NATURAL ORGANIC MATTER RESEARCH

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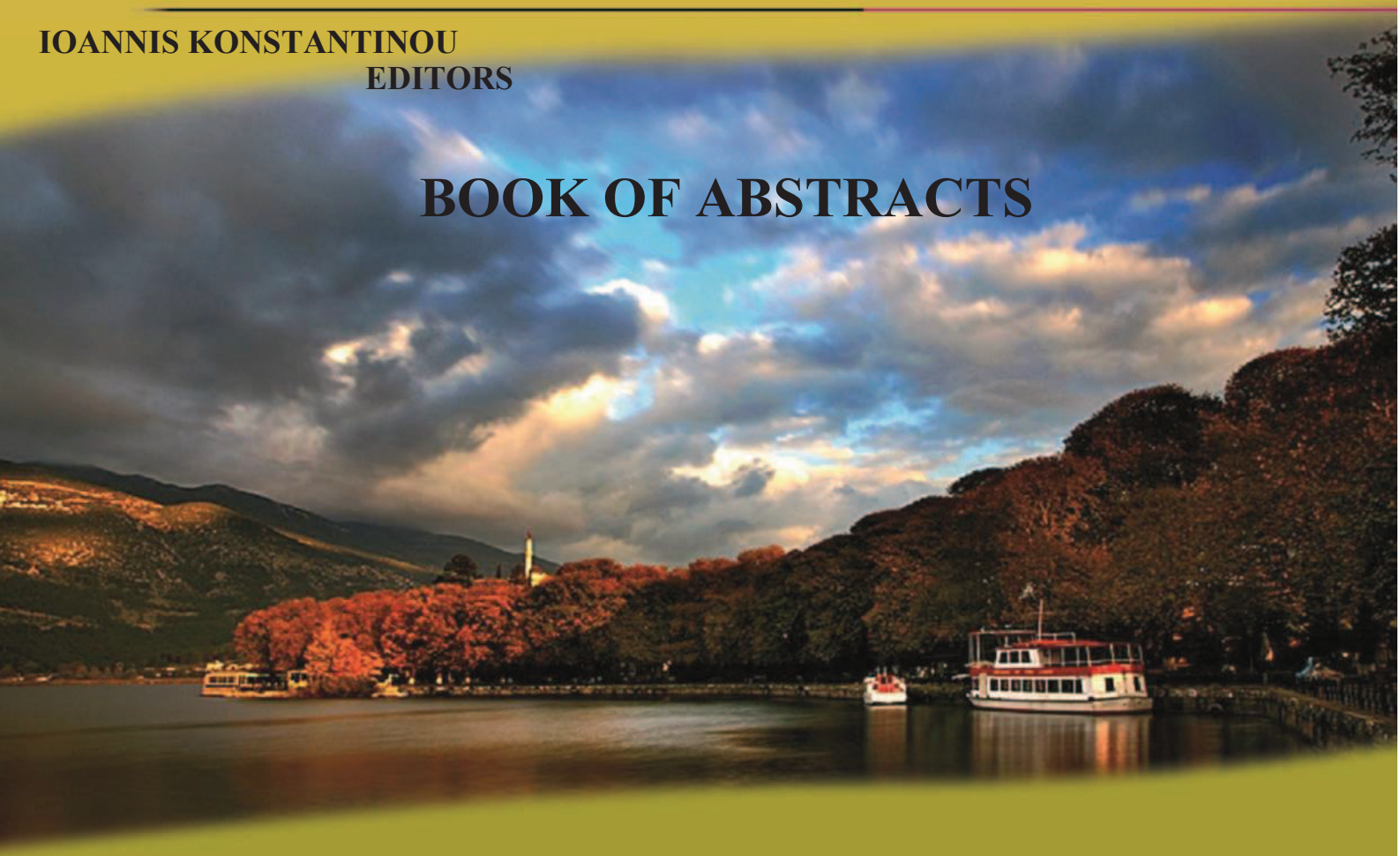

BOOK OF ABSTRACTS

NATURAL ORGANIC MATTER:

Structure-Dynamics

Innovative Applications

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Characterization of organic matter in areas under different covers in the Savannah biome (SP) - Brazil

M. C. Piccolo [(a)] *, W. Bieluczyk[(a)], L. C. Reis[(a)], M.G. Pereira[(b)], F. C. Balieiro[(c)]
(a) Laboratório de Ciclagem de Nutrientes, CENA-USP, Av. Centenário 303, CEP 13400970, Piracicaba-SP, Brasil.
[(b)] Laboratório de Gênese e Classificação do Solo, UFRRJ, BR 465, Km 7, CEP 23897000, Seropédica–RJ, Brasil.
[(c)] Embrapa Solos, Rua Jardim Botânico, 1024, CEP 22460000 Rio de Janeiro-RJ, Brasil.
* Corresponding author e-mail: mpiccolo@cena.usp.br

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Abstract. The identification and quantification of labile and recalcitrant soil organic matter (SOM) forms can be used to evaluate the impacts of management on soil quality (SQ). This study characterized the SOM through chemical and granulometric fractionation in areas located in the Savannah biome. Preserved, cultivated and environmental recovering areas were evaluated. For all fractions of SOM, except for the particulate organic carbon (POC), the preserved areas showed higher levels. The SOM had a positive correlation with the cation exchange capacity and negative with bulk density of soil ($p \leq 0.01$). The results showed that SOM improved the physical and chemical SQ, and crops reduced the levels of carbon (C) in SOM fractions, negatively affecting the SQ.

Introduction

The need to increase the food production, coupled with technological innovations in agriculture, has resulted in breakthrough on the Brazilian agricultural frontier. The main areas currently exploited are located in the Savannah biome, which originally covered an area of 2.100.000 km^2, and from this total, about 49% of the area is already deforested. São Paulo is Brazilian state with the highest levels of deforestation of the Savannah vegetation, with reduction of about 90% of the original area *(1)*.

Oxisols embrace approximately 50% of the Brazilian Savannah. These soils are characterized by having high acidity and low contents of essential nutrients to plants *(2)*. Increasing the levels of soil organic matter (SOM) in Oxisols means increasing the cycling of nutrients, cation exchange capacity (CEC), water availability, and improve soil aggregation and soil biological activity *(3)*.

The SOM is a heterogeneous mixture of organic substances with different composition, lability and functions in soil. Considering these aspects, the SOM can be fractionated, chemically an/or physically. To evaluate these compartments can set, or even predict, the function of soil in carbon (C) storage or loss in systems *(4)*. One of these methods is the chemical fractionation of SOM. It consists in obtaining the humic fractions by differential solubility. Fulvic acid fraction (FAF) and the humic acid fraction (FAF) fraction represent the portion of SOM soluble in alkaline solution. The humin fraction (HUM) is recalcitrant and connected to the minerals of soil *(5)*.

Granulometric fractionation separates the MOS by size. It is widely used in Brazil because of its methodological facility, low cost and successful results. Particulate organic carbon (POC) has the size of 53-2000 µm, composed of SOM recently added to the soil. The C associated with minerals (CAM), (< 53 µm) is a recalcitrant SOM, bound to soil minerals *(6)*.

Given the above, this study aims to characterize the SOM in areas with different degrees of anthropic impacts, evaluating a dystrophic Oxisol in the Savannah biome. Within this context preserved, cultivated and environmental recovery areas were selected, aiming to generate information on quality characteristics of SOM and soil in these settings.

Experimental

The study was conducted in areas located in the city of São Carlos, São Paulo (21º57'56'' S 47º51'10'' W) in subtropical highland climate (Cwa). The soil was classified as dystrophic Oxisol (Typic Haplustox) and presented Sandy clay loam textural class (USDA) with 288 g kg^{-1} clay, 31 g kg^{-1} silt and 681 g kg^{-1} sand.

Six areas were selected for the study: (i) semideciduous forest (SF), preserved at least 50 years; (ii) preserved Savannah (PS), with transition between "Cerrado *sensu stricto"* and "Savannah forest", preserved since 1970; (iii) recovery of the Savannah (RS), classified as "Cerrado *sensu stricto"*, with management aiming at regeneration of native species since 1997; (iv) Eucalyptus (EUC), planted in 1994 for commercial purposes, with a single liming being held in 2005; (v) pasture (PAST), implanted after cutting down the forest in 1992. *Urochloa decumbens* was seeded and remained in the area for 15 years, after this period a singular soil amendment with lime and NPK was done, seeding the *Urochloa brizantha* in the area; (vi) Sugarcane (SUC), set in 1974. The SUC harvesting was performed with the practice of burning up to 1980, and after, mechanically and without burning. Liming and fertilization practices were based on soil chemical analyzes.

Soil sampling was conducted in 2012, with five replicates (n=5) in the 0.0 to 0.2 m layer. Chemical fractionation of humic substances by differential solubility technique was performed. The HAF and FAF were extracted and the residue was reserved for determination of C in the form of HUM *(5)*. The granulometric fractionation of SOM, separated the POC and CAM *(6)*. To support the discussion related to the fractions of SOM density (Bd) and cation

exchange capacity (CEC) were determined *(7)*. Finally, the mean attributes were compared by Tukey's t test at 5% probability.

Results and Discussion

Granulometric fractions of SOM: [Figure 1] The contents of total organic carbon (TOC) and CAM were higher in the area of SF, followed by the area of PS. The lower values of these attributes were found in the area of EUC. Areas of SR, PAST and SUC had intermediate levels. The increases in the levels of TOC and CAM usually occur only in long-term *(4)*, and the management modified these attributes, mainly in EUC area, generating the found gradient. On the other hand, fertilization used in areas of PAST and SUC, could have promoted improvements in soil fertility and increase of TOC levels through *gramineae* roots. No differences were found POC contents, indicating similar C input for all the areas in the layer evaluated.

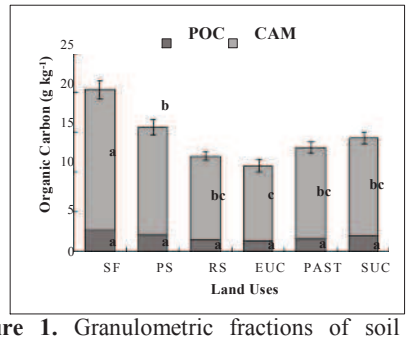

Figure 1. Granulometric fractions of soil organic carbon of the Savannah soil with different vegetation covers in São Carlos (SP-Brazil). **POC:** particulate organic carbon. **CAM:** carbon associated with soil minerals. **SF:** semideciduous forest. **PS:** preserved Savannah. **RS:** recovery of the Savannah. **EUC:** eucalyptus. **PAST:** pasture. **SUC:** sugarcane. **Note 1:** The letters compare the averages (n=5) of the attributes between areas by the Tukey t test at 5% probability. **Note 2**: error bars refer to the TOC contents.

Humic fractions of SOM: [Figure 2] The carbon content in humic fractions were higher in the area of SSF, followed by the area of PS. When evaluated the FAF, the SUC area had the lowest concentrations of C.

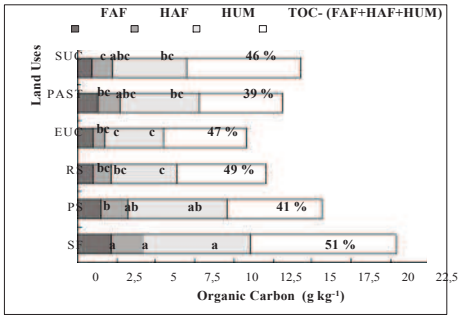

Figure 2. Humic fractions of organic carbon of the Savannah soil with different vegetation covers in São Carlos (SP-Brazil). **FAF:** fulvic acid fraction. **HAF:** humic acid fraction. **HUM:** humin. **TOC-(FAF+HAF+HUM)**: soil carbon not recovered by the humic fractions, also indicated in bars in percentage. **SF:** semideciduous forest. **PS:** preserved Savannah. **RS:** recovery of the Savannah. **EUC:** eucalyptus. **PAST:** pasture. **SUC:** sugarcane. **Note:** The letters compare the averages (n=5) of the attributes between areas by the Tukey t test at 5% probability.

Comparing to the other areas the area of EUC had the lowest concentrations of C in HAF and HUM. HUM had the largest contribution (between 62 and 69%) for the total humic substances. This means that even the FAF+HAF combination has not exceeded the levels observed for the HUM. For the granulometric fractionation between 87 and 89 % of the TOC was composed by CAM. The HUM and CAM are recalcitrant fractions and strongly stabilized with mineral soil matrix, having a half-life ranging from decades to hundreds of years *(4)*. Therefore, the HUM and CAM, due to its stability, stay longer in Savannah soils, where the edaphoclimatic conditions favor the decomposition and mineralization of SOM.

Correlations of SOM fractions with Bd and CEC: All variables were correlated at less than 1% probability ($p \leq 0,01$) [Table 1]. The fractions of the SOM inter-related positively with each other and with the TOC, showing that its dynamics walk in parallel on the evaluated systems. Humic and granulometric fractions of SOM showed positive correlations with soil CEC. On the other hand, the Bd correlations with the attributes were always negative. These results in the assessed areas that increases in the levels of SOM and/or its humic and granulometric fractions improves quality. Such affirmative is supported by the decreased levels of Bd and increased CEC.

Table 1. Pearson Correlation (r) between the attributes of the Savannah soil with different vegetation covers in São Carlos (SP-Brazil)

	TOC	FAF	HAF	HUM	POC	CAM	CEC
FAF	0.82						
HAF	0.85	0.71					
HUM	0.84	0.70	0.86				
POC	0.63	0.47	0.74	0.71			
CAM	0.98	0.81	0.78	0.78	0.46		
CEC	0.68	0.62	0.61	0.65	0.50	0.65	
Bd	-0.58	-0.52	-0.54	-0.55	-0.48	-0.54	-0.78

TOC: total organic carbon. **FAF:** fulvic acid fraction. **HAF:** Humic acid fraction. **HUM**: humin. **POC:** particulate organic carbon. **CAM:** organic carbon associated with soil minerals. **CEC:** Cation exchange capacity; **Bd:** Bulk density. **Note:** All variables were correlated at less than 1% probability.

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