the understanding about the soils and the importance of the correct use of this resource. The workshops allowed the students contact with soil, being qualified as satisfactory. The students learned how to make paints from soils, which began to be used in painting activities; they knew and planted different seeds of agronomic and forestry importance; accompanied the construction of the garden and vegetable garden, and plant growth; and have learned about the importance of healthy foods to have a healthy life. The products grown in the garden have been used in school meals. Moreover, the garden has contributed to the well-being of students and school staff. In conclusion, the project's actions allowed the students basic knowledge about soils, awakening the sensitivity and awareness of children and teenagers regarding the importance of this natural resource by stimulating environmental perception and sustainable practices, also considering the Amazonian environment.

Keywords: Keywords: Soil education, environmental education, sustainability.
Financial support: Financial Support: Banco da Amazônia. Protocolo 148 – Edital Patrocínio – 2017.

(9013 - 2691) Soils and environment: Conception of students from a rural and an urban school

Viviane Terezinha Sebalhos DalMolin[1]; Eva Cristiane Cortelini Gabriel[1]; Ricardo Simão Diniz Dalmolin[1]
Universidade Federal de Santa Maria[1]

In the Brazilian educational system, there is a proposition of sociocultural contextualization associated with the representation and communication between those involved in the pedagogical practice. Soil education, as a transversal theme in teaching, offers the possibility of contextualizing scientific knowledge addressed in the classroom with sustainability themes. The objective of this work was to analyze the conceptions about soils from students of a rural secondary school (RS) and an urban secondary school (US), as well as the alterations in knowledge, after interventions about topics related to soils and the environment. The work was developed in three stages, as follows: 1. Initial questionnaire (Qi); 2. Seminar on Soils and Environment (Ss) and 3. Reapplication of the questionnaire (Qf). 23 RS and 76 US students participated in this research. For the systematization of the responses, the methodology of content analysis, based on the categorical analysis, was adopted. The conception of soils was one of the issues addressed. The category: *Place of cultivation* was the response of 42.5% of the RS students in Qi and 33.4% in Qf. For US students, the values found were, respectively, 24.7% and 30%. The category: *Place to be preserved*, the conception was of 22.5% in Qi and 24.25% in Qf for RS students and 3.5% in Qi and 5.1% in Qf for US students. These results reinforce the difference in crop production and land use in the different realities. Another category observed was *The place where we stepped*, is the response of 27.5% of the RS students in Qi, and zero in Qf. The result found for US students in this category was 44.7% in Qi and 25.5% in Qf. *Soils as the foundation for life* was one of the answers found only in Qf with 33.4% in RS students and 20.4% in US students. In both schools, it is possible to notice that the conception of soils presented a greater comprehension after the Ss. The relationship between soils and Environmental Education was also discussed in Qi and Qf. For RS students, considering Qi and Qf, 92% and 95%, respectively, they believe in a relationship between these factors. For US students, 62% and 70%, respectively, they consider that the factors are interconnected and complementary. The results show that there is a different view about soils, their use, and preservation in these two groups of analyzed students. Soil Education can be an important pedagogical tool to corroborate in the re-signification and globalization of education.

Keywords: soil education; soil awareness; contextualization
Financial support:

(9771 - 3051) Survey on teaching, research and extension activities performed by pet solo between the years of 2011 and 2017

Aline Roma Tomaz[1]; Amanda Dias dos Reis[1]; Maíra do Carmo Neves[1]; Ana Maria S. S. Moreau[1]
Universidade Estadual de Santa Cruz[1]

The PET-Solos of the State University of Santa Cruz was implemented in 2011, being the first PET in the area of Brazilian soil. Currently it is composed of seven Agronomy and Geography Bachelor students with scholarships and the tutoring of a teacher. Within PET the student is offered the opportunity to work with teaching, research and extension, since PET is based on the development of this tripod in Universities and College Institutions. According to the Basic Guidelines Manual (2006), the articulation between teaching, research and extension allows a global training of both the student who receives a scholarship and other students of the major, providing a more complete understanding of what happens to himself and in the world. The aim of this project was to conduct a survey of the research, teaching and extension activities performed between the years of 2012 and 1017, by the PET-Solos of the State University of Santa Cruz. The activities developed by the group are based on the tripod, teaching, research and extension, and they are constituted in: Earth Science Workshop (OCT), Cycle of lectures (CP), collective and individual research, besides participation in the Science Truck (CC), National Science and Technology Week (SNCT) and SBPC. To obtain the data, a search was made using the logbooks with the activity records. From the survey it was obtained that between the years of 2011 and 2017, PET-Solos, attended through the CC 1723 people, OCT 2942 students from private and public schools, held 11 courses, 25 lectures, contributed to the scientific progress with the production of 49 academic papers, presented at Soil Science events. In addition, there was participation in the SBPC in 2016 and SNCT in the years 2011, 2012 and 2014, attending a total of 902 people in the latter. Therefore, it is evident that the PET-Solos of the State University of Santa Cruz has contributed to the spread of soil science, as well as its popularization besides contributing to the training of undergraduate students of the Agronomy and Geography majors in the Institution.

Keywords: Tutorial Education Program; tripod of the university; Soil Science Dissemination;
Financial support: Universidade Estadual de Santa Cruz ; FNDE

(9881 - 2486) The soil in an interdisciplinary approach through chemistry teacher training

Ednalva Dantas Rodrigues da Silva Duarte[1]; Valdinar Ferreira Melo[1];

Maria Lúcia Taveira[1]; Viviane Araújo Cardoso[1]; Augusto César Rodrigues Santos[1]; Kaio da Silva Vieira[1]; Ronilson José Pedroso Amorim[1]; José Frutuoso do Vale Júnior[1]
Federal University of Roraima[1]

The soil is one of nature's elements which is little explored by chemistry teachers in the approach to contents in High School and Higher Education, despite its importance for the life of man and nature. This study reports the experience gained from a program developed in 2017 to spread and promote this element. The focus of the study is the soil found in the lakes, buriti (*Mauritia flexuosa L.*) paths at Boa Vista's savannas, Brazil. The program was developed with the students of the discipline QA236 Internship Supervised in Chemistry IV and professors of the Degree in Chemistry-CLQ of the Federal University of Roraima - UFRR. The objectives were to spread and promote the study of the soil, as well as to know the perception of students and teachers about the subject, that is, chemical approach of the soil and its interactions with the environment. In order to reach these objectives, a guided tour was conducted at the Roraima's Solo Museum-MSRR, belonging to the Agrarian Science Center of UFRR, which enabled visual and sensorial contact with the soil profiles of Roraima and the discussion of the concepts of Chemistry and Soil Science, as well as common sense knowledge. The students were asked to make a text referring to the use of the soil as a transversal theme in the approach to the contents of Chemistry, as well as to take the students of the High School to visit the MSRR. With the accomplishment of these activities it was possible to raise a greater interest in the study of the interdisciplinarity between Chemistry and Soil Science, the perception of the relation between the soil and the landscape formed by the lakes and buriti paths, and to provide the chemistry's professors and to the CLQ's students a formation committed to the change of values and attitudes towards the soil, in order to contribute to the promotion, conservation and sustainable use of biodiversity.

Keywords: Chemical Education; Environmental education; Man-Nature Relationship; Conservation and Biodiversity.
Financial support: CNPq; CAPES

(4366 - 369) Utilization non-formal education for the teaching-learning process of soil in the Manaus metropolitan region

Jean Dalmo de Oliveira Marques[1]; Elizalane Moura de Araújo Marques[1]; Juvenal Severino Botelho[1]; Alexandre Nicolette Sodré Oliveira[2]
IFAM[1]; SEMED[2]

The teaching of soil in non-formal spaces can to make a significant role in understanding of soil contents being a viable alternative for improvement in the teaching-learning process. The objective of this study was to investigate the contributions of non-formal spaces to the teaching-learning process of soil. It was developed in the metropolitan region of Manaus with 30 undergraduate students. The research is of the qualitative type and it was developed from the accomplishment of intervention activities characterized by dialogic expositive classes and practical activities in the field. The instruments of data collection used were questionnaires, field guiding script and image registration. The areas visited were: BR-174 (at km 5,12,44 and 51) (2^{o}56'S and 60^{o}02'W), Future Avenue (03º06'S and 60º01'W) and in the Brasil SokaGakkai Association at Ponta das Lajes (03º08'S and 59º52 'W). In the visited spaces, were identified and discussed thematic related with pedogenetic processes as: Laterization (km 5, Podzolization, km 12, new kaolinite, km 44, Clay Neoformation, km 51) both along BR-174; characteristics of Oxisol (Future Avenue) and rock of Alter Chão Formation, oxisol cliff, antropic soil and new caulinita), both at Ponta das Lajes. The results showed that the strategy of using non-formal spaces for soil education contributed significantly to the teaching-learning process. 85% of the students reported that they better understood the contents trained in the classroom after the field practice in the non-formal spaces visited. With the field practice it was possible to resignify concepts trained in the classroom, in addition to improving the understanding about the knowledge approached. But only using these spaces is not synonymous of success in teaching. It is necessary for the teacher to lead the classes in a dynamic perspective, not isolated, challenging, reflexive, regionalized, contextualized with regional factors and processes integrating rock-soil-landscape.

Keywords: Soil education; non-formal space; Manaus
Financial support: IFAM

C4.4.3 - Placement and accreditation of soil science in the workforce related to natural resources

(3204 - 3229) Maanaim environmental: environmental education in practice.

João Luiz Lani[1]; Julio César Costa[2]; Marco Aurélio de oliveira Ribeiro[3]; Agnaldo Roberto de Jesus Freitas[1]
Department of Soils, Federal University of Viçosa[1]; General Administrator of the Sustainable City of Maanaim[2]; Direct responsible for the Sustainable City of Maanaim[3]

Over the last few years more than 1,200 children from different parts of Brazil and abroad have received and experienced in practice important concepts of Environmental Education in the Atlantic Florest Biome in the city of Marechal Floriano, ES, with theoretical and practical education. This place, called MAANAIM, with the frequency of approximately more than 3,000 people in fortnightly meetings, is already known as CITY MAANAIM SUSTAINABLE because of its housing complexity and the practical solutions adopted. Pleasant place, with excellent landscaping, where there is wise and architecturally intertwined interaction between man and nature. This aspect is one of the highlights. The effective actions are the result of working teams of different professionals from all over of Brazil and voluntarily with modern practices and concepts of rational and sustainable use of natural resources are applied. They are professionals specialized in the most diverse areas that interact and look for suitable solutions. Among the innumerable actions, each one of which seeks harmony between nature, beauty and spiritual, the following stand out: a modern project of garbage collection with recycling, plantings of more than 10,000 native tree seedlings in the areas of degraded pastures; use of rainwater for internal use; modern techniques of recovery of springs; interaction of residences and lodgings with vegetation; wildlife refuge, food waste control; modern techniques for using commonly used water such as automatic faucets in drinking fountains and toilets; treatment and reuse of waste water - ETE; implantation of the living museum (boards using QRcode) and distribution of didactic material (Play and Learn booklets). In this place the children are welcomed and remain for a day or more and participate in excursions in each one of the actions, first aid training with firefighters, in an instructive process where apply learning to do and to do to learn. They are explanations of each activity or solutions with lectures with professionals of high university level on the environment and also participate effectively in the planting of native trees in places of recovery of degraded areas. These actions of environmental education and citizenship have brought countless results through the testimony of family members and the community in which they live and even observed improvements in behavior, as responsible for environmental actions and surveillance in the SUSTAINABLE MAANAIM CITY.

Keywords: Soil, education, public awareness
Financial support:

(4682 - 1718) Reflections on the Gender Distribution and Parity of U.S. Soil Scientists

Chelsea Duball[1]; Karen Vaughan[1]; Amanda Pennino[1]; Yamina Pressler[2]; Eric Brevik[3]; Caitlin Youngquist[4]; Lorenne Lynn[5]; Samantha Ying[6]; Pam Thomas[7]

University of Wyoming[1]; Colorado State University[2]; Dickinson State University[3]; University of Wyoming Extension[4]; Red Mountain Consulting[5]; University of California, Riverside[6]; United States Department of Agriculture[7]

Most soil scientists have a personal impression about the distribution of female and male soil scientists in the United States. Until this time, no data were readily available to guide a discussion on the state of gender parity within soil science. In order to determine the gender distribution, data were collected on the gender of individuals employed by the federal government as soil scientists, academic faculty in soil science, private consulting soil scientists, professional society membership in soil science, and graduate students studying soil science. Unsurprisingly, we found that women make up approximately 27% of the professional soil scientists within the employers and groups stated above. Female federal soil scientists make up 26% of the workforce with greater percentages in the middle grades (9 and 11) than in the lower (3 and 5) and upper (12, 13, 14, and 15) grade levels. The overall distribution among soil science faculty is 24% female, however, distributions varied across faculty level, with assistant, associate, and full professors being 36%, 24%, and 18% female, respectively. Faculty gender distribution also varies considerably as a function of sub-discipline, ranging from 13 to 51% female for soil fertility specialists and soil ecologists respectively. Professional soil scientists in consulting positions are approximately 26% female, however, these data are more challenging to collect without a centralized database or uniformity in job titles. Twenty-seven percent of the membership of the Soil Science Society of America is female with 26% and 11% of division chairs and board representatives being female respectively. The gender distribution of graduate students studying soil science is more evenly split with 54% female M.S. students and 53% female Ph.D. students. With these data in hand, we can begin to unfold the complexity of gender equity in soil science, examine what gender parity should look like in soil science, and identify steps, if necessary to obtain parity.

Keywords: Gender, soil science, diversity, career, equity
Financial support: All voluntary

(7419 - 3199) Regional Cooperation and Soil Awareness Raising for Sustainable Soil Management in Alps – the EU Interreg Links4Soils Project

Borut Vrščaj[1]
Agricultural Institute of Slovenia, Department of Agricultural Ecology and Natural Resources, Ljubljana, Slovenia[1]

The contribution discusses and points-out the importance of soil awareness rising and trans-border cooperation for better management and protection of soils. A self-reflection of a 'soil person' that deals with soils, land uses, soil quality and soil information quite some time, reveals the fact that soil science is still not successful enough in conveying the product of soil research (soil knowledge, soil information, soil awareness) to a variety of end-users of different sectors. At the same time it was recognised that recent global and regional soil awareness rising, a very much needed activities, are too often (or traditionally?) neglected by soil scientists, soil experts and even professors of soil science. The contribution presents the EU Links4Soils Interreg project that aims to mitigate sustainable soil management gaps by improving the systematic applicability of the Soil Protection Protocol of the Alpine Convention by raising awareness on soils amongst observers and stakeholders of different sectors. In particular, it focuses on linking (soil) experts and decision makers, creating a trans-border community dedicated to soil protection within a specific European region – the Alps. The important project aims are collection of existing Alpine and national soil data to generate user-friendly and applicable soil information, transfer of soil knowledge and best soil management and protection practices to policymakers and other stakeholders, and promotion of efficient soil protection strategies through the web-based Alpine Soil Platform. Very important project goal is the establishment of the Alpine Soil Partnership, a voluntary community of individuals, institutions, administrative bodies, soil experts, public servants, experts, NGOs and environmentalists committed to soil protection and sustainable management of Alpine soil resources. The Links4Soils project aims to generate an example of regional and transborder cooperation on sustainable soil management and protection in environmentally specific area (Alps) of six EU countries (Austria, Germany, France, Italy, Switzerland and Slovenia) and to act as a sub-regional initiative following the Global and European Soil Partnership, important soil awareness raising and soil protection activities coordinated/lead by the FAO.

Keywords: soil awareness, Interreg, Alpine Soil Partnership
Financial support: EC, Interreg Alpine Space Programme, www.alpine-space.eu, Links4Soils

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WG01 Cryosols: Progress in understanding the dynamic soils of colder regions

(6187 - 1625) Genesis and diversity of loamy soils in Middle Taiga Zone of Siberia

Golovleva Iuliia[1]; Krasilnikov Pavel[2]; Korkina Elena[3]; Konyushkov Dmitry[4]
Lomonosov Moscow State University, Departments of Soil Science, Leninskie Gory 1, building 12, Moscow, 119991, Russia (Julango85@gmail.com)[1]; Lomonosov Moscow State University, Departments of Soil Science, Leninskie Gory 1, building 12, Moscow, 119991, Russia[2]; Nizhnevartovsk State University, Faculty of Ecology and Engineering, Dzerzhinskogo Street 11, Nizhnevartovsk, 628615, Russia[3]; V.V. Dokuchaev Soil Science Institute, V.V. Dokuchaev Soil Science Institute, Pyzhyovskiy lane 7, building 2, Moscow,119017, Russia[4]

Pedogenesis in Siberia occur in cold environment, and in the past the climate was even colder and permafrost was more common than now that implies the development of cryogenesis both in the present and in the past. The presence of texturally differentiated and practically undifferentiated soils at relatively short distances may be explained by the differences in hydrothermal regimes, which depend on topography, lithology and vegetation of particular sites. We aimed at revealing the dependence of processes leading to the formation of textural differentiation in loamy soils in the Middle taiga zone of Siberia on past and present pedoenvironments. The research was done in Western and Eastern Siberia. Western Siberia is characterized by flat topography. The climate is moderately cold with mean annual temperature -4 -2°C, mean January temperature -20°C and mean June temperature +18°C. The annual precipitation is 580 mm. The area has insular permafrost. Central Yakutia (Eastern Siberia) is located on plateau. Its climate is more continental with mean annual temperature -10.2°C, mean January temperature -38,6°C, and mean June temperature +19,5°C. The annual precipitation is 238 mm. The area has continuous permafrost. Both are covered with taiga forests with larch, pine and Siberian pine. The parent materials of the studied soils are loams, sandy loams, sands of alluvial and ancient alluvial origin. Soil pits on the Severo-Sosvinsk Upland, the Agan Uval, the left bank of the Kiryas's distributary in Western Siberia and the Prilenskoye plateau in Yakutia were studied. Soils is brownish and pale colors with specific caviar and cryo-platy structures, which are typical for permafrost-affected soils. Micromorphological study of soil thin sections in transmitted and reflected light showed the presence of rounded aggregates. Soil pairs with and without textural differentiation were identified as Cambisol and Alisol in Western Siberia, and Cryosol and Planosol in Eastern Siberia. We hypothesized that as a result of divergent evolution under similar conditions, there was a discrepancy between the types of soils studied. The texturally differentiated loamy soils can be formed in warmer areas and earlier thawing, and are characterized by leaching water regime practically throughout the growing season. In recent decades, global climatic changes have been observed, which have an impact on current soil formation, and can lead to increased differentiation processes in soil.
Keywords: permafrost, texturally differentiated soils, climatic change, divergent evolution
Financial support: This work was supported by the grant of Russian Science Foundation a No. 17-17-01293

(7864 - 445) Greenhouse gas fluxes from forest soil in an upland black spruce stand in interior Alaska

Tomoaki Morishita[1]; Kyotaro Noguchi[1]; Yojiro Matsuura[1]; Yongwon Kim[2]
Forestry and Forest Products Research Institute[1]; University of Alaska Fairbanks[2]

Forest soils are sources of CO_2 and N_2O, and a sink of CH_4 those are konwn as greenhose gases. The purpose of this study is to evaluate the annual changes of these gas dynamics in an upland black spruce forest in interior Alaska. The study was conducted near Fairbanks in interior Alaska (65^{O}N, 147 ^{O}W). Three experimantal plots were set in black spruce stand (Picea mariana) those were upper (U), middle (M), and lower part (L) on a slope. Biomass of the trees, organic layer depth, and the species of moss and lichen were different among the plots. Soil CO_2, CH_4, and N_2O fluxes were measured by using a closed chamber technique. The differences of soil temperature and moisture were not clear smong the plots. The CO_2 flux at L was higher than that at U, maybe due to deep organic layer. On the other hand, the CH_4 uptake was relatively higher at U than at L. The N_2O flux was negligible small at all plots. At each plot, the CO_2 flux was positively correlated with soil temperature, on the other hand, the CH_4 uptake was negatively correlated with soil moisture. It was suggested that these gas fluxes were different among the plots due to the depth of organic layer and soil moisture.
Keywords: Alaska, black spruce, CO2, CH4, N2O
Financial support: JSPS KAKENHI Grant Number JP15H05238 and JP16H05790

(8344 - 850) Influence of 100 artificial freeze-thaw cycles on soil formation and microbial community structures on James Ross Island, maritime Antarctica

Lars Arne Meier[1]; Patryk Krauze[2]; Isabel Prater[3]; Thomas Scholten[1]; Dirk Wagner[4]; Carsten W. Mueller[3]; Peter Kühn[1]
University of Tuebingen, Department of Geosciences, Chair of Physical Geography and Soil Science, Tuebingen, Germany[1]; GFZ German Research Centre for Geosciences, Helmholtz Centre Potsdam, Section 5.3 Geomicrobiology, Potsdam, Germany[2]; TU München, Lehrstuhl für Bodenkunde, Freising, Germany[3]; GFZ German Research Centre for Geosciences, Helmholtz Centre Potsdam, Section 5.3 Geomicrobiology, Potsdam, Germany / University of Potsdam, Institute of Earth and Environmental Science, Potsdam, Germany[4]

An important question related to Antarctic research is how soil formation and microbial communities are affected by changes in climate conditions, such as higher temperatures and humidity. We explore this together with the fundamental question of how biotic and abiotic processes interact in a unique environment such as James Ross Island, eastern Antarctic Peninsula Region. Microbial communities (bacteria, archaea and fungi) are primarily controlling soil biological and chemical processes in the extreme environment of this region, a landscape characterized by a mean annual air temperature < 0° C and the absence of higher plants and borrowing animals. We investigate potential effects of changes in temperature and humidity on soil-forming processes, and responses of microbial communities on James Ross Island by conducting an incubation experiment. Samples from two sites (St. Martha Cove and Brandy Bay), which are similar in relief and parent material, but differ in position relative to the most southwestern winds, were collected during a field campaign in 2016. With respect to spatial heterogeneity, we sampled a central profile together with 12 additional satellite samples at a distance of 2 m and a depth of 0-20 cm. All samples were bulked and partially sterilized to obtain control samples. The prepared samples were exposed to 100 freeze and thaw cycles (-5°C - +5°C) at two different, constant soil moisture levels (40% and 80%). We will present the results of pH, EC, CNS, TIC, TOC, DNA content, microbial abundance and micromorphological analyses of the freeze-thaw cycle 0 compared to the results after 100 freeze-thaw cycles.
Keywords: Climate change, Incubation experiment, Permafrost-affected soils, Pedogenesis, Microbial communities, Maritime Antarctica
Financial support:

(6205 - 1650) mineralogical transformations and microchemistry of acid sulphate soils in Antarctica

Daví do Vale Lopes[1]; Fábio Soares de Oliveira[1]; José João Lelis Leal de Souza[2]; Carlos Ernesto G.R. Schaefer[3]; Luís Flávio Pereira[3]

Federal University of Minas Gerais (UFMG)[1]; Federal University of Rio Grande do Norte (UFRN)[2]; Federal University of Viçosa (UFV)[3]

The oxidation of sulphides is the most important pedogenetic process in acid sulphate soils from Antarctica. Although sulfate soils have been previously reported, no detailed study about microanalysis and its effect on pedogenesis has been carried out. The present study characterizes mineralogy and microchemistry of acid sulphate soil found in ice-free areas of Barton Peninsula, King George Island, Maritime Antarctica. Three pedons were selected, described, sampled, classified and soil microchemical/mineralogical properties were analyzed. The mineralogy was determined by X-ray diffraction (XRD) on powdered samples. The clay was separated by the centrifuge method and was subjected to the following treatments prior to analysis: removal of kaolinite with 5 M NaOH and iron oxides with dithionite-citrate-bicarbonate (DCB). Undisturbed soil samples were collected, dried at 40 °C and impregnated with resin for microchemical analysis. Glass slides were analyzed by means of polarizing microscope. Microanalysis (chemical maps and quantitative point analysis) were examined under a Transmission Electron Microscope Zeiss and Scanning Electron Microscope coupled to the X-ray tube. This study indicates that precipitation of secondary crystalline iron oxides results from an unusual pedogenic processes to Antarctic conditions. The XRD patterns in the clay fraction revealed the presence of chlorite, montmorillonite, Na-plagioclase, illite, pyroxene and goethite. The iron oxide removal treatment by DCB was efficient for the complete removal of goethite. Two microchemical domains were recognized, ferruginous microsites and other domain more diverse chemical composition, involving, in addition to Fe, higher content of Al and S. The chemical composition of the concretions involves reached more than 73% iron. This accumulating evidence that acid environment is able to enhance metal mobilization in soil system, landscape shows an important role of Fe mobilization along the slope, as well as freezing and thawing cycles. The microchemical results suggest a direct mineralogical transformation system of primary and/or secondary sulphides to iron-rich mineral phases. The sulfurization is chemical process that promote strong soil acidification and accelerate mineralogical changes even under periglacial conditions.

Keywords:oxides; ferruginousmicrosites; pedogenesis; Antarctica

Financial support: CAPES, CNPq.

(1243 - 819) Modern dynamics of cryolithozone soil cover in siberia under conditions of climate change

Desyatkin R.V.[1]; Desyatkin A.R.[1]; Okoneshnikova M.V.[1]; Ivanova A.Z.[1]; Fedorov P.P.[1]; Filoppov N.V.[1]

Institute for biological problems of cryolithozone SB RAS, Yakutsk[1]

Large areas on the Earth are occupied by permafrost. The center of continuous permafrost is located on Eastern Siberia and has a depth of 500-700 m with ground temperatures from -3 to -15 °C. In the lowland and plain areas, the permafrost layer contains huge reserves of underground ice named ice complex. Modern climate changes, primarily the increase in air temperature, had a significant impact on the state of permafrost soils. During the 1966-2009 period, average annual air temperature in Yakutsk increased by 3 °C, Verkhoyansk - 1.8 °C and Oymyakon - 2.2 °C. Such dynamics of the average annual temperature caused an increase in the temperature of the upper layers of frozen soils by 0.4-1.3 °C, which caused an increase in the depth of soils summer thawing and activation of cryogenic processes. Degradation of ice began in the open and disturbed parts of the cryolithozone. Especially active thermokarst is manifested in abandoned arable lands and other territories with disturbed vegetation (fires, clear cutting, destruction of forest from insects, etc.) covering an area of hundreds and thousands of hectares. The melting of ice complex and associated deformations in the relief cause a transformation, and subsequently a degradation of the natural soil cover of the boreal taiga. The initial stage of soil transformation leads to a disruption of the morphological structure of the soil profile and water-physical properties. Further activation of thermokarst leads to complete degradation of the soil cover and flooding it by primary thermokarst lakes. The ongoing climatic changes will cause an intensification of thermokarst processes in the future, and in the coming decades (centuries), complete degradation of the soil cover on large territories with an ice complex with complete loss of soil fertility can occur. Further development of soils in these areas will proceed according to the type of alas soil formation. It is established that an increase in the depth of seasonal thawing of permafrost soils leads to a change in the water regime of soils. In the upper layers of permafrost soils (depth 1.5-5 m) under larch, pine and birch forests in Central Yakutia, in each 10-cm layer there are 25-40 mm of moisture. An increase in the soil thawing depth by only 10 cm results in the release of moisture reserves that have been preserved by permafrost for up to 30,000 t/km^2 of water. Abrupt increase in soil moisture affects the water balance of large areas on the permafrost zone.

Keywords: Cryolithozone, soil cover, global change, soil transformation

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(4373 - 1588) Soil climate and active layer depth, Ross Sea Region, Antarctica

Annette G. Carshalton[1]; Megan R. Balks[1]; Karin R. Bryan[1]; Cathy A. Seybold[2]

University of Waikato[1]; NRCS, USDA, Lincoln, Nebraska, USA[2]

The depth of seasonal thaw (the active layer), is a good integrator of a range of climate variables and has potential to provide a clear signal of climate change. Soil and permafrost climate monitoring has been undertaken in the McMurdo Dry Valleys across 9 stations: Mt Flemming (1700 masl, established in 2002); Wright Valley South Wall (700 masl, established in 2011); Wright Valley North Wall (835 masl, established in 2012); Wright Valley Floor (150 masl, established in 1999); Victoria Valley (410 masl, established in 1999); Marble Point (50 masl, established in 1999); Scott Base (38 masl, established in 1999); Minna Bluff (37 masl, established in 2003); and Granite Harbour (4.5 masl, established in 2003). At each monitoring station soil temperatures are measured at a range of depths down to 120 cm. Wind speed and direction, air temperature, relative humidity, and solar radiation are also monitored. Atmospheric data are measured every 10 seconds, and soil temperature every 20 minutes, with hourly means recorded. The data are downloaded annually. Mean active layer depths ranged from 7.5 cm at Mt Flemming, through to 37.5 cm at Wright Valley South Wall, 40 cm at Wright Valley North Wall, 23.5 cm at Victoria Valley, and 50 cm at the Wright Valley floor, to 47 cm on the coast at Marble Point. At the remaining coastal sites mean active layer depths ranged from 36 cm at Minna Bluff, through 34 cm at Scott Base, to 81 cm at Granite Harbour. There was a moderate correlation between active layer depth and altitude (R^2 = 0.7). There was marked between-season variability, however, no distinct warming or cooling trends are evident over the length of the record. The lag between maximum soil temperature at the soil surface and maximum temperature near the permafrost interface was; 15 days at Mt Flemming, 11 days at Wright Valley South Wall, 20 days at Wright Valley North Wall, 22 days on the Wright Valley Floor, 18 days at Victoria Valley, 22 days at Marble Point, 17 days at Minna Bluff, 21 days at Scott Base, and 10 days at Granite Harbour.

Keywords: Change, permafrost, temperature, Dry Valleys

Financial support: Antarctica New Zealand; Ross Sea Region Terrestrial Data Analysis research programme - C09X1413

(8360 - 3235) Spatial heterogeneity and environmental controllers of

permafrost SOC stocks

Umakant Mishra[1]; Julie Jastrow[1]; Roser Matamala[1]

Argonne National Laboratory[1]

Permafrost affected soils are a key component of the global carbon cycle and play an important role in moderating the global climate system. Previous permafrost soil organic carbon (SOC) stock estimates used a variety of upscaling approaches and reported substantial uncertainty in SOC stocks estimates. In this study, we used spatially referenced data of soil-forming factors (topographic attributes, land cover types, climate, and bedrock geology) and SOC pedon description data (*n = 2552*) in a regression kriging framework to predict the spatial and vertical heterogeneity of SOC stocks across the Northern Circumpolar and Tibetan permafrost regions. Our approach allowed us to take into account both the environmental correlation between SOC and environmental factors and the spatial autocorrelation among SOC observations to separately estimate SOC stocks and their spatial uncertainties (90% CI) for three depth intervals at 250 m spatial resolution. In Northern Circumpolar region, our results show 510 (449 – 572), 355 (324 – 401), and 298 (255 – 348) Pg C in 0 – 1, 1 – 2, and 2 – 3 m depth intervals, respectively. In Tibetan region, our results show 11 (9 – 13), 3 (0.5 – 6), and 3 (1.4 – 5) Pg C in 0 – 1, 1 – 2, and 2 – 3 m depth intervals, respectively. We captured large spatial variability (13 – 129% coefficient of variation) depending upon the study region and depth interval. Our estimates show larger uncertainty range in 1-2 m depth interval in both permafrost regions. Soil wetness index and elevation were significant controllers of SOC stocks in both permafrost regions. Surface air temperature was only significant controller of permafrost SOC in the circumpolar region. However, precipitation was a significant controller in the Tibetan region. Similarly bedrock geology, which was a significant controller of SOC in circumpolar region, was not a significant controller in the Tibetan region. Flat areas (<2% slope angle) stored largest amount of SOC in the Northern circumpolar region, whereas hill toe-slope positions stored largest amount of SOC stocks in the Tibetan region. Largest uncertainty in SOC stocks (27%) was found in the hill toe-slope positions in the circumpolar region whereas the uncertainty was highest (62%) in flat areas in the Tibetan region. We think our results provided the first global assessment of permafrost SOC stocks and quantified their relations to environmental factors at a high spatial resolution (250-m).

Keywords: Tibet, Northern Circumpolar, Permafrost Carbon Network
Financial support: Argonne National Laboratory

(3629 - 384) Statistical analysis of the soils of the James Ross Islands Group, Antarctica

Mayara Daher de Paula[1]; Carlos Ernesto Gonçalves Reynaud Schaefer[1]; Elpídio Inácio Fernandes Filho[1]; Matheus Manso Cóser[1]

Universidade Federal de Viçosa[1]

The James Ross Islands Group (JRIS) is located southeast of the Antarctic Peninsula and consists of four main islands: Vega, James Ross, Seymour and Snow Hill, and several smaller islands: Cockburn, Lockyer, Humps, among others. The present study includes three JRIS islands (Cockburn, James Ross, and Seymour), where 71 soil profiles were collected. The descriptive statistical analyzes included the calculations of mean, median, the coefficient of variation (CV), maximum values and minimum values of the physical and chemical properties of the soils. Statistical analyzes were performed in R program. The results of the statistical analysis of the soils showed that there is a great difference between the maximum and minimum values of all the properties of the soils. Mean and median values were close to the physical properties, and some chemical, such as pH, Mg, base sum, base saturation, CTC at pH 7.0 and effective CTC. In the soil properties in which the mean and median values are very different, the values of medians are always lower, indicating that the maximum values were responsible for the increase of the average, with emphasis on the values of Na and P (Mehlich-1). Regarding the coefficient of variation (CV), K, Na, and P (Mehlich-1) had the highest CV (>250 %). The other properties had CV <24 %. The studied profiles presented texture with a greater sand contribution (65 %), revealing the predominance of physical weathering in these soils, to the detriment of chemical weathering. However, in certain areas, the chemical weathering and/or the source material demonstrated more influence. An example is the high clay content (58 %) in a profile on Seymour Island, related not only to the sedimentary material but also to the sulfurizing process. The Na median was high (616.8 mg dm^{-3}), reaching maximum levels of 7000.00 mg dm^{-3}. The maximum levels were recorded in the marine terrace, concluding that these salts are originated from marine aerosols. In Seymour Island most of the soils have a sodic character, indicating salinization as one of the main processes of soil formation in this region. The maximum extractable P content by Mehlich-1 was very high, recording the 2018.9 mg dm^{-3} content on Seymour Island. However, the median value of P (Mehlich-1) was only 68.5 mg dm^{-3}, related to the occurrence of penguin nesting, and limited to a few areas of Seymour Island.

Keywords: Cryosolos, periglacial soils, soil process formation
Financial support: CAPES and FAPEMIG

WG02 Digital soil mapping: Progress in digital soil mapping

(6256 - 1937) Applying machine learning methods for large-scale soil types prediction

Anna Petrovskaia[1]; Nikolai Lozbenev[2]

Skolkovo Institute of Science and Technology, Moscow, Russia[1]; Dokuchaev Soil Science Institute, Moscow, Russia[2]

One of the main challenge to digital soil mapping nowadays is giving the formal account of the soil mapping process, which implies all stages of the cartographic data model development. The complexity of soil-landscape relationships determination encourages soil scientists to use modern powerful instrument - the methods of the machine learning. Model of soil-landscape relationships was constructed in our study using four machine learning methods: linear discriminant analysis, random forest, supported vector machine and bayesian neural network. The model is then applied to predict probability of each soil class and find dominant soil on a fine-scale key plot. Field data for providing this study were collected in 2013-2016 during detailed mapping of the soil cover in the virgin forest-steppe of the Central Russian Upland. The source materials include a digital elevation model (DEM) with a resolution of 2.5 m, created by more than 10000 points of GNSS survey. Soil data consist of 157 soil descriptions and the depth of the top of the calcic horizon. The soil points were located considering specific hollow microrelief of virgin forest-steppe. It was revealed that soil cover of the study area is presented by four soil types ("Classification and Diagnostics of soils of the USSR", 1977): chernozems typical, chernozems typical mycelial-calcareous with bioturbations, chernozems leached, meadow-chernozemics. The main factor of soil cover differentiation is runoff depth, which determines the depth of carbonates occurrence in the soil profile. Therefore, the models were created based on a set of drainage morphometric parameters that describe distribution of soil moisture by microrelief. The parameters were calculated from DEM. Models of soil-landscape relationships were created in the R environment. The comparison of the obtained models were made by the overall accuracy (the correspondence between the simulated and actual soil types in particular point), by the Cohen's kappa coefficient, which takes into account the possibility of the variables agreement occurring by chance, and by the assessment of expert. In general, all four models have high predictive accuracy (at least 70%).

Keywords: Digital soil mapping, machine learning, model comparison
Financial support: This study was supported by the Russian Science Foundation (project No. 15-16-30007).

(9489 - 440) Artificial neural networks and object-based classification

for digital soil mapping

Fabrício Fernandes Coelho[1]; Elvio Giasson[1]; Alcinei Ribeiro Campos[1]; José Janderson Ferreira Costa[1]; João Augusto Coblinski[1]; Elisângela Benedet da Silva[1]

Universidade Federal do Rio Grande do Sul[1]

Detailed soil maps are not available in most of the Brazilian territory. Remote sensing data and artificial intelligence techniques can be integrated into an object-based classification to improve spatial prediction of soil class and soil map availability. This work aimed (i) to compare the spatial predictive of soil class of Artificial Neural Network (ANN) and Decision Trees (DT), (ii) to produce digital soil maps by an object-based classification. The study area is located in northwest Rio Grande do Sul State, southern Brazil. The surface area is 900 km². In this area, there are four soil orders: Oxisols, Molisols, Inceptisols and Entisols. Normalized Difference Vegetation Index (NDVI), Normalized Difference Water Index (NDWI) and Normalized Difference Soil Index (NDSI) were derived from Landsat 8 OLI (Operational Land Imager) sensor imagery. Fifteen terrain attributes were derived from SRTM (Shuttle Radar Topography Mission) using RSAGA package in RStudio environment. This spectral indices and terrain attributes were used as discriminating variables. The multiresolution segmentation (MRS) algorithm (eCognition Developer 9.0) was used to create image objects. The shape and compactness criterion were 0.1, the scale parameter (SP) tested were 1, 2, 5, 10, 25 and 50. Three classification repetitions with Multilayer Perceptron (ANN), Simple Cart (DT) and J48 (DT) algorithms were performed with 4993 random samples using cross-validation technique (5 folds) in Weka Experiment Environment. The algorithm with the greater overall accuracy (OA) was used to object-based classification. The object-based digital soil maps accuracies were evaluated by the agreement with a legacy soil map. The Multilayer Perceptron algorithm had the highest OA (61%), followed by Simple Cart (59%) and J48 (52%). The MRS provided the reduction from 999,206 pixels to 23,616 (SP 1), 9,528 (SP 2), 3,658 (SP 5), 2,350 (SP 10), 1,769 (SP 25) and 1,660 (SP 50) image objects. The object-based approach OA with original legend were 62% (SP 1), 60% (SP 2), 57% (SP 5), 53% (SP 10), 50% (SP 25) and 45% (SP 50). The object-based approach OA with simplified legend were 77% (SP 1), 75% (SP 2), 72% (SP 5), 69% (SP 10), 66% (SP 25) e 62% (SP 50). The classifier based on ANN had the higher OA than the classifiers based on DT. Larger SP provides greater object's size and smaller its number to classify thus reducing the OA. The object-based classification is a promising approach for digital soil mapping.

Keywords: multiresolution segmentation, multilayer perceptron, data mining

Financial support:

(8818 - 2256) Calibration of a pedological conceptual model for digital soil mapping in Colombia. Case study municipality of La Virginia, Risaralda.

Yolanda Rubiano Sanabria[1]; Edinson Chacon Pardo[1]; Juan Carlos Loaiza Usuga[2]; Luis Marino Santana[3]

Universidad Nacional de Colombia, Campus Bogotá[1]; Universidad Nacional de Colombia, Campus Medellín[2]; Universidad del Valle[3]

It is necessary to improve and generate a regional pedological conceptual model for soils in Latin America. In this way, knowledge of the genesis of the soil could be linked to soil properties through the use of digital soil mapping tools (DSM). A pedological conceptual model was generated and calibrated in field conditions. The model is based on structural equations (SEM) to predict the horizontal and vertical distribution of clay, sand, silt, fragments, pH and organic carbon (CO) in the horizons A, B and C of the soils of La Virginia, Risaralda, Colombia (1700 ha). The most representative factors and processes of soil formation in the study area were identified to define the conceptual model (soil-landscape relationship.) Factors and processes were associated with the properties of the soil modeled, and with these relationships the SEM graphical model The SEM equations were derived and implemented in the R program using the latent variables analysis (washing) package The model was calibrated with the data of 15 modal profiles, 140 detailed observations and eight layers of environmental covariance. Five maps of soil properties and the SEM diagram that shows the relationships between the properties of the soil under analysis, the accuracy of the maps was estimated using the cross validation approach, while the overall precision was determined using the error medium quadratic (RMSE), the predicted properties, clay content and pH showed the highest precision. To the environmental covariates, the attributes of the terrain and the material of the parents were the best predictors among the different auxiliary variables studied. Similar models have been applied in soils of the Argentine pampas, demonstrating that the integration of the knowledge and experiences of Latin America to generate more representative pedological models of the region is a priority

Keywords: auxiliary variables, DSM, SEM

Financial support: Instituto Geográfico Agustín Codazz; Universidad Nacional de Colombia, Campus Bogotá

(1001 - 1982) Digital segmentation of hillslope position to improve detailed soil mapping

Karina P. P. Marques[1]; José A. M. Demattê[1]; Bradley A. Miller[2]; Igo F. Lepsch[1]

Department of Soil Science, "Luiz de Queiroz" College of Agriculture, University of São Paulo, Pádua Dias Avenue, 11, CP 9, Piracicaba – São Paulo, Code 13418-900, Brazil.[1]; Department of Agronomy, Iowa State University, Ames, Iowa, USA; Leibniz Centre for Agricultural Landscape Research (ZALF) e.V., Institute of Soil Landscape Research, Eberswalder Straße 84, 15374 Müncheberg, Germany.[2]

Exploratory or reconnaissance soil maps cover most of the Earth's ice-free land surface. These maps were produced using knowledge of soil-landscape relationships, which is largely based on the tacit knowledge of field experienced pedologists. A quantitative approach to generate and store information of the landscape characteristics would be useful to make this knowledge explicit to improve soil mapping in an objective, consistent, updatable, and reproducible method. Among the detailed landscape features, hillslope elements have considerable potential to predict the soil attributes and types because they identify functional zones in the context of water and sediment flow in a landscape. The purpose of this research was to apply a previously developed digital hillslope position (DHP) model, calibrate it as needed to a Brazilian landscape, and test its utility as a basis for identification of detailed soil map units. The study area covers 2,500 ha and is located on the border between the municipalities of Piracicaba and Santa Bárbara d'Oeste, São Paulo state, Brazil. A digital elevation model, with spatial resolution of 5 meters, was used to obtain slope gradient, profile curvature, and relative elevation with different analysis scales. Hierarchical rules for these digital terrain derivatives were used to identify the hillslope position. The DHP model was validated by identifying the hillslope position in the field and comparing it with the model classification using the Kappa index and a confusion matrix. Soil samples were collected across multiple hillslopes with different lithologies. These samples were analyzed for chemical composition and particle size distribution, and their results were assessed for statistical significance by variance analysis among hillslope position, parent material, and the interaction between the two. After that, student's t-tests were performed iteratively across each hillslope position within a given parent material to identify specifically which soil properties were significantly different among the hillslope position map units. When calibrated to local knowledge of the landscape, the model allowed the hillslope position segmentation with high accuracy. Summit, backslope, and toeslope were the hillslope elements best identified by the method used. Statistical comparison of soil properties between hillslope positions within different parent materials demonstrated that the DHP model can

be useful to identify soil mapping units.
Keywords: geomorphometry; digital terrain derivatives; decision tree; landform; soil mapping.
Financial support: São Paulo Research Foundation - FAPESP (2015/16172-0; 2014/22260-0).

(9443 - 1095) Digital soil mapping in peruvian highlands: predicting soil classes

Carlos Julian Mestanza Novoa[1]; Julio César Nazario Ríos[1]
Universidad Nacional Agraria La Molina[1]

In Peru, the production of soil maps is done using factors of soil formation model. The boundaries of the cartographic units are determined by intersecting physiography, geology and life zones maps, which represent relief, parent material, time, and climate factors. With the peak of digital age, numerical methods to infer and analyze spatial distribution of soils began. The use of statistics to model soil forming factors is called Digital Soil Mapping (DSM). The present investigation seeks to verify this new methodology by establishing a soil map for the agricultural zones of the San Mateo de Otao district in Huarochiri province (Peru) and comparing it with the traditional soil map. Qualitative and quantitative information was used, derived from the digital elevation model, Landsat 8 images, WorldClim information, geological and life zone maps for model estimation. Sampling was done using geopedologic approach. Twenty-one pits and four checkpoints were evaluated and classified to subgroup level using twelfth edition of soil taxonomy. Profiles were modeled using naïve bayes algorithm and twenty covariates of climate, organisms, relief and parent material. The uncertainty measures were obtained with a confusion matrix using the predicted values and checkpoint values. As a result, a map of taxonomic units was obtained, with the subgroups Aridic Haplustolls, Cumulic Haplustolls, and Typic Torriorthents. The global accuracy and Kappa index were 0.75 and 0.50, respectively. The comparison of the map of cartographic units (traditional method) and taxonomic units (digital soil mapping) was carried out by chi-square independence test and visual comparison. The results show a high association (no independence) between both and similar limits between cartographic units and taxonomic units.
Keywords: pedometric mappings, soil forming factors, classification models
Financial support:

(2896 - 2027) Digital Soil Mapping of functional soil properties - Tool for decision making at various levels and a technical training process in El Salvador

Minero Norma[1]; Tobar Jaime[1]; Torres Luis[1]; Vásquez Fernando[1]; Saleh Douglas[1]
Catholic Relief Services[1]

Results obtained through a multi-institutional digital soil mapping training process from a pilot area of El Salvador will be presented. A series of digital maps of continuous properties such as organic matter and effective soil depth were developed. These maps were developed in a training process of government institutions, universities and the development sector with the aim to establish a critical mass of digital soil mapping capacity in El Salvador. Throughout the learning process and validation period the resulting maps were identified as useful information for enhanced decision making at several scales, from farmer's field to country level. Particularly information for soil fertility management and water harvesting are important elements for improved management of rain fed agriculture systems in El Salvador. Although it is very early in the process to talk about the impacts, the project has generated a growing interest in solving the problem of lack of data and information about soils. Different groups in the country receive requests from additional institutions, universities and public-sector entities to join the mapping process. The innovative approach of the mapping process through the creation and strengthening of capacities of multi-institutional groups at a national level facilitated the respect and response to the interests of the participating institutions in the definition of concrete output products (demand), the planning of the work process without data transfer outside the country, and provision of technical assistance according to the needs of each institution. It also facilitated the emergence of strong national leaders for ongoing mapping processes, which is expected to be a key factor for post-project sustainability
Keywords: Keywords: Digital Soil Mapping, map of classes, Digital Elevation Model.
Financial support: Howard G. Buffett Foundation.

(1956 - 3211) High resolution mapping and soil organic carbon stocks in the Colombian savannas.

Mayesse da Silva[1]; Phillip Owens[2]; Zamir Libohova[3]
International Center for Tropical Agriculture (CIAT)[1]; United States Department of Agriculture, Agriculture Research Service[2]; United States Department of Agriculture, Natural Resources Conservation Service[3]

Colombia's economy is highly dependent on agriculture and natural resources. Considered the last agriculture frontier, the Colombian savannas has been highlighted as a key region for future economic and social development of the country. Government projections indicate a potential of 278 percent increase in the area dedicated to annual crops. In order to understand what the consequences of land use might be for the sustainable development in this region, we evaluated the land use effects on soil organic carbon (SOC) stocks in order to guide future land management strategies and monitor changes in ecosystem services in the Colombian savannas. The study was carried out at Meta state in an area of 970,000 ha. Approximately 3,660 soil samples distributed over 158 sites were taken at 8 different soil depths up to 1 meter. SOC and soil bulk density were determined in laboratory and SOC stocks for each sampled depth were calculated. A Digital Soil Mapping (DSM) approach based on expert knowledge and fuzzy logic was used and calibrated for two scenarios: with and without including land use as covariate. About 80% of total field data were used for model development and calibration while the remainder 20% was used for model evaluation and comparison. The results showed that both models predicted well the SOC average when compared with the observed values. However, under both scenarios the maximum and minimum values were underestimated and overestimated respectively. Also, the model that included land use as covariate showed a greater improvement for the first 40 cm of soil depth with a 20% error reduction. The incorporation of land use showed slight or no improvements for SOC for soil layers below 40 cm. The region mapped represents 0.08 Gt of carbon up to 1 m of soil depth. This value constitutes 1% of total global emissions in 2010 in which Colombia contribution was 0.46% (224 Mt de CO_2eq) according to its greenhouse gas emissions (GHG) inventory for the same year. Most of the carbon reserves in this area are found in the first 40 cm of soil accounting for approximately 63% of total carbon (0.05 Gt C). This is also generally the depth of soil management in agricultural lands indicating the need to adopt management practices that enhance carbon sequestration as well as reduce emission. Further estimates of land use change impact in SOC for different scenarios is necessary for adequate planning of management practices and sustainability of environmental resources.
Keywords: digital soil mapping; sustainable development; climate change.
Financial support: Ministerio de Agricultura y Desarrollo Rural de Colombia and Corporación Colombiana de Investigación Agropecuaria (Corpoica). Supported by CGIAR Research Program on Water, Land and Ecosystems.

(1118 - 3175) Incorporating expert knowledge into iterative digital soil mapping

Minerva J Dorantes[1]; Phillip R Owens[2]; Zamir Libohova[3]; Bryan

Fuentes[4]
ORISE[1]; ARS-USDA[2]; NRCS-USDA[3]; University of Arkansas[4]

Soil degradation, water pollution, soil erosion, and a changing climate are just some of the problems that impact food production and ecosystem services in Central America. Understanding the soil resource is integral to managing it efficiently. The current state of soil data limits its use in decision-making for people in this region, many of whom practice subsistence farming from small plots. An initiative began in 2015 to develop new soil maps for El Salvador, Guatemala, Honduras, and Nicaragua that can be used as an instrument for land planning. The project merges the expert knowledge of local scientists with digital soil mapping techniques to develop nationwide, continuous soil property maps. The DSM approach will be presented for a pilot study in El Salvador. Focus will be made on the integration of local scientists' knowledge of the patterns in the area into the predictive mapping model. The first version of the maps will be validated by expert knowledge and statistical analysis and will be used as inputs for the iterative process to produce a more accurate version of the maps.
Keywords: expert knowledge, central america, digital soil mapping
Financial support: Catholic Relief Services, ORISE

(3024 - 1335) Mapping and analysis of soil types in the agro-pastoral transitional landscape system of Bashang area in North China

Zhuodong Zhang[1]; Mingjian Xiahou[1]
State Key Laboratory of Earth Surface Processes and Resource Ecology,Faculty of Geographical Science, Beijing Normal University[1]

There are a wide variety of soil types with high spatial variability in the agro-pastoral transitional zone (APTZ) in North China even at landscape scale, which is a result of the complex soil-forming environment such as the topography, transitional climate and different land uses. In this study, two study areas of different sizes were chosen in the APTZ of Bahsang area in Hebei province, China. In the smaller study area of 18 km^2, traditional soil mapping approach based on field investigation and the other approach Random Forest (RF) algorithm using environmental factors including parent material, climate, topography, hydrology, land use and so forth were employed respectively to identify the spatial distribution of soil types. The results of the traditional method and RF were compared and evaluated. Then, RF was applied to the larger study area of 166 km^2 which covered the smaller one, and the soil type distribution was achieved. Results show that there are eight different soil types in the whole study area, and there is a strong spatial variability of the soil type distribution. The controlling factors of soil type distribution are hydrology, slope, and aspect, which means hydrological conditions, micro topography and micro climate have great influences on soil forming process. RF based digital soil mapping approach shows good performance and high efficiency. Soil mapping is of great importance to the utilization and conservation of soils in the APTZ. Fragile natural environment and serious human disturbance lead to higher risks of soil erosion and degradation in the APTZ. Therefore, conservation tillage and control of the grazing intensity are expected to prevent soil degradation in the APTZ in North China.
Keywords: digital soil mapping, random forest, traditional soil mapping, agro-pastoral transitional zone, Bashang area
Financial support: National Natural Science Foundation of China (Grant No. 41301282)

(8443 - 2121) Mapping soil bulk density in Brazil by machine learning

Raiza Moniz Faria[1]; Lucas Carvalho Gomes[1]; Gustavo Vieira Veloso[1]; Eliana de Souza[1]; Elpídio Inácio Fernandes Filho[1]; Carlos Ernesto Gonçalves Reynaud Schaefer[1]; Márcio Rocha Francelino[1]
UFV[1]

The bulk density is a key soil property that allows understanding soil quality and process, hence using more precise map of bulk density can lead to more effective soil monitoring. To achieve the best performance on bulk density mapping, in this study, we used techniques for selecting powerful variables and robust predictive model to estimate soil bulk density in Brazil territory at five depths (0-5, 5-15, 15-30, 30-60, 60-100 cm). The soil dataset accounted for 37,000 soil samples from 8,227 sites distributed across Brazil. A total of 62 spatial dense maps of environmental variables used as predictors variables, with 1 km resolution, included map of soils, vegetation, lithology, terrain attributes and bioclimatic variables (temperature and rainfall). For each soil depth the most important variables were selected by applying the Recursive Feature Elimination algorithm, implemented in R software and the bulk density estimated using the Random Forest algorithm. The most important variables were soil class map, Gross primary production vegetation index, slope height, latitude, topographic wetness index and NDVI index. Model assessment with external validation showed R^2 range from 0.36 to 0.40, related to the depth 60-100 and 15-30 cm, respectively. The average value of bulk density was 1.30 kg / dm^3. Overall, bulk density in depth, showed lower variation with no evident abrupt changes in the soil texture, in soil types where this change usually happens. The highest values of bulk density occurs in the North of Minas Gerais State, Northeast and the Midwest of Brazil, with values around 1.35 kg / dm^3. The lowest values are in the southern Brazil. The variables selection proceed allowed to reduce the number of predictor with good performance of Random Forest on mapping bulk density at all depth
Keywords: pedotransfer functions, digital soil mapping, random forest, feature selection
Financial support: UFV

(8034 - 3166) Morphometric functional units as an input for inferring the spatial variability of soils

Bryan Fuentes[1]; Phillip R Owens[2]; Zamir Libohova[3]; Minerva J Dorantes[4]
University of Arkansas[1]; USDA - University of Arkansas[2]; NRCS[3]; ORISE[4]

Data mining techniques are useful to identify patterns associated with datasets. Among data mining techniques, clustering is an efficient way to group data into homogenous units based on similar criteria. When no prior knowledge of the data under analysis exists, clustering can recognize patterns that become useful for subsequent analysis. Given the complex nature of terrain, hardening continuous morphometric derivatives into homogenous classes becomes useful when analysis based on discrete units, rather than on pixels, is needed. This research aims to perform an exploratory analysis of different clustering techniques and to evaluate the perfomance of clustering algorithms in hardening morphometric derivatives into classes. The impact of dimensionality reduction of the morphometric derivatives on the quality of the resulting classes, was assesed through expert knowledge of the study area. In addition, a comparison of different statistical indices to select the optimum number of classes was conducted. The final selection of the tested algorithms and parameters was made based on the performance of the classes as inputs for a predictive soil mapping model.
Keywords: Clustering; morphometry; digital soil mapping
Financial support: USDA - University of Arkansas cooperative agrément

(7888 - 2144) Soil pH spatial distribution with digital soil mapping (DSM) in central Andes of Peru

Julio Cesar Nazario Rios[1]; Carlos Julian Mestanza Novoa[1]; Guillermo Federico Olmedo[2]; Domingo Marcelo Portuguez Maurtua[1]
Universidad Nacional Agraria la Molina[1]; EEA INTA - Mendoza[2]

In last years, climate change has alerted about the influence of human activities on natural resources. Activities such as agriculture require better and detail spatial information for proper management with minimal impact on the environment. Digital soil mapping (DSM) is a tool that allows obtaining high quality information using statistical models to

infer and study soil properties and classes, having assigned error measures that differentiate it from traditional mapping. The present investigation was carried out to determine the spatial distribution of soil pH in some areas of six provinces of the department of Junin, in central Andes of Peru, using digital soil mapping. One hundred twenty four randomly distributed sampling points were used in homogeneous units of land whose limits were obtained by combination of physiographic, lithological, and ecological maps. The pH was modelled using regression kriging technique, initially entering 39 covariates that were reduced to 7 by selection with stepwise. The results showed a direct relation between soil pH and the average temperature of the warmest month, Enhanced Vegetation Index (EVI), slope, Multiresolution Index of Valley Bottom Flatness (MRVBF), and some rocks (sandstones and shales, conglomerates, boulders, gravels and sands). On the other hand, and inverse relation was found with the longitudinal curvature, LS factor, and acid intrusive rocks (granite and granodiorite). The spatial distribution of pH is shown in aggregate patterns, with the highest values in alluvial valley of Mantaro and middle basin of Tulumayo, while the lowest values were found in zones of highest altitudes.

Keywords: pedometric mapping, scorpan, soil mapping
Financial support:

(3481 - 3161) Soil property prediction: comparing covariates spatial resolution

Renato Corrêa Taques[1]; Eliana de Souza[2]; Elpídio Inácio Fernandes Filho[3]; Márcio Rocha Francelino[3]; Nerilson Terra Santos[3]
Institute of Research, Technical Assistance and Rural Extension of Espírito Santo - Incaper, Vitória-ES[1]; Federal University of Viçosa – UFV, Av. P.H. Rolfs, s/n. CEP 36570-000 Viçosa (MG) (e-mail: eliana.souza@ufv.br)[2]; Federal University of Viçosa (UFV), Viçosa-MG[3]

This study assessed the prediction of soil properties (pH-H2O, CEC, OC, clay, silt, sand) using covariates with spatial resolution of 90, 30, 10 and 5 m. The study case was carried out for the Rio Pongal basin, in Anchieta-ES, Brazil. The area is 11,000 ha where soil were sampled in 154 sites at 15-30cm depth. A total of 31 covariates were used. The terrain attributes was derived from the digital elevation models (DEM) with different spatial resolutions (SRTM-90m, Aster GDEM-30m; Cartographic base at 1:50,000 scale interpolated to 10m and Aerophotogrammetric survey at scale 1:10,000, interpolated to 5m). From each DEM fourteen terrain attributes were derived: elevation, slope, aspect, curvature, profile of curvature, multiresolution ridge top flatness-MRRTF, multiresolution valley bottom flatness-MRVBF, mean slope position (MSP), terrain ruggedness index-TRI, topographic wetness index-TWI and solar radiation (total solar radiation, direct solar radiation, diffuse solar radiation and duration of direct solar radiation). From gamma-spectrometry (125m spatial resolution) were used images of concentration of thorium-Th, uranium-U and potassium-K. Additionally we calculate the ratio of Th/K, U/K and, U/Th. The bands 2 to 7 of Landsat-8 were used, as well as the indexes: clay mineral index-CMI, iron oxide index-IOI, normalized difference vegetation index-NDVI, and the band ratio band-4/band-3 and band-4/band-7. The approach of covariates selection combined the stepwise method combined with the variance inflation factor. All analyses were run in R program with prediction by Random Forest and accuracy assessed by 5-fold cross-validation. The number of covariates selected per soil property increased with decreasing the spatial resolution. For the 90m dataset was selected between 4 to 9 covariates, whereas for 5m, the datasets contained from 2 to 5 predictors. The most frequent selected attributes, derived from DEM were TWI, slope, MRRTF, MRVBF and direct solar radiation, and from Landsat: (NDVI, B4/B7). From gamma-spectrometry were selected: K, Th and Th/K and U/K ratio. Overall, accuracy using the dataset of 5m was higher than prediction using lower resolution, except for sand and OC, whose best performance were using the dataset of 10 and 30m, respectively. Among soil properties, pH scored the lowest R^2, 0.09 for the best model, while CEC showed the highest (0.40) followed by OC and clay (0.16), silt and sand, 0.13 and 0.09 respectively.

Keywords: Digital soil mapping; organic carbon; Random Forest; variable selection; variance inflation factor
Financial support: Fundação de Amparo à Pesquisa do Estado de Espírito Santo (FAPES) and PNPD/Capes

(4113 - 1977) Validating POLARIS and DSMART disaggregated soil maps using field-scale soil surveys

Jason P. Ackerson[1]
Purdue University[1]

The United States soil database (SSURGO) represents soils as compound classes referred to as map units. Map units are displayed as polygons on SSURGO maps with map units containing several components, or unique soil class. A major limitations of SSURGO is that maps units contain no information on the location of components within polygons. In order to improve the representation of SSURGO data, it is desirable to disaggregate SSURGO polygons into their respective components so the resulting database will have a polygon representing each component. One of the most widely implemented disaggregation tools is DSMART which has been applied to soils in SSURGO in the contiguous United States and published as the POLARIS database. One of the chief challenge with all disaggregation strategies is that ground-truthing maps is difficult due to the expense of developing sufficiently high-resolution component maps. In this paper we utilize existing component-level soil maps developed by USDA soil scientists for agricultural research farms. We use these component-level maps to evaluate the accuracy of POLARIS products and validate the assumptions of the DSMART algorithm.

Keywords: Digital soil mapping, DSMART, disaggregation
Financial support:

WG03 Digital Soil Morphometrics: Soil imaging and image analysis at multiple scales

(6191 - 1775) Assessment of water reservoir sediment by ground penetrating radar and x-ray fluorescence analysis

Elaine Caliman Sposito[1]; Athos Alves Vieira[1]; Rafael Gomes Siqueira[1]; Márcio Rocha Francelino[1]; Elpídio Inácio Fernandes Filho[1]; Elton Eduardo Novais Alves[1]
UFV[1]

Currently, around estimated 80% of the world's population is exposed to risks related to water security. Brazilian National Water Agency (ANA) predicts future deficits in water supply in more than half of the Brazilian municipalities due to lack of infrastructure and investments. Thus, protecting the world's freshwater resources requires diagnosing threats at global and local scales. Similar to what happens in other cities, Viçosa, in Minas Gerais State (Brazil), has been frequently exposed to deficit of water supply to the population. Since 2014, Viçosa has accumulated precipitations below the historical average. In Viçosa, there are two water treatment plants, and one of them uses water from the reservoir located on the campus of the Federal University of Viçosa. Over the last year, this dam has been suffering silting process with sediments coming from the São Bartolomeu stream basin, upstream of the catchment area. In order to evaluate the thickness of the deposition layer near the reservoir, a Ground Penetrating Radar (GPR) equipped with a 200 MHz antenna was used. Auger observations were carried out to calibrate the radargram generated. Sediment samples were collected at twelve different depths and, after their preparation in pellets, analyzed using Energy Dispersive X-Ray Fluorescence Spectrometry (XRF), in order to determine the presence of heavy metals. GPR analysis showed that the reservoir has a sediment layer with 3 m of average depth, which corresponds more than half of lose in the initial water storage capacity of the dam. The chemical elements contents, obtained by XRF, indicated that As, Co, Cr, Cu, Hg, Ni, Pb, V and Zn were higher than the minimal

values established by National Environment Council (CONAMA). In addition, Mn had the highest value observed among heavy metals, which can be related to the yellow color of the water supplied to the population of Viçosa in the second semester of 2017. P content were also high. The use of GPR allowed the evaluation of the layer depth of sediment of the reservoir, indicating that its removal could increase the storage capacity of the water dam. In addition, the analysis with XRF evidenced the presence of heavy metals in amounts above the limits established by regulation, which can lead to health problems to the population.

Keywords: XRF; GPR; heavy metals; water supply
Financial support: CAPES and FAPEMIG

WG04 Global Soil Map: Progress and challenges

(8920 - 1523) A GlobalSoilMap Prototype for the Conterminous United States: Characterizing Uncertainty

Norman B. Bliss[1]

USGS/EROS[1]

The legacy soil survey geographic databases for the United States have been processed to match the standards of the GlobalSoilMap. The source data are primarily from the detailed Soil Survey Geographic (SSURGO) dataset, and areas that are not yet mapped by SSURGO are filled from the General Soil Map (STATSGO2). These legacy databases were developed by the U.S. National Cooperative Soil Survey under the leadership of the U.S. Department of Agriculture, Natural Resources Conservation Service. The source data structure includes map units, which are delineated spatially on a map, and components, which have attribute information representing a percentage of the map unit but are not mapped. Although the 'representative value' for each quantitative attribute was used to calculate the values used for the GlobalSoilMap results, the source databases also include 'low' and 'high' values that can be used to represent the uncertainty. Although the standards for coding 'low' and 'high' values were not well defined, by assuming that they represent a 90% confidence interval, it is possible to estimate the uncertainty for each component. Each component may have a distinct range of 'low' and 'high' values, but the goal is to have an uncertainty measure representing the map unit. I developed a method to create 1000 'pseudo-observations' for the map unit, distributed according to the confidence interval for each component, from which it is possible to determine the 90% or 95% prediction interval for the map unit. This method makes it possible to merge component records with differing confidence intervals into a single map unit prediction interval. Not all data records are populated with the 'low' and 'high' values. For example, in the attribute representing the percentage of sand, only 115,274 of the 309,916 map units (37%) had both 'low' and 'high' values. The size of the 90% confidence interval varies considerably for these records. I developed methods to extrapolate uncertainty estimates to the remaining 63% of the sand records by using other GlobalSoilMap attributes to identify similar soils. For example, the sand percentage has narrower uncertainty ranges near zero or 100% sand, whereas near 50% sand, there is a much larger prediction interval. Providing uncertainty estimates will fulfill a requirement of the GlobalSoilMap specifications and enable these data to be distributed, leading to improved decision making by farmers and resource managers.

Keywords: GlobalSoilMap, Uncertainty, data quality
Financial support: USDA/NRCS, USGS/EROS

(7115 - 288) Comparisons between splines and weighted means for filling missing soil horizon data for GlobalSoilMap standard depths

Zamir Libohova[1]; Phillip R. Owens[2]; Jim Thompson[3]; Skye Wills[1]; Steve Peaslee[1]; Davis Lindbo[4]

USDA-NRCS-National Soil Survey Center[1]; USDA-Agricutural Research Service[2]; West Virginia University[3]; USDA-NRCS-Soil Science Division[4]

The GlobalSoilMap specifications require the generations of high resolution gridded soil property maps for 6 depths (0-5, 5-15, 15-30, 30-60, 60-100, and 100-200 cm) based on equal area splines. The use of equal area spline is advantageous as it provides standardization of soil data from different vintages as well as means to fill in gaps in soil data horizons with missing values. We explore the impact of equal area splines for filling in values for missing soil horizons and/or soil layers and compare them with the weighted mean approach for Soil Survey Geographic (SSURGO) Database, U.S. General Soil map (STATSGO2) and Kellogg Soil Survey Laboratory (KSSL) National Cooperative Soil Survey Soil Characterization Database (Pedons). The correlations coefficients between adjacent layers were significant and varied from 0.37 to 0.99 depending on the soil property and depth across all three databases. The correlation coefficients were higher for the adjacent surface horizons varying from 0.80-0.99 compared to the one- (0-5 vs. 15-30 cm) to five-removed (0-5 vs. 100-200 cm) varying from 0.95 to 0.09. Within each soil database the correlation coefficients between splined and weighted means were comparable with a mean difference of only 0.02 for SSURGO and 0.04 for STATSGO2. For all the depths combined the correlation coefficients were higher for STATSGO2 (0.78) compared to SSURGO (0.66) and KSSL (0.43). However, the root means square errors (RMSE) were generally higher for STATSGO2 compared to KSSL and SSURGO. Though these relationships are unique to the U.S soil databases it demonstrates the promise this approach brings to fill in data gaps for missing soil horizons for other similar data bases and standardize them to meet the GSM standards.

Keywords: GlobalSoilMap, soil properties, spline, weighted means, profile depth
Financial support:

(6949 - 1179) Updating the categorical soil map of Iran using limited soil legacy data

R. Taghizadeh-Mehrjardi[1]; K. Schmidt[1]; K. Eftekhari[2]; T. Rentschler[1]; T. Scholten[1]

Soil Science and Geomorphology Department, Institute of Geography, Eberhard Karls University Tübingen, Tübingen, Germany[1]; Soil Genesis and Classification Department, Soil and Water Research Institute, Karaj, Iran[2]

However, there are a large number of available DSM techniques, but little attempt has been made to explore the impact of sample size used to train machine learning algorithms on the quality of DSM products. The use of limited soil legacy data to produce digital soil maps is vital, particularly in large, remote and public arid regions of Iran where traditional soil survey is difficult to perform. Therefore, the main objective of this research was to explore whether prediction improvements could be achieved using the higher sample sizes. At present research, we applied four random forest (RF) models with different sample sizes (i.e. 25, 50, 75 and 100% of total data set) and different environmental covariates including remote sensing images (e.g. Landsat and MODIS), digital elevation models (e.g. SRTM and ALOS), categorical covariates (e.g. soil map, land use, geology), soil properties (e.g. pH, clay, sand, silt), climate (e.g. precipitation and temperature) to produce a digital map of soil class in Iran. Results of 5-fold-cross-validation indicated the constructed $RF_{25\%}$ model with 25% of data set could capture 54% of the variation of soil classes. However, $RF_{100\%}$ with 100% of dataset result in capturing the highest variation of soil classes (OA=67.2% and Kappa=0.60). It is worth noting, the obtained overall accuracy of the $RF_{75\%}$ was fairly similar to $RF_{100\%}$ (OA=64.73% and Kappa=0.57). As an expectation, all four models could not correctly predict the Chernozems which have the lowest density (i.e. nine soil samples). Our findings recommended the use of random forest model for the spatial prediction of soil classes in Iran.

Keywords: digital soil mapping, random forest, soil legacy data
Financial support: Alexander von Humboldt Foundation

WG05 Proximal soil sensing (PSS)

(4309 - 258) A Hybrid Soil Laboratory Analysis for low environment impact

José Alexandre M Demattê[1]; Andre Carnieletto Dotto[1]; Luis Gustavo Bedin[1]; Veridiana Maria Sayão[1]; Arnaldo Barros e Souza[1]; Jose Lucas Safanelli[1]
College of Agriculture Luiz de Queiroz - ESALQ, University of São Paulo - USP[1]

Soil analysis is an important information for agriculture and environment monitoring. They are usually performed by wet combustion analysis with high cost and chemical products consumption. In the world, it is estimated that 1.5 billion ha is used for agricultural area, reaching around 600 million soil samples for chemical and granulometric analyses. Considering just organic matter method, we would be using about 840 thousand kg of dichromate and ammonium ferrous sulfate, and 3 million L of sulfuric acid, with huge ecological impact. Therefore, the objective of this work was to discuss the possibility of a hybrid laboratory with low environment impact. For this, we did the following: i) evaluate the analytical quality of soil attributes via different traditional laboratories and sensors, ii) evaluate the prediction of the models using sensors, iii) assess the uncertainties of lime recommendation (LR) analyzed by the laboratories and sensors. We utilized 96 soil samples distributed along São Paulo State, Brazil. The determination of 15 soil attributes (SA) was performed by 4 different routine laboratories, and predicted by 4 sensors (400-2500 nm). The results showed that the performance of predictive models was influenced by the analytical precision and accuracy of the laboratory reference. The variance of analysis between laboratories, for a same attribute, was higher than between sensors. Sensors indicated more stability than traditional methods. Overall, predictions of SA using different sensors showed high reproducibility, which are associated with the analytical capacity of reflectance spectroscopy technique. The quality of the spectral prediction models reached great result ($0.71 < R^2 < 0.92$) for sand, silt, clay, OM, CEC, K, and pH. According to the criteria for classification of analytical performance (inaccuracy, imprecision, and excellence indexes), the results were quite interesting for sand, silt, clay, pH, OM, CEC, and V. The LR can be determined by spectral analysis, since it presented a high correlation with the laboratory result. The Hybrid Soil Laboratory Analysis must be stimulated. The indication is to analyze one part of the samples (20%) via routine laboratory and the remainder (80%) via sensor analysis. The reflectance spectroscopy can complement the traditional methods, reducing costs, demanded time, and decreasing the use of harmful toxic elements for the characterization of soil attributes.

Keywords: soil analysis, proximal sensing, chemometrics, precision agriculture, reflectance.
Financial support: São Paulo Research Foundation - FAPESP (Projects n. 2014/22262-0 and 2017/03207-6)

(2142 - 691) Application of Hyperspectral and GF-1 remote sensing data to predict and map soil carbon content

Liu Ting[1]; Wang Laigang[1]; He Jia[1]; Zheng Guoqing[1]; Guo Yan[1]
Institute of Agricultural Economics and Information, Henan Academy of Agricultural Sciences[1]

During the early twenty-first century, China has developed and launched a variety of satellites, such as the China and Pakistan resources satellite (CBERS), the environment satellite (HJ-1A/1B), and the resources satellite (ZY-3) that are intended for studying multi-scale land cover change, monitoring natural resources, and assessing environmental quality and changes in the ecological environment. As part of the "High-Resolution Earth Observation System", many major projects have being implemented. The Chinese GF-1 satellite is a new high spatial resolution satellite successfully launched by the Long March II rocket on April 26, 2013. GF-1 was equipped with two types of sensors. One is the wide field view sensor (WFV sensor); the other is the panchromatic and multispectral sensor (PMS sensor). The WFV sensor can acquire multispectral image in blue, green, red, and near-infrared bands with 16 m spatial resolution and 4 days temporal resolution. The PMS sensor can acquire a panchromatic and multispectral image with 41 days temporal resolution. The present study focused on assessing the feasibility of multi-spectral data in monitoring soil carbon (SOC). The data source comes from hyperspectral measured under laboratory condition, and simulated multi-spectral data from GF-1 remote sensing images. According to the reflectance response function of GF-1, the hyperspectra were resampled for the corresponding bands of multi-spectral sensors. The correlations between hyperspectral, simulated reflectance spectra with different soil vegetation indexes and SOC content were calculated, indicating the highest correlation coefficient for the first derivatives of hyperspectral and simulated GF-1 reflectance. The partial least square regression (PLSR) method was used to establish experiential models to estimate SOC content. The first order derivative hyperspectral data showed good result to predicted SOC with R^2=0.962, and the model was steady with RPD=4.87; Simulated GF-1 spectral data can also be a good prediction of SOC (R^2=0.557), but relatively poor stability of the model (RPD=1.43). Meanwhile, the spatial distribution of SOM showed that similar spatial characteristics between measured SOC and predicated SOC with the first derivative of the measured hyperspectral data and simulated GF-1 multi-spectral data. Therefore, it has potential ability to evaluate SOC in large-scale with multi-spectral data.

Keywords: Soil carbon (SOC); Hyperspectral; GF-1 multispectral remote sensing image; Geostatistics; Mapping
Financial support: the National Natural Science Foundation of China (No. 41601213), the National key research and development program (2017YFD0700501), the Major science and technology projects of Henan (171100110600), the Key Science and Technology Program of Henan (No. 17)

(7547 - 1131) Contribution of different Vis-NIR spectral regions to the prediction of soil organic carbon content

Alexandre ten Caten[1]; Fabiana Zorzi Breda[2]; Geisy Bahls Fogaça[2]; Luiza Mantiça Kreimeier[2]
UFCS - Curitibanos[1]; UFSC - Curitibanos[2]

Relevant information on soil attributes and types can be obtained using spectradiometers, which allow the detailed observation of soil, spectral behavior. Soil organic carbon (SOC) influences spectral response of the soil, producing different features along the Vis-NIR region. The objective of this study was to verify, through the segmentation of a spectral dataset, the influence of different Vis-NIR spectral regions to the prediction of SOC. The study area is the region of Marombas river watershed located in the mountainous region of Santa Catarina state. We collected 594 soil samples, and divided them into 416 for calibration and 178 for validation. Spectral readings were performed with a FieldSpec 3 Spectroradiometer (ASD Inc.) with a spectral range of 350-2500 nm. Spectral data processing was performed using the R programming language and the Alrad Spectra interface. Noise of the spectral signatures was removed at the edges of the spectra, and reflectance values of 400-2400 nm were used. For modeling two sets of radiometric data were produced. The first one was made out of adding increasing segments of 100 nm intervals (e.g. 400-500,..., 400-2400). For the second dataset the segmentation occurred inversely (e.g. 2400-2300,..., 2400-400). Modelling was conducted with Partial Least Squares Regression (PLSR), and as a pre-processing technique the Smoothing procedure was applied. Quality of statistical adjustment was accessed by the R^2 and RMSE values. Climatic conditions of the region influenced SOC content due to the low temperatures throughout the year (mean anual temperatures of 16 °C). High levels of SOC were found in the samples with maximum values up to 6.87%. The validation of the PLSR model

reached R^2 = 0.78 and RMSE = 0.54%, corresponding to the spectrum 400-2300 nm. It was observed that a continues addition of spectral segments up to 500-1100 nm reflected also in an increased R^2 value. This spectral region covers, very important absorption bands for SOC accordingly to literature. However, with the addition of the remaining segments of the spectrum, an increase of only 3% in R^2, and even 2% decrease in RMSE was noted. Higher and less variable R^2 values occurred predominantly in the infrared region. Thus, the investigation of the influence of a particular region of the spectral, via the segmentation of spectral data, may be relevant for SOC prediction.

Keywords: spectral behavior; radiometric data; spectral features; Santa Catarina

Financial support: CNPq

(6068 - 1969) Diffuse Reflectance spectroscopy for determination of soil texture

Alexandre ten Caten[1]; Fabiana Zorzi Breda[1]; Geisy Bahls Fogaça[1]; Luiza Mantiça Kreimeier[1]

Universidade Federal de Santa Catarina - Campus Curitibanos[1]

Diffuse Reflectance Spectroscopy (DRS), a Soil Proximal Sensing technique, records the electromagnetic radiation reflected by soil samples revealing a series of features characterizing its spectral signatures, related to the physical, biological and mineralogical characteristics of the soil. The objectives of this study were: i) to test a model to predict soil texture through the DRS technique; ii) to identify spectral regions important for soil texture prediction related to spectroradiometer costs. The development of this study comprised the region of the Marombas river basin, located in the Serrana mesoregion of Santa Catarina state. A total of 594 soil samples were collected from 104 locations, divided into 416 samples for calibration and 178 samples for validation of soil texture models. Spectral readings were performed by the FieldSpec Pro 3 Spectroradiometer (ASD inc.), with a spectral range of 350-2500 nm. Spectral signature noise was removed from the samples at the initial and final edges of the spectra, which kept reflectance values between 400-2400 nm. For data processing, the programming language R was used, through the graphical interface AlradSpectra. For modeling, a radiometric dataset was produced by adding increasing segments of 100 nm intervals (e.g.: 400-500 nm, 400-600 nm,..., 400-2400 nm). For the pre-processing, the smoothing statistical technique was used, and for modeling the statistical method PLSR (Partial Least Squares Regression) was applied. The evaluation of model quality was verified by R^2 values and RMSE. The sand fraction presented the best model with R^2 = 0.83 and RMSE = 0.77% in the spectrum range of 400-1700 nm. The silt fraction presented R^2 = 0.55 and RMSE = 0.62% in the spectrum range of 400-2200 nm. The clay fraction presented a model with R^2 = 0.68 and RMSE = 0.83% in the spectrum range of 400-1400 nm. Soil has characteristic features in visible and near infrared regions of the spectrum. Sand predictions were influenced by quartz minerals in the 400-880 nm regions. And Clay predictions are related with the influence iron oxides, hematite and goethite in the 480-900 nm region. According to soil and its contend of sand, silt and clay fractions, prediction models reached good performance, reaching R^2> 0.50 between the 400-1000 nm region, indicating that low cost spectroradiometers can be used to predict soil texture.

Keywords: Spectral soil reflectance; soil texture; Soil Proximal Sensing; pedometry; Santa Catarina.

Financial support: CNPq, FAPESC

(8030 - 1112) Estimation of soil organic matter content in the Yangtze River Delta by Vis-NIR in situ

M H Yang[1]; Z Shi[1]; H Y Li[1]

College of Environmental and Resource Sciences, Zhejiang University, Hangzhou 31008, China[1]

Paddy soils are very important in China and they are widely distributed in the Yangtze River Delta in South China. Organic matter (OM) are essential soil properties for assessing the fertility of paddy soils. It can be measured with visible and near infrared (vis–NIR) spectroscopy effectively in the field using the Chinese soil spectral library (CSSL) of dry ground after removing the influences of the environmental factors. However, A needed steep is the development of soil spectral libraries and models (calibrations using multivariate techniques). The model of calibrations only can be useful when it contains the variability of the target site soils. A classical way to use is by the spiking of models with a few samples from the target site (local samples), and the subsequent recalibration of models. For these reasons, we hypothesized that the accuracy of the regional-scale calibrations can be improved when a small subset of local samples (spiking subset) is added to recalibrate the initial calibration. In this paper, we investigated the possibility of using the Chinese soil spectral library (CSSL) of dry ground soils to predict OM using spectra of fresh (non-processed) paddy soil samples measured in situ using spiking sample methods in the Yangtze River Delta. Here we first removed the influences of the environmental factors implementing external parameter orthogonalization (EPO). Next, we used two spiked methods to select the best spiking subset according to spectral characteristics and geographical range spiked from target sites. A partial least squares regression (PLSR) of SOM on the laboratory spectra and spiked sample spectra of the training set was then used to predict the EPO-transferred field spectra. Results showed that spiking methods led to simultaneous improvement in the predictions of OM. The accuracy was improved significantly when the spiking subset was obtained according to spectral characteristics than those obtained with 'geographically-local' models.We recommended that the use of EPO and CSSL models for the efficient prediction of SOM using field scans of paddy soils when a few sample the spiking subset was used.

Keywords: Soil organic matter; Chinese soil spectral library;Vis NIR; fresh paddy soil.

Financial support: National Natural Science Foundation of China (No. 41271234)

(4537 - 2402) Evaluation of soil humidity with the use of ground penetrating radar (GPR)

Nathalie Cruz Sena[1]; Francis Henrique Tenório Firmino[1]; Lucas de Carvalho Gomes[1]; Judyson de Matos Oliveira[1]; Márcio Rocha Francelino[1]; Elpídio Inácio Fernandes Filho[1]

Universidade Federal de Viçosa[1]

Ground Penetrating Radar (GPR) is a non-invasive subsurface survey method that generates a variety of soil information. However, in Brazil few studies used GPR to access soils information. The objective of this study was to verify the volumetric moisture data obtained indirectly from the GPR, in relation to the standard method and the Time Domain Reflectomery (TDR) method. The study was carried out in a 30 m transect in a hilly experimental area of the Federal University of Viçosa, Minas Gerais, Brazil. We used the GSSI SIR-3000 device, composed 900 MHz shielded antenna, with a sweep in the slope - valley direction. The radargrams were processed in RADAN 7® software. In the transect we determined equidistant points by each 6 m, where undisturbed samples were collected at a depth of 0.20 m, to determine volumetric moisture method (standard). In addition, we installed 5 TDR sensors (model CS616, Campbell Scientific Inc.), vertically on the surface of the soil. The values of the dielectric constant obtained by GPR and TDR were inserted into the equations of Topp et al. (1980), Roth et al. (1992), and in the equation calibrated in situ for these soils developed by Pires (2016). The data obtained were compared to the standard method. The relief performance in the water dynamics was confirmed by the higher values of humidity in the valley bottom. In general, the 3 equations show higher values of soil moisture by GPR and TDR methods in relation to the standard method. However, the equation of Roth et al. (1992) and Pires (2016) presented better adjustment, because of its empirical character and the fact that it is correlated with the attributes of the area,

respectively. Soil volumetric moisture obtained by GPR showed good correlation with TDR data. In addition, the radargrams allowed to determine the level of the water table and, horizontally from the dielectric constant gradient, it was possible to demarcate the transition between Oxisol and Entisol (based on previous mappings and confirmed from mini-trenches in the field). The information obtained by the radargrams helps both the estimation of soil moisture and spatially can diagnose non-homogeneous areas, with low cost and time, for soil studies integrated to the toadsequences.
Keywords: Toadsequences, dielectric constant, sensors
Financial support: FAPEMIG

(5093 - 1319) Experimental evidence of internal scattering and absorption in soil particles

William Philpot[1]

Cornell University[1]

Observations of transmission through a thin layer of quartz sand indicate that the transmitted radiation – from the visible through the shortwave infrared – is essentially diffuse after little more than one attenuation length. This was the case whether the sample was air-dry or saturated. A simple model designed to describe the observations suggests that the directional nature of reflectance is controlled by the near-surface layer; below that, transmission was diffuse. The spectral attenuation coefficient for the air-dry samples indicated an increase in attenuation at shorter wavelengths that could be modeled with an inverse power law, a pattern that was suggestive of a long optical path and absorption within the particles. The implication was most of the transmitted light had passed through the sand particles, undergoing multiple scattering and wavelength-dependent absorption. The addition of water decreased the wavelength dependence over the visible somewhat, while exhibiting very strong water absorption features in the shortwave infrared. These results are confirmed and expanded using similar observations of the quartz and other soil samples.
Keywords: absorption, scattering, soil particles,
Financial support:

(9310 - 2563) Ground Penetrating Radar in the determination of gravimetric moisture in Oxisols

Viviane Flaviana Condé[1]; Adalberto Rodrigues Lira Gomes[1]; Elpídio Inácio Fernandes Filho[1]; Márcio Rocha Francelino[1]

Universidade Federal de Viçosa (UFV) - Viçosa, Minas Gerais, Brazil[1]

The use of proximal sensors is still incipient in soil science. Ground Penetrating Radar (GPR) allows to survey soil properties in a quickly and non-invasively ways. The study of dynamics and spatial distribution of moisture is fundamental for decision-making and soil management. Therefore, this study aimed to evaluate the applicability of GPR to determine the soil gravimetric moisture. The study was developed in a hilly grassland in Viçosa, Minas Gerais, Brazil. Two sweeps were performed on three different transects, with 70, 100 and 130 meters long, from the top towards the valley in a mountainous relief, and the soil was identified as an Oxisol. We used the GPR SRI-3000 model from GSSI® with shielded antennas of 200, 400 and 900 MHz and the radargrams were processed in RADAN 7® software. We applied several processes to radargrams, as filters, gains, and migration, aiming to improve the electromagnetic signal and determination of the dielectric constant. In adittion, we collected at 26 samples points disturbed soil samples at 0-20, 20-40, 40-60, 60-80, 80-100 cm depths to evaluate soil moisture analysis. To calculate the volumetric soil moisture using GPR data, it was used the dielectric constant, which was obtained by processing the radargrams, applying the equations of Topp et al. (1980), Ledieu et al. (1986), Roth et al. (1992) and Malicki et al. (1996). R statistical software was used to adjust the regression equations and correlation between soil moisture measured in the laboratory, and the data obtained by GPR. Roth et al. (1992) model shows the highest coefficient of Pearson's correlation of 0.73 and R^2 of 0.53. The models described did not show significant statistical differences by t-test, at 5% significance. Then, a local calibration equation was generated, with the humidity being a function of the dielectric constant and the depth of sample collection. As a result, a correlation of 0,83 and R^2 of 0,69 were found, which improved the model performance. The values of volumetric moisture obtained by GPR were satisfactory, which indicates the possibility of using the methodology in the spatialization of the soil moisture variable, optimizing studies that require moisture values as a variable with continuous distribution.
Keywords: GPR, soil dielectric constant, soil moisture calibration equations
Financial support: Capes, UFV and Fapemig

(7704 - 518) Hyper-spectral Characteristics of Major Types of Soils in Red Soil Region of Jiangxi Province, China

Xiaomin Zhao[1]; YANG Meihua[2]
Land Resources & Environment College/Key Laboratory of Poyang Lake Basin Agricultural Resources and Ecology of Jiangxi Province, Jiangxi Agricultural University[1]; Nanchang Teachers College[2]

Soil spectrum, as a comprehensive reflection of soil properties, is important significance to soil quality management, digital soil mapping, analysis of soil properties and soil classification in the red soil regions. In this paper, a total of 443 surface soil samples were collected in the typical red soil regions, e.g. Ji'an County, Yujiang County, Xingguo County and Wanli District of Jiang Province, and visible and near infrared reflectance hyper-spectra (350～2 500 nm) of the samples were measured with an ASD spectrometer in laboratory. After the treatment of the spectra with the continuum-removal and second order derivative methods, the spectra of the four major soil subgroups and their subordinate soil families in this region were characterized. Then, 19 characteristic variables, such as spectral reflection and absorption of parent materials, iron oxide (goethite and hematite) minerals, organic matter and clay minerals and hyper-spectral reflectance, were cited as indices for Fastclus cluster analysis of the spectra. Results show that the soils in the region varied sharply in spectral reflectance from sub-group to subgroup. In terms of spectral characteristic absorption area, in the 620～740 nm spectral bands, the four subgroups exhibited an order of yellow red soil＞red soil＞brown red soil＞weakly red soil, but in terms of the difference between second order derivatives at 420 nm and at 447 nm, they followed an order of yellow red soil＞brown red soil＞red soil＞weakly red soil. The brown red soil was higher in reflectance in the Vis-NIR spectral range, but lower and wider in spectral absorption intensity in the range of 1 900 nm than all the other subgroups.The weakly red soil was the steepest in spectral curve and the highest in reflectance in the near infrared region, showing two relatively strong absorption peaks at 1 400 nm and in 1 900 nm, separately, and a super strong peak at 2 200 nm. In terms of the peak at 2 200 nm, the sub-group of red soil was similar to the sub-group of reddish soil in spectral curve variation tendency, but lower in absorption intensity at 900 nm, 1 400 nm, 1 900 nm and in 2 200 nm and higher in position of the curve.As a result of variation of the duration of flooding, paddy soils of the four sub-groups of red soils varied greatly in spectral characteristics. Classification, based on the 19 indices, of red soils in the region by soil subgroup reached 86.23% in accuracy and by soil family 66.37%.
Keywords: Soil type; Vis-NIR; Spectral characteristics; Red soil region; Jiangxi Province
Financial support: National Natural Science Foundation of China (No. 41361049); 555 Talent Candidates of Jiangxi and Jiangxi Agricultral university [grant numbers YC2016-S181, 2016]

(4457 - 749) Hyperspectral proximal sensor to evaluate the spectral behavior of soil with mining co-product application

Marlon Rodrigues[1]; Marcos Rafael Nanni[1]; Carlos Augusto Posser

Silveira[2]; Glaucio Leboso Alemparte Abrantes dos Santos[1]; Renato Herrig Furlanetto[1]; Luis Guilherme Teixeira Crusiol[1]
State University of Maringá[1]; Embrapa Temperate Weather[2]

Proximal sensing is an important tool for collecting information quickly and non-destructively. This is possible because all material presents a spectral behavior resulting from the interaction between electromagnetic radiation (EMR) source and object. Thus, it is possible to relate EMR to soil attributes, giving support to better decision of the rural producer. The aim of this paper was to evaluate the spectral behavior, obtained by the proximal hyperspectral sensor, in two classes of soils submitted to the application of different co-products from limestone mining. The soils evaluated were a Oxic Dystrudepts (OD) and an Typic Quartzipsamments soil (TQ). The co-products used were extracted from a limestone mining and consisted of materials from the Irati and Corumbataí Formations. The treatments were: T1: 100% Irati Formation (Ca^{2+} source); T2: 100% Corumbataí formation (source of K^{+}); T3: 50% Formation Irati + 50% Formation Corumbataí (sources of Ca^{2+} + K^{+}). Based on the initial characterization of the soil, corresponding amounts of the co-products were used to increase the Ca^{2+} (T1 and T3) and K+ (T2) contents to the critical soil level, according to the Brazilian Soil Science Society – RS/SC. The experiment was conducted in pots (10 replications per treatment) of 2.8 kg of dry soil, kept near the field capacity, and allocated inside a greenhouse. After 150 days incubation of the soil with the co-products the radiometric data were obtained in the spectral range between 450 and 2,500 nm using FieldSpec spectrorradiometer ASD (20 readings per treatment). Multivariate statistical analyzes were performed using The Unscrambler 10.3 software for the construction of calibration models. By the collected data, it is possible to observe a significant difference between the reflectance of the two classes of soils evaluated, in which the TQ presented the highest values. This was due to the high levels of sand and low organic matter and Fe oxides present in this class. Among the co-products used, in the TQ class there was a significant difference between all the treatments. In the OD, there was no difference between the spectral curves evaluated. Regarding the inflections in the spectral curve of each treatment, especially in the TQ, they may be related to the presence of carbonates and silicates. Thus, it can be concluded that the different classes of soils and co-products have different spectral behavior and can be discriminated by proximal hyperspectral sensing.

Keywords: hyperspectral; sensors; incubation
Financial support: CAPES

(8827 - 1790) Identification of soil profile classes using 3D spectral surface features

Xian-Li Xie[1]; An-Bo Li[2]
Institute of Soil Science, Chinese Academy of Sciences[1]; Nanjing Normal University[2]

Classification of soils is of fundamental importance to soil use and management. The conventional method of classifying soil profiles is based on the characterization of many morphological, physical, and chemical properties, which involves a wide range of laboratory analyses and is time-consuming and expensive. Visible-near infrared (Vis-NIR) diffuse reflectance spectroscopy has shown to be a potential analytical technique to measure soil properties rapidly and cheaply, especially those properties important for soil taxonomic diagnosis. The objective of this study was to develop a new method for identifying soil profile classes at order, suborder and group level of the Chinese Soil Taxonomy (CST) by using soil Vis-NIR diffuse reflectance. We used 2260 legacy soil samples collected from genetic horizons of 527 soil profiles in the soil series survey of China, and divided these profiles into a training set (75%) and a validation set (25%). The Vis-NIR (350-2500 nm) diffuse reflectance spectra for soil samples were measured using a Cary 5000 Spectrophotometer. For each soil profile, the measured reflectance from genetic horizons were interpolated to its maximum depth with 1 cm increments by fitting an equal-area spline function, to produce three dimensional (Depth-Wavelength-Reflectance) spectral surface. All the soil profile spectra were preprocessed with Savitzky-Golay first derivative. The feature points of the 3D spectral surface were extracted including top-points and bottom-points at various wavelength ranges. Random forests (RF) algorithm was used to predict soil profile classes based the attributes of the feature points. The results showed that for the identification of soil orders, suborders, and groups, the overall validation accuracies were 0.63, 0.62, and 0.40, respectively. It is concluded that the 3D spectral surface has the ability to identify soil profile classes at higher taxonomic levels in the CST system, and the identification ability will be improved with the algorithm optimation for extracting feature points.

Keywords: Visible-near infrared diffuse reflectance spectroscopy; Chinese Soil Taxonomy; 3D spectral surface; Feature point extraction; Random forests
Financial support: National Natural Science Foundation of China, Project Number 41471175, 41771431; S&T Basic Work Program of Ministry of Science and Technology of China, Project Number 2008FY110600

(2951 - 2132) Kaolinite and Gibbsite spectral characterization in different geological and geomorphological compartments of the Western Paulista Plateau

Kathleen Lourenço Fernandess[1]; Angélica Santos Rabelo de Souza Bahia[1]; José Marques Júnior[1]; Milene Moara Reis Costa[1]
UNESP/FCAV[1]

Diffuse reflectance spectroscopy (DRS) is a technique known worldwide and used as it is fast, practical and presents encouraging results for the characterization of different soil attributes. However, the characterization of kaolinite (Kt) and gibbsite (Gb) in different geological and geomorphological compartments is still controversial. Thus, the aim of this study was to use DRS to characterize the occurrence of Kt and Gb minerals in the soils of different geological and geomorphological compartments of the Western Paulista Plateau. Samples were selected from soils of Basalt and Sandstone in the area of the Western Paulista Plateau. Each sample represents a geomorphological compartment: highly, moderately and not dissected. The level of dissection refers to the level of carving of the landscape. Highly dissected environments have higher geomorphogenicity rates than pedogenesis rates. While in a few dissected environments the rates are opposite. The spectral curves interpretation allowed the identification of characteristic valleys of Kt and Gb, for the pure minerals. The different combinations of the Kt and Gb ratios have a direct effect on the reflectance and intensity of the valleys from 2100 nm. Soil samples with higher percentages of Kt present higher reflectance and more characteristic valleys up to 2220 nm. The addition of Gb in the samples reduces the reflectance and increases valleys intensity as from 2220-2230 nm. In the soil samples it is also possible to characterize the Kt and Gb valleys, with different expressions for the geological and geomorphological compartments. For the Sandstone soils, the characteristic valley is between 2100 to 2230 nm, allowing to indicate the predominance of Kt in this compartment. Whereas in the Basalt soils from 2100 nm two valleys are observed, the first characteristic of Kt, between 2100-2130 to 2240-2260 nm, and the second of Gb, between 2240-2260 to 2280-2300 nm. The valleys intensities from Kt and Gb, for both geological compartments, did not allow the differentiation of the geomorphological compartments to the dissection levels. The intensity of the valleys and the reflectance still allows the identification of the geological compartment to which the sample belongs, facilitating even more studies of this magnitude. The kaolinite has a characteristic spectral range between 2130 and 2260 nm, while gibbsite has a higher occurrence between the bands of 2240 to 2300 nm, for the soils of Western Paulista Plateau.

Keywords: Spectral band; landscape soil relationship; landscape dissection

Financial support: FAPESP Processo Nº 2015/20692-0

(4052 - 1212) On-farm technique to assess the nitrogen status of winter crops from optical sensors

Jaime Andres Gomez[1]; Marisa Domenech[2]; Fernando Ross[2]; Mauricio Castro-Franco[3]

Unillanos[1]; INTA[2]; CONICET[3]

Agriculture precision (AP) technologies allow increasing the efficiency of nitrogen (N) application. However, it is necessary to optimize those using AP techniques that allow evaluating N spatial status in a fast, accurate and robust way. The objective was to propose and test a field technique to determine the spatial status of N in wheat/barley, combining on-farm strip-trials and optical sensors. The technique includes: *(i)* to delimitate zones within field using an algorithm coupling spatial principal components and Fuzzy K-means (sPC-FKM); (*ii*) to design a strip-trial of increasing dose of N; and (*iii*) to determine sampling points in each strip, using Latin Conditioned Hypercube (cLHS). Three agricultural field located in the southeast of Buenos Aires Province, Argentina (Lat: -38,529; Lon -60,419) were used. Zone within field were delimitated based on elevation, terrain and vegetation indices, using sPC-FKM. A strip-trial was designed including a wide range of soil series. The treatments were: control (0 N), doses commonly used by farmer and double dose used by farmer. A total of 10 sampling points were determined per strip using cHLS. At each point, NDVI using GreenSeeker®, chlorophyll content with SPAD 502® and biomass per m^2 at tillering, stem elongation, heading and ripening stages were measured. Also, grain yield and quality parameters were determined. Yield indices such as agronomic efficiency (AEN), grain yield response index (GYRY) and N recovery efficiency (R_{EN}) were calculated. Sensor indices such as INSEY (in-season estimated yield) and grain N uptake were also calculated. Two zones were delimitated in all fields. The results suggest that the on-farm technique proposed was able to capture the spatial variability of AEN, GYRI and R_{EN}, per zone and field. The ranges of differences for AEN, GYRI and R_{EN} were 12.06 kg grain kg N^{-1}, 76.12 % and 11.02 kg grain kg N^{-1}, respectively. INSEY, calculated from the sum of NDVI at tillering and stem elongation, showed a high correlation with yield (R^2=0.72), as have been reported in other studies. INSEY, calculated from SPAD, showed a low correlation with yield (R^2=0.2). Grain N uptake showed a high correlation (R^2=0.72) with SPAD measured at heading. These results demonstrated that the technique was efficient to evaluate the spatial variability of N status at regional scale, in a fast, accurate and robust manner.

Keywords: nitrogen spatial status; Argentina; strip-trial; sensor
Financial support: PNSUELO-1134023

(7818 - 613) Potential of synergy of multiple sensor data layers to predict soil properties

Julyane Vieira Fontenelli[1]; Paulo S. Graziano Magalhães[1]; Viacheslav I. Adamchuk[2]; José Alexandre M. Demattê[3]; Clécia Cristina Barbosa Guimarães[3]; Arnaldo Barros e Souza[3]; Bruna Cristina Gallo[3]

University of Campinas[1]; McGill University[2]; University of São Paulo[3]

Site-specific management of crops is essential to ensure maximum crop production profitability with minimum negative environmental impact. Today, systematic (grid) soil sampling is the most common practice to obtain the data needed to produce variable rate prescription maps. However, the cost and the labor needed to obtain this high-density soil sampling limit the ability to accurately represent spatial and, in some cases, temporal variability of soil properties across a field. Thus, it is expected that emerging proximal soil sensing technologies could help to reduce significantly the cost of data acquisition while increasing the accuracy of thematic soil maps. The objective of this work was to evaluate the synergy of multiple sensor data layers to predict maps for several important soil attributes (e.g., texture, organic matter content and chemical soil properties). The work was performed in Brazil on a 100-ha agricultural field used for sugarcane production. Within a couple of days, 423 soil samples were collected and subdivided randomly into a calibration (70% - 296) and a validation (30% - 127 samples) set of soil samples. All the samples were simultaneously sent to a commercial soil-testing laboratory for wet chemical and physical analysis. Gamma-ray spectroscopy and apparent soil electrical conductivity measurements were collected *in situ*. Field topography was measured using a real-time kinematic (RTK) global navigation satellite system (GNSS) receiver. To represent bare soil imagery, a Landsat 8 satellite image obtained within five months of soil sampling with minimum crop coverage was used. Each data layer provides unique information pertaining to soil characteristics. Based on these data, predictive variables were calculated and used to compose a series of prediction models to estimate both physical and chemical soil properties. As a result, it was determined that successful models were obtained to predict percent clay and sand, organic matter content, cation exchange capacity and copper using all data layers together, mostly achieved by bare soil imagery, field topography and apparent soil electrical conductivity. Unfortunately, a relatively poor connection was found between the gamma-ray count with the most soil properties. Such capability was not found for chemical soil properties typically used to prescribe mineral fertilization rates such as phosphorus or potassium.

Keywords: Soil sensing, library, remote sensing, soil mapping, environment, big data
Financial support: FAPESP 2014-22262-0

(5752 - 1182) Predicting soil clay content from NIR, gamma-ray and XRF curves

Gustavo M Vasques[1]; Hugo M Rodrigues[2]; Sílvio R L Tavares[1]; Mauricio R Coelho[1]

Embrapa Solos[1]; Universidade Federal Rural do Rio de Janeiro[2]

Near-infrared spectral reflectance curves, and gamma ray and x-ray fluorescence (XRF) energy curves contain data that can be exploited as covariates in multivariate models for soil property prediction. This is the typical approach in the case of NIR reflectance curves. However, for gamma ray and XRF energy curves, the usual approach is to use the derived information they provide, that is, K, eU and eU contents, and multiple element contents, respectively. These element contents are derived from algorithms that are pre-calibrated in the factory using data from the energy curves, whose shapes and peaks relate to specific or multiple elements. In this study, data from NIR, gamma ray and XRF curves, and three multivariate methods (partial least squares regression - PLS, random forest – RF, and support vector machine - SVM) were used to predict soil clay content at 0-10-cm depth. Training and validation data included 103 and 25 samples, respectively. Gamma ray and XRF data were taken *in situ* at the soil surface, using portable sensors, whereas NIR reflectance curves (800-2500 nm) were measured from air-dried fine earth samples in the laboratory. Clay contents were measured by the densimeter method. In the case of XRF, curves from the three x-ray beams were used separately to derive distinct prediction models. Clay contents minimum, maximum, mean, median, and standard deviation were 40, 360, 180, 170, and 90 g kg^{-1}, respectively. Training R^2 and root mean squared errors (RMSE) for NIR, gamma ray and XRF (x-ray beams 1 through 3) models were (R^2/RMSE): 0.91/26, 0.86/33, 1.00/4, 0.85/34 and 0.90/28 (PLS); 0.95/22, 0.96/21, 0.98/17, 0.98/17 and 0.96/20 (RF); and 0.90/28, 0.99/9, 1.00/0, 1.00/0 and 1.00/0 (SVM), respectively. Validation RMSE were: 49, 109, 45, 35 and 44 (PLS); 43, 61, 54, 52 and 46 (RF); and 50, 63, 45, 30 and 52 (SVM), respectively. In validation, the XRF curves derived the best clay content predictions from PLS and SVM models, and the NIR curves were superior in RF. Compared to NIR, the XRF sensor is field-portable, and thus, it is preferred for faster and cheaper clay content prediction. The same applies for the gamma

ray sensor if the magnitude of the errors are acceptable for the desired use. Overall, the results support NIR, gamma ray and XRF curves as potential covariates for soil clay content prediction, though there is room for improvement, for example, by testing other prediction methods or pre-processing the curves.
Keywords: Proximal soil sensing; Geophysics; Multivariate modeling; Near-infrared diffuse reflectance; X-ray fluorescence
Financial support: Embrapa; CNPq

(4145 - 2672) Prediction of Soil Organic Carbon using Neural Network with Vis–NIR spectra in highlands of Itatiaia National Park, Rio de Janeiro

Gelsleichter, Yuri[1,2]; Anjos, Lúcia H. C. dos[1,2]; Antunes, Mauro H. A.[1,2]; Valente, Gabriela[1,2]; Costa, Elias M.[1,2]; Marcondes, Robson A. T.[1,2]
[1]Federal Rural University of Rio de Janeiro, Rodovia BR 465, km 07, Seropédica - RJ, 23890-000, Brazil (yuriplanta@gmail.com); [2]Szent István University, Gödöllő, Páter Károly u. 1, 2100, Hungary[1]; [1]Federal Rural University of Rio de Janeiro, Rodovia BR 465, km 07, Seropédica - RJ, 23890-000, Brazil[2]

Visible and near-infrared reflectance (Vis–NIR) techniques are alternative methods to conventional chemical laboratory soil analyses for many soil attributes, including soil organic carbon. Besides, Vis–NIR techniques are fast, environment friendly, and non-destructive of samples. In this study soil organic carbon (SOC) was predicted applying Vis–NIR, and the spectrums on 305 soil samples by using a FieldSpec 4® spectrometer (350–2500 nm). The study area is located at the western region of Rio de Janeiro State, in the highlands of Itatiaia National Park (INP) that has its highest point at 2.791,6 m. Conditioned Latin hypercube sampling (cLHS) method was used to design the collection of samples from 90 soil profiles. The INP plateau has a relatively expressive area of organic soils, located in the valleys formed among the rocky outcrops. Organic carbon was also measured in all samples in the laboratory by using the dry combustion method. Prediction was performed with Neural Network using the R package neuralnet. The RMSE for normalized 0-1 values was of 0.067 and the R^2 0.90. The technique shows potential for large application, and it is especially important in areas of limited access such as the INP. Considering the SOC is an important indicator of soil quality and degradation, it is also relevant for the management plan of the INP, since the good correlation with Vis–NIR techniques allows for future monitoring by using remote sensing tools.
Keywords: Keywords: Soil properties; organic soils; chemometrics; remote sensing.
Financial support: CAPES, TEMPUS PUBLIC FOUNDATION, FAPERJ.

(1469 - 2887) Qualitative evaluation of soil organic matter using Vis-NIR diffuse reflectance spectroscopy in an agroecological production system in Seropédica, Rio de Janeiro (Brazil)

Marcela Lopes Lázaro[1]; Gustavo M. Vasques[2]; Maria Gabriela Ferreira da Mata[1]; José Guilherme Marinho Guerra[3]; Marcos Bacis Ceddia[1]; Érika Flávia Machado Pinheiro[1]
UFRRJ[1]; Embrapa Solos[2]; Embrapa Agrobiologia[3]

Soil organic matter (SOM) is a key component to understand and monitor soil quality and processes, providing information on agronomic and ecological use and management of agroecological production systems. Visible and near infrared reflectance (Vis-NIR) has presented potential as a non-invasive and non-destructive method to characterize soils and their chemical, physical and mineralogical attributes. The aim of this study was to compare SOM contents and associated Vis-NIR spectral curves among areas with different agroecological production systems/treatments.The experiment was carried out in 2014 at the *Sistema Integrado de Produção Agroecológica* (Integrated System of Agroecological Production), in Seropédica city, Rio de Janeiro state, Brazil. The area has Planosols and was divided in two sub-areas: Sub-area 1 (3578 m²) – for organic vegetables production with (3051 m²) and without shading screens (527 m²), and Sub-area 2 (4676 m²) – for biomass production (straw) with 3982 m² of elephant grass cv. Cameroon (*Pennisetum purpureum*) and 694 m² of shrub legumes (*Gliricidia sepium*). A total of 246 soil samples were collected at a depth of 20 cm on a 0.5 by 0.5 m regular grid. After air-drying, they were sieved (2 mm) and analysed for SOM via wet oxidation. Then, Vis-NIR reflectance spectral curves (350-2500 nm) were obtained in the laboratory and interpreted qualitatively in relation to the SOM contents and chemical groups. The screen-covered area (36 samples) showed the highest SOM contents (1,55% of SOM and 25% of reflectance on average) whereas the shrub legumes area (27 samples) showed the lowest SOM contents (0,86% of SOM and 30% of reflectance on average). The sun-exposed organic vegetables area (120 samples), and elephant grass area (63 samples) showed similar Vis-NIR curves and intermediate SOM contents of about 1,43% of SOM and 28% of reflectance on average. The spectral curves of soils from the four areas/treatments showed absorption peaks at the same wavelengths, related to water and C-H, O-H, C-O, N-H and S-H groups. On the other hand, higher SOM contents produced lower Vis-NIR reflectance (albedo), enabling to rapidly (qualitatively) screen and monitor SOM contents among the different agroecolgical production system/treatments.
Keywords: Organic farming; Tropical soils
Financial support: CNPq; UFRRJ; Embrapa Solos; Embrapa Agrobiologia.

(7630 - 1940) Soil analysis through portable fluorescence X-ray (pXRF) spectrometer: predicting sum of bases (SB) and cation exchange capacity (CEC) in tropical soils.

Marcelo Mancini[1]; Wilson Missina Faria[1]; Sérgio Henrique Godinho Silva[1]; Michele Duarte de Menezes[1]; Luiz Roberto Guimarães Guilherme[1]; Nilton Curi[1]
Federal University of Lavras[1]

Traditional methods to evaluate important soil chemical properties such as cation exchange capacity (CEC) and pH require laborious chemical analysis that are often expensive and time consuming. As an alternative to these methods, some studies have recently introduced the use of portable X-ray fluorescence (pXRF) spectrometry as a means to infer soil properties. However, such analyses are still scarce in tropical soils and, thus, need to be evaluated. This work further studies this possibility by utilizing data obtained via pXRF to predict the sum of bases (SB) and the CEC of Brazilian soils. 594 samples of soil A horizon were collected in 6 Brazilian states and subjected to laboratory analyses of SB and CEC. The samples were also analyzed by a Bruker® pXRF S1 Titan, in triplicate for 60 seconds using Trace mode. Ordinary least square (OLS) and random forest (RF) methods were used to create SB and CEC predictive models with 70% of the total data. The models were further validated by calculating the root mean square error (RMSE), mean error (ME) and R^2 using the remaining 30% of the data. Results by the RF method were evaluated through the mean of squared residuals (MSR) and the percentage of explained variance obtained from the generated models. The models achieved through OLS to predict SB and CEC, respectively, are given by: $SB = 2.5411 + 38.2560CaO + 14.0360Cl - 13.8962K_2O + 7.6625Mn + 7{,}0441Rb$ ($R^2 = 0.45$); and $CEC = 8.838 - 4.9681Al_2O_3 + 38.0318CaO - 9.1297K_2O + 13.1336Ni + 36.2903Y + 4.1521Zn - 14.2889Zr$ ($R^2 = 0.31$). Random forest resulting mean of squared residuals (MSE) and explained variance were 8.52 and 52.83% for SB and 22.52 and 29.36% for CEC. Random forest models performed better in validation tests when compared to OLS, providing overall higher R^2 (0.8 vs. 0.63 and 0.59 vs. 0.54, for SB and CEC models, respectively), as well as lower RMSE (1.95 vs. 2.6 and 3.13 vs. 3.78) and ME (1.32 vs. 1.92 and 2.41 vs. 3.04). pXRF spectrometry can ease the efforts to gather important information about tropical soils and the models generated show it is conceivable to apply and further improve this idea for these

and other soil properties in different types of soils, reducing the cost and time required for characterizing soils around the world, especially in developing countries, such as Brazil, where there is a lack of financial support for such activities.

Keywords: random forest, ordinary least square, soil properties prediction, soil characterization.
Financial support: CNPq, CAPES, Fapemig

(5947 - 767) Soil apparent electrical conductivity correlated with crop yield

João Pedro Moro Flores[1]; Ricardo Simão Diniz Dalmolin[1]; Jean Michel Moura Bueno[1]; Diego José Gris[1]; Luciano Campos Cancian[1]; Nicolas Augusto Rosin[1]; Taciara Zborowski Horst[1]

Universidade Federal de Santa Maria[1]

The apparent electrical conductivity (ECa) of the soil has a high correlation with the physical-chemical attributes of the soil, for example, texture and cation exchange capacity. These attributes are related to crop yields. In this sense, ECa maps can serve as indicators of soil suitable for high crop yields. However, few studies have addressed the correlation between ECa obtained by proximal sensors and crop productivity. Thus, the objective of this study was to analyze the spatial variation of soil ECa obtained by the Veris sensor and its correlation with cotton yield. The study was carried out in an agricultural area in Primavera do Leste county, state of Mato Grosso, Brazil. Soil ECa evaluation were performed using a Veris 3100 sensor, capturing ECa values at depth 0.0 - 0.3 m (shallow) and 0.0 - 0.9 m (deep). Quantification and spatialization of the production was performed by a mass flow sensor installed in the cotton harvester. ECa and yield maps were interpolated by the nearest neighbor method as an approximation technique, using SAGA GIS® software, generating spatialized maps of soil ECa and cotton yield. The data were evaluated through descriptive statistics to characterize the spatial variability of ECa and cotton yield. Data were also analyzed by Pearson correlation with an error probability of 5% through t-test. From the analysis of the data, it is possible to verify that shallow ECa and deep ECa have a high correlation with each other (0.95), and cotton yield correlated significantly with shallow ECa (0.69) and deep ECa (0.65). The shallow and deep ECa and cotton yield presented an adjustment to a polynomial of order 2, with values of R^2 = 0.63 and 0.54 respectively, indicating that the higher the ECa value, have relation with the higher the crop yield. Both correlation coefficients obtained for the present study were moderate, indicating that this soil parameter can be a useful alternative for the delimitation of different management zones within the agricultural field. There is a great potential for the use of soil ECa in order to identify and predict productivity zones in an agricultural area, which may be influenced by soil physical-chemical attributes, especially clay, cation exchange capacity and consequently the soil classes present in the area. Future studies should be carried out using digital soil mapping techniques to predict and map ECa, identifying areas of management according to the soil's agricultural potential.

Keywords: Spatial variation, pedometer, soil attributes, Veris equipment, cotton.
Financial support: Fundação de Amparo à Pesquisa do Estado do Rio Grande do Sul

(3598 - 2195) Spatial variability of elemental contents in a Brazilian cerrado Ustept profile through portable X-ray fluorescence (pXRF) spectrometer

Thaís Santos Branco Dijair[1]; Sérgio Henrique Godinho Silva[1]; Anita Fernanda dos Santos Teixeira[1]; Luiz Roberto Guimarães Guilherme[1]; Nilton Curi[1]

Universidade Federal de Lavras[1]

In recent years, new tools have become available to support soil-related studies, such as proximal sensors. Among these sensors, the portable X-ray fluorescence spectrometer (pXRF) has been increasingly used, especially for rapid field and laboratory analyses. The pXRF is able to obtain the content of several elements of the Periodic Table and, in this way, has been used in the characterization of soil profiles, but these so-called digital soil morphometrics studies are still very rare in Brazilian soils. The objective of this work was to evaluate the spatial distribution of the contents of CaO, K_2O, Fe_2O_3, and SiO_2 present in a profile of Ustept of the Brazilian cerrado derived from phyllite. 24 places in an Ustept profile were analyzed with pXRF in Trace mode, during 60 s, in triplicate, forming a regular grid with 12.5 cm distance between analyzed places. The analyses included the A, B, C, and Cr horizons in order to capture variability of these compounds following weathering pathways. The spatialization of CaO, K_2O, Fe_2O_3, and SiO_2 contents was performed using the inverse distance weighting method. Through these data, it was possible to observe the change of concentration of these compounds across the horizons. CaO and K_2O presented higher contents in depth due to the greater amount of these compounds in the horizons closest to the parent material (C and Cr horizons), where there are more Ca- and K- bearing minerals. SiO_2 showed a slight increment of concentration in depth, where analyses of X-ray diffraction showed higher amounts of silicates than in the upper horizons. Fe_2O_3 presented a varied concentration along the profile, which is a probable reflection of the variability of the concentration of this compound in the parent material. The use of pXRF in the morphometric characterization of an Udept profile enabled us to obtain detailed results on the spatial variability of chemical elements in a soil profile in a rapid and more economical way. Future work will focus on the analyses of these and other elemental contents in the sand, silt and clay fractions of the A, B, C, and Cr horizons of this profile to better understand the particle size fraction in which each element tends to concentrate and, then, correlate such data with mineralogy of such particle size fractions.

Keywords: Digital soil morphometrics; soil variability; proximal sensor; Brazilian soils.
Financial support: CNPq, CAPES, Fapemig.

(1470 - 3028) Spectroscopic mining of soil archives to fill critical data gaps.

Jonathan Sanderman[1]; Shree R. S. Dangal[1]; Jeffrey Baldock[2]; Richard Ferguson[3]; Syke A. Wills[3]

Woods Hole Research Center[1]; CSIRO Agriculture and Food[2]; USDA National Soil Survey Center[3]

Proximal soil sensing using visible, near and mid infrared spectroscopy has become an indispensable tool in a soil scientist's tool box. For mapping and survey work, the small sacrifice in accuracy and precision is typically more than offset by the time and cost savings of spectroscopy-based inference systems. A number of nations have now built substantial soil spectroscopic libraries each with differing sets of accompanying analytical data. Here we report on progress in linking the mid infrared spectral library and soil carbon fraction database from the Australian Soil Carbon Research Program with the large and growing spectral library of the United States Department of Agriculture Kellogg Soil Survey Laboratory with a goal of mapping the distribution of organic carbon into biologically significant fractions across the agronomically important Great Plains ecoregion of the United States.

Keywords: Proximal sensing; Mid infrared spectroscopy; Chemometrics; Soil carbon
Financial support: United States Department of Agriculture National Institute of Food and Agriculture (USDA NIFA) Award # 2017-67003-26481

(4735 - 1565) Stratification of a spectral library accordingly to soil texture produces more accurate soil organic carbon predictions?

Jean Michel Moura-Bueno[1]; Ricardo Simão Diniz Dalmolin[1]; Alexandre

ten Caten[2]; Diego José Gris[1]; Nicolas Augusto Rosin[1]; Taciara Zborowski Horst[1]; João Pedro Moro Flores[1]
Universidade Federal de Santa Maria[1]; Universidade Federal de Santa Catarina - Campus Curitibanos[2]

Prediction models for soil organic carbon (SOC) using spectral data have shown variable accuracy due to multivariate calibration methods and the number of samples used for model calibration. However, few studies have demonstrated the performance of the models when using a regional spectral library (RSL) composed by samples with distinct soil properties, characterizing a heterogeneous RSL (HRSL). Considering the hypothesis that the predictive ability of the models is linked to soil data complexity, the stratification of a spectral library based on soil texture is a strategy to improve the accuracy of SOC predictions. Therefore, the objective of this study was to evaluate the performance of SOC prediction models after the stratification of a HRSL, using soil texture as criterion. A HRSL (n = 1,922 samples) from the Rio Grande do Sul (RS) and Santa Catarina (SC) state, south of Brazil, was used. The database is composed by samples from the Planalto and Depressão Central of RS and from the mountain region of SC. The spectral reflectance measurements were performed in laboratory with a spectroradiometer in the 350-2500 nm range. Spectral data were submitted to normalization preprocessing analysis. The multivariate partial squares regression (PLSR) calibration method was used to generate the models. Firstly, a model was generated using all the samples in the HRSL and then the spectral library was stratified in two groups based on soil texture, namely sandy, silt and medium texture (> 15% sand and < 35% clay – 332 samples) – T1; and, clayey and very clayey texture (> 35% clay – 1,590 samples) – T2. Models were built with 70% of the samples for calibration and 30% for validation. Coefficient of determination (R^2_V) and root mean square error ($RMSE_V$) of validation were used to assess the performance of the models. The model generated with all the samples reached an accuracy of R^2_V = 0.60 and $RMSE_V$ = 0.67%. After stratification, the model generated for group T2 showed the best accuracy (R^2_V = 0.70, $RMSE_V$ = 0.46%), followed by group T1 (R^2_V = 0.41, $RMSE_V$ = 1.52%). This study highlights that samples with sandy and medium texture have smaller accuracy of regional prediction models for SOC. The application of VIS-NIR spectroscopy shows potential as a reliable and inexpensive tool to quantify SOC for subtropical soils with high clay contents. Predictive models for soil properties can be improved when the variability of soil characteristics is considered in HRSL.
Keywords: Hyperspectral remote sensing; soil carbon; regional spectral library; partial least squares regression
Financial support: Conselho Nacional de Desenvolvimento Científico e Tecnológico – CNPq

(7624 - 3204) The Brazilian Soil Spectral Library (BSSL): a general overview

José Alexandre Melo Demattê[1]; André Carnieletto Dotto[2]; Ariane Francine Desidério da Silveira[2]; Marcus Vinicius Sato[2]; Ricardo Simão Diniz Dalmolin[3]; Maria do Socorro Bezerra de Araújo[4]; Elisângela Benedet da Silva[5]; Marcos Rafael Nanni[6]; Norberto Cornejo Noronha[7]; Marilusa Pinto Coelho Lacerda[8]; José Coelho de Araújo Filho[9]; Rodnei Rizzo[2]
Luiz de Queiroz College of Agriculture (ESALQ), University of São Paulo (USP), *Corresponding author[1]; ESALQ - USP[2]; Universidade Federal de Santa Maria[3]; Universidade Federal de Pernambuco[4]; EPAGRI[5]; Universidade Estadual de Maringá[6]; Universidade Federal Rural da Amazônia[7]; Faculdade de Agronomia e Medicina Veterinária da Universidade de Brasília[8]; Embrapa Solos UEP - Recife[9]

The Brazilian Soil Spectral Library (BSSL) began its collection in 1995 at the Department of Soil Science (ESALQ-USP). Currently, SSLB has gathered data from all the 26 States of Brazil, reaching more than 38,000 soil samples. This achievement was only possible to reach due to the collaboration (33instituitions) and 49 researchers. The objective of this manuscript is to present the system on the utilization and applications of this dataset. The spectral data range from visible to shortwave infrared (350 to 2.500 nm). The BSSL allow identify the main spectral behavior of Brazilian soils. With the development of BSSL, it is possible to: a) locate partners for joint research development; b) assess, via internet, whether a local, regional, or national estimative of your own spectra, based on calibrated models. In this context, we also can perform the prediction of soil color by using the reflectance data. In the present work, we determined how many spectral patterns are required to represent Brazilian soils. The preliminary results showed that 5 spectral curves can represent the spectral patterns of Brazilian soils. The BSSL can be informative regarding classification, soil surveys and quantification. It will be presented the utility of national spectra to predict soil attributes, such as organic matter (OM), sand, silt, clay, cation exchange capacity (CEC), and pH. The result of national estimation model for these attributes showed that the granulometry presented good performances (R^2 between 0.55 and 0.70) and slightly smaller for OM, CEC and pH. New contributions to the BSSL are still encouraged for a second round for 2019. We hope that this work reinvigorate our community's discussion towards the importance of sensors in agriculture, environment and extend the soil researches.
Keywords: Soil sensing, library, remote sensing, soil mapping, environment, big data
Financial support: Grant #2014-22262-0, São Paulo Research Foundation (FAPESP)

(1791 - 3209) The geographic and environmental characterization of the Brazilian Soil Spectral Library (BSSL)

José Alexandre Melo Demattê*[1]; Ariane Francine Desidério da Silveira[2]; André Carnieletto Dotto[2]; Marcus Vinicius Sato[2]; Ricardo Simão Diniz Dalmolin[3]; Maria do Socorro Bezerra de Araújo[4]; Elisângela Benedet da Silva[5]; Marcos Rafael Nanni[6]; Norberto Cornejo Noronha[7]; Marilusa Pinto Coelho Lacerda[8]; José Coelho de Araújo Filho[9]; Rodnei Rizzo[2]
Luiz de Queiroz College of Agriculture (ESALQ), University of São Paulo (USP), *Corresponding author[1]; Luiz de Queiroz College of Agriculture (ESALQ), University of São Paulo (USP)[2]; Federal University of Santa Maria[3]; Federal University of Pernambuco[4]; EPAGRI[5]; State University of Maringa[6]; Federal Rural University of Amazônia[7]; University of Brasília[8]; Brazilian Agricultural Research Corporation - Soils[9]

The Brazilian Soil Spectral Library (BSSL) started with a collection of soil samples in 1995 at the Department of Soil Science (ESALQ-USP). Currently, BSSL has gathered data from 26 States of Brazil, totaling more than 38,000 soil samples. Thus, the objective of this work was to present the first results of this databank in relation to Brazilian soils and its soil attributes. The BSSL allows to extract and associate the inherent spectral information with the geographic and environmental variables. With the development of BSSL, it was possible to demonstrate the potential of this tool for tropical soils management, and relate the soil spectral reflectance to the regions and states, biomes, geology, soil classes, and vegetation. Principal component analysis was performed to explore and visualize correlated data. The average spectrum was determined for each group. The group of spectra of Amazonas and Pernambuco States, the North and Northeast regions showed higher reflectance corroborating the presence of sandy soils. While spectra from the States of Rio Grande do Sul, Rio de Janeiro, and Mato Grosso do Sul, also the South, Southeast and Center-West regions revealed low spectral

reflectance. This low reflectance is correlated with clayey soils, which are iron oxides and organic matter abundant. In relation to the types of geology, spectral curves from igneous rocks, rich in calcium and iron, had low reflectance, while metamorphic rocks exhibited with high reflectance and well-defined features mainly linked to the minerals of feldspar, quartz, and plagioclase. Among the soil classes, the behavior of the Oxisol spectral curve showed the lowest reflectance due to the high levels of clay and iron oxide contents. The spectral curve of the Histosol presented low reflectance in the visible region due to the high content of organic matter in these soils. On the other hand, the Spodosol had the highest reflectance followed by Aridisol class, since these soils present very high sand content. With SSLB, it was possible to characterize and group the intrinsic spectral soil information geographically and environmentally. The use of sensors and geotechnologies, due to their agility and low cost in the analysis, allows a higher sample density practice, improve the problem of detailed soil mapping, and generate data for the soils survey and mapping that can assist in the management of agriculture in a rational way.

Keywords: Soil sensing, library, remote sensing, soil mapping, big data.
Financial support: Grant #2014-22262-0, São Paulo Research Foundation (FAPESP)

(7452 - 519) The Research of Paddy Soil Quality Spatial and Temporal Change in Fengxin County, Jiangxi Province of China

Guorui Hu[1]; Xiaomin Zhao[2]
Yichun University[1]; Land Resources & Environment College/Key Laboratory of Poyang Lake Basin Agricultural Resources and Ecology of Jiangxi Province, Jiangxi Agricultural University[2]

Soil Quality is the comprehensive reaction of soil properties, and the crop yield react the crop grow situation. The differences of the soil quality cause the crop growth difference and then intensify the soil fertility variability. To research the spatial and temporal change of soil quality is the basis of scientific to manage soil fertility and crop fertilization. In the research, 2016 paddy soil samples was surveyed and analyzed in Fengxin County, and then, the analysis results was compared with the results from the second soil survey to research spatial and temporal change of the soil properties by GIS. Then, the soil quality was evaluated and classified. The results show that soil fertility in Fengxin County was raised in last 30 years, the highest raised paddy field are located at east low hill region, especially the field at plain nearby the main road by compared the soil properties between soil samples analysis and the second soil survey paddy. The ratio of soil quality class which highest raised for effective phosphorus to total paddy field is 98.2%, especially the ratio of class rise 2 or 3 are 37.87% and 33.40%, respectively. The ratio of raised soil quality class for effective potassium, organic matter content and total nitrogen are 71.34%, 68.39% and 47.44%, respectively. Based on GIS, the paddy soil quality evaluation index system and evaluation models were established, and the paddy soil quality was evaluated comprehensively. The results include 7 soil quality class, the ratio of each class area to the total area are 10%, 13.86%, 17.81%, 18.63%,11.80%,15.35% and 12.55%, respectively.

Keywords: Paddy soil, Quality evaluation, GIS, Fengxin County
Financial support:

(5122 - 2152) Accuracy of clay content prediction through spectroscopy affected by multivariate method

Nícolas Augusto Rosin[1]; Ricardo Simão Diniz Dalmolin[1]; Jean Michel Moura-Bueno[1]; Diego José Gris[1]; Taciara Zborowski Horst[1]; João Pedro Moro Flores[1]
Universidade Federal de Santa Maria[1]

The determination of clay content is important for sustainable soil management. Soil particle size distribution have a direct impact on physical, chemical and biological functions of soil. Clay content can be predicted allying the spectroscopy technique with multivariate statistical models. Among the factors that influence the accuracy of prediction models are the many different of multivariate methods. According to the literature, the method of partial least squares regression (PLSR) is better for samples of homogeneous areas at local scale. However, there is a lack of papers using a spectral library derived from distinct soils and places, presenting samples with a sharp variation in the physical, chemical and mineralogical attributes. Therefore, the objective of this study was to evaluate the accuracy of different multivariate methods for clay content prediction from of a heterogeneous soil spectral library. A database with 1992 samples from the south region of Brazil was used, encompassing soils from Planalto and Depressão Central of Rio Grande do Sul and mountain region of Santa Catarina. Clay content was determined via pipette method. Spectral analyses were performed using a spectroradiometer in range 350-2500 nm. The spectral data was submitted to smoothing pre-processing with a mobile window of 9 nm. The following multivariate methods were tested: PLSR, random forest (RF), support vector machine (SVM) and multiple linear regression (MRL). 70% of samples were used for calibration and 30% for validation of the models. Model accuracy was evaluated coefficient of determination (R^2_V) and root mean square error ($RMSE_V$). The models were generated in the graphic interface AlradSpectra. The best accuracy was achieved using the PLSR model, with R^2_V = 0.78 and $RMSE_V$ = 8.82%, followed by the models SVM, with R^2_V = 0.77 and $RMSE_V$ = 9.09%, MRL, with R^2_V = 0.76 and $RMSE_V$ = 9.19% and RF, with R^2_V = 0.68 and $RMSE_V$ = 10.72%. The PLSR method demonstrated superiority in the accuracy in relation to the others, however, the difference was less accentuated than in the studies with homogeneous samples. More studies should be performed approaching the effect of spectral processing techniques and number of samples in the calibration of models with heterogeneous data.

Keywords: pedometry, spectral analysis, multivariate calibration, clay prediction;
Financial support: CAPES; FAPERGs;

WG06 Soil Monitoring: Soil monitoring evolving tools and challenges

(4231 - 542) Turning Band Co-simulation algorithm approach to multivariate mapping of heavy metals spatial contamination in a Cu-Ni exploration field

Peter N. Eze[1]; Nasser Madani[2]; Amoussou Adoko[2]
Department of Earth & Environmental Science Botswana International University of Science & Technology, Palapye, Botswana[1]; Department of Mining Engineering, School of Mining and Geosciences, Nazarbayev University, Kazakhstan[2]

The mining and smelting of copper and nickel around Selibe-Pikwe in the Central Province of Botswana is capable of releasing heavy metals including Pb, Fe, Mn, Co, Ni and Cu into the soil environments, thereby exposing humans, plants and animals to health risks. In this study, turning band co-simulation, a multivariate geostatistical model, was presented here as a tool for spatial uncertainty quantification and probability mapping of cross-correlated heavy metals (Co, Mn, Fe and Pb) risk assessment in a semi-arid Cu-Ni exploration field of Botswana. A total of 1050 soil samples were collected across the field at a depth of ~10 cm in a grid sampling design. Rapid elemental concentration analysis was done using an Olympus Delta Sigma portable x-ray fluorescence device. Enrichment factor (EF), geoaccumulation index (Igeo) and pollution load index (PLI) were used to assess the potential risk of heavy metals contamination in soils. The partially heterotopic nature of the dataset and strong correlations among the heavy metals favours the use of co-simulation instead of independent simulation in the probability mapping of heavy metal risks in the study area. The strong correlation of Co and Mn to iron infers they are of lithogenic origin, unlike Pb which had weak correlation pointing to its source in the area being of anthropogenic source. Manganese, Co and Fe show low enrichment,

whereas Pb had high enrichment suggesting possible lead pollution. We, however, recommend that speciation of Pb in the soils rather than total concentration should be ascertained to infer chances of possible bioaccumulation, and subsequent health risk to human by chronic exposure.
Keywords: Gaussianity; semi-arid soils; portable XRF device; uncertainty quantification; soil monitoring
Financial support: None

WG08 WRB: Soil Classification for understanding soil genesis, map legends and soil functions. Experiences with WRB and other systems

(8773 - 1002) Applying the World Reference Base 2015 to soil profile databases of various nomenclatures: Tool, performance and feedbacks

Einar Eberhardt[1]; Peter Schad[2]
Bundesanstalt für Geowissenschaften und Rohstoffe, Stilleweg 2, D-30655 Hannover, Germany (einar.eberhardt@bgr.de)[1]; Technical University of Munich, TUM School of Life Sciences Weihenstephan, Chair of Soil Science, Emil-Ramann-Str. 2, 85354 Freising, Germany[2]

An MS Access-based application for identifying soils according to the World Reference Base for Soil Resources (WRB), third edition, update 2015, has been developed. The derivation procedures use soil description data and laboratory data. The description data are either according to the German Soil Survey Guidelines, 5th ed. (2005), or according to the FAO Guidelines for Soil Description, 4th edition (2006). Various levels of data quality are accepted and uncertainty of the derivation result is addressed. The tool is basically multi-lingual; currently English and German are implemented. The modular architecture allows flexible adaptations and easy bug-tracking. Earlier, we developed a similar tool according to the second edition of the WRB. The comparison of the algorithms of the two versions reveals that the new WRB follows a better logic and makes many algorithms clearer and less complex. Performance has been tested using a 200-profile dataset representing the most abundant soil types of Germany, Switzerland and Austria. Classification results depend on data quality; medium level data quality is sufficient for > 80 % correct identification of the reference soil group (RSG) and the qualifiers. Algorithm design and classification results enable some feedback for soil description guidelines and their use, and for further enhancing WRB. It is suggested to define a better structure of soil description data, complete codelists and enhance soil description in the field. We also recommend some improvements of diagnostic criteria of the WRB for better applying them to soil data in databases.
Keywords: Automated classification, Software tool, Soil profile database
Financial support:

(9703 - 2021) Beyond Earth: Can we classify Martian soils with WRB?

Jérôme Juilleret[1]; Giacomo Certini[2]; Riccardo Scalenghe[3]; Stefaan Dondeyne[4]
Luxembourg Institute of Science and Technology, Department Environmental Research and Innovation, 41 rue du Brill, L-4422 Belvaux, Grand Duchy of Luxembourg (jerome.juilleret@list.lu)[1]; Università degli Studi di Firenze, Dipartimento di Scienze delle Produzioni Agroalimentari e dell'Ambiente, Piazzale delle Cascine n° 28, 50144 Firenze, Italy (giacomo.certini@unifi.it)[2]; Università degli Studi di Palermo, Dipartimento di Scienze Agrarie, Alimentari e Forestali, Viale delle Scienze 13, 90128 Palermo, Italy (riccardo.scalenghe@unipa.it)[3]; University of Leuven, Department of Earth and Environmental Sciences, Celestijnenlaan 200E, B-3001 Leuven, Belgium (stefaan_dondeyne@yahoo.co.uk)[4]

With interplanetary exploration in recent years planet Mars is a priority for future potentially manned missions. Since the first missions in 1970s, multiple landers have delivered data and new knowledge on Mars' surface. With new missions scheduled in the future, there is a need for classification tools adapted to extra-terrestrial soils. This stands as a prerequisite for solving issues related to space or farming and mining. The classification of Martian soils stands as an exercise, just as for terrestrial soils, to group our knowledge and increase our understanding on soil evolution. Historically, soil classification has been conducted in support of agriculture and tended to focus on the *solum* part of the Earth's skin characterised by addition and decomposition of organic matter, which largely drives pedogenic processes. In the last decade research on soil classification has extended its focus to the underlying *subsolum*, as it is recognized as being essential to critical zone sciences. While the Earth's *solum* is unique in our solar system, equivalents to the *subsolum* are present on all rocky planets. A recent paradigm shift in soil classification – essentially excluding biotic agents – offers the potential for exploring new avenues towards extra-terrestrial soil classification. In the 2006 edition of WRB, to "*avoid sterile discussions on a universally agreed definition of soil*" soil is considered to be "*any material within 2 m of the Earth's surface that is in contact with the atmosphere, excluding living organisms, areas with continuous ice not covered by other material, and water bodies deeper than 2 m*". Ultimately, this definition could potentially be applied to Martian soils defined by planetary geologists as "*any loose, unconsolidated materials that can be distinguished from rocks, bedrock, or strongly cohesive sediments. No implication of the presence or absence of organic materials or living matter is intended*." Based on this extended concept of soils, we propose a blueprint for transposing terrestrial soil classification concepts to Martian soils. We used a simple geopedological approach, including outcrops and landscape pictures taken by NASA's Curiosity Mars rover inside the Gale Crater, aiming at triggering a discussion on exo-pedology classification systems for rocky planets. This debate will contribute to overcome current limitations and open questions, in soil classification in general, as well as in extra-terrestrial soil exploration.
Keywords: soil classification, planetary pedology, whole regolith pedology
Financial support:

(4243 - 2413) Comparative adaptive world soil classification systems for map legend design in Nigeria: Soil Association [Local System], Soil Taxonomy, and World Reference Base.

Temitope A. Okusami[1]
Federal University, Wukari. Taraba State.Nigeria[1]

The objective is to use the characteristics of soils mapped from some selected agroecological areas within Nigeria to do a comparative classification for adaptive mapping legend using the "USDA-Soil Taxonomy" and the " World Reference Base [WRB]" systems with the Soil Association –Soil series sequence serving as the dependent variable. In this instance the concern of this paper is what is applicable during the mapping phase , i.e., when mapping legend is being defined for the different soils identified during field research and/or field activities for actual mapping work. The soils used are derived from basement complex rocks[Ilero at 08.05N/03.22E] and the coastal sediments [at Igbodu [6.28'13'N/4.19'30"] in the sub-humid and humid parts of southwest Nigeria respectively. The soils pattern reflect the toposequence and/or lithosequence concepts with a typical sequence of soils on the crest, shoulder and/or upper slope, middle slope, lower slope, fringe and/or valley bottom positions. At the mapping phase, the WRB nearly corroborates the intrinsic qualities of the Soil Association-Soil Series concept. This comparison is fully developed when the characteristics of the different classification units are compared to the morphological expression as shown in the Soil Association-Soil Series concept. Although it should be noted that the philosophy behind these two systems only slightly overlap as classification systems adaptabke for soil mapping purposes at the level of soil management requirements.
Keywords: Legend, Soil Classification, Soil Map

(1443 - 224) Red book of soils of Georgia – experiences with a competitive use of the national soil classification and the WRB

Tengiz F. URUSHADZE[1]; Tamar O. KVRIVISHVILI[2]; Winfried E.H. BLUM[3]
Agricultural University of Georgia, Michail Sabashvili Institute of Soil Science, Agrochemistry and Melioration, Tbilisi, Georgia[1]; Agricultural University of Georgia[2]; University of Natural Resources and Life Sciences (BOKU), Vienna, Austria[3]

The establishment of a Red Book of Soils is a first important step towards soil protection. Some countries have already realized such activities. Unfortunately, there is no general standard for classifying and grouping soils within those Red Books, what would be necessary in order to compare endangered soils across national borders. Georgia as a natural Open-Air Museum of Soils'' raised a great interest among many generations of soil scientists. Therefore, special studies of the soil cover on the basis of the World Reference Base for Soil Resources (WRB) are required. The concept of the WRB aims at establishing a unified soil language making it possible to compare and to correlate national soil classifications under its umbrella. For the Red Book of the Soils of Georgia we classified soils into 3 groups: Unique, Rare and Standard. Unique soils are represented by three soil types: Cinnamonic soils (Cambisols & Kastanozems); Meadow-cinnamonic soils (Kastanozems) and Yellow brown forest soils (Luvisols & Stagnosols). All these three types of soil were described in Georgia for the first time: Cinnamonic soils in East Georgia, near the town of Mtskheta, by Prof. S. Zakharov in 1904. Meadow-cinnamonic soils were first described by Prof. V. Fridland in 1957 also in East Georgia, near the village of Mukhrani. Yellow-brown soils in West Georgia, near the town of Batumi, were described by Acad. T. Urushadze in 1967 for the first time. Under the group of rare soils the following soil types were distinguished: Terra Rossa (Rendzic Leptosols (Brunic), Mountain-meadow humus-illuvial soils (Sombric horizon); Brown forest black soils (Stagnosols) and Andosols (Andosols). Terra Rossa soils are formed on carbonate rocks (mainly limestones). Mountain-meadow humus-illuvial soils are formed in depressions of high mountain areas. Brown forest black soils are characterized by thick humus horizons with a humid water regime. Andosols occur in mountain plateau areas. Within the group of standard soils we distinguish all other soil types in Georgia: Red (Nitisols); Yellow (Luvisols); Bog (Gleysols & Histosols); Yellow Podzolic (Acrisols); Brown Forest (Cambisols); Raw Carbonate (Leptosols); Grey Cinnamonic (Kastanozems); Meadow Grey Cinnamonic (Kastanozems); Black (Vertisols); Chernozems (Chernozems); Mountain Forest Meadow (Umbrisols); Mountain Meadow (Umbrisols); Mountain Meadow Chernozems (Phaeozems); Saline (Solonchaks & Solonetz); Alluvial (Fluvisols); Alluvial (Fluvisols).

Keywords: red book of soils, WRB, rare soil, unique soil, standard soil
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(7885 - 3234) Soils on calcareous rocks in recent soil classification systems

Dmitry Konyushkov[1]; Maria Gerasimova[1]; Tatiana Ananko[1]
Dokuchaev Soil Science Institute[1]

The first stage of updating of the Soil Map of Russia (1:2.5 M, 1988) assumes finding proper equivalents to soil names on the map in the new Russian soil classification system (2004, 2008); in parallel, their correlation with other classification systems, including WRB-2014 is being performed. This work is based on the analysis of diverse soil information for each polygon rather than a simple renaming of soils in the legend. In this report, we consider the problems related to reclassification of soddy-calcareous soils (Rendzinas). For a long time, Rendzinas were considered intrazonal soils with the A–C(R) profile and classified at the high taxonomic level. This decision was preserved on the FAO Soil Map of the World and on the Soil Map of Russia, where Rendzinas occupy about 500 000 sq. km and occur in a wide range of environments. At lower levels, their subdivision was based on evolutionary stages of soil development; thus, leached and podzolized Rendzinas and soils with residual carbonates (calcaric or dolomitic materials) were identified. In the new Russian soil classification system, as well as in the WRB and other recent systems, Rendzinas are not distinguished at the high (order or reference group) level. If the depth to the underlying calcareous bedrock is less than 30 cm, they fall into the order of Lithozems with the types of Dark-Humus and Mucky–Dark-Humus Carbolithozems analogous to Rendzic Leptosols in the WRB system, except for the depth to the bedrock criterion (25 cm). Primitive shallow Rendzinas without dark-humus horizon are classified as Typic or Humic Carbopetrozems corresponding to Rendzic Nudilithic or Lithic Leptosols. The humus horizon of Carbolihozems does not always fit the criteria of dark-humus or mollic horizons. In cold humid regions, it is enriched in weakly decomposed comminuted plant residues and/or may be overlain by a thin peat layer; upon active leaching of carbonates, it is replaced by the acidic gray-humus horizon. In the case of a greater depth to the underlying calcareous rock, the former soddy-calcareous soils mainly fall into the order of organo-accumulative soils subdivided into several types (by the character of their topsoils) and subtypes (by pedogenic features in the middle part of the profile). There is no analogue to this order in the WRB system, which complicates correlation decisions. Geographic regularities of pedogenesis on calcareous rocks as displayed on the updated Soil Map of Russia are discussed.

Keywords: Rendzinas, Rendzic Leptosols, Carbolithozems, diversity of calcaric soils
Financial support:

(4413 - 3142) WRB Classification of anthropogenic soils in Korea

Yeonkyu, Sonn[1]; Sangho, Jeon[1]; Byungkeun, Hyun[1]; Sungang, Yun[1]; Sukyoung, Hong[1]
NAS[1]

In Korea, human influence on soil formation has dramatically increased by urbanization, industrialization and using heavy equipment for the agricultural practice. The increase of anthropogenic soils induced researchers to study on the anthropogenic soils; classification, chemical and physical properties of anthropogenic soils. In 2004, Korea already developed a classification system of anthropogenic soils that was modified from the Soil Taxonomy. The anthropogenic soils classified to 1 order, 5 suborders, 10 great groups and 16 subgroups by the Korean soil classification system. However, this classification has many rooms to improve such as a precise description of the type pedon because majority studied area including agricultural soils and some mine remnants. The World Reference Base for Soil Resources (WRB) has one reference soil group (RSG) to classify anthropogenic soils Technosols. Artefacts and technic hard materials were defined as diagnostic materials. Artefacts are substances that are modified or created by man or brought to the surface from a depth and Technic hard material is substances resulting from an industrial process (unlike natural rock). This classification system is relatively new and may not enough to cover newly developed anthropogenic soils. We surveyed 7,727ha of remodeling farmland and our study showed that most of the level of soils are increased by adding other soil on the top of the original soil to improve soil conditions for agricultural or constructional purposes in Korea. The most distinguishable result was the stack of soil was 1~10 m. That even changes topography in its area. We assume this phenomenon may not exist in other countries and there is not anthropogenic soil classification system to classify this type soil in WRB. We propose that this type soil need to classify as Technosols in the WRB system because there are significant human influences to form. Our future research will focus on classification and characterization of urban soils including metropolitan area such as parks, apartment complex, landfills, and various sports facilities.

Keywords: WRB, anthropogenic soils, soil survey, classification
Financial support: NAS research and development Project

WG09 Soil Modeling: Challenges and perspectives in soil modelling

(2682 - 1591) Hydroponic nutrient solution for pineapple cultivation

Ronald Alberto Chaves Corea[1]; Marco Vinicio Gutierrez Soto[2]

Centro Investigaciones Agronómicas, Universidad de Costa Rica[1]; Estación Experimental Agrícola Fabio Baudrit, Universidad de Costa Rica[2]

A nutrition solution was formulated for the hydroponic cultivation of Ananas comosus, var. MD-2 in a greenhouse between August 2015 and June 2016. The plants were sown in pots of 20 L filled with coconut fiber, distributed in 6 double rows of 7m of length (2m of each other), and 40 cm of each other. An automated system was used to control time, volume, flow rate and irrigation frequency, pH, electrical conductivity (EC), and the proportion of minerals dissolved in the nutrition solution. The substrate moisture content (v/v) was maintained between 30- 50%. The pH of the nutritive solution for irrigation remained around 5.5, and the electrical conductivity between 2.4-2.6 ds m-1. A randomized design was used, with three treatments distributed chronologically, during the vegetative cycle of the crop. The elements were determined through foliar analysis. The analysis of correlation and clustering performed using principal components analysis were used to determine factors that significantly affected the leaf concentration of each nutrient. Prediction models allowed concluding that the N concentration in solution should be maintained between 102-188 mg L-1 to achieve foliar concentration levels between 1.3-1.8%. Similarly, to maintain foliar concentrations (%) of P (0.15-0.25) solution concentrations (mg L-1) should be keep (39-65); and for K (3.5-4.1) solution concentrations (107-185). To maintain Fe and B foliar concentrations (mg kg-1) at (70-100) and (13-18) solution concentrations (mg L-1) should be maintain at (5.88-12.70), and (0.5-1.0), respectively. The foliar contents of Ca, S, Zn, Mn, did not respond to the fluctuations of solution concentrations but were significantly affected by the fluctuations of N in the solution. Nevertheless, when maintaining the concentration of N in solution between 102-188 mg L-1, and that of Ca between 140- 200 mg L-1, S concentrations between 45-60 mg L-1, Zn between 0.2-1.0 mg L-1 and that of Mn between 0.5-2.0 mg L-1, the foliar concentration of Ca, S, Zn, Mn, remained between 0.3-0.5%, 0.10-0.15%, 11-19 mg kg-1, and 60-180 mg kg-1, respectively. The foliar concentration of elements such as Mg and Cu did not generate any statistically significant prediction model. With the concentrations used in this work no symptoms of Mg or Cu deficiencies were detected, so it is recommended to maintain their contractions in solution between 50-70 mg L-1 and between 3-6 mg L-1, respectively.

Keywords: Pineapples, Nutritive Solution, Hydroponics.

Financial support:

(7935 - 2646) Litter dynamic in different landscape compartments of the Brazilian Southern Amazon

Marco Antônio Camillo de Carvalho[1]; Fabiana Ferreira Cabral Gomes[2]; Diego Silva Siqueira[3]; Alan Rodrigo Panosso[4]

UNEMAT – Mato Grosso State University, Rodovia MT 208, km 145, Jardim Tropical, Alta Floresta, MT, 78580-000, Brazil. (marcocarvalho@unemat.br)[1]; UNEMAT – Mato Grosso State University, Rodovia MT 208, km 145, Jardim Tropical, Alta Floresta, MT, 78580-000, Brazil. (fabiherbam@gmail.com)[2]; FCAV/UNESP – College of Agricultural and Veterinarian Sciences, Sao Paulo State University, Via de Acesso Prof. Paulo Donato Castellane s/n, Jaboticabal, SP, 14884-900, Brazil. (diego_silvasiqueira@yahoo.com.br)[3]; FEIS/UNESP – College of Engineering of Ilha Solteira, São Paulo State University, Av. Brasil Sul, 56 – Centro, Ilha Solteira, São Paulo, 15385-000, Brazil[4]

The processes of litter production, accumulation and decomposition are controlled by biotic and abiotic factor such as environmental conditions, quantity and quality of the deposited material, besides the decomposition community. These factors are often related to the landscape form and, therefore, presenting spatial variability. The aim of this work was to evaluate the litter production, accumulation and monthly decomposition, as well as the influence of dendrometric parameters of the trees on these processes, in two Southern Amazon native forest fragments (open ombrophilous forest) located in different landscape compartments: F1) linear-concave surface whit high slope and F2) concave-convex surface whit low slope. Litter components were evaluated during 12-month periods (November 2014 to October 2015). Data were initially analyzed by classical statistics (mean, analysis of variance, coefficient of correlation, linear and non-linear regression), followed by geostatistical and multivariate analysis (cluster analysis and principal components analysis). Multivariate analysis of the data allowed the division of litter production and accumulation among the highest values (months of drought), the lowest values (rainy months), and a transitional period (October) coinciding with the period of soil water replenishment. Positive and significant coefficients of correlation ($p < 0.01$) were observed between litter production and diameter at breast height (0.65), volume (0.58), total height (0.63) and number of trees (0 , 63) located at distances until 10 m from the collectors, only for F2. The rates of litter decomposition were 0.70 $year^{-1}$ for F2 and 0.83 $year^{-1}$ for F1 and the time for the decomposition of 50% of the initial mass was from 305 to 359 days, respectively. In the first 150 days, the linear-concave compartment presented a decay rate of 21.05% greater than the concave-convex compartment. Spatial patterns of principal components indicated the formation of homogeneous groups of individuals for F2 in relation of dendrometric parameters being the concave-convex compartment more favorable to the higher values of diameter at breast height, stem and total height. Therefore, our results confirm the potential of the hybrid approach (using multivariate and geostatistical techniques) to identify compartments with different litter production, accumulation and decomposition potentials in the southern Amazon forest.

Keywords: *principal components analysis, geostatistics, litter decomposition, deposition of litter*

Financial support: CAPES (Coordination for the Improvement of Higher Level – or Education Personnel)

(4017 - 2103) LS-SVM data mining analysis: how does biochar influence soil net nitrogen mineralization in the field

Jianqiang Deng[1]

Enshi Tobacco Company of Hubei Province[1]

Purpose Biochar was considered as a stable-carbon source for improving soil quality and the long term sequestration of carbon. However, in view of the ecological environmental feedback function and the high coupling system of carbon-nitrogen cycling, it attracted further attention to the effect of biochar on soil net nitrogen mineralization (SNNM). Recently, ecological environmental evaluations of biochar were mostly based on laboratory incubation or pot experiments, ignoring the external and uncontrollable natural factors. Therefore, the essential characteristics of local environment were not accurately described. Materials and methods In this paper, the nonlinear stochastic model of SNNM based on Least squares support vector machine (LS-SVM) was set up to study the effect of biochar on nitrogen cycling in a field experiment. In order to explore this effect in natural conditions, Partial Derivatives (PaD) Sensitivity Analysis of LS-SVM was firstly proposed, evaluated by the data from a known equation, and was then applied to open the "black-box" stochastic model of SNNM. Results and discussion Comparing with the sensitivity analysis of ANNs, the RD values by LS-SVM PaD1 algorithm were almost the same with the ones of ANNs PaD1 algorithm. However the RSD values of LS-SVM PaD2 algorithm were more adequate to the given equation. In the SNNM model, RD values of initial nitrogen, time and precipitation by LS-SVM PaD1 algorithm were 21, 15 and 14%, and the one of biochar was only 0.51%, implying that biochar did not influence SNNM directly. However, the cumulative RSD of boichar with the other factors by the PaD2 algorithm was 15.05%, which was maximal of the interactions, implying that it could greatly enhance the tendency

for SNNM by interacting with other factors. Conclusions PaD Sensitivity Analysis of LS-SVM was a stable and reliable data mining method. In the SNNM model, initial nitrogen, time, precipitation and relative humidity were main control factors of SNNM model. Biochar did not directly influence SNNM, however it could greatly enhance the tendency for SNNM by interactions with other factors by decreasing the inhibitory effect of initial nitrogen on SNNM and modifying soil condition to change the effect of other factors on SNNM.

Keywords: Artificial intelligence; Biochar; Model; Partial derivatives sensitivity analysis; Soil nitrogen
Financial support:

(4784 - 2069) Machine learning applied to the mapping of mountain coffe from terrain atribute.

Raiza Moniz Faria[1]; Elpídio Inácio Fernandes Filho[1]; Maola Monique Faria[2]; Cibele Hummel do Amaral[1]; Márcio Rocha Francelino[1]
Federal University of Viçosa[1]; Development Company of the State of Roraima[2]

The state of Minas Gerais is the main producer of coffee in the country, responsible for much of the national production. Because of the importance of coffee, we had intended to work with this map the Mountain coffee from the spectral data and terrain attributes. For the study were developed methodologies of classification of coffee areas in three municipalities of the state of Minas Gerais. The database consisted of 59 variables, including a Sentinel 2A image, vegetation indexes and attributes derived from the ALOS / Palsar digital elevation model (MDE). The sample set was separated in training and validation in the proportion 0,90: 0,10. In order to reduce the dimensionality of the model, the Recursive Feature Elimination variable selection method was applied to the data. Two areas had their crops validated in a high resolution image. The selected variables were submitted to the Random Forest (RF), Stochastic Gradient Boosting (GBM), Logistic Model Tree (LMT) and CTREE algorithms, where the performance evaluation of each classifier was performed. The most important variables for the classification of mountain coffee were the NDVI index, band 12, band 2, band 8 and MDE with 0.86 correlation. The CTREE and LMT were not satisfactory for classification of coffee areas in mountainous terrains, not being able to separate coffee from other tree coverings such as forest and eucalyptus areas, with great confusion among these classes. The GBM and RF algorithms had a Kappa index of 0.86 and 0.88, with the accuracy of the user and producer with values above 0.90 for the entire area with the insertion of the terrain attributes. In the validation area I, the user accuracy was 0.66 for RF and GBM and in area II, the user accuracy was 0.79 and 0.81. The area II presents a diversity of coverings with spectral patterns similar to coffee larger than area I and the busiest relief, and the RF and GBM algorithms were efficient in separating the coffee areas from the others. Both GBM and RF are good classification algorithms for coffee areas in mountainous relief.

Keywords: machine learning; coffe classification, classification
Financial support: Fapemig

(5217 - 1736) Modeling Evapotranspiration and Crop Growth of Irrigated and Non-irrigated Corn under Warm Climate

Huihui Zhang[1]; Robert Wayne Malone[1]; Lajpat R. Ahuja[1]; Liwang Ma[1]; Saseendran S. Anapalli[1]; Gary Marek[1]; Prasanna H. Gowda[1]; Steve Evett[1]; Terry Howell[1]
USDA-ARS[1]

Accurate quantification and management of crop evapotranspiration (ET) are critical to optimizing crop water productivity for both dryland and irrigated agriculture, especially in the semiarid regions of the world. In this study, four weighing lysimeters were planted to maize in 1994 with two fully irrigated and two non-irrigated for measuring crop ET in Bushland, Texas. The two fully irrigated lysimeters were used for calibrating the Root Zone Water Quality Model (RZWQM2) and the non-irrigated ones were reserved for model evaluation, in terms of leaf area index, biomass, soil water contents, and daily ET. The Nimah-Hanks approach in RZWQM2 was used for calculating actual crop water update (AT), and the Richards' equation was used for actual soil evaporation (AE). The Shuttleworth and Wallace method (S-W) and ASCE Standardized alfalfa Reference ET plus crop coefficients (ASCE) were used to calculate potential ET (PET), which were partitioned into potential evaporation (PE) and potential transpiration (PT) based on leaf area index. As a result, four water stress factors were tested in the model against the lysimeter data, i.e., AT/SW-PT, AT/ASCE-PT, (AT+AE)/SW-PET, and (AT+AE)/ASCE-PET. Root Mean Squared Deviations (RMSDs) and relative RMSDs (RMSD/observed mean) values for leaf area index, biomass, soil water contents, and daily ET were within simulation errors reported earlier in the literature. For the two non-irrigated lysimeters, the simulated daily ET values were also reasonably close to the measured values, but were under-estimated during mid-growth stage. In general, water stress factor defined by (AT+AE)/SW-PET was better than other stress factors in simulations of non-irrigated corn biomass and grain yield. Additional studies of crops grown under dryland conditions using weighing lysimeters are needed to corroborate these findings and aid in the development of new water stress algorithms.

Keywords: RZWQM, ET, Yield, Leaf Area Index, Lysimeter
Financial support:

(2738 - 908) Modeling for fertilization and liming for sugarcane in low fertility soils

Fernando José Freire[1]; Fábio Cesar da Silva[2]; Victor Hugo Alvarez Venegas[3]
1Universidade Federal Rural de Pernambuco, 52171-900 Rua Manuel de Medeiros, s/n - Dois Irmãos, Recife - PE, Brazil (Email: fernandojfreire@uol.com.br);[1]; 2Embrapa Informática Agropecuária, 13083-886 Av. Dr. André Tosello, 209 - Cidade Universitária, Campinas - SP, Brazil (Email: fabio.silva@embrapa.br)[2]; Universidade Federal de Viçosa R. Purdue, 392-486 - Santo Antonio, Viçosa - MG, 36570-000,Brazil[3]

Currently fertilizers recommendation for the sugar cane culture in Brazil are based on growth curves, obtained from the relationship between fertilizer rates and yield increment. Predictive recommendation systems are desirable and of wider application. This work was carried out aiming to structure and develop a System to estimate the nutritional balance and recommend lime and fertilizers to sugar cane plants (SBNR-C) based on the nutritional demand (ND) and expected yield (EY). The input information required by the System is the expected yield and the nutrient use efficiency (NUE). The nutrient demand is estimated dividing EY by NUE. Specifically for P, S and Zn, besides the EY and NUE values, the System requires information related to soil's buffer capacity. This way, the System estimates the critical level for each nutrient for the EY and compares this value with the nutrient availabilit y in the soil, indicating the need or not for lime and, or, fertilizer application. The recommended fertilizer rate may be multiplied by a factor that increases the amount of nutrient added in order to avoid soil nutrient depletion and to assure yield sustainability. The proposed model for lime recommendation showed itself consistent for being possible variable recommendations depending on the EY, allowing a wider inter-relationship with the plant-soil system and estimating the final pH value for any lime dose. The estimate of the critical level and K doses for ratoon were coherent with the nutrient recommendation for sugar cane plants and ratoon, specially for the last cultivation since it's not contemplated in any recommendation tables in Brazil. The estimate of the residual effect of P in first and second ratoon was consistent, allowing to infer that shorter cultivation periods, for example with early cultivars, results in more pronounced residual effects. The adjustment of a predictive model for quantification of the mineralizable N in Sugar

cane plants, first and second ratoon, using organic matter and clay content in the soil allowed the th estimation of this nutrient's necessity. The simulations for Zn, B and Cu resulted in compatible critical values when compared with critical levels in the literature. The little information existing for Fe and Mn didn't allow the complete modeling for these elements. The SBNR-C represents na efficient tool for the recommendation of lime and fertilizers for sugar cane plants.

Keywords: soil fertility modeling, efficient use, sugarcane nutrition
Financial support: UFRPE / EMBRAPA.

(2559 - 1706) Modelling soil respiration and net ecosystem exchange in agrolandscapes

Sukhoveeva O.E. 1[1]; Karelin D.V. 1,2,3[2]
1 Institute of Geography, Russian Academy of Sciences, Staromonetniy 29, Moscow, 119017, Russia (olgasukhoveeva@gmail.com)[1]; 1 Institute of Geography RAS, Staromonetniy 29, Moscow, 119017; 2 Lomonosov Moscow State University, 1-12 Leninskie Gory, Moscow,119991; 3 Center for Problems of Ecology and Productivity of Forests RAS, Profsoyuznaya 84/32, str. 14, 117997, Moscow, Russia[2]

The goal of the research was to evaluate the possibilities and quality of different modelling approaches to estimate major CO_2 fluxes in agroecosystems. The regression method and simulation biogeochemical model DNDC (DeNitrification-DeComposition) were applied to the following field objects and data sets: (a) soil respiration (SR) of the arable Haplic Chernozem under crop rotation in Kursk region, Russia, 51°54'N, 36°10'E, 2017; (b) SR of the arable Luvic Phaeozems under unfertilized cereal-fallow rotation in Moscow region, Russia, 54°49'N, 37°34'E, 1997-2009 (field data by I.N. Kurganova, Institute of Physical-chemical and Biological problems of Soil science RAS); (c) net ecosystem exchange (NEE) of semidesert sagebrush pasture in Uzbekistan, 39°40'N, 65°46'E, 1998-2001 (field data by M.G. Nasirov, Samarkand State University). The quality of modelling was estimated by use of Nash and Thail coefficients, and ANOVA. In Kursk region mean seasonal (April - October) SR was equal to 0.138 ± 0.068 (barley), 0.143 ± 0.075 (potato), 0.146 ± 0.095 (sunflower), 0.173 ± 0.114 (winter wheat) g C m^{-2} h^{-1}. Measured and modelled estimates don't differ significantly; for all crops Thail coefficients were less than 0.30 (good quality). DNDC predicts that during the next 50 years SR will increase by 19 (potato) – 50 (wheat) kg C ha^{-1} yr^{-1}, if the CO_2 concentration in the atmosphere will follow the current trend (+3 ppm/yr). In Moscow region the observed mean SR was equal to 0.038 ± 0.046 (fallow) and 0.050 ± 0.048 g C m^{-2} h^{-1} (winter wheat), whereas the corresponding modelled estimates were 0.040 ± 0.033 and 0.035 ± 0.031 g C m^{-2} h^{-1}, respectively. The modelling was particularly effective for fallow: Nash coefficients were higher than 0.50. Proportion between root and microbial respiration was estimated by DNDC at 33.2/66.8%, accordingly. Regression modeling based on shallow soil temperature and moisture explains 31-41% of soil respiration variance. In Uzbekistan experimental site NEE was estimated at +0.129 ± 0.046 g C m^{-2} h^{-1} (source of carbon to the atmosphere). The results of DNDC also prove this region to be the annual net source of CO_2. Intensity of NEE was correlated to air temperature and heat flux, whereas it was negatively correlated to relative humidity and amount of precipitation. These controls were able to change the sigh of the net CO_2 flux from source to sink in a short time. Nevertheless only 16% of net CO_2 flux variation was due to weather conditions.

Keywords: soil respiration, CO_2 emission, simulation modelling, agrolandscapes
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(4297 - 273) Redox potential and nitrous oxide emissions in response to flood irrigation with waste water in central Mexico

Blanca Gonzalez Mendez[1]; Richard Webster[2]; Christina Siebe[1]
Unam[1]; Rothamsted Research Station[2]

Irrigation with untreated sewage water is becoming a common practice in the arid and semiarid regions around the world. Waste water adds labile carbon and nitrogen compounds to the soil, and when applied by flooding it rapidly changes the redox potential and soil's atmosphere, as consequence of temporarily waterlogged and depleted oxygen, generating nitrous oxide (N_2O) emissions. We monitored the redox potential, E_h, in the soil and the nitrous oxide emissions at two sites in the Mezquital Valley to discover whether the short-term gas emissions matched the changes in *E*h. One site is irrigated periodically by flooding with waste water and has alfalfa, rye grass and maize grown in succession; the other site grows rain-fed maize only in summer. At each site we buried platinum electrodes at different depths in the soil and around them, on the surface, we installed static chambers to measured the N_2O emissions simultaneously. Measurements were made all along 21 months considering the time before, during and after each irrigation event. We also measured both variables in the rain-fed maize before and shortly after two rain events. The data from repeated measurements from the same chambers and electrodes were correlated in time, so we modelled the correlation and took it into account to analyse the effects of the irrigation by residual maximum likelihood (REML). After each flooding, the redox potential under alfalfa and rye grass decreased by 150–200mV from a norm of about 450mV for 2 days, after which it returned to its norm. The short-term response to flooding under maize was similar, but the redox potential did not recover completely; instead there was a decrease from one irrigation event to another, in particular as a result of heavy rain in September that saturated the soil. The soil under rain-fed maize was slower to respond, partly, we believe, because infiltration into the less aggregated clay soil and drainage from it were also slow. Irrigation with untreated sewage water caused a sharp decrease in E_h lasting 1–2 days. The emissions of N_2O increased dramatically during the next few days after irrigation and then declined. It seems to be related with the water infiltration that replace the gas from air-filled pores and with the soil oxygen depletion, causing reduction in microhabitats rich in carbon and nitrogen and generating N_2O, which was captured in the closed chambers that we had installed.

Keywords: Redox potential, Nitrous oxide, REML, Waste water irrigation.
Financial support: DGAPA-PAPIIT programme (IN113307-3) and CONACYT/SEMARNAT 2006: 23496

(2119 - 1064) Simulating the effects of soil heterogeneity on grazing management strategies in semi-arid rangelands of the western North American Great Plains

Liwang Ma[1]; Justin Derner[1]; Daren Harmel[1]; Patricia Bartling[1]; Cody Ziverberg[2]; Jimmy Williams[2]; David Augustine[1]; Loren Porensky[1]; David Hoover[1]; Dana Blumenthal[1]
USDA-ARS[1]; Texas A&M University[2]

Aspirational management strategies for semi-arid rangelands in the western North American Great Plains are needed to collectively sustain livestock production, improve profitability for ranchers, reduce adverse environmental impacts, and enhance vegetation structure and composition heterogeneity for wildlife habitat, all of which will occur under a changing climate. We compared traditional grazing management (TGM, mid-May to October grazing at moderate stocking rate with low stocking density and cattle remaining in the same pasture for the full grazing season) to an adaptive grazing management (AGM, at ten-fold higher stocking density but grazing pastures for short periods – weeks – and rotated among 10 pastures) strategy using the APEX model. Primary emphasis here was to simulate effects of soil heterogeneity on grazing management. 5 years (2013-2017) of

experimental data from the Central Plains Experimental Range (CPER), shortgrass steppe rangeland, were used to calibrate the APEX model for plant biomass and animal production across a range of soil textures (sand to silty clay loam with clay content from 4% to 40%). Initial results indicate that APEX effectively simulated differences in plant biomass and cattle gains between the AGM and TGM using a representative soil type. Additional efforts will focus on expanding modeling simulations to incorporate the soil texture gradient and slope (0 to 30%) in the field for plant biomass and cattle gains, as well as evaluating environmental impacts and influences on plant diversity.

Keywords: APEX, Soil Spatial Variability, Soil Carbon Sequestration
Financial support:

(5527 - 2449) Soil Macroinvertebrates under a livestock system in an Oxisol of Colombian Eastern High Plains.

Lina Moreno[1]; Nubia Rodriguez[1]; Orlando Arguello[1]; Miguel Arango[1]; Jaime Bernal[1]; Jose Baquero[1]; Otoniel Perez[1]
Corpoica[1]

Agricultural practices related to livestock systems affect the soil ecosystems services such as biological diversity, nutrient cycling and climate regulation. The objective of this work was to assess the impact of agricultural practices on the soil macroinvertebrate community. In Corpoica`s research center Carimagua (Meta), agricultural practices to improve productive and reproductive parameters of breeding livestock were adjusted and validated. Such practices included: Improved pastures (*B. dyctioneura)*, corn-soybean rotation, timber trees and a spontaneous trees patch cover. Biodiversity indicator was evaluated since 2012. The soil sampling was carried out following the methodology described by the Tropical Soil Biology and Fertility Program (TSBF). The data were analyzed using a principal components analysis (PCA) and the Simpson's diversity index (H) was estimated. An indicator value was generated from the first two components principal and ranged from 0.1 to 1. The PCA explained an average of 55.23% of the macrofauna variability found during three years of evaluation. The systems established with *B. dyctioneura* and a spontaneous trees patch cover had the highest indicator value. The order *Isoptera* had the highest correlation with abundance and highest dominance based on the Simpson's diversity index. The Isoptera was dominant under corn-soy rotation system (H = 0.23) followed by the forest (H = 0.28). Overall, the ecosystem engineers such as termites, ants and earthworm were found across all practices.

Keywords: *Macroinvertebrates, Ecosystem Services, Diversity, Ecosystem Engineers.*
Financial support: Corporación Colombiana de Investigación Agropecuaria Corpoica

(6090 - 913) Stolf-Scardua model for estimating soil water retention curve (WRC) by clay content

Rubismar Stolf[1]; Douglas Roberto Bizari[1]; Rubens Scardua[2]
Federal University of São Carlos-campus Araras[1]; University of São Paulo (retired)[2]

The proposed model differs by using, for each tension, an equation correlating "water retention" with "clay content". In this way, the model is composed of a set of equations, each one representing one point of tension. We searched, for a work with wide variation of clay content and tension in order to adjust the model. The selected one (Scardua, 1972) presents Water Retention Curves (WRC) in soil samples of 12 different clay contents (Clay %): 7.1; 10.6; 17.2; 17.9; 22.4; 21.8; 34.8; 39.4; 37.4; 53.4; 59.2; 60.5 and in 13 tensions (kPa): 0; 0.1; 2; 6; 8; 10; 20; 33; 70; 100; 300; 600; 1500, each one as average of four replicates. That is, a data universe of 12 retention curves, with 13 tensions, 156 points. Each point average of four repetitions, totaling 624 measurements of soil sample. The model that best represented the variation for each tension was the linear one: water retention WR= a + b.Clay. The correlation coefficients (r^2) resulted in the following values, respectively (for each tension from 0 to 1500 kPa): 0.940; 0.906; 0.930; 0.904; 0.885; 0.882; 0.881; 0.892; 0.886; 0.889; 0.850; 0.882; 0.938. Comparing the measured (Scardua, 1972) with the estimated data (model), absolute mean error ME = $(\Sigma|Y_{measured} - Y_{estimated}| / N = 0.018\ cm^3\ cm^{-3}$ (1.8%) was obtained, classifying the adjustment as excellent. Using the 13 equations, an abacus was been calculated for estimation of retention curves of 2.5 in 2.5 % clay, in the range of 5 to 70%. This option dismiss the direct use of the equations. By the other hand, we can generate a spreadsheet in which we enter the clay content to generate the data of the curve. The application of the model, especially for the analysis of available water capacity (AWC) is been discussed.

Keywords: Linear relationship, retention versus clay, building WRC
Financial support: Foundation of Institutional Support to the Scientific and Technological Development (FAI-UFSCar)

(2252 - 1692) The importance of the rizospheric priming effect for Eucalyptus nitrogen nutrition in Brazil and Australia

Rafael Vasconcelos Valadares[1]; Maurício Dutra Costa[1]; Júlio César Lima Neves[1]
Universidade Federal de Viçosa[1]

Nitrogen (N) is one of the most accumulated nutrients in *Eucalyptus* plantations, with values between 120 and 1,300 kg/ha. Interestingly, the stands often present little or none N fertilization response in tropical contries, like Brazil. The responses, when present, occur within the first two or three years, and cease to exist during the time of the harvest. Therefore, *Eucalyptus* plants can meet their high N demand without fertilization or with the application of low doses, between 40 and 70 kg/ha of N. To explain this phenomenon, we hypothesized that rhizosphere priming effect (RPE) is quantitatevely important for *Eucalyptus* nitrogen nutrition. To test this hypothesis, it was simulated the *Eucalyptus* growth using the general *Eucalyptus* APSIMex model and the rhizosphere processes using ForPRAN model. It was projected the *Eucalyptus* growth in four sites, being two at Brazil (Aracruz/ES and Curvelo/MG) and the other two at Australia (Wagga Wagga/NSW and Coffs Harbour/NSW). The planting space was of 3 x 3 m for all the sites and the soil and climatic conditions were specific of each city. It was considered the N cycling in the first 20 cm layer of the soil. At the end of seven years rotation, it was estimated that 12, 11, 10 and 5 % of the total soil was occupied by the rhizosphere at Aracruz, Coffs Harbour, Wagga Wagga and Curvelo sites, respectively. As a result of the rhizodeposition, the ForPRAN model suggests in all four sites an increase in the rhizospheric microbiota activity, in which the average values were between 70.3 µg/cm³ and 246.1 µg/cm³ of C, according to each pedoenvironment. In general, RPE has the potential to meet between 15 and 38 % of the forest ecosystem N demand (trees + litter), under the studied situations. Higher temperatures and rainfall volumes may contribute to a more exuberant rhizospheric contribution (in absolute values) in Brazil than in Australia, what also explain the low N limitation in the first country.

Keywords: Modeling; fine roots; rhizosphere priming effect; microbial biomass; mineralization
Financial support: Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) and Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES)

(2856 - 2291) Variation of nematode population of soil in tomato crop with introduction of service crop (*Sinapsis alba L.*).

Maria de los Ángeles Quinteros[1]; Hector Alfredo Sanchez[1]; Cristina Picon[2]; Elena Boggiatto[2]
INTA[1]; Fundación Miguel Lillo UNT[2]

Horticulture production in Tucumán is important economically and socially; the productive area is extended mainly along the foothill plain

of the province, associated to the streams and rivers that run down the mountains satisfying its irrigation necessities. The soil where this activity is done is generally alluvial, with a loam texture or enriched with silt and fine sand due to the influence of rivers and streams. The principal management does not consider crop rotation to maintain soil fertility. Although there is a crop alternation, it is generally of the same botanic genre, which makes some plagues endemic. The main cause of crop yield reduction is the presence of nematode phytophagous. The use of control measurements is needed to reduce the level of population. For this reason, the development of management strategies to reduce the density of the population to a level below the threshold of the crop damage is considered fundamental. The aim of this work is to evaluate the effects of mustard crop (*Sinapsis alba L.)* as a service crop to diminish the nematode phytophagous population in soil. Materials and methods: mustard was sown in a recently harvested tomato lot, highly infested with nematodes. Before sowing, a sample was taken to evaluate nematodes. New samples of the same soil were taken after harvesting the mustard. In this work, the information presented is related to the variation of soil nematode population with the incorporation of a service crop. Results: It was observed a reduction of a nematode pfytophagous in soil; it indicates the importance of the introduction of a service crop, such as mustard, to control nematode pfytophagous and to contribute to soil sanity.

Keywords: Nematode,tomato,SinapsisAlba L.
Financial support:

WG10 Hydropedology: Hydropedology and critical zone science: toward systems soil Science

(7809 - 796) Comparison of Physical Quality and Water Management of Substrates Mixtures and Soil Through the Least Limiting Water Range Index

Gabriel Garbanzo León[1]; Róger Fallas Corrales[1]
University of Costa Rica[1]

In oil palm, the physical soil quality and water management in the bags substrate is important for healthy root development. The oil palm nurseries requires loamy soil texture, balance nutrient status, good drainage and low bulk density. In the present study the physical quality of the soil and water management were evaluated in substrates mixtures calculated by using the Least Limiting Water Range index (LLWR) in oil palm nurseries and total biomass productivity. We made volumetric mixtures of 12, 25, 37, and 50% composted residues of oil palm fiber (C) with Eutric Inceptisol material. Compacta x Ghana oil palm hybrid plants were planted in 20 L bags. At 90, 210 and 320 days after sowing (dds) rings with soil were sampled, saturated with water and then equilibrated on pressure plates at potentials (ψ) of -0.005, -0.015, -0.033, -0.1, -0.5 y -1.5 MPa. Bulk density, volumetric water content, soil resistance and air-filled porosity (10%) were correlated with the LLWR Index. The water retention curve model decreased with the substrates mixtures (r^2= 0.3 – 0.4) in comparison to 100% soil bags (r^2= 0.6). Likewise, the soil resistance curve model increased to applied 12% fiber with 88% soil (r^2= 0.7) in comparison to 100% soil (r^2=0.6). Total biomass showed the highest accumulation in the 12% C than the 100% soil in the bags. It was concluded that application upper that 25% C with soil can affect the physical properties if the mixtures by decreasing the water content in oil palm nurseries bags. Also LLWR Index can help to quantify the quality and this could be an alternative to adjust irrigation in oil palm nursery.

Keywords: Water matric, LLWR, Oil palm, Nurseries, Substrate.
Financial support: University of Costa Rica and Palma Tica S.A.

(3245 - 2755) Fostering a Global Alliance for Monitoring, Mapping, Modeling, and Managing the Earth's Critical Zone

Henry Lin[1]; Han Zheng[2]; Yunqiang Wang[2]; Zhao Jin[2]; Yi Song[2]; Li Feng[2]; Da Luo[2]; Yunlong Yu[2]; Harry Vereecken[3]; Kris Van Looy[3]
Dept. of Ecosystem Science and Management, Penn State Univ.; State Key Laboratory of Loess and Quaternary Geology, Institute of Earth Environment, Chinese Academy of Sciences[1]; State Key Laboratory of Loess and Quaternary Geology, Institute of Earth Environment, Chinese Academy of Sciences[2]; Forschungszentrum Juelich GmbH; International Soil Modeling Consortium[3]

With growing interests in international scientific communities to establish various observatory networks to monitor the ever-changing environment, a synergistic effort to foster a global alliance for monitoring, mapping, modeling, and managing ("4M") of the Earth's Critical Zone (from the top of the vegetation down to the bottom of the aquifer) is needed. Large-scale monitoring networks are increasingly called for by funding agencies and scientific consortia to address "big" science questions. Long-term recording of the health of our land – through monitoring its "blood pressure," temperature, respiration, and other vital signs is critical. The emerging interests in Critical Zone science bring a promising hope of a unified framework for the holistic understanding of soil, water, rock, air, and biotic resources in the Earth's surface and near-surface environments. Long-term monitoring, along with precision spatial mapping, process-based modeling, and sustainable management of the landscape-soil-water-ecosystem relationships across scales and regions can serve many purposes of societal importance. Optimization of whole systems for multiple benefits rather than one benefit permit synergistic outcomes and cost-effectiveness. Since nature does not recognize disciplinary divides, and artificially-fragmented knowledge hinders integrated understanding of the complex Critical Zone, it is imperative that a systems approach be taken to achieve a comprehensive understanding and integrated management. Thus, while large-scale environmental observing networks are being developed in different parts of the world for various spheres of the Earth system (e.g., the atmosphere, the biosphere, the hydrosphere, and the lithosphere), an integrated one for observing, mapping, modeling, and managing the Earth's Critical Zone as a whole is still lacking. The complex interdependence of climate, hydrology, biology, lithology, topography, pedology, chronology, and anthropogenic forcing at the central juncture of the Critical Zone (i.e., soils) provides an excellent opportunity to study important interfaces, decisive moments, controlling mechanisms, and feedback loops in the Critical Zone across space and time. However, no one team or organization can do that alone, and a diversity of funding sources supporting a heterogeneous mixture of overlapping programs is probably the best formula for long-term stability of such a systems approach. Hence, a global alliance is suggested here.

Keywords: Systems soil science, Critical Zone science, Systems approach
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(2830 - 1193) Optimizing and coupling the hillslope hydrological and biogeochemical simulations in stony soils

Qing Zhu[1]; Xiaoming Lai[1]; Zhiwen Zhou[1]; Kaihua Liao[1]
Nanjing Institute of Geography and Limnology, Chinese Academy of Sciences[1]

Stony soils with rock fragment contents more than 30% are widely distributed in the mountainous areas. However,pedotransfer functions, which are the key parameters in soil hydroloy and biogeochemstry models, are not reliable in predicting the soil hydraulic parameters for these soils due to the impacts of rock fragments. In addition, traditional soil hydrology models lack of sound mechanisms in describing biogeochemical processes, while traditional biogeochemstry models are weak in simulating soil hydrological processes. This may result in the poor simulations of these models. In this study, we aimed to (i) improve the model simulations of Hydrus-3D and DNDC by considering the rock

fragment, and (ii) couple these two models to better simulate the spatial and temporal variation of nitrate leaching on a stony-soil hillslope in Taihu Lake basin, China. We obtained soil hydraulic parameters using different approaches including (1) Rosetta predicted, (2) Rosetta predicted and then corrected by rock fragment content, (3) extracted from observed soil-water retention curves fitted by dual-pore function, and (4) model defaults. These different sets of soil hydraulic properties were then input into Hydrus-3D and DNDC to simulate the soil hydrological and biogeochemical processes, and then the simulation results were statisticall validated by the observed data. The optimal strategies of simulations were then determined. After this, the sursurface flow simulated by Hydrus-3D and the soil nitrate concentrations simulated by DNDC were used to calculate the spatial and temporal variations of nitrate leaching on this stony-soil hillslope using the nitrate leaching equation extracted from the codes of DNDC. Finally, controlling factors and their contributions to the spatial and temporal variations of nitrate leaching were quantitatively determined.
Keywords: nitrogen cycle, soil physics, watershed nutrient losses
Financial support:

(9525 - 1276) Phosphorus contents as indicator of the chemical quality of a yellow red latosol under direct planting with npk, organomineral and bioactivator

Lucas Alves Fernandes[1]; Wilber Pereira Machado[1]; Guilherme Camilo de Andrade[1]; Fabrício Messias Dias da Silva[1]; Roberta Ferreira Coutinho[1]; Gabriel Junqueira Pires[1]; Adriana Aparecida Ribon[1]; Camilla Barbosa de Oliveira Madruga[1]; Taíza Nogueira Barros[2]; Bruno Mikael dos Santos Mariano[1]
State University of Goiás[1]; Federal University of the Recôncavo of Bahia[2]

The management of fertilization is one of the most common practices of Brazilian agriculture. Most of the state of Goiás is covered by Latosols, which are soils of low natural fertility and require greater care regarding the levels of nutrients existing to maintain agricultural productivity. The Latosols, because they present higher levels of iron oxides present specific adsorption for the phosphorus (P). The objective of this work was to evaluate the effect of fertilization with NPK, organomineral and bioactivator on the P content of a Yellow Red Latosol under no - tillage, under soybean succession in the Palmeiras region of Goiás. The experiment was carried out at Bom Sucesso farm, Palmeiras de Goiás - GO, under the coordinates 16º 52 '48,63' 'S and 49º 59' 30,06 "O, at 669.2 m altitude, during agricultural crops 2014/15 and 2015/16 under Red Latosols, in a completely randomized design. A soil analysis was performed before the installation of the soil classification and classification experiment. The sample was collected in the 0 to 0.20 m layer. For sampling a drill was used on a bro drill bit, associated with the tractor battery. Several simple samples were collected, and after homogenization, the sample was transformed into a composite sample. According to the soil analysis, shown in Table 1, the soil was classified as YELLOW RED YELLOW Eutrophic clay (400 g kg-1 of clay and 420 g kg-1 of sand), according to the classification criteria of the Brazilian Classification System Solos (EMBRAPA, 2013). The treatments were organized as follows: T1 - 0.05 kg ha - 1 of Penergetic P and 0.05 kg ha - 1 of Penergetic P; T2 - 0.05 kg ha-1 of Penergetic K and 630 kg ha-1 of NPK; T3 - 630kg ha-1 of NPK; T4 - 0.05 kg ha-1 of Penergetic K, 630 kg ha-1 of NPK and 0.05 kg ha-1 of Penergetic P; T5 - 0.05 kg ha-1 of Penergetic K, 2100 kg ha-1 of organomineral and 0.05 kg ha-1 of Penergetic P; and T6 - 2100 kg ha-1 of organomineral. The treatments with NPK provided the highest levels of initial soil P. Followed by the treatments that associated the organomineral associated with Penergetic. The use of organomineral fertilizer and bioactivator can be used in association and / or substitution of mineral fertilizer.
Keywords: management of fertilization; chicken-bed; adsorption of P
Financial support:

(1993 - 528) Significant Accumulation of Reactive Nitrogen in the Deep Red Soil Critical Zone

Huayong Wu[1]; Xiaodong Song[1]; Xiaorui Zhao[1]; Xinhua Peng[1]; Hu Zhou[1]; Gan-Lin Zhang[1]
Institute of Soil Science, Chinese Academy of Sciences[1]

The commonly recognized low potential nitrification of highly weathered soils with low pH suggest that nitrate is difficult to accumulate in these acidic soils where ammonium-based nitrogen fertilizers or urea are the main N fertilizers applied in agriculture. Here we determined the amounts of NO_3^--N, NH_4^+-N and dissolved organic nitrogen (DON) across the regolith with depth up to 9 m under land uses of upland, woodland and paddy field in the Red Soil Critical Zone Observatory, in a typical subtropical region. The results displayed 92% (827 ± 97 kg N ha^{-1}) of NO_3^--N and 82% (521 ± 153 kg N ha^{-1}) of DON on average stored in the deep (from 1 m to bedrock surface) of the upland regolith. More than 92% (283 kg N ha^{-1}) of NO_3^--N and 78% (820 kg N ha^{-1}) of DON were stored in the deep of woodland regolith. No significant accumulation of reactive nitrogen was observed in the deep of paddy field regolith with different cultivation ages. The low macroporosity (> 25 μm) of the regolith, measured using micro-Computed Tomography, may greatly contribute to nitrate leaching to the deep of regolith and its sharp decrease most likely resulted in the occurrence of peak nitrate storage. Our findings put forward a challenge to the common understanding of low potential nitrification and little nitrate accumulation in subtropical and tropical acid soils and the huge reactive nitrogen storages in the deep Critical Zone raise concerns about groundwater contamination under heavy rainfall in humid regions.
Keywords: Nitrate accumulation, Dissolved organic nitrogen, Macropore structure, Red Soil Critical Zone
Financial support: National Natural Science Foundation of China, Project Number: 41571130051, 41501228

(8637 - 932) Soil Classification System based on Pore Space Structure

Marta V. Ottoni[1]; Theophilo B. Ottoni Filho[2]; Maria Leonor R.C. Lopes-Assad[3]; Otto Corrêa Rotunno Filho[2]
Geological Survey of Brazil (CPRM)[1]; Federal University of Rio de Janeiro (UFRJ)[2]; Federal University of São Carlos (UFSCAR)[3]

A soil classification system was proposed based on the clustering of similar air availability curves [$A_a(s)$ curves, s is the suction] determined in the soil sample scale, where $A_a(s)$ is the complement of the water retention curve, θ(s), in relation to the saturated water content, Φ. This system is identified by the acronym SPSCS (*Soil Pore space-Structural Classification System*) and defines the structural Families as the soil classes that group similar $A_a(s)$ curves. In SPSCS, the $A_a(s)$ curve was modelled by the van Genuchten (VG) equation with a protocol for the determination of its parameters valid in the suction range from 30 cm to 18000 cm, for which the prediction of water retention data by the VG model is acknowledged to be more adequate. Two categorical levels are indicated in SPSCS: Orders and Suborders. SPSCS was based on the textural classification system and conceives a triangle analogous to the textural triangle, called structural triangle, where samples plotted in specific sub-areas have similar pore size distribution curves. These sub-areas define the soil Orders. The Suborder represents the soils with similar active pore space, a term proposed in this work to express the difference between Φ and the residual water content, θr. Nine Orders (from A to I) and four Suborders (from 1 to 4) are proposed, thus resulting in 36 possible structural Families. SPSCS was implemented with a broad and diverse soil database with approximately 3,000 soil samples from tropical and temperate environments. All the structural Orders and Families were represented, with exception of three Families, with a greater concentration of samples in Orders B, G

and H and Suborders 2 and 3. Because it is based on an analytical methodology, SPSCS may be a useful tool in the development of pedotransfer functions of hydraulical properties when information related to the soil structure is taken into account. Its use may also be relevant in studies to correlate soil pore structure and hydraulic functioning, pedological classes and soil physico-chemical properties, which may contribute to build up knowledge on hydraulical and pedological processes.
Keywords: pore space; soil database; soil classification
Financial support: Geological Survey of Brazil, Capes

(1677 - 2426) Soil water repellency influenced by two tillage systems and wheel track in a Mollisol of central Chile

Ángela Faúndez[1]; Oscar Seguel[1]; Edmundo Acevedo[1]; Cristian Kremer[1]; Manuel Casanova[1]
Universidad de Chile[1]

Excessive water repellency is a problem to a greater or lesser extent in most soils, caused by the accumulation of organic compounds. The hydraulic behavior of the soil depends on the continuity of the porous system, which is negatively affected by conventional tillage (CT) during plowing. The no tillage (NT) maintains the soil structure, being a more stable system, however, it increases the superficial mechanical strength and accumulate salts and organic matter (OM), potentially forming physical, chemical and/or biological seals. The objective of this work was to evaluate the origin and influence of surface seals on the water repellency of a Mollisol under conventional and no tillage systems. The trial was conducted at the Antumapu Campus of the University of Chile, during the 2016-2017 season. The classical method of water repellency, which relates the sorptivity (S) in ethanol and water (R index = $S_{ethanol}/S_{water}$, where R>2 means water repellency) does not discriminate the agent of sealing or repellency. In the present study we proposed two new indices: HCl index for carbonates (R_{CO3} = S_{HCl}/S_{water}, with critical value of R_{CO3}³1.2) and H_2O_2 index for OM (R_{OM} = S_{H2O2}/S_{water}, with critical value of R_{OM}³1.08), where the ethanol, H_2O_2, HCl and water were measured outside (OT) and inside (IT) of the machinery wheel track, in order to determine possible agents of sealing. Also, we determined the OM and the $CaCO_3$ contents at the surface (0-2 mm). Both, tillage systems and positions, showed water repellency, being higher in CT (R = 4.17) than NT (R = 2.91). The concentration of $CaCO_3$ was the same in both systems, and the OM reached values close to 9% in the crust in NT, while in CT did not exceed 2.3%. In the case of R_{CO3}, only the CT shown values above the critical level, with R_{CO3}=1.43, possibly by clogging of the porous system. Finally, in R_{MO} both systems are affected, but NT had significantly higher values than CT, with R_{MO} = 3.4 in NT and R_{MO}= 2,0 in CT. In the case of the wheel track, CT in the three indices showed higher values at OT position, attributed to the mechanical breakdown of the crust by traffic. In conclusion, tillage systems showed hydrophobicity, but the CT system is affected mainly by the presence of $CaCO_3$, generating a chemical seal, while in NT the OM acts as a structuring agent.
Keywords: Hydrophobicity, tillage systems, soil sealing.
Financial support:

(5249 - 1268) The resistance of soil to penetration as indicator of compaction in different classes of soil under the integration system for livestock and native wood

Gabriel Junqueira Pires[1]; Wilber Pereira Machado[1]; Guilherme Camilo de Andrade[1]; Fabrício Messias Dias da Silva[1]; Roberta Ferreira Coutinho[1]; Lucas Alves Fernandes[1]; Adriana Aparecida Ribon[1]; Camilla Barbosa de Oliveira Madruga[1]; Taíza Nogueira Barros[2]; Sidarta Oliveira[1]
State University of Goiás[1]; Federal University of the Recôncavo of Bahia[2]

Soil compaction is a limiting character for agriculture, usually caused by man's action. Among the properties indicative of compaction, soil resistance to penetration is highlighted, being considered a rapid and direct measure of the degree and / or state of compaction of the soil in cultivated areas. The objective of this work was to measure soil resistance to penetration in five soil profiles in an area on the Forest Animal Husbandry Integration System (HIS) and adjacent native forest in the region of Midwest of Goias. The Penetrometric samplings were obtained up to 60 cm depth with Stolf (1996) model impact penetrometer, following the STOLF methodology (1991), with a standard weight of 7 kg and a drop weight of 4 kg in the 5 soil profiles in open trenches up to 2 m deep and 2 m long in distinct locations of the Forest Livestock Integration area and in a legal Mata reserve area adjacent to the Livestock Forest Integration area in the city of Palmeiras de Goiás-GO. Together with soil penetration resistance, samples were collected to determine the gravimetric moisture of the soil and this was randomly collected, in a total of 6 points / ha in the experimental area, on the same days of soil resistance to penetration. For determination of soil moisture (FORMULA 1), the gravimetric method was used to determine the mass of the humid soil using a precision analytical balance. The soil resistance to penetration curve varied according to the classes of soils and managements submitted in the area. Soil resistance to penetration has been shown to be a sensitive indicator of the physical quality of soils under integration systems and native forest, with values considered critical for the growth of the root system of the crops for all soil classes, also showing that the implantation of systems of production in function of different soil classes through the pedological survey in cultivated areas should be encouraged due to the benefits related to productivity and to the improvement in the physical quality of the soil.
Keywords: Native, degradation, cerrado soils
Financial support:

WG11 Land Degradation: Restoring degraded lands through soil carbon management

(8250 - 2267) Calcium and magnesium contents accumulated in different soil uses in the municipality of Pindaré Mirim, Maranhão, Brazil

Elimilton Pereira Brasil[1]; Victor Roberto Ribeiro Reis[1]; Luciano Cavalcante Muniz[1]; Thaís Santos Figueiredo[1]; Diana Signor Deon[2]; Joaquim Bezerra Costa[2]
UEMA[1]; EMBRAPA[2]

Due to the use of the soil and forests in the Amazon region we have sought to reduce deforestation. Thus, the systems of Crop-Livestock-Forestry integration - CLFi appear as technological alternatives for a more productive and sustainable livestock. The objective was to evaluate the calcium and magnesium contents accumulated in different land uses in the municipality of Pindaré Mirim, MA. The soil samples were collected in four different environments in the municipality of Pindaré Mirim / MA: Native forest with babassu (*Attalea speciosa*), Capoeira, degraded pasture (with *Brachiaria brizantha* cv. Marandu) and ILPF (with corn in a consortium with Marandu grass and eucalyptus). Samples were collected at seven depths: 0-10, 10-20, 20-30, 30-40, 40-60, 60-80 and 80-100 cm. Calcium and magnesium were extracted with 1 mol L-1 KCl solution. Calcium and magnesium were determined by atomic absorption spectrophotometry. The means were submitted to analysis of variance by the Kruskal-Wallis method, followed by the comparison of means by the Bonferroni test (Dunn), at 95% confidence level. In layers 20-30, 30-40 and 40-60 cm, the Ca2 + contents were higher in the degraded pasture and in the ILPF system. These two areas also presented high levels of Mg2 + at depths greater than 40 cm. Among the layers, the Mg2 + contents were similar for areas with degraded pasture, ILPF and native forest. Ca2 + values increased in depth in all uses. It is a fact that conserving or increasing soil quality can provide a number of economic and especially environmental benefits. However, the evaluation of soil quality is not a simple task, given the great complexity of the physical, chemical and biological processes that occur in the soil and the heterogeneity of the system.
Keywords: Integrated system, Soil quality, Sustainable management.
Financial support: FAPEMA, CNPq, EMBRAPA, UEMA

(5706 - 1324) Carbon stock of an Oxisol under conventional management in chronosequence in the cerrado Northeastern

Leovânio Rodrigues Barbosa[1]; Fernando Julião de Medeiro Júnior[1]; Francisco Rafael da Silva[2]; Victor Vinicius Rodrigues[2]; Catharina T. Cortez[3]; Luiz Alfredo Pinheiro L. Nunes[2]
Universidade Federal da Paraíba[1]; Universidade Federal do Piauí[2]; Fundação Agente[3]
Carbon stock of an Oxisol under conventional management in chronosequence in the cerrado Northeastern Leovânio Rodrigues Barbosa[1]; Fernando Julião de Madeiro Júnior[1]; Francisco Rafael da Silva[2]; Victor Vinicius Rodrigues[2]; Catharina Teixeira Cortez[3]; Luís Alfredo Pinheiro Leal Nunes[4] (1) Doutorando em ciência do solo - UFPB, leovaniobarbosa@hotmail.com;(2) Eng. Agrônomo; (3) Biologa; Professor Dr - Universidade Federal do Piauí.

Conventional soil management in the Northeastern cerrado is still a practice adopted by many producers due to the need for soil correction. However, the negative effect from the adoption of this agricultural practice can be verified over time years after the installation and maintenance of this production system by reducing the carbon stock. The objective of the present work was to evaluate the carbon stock in an Oxisol under a conventional system in chronosequence in the Northeastern cerrado. The study was carried out at Chapada Grande Farm located in Regeneração municipality, in the northern region of the State of Piauí, in an area under Cerrado biome. Areas with one, three and six years of conventional soybean cultivation were selected. In each area, soil samples were collected in the 0.00 - 0.10 m layer and 0.10 - 0.20 m, to determine the soil carbon stock. The carbon stock in the superficial layer in absolute values was higher in the area under native vegetation, however there was no statistical difference between the treatments studied. On the other hand, under subsurface, the areas under native vegetation and soybean cultivation in the first year, obtained a lower carbon stock, differing statistically from the other areas with a longer time of adoption of conventional management (three and six years). The constant upwelling of the soil over time adds plant residues to the subsurface layer and provides higher C stock in this soil layer. Areas under conventional management in the Piauí cerrado with up to six years, have in the superficial layer, carbon stock statistically similar to that found in an area of native vegetation. Conventional management over time provides greater carbon stock in depth. Keywords: chemical attribute, chronoseguence, degradation
Keywords: chemical attribute, chronoseguence, degradation
Financial support: CAPES

(9916 - 631) Dry matter yield and soil physical properties after growing cover crops in winter

Katiely Aline Anschau[1]; Edleusa Pereira Seidel[1]; Jean Sérgio Rosset[2]; Emerson Fey[1]; Marcos Cesar Motin[1]; João Henrique Silva Caetano[1]; Marcio André Fransczisko wski[1]
Unioeste[1]; Universidade do Est do Mato Grosso do Sul[2]

The objective of this work was to evaluate the dry matter yield of winter cover crops grown in monoculture and intercropping in no-tillage system, and its effects on soil physical properties. The experimental design was a randomized complete block design, with four replications. The treatments used were: black oat, black oat + forage turnip, forage turnip, black oat + forage pea, forage pea, and control (fallow). The winter cover plants were sowing mechanically under no-tillage system, used 45 kg ha^{-1} of forage pea (*Pisum sativum* L.), 15 kg ha^{-1} forage turnip (*Raphanus sativus*), and 80 kg ha^{-1} of black oat (*Avena strigosa* S). In the sowing of forage turnip, consorciated with black oats, 5 and 30 kg ha^{-1} of seeds were used, and forage pea with black oats, 25 kg and 30 kg ha^{-1} of seeds. After 100 days of sowing of the cover plants, the dry matter yield was evaluated, and the values observed were: oat 4.69 t ha^{-1}; forage turnip 6,24 t ha^{-1}; pea 6.01 t ha^{-1}; oat + forage turnip 7.81 t ha^{-1}; oat + forage 7.31 t ha^{-1}; and the control (fallow) 0.45 t ha^{-1}. It was found that the consortium of oats + forage pea, and oat + forage turnip provided an increase in dry matter yield to the soil of 35% and 41%; respectively, when compared with monoculture oat cultivation; and then, the cover plants were managed chemically, and after desiccation, undisturbed soil samples were collected at 0 - 0.10; 0.10 - 0.20 and 0.20 - 0.30 and 0.30 - 0.40 m layer for the determination of macroporosity, microporosity, total porosity, and soil bulk density. The highest volume of macropores was found in the 0 - 0.10 m layer in treatments with forage and forage turnip. Control was the one with the highest soil density for all the evaluated strata; for microporosity of the soil no changes were observed after the cultivation of the different cover plants. The soil resistance to penetration was evaluated using the digital penetrometer, and there was a difference between the control and the oat / forage pea consortium in the depth of 0.15 m. Key words: Green manures, soil physical quality, soil management.
Keywords: Green manures, soil physical quality, soil management
Financial support: CAPES: Coordenação de Aperfeiçoamento de Pessoal de Nível Superior

(6144 - 2545) Including winter service crops for forage production and soil organic carbon buildup in soybean rotations

Girard Rodrigo[1]; Eclesia Roxana Paola[2]; Ojeda Jonathan Jesús[1]; Piñeiro Gervasio[3]; Caviglia Octavio[4]

Facultad de Ciencias Agropecuarias, Universidad de Entre Ríos[1]; Instituto Nacional de Tecnología Agropecuaria, EEA Paraná. Oro Verde. Entre Ríos[2]; 3IFEVA-Facultad de Agronomía, Universidad de Buenos Aires; Consejo Nacional de Investigaciones Científicas y Técnicas[3]; Facultad de Ciencias Agropecuarias, Universidad de Entre Ríos; Instituto Nacional de Tecnología Agropecuaria, EEA Paraná; Consejo Nacional de Investigaciones Científicas y Técnicas[4]

The use of winter service crops (SC) for both forage production and soil organic carbon (SOC) buildup could be an interesting option for agricultural sequences dominated by soybean (*Glycine max [L.] Merr.*). We evaluate the effects of harvesting aboveground biomass of two winter SC in rotation with soybean, on SOC dynamics. Three crop sequences were evaluated: melilotus (*Melilotus albus Medik.*)/soybean (Mel/S), ryegrass (*Lolium multiflorum Lam.*)/soybean (Rye/S) and soybean as monoculture (S-S), under no-till systems. The field experiment was conducted for three years on a vertisol soil. Each year Melilotus and ryegrass were planted in april and cut at a low intensity (LI, the SC was cut leaving a remnant of 12 cm) and at a high intensity (HI, the SC was cut leaving a remnant of 6 cm), two or three times during their growing season and killed in October, to allow soybean planting on November. A reference treatment included SC without defoliation. We evaluated the aboveground and belowground biomass in all sequences each year and Soil organic matter (SOM) after the third year. SOM was fractionated into particulate organic matter (POM) and mineral associated organic matter (MAOM) and the carbon and ^{13}C content in each fraction were analyzed. ^{13}C was used to estimate the new SOC inputs from crops (Cn) and the SOC remaining from initial SOC previous to the installation of the experiment (Cr), in each SOM fraction. The Cn-POM in Ry/S was ~ 30% and ~ 60% higher than Mel/S and S-S, respectively. No differences were found in Cr contents. Defoliation treatments did not significantly alter total SOC, Cn or Cr contents. Belowground biomass production was associated with the POM contents (R^2=0.74) and Cn-POM (R^2=0.60 to 0.76) but not with the Cn-MAOM stocks. The inclusion of SC increased near 50% total C-SOM contents during the period evaluated. Our results showed that the inclusion of SC for forage productions during winter in rotation with soybean is an alternative to increase SOC contents.

Keywords: roots, cover crops, agricultural systems

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(3771 - 3189) Organic matter humified as a phytostimulant of *Brachiaria decumbens*: effect on the metabolic profile of the microbial community rizosferica Field experiment

Lady Karina Aparicio Sánchez[1]; Nelson Valero Valero[2]

National University of Colombia (Bogotá, D.C.)[1]; University of La Guajira (Riohacha, La Guajira)[2]

Humic acids as phytostimulants influence metabolism and increase rhizodeposition, this leads to plants releasing compounds into the rhizosphere, which can induce changes in the structure of microbial communities and therefore improve the growth of plants. In post-mining land reclamation processes, the establishment of gramineous plants in the initial stage is a key factor, since their high potential to contribute with soil organic matter yield, as well as their influence on microbial populations, which in turn can promote plant growth. In this research, changes in the metabolic profile of the rhizosphere of *Brachiaria decumbens* were evaluated in response to the application of humic acids obtained from lignite coal and a lignite-based humic bioconditioner inoculated with coal biotransformer bacteria. The trial was conducted under field conditions in plots in the initial stage of rehabilitation after coal mining, in a semiarid zone located in the Colombian dry Caribbean. The metabolic profiles of the microbial community of the soil were determined through the BIOLOG® panel ECOPLATE method; the evaluated parameters were the average metabolic response, the metabolic diversity of the microbial community and the metabolic profiles. It was found that the metabolic response was increased with the application of humic materials and differences were found with respect to the control treatment; an increase in the levels of metabolic activity was also observed in response to treatment with humic acids, this is related to the increase of the microbial populations of the rhizosphere, induced by the hormonal effect enhanced by humic acids on plant growth. These results support the purpose of using residual lignite coal as a source of humic acids to improve the establishment of vegetation cover in the early stages of rehabilitation, through constructed soil in open-cast coal mines in the Colombian dry Caribbean.

Keywords: *Biolog, constructed soils, humic bioconditioner, humic acids, rizodeposition.*

Financial support: Colciencias Colombia agreement 8790-4494-13

(4586 - 2523) Particulate organic carbon in agrosystems in the brazilian semiarid

Mônica da Silva Santana[1]; Eunice Maia de Andrade[1]; Vanderlise Giongo[2]

Universidade Federal do Ceará[1]; Embrapa Semiárido[2]

Drylands cover about 40% of the planet, in which 44% are occupied with cultivated systems. Covering 45% of Brazilian Semiarid the grasslands are main land use this region. In order to increase biomass production and provide food for goats, sheep and bovines are implanted different agrosystems with differences species *Cenchurs ciliairis* L. (CC), *Opuntia ficus indica* Mill. (OF), *Gliricidia sepium* Jacq. (Walp.) (GS), *Leucaena leucocephala* Lam. De Wit. (LL). However, with removal of native vegetation (NV) there is a change in supply plant material and hence in soil organic matter (SOM), which is formed by substances in different stages of decomposition. Among the chemical components contained in SOM is carbon (C), the main structuring element of nature. In soils, the C can be in the form particulate organic carbon (POC), coming from the biotic residues being quite susceptible to change of land use, and mineral-associated carbon fraction formed by organomineral complexes that are not available to decomposition . POC is associated with the active compartment and can be lost more easily, depending on land use. In sense, to evaluate how the introduction of new species for animal feeding can modify the POC, soil samples were collected at following depths: 0-5, 5-10, 10-15, 15-20, 20-30, 30- 40 cm, with four replicates for uses with different ages: NV (always preserved), CC (30 yr), OF (21 yr), GS (17 yr) and LL (24 yr). The air dried soil was separated in a 53 µm sieve, where the particles larger than >53 µm corresponded to POC. The C levels were determined in the LECO elemental analyzer. In the 0-5 cm layer CC showed the highest POC content (3.42 g kg^{-1}), in 5-10 cm depth NV had the highest POC content (3.12 g kg^{-1}) while in the other layers (10-40 cm), the GS and LL uses had the highest POC values. The OF use exhibited lowest POC content. Thereby, we can verify that GS and LL can be cultivated in semiarid region without compromising the levels POC, while the OF can be used but in consortium with other species, such as CC, that increase organic materials on soil and consequently increase C concentration. NV presented POC levels varying between 0.85 and 3.12, while the other uses had values between 0.78 and 3.42, which indicates that agrosystems when properly managed, there may be increase POC levels. Thus, ensuring higher C concentration and sustainability in agrosystems in the Brazilian Semiarid.

Keywords: land use change, grasslands, organic matter soil

Financial support: Banco do Nordeste

(6951 - 3144) Phosphorus and potassium contents in the soil of an agroforestry system, deforested and fallow area, and under native vegetation

Julian Junio de J. Lacerda[1]; Luiz Eutimio R. Nogueira[1]; Ariane S. R. L Ascenso[1]; Sara Leticia P. da Silva[1]; Caio de M. Cabral[1]
UFPI[1]

Agroforestry systems (AS) are land use systems in which, as trees interspersed with agricultural and / or animal cultures, simultaneously or sequentially, in order to increase the total production of plants and animals in a sustainable manner per unit area. Agroforestry systems, by approaching natural ecosystems in structure and diversity, represent a great potential for restoration of degraded areas and ecosystems. The objective of this work is to evaluate the available P and K content of the soil in a regenerative agroforestry system, after one year of implantation in Bom Jesus, Piaui State. The experiment was carry out in a regenerative SAF implanted in October 2016, characterized by the cultivation of plant species in consortia. The SAF is located in the experimental area of the Federal University of Piauí, Campus Cinobelina Elvas, in Bom Jesus-PI. The experimental design was completely randomized with subdivided plots and four replications, totaling 48 experimental units. The 12 treatments consisted of three adjacent areas: the agroforestry system, a deforested and fallow (DF) area and another under native vegetation (NV); and four soil layers, at depths of 0-10, 10-20, 20-30 and 30-40 cm. Avaliable P (Mehlich-1) and K was mensuared in the soil samples. Data was subjected to variance analysis, applying F test at 0.05 level, and when F was significant, the means were compared by the Skott-Knott test at 5% probability. It was observed that both the uncovered soil and the AS presented similar available P content (DF= 4.08 mg dm^{-3}; AS= 3.36 mg dm^{-3}) and the soil under native vegetation, presented lower values (NV= 2.37 mg dm^{-3}). Regarding depths, the surface layer presented a higher value of available P than the others (0-10 cm- 7.16 mg dm^{-3} a; 10-20cm - 2.57 b; 20-30 cm- 1.75 b; 30-40 cm - 1.60 mg dm^{-3} b). K content in the soil under native vegetation presented the higher value (NV = 62.37 mg dm^{-3} a), while the others had similar levels (DF= 43.66 mg dm^{-3} b, AS 46.93 mg dm^{-3} b). The values of K found in the depths also were higher in the first layer (0-10 cm- 80,20 a; 10-20 cm - 51,16 b; 30-40 cm - 39,46 b; 20-30 cm - 33,12 mg dm^{-3} b). With the one-year implementation period of agroforestry system, it is not possible see the benefits in the content of P and K available to the soil, in relation a deforested and fallow area.

Keywords: P and K available, agroecology, forest
Financial support: FAPEPI

(5678 - 2673) Proctor test with undisturbed samples and its relation with the structural quality in a Mollisol

Evelyn Henríquez Aravena[1]; Oscar Seguel Seguel[1]; Ian Homer Bannister[1]; Hugo Peréz[1]
Universidad de Chile[1]

The Proctor test corresponds to a mechanical test used in engineering to evaluate the water content at which a material undergoes the highest densification in response to standard compaction energy, equivalent to a known mechanical load. The procedure considers the use of disturbed soils, so it is exclusively dependent on the particle size distribution; however, it could be used with undisturbed soils to characterize the effect of structure on aggregate stability under mechanical loads. Disturbed and undisturbed samples of a Mollisol were taken from a loam soil (clay content 27±6%) with different uses, considering from lower to higher structural quality: agricultural road, traditional tillage, vineyard, fruit trees with organic management and meadow. Bulk density, OM content, aggregate stability and Proctor test (standard, with undisturbed samples and with natural aggregates >4mm) were measured. Bulk density was not useful to discriminate the different soil uses, but the OM content follow the expected results, with values from 1.3 to 5.0% according to soil use. Compared to the same energy of compaction in the Proctor test, there is a logical order of uses, where the agricultural road showed the highest bulk density with the lowest water content, and as the structure increases (ie, the intensity of use decreases) the water content increases and the maximum bulk density decreases. The difference between the maximum bulk density of a high and low intensity of use increases when the Proctor test is performed with aggregates, validated by the microaggregate stability, reason why this test can be used to evaluate the structural quality of the soil.

Keywords: Soil use, aggregate stability, soil organic matter
Financial support:

(3893 - 2571) Short-term effects of loosening and incorporation of straw into the upper subsoil on soil physical properties and crop yield

Gizachew Tarekegn Getahun[1]; Thomas Kätterer[1]; Lars Juhl Munkholm[2]; Mohammed Masud Parvage[1]; Thomas Keller[3]; Katrin Rychel[1]; Holger Kirchmann[1]
Department of Soil and Environment, Swedish University of Agricultural Sciences, Sweden[1]; Aarhus University, Faculty of Agricultural Sciences, Department of Agroecology and Environment, Research Centre Foulum, Denmark[2]; Department of Soil and Environment, Swedish University of Agricultural Sciences, Sweden; Agroscope Reckenholz-Tänikon Research Station ART, Switzerland[3]

Subsoils that are compacted, nutrient-poor or low in soil organic matter (SOM) often limit crop growth and yield. Improvement of subsoil conditions by deep loosening is laborious and expensive and its positive effect may not last. This study investigated the effect of deep loosening and injection of slurry made from cereal straw (30 Mg dry mass ha^{-1}) at 25-34 cm depth on soil properties and crop performance in a Swedish field experiment that started in autumn 2015 and monitored soil and crop properties during 2016. Loosening + straw incorporation into subsoil resulted in higher soil organic carbon (SOC) content, water content and porosity and lower bulk density (BD) in spring 2016 compared with the control. Bulk density remained low throughout 2016 even after a number of field operations. In autumn 2016, penetrometer resistance (PR) and BD were both significantly lower and SOC, water content and porosity were still higher in the loosening + straw treatment compared with the control (29-34 cm). Furthermore, BD was lower in the loosening + straw treated subsoil than in the top soil layer of the control (0-10 cm). Observations indicated that continuous pores were occupied by roots to a greater extent in the loosening + straw treatment than in other treatments. Roots and soil fauna were found more frequently where straw was incorporated. Grain yield increased by 5.6% due to loosening + straw addition (P=0.03) and by 4% due to loosening only (P=0.07). These results indicate that loosening + straw input into subsoil had a positive short-term influence on soil physical properties, potential plant-available water and grain yield. Straw addition prolonged the effect of loosening.

Keywords: subsoil, loosening + straw slurry, bulk density, compaction, crop performance, grain yield
Financial support: Future Crop Production Relies on New Management Strategies for Soils project funded by the Swedish Research Council Formas (grant number 229-2013-82)

(4296 - 1949) Soil organic carbon recovery and coffee grain yield following bauxite mining

Hiran F. Vilas Boas[1]; Luís Fernando Januário Almeida[1]; Rafael Silva Teixeira[1]; Ivan Francisco de Souza[1]; Ivo Ribeiro da Silva[1]
Universidade Federal de Viçosa[1]

Bauxite mining requires the removal of topsoil, which causes considerable impacts on both natural and managed ecosystems. This is typically the case of agricultural activities across Minas Gerais, southeastern Brazil, where bauxite mining often displaces pastures and coffee plantations. In this study, our objective was to assess the effects

of chemical and organic fertilizations combined with cover crops on the reestablishment of coffee plantations following bauxite mining. The experiment consisted on a split-plot design which main plot received four types of fertilization: no fertilization (NF), chemical fertilization (CF), poultry litter (PL), and chemical fertilization + poultry litter (CF+PL). In subplots, four cover crops were cultivated in between the rows of the coffee plantation, including: no cover crops (NCC), grass (*Brachiaria brizantha* (B)), legume (*Stylosanthes macrocephala* (S)) and grass + legume (*Brachiaria* + *Stylosanthes* (B+S)). We had 4 blocks as replicates. Organic and chemical fertilization (PL+CF) combined with cover crops (B+S) led to significant recovery of soil organic carbon (SOC), N (SON) and $KMnO_4$-oxidizable SOC. PL+CF and B+S, led to SOC increments of 14.5 g kg^{-1} soil (0–10 cm depth). Based on isotopic data, (^{13}C), both B and S contributed to recover SOC. Over three consecutive harvests, coffee grain yield as high as 1800–2000 kg ha^{-1} occurred under PL or PL+CF. There was no recovery of coffee grain yield when B was the cover crop, irrespective of fertilization. Overall, recovering SOC and SON contents determine the capacity of soil to sustain the reestablishment of coffee plantations following bauxite mining.

Keywords: bauxite mining; soil reclamation; cover crops; soil organic carbon; coffee productivity.

Financial support: Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq), Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES), Fundação de Amparo à Pesquisa do Estado de Minas Gerais (FAPEMIG) and Votorantim Metais

(9565 - 1249) β-Glucosidase and total organic carbon as indicators of the erosion stabilization process of gullies in "Mar de Morros" environment, Rio de Janeiro, Brazil

Cristiane Figueira da silva[1]; Luiz Alberto da Silva Rodrigues Pinto[1]; Marcos Gervasio Pereira[1]; Sabrina Aparecida Teodoro[2]; Marcelo Antoniol Fontes[3]

Universidade Federal Rural do Rio de Janeiro[1]; Universidade Federal de Lavras[2]; Embrapa Agrobiologia[3]

In the state of Rio de Janeiro, especially in the Pinheiral region, rugged relief, the vegetation cover (pasture), land use, and high rainfall have favored the occurrence of water erosion, which is one of the main forms of soil degradation, causing damages of economic, environmental and social order. This kind of erosion leads to the emergence of gullies, which are formed by run-off mass processes and high soil loss. The objective of the study was to use the enzyme *β*-Glucosidase activity and total organic carbon (TOC) as indicators of the erosion stabilization process in gullies at different period of formation, using as reference a forest fragment, and two pasture areas, in the municipality of Pinheiral, Rio de Janeiro, Brazil. The study was carried out in three gullies (stages: initial, mature and senile), two pasture areas (with and without natural regeneration) and a forest fragment. At the end of the rainy season, in the areas of forest and pasture, soil samples (depth 0-0.5 m) were collected in an area of approximately 400 m^2, while in the gullies the samples were collected in the inner part throughout its length. In each of the sample units 16 single samples of soil were collected in a total of four samples composed per unit. *β*-Glucosidase activity was analyzed according to Tabatabai (1994), using 1.0 g of soil and the substrate PNG (p-nitrophenyl-β-d-glucoside; 0.05 mol L^{-1}). Colorimetric determination was performed in a spectrophotometer at 410 nm. Results were expressed in µmol · g^{-1} · h^{-1} p-nitrophenyl. Total organic carbon in the soil was quantified according to Yeomans & Bremner (1988). The highest levels of *β*-Glucosidase and TOC in general were observed in forest and pasture areas (with and without natural regeneration), while the lowest values were verified in the gullies at initial and mature period of formation. The senile stage gully, which presents the vegetation cover almost everywhere, presented intermediate values when compared to the other sample units. In this way, it can be suggested that due to the gully colonization by the vegetation, the erosion processes decrease, the litter accumulation favoring the stimulation microorganisms activity and the soil carbon incorporation, which can be verified in the gully senile period. Thus, both *β*-glucosidase and TOC can be considered good indicators to erosive processes stabilization in gully areas.

Keywords: Enzymatic activity, land degradation, biomonitoring

Financial support: CAPES e PPGCAF

WG12 Paddy Soils: Mitigating GHG emission and enhancing productivity in rice-based systems

(2445 - 2467) Could biochar and green manure be a substitute for synthetic nitrogen fertilization to guarantee rice grain yield and decrease greenhouse gas emissions?

Mellissa Ananias Soler da Silva[1]; Alberto Baêta dos Santos[1]; Beáta Emoke Madari[1]; Márcia Thais de Melo Carvalho[1]; Adam Price[2]; Priscilla Lacerda Mendonça[3]; Yoná Serpa Mascarenhas[3]

Embrapa Rice and Beans[1]; University of Aberdeen[2]; Federal University of Goiás[3]

Hunger, poverty, climate change, health, soil quality and clean water are all connected by the agriculture sector. In the world, there are about 815 million people who are undernourished, and 663 million do not have access to clean water. More than 33% of the soils are degraded, largely due to intensively mechanized agriculture, and excessive pesticides and mineral fertilizer use. Rice is a staple food for most of the world population, and improving the nitrogen use efficiency (NUE) and reducing greenhouse gas (GHG) emissions is fundamental for the sustainability of this crop. Within this context, the objective of this study was to find a feasible alternative to the use of nitrogen fertilizers for smallholders and commercial farming in tropical flooded rice systems. The cultivation of rice (BRS Catiana) was assessed in a flooded system on a Latossolo Amarelo (Ferralsol, FAO, 2014), throughout the 2016/2017 growing season. The field experiment was carried out in strips without (0 char +0 N [control], 0 char+ green manure (GM), 0 char + synthetic nitrogen (N)), and with application of biochar (char +0 N, char+ GM, char + N) made of rice husks (21 Mg ha^{-1}, composition: 8% total C, 0.08% N, 63.6 g kg^{-1} organic C, 1482 mg dm^{-3} K and 10.9 mg dm^{-3} P), incorporated into 10 cm soil depth using a harrow, about six months before sowing rice. Within each strip, N sources treatments were added: green manure (*Crotalaria juncea*), cultivated for 60 days and incorporated into the 10 cm soil depth using a harrow at 10 days before sowing rice; and synthetic N (urea, 115 kg ha^{-1} N) applied at sowing rice (15 kg ha^{-1} N), and twice during rice growth (24 days after sowing [DAS] and 60 DAS). Fluxes of N_2O and CH_4 were quantified using manual static chambers throughout the rice growing season. The highest fluxes of N_2O were observed in the treatment with green manure. The treatments with synthetic N, without or associated with biochar, and the treatment with green manure only, increased N2O emissions. Similarly, synthetic N and green manure associated with biochar promoted higher total CH_4 emissions than the treatments with biochar only and the treatments with synthetic N and green manure only. The total emissions of N2O and CH4 per unit of grain produced were higher in treatments with biochar. Grain yield by the use of green manure and N synthetic fertilizer had no statistical diferences, with or without biochar. However, rice grain yield was lower in treatments with biochar.

Keywords: flooding, tropic, yield, Oxisol, NUE

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(8506 - 482) Cropping systems and conservation tillage impacts on soil

health and functionality in a rice ecosystem

Mohammad Mofizur Rahman Jahangir[1]; Rahana Pervin[1]; Mohammad Jahiruddin[1]

Bangladesh Agricultural University[1]

Soil health and functionality is a critical concern for sustainable intensification of agroecosystems for advancing food security and environmental safety. Response of soil health to crop and cropping systems has not been evaluated in subtropical rice ecosystem like Bangladesh. Impacts of cropping systems and conservation tillage on soil quality and crop yields were evaluated over three years in Old Brahmaputra Floodplain soils (Aquept Inceptisols). The experiment comprised two factors with three replications in a split-plot design. Factor A: minimum soil disturbance with 20% crop residue retention (MT) and conventional tillage (CT) in the main plots and factor B: three cropping systems with mustard –rice–green manure–rice, wheat–rice–rice, and lentil–rice–rice in the subplots. Soil aggregate formation and stability were higher in MT than in CT ($p<0.05$). Soil organic carbon (SOC) was influenced by tillage and cropping systems ($p<0.01$), being higher in MT than in CT, and lower in wheat than mustard and lentil based systems. Macro and micro aggregate protected SOC was higher in MT compared to CT and in lentil and mustard compared to wheat based system. Likewise, soil total nitrogen (TN) was higher in MT than in CT. With respect to the cropping systems, TN was higher in lentil and mustard than the wheat based system ($p<0.05$). Unlike SOC and TN, basal respiration (BR) rate was higher in CT than MT and in wheat and lentil than the mustard based system. Higher BR rate in CT and wheat/lentil based systems indicates that these soils are more stressed for microbial activities. Net N mineralization rate (mainly nitrate) was higher in MT than in CT and lower in wheat than mustard and lentil based systems. Soil moisture content was significantly higher in MT than CT, but not influenced by the cropping systems. Soil bulk density in these three years of conservation tillage was similar in all tillages and cropping systems. Soil earthworm population was consistently higher in MT compared to CT. Results suggest that MT can enhance soil aggregation and aggregate protected C and N content and soil microbial processes (e.g. nitrification). The system productivity can be ranked in the order of mustard-green manure-rice-rice > wheat-rice-rice > lentil-rice-rice. In addition, being with lower BR rate, MT with mustard-green manure-rice-rice system can lower the agricultural input cost (e.g. fuel) and enhance soil health and functionality without compromising crop yield.

Keywords: carbon sequestration, SOC, basal respiration, mineralization, aggregation

Financial support: University Grants Commission Bangladesh in association with BAURES; project No. 2016/14/AU-GC

(9230 - 1451) Effects of cover crops on soil organic matter fractions under no-tillage systems in the Cerrado

Arminda Moreira de Carvalho[1]; Luana Ramos Passos Ribeiro[2]; Cícero Célio de Figueiredo[2]; Thais Rodrigues de Sousa[2]; Douglas Lino Vieira[2]; Thais Rodrigues Coser[2]

Empresa Brasileira de Pesquisa Agropecuária[1]; Universidade de Brasília[2]

In Brazil, approximately 31 millions of hectares of land are managed under no-tillage system. In this scenario, the use of cover crops can improve soil's chemical, physical and biological qualities, and therefore, its productivity. The diversity of plant species associated with practices such as succession, rotation and consortium of crops, may provide more favorable conditions for the stock of carbon (C) and nitrogen (N) in the upper soil layers in a short-term period and also in deeper layer in a long-term period. Soil organic matter (SOM) is considered a key indicator of soil quality because it is important for the formation and maintenance of soil functions, especially in highly weathered soils, such as Oxisols. In this sense, it is important to understand the relationship between the chemical composition of cover crops and the accumulation of labile and stable fractions of SOM in the no-tillage system. The experiment was conducted at Embrapa Cerrados, Planaltina, DF, Brazil. The succession of cover crop/maize under no-tillage system was established in March, 2006 and the cover crops were: *Urochloa ruziziensis* (syn.: *Brachiaria ruziziensis* - Poaceae), *Canavalia brasiliensis* (Mart. ex Benth - Fabaceae), *Cajanus cajan* (L. Millsp - Fabaceae) and *Sorghum bicolor* (L. Moench - Poaceae). Soil samples were collected in March, 2014 at 0.0 to 0.10 m and 0.10-0.20 m soil layers. Cover crops were characterized in terms of hemicellulose, cellulose and lignin, following a serial method and of total-N by the Kjeldahl method. The cover crops organic carbon content was determined by oxidation. The physical and chemical fractionation of SOM, labile C content (LC) and microbial biomass carbon (MBC) were also performed. The results showed that the high levels of N in cover crops associated with increased production of dry matter, higher concentration of hemicellulose and lower lignin content resulted in higher SOM under the use of *Canavalia brasiliensis*, represented by higher C in the humic acid (HA), in the ratio humic/fulvic acid (HA/FA) and in the labile carbon (LC). The use of *Brachiaria ruziziensis* with lower lignin contents and lignin/N ratios increased soil organic C stocks and C in the mineral associated organic matter (MAOC). Therefore, *Canavalia brasiliensis* may be recommended as cover crop to increase SOM quality in terms of HA, HA/FA ratios and LC, whereas, *Brachiaria ruziziensis* may be used to increase soil organic C stocks, mainly in the MAOC fraction.

Keywords: maize, green manure, nitrogen, soil carbon and lignin

Financial support: To Empresa Brasileira de Pesquisa Agropecuária (EMBRAPA) and to Universidade de Brasília (UnB) for the Fellowships.

(8392 - 1795) Four-year impact of the adoption of different integrated crop-livestock systems on the chemical attributes of a lowland soil

Luiz Gustavo de Oliveira Denardin[1]; Amanda Posselt Martins[1]; Tales Tiecher[1]; Lucas Aquino Alves[1]; Dionata Filippi[1]; Filipe Selau Carlos[2]; Paulo César de Faccio Carvalho[1]; Ibanor Anghinoni[1]

Universidade Federal do Rio Grande do Sul[1]; Instituto Rio Grandense do Arroz[2]

Lowland soils represent 4 to 6% of the earth's surface, occupying an area of 7 to 9 million km^2. In Brazil, most of these soils are situated in the southern region, mainly under crops such as irrigated rice. These soils commonly have low fertility due to the traditional irrigated rice cultivation systems, which are based on intensive soil tillage and rice monocropping. On the other hand, conservationist soil systems, such as integration crop-livestock systems (ICLS), promote several benefits, such as nutrient cycling, leading to a rapid improvement in soil chemical fertility. Therefore, our study aimed to evaluate some soil chemical attributes by measuring soil organic matter (SOM) and available phosphorus (P) and potassium (K) contents, four years after the adoption of different paddy-farming systems in an Albaqualf soil from Southern Brazil. The treatments consisted of four ICLS under no-tillage (NT), with different arrangements containing different intensities and frequencies of the animal and of cash crops in the system, in comparison to the traditional system (TS) of irrigated rice cultivation with ploughing and heavy disking. The experiment was established in a long-term ICLS trial at the Corticeiras Farm, located in Cristal County, Rio Grande do Sul State, Brazil. It was verified that soil chemical attributes were affected by the adoption of NT, crop diversity and integrated grazing practices. After four years, the TS was the only one that presented a reduction in SOM, of 0.23%, with a content of 1.8% SOM. All other ICLS increased SOM in 0.13 to 1.21%. Similar behavior was verified in available P, with reduction of 0.7 mg P dm^{-3} in TS and increase of 5.7 to 24.7 mg P dm^{-3} in the other treatments. All treatments increased the available K over time, although in different proportions. While TS showed an increase of only 5.7%, the treatment with NT, crop rotation (rice and soybean) and insertion of the animal component showed a 64% increase in available K. Based on the results, it was concluded that adoption of conservation management practices in lowlands, such as NT, combined with crop rotation and ICLS, promote improvement in soil chemical attributes, as seen in SOM and available P and K contents. Thus, unlike the traditional

systems of irrigated rice cultivation, ICLS coupled with NT are capable of improve soil chemical attributes and reaching the sustainable intensification of the lowlands in Brazilian subtropics.
Keywords: Paddy fields, irrigated rice, soil fertility
Financial support: Agrisus, CNPq and UFRGS

(7107 - 1238) The impact of nitrogen fertilizer management on nitrous oxide and ammonia emission in an irrigated rice crop system in the Brazilian Savannah

Beata Emoke Madari[1]; Glaucilene Duarte Carvalho[2]; Alberto Baêta dos Santos[1]; Mellissa Ananias Soler da Silva[1]; Márcia Thaís de Melo Carvalho[1]
Embrapa Arroz e Feijão[1]; Embrapa Arroz e Feijão / Univ. Fed. Goiás[2]

The lack of synchronism between nitrogen (N) fertilization and the stage of high demand by plants results in a low efficiency recovery of N in the cropping system, mainly due to losses of N. The objective of this study was to estimate the gaseous losses of N (N_2O and NH_3 emission) and characterize the dynamics of N-N_2O fluxes in an irrigated rice production system of the Brazilian Savannah. The experiment was conducted on a Gleissol, located at the *Meia Ponte* river basin, along two cropping seasons 2011/2012 (S1) and 2012/2013 (S2). The cultivar used was BRS Tropical. The experiment consisted of three treatments: (T0) control (without N); (T1) application of recommended dose of N (110 kg ha^{-1}); and (T2) application of N based on reference index using the Minolta SPAD-502 chlorophyll meter. Fluxes of N_2O and volatilization of NH_3 were quantified using manual static chambers. Soil variables related to gaseous losses were also monitored along seasons. The highest N-N_2O fluxes occurred soon after sowing at the period before flooding. These fluxes were related to soil moisture and nitrate availability. The emission factor for N_2O due to nitrogen fertilization was low (0.3%). The volatilization intensity (g NH_3 emitted per kg of grain produced) was lower for T2. The total loss of N was greater along the off-season period han along the cropping seasons.
Keywords: nitrogen, inundation, chlorophyl meter, emission factor, neotropical Savannah
Financial support: Embrapa, FAPEG - Goiás Research Foundation. This work was also undertaken as part of NUCLEUS, a virtual joint centre to deliver enhanced N-use efficiency via an integrated soil–plant systems approach for the United Kingdom and Brazil.

WG13 SUITMA: Soils of Urban, Industrial, Traffic, Mining and Military Areas

(2219 - 2871) Agromining for the recovery of nickel from contaminated and anthropized soils

Marie-Odile SIMONNOT[1]; Baptiste LAUBIE[1]; Mathilde GUILPAIN[1]; Vivian HOUZELOT[1]; Claire HAZOTTE[1]; Guillaume ECHEVARRIA[1]; Jean Louis MOREL[1]
University of Lorraine[1]

Hyperaccumulator plants are able to extract and accumulate metals (or elements) at high rate from soils. The recovery of these metals and the production of compounds of industrial use would contribute to mitigate the costs of disposing the contaminated biomass from soil remediation projects. Moreover, recovering metals from secondary sources (e.g. polluted soils, serpentine soils, mine tailings, wastes) has become an essential challenge in a context of increasing demand of metals and rarefaction of mineral resources. Agromining is a chain of processes aiming at growing hyperaccumulator plants in order to reach high yields of metals and recover metals by pyro or hydrometallurgy. It has been mainly developed for nickel (Ni) since i) more than 400 Ni hyperaccumulators have been identified, ii) large areas covered by serpentine soils or mine tailings are available worldwide, and iii) processes have been designed and upscaled to obtain Ni metal or Ni-based compounds (salts, oxide, catalysts). The objective of this contribution is to present two types of hydrometallurgical processes to recover Ni from the biomass of a Ni hyperaccumulator, *Alyssum murale*, containing *ca* 1 wt% of Ni. It has been demonstrated that yields of 110 kg of Ni per ha can be reached by growing this plant, with appropriate agronomic practices. The first approach consists of burning dry plants to produce ashes and energy. Ashes contain 15-20 wt % of Ni, which is far higher than any Ni ore. They also contain potassium, calcium and magnesium as major cations. Ni can be recovered from ashes, after ash washing, acid leaching and several precipitation steps, in order to produce Ni salts or oxide. These processes have been designed at the lab scale and up-scaled to the pilot scale. Details will be presented on the operating conditions and Ni mass balance along the process. The re-use of the by-products has been also investigated, as well as the overall environmental impacts of the agromining chain. The second approach consists of extracting Ni directly from the dry plant, using water as a solvent. The challenge is to recover Ni from the leach liquor, which is a multicomponent solution containing dissolved organic matter to which Ni is strongly bound. An original method has been developed using a complexing resin, selective of Ni. The presentation will end up with a comparison of both approaches, to show the advantages and drawbacks of recovering Ni after combustion or directly from the dry plant.
Keywords: metals, agromining, SUITMAs, contaminated soils, serpentine soils
Financial support: Anr, France (Agromine project) ; Life, EU (Agronickel project) ; Gisfi, France

(1424 - 1894) Characterization and classification of the soils used for urban agriculture in Seoul and its vicinity through soil profile description

Kye-Hoon Kim[1]; Jun-Seok Oh[1]; Dan-Bi Lee[1]
The University of Seoul[1]

Presently, about 50% of Korean population lives in Seoul and its vicinity which cover only 12% of Korea. Like any other countries, demand for urban agriculture is increasing in Korea for various reasons such as leisure activities, enhancing mental health, educational purposes, food safety, etc. Most of the soils used for urban agriculture in Seoul and its vicinity were known to be transported from other areas. This made the difference of soil characteristics between the natural soils and soils used for urban agriculture. Natural soils are developed slowly by the interaction of soil forming factors, whereas anthropogenic soils including soils used for urban agriculture can be changed rapidly within a short time due to the influence of human activities. For that reason it is very important to identify characteristics of the soils used for urban agriculture. Therefore, this study was carried out to investigate the soil characteristics of five urban agriculture areas of Seoul and its vicinity by soil profile description. Eight pits were prepared in these areas, followed by profile description and sampling of 75 soils. All the soils from 8 pits were not developed naturally from the site but transported from outside. Some soils had even foreign materials like municipal waste. The transported materials seemed to affect characteristics of the original soils. Results showed that the average soil pH was higher than that of upland soils, whereas the average EC (electrical conductivity) was lower than that of upland soils. The heavy metal contents of all the analyzed samples were lower than the concern level of the Soil Environment Preservation Act of Korea. Results of the classification of the soils in 8 pits based on WRB classification system showed that all the urban soils in this study belonged to anthrosols or technosols. They have very different soil characteristics from those of conventional upland soils. Therefore, the management plan for the soils used for urban agriculture should be prepared for maintaining sustainable soil health through systematic investigation.
Keywords: urban agriculture, soil classification, profile description, anthrosols, technosols

Financial support: The University of Seoul

(4335 - 614) Direct-push techniques applied to high-resolution lithostratigraphic characterization of a brownfield site in alluvial environment

Leandro Gomes de Freitas[1]; Marco Aurélio Zequim Pede[2]; Hung Kiang Chang[2]
IPT[1]; LEBAC/UNESP[2]

The application of high resolution characterization tools based on Direct Push drilling methods, for the lithostratigraphic assessment of contaminated sites, has made it possible to obtain more consistent conceptual models. To evaluate the application of these techniques in alluvial environments, a university campus, built on a redeveloped brownfield site on the Tiete river floodplain, in São Paulo city, Brazil, was chosen for the present study. At this site, sediments dredged from the river channel rectification were deposited on a 25 hectares settlement pond, creating a 4 m high terrace. This landfill covers the Quaternary fluvial sediments (~ 6 m thickness), which in turn overlies the neogenic sediments of the São Paulo Basin. Three field techniques were adopted: electrical conductivity sensor (EC) probing, Soil Color Optical Screening Tool (SCOST) probing, and whole core soil sampling with Direct Push Dual Tube system. Additionally, laboratory procedures were adopted for grain size and organic matter content analyses of the soil samples. The high-resolution profiles obtained with the EC and SCOST showed a good qualitative correlation with the lithological descriptions and with the grain size distribution profiles, improving the lithostratigraphic characterization of the site. Organic matter profile analysis showed presence of high organic content and high methanogenic potential layers, especially in the organic clay and silt layers of the Quaternary sediments. The Direct Push techniques demonstrated great potential for high resolution lithostratigraphic characterization of alluvial environments.

Keywords: Direct Push; Lithostratigraphic characterization; High resolution site characterization; Brownfield site; Alluvial environment
Financial support: Instituto de Pesquisas Tecnológicas do Estado de SP – IPT; Laboratório de Estudos de Bacias – LEBAC/CEA/IGCE – UNESP - Campus Rio Claro.

(6993 - 693) Estimating Bioaccessible Pb and As in Urban Soils: Application of Vis-NIR Diffuse Reflectance Spectroscopy

Anna Paltseva[1]; Claudio Colombo[2]; Maha Deeb[3]; Erika Di Iorio[2]; Valentina Torino[2]; Zhongqi Cheng[1]
CUNY Graduate Center, Brooklyn College[1]; University of Molise[2]; CUNY ASRC[3]

As lands contaminated with lead (Pb) and arsenic (As) are converted to residential and farming uses, the potential risk to human health is increased through direct or indirect exposure pathways arising from incidental ingestion and further transfer through the food chain. The popularity of urban gardening in recent years emphasizes the need for fast and reliable field techniques to evaluate the bioaccessibility of Pb and As, and to monitor the effectiveness of remediation. Diffuse Infrared Reflectance Spectroscopy in the visible-near infrared (Vis-NIR) has rarely been applied in environmental protection and urban soil management. The aims of the research are to develop a diagnostic screening method for Pb and As bioaccessibility in treated and untreated urban soils using Vis-NIR. VisNIR analyses were performed on 21 samples from a New Jersey (USA) urban farm. The use of VisNIR resulted in a good estimate of both phytoavailable Pb (extracted with ammonium acetate – modified Morgan method) and bioaccessible Pb (extracted with 0.4 M Glycine - EPA method 1340). Total and bioaccessible elements were predicted by improving the 'cross' correlation between surface soil metal concentrations and Vis-NIR reflectance measurements via partial least-squares regression (PLSR) modelling. The two principal components (PC1 and PC1) accounted for 94 % of the variation in the data. Both the PC1 and PC2 were mainly correlated with Vis wavelengths. The plot of the first two principal components (PC1 and PC2) allowed to identify five different clouds based on the soil treatment. These clouds primarily depend on similar adsorption in Vis range and are related to several chemical soil components. The total and bioaccessible concentrations of Pb and As were qualitatively estimated (RPD > 1.5). The two principal components likely indicate that bioaccessible Pb and As are linked to the form and distribution of the organic matter and the crystalline Fe oxides or Fe amorphous mineral. Therefore, the NIR spectroscopy provides a potential diagnostic screening method for bioaccessible Pb and As in urban soils.

Keywords: Lead, arsenic, Vis-NIR spectroscopy, urban soil, metal bioaccessibility
Financial support:

(2561 - 460) Phytoextraction of lead, cadmium, chrome and nickel in contaminated soil of the Santo Amaro de Purification municipality - BA

Romualdo de Almeida[1]; Robson Rui Cotrim Duete[2]; Weliton Antônio Bastos de Almeida[3]
Environmental Engineer, specialist in Audit and Environmental Expertise; Master in Regional Development and Environment - FAMAM; romuangel@hotmail.com;[1]; Agronomist D. Sc., Prof. Advisor and Assistant at FAMAM; rrcduete@oi.com.br;[2]; Agronomist D. Sc., Prof. Co-advisor and Assistant at FAMAM and UFRB; weliton@famam.com.br.[3]

Phytoremediation is a technique with increasing application in areas of polluted soil aiming at the decontamination of soil and water, using plants as decontamination agent. It is of lower cost, environmentally correct and operationally feasible. This research aimed to identify plant species with the extraction potential for lead, cadmium, chrome and nickel in soil contaminated with lead ore slag. For this, an experiment was carried out under semi-controlled conditions, at the Maria Milza Faculty Campus, located in the municipality of Governador Mangabeira-BA. The experimental design used was a completely randomized with four treatments and six repetitions. The species investigated were jack bean (Canavalia ensiformis), sunflower (Helianthus annuus), sweet basil (Ocimum basilicum), maize (Zea mayz). The plants were cultivated in recycled black pots with a capacity of 9 L, filled with 8 L, of the substrate (soil + slag) in a 50/50% (v/v) ratio. Soon after, five seeds of each of the species were sown (maize, sunflower, jack bean) as well as a seedling of basil. The cultivation took place under an improvised roof, protected in the upper and the lateral sides by a black sombrite screen with a mesh of 50% of interception of solar radiation. The pots were irrigated daily. After 60 days of cultivation, the plants were harvested and separated in the aerial part and the roots. The variables evaluated were: Dry phytomass of the aerial parts and the roots; concentration of metals in the aerial parts and the roots; their contents in the aerial part, roots and whole plant; bio-concentration and translocation factor. The statistical analyses of the data included the use of parametric techniques for some variables and the use of non-parametric methods for other variables. The species differed as regard to the phytomass production; as to the contents of heavy metals in their tissues, the roots of all the species showed higher concentrations of all the heavy metals compared to the aerial parts. The jack bean and the maize plants accumulated more Pb, Cd and Ni; while the basil and the jack bean plants held more Cr. All the species are considered phytoextractive, but none of them can be considered a hyper-accumulating plant. The jack bean and basil plants can be considered Cd excluders; the jack bean, sunflower and basil plants as Ni excluders.

Keywords: Phytoremediation. Toxic elements. Environment. Contamination by heavy metals.
Financial support:

(9969 - 302) Phytoremediation of soil contaminated with residues of civil of construction (RCC)

Herika Karine Silva Gonçalves[1]; Domingos Sávio Barbosa[1]
Universidade Federal de Mato Grosso[1]

Construction and demolition residues represent 2/3 of the municipal solid waste, 50% of that volume refers to masonry, concrete, mortar and ceramic. In most cases the soil is the destination of these residues and these may interfere directly in vegetable production. The objective of this study is to evaluate the interference of civil construction residues (RCC) in the soil, using as indicators the soybean (*Glycine max*) and *Crotalaria ochroleuca* (cv. Common). Soils were sampled with RCC containing residues of a class located in a construction site laid down for 24 months and as close-to-ground control without RCC. The phytotoxicity trials were developed in 500ml vessels, with random distribution in 12 repetitions for each treatment. 7 Soy seeds and 10 crotalaria observing for 15 days were sown. After this period, the average length of the air was larger in *Crotalaria* (165 mm) relative to soybeans (333 mm). For soybeans there was no significant difference ($p > 0.05$ ANOVA) of the soil with RCC in relation to the control. For the *Crotalaria* there was significant difference. The results suggest *Crotalaria* as a probable indicator of phytotoxicity and soy as a potential fitorremediation.

Keywords: phytotoxicity, soybean, *Crotalaria ochroleuca*
Financial support: Universidade Federal de Mato Grosso

(1726 - 1417) Rehabilitation of iron ore mine lands in the Southeastern Amazon: Enhancement of soil proprieties, plant establishment, and revegetation assessment

Silvio Ramos[1]; Cecílio Frois Caldeira[1]; Markus Gastauer[1]; Joyce Reis Silva[1]; Pedro Walfir M. Souza Filho[1]; José Oswaldo Siqueira[1]
Instituto Tecnológico Vale[1]

The exploitation of mineral resources in Amazon has been intensified in the last decade. One particular situation is the Carajás Mineral Province (CMP), which is recognized as one of the most important mineral provinces in the world, encompassing large iron ore reserves that has been extracted through open pit benching. This operation cause substantial changes in land cover, which has to be reclaimed. This process involves several steps, such as topological reformulation, soil fertilization, and planting native or non-native plant species to revegetate and to protect the soil. The main challenge of mineland revegetation is the establishment of species that promptly accumulate adequate biomass in the different mineland substrates. These are usually inadequate for plants establishment, requiring intensive interference. In CMP, there are several areas in different stages of revegetation, varying from bare soil to areas with more than 15 years of rehabilitation. In order to assess the rehabilitation status of these areas, soil quality, occurrence of plant species, and ecosystem services have been conducted. The results have shown that in more advanced revegetation sites there is an increase in soil organic matter. In some areas, the assessment of soil attributes has indicated the recovery of soil proprieties which are close to those found in native reference sites. It was also observed that the overall number of plant species is higher than those of native sites, while species richness and phylogenetic diversity is higher in native sites. Plant field establishment and the nutrient requirement for growth of native species are another important challenge we face. Seed purity, biometry, moisture, and germination rates have significant variation among species. Some native species requires treatments for suitable germination, while other exhibit low germination because of embryo abnormalities. Several of these species have shown consistent growth increase after application of macronutrient and lime, but a low response to micronutrients application. Although preliminary, these results are quite useful for efficient revegetation and environmental rehabilitation of iron ore mineland in the southeastern Brazilian Amazon.

Keywords: mineland revegetation, native species, rehabilitation
Financial support: Vale and Instituto Tecnológico Vale

(1054 - 814) Remediation of mining affected soil by a two-step process: washing with ferric chloride and amending with lime and organic matter: field experiments

Xiaofang Guo[1]; Zebin Wei[2]; Yangmei Chen[2]; Qi-Tang Wu[2]
South China Agricultural University; Taiyuan University of Science and Technology[1]; South China Agricultural University[2]

The efficiency of Cd, Pb, Zn and Cu removal by only $FeCl_3$ washing or combining with mixture of chelators (MC) was assessed in a field experiment on multi-metal contaminated soil. Soil amendment with lime and organic matter were conducted to revitalize washed-soil. The concentrations of heavy metals in groundwater were evaluated the leashing risk of soil washing with $FeCl_3$ and MC. Results showed that the removal efficiencies of Cd, Zn, Pb, and Cu were 70%, 17%, 33%, and 40%, respectively, when the $FeCl_3$ (25 mmol kg^{-1} topsoil) were used for 60 d. In addition, the leached Pb from topsoil was fixated in subsoil. Compared to the only amending treatment, the yields of *Z. mays* were significantly decreased with soil washing and amending treatment, while the yields of *B. juncea* were significantly increased. This indicated that the shallow root plant (*B. juncea*) could grow better than *Z. mays* on the remediate soil. In particular, the concentrations of Cd, Zn, Pb, and Cu in the grains of *Z. mays* and the edible parts of *B. juncea* with soil washing and amending were below the Tolerance Limit of Contaminants for foods in China. Soil washing with $FeCl_3$ did not worsen groundwater contamination during the study period. The results demonstrate that *in situ* soil washing with $FeCl_3$ combined with subsequent amendments is technically feasible for remediation of agricultural soils contaminated by heavy metals in mining area.

Keywords: Heavy metals; Soil washing; $FeCl_3$; Mixture of chelators (MC); Amendment; Groundwater
Financial support: Natural Science Foundation of China (No. 41371308); Science & Technology Projects of Guangzhou City (No. 201604020076)

(7015 - 1972) Soils functions affected by urban use in Santa Maria, Brazil.

Jéssica Rafaela da Costa[1]; Fabrício de Araújo Pedron[1]; Ricardo Simão Diniz Dalmolin[1]; Luis Antonio dos Santos[1]
Universidade Federal de Santa Maria, Av. Roraima nº 1000, Camobi, Santa Maria, 97105-900, Brazil[1]

The number of research about urban soils has increased around world. These soils are classified in the World Reference Base (WRB) as Technosols, whose has been associated with variations in physical, chemical and morphological features associated with the presence of human artefacts. Although vulnerable to various alterations, these soils are responsible for environmental services essential in urban areas (e.g. vegetation support, building support; urban agricultural support; flood control; regulation of water and air quality; and while a place for heritage conservation). In Brazil, there are few studies urban soils. Therefore, the aim of this work was to evaluate how urban soils affect environmental services at urban perimeter of the municipality of Santa Maria (Brazil). The area has 125.48 km^2 and 261 thousand residents, characterizing a population density of 145.98 inh km^2. Five representative soil profiles were studied. The physics parameters bulk density (BD) and hydraulic conductivity (K) in the superficial layer were determined. The results revealed that all soils can be classified as Technosol due mainly to the presence of the anthropic material. The mean value of BD was 1.5 g cm^{-3} (variation from 1.42 to 1.53 g cm^{-3}), and K from 0.3 to 67.76 cm h. The most variable morphological characteristics were horizon/layer thickness, clay content (presented abrupt changes), soil color, size and strength of soil structure, showing the heterogeneous behavior of urban soils. Inputs of exogenous

materials were verified in all profiles. Thus, due the heterogeneous behavior of these soils there is a decrease in the functions related to soil/atmosphere interaction, such as water infiltration and gas diffusion, while there is an increase in soil density to benefit the infrastructure support and place for waste disposal. As these soil characteristics change, the environment becomes more vulnerable to events with negative social and environmental impacts like erosion, flood, and declined vegetation support capacity.

Keywords: Urban soil; soil functions; soil properties.
Financial support: Coordination for the Improvement of Higher Education Personnel (CAPES); Soil Museum of Rio Grande do Sul (UFSM).

(5022 - 3138) Source identification of heavy metals in farmland soil surrounding Huludao Zinc Plant in northeastern China

Guochen Li[1]; Yanhong Wang[1]
Institute of Applied Ecology, , Chinese Academy of Sciences[1]

The severe pollution of heavy metals of the farmlands soil surrounding Huludao Zinc Plant (HZP)has been a historical problem and gained long-term intense attention from both local residents and government. HZP was supposed to be the primary or even the only source for the heavy metals in the surrounding area. In order to illustrate the specific sources for all the 8 species of heavy metals in this area, PMF and UNMIX were both used to analyze the data of concentration of 13 species of elements (including the 8 heavy metals) in 43 soil samples. The results indicated: UNMIX has better correlation between the predicted value and determined value for each element species than PMF, while PMF has better identification of sources since UNMIX did not divide anthropogenic and natural sources. However, both the two models indicate that although industrial source represented by HZP is the primary source, not all the 8 heavy metals are from it. Agricultural activities had a clear impact on As, Pb contamination of the farmland. Suggestions for soil use and management were proposed based on the above results for source identification.

Keywords: Soil use; PMF; UNMIX; Receptor model; Traceability
Financial support: supported by the project of “Source Identification and Contamination Characteristics of Heavy Metals in Agricultural Land and Products” (2016YFD0800303), the National Key Research and Development Program of China.

(5557 - 522) Study on Soil Quality Changes of In-Situ Leaching Rare Earth Tailings Before and After Reclamation in south, China

Qin Zhang[1]; Xiaomin Zhao[1]
Land Resources & Environment College/Key Laboratory of Poyang Lake Basin Agricultural Resources and Ecology of Jiangxi Province, Jiangxi Agricultural University[1]

Due to the special mining technology of ion-adsorption type rare earth mine, the ecological environment was seriously destroyed, especially leaching agent residual, soil acidification, soil fertility degradation and heavy metal pollution. In this paper, an in-situ leaching ion-adsorption type rare earth tailings from Ganzhou Longnan County is studied. The soil quality changes before and after reclamation were compared through NH_4^+ concentration, soil pH value, soil nutrient content and heavy metal content, and the effects and potential problems of the reclamation were discussed. The results show that after reclamation the concentration of NH_4^+ decreased from 89.00 mg kg^{-1} to 8.70 mg kg^{-1}, soil pH increased from 4.15 to 5.16, and the comprehensive index of soil fertility decreased from 0.44 to 0.31. The Nemerow integrated pollution index of non-rare earth heavy metal indicated that the pollution level of tailing was clean before and after reclamation, and the geoaccumulation index of rare earth heavy metal showed that the pollution levels of tailing before and after reclamation were unpolluted to moderately polluted and unpolluted, respectively. Hence, reclamation could significantly improve the problem of leaching agent residue and soil acidification, but did not improve the problem of soil fertility degradation. In addition, heavy metal pollution is not serious and the soil is cleaner after reclamation.

Keywords: reclamation; ion-adsorption type rare earth; leaching agent; acidification; heavy metal; soil nutrient
Financial support: Jiangxi Postdoctor Foundation of China(2015KY23) ; 555 Talent Candidates of Jiangxi and Jiangxi Agricultral university [grant numbers YC2016-S181, 2016]

(3637 - 1552) The 20th years IUSS WG Urban Soils/Soils of Urban, Industrial, Traffic, Mining and Military Areas (US/SUITMA) anniversary: from its foundation to today

Wolfgang Burghardt[1]; Jean-Louis Morel[2]; Salah A. Tahoun[3]; Ganlin-Zhang[4]; Richard K. Shaw[5]; Ali Bourlabah[6]; Przemyslaw Charzynski[7]; Christina Siebe[8]; Slava Vasenev[9]; Kye-Hoon John Kim[10]
University Duisburg-Essen, Faculty of Biology, Soil Technology, 45141 Essen, Germany, email: wolfgang.burghardt@uni-due.de[1]; Laboratoire Sols et Environnement, University of Lorraine, INRA, 54505 Vandoeuvre-lè s-Nancy, France, jean-louis.morel@univ-lorraine.fr[2]; Soil Science Department, University of El-Zagazig, El-Zagazig, Egypt, stahoun@gmail.com[3]; State Key Laboratory of Soil and Sustainable Agriculture, Institute of Soil Science, Chinese Academy of Sciences, China, glzhang@issas.ac.cn[4]; USDA-Natural Resources Conservation Service, Somerset, NJ, USA; Richard.Shaw@nj.usda.gov[5]; Université Cadi-Ayyad, Faculté des Sciences et Techniques de Marrakech, Laboratoire Aliments, Environnement et Santé, BP 549, M-40000, Guéliz, Marrakech, Morocco, email:a.boularbah@uca.ma[6]; Department of Soil Science and Landscape Management, Faculty of Earth Sciences, Nicolaus Copernicus University in Toruń, Poland, pecha@umk.pl[7]; Universidad Nacional Autónoma de México, Instituto de Geología, 04510 Ciudad de México, Mexico e-mail: siebe@unam.mx[8]; RUDN University, Department of Landscape Design and Sustainable Ecosystems, 117198, Miklukho-Maklaya 8/2, Moscow, Russia. E-mail: Vasenev_vi@rudn.university[9]; Department of Environmental Horticulture, The University of Seoul, Seoul, Korea, johnkim@uos.ac.kr[10]

The progress of urban areas is rapid. Similarly the demands on urban functionality develop very fast. This trend accelerated by population growth and changes in way of life in cities. The smart city concept, one with urban components and systems completely controlled and managed by a myriad of diverse communication networks, will also include functioning soils. With this future perspective it is of interest to understand what is the current trend of soil research and how did it develop in the last 20 years. The nine specific SUITMA conferences in nine different countries representing all continents, besides Australia and Antarctic, and each 5 symposia on the World Congresses of Soil Science and EUROSOIL offer a good opportunity to check this. The poster will show the objectives of presentations of the founding symposium of WG US/SUITMA at the 16th WCSS in Montpelier and of the following nine SUITMA Conferences. The treatment of themes of the individual SUITMA Conference was always complemented by one-day and post-conference field tours to visit urban, industrial, traffic and mine soils which are a regular part of SUITMA conferences. They are included in the poster as well. The poster will show the continuum of urban soil formation and classification research over the 20 years. Similar constants include pollution, remediation and heritage objectives. Not so frequent but also constant were questions of urban soil hydrology. In the last eight years new upcoming themes were ecosystem services such as biodiversity, soil carbon, health aspects and food production with a number of additional aspects presented as well. In part they indicate new upcoming urban soil problems or regional urban demands and hazards. By the diverse locations of performance of SUITMA

Conferences over the world, completed by the IUSS Soil World Congresses, the EUROSOIL and EGU Congresses, a good overview of worldwide awareness of urban soils and their services is achieved. Thus the poster about themes of WG SUITMA in the last 20 years will provide an overview on which types of soil information are available and which should be deepened and wait to be developed.

Keywords: Keywords: WG SUITMA, urban soils, research
Financial support:

WG14 Acid Sulfate soils: Acid sulfate soils: processes, assessment and management

(4695 - 1126) Determination of the potential acidity of a drained peat bog in the Catalan Pyrenees.

A. Catalán[1]; R.M. Poch[2]; E. Ascaso[2]; A. Baltiérrez[3]
Student of University of Lleida, Lleida, Spain[1]; Department of Environment and Soil Sciences, University of Lleida, Lleida, Spain[2]; Cartographic and Geological Institute of Catalonia (ICGC), Spain[3]

The Pyrenean range (NE Iberian Peninsula), has some favourable lithological (iron-rich parent materials) and climatic (udic moisture regimes) conditions for the formation of acid sulphate soils. In spite of that, they have never been reported until now, probably due to the lack of adequate geomorphic locations with strong reduction conditions. In this context, the construction of C-28 road near València d'Àneu and the realization of land movements totally modified the morphology of a 2 ha old peat bog, partly drained at present, on the right bank of the Bonaigua River, at an altitude of 1.500 meters. In this spot a soil monolith was extracted as part of the Pyrenean soil museum project of the ICGC. Analyses revealed a high electrical conductivity in the first organic horizons reaching levels of 9.23 dS/m at 25 °C, an actual or effective acidity around 3.7 pH units according to the method of soil:water suspension (1:2.5) and around 2.5 pH units according to the method of soil:water suspension (1:5). We hypothesize that the old peat bog contained sulphydic material that was oxidized during the drainage, which could have caused a decrease in pH in organic soils. The main goal of this study is to characterize these peat bog soils to know their potential acidity and the consequences that could generate in the current environment. The experimental design has been based on delimiting the study area, describing several profiles in the field and augering to determine the volume extent of the black organic horizons. Subsequently, the samples have been analysed in the laboratory to determine the main chemical characteristics of the soils. From these results, on the one hand, it is discussed what could have happened to obtain high electrical conductivities and, on the other, whether the pH values could be an indication of acid sulphate soils (ASS) and to evaluate the possible sulphydic or sulphuric materials, not reported until now in the Pyrenees. The results will be useful to locate other spots with acidification risk and eventually add it to the geological risk programme of the ICGC.

Keywords: Acid sulphate soils; acidity potential; peat bog; acidification risk
Financial support:

(8305 - 1851) Quantification of metals and acidity leached from coarse-grained acid sulfate soil materials in western Finland

Stefan Mattbäck[1]; Anton Boman[2]; Andreas Sandfält[3]; Peter Österholm[3]
Åbo Akademi University / Geological Survey of Finland[1]; Geological Survey of Finland[2]; Åbo Akademi University[3]

Since the national mapping of acid sulfate (a.s.) soils in Finland began 2009, coarse-grained ($d_{50\%}$ grain size ≥ 63µm) hypersulfidic material (i.e. soil material with sulfidic S ≥ 100 mg/kg and a pH < 4.0 upon oxidation; Sullivan et al., 2010; IUSS Working Group WRB, 2014) attracted research attention due to many unknowns related to their classification and characterization. We quantified the acidity potential and the metals leached from some of these materials by conducting leaching experiments using a modified version of European norm EN 12457-2:2002 (cf. Åström & Björklund, 1996; Mattbäck et al. *in prep*), after the samples had undergone a 16-week incubation procedure (cf. Creeper et al., 2012). During and after the incubation period, the samples were leached with deionized water, and the leachates were recovered. The hypotheses were that (1) the electrical conductivity (EC) could be used for the quick assessment of the amount of acidity and metals released from soil materials to the liquid phase upon oxidation, and (2) the coarse-grained a.s. soils release less acidity and metals than fine-grained a.s. soils. Thus, EC in the leachates were compared with corresponding pH, acidity and element concentrations of different types of a.s. soil materials. For determination of the acidification rate, and the amount of acidity in the oxidized soil, duplicate soil samples were analyzed for the titratable incubation acidity (TIA; Österholm & Nystrand, 2016) at specific time intervals (in parallel to the leaching experiments). The aqua regia leachable trace and major elements in the soil samples were analyzed with ICP-OES and reduced sulfur species were quantified using a distillation sulfur speciation method (Dalhem et al., 2016). In accordance with previous studies (Mattbäck et al., 2017), sulfur has been extensively leached from the oxidized portions of the coarse-grained a.s. soil profiles, which therefore lack sulfuric horizons (i.e. pH < 4.0). The EC of the leachates from coarse-grained a.s. soils was significantly lower than that of fine-grained a.s. soils; and as expected higher than for coarse-grained non-a.s. soils, which shows that the leaching of potentially harmful elements from coarse-grained a.s. soils is less than from fine-grained a.s. soils.

Keywords: sulfidic materials, sand, leaching, acidity
Financial support: The authors acknowledge financial support from K. H. Renlunds stiftelse.

(3791 - 1341) Sulfur gas analysis as a potential identification method for acid sulfate soils

Moa Sunabacka[1]; Antti Pasila[2]; Asko Simojoki[1]
Department of Agricultural Sciences, Environmental Soil Science, University of Helsinki, FINLAND[1]; Seinäjoki University of Applied Sciences, FINLAND[2]

In recent years, research on the environmental impacts by acid sulfate soils have been in focus, but studies on sulfur gas emissions are still relatively few. The aim of this study was to assess the potential of sulfur gas analysis for the identification of acid sulfate soils, especially sulfidic materials. In autumn 2016, soil samples were taken from three agricultural fields in Ostrobothnia and Southern Ostrobothnia, Finland. The fields have been classified as acid sulfate soils by the Geological Survey of Finland (GTK). The occurrence of sulfides in the soil material was identified based on the pH drop during a 10-wk aerobic incubation. First, the sulfur gas emissions after a short incubation period were investigated by gas chromatography (GC) and with a portable ChemPro100i gas detector (Environics Oy) in the laboratory. In summer 2017, the use of gas detector was tested directly in the field. Further, an additional tool for soil sampling and heating the sample to enhance gas detector measurements was tested and several factors likely involved in the sulfur gas emission/release were evaluated. Contrary to the expectations, hydrogen sulfide (H_2S) could not be identified in any soil sample and the occurrence of sulfur dioxide (SO_2) was lower than expected. The unknown gas that was present in most samples and had the biggest peak areas in GC was tentatively identified as carbonyl sulfide (COS) based on indirect evidence. The identification is to be confirmed with a standard gas in near future. Based on the GC analysis, the emissions of sulfur gases from soil samples were the larger, the larger was the pH drop after the aerobic incubation. According to the first results, five of the sensors (signals) of the gas detector showed significantly lower ($p < 0.05$) resistance for sulfidic compared with non-sulfidic soil materials. In further tests, one of these five signals have shown greater potential for the purpose to identify/differentiate sulfidic

soil material. Despite the promising results showing the potential of sulfur gas analysis to become a tool to aid the mapping of acid sulfate soils, more tests are needed. According to current results, it seems the sensitivity of gas detector measurements should be increased, for instance, by increasing the amount of soil in the ground probe, before the method can be usefully applied in practice. The speciation and quantification of emitted S gases needs GC or other more advanced analytical techniques.

Keywords: Acid sulfate soils, sulfide material, sulfur gases, sulfur gas emission, identification

Financial support: Drainage Foundation sr (Salaojituksen Tukisäätiö sr), Finland

(4210 - 1350) Temperature sensitivity of microbial greenhouse gas production in a boreal organic acid sulphate soil with a black schist derived subsoil

Asko Simojoki[1]; Kazi Md. Jahangir Kabir[2]; Minna Mäkelä[1]

Department of Agricultural Sciences, Environmental Soil Science, University of Helsinki, Helsinki, Finland[1]; Department of Soil and Environmental Sciences, University of Barisal, Barisal, Bangladesh[2]

Environmental problems by acid sulphate (AS) soils are of concern worldwide in the coastal areas of Asia, Australia and Nordic countries as well as some inland areas with black-schist derived subsoils, including acidic and metal discharge to waterways and high greenhouse gas (GHG) production. This study presents results from a series of experiments conducted to reveal the mechanisms and factors regulating and limiting GHG production in boreal AS soils. Soil samples were taken from a former peat excavation area in Pärnänsuo (Joensuu, Finland) at a site where black-schist derived subsoil is covered by a 50-cm peat layer and where the groundwater level is typically high at c. 60 cm depth and the overlying soil is often wet. Despite conditions seemingly favourable to denitrification, our earlier results indicated only modest N_2O emissions with little or no correlation to environmental conditions in the field. Temperature sensitivity of GHG production was studied by incubating moist soil samples (60% WFPS) from four different horizons (H1 upper peat at 0-15 cm, lower peat H2 at 15-30 cm, Cg upper mineral soil at 50-60 cm and Cr deep mineral soil at 90-110 cm Cr) at 5 or 20 °C temperatures for 12 days. The production rates of CO_2 and N_2O were measured twice a week by sealing the incubation bottles for 24 h and analysing the headspace air by GC. After the experiment, mineral N was extracted and measured from the samples. In the peaty horizons, the rate of CO_2 production was > 10-fold of that in subsoil. N_2O production was highest in topsoil but decreased strongly with depth. The production of CO_2 and N_2O decreased as organic C and nitrate N decreased, respectively, with depth. Such a pattern reflects a microbial activity distribution typical for mineral soils, but it contrasts to previous research conducted on boreal coastal AS soils with high microbial activity in subsoil. The CO_2 production was temperature sensitive in topsoil (Q_{10} about 2) but less so in mineral subsoil (Q_{10} about 1.3). In contrast, N_2O production did not increase with temperature in any horizon, which suggests cold boreal climate is not limiting N_2O production in this soil. Even though the factors limiting GHG production as identified at later steps of the experiments are not reported here, the above results suggest contrasting mechanisms and factors being involved in GHG production in different types of AS soils, such as in black schist derived inland and sediment derived coastal AS soils.

Keywords: acid sulphate soils, nitrous oxide, carbon dioxide, black schist

Financial support: Suoviljelysyhdistys-Mosskulturföreningen r.y., Finland.

WG16 Cultural Patterns of Soil Understanding B: Dialogues between traditional and scientific knowledge and perceptions of soils by different stakeholders

(5177 - 2740) Contrasting female and male farmers' perceptions on soil ecosystem services

Angélica da Silva Lopes[1]; Heitor Mancini Teixeira[1]; Irene Maria Cardoso[1]; Cristine Carole Muggler[1]
Universidade Federal de Viçosa[1]

Soils can provide many ecosystem services, also known as nature benefits, including climate regulation, nutrient cycling, food production and cultural heritage. However, the maintenance of these services has been threatened by the use of technologies that produce changes in the dynamics of ecosystems, loss of biodiversity and soil degradation. To reverse this situation and to conserve soils functions, practices that promote and maintain soils quality and are needed. Family farmers hold rich and valuable indigenous knowledge, based on their practices and reality. Indigenous knowledge can be combined with scientific knowledge in order to develop effective and useful soil management strategies aiming the provision of multiple ecosystem services. Among farmers, the perception of women about ecosystem services can be rather different from men´s ones. The objective of this research was to compare perceptions of female and male farmers about nature benefits related to soils. The methodology followed action research principles. Fuzzy Cognitive Maps (FCM) were constructed to quantify and make explicit the perceptions among the two groups (female and male farmers) of São Miguel do Anta, in Zona da Mata Mineira region, Brazil. Twenty FCM were built individually, ten with female and ten with male farmers. The ten FCM in each group were combined to create social maps, which allowed to compare and to integrate different perspectives of female and male farmers on the nature benef
its related to soil. The women`s social map showed that female farmers can play an important role for maintaining the family well-being. The concept of health, for instance, is a component of human well-being which relies on different benefits obtained from nature, and appears only in the women's map. The concept of erosion was pointed out only in the men's map and was associated with practices that increase water infiltration into the soil. However, the importance of soil for water infiltration and storage was present in the map of both groups. The understanding of farmer´s perceptions can raise awareness about soil conservation and ecosystems services related to it. To understand the differences of male and female perceptions can contribute to find strategies for soil conservation and to empower women.
Keywords: Action Research; Fuzzy Cognitive Map; Ecosystem's services.
Financial support: FAPEMIG, PROEXT-MEC, CAPES

(3664 - 2562) Green and black landscapes: participatory environmental stratification and local soil knowledge in a quilombola community

Lucas Teixeira Ferrari[1]; Raphael Bragança Alves Fernandes[2]; Irene Maria Cardoso[2]; Ivan Carlos Carreiro Almeida[1]; Carlos Ernesto Gonçalves Reynaud Schaefer[2]
IFNMG[1]; UFV[2]

Traditional farmers' communities accumulate practical knowledge with the passing of generations, which allows them to elaborate their own interpretation, stratification and classification systems of the environmental units in their territories, which can be articulated with the scientific knowledge about soils and environments through an integrated ethnopedological approach and thus contribute to a suitable territorial planning on local reality. The objective of this work was to understand the relationships between local and scientific knowledge about soil and its interfaces with environmental components, in *Quilombo* Santa Cruz, in Ouro Verde de Minas, Mucuri Valley-MG. In this sense, we retrieved the history of land use and occupation with semi-structured interviews, conducted a participatory environmental stratification through participatory mapping and walking guided by different enviromental transects, allied to soil profiles description and sample collection for chemical and granulometric analysis. Finally, we compared local and scientific soil classification. The *quilombola* community of Santa Cruz has a strong political protagonism that allows its survival and the reproduction of its culture, facing scenarios of land conflicts and environmental degradation. The famers stratify the landscape, in different levels, according to varied criteria. The position in the landscape is decisive in distinguishing the larger and more heterogeneous environmental compartments (*Highlands, Lowlands and Stone*) and as the environmental stratification is deepened, other criteria appear, such as face of exposure, pedoform and presence of rocky outcrops, to distinguish smaller and more homogeneous *ethnoenvironments* (*Top of Highlands, Stone Foot, Rocky Hill, Non-rocky Hill, Dry Lowlands* and *Swamp*), that condition different soil types. Structure, moisture, colour and texture were the local criteria used to distinguish the four main soil classes: *Red Land, Sandy Land, Dusty Land* and *Mud*. These soils were mapped and corresponded to the following classes in Brazilian Soil Classification System, respectively: Argissolo Vermelho-Amarelo, Neossolo Regolítico, Cambissolo Háplico and Gleissolo Háplico. The participatory enviromental stratification revealed the diversity of the landscape in Quilombo Santa Cruz, which shows pedological gradients that determine agroecosystems design.
Keywords: Ethnopedology Soil-enviroment relationship Tradicional comunity
Financial support: UFV e IFNMG

(7992 - 437) Land use and soil management: The genuine decision-maker and challenges of public policies in Brazil

Juliana Silva de Souza[1]; Lúcia Helena Cunha dos Anjos[2]
PPGA-CS, Federal Rural University of Rio de Janeiro[1]; Soils Department, Federal Rural University of Rio de Janeiro[2]

Despite the existence of environmental protection and nature conservancy laws in Brazil, there is no national policy to deal with soil protection and conservation. However, there are several public provisions or regulations focused on the agricultural sector, including financial incentives that have a direct impact on land use and management, with specific programs to smallholders like the National Program to Strengthen Family Farming - PRONAF. Considering that a public policy is the sum of the activities of governments, acting directly or through delegation, and influencing the lives of citizens, it is necessary to include in the government agenda the soil resources protection connected with the public policies of the agricultural sector. The decision-making process consists in finding the best solution to a problem or opportunity. Decision-making is a common everyday process in our lives, however, some decisions are more complex than others, and to find the best choice it is necessary to have sufficient knowledge about the risk involved in each possible choice. This is also demanded by smallholders in their unit of production, for decisions on how to improve production and choices of land usage. The term decision-maker, in general, is associated to the responsibilities of governor, minister, mayor and other rulers. Decisions on the best soil management practices depend on higher level decision-makers to promote public policies that increase the security of smallholders and allow the adoption of soil protection and conservation provisions. However, at the farm level, the decision-maker in the soil management is the smallholder. To test this hypothesis, a case study in the rural settlement Zé Pureza, located in Rio de Janeiro State, is ongoing to discriminate the criteria used by smallholders to decide on soil management and land usage. The goal is to show that to change the adopted soil management toward sustainable practices it is necessary to rethink the public policies from the smallholder perspectives and perceptions. Therefore, the first step is to recognize them as a genuine decision-maker and to understand the factors and constraints defining their choices. Next step is to look for ways to insert mechanisms in some public policies already existent that could benefit, preferentially, the smallholders that implemented the

best soil management practices.
Keywords: Decision-making; soil management; public policy.
Financial support: UFRRJ, PPGA-CS, CAPES, INCRA

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