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Management of Different Indicator for the Application of Biological Alternatives in Sialitic Brown Soils (Loosened, Typic, Eutropept, Cambisol)

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Abstract: Traditionally soil management has responded to variants of conventional agriculture, i.e to the indiscriminate use of chemical fertilizers. This has contributed to soil degradation with the subsequent decrease of agricultural yields. This work with the objective to value indicators of quality of soil for application of alternatives biological was carried out in areas of the Sugar Cane Enterprise Sergio Gonzalez, of The Colon Municipality, on a Sialitic Brown soil. Soil samples were taken of which pH, organic matter, exchangeable cations, hydrolytic acidity, micro-organisms present, among others, were determined. They were processed according to a Multivariate Statistical Analysis of Main Components, Through SPSS version 11. The main results obtained indicated that the microbiological indicators followed by organic matter and assimilable potassium constituted essential elements to be taken into consideration in the agroecological management of this soil and that for application of nutritional amendments in the soils, this type of analyses should be considered for their more efficient management. This kind of analyses can constitute important methodological aspects to be followed for the evaluation and integrated management of soil.

Key words: Soil · Management · Indicators · Quality

INTRODUCTION

The oldest industry of country has been subject for a long time to the rigorousness of modern agriculture. Large material and financed resources were provided to it in order to obtain high yields, it was necessary to invest a lot of agrochemicals.

Nova [1] stated that sugarcane agriculture planted sugarcane over and over on favored soil compaction and, as final result, their impoverishment.

The increase of yields in the 80´s was obtained mainly due to the use of high doses of chemical fertilizer and use brought about the rupture of balance in the different agroecological systems.

Nowadays, with the climatological changes, environment degradation has been occurring, which includes many areas of sugarcane production according to Torriente [2].

According to Anonymous [3] of nitrogen fertilizers applied to the crops is utilized by plants, the other percentage is accumulated in the soil to be utilized in the next crops, but a large part of them is transformed into atmospheric N_2 by means of denitrification processes by microorganisms and other large part is leached to lower layers where it contaminates underground waters as nitrates (No_3).

For a long time higher attention has been paid to physical-chemical factors in soil development, lout different specialist have coincided in stating that the microbiological indicators play an import role in the agroecological management of crops.

Font *et al*. [4] studied the environmental impact caused in the soils, taking into consideration the integrated use of microbiological, physical and chemical indicators. This study allowed to diagnose, with great effectiveness, change in soil fertility and the unbalance conditioned in agroecosystems by the inadequate management of the soil, aspect little studied under our conditions, in spite of being considered worldwide as the most sensitive for defining soil quality.

The objective of work is to evaluate the integrate effect of the main indicators that could influence the loss of soil properties, for their later adequate agroecological management.

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MATERIALS AND METHODS

This work was carried out in the areas of the livestock Production Farm Sergio Gonzalez of Matanzas province, for study a thorough soil sampling was made in 20 points of the fields, taking samples from 0-20 cm of depth according to the methodology recommended by Villegas [5].

The Following Soil Indicators Were Determined: P_2O_5, K_2O, OM, pH in KCL, pH in H_2O, Ca, Mg, Na, K, hydrolitic acidity, Actinomycetes, Bacteria, Fungi.

A Main Component Multivariate Analyses was performed to determine the relation and correlation level of the different variables or indicators studied.

RESULTS AND DISCUSSION

In the relationship that is established between the rhizosphere of the plant and microorganisms the adequate management of soil indicators plays an important role. The influence of soil type on the determination of fertilizer doses was suggested by Arzola y García [6], who found higher productive increases in Sialitic soils than in Ferralitic ones, they suggested that this effect occurs due to higher chemical, physical and mainly microbilogical fertility in the first 50 cm of the soil more favourable for the maintenance and viability of such microorganisms.

The MCA carried out on the different soil indicators studied shows that the component 1 contributed the highest values to the system with 27.3% of cumulative variance; this component and factor contributed more than 50% of the cumulative variance (Table 1).

Interpreting the result of the MCA, together with experiences of specialists and studies consulted, we can infer that the microbiological indicators for this study showed a remarkable influence on the cumulative variability, followed by the chemical ones. Within the latter, the organic matter and such elements as potassium stand out in order.

Table 2 shows an order of influence of the variables studied, in which Actinomycetes occupied the first places, followed by fungi and the populations of bacteria.

Microbiological Indicators: Calero *et al.* [7], reported that biological aspects have occupied the background when studying the soil and they ascribed it to the large complexity that is shown in these studies, but they are being increasingly taken into consideration when planning the activities to be performed within the system.

Table 1: Main Component Matrix for the study of the soil indicators

Variables	Comp. 1	Comp. 2	Comp. 3
Actinomycetes	0.86	-0.06	0.26
Bacteria	0.33	0.76	-0.38
CA	0.11	-0.10	0.12
Fungi	-0.75	0.08	-0.36
K	0.17	-0.09	0.94
K_2O	-0.12	-0.12	0.92
Mg	0.00	0.91	-0.11
OM	-0.29	0.86	0.04
Na	0.20	0.16	-0.06
pH H_2O	0.79	0.01	-0.22
pH KCL	0.30	-0.14	0.07
Proper values	3.28	2.89	1.92
% of Variance	27.30	24.20	16.00
Accumulated variance	27.30	52.50	67.50

Table 2: Influence of the evaluated soil indicators, according to MCA.

Indicators	Variables
1.Microbiological indicators	Actinomycetes
	Fungi
	Bacteria
2.Chemical indicators	Organic matter
	K

This result indicates a variation in the microbiological composition of the soil, because predominance of Actinomycetes and fungi over bacteria is observed. This can be due to many factors, among them the inadequate management of fertilization for several years could be the main cause.

The scientific opinions about the influence of fertilization on soil microorganisms are diverse. Some authors, such as Rodríguez [8], state that mineral fertilizers can be noxious to microbial populations, they can even sterilize the soil; but this depends on the type of fertilizer that is used, the doses, the crop and its management within the ecosystem.

On the other hand, Pérez *et al.* [9] in Brown soils without applying fertilizers found populations, in order, of bacteria, Actinomycetes and fungi, explaining this behavior starting from the fact that fungi and Actinomycetes are less numerous with regards to bacteria and grow more slowly. With the increase of the doses of fertilizer the bacteria were depressed and the fungi increased because they need certain nutrients for their development, as they do not have nitrogen fixing capacity; Actinomycetes were temporarily reduced, because a trend was found to increase in time. They

Table 3: Results of the soil chemical analysis

OM (%)	p^H KCl	Mg (meq/100g)	K (meq/100g)	K_2O (meq/100g)	Na (meq/100g)
3.27	5.80	4.00	0.42	15.50	1.12
3.49	6.50	5.40	0.43	12.34	1.64
3.30	6.60	4.40	0.57	21.11	1.12
3.43	6.70	5.60	0.41	10.23	1.01
3.02	6.70	2.00	0.45	15.50	0.51
2.82	6.70	3.60	0.54	15.14	0.63
3.49	6.80	4.00	0.45	15.85	1.17
2.74	6.70	3.20	0.41	11.99	1.29
3.23	6.80	4.60	0.45	14.09	0.25
3.30	6.50	4.60	0.45	13.74	0.22

suggested, in general, that as the nitrogen levels increase, nitrates increase in the rhizosphere, which would cause the decrease of the pH favoring the micotic microflora and depressing bacteria and Actinomycetes as well.

This unbalance can be also due to the sugarcane monocrop for a long time in those areas. Regarding this, Sánchez *et al*. [10] found a higher colonization of microorganisms in Brown soils than in Ferralitic ones and they relate to the high humidity content the former have. They concluded, that the existence of certain plant species in a system plays an important role in the activation of certain species of the microbiological fauna.

Chemical Indicators: The integral interpretation of the MCA carried out suggests that chemical indicators occupied a second place after microbiological indicators. This possibly occurs because Brown soils show certain levels of fertility

Influence of Organic Matter: According to the MCA this indicator can be interpreted as an important factor to take into consideration the response of regrowth to the application of Rhizobacteria (Table 2). It occupied the first places due to the variability contributed to the system.

The result of the soil analysis showed values between 2.82 and 3.49% (Table 3) [11]. The organic matter contents found in the soil analysis are moderate, aspect favored by the content of bases found, the development of microorganisms and the type of vegetation; the regrowths of more than four cuttings should contribute a higher quantity of old leaf and root residues to the soil.

Cabrera [12] suggests that at least half the capacity of cationic exchange of the soils is due to organic matter and that it is responsible for the stability of the aggregates and provides microorganisms with energetic and somatic constituents.

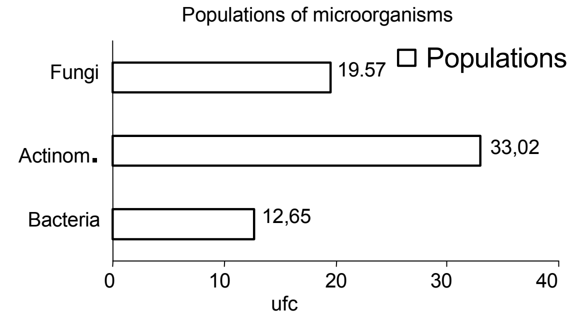

Fig. 1: Populations of microorganisms according to soil study

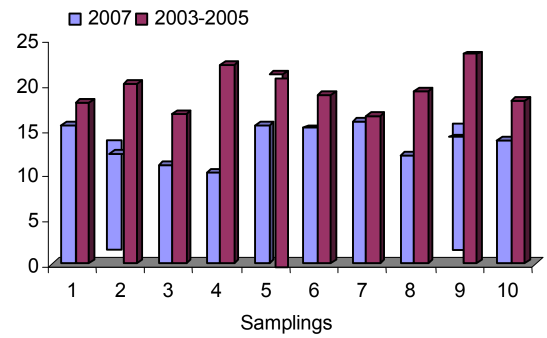

Fig. 2: Potassium contents (K_2O, mg/100g) per years analyzed

Exchangeable Cations: Potassium was another element which according to the MCA offered an important variability to the system studied. The values found of K_2O and K, according to the chemical analysis, vary from 10.23 to 15.85 and 0.42 to 0.57 mg/100 g, respectively. Cairo and Fundora [13] consider that for Brown soils with carbonates, K values have been found of 0.86 cmol kg^{-1}. On the other hand, Cuellar *et al*. [14] reported it in sugarcane soils between 0.08 and 2.30% and in Sialitized soils between 0.47 and 2.30% and refer that a little more than a third of the latter are poor in exchangeable potassium. The values found are considered very low.

In the recommendations made by SERFE in the previous years (2003, 2004 and 2005) acceptable contents of this element were shown, for which no applications of it were recommended. In the study carried out potassium was lower (Fig. 2) in its content with regards to previous years, for which potassium fertilizers should be recommended. Regarding this, Torriente [15] recommended for these soils, in sugarcane cultivation, potassium fertilization according to the levels found. She also found significant differences between fertilization variants with and without potassium. This can occur because these soils are in a moderate slope close to 15%, where the surface is exposed to wash outs and leaching due to rainfall and to lose fertility levels in the topsoil.

This element must be taken into consideration for the application of Rhizobacteria. With regards to this, Chistiansen *et al*. [16] summarize that in a medium rich in organic matter, with enough moisture and minerals, microorganisms are multiplied rapidly and they suggest that the application of organic matter must occur together with essential nutrients, because they consider microorganisms as microplants, which need nutritive elements as plant species do and which are damaged when there is lack of these elements.

CONCLUSIONS

- The indicators which contributed higher variability to the system were the microbiological ones.
- Organic matter was one of the indicators that showed remarkable influence on the results obtained.
- Potassium turned out to be one of the chemical indicators that exerted remarkable influence on this soil type and could limit the yields to be obtained in future plantations.

RECOMMENDATIONS

- To continue the integrated study of chemical, physical and microbiological indicators, for soil management under different edaphoclimatic conditions.
- To carry out further studies on soil reaction, because, although it was not a problem at the moment of this work, it could show difficulties at long term in the development of the soil micro- and macrofauna.

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