QUALITY OF FAUNA AND SOIL STRUCTURE IN PRODUCTION SYSTEMS IN THE REGION OF NOVA FRIBURGO-RJ

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Abstract

The present work aimed to identify Soil Quality Indicators in a vegetable production system in the Rio Grande Hydrographic Basin, in Nova Friburgo-RJ. The Soil Structure Rapid Diagnosis - DRES - was adopted as an instrument to assess soil quality, followed by the collection, identification and measurement of soil fauna using *Pitfall traps*. Different types of management were evaluated in three rural properties: A - modified conventional planting; B - no-tillage and conventional tillage and C - minimum cultivation. The largest record of group of epigeal fauna occurred in the management with CM, followed by the PD. The lowest activity records were verified in the PC area. The greatest stability of soil aggregates occurred in the PD and CM, and the lowest in PCM and PC. It is concluded that the indicators of Soil Quality adopted allow a technical analysis in the decision making for adoption of vegetable production systems. It is interpreted that the absence of mechanization associated with the planting of Direct Planting and Minimum Cultivation tend to promote an adequate environment for soil conservation and the presence of fauna. A relationship should be established by adopting more indicators of soil sustainability and productivity, to identify the ideal management that promotes production, preservation and profitability to the producer.

Keywords: Minimum cultivation, no-tillage, Rapid Soil Structure Diagnosis, soil fauna

Presentation: https://youtu.be/l_j25BcJopc

INTRODUCTION

The loss of soil quality, understood as degradation, in practice represents a carbon deficit - structural component of organic matter linked to fertility and soil structure and biological activity. Agricultural activity has a great potential for environmental degradation (LAL, 1999; OLDEMAN, 1994; SHARPLEY, 2002). However, agricultural production conservation practices represent a sustainable strategy. But, their acceptance by farmers also depends on knowledge about their financial gains.

These practices encourage the removal of CO_2 from the atmosphere (carbon dioxide that promotes global warming) and immobilization (sequestration) in the soil, that is, they promote an increase in the content of organic matter and fertility (BARRETO et al., 2009; BONATO and HENKES, 2013), favoring carbon sequestration and water regulation services. To understand the behavior of the soil according to each management to which it is submitted, the Rapid Diagnosis of Soil Structure - DRES (RALISH, et al., 2017) was adopted. The adoption of Pitfall traps allowed the capture of edaphic fauna. As a hypothesis, it was adopted that the systems with conservationist practices, promote the greater presence of edaphic fauna and the improvement of the soil structure, contributing to the improvement of ecosystem services and the economic viability of production.

MATERIALS AND METHODS

Study Area - The work took place in 3 rural properties, in the Rio Grande Hydrographic Basin, in the municipality of Nova Friburgo, RJ. In this basin there is a predominance of family farming and intensive use of labor, the center of economic activity is Horticulture. The present study named the properties as A, B and C, with management systems, as follows: modified conventional planting – PCM where it maintains the reduced use of rotary hoe in soil preparation, however it already adopts black oats as soil cover; no-tillage - PD and conventional planting PC (B) adopt, respectively, the absence of mechanization associated with the use of intercropped legumes and mechanization without vegetation cover, and minimum cultivation - CM (C) where black oats are the vegetation cover and the coving is done by hoe, in the same type of soil (Cambissolo), relief and position in the landscape.

Sampling - For sampling the epigeal edaphic fauna, the Pitfall traps method was adopted, which according to Moldenke (1994), consists of the placement and permanence of cylindrical plastic containers about 15cm high and 10cm in diameter, at ground level. 200ml of formaldehyde solution (1%), to capture fauna. In each type of management, a total of 10 traps were allocated, randomly distributed over the beds, respecting a minimum distance of 5m between them. After 7 days, the traps were collected in the field and sent to EMBRAPA Solos, where the material was screened and the organisms stored in 70% alcohol. The fauna was quantified and identified, at the level of large taxonomic groups, at EMBRAPA Agrobiologia, using a stereoscope microscope. The structural quality of the soil was evaluated through the use of the Rapid Diagnosis of Soil Structure - DRES, a field method that allowed to classify the degree of this quality through the characteristics visually identified, in the soil samples, collected from 0 to 25 cm, with 3 repetitions, by type of management. The grades range from 1, low structural quality soil, to 6 soil with good structural formation.

Data Analysis - The data analysis of the edaphic fauna was based on the quantification of the total number of individuals per trap per day (in the ind. Arm. Dia-1) and the numbers of individuals per taxonomic group. The attribution of notes to the collected soil samples was based on the quality of the sample structure, by type of management, with three repetitions.

RESULTS AND DISCUSSION

A total of 28 groups of epigeal fauna were recorded in the studied areas, with the highest activity values recorded in the CM area, followed by the PD. The lowest activity records were observed in the conventional planting area. Thus, it can be said that areas with more conservationist management favored the presence of epigeal fauna. The edaphic fauna in general is sensitive to stress conditions or other disturbances (EATON et al., 2004) that can be represented by conventional soil management.

The most representative fauna group was that of Entomobryomorpha colembolas in all areas, however in the areas of CM and PD, which had covered soil, this group was more expressive. Poduromorpha colemboli, on the other hand, were verified only in conventional planting areas (PC and PCM). Collembola (Arthropoda, Hexapoda), is a typically edaphic taxon, with a large number of representatives in the soil fauna samples (PONGE et al., 2006). These microarthropods feed on a wide range of resources, including fungi, bacteria, lichens and debris (HOPKIN, 1997). As they feed directly on decomposing organisms, regulating microflora populations, they play an important role in the decomposition of organic matter (LAVELLE & SPAIN, 2001), aspects of extreme relevance in the management of agrosystems.

According to the evaluation carried out in the field, using the DRES method, the samples collected from soils obtained punctuation, as shown in Figure 1. Thus, it is observed that the management of PCM and PC establish a similarity between each other, in the use of mechanization, by rotary hoe. Even with the reduction of 2 hoe passes during the preparation of the soil in the "modified" management, its aggregates are still exposed to a spraying action of its structure, making the score low.
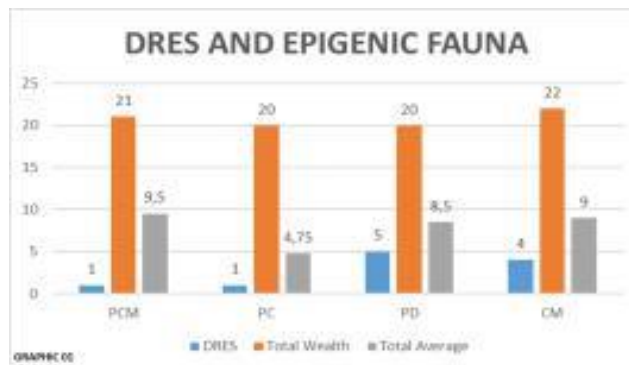
Figure 1. Relationship of the DRES score, with Total Wealth (number of groups found per assessed area) and Average Wealth (which corresponds to the average number of orders or groups found per trap).

When PCM presents a diversity of individuals of edaphic fauna higher than PC and the same DRES score, it is observed that this action of destabilization of soil aggregates has such a negative interference on them, to the point of soil cover, adopted in the management "modified", not having had enough time to guarantee a better soil structure. However, the diverse presence of edaphic fauna suggests a process of improvement. Observing the results of CM and PD, there is a satisfactory relationship of soil health indicators, which can represent managements that meet the issues of productivity, economy and profitability to the producer, associated with the preservation of the modified environment.

CONSIDERATIONS

The absence of mechanization associated with vegetation cover promotes an adequate environment for soil conservation and the presence of fauna. Direct management and minimum cultivation are the most recommended for the cultivation of vegetables in the region, according to this work. Thus, the proposed hypothesis was proven, pointing to a complementary relationship between these soil sustainability indicators, which contributes to the improvement of ecosystem services and the economic viability of production.

It is appropriate to establish other relationships, adopting more indicators of soil sustainability and productivity, to identify the ideal management that promotes production with preservation, and with profitability for the rural producer.

REFERENCES

BARRETO, L. V.; FREITAS, A. C. S.; BARRETO & PAIVA L. C. Sequestro de carbono. **Enciclopédia Biosfera**, 2009.

EATON, R.; BARBERCHECK, M.; BUFORD, M. & SMITH, W. 2004. Effects of organic matter removal, soil compaction and vegetation control on Collembolan populations. **Pedobiologia**, 48, p.121–128.

HOPKIN, S. 1997. **Biology of the springtails** (Insecta: Collembola). Oxford University Press. 330 p.

LAL, R.; FOLLETT, R. F.; KIMBLE, J.; COLE, C. V. Managing U.S. cropland to sequester carbon in soil. **Journal of Soil and Water Conservation**, Ankeny, v. 5, p. 374-381, 1999.

LAVELLE, P.; SPAIN, A. V.; BLANCHART, E.; MARTIN, A.; MARTIN, S. 1992. Impact of soil fauna on the properties of soils in the humid tropics. In: Lal, R. & Sanches, P. A. (Eds). **Myths and science of soils of the tropics**. SSSA, Madison, USA, p.157-185.

MOLDENKE, A. R. 1994. Arthropods. In: WEAVER, R.W.; ANGLE, S.; BOTTOMLEY, P.A. **Methods of soil analysis**: Microbiological and biochemical properties. Part 2. Madison, SSSA, p. 517-542.

PONGE, J-F.; DUBS, F.; GILLET, S.; SOUSA, J. P. & LAVELLE, P. 2006. Decreased biodiversity in soil

springtail communities: the importance of dispersal and land use history in heterogeneous landscapes. **Soil Biology & Biochemistry**, 38: 1158–1161.

RALISCH, Ricardo *et al.* Diagnóstico rápido da estrutura do solo – DRES. **Documentos 390**. Londrina, PR: Embrapa Soja, 2017. 65 p.

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