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CURRENT CONDITION OF TOBACCO SOILS OF "LÁZARO PEÑA" ENTERPRISE IN ARTEMISA PROVINCE

Situación actual de los suelos tabacaleros de la empresa "Lázaro Peña" de la provincia Artemisa

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ABSTRACT. During the last 20 years the science of soil has worked on the soil degradation. The Red Ferralitic Soils of "Lázaro Peña" enterprise are not excluded of this process as they are extremely subjected to an intensive cultivation, which causes alterations of its chemical and physical - chemical properties. The diagnostic of these processes allows to design strategies for its recovery, so that this work has the objective to characterize since the physical and chemical points of view the soils of this enterprise. For this reason samples of soils of each Basic Units of Cooperative Production of the enterprise were taken and the correspondent analisys at Research Tobacco Institute were carried out. The results showed high value of pH on the soils which constitutes a limit for tobacco production due to the requirements of tobacco plant. Besides the content of organic matter are low in spite of proving an increase which improves the levels of soil fertility. An unfavourable calcium / magnesium and relationship is shown as a a result of an intensive tobacco cultivation because the irrigation is carried out with hard water which limits besides limits the absorption of magnesium due to they are antagonistic elements. The phosphorus and potassium values are suitable for these soils. As conclusion, there is a high Ca/Mg relationship and reaction of the soil, that suggests to search of new alternatives for improvement and conservation of the soils.

Key words: degradation, soils, tobacco, improvement, soil conservation

RESUMEN. En el campo de la edafología, durante los últimos 20 años, se trabaja en la degradación de los suelos. Los suelos Ferralíticos Rojos, que componen la cubierta edáfica de la Empresa Tabacalera "Lázaro Peña", no se encuentran exentos de este proceso, pues están sometidos a un régimen de cultivo intensivo, que provoca alteraciones de sus propiedades químicas y físico-químicas. El diagnóstico de estos procesos, permite diseñar medidas para su recuperación, por lo que el objetivo de este trabajo es caracterizar físico-químicamente los suelos de esta empresa. Para ello, se procedió a la toma de muestras de suelo en cada Unidad Básica de Producción Cooperativa de la entidad y se realizaron los análisis correspondientes en el Instituto de Investigaciones del Tabaco. Los resultados mostraron valores altos de pH en el suelo, lo cual constituye una limitante para la producción tabacalera debido a los requerimientos de la planta de tabaco. Además, los tenores de materia orgánica aún son bajos, a pesar de constatarse un incremento, lo cual mejora los niveles de fertilidad del suelo en este territorio. Se observa una relación calcio/magnesio desfavorable, como resultado del cultivo intensivo del tabaco, porque el riego se realiza con aguas duras, lo que además limita la absorción del magnesio por ser elementos antagónicos. Los valores de fósforo y potasio resultan adecuados para estos suelos. Se concluye que existen una elevación de la relación Ca/Mg y de la reacción del suelo, lo que sugiere la búsqueda de nuevas alternativas de mejoramiento y conservación de los suelos.

Palabras clave: degradación, suelos, tabaco, mejoramiento, conservación de suelo

INTRODUCTION

Edaphology in the last 20 years has been working on soil degradation due to the anthropogenic activity and specifically on the silent deterioration of its physical and chemical properties which has led to the loss of agroproductivity (1).

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In particular, red ferralitic soils of Artemisa province, considered very productive soils, pH increase has shown records exceeding values of 7,4-7,5 (2). This situation can affect crops like tobacco and potato if values of 8.0 units or higher are reached, since this pH makes difficult nutrients uptake. For these reasons, this research aims at characterizing the physical and chemical properties of the soils in all production units of the "Lázaro Peña" Collecting and Packing Tobacco Enterprise.

MATERIALS AND METHODS

The study was carried out in different tobacco plots of the above-mentioned enterprise located in the road to Alquízar km 4½, "Parra Farm", San Antonio de los Baños, Artemisa province. Its edaphic cover is not complex and is represented by typical red compact and hydrated ferralitic soils (3).

The entire area of the enterprise was checked to identify different soil types and subtypes shown in the Soil Map 1: 25 000 drawn in 1997 by the Soil Institute. Soil samples were then taken from each field which were calibrated, three buffer solutions from MERCK, pH 4,00, 6,86 and 9,18 were respectively used, with a soil / extractive solution relationship of 20/50 according to the NC-ISO 10390 (7).

RESULTS AND DISCUSSION

pH

Red ferralitic soils are characterized for being fairly saturated by alkalinoearthen basis as a result of the intense rainy periods with free iron content above 60 % and a slightly acid pH (5,6–6,6), (8, 9).

Figure 1 shows pH values found in the soils of each Basic Cooperative Production Unit of the "Lázaro Peña" Tobacco Growing Enterprise. In all tested soils pH values exceeded the neutral condition of the soil (pH=7.0). These values are very high for the mean of Red Ferralitic Soils (8, 9).

Increased pH values are unfavorable for tobacco production because such high levels limit nutrients assimilation. The optimum pH range to achieve a maximum availability for most of the nutrients is from 5.0 to 6.0 (10). Moreover, tobacco (*Nicotiana tabacum* L.) is an acidofilous plant that reaches its maximum growth and production around a fairly acidity from 5.5 to 6.5 (11). This situation turns into a limiting factor to obtain layers suitable for exports.

These data confirm reports from other authors who have found alkalinity above 40 % as one of the main problems linked to Red Ferralitic soil degradation in Havana province (2).

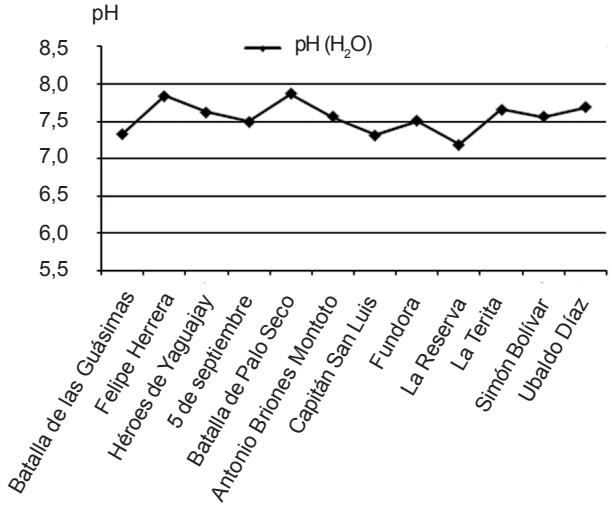

Figure 1. pH of the soils at the Tobacco Growing Enterprise "Lázaro Peña"

The alkalinity problems of these soils are related to anthropic factors (1, 2), as the use of hard waters for irrigtation for decades (calcic bicarbonated) and soil tempetrature increase in 0.6 °C, due to the influence of climate change.

These increased pH values in Red Ferralitic Soils of the "Lázaro Peña" Tobacco Growing Enterprise confirm the statement of those who consider alkalinity as the most influential factor in soil degradation (2).

Soil organic matter

Soil productive capacity rests upon the ability soils have to provide crops with the necessary quantities of nutrients for their right development. The availability of these nutrients depends on different factors like the organic matter content and quality that is one of the most influential one. However, it is not easy to maintain a satisfactory level of these constituents in most of the soils (12).

Organic matter is an organic soil component that gathers different compounds sthat vary in rates and status and include plant biomass, animal biomass and fresh microbial biomass, organic residues under decomposition as manure, harvest wastes, compost, and humus. This organic matter plays an extraordinary role in keeping soil fertility (13).

Figure 2 shows organic matter contents; it is interesting to check their increase in the soils of the already mentioned enterprise as compared to those found in these soils[A].

It is outlined that tobacco is one of the most troublesome crop in agricultural production regarding soil fertility, since the postharvest residues derived from

[A] Frómeta, Enrique. Variaciones producidas en algunas propiedades de un suelo Ferralítico Rojo durante el cultivo continuado. [Tesis de Doctorado]. ISCAH. 1983.

it are very scarce to participate in the biological cycle of substances like the restoration of organic matter and other soil nutrients (9, 14). It has been reported that this crop empoverishes soils as to this indicator, a situation that has been reverted by some measures that permit to improve and conserve soils with the use of green manure and the application or organic matter.

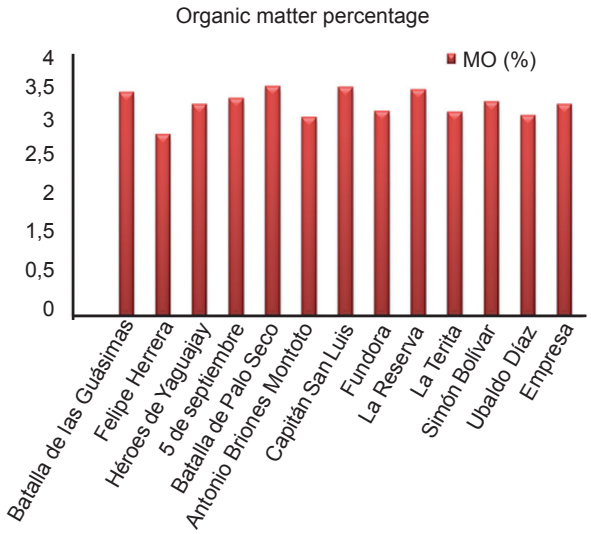

Figure 2. Organic matter content of the soils from the "Lázaro Peña" Tobacco Growing Enterprise (expressed in percentage)

Soil organic matter in this enterprise show values from 2.5 to 3.5 % which tend to increase thouth they are not significant to leave aside the use of organic fertilizers and green manure. In general, organic matter content is considered low for the territory.

Calcium and magnesium

Soil exchangeable cations like calcium and magnesium are an important source of fertilizers for plants. Their evaluation is more complex and depends on the cation exchange capacity, from soil clay content and the relationship among them (2).

Figure 3 shows soil calcium content in each of the growing areas of the above-mentioned enterprise. At territorial level, there are high exchangeable calcium contents, with a mean value for the enterprise of 14.14 cmoles kg^{-1}. The "Batalla de Palo Seco" Basic Cooperative Production Unit has excessive calcium values that reach 19,84 Cmoles kg^{-1}, a situation that does not favor tobacco growing mainly due to the antagonism with magnesium as to ash color.

These high values of soil calcium are worrisome because, in spite calcium is not considered a toxic element for tobacco plants, it can indeed reduce the uptake of some nutrients like P, K, Mg, B, Cu, Fe and Zn, causing shortage sometimes (15).

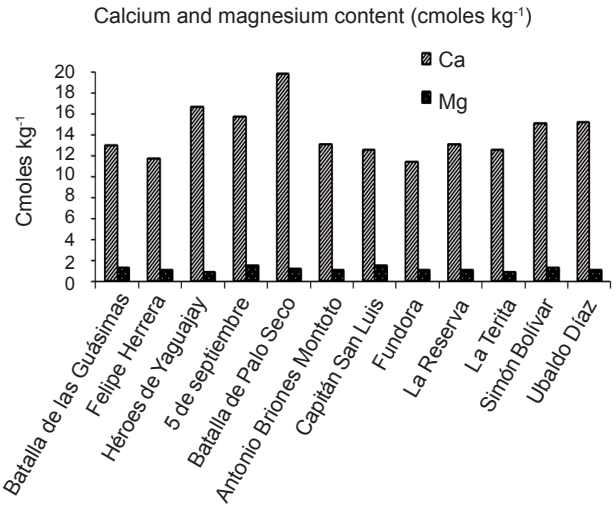

Figure 3. Ca and Mg content in soils of the "Lázaro Peña" Tobacco Growing Enterprise

Contrary to calcium values, magnesium exchangeable values are notably low. It clearly expresses the antagonic relation between calcium and magnesium. Added to it is also the result of a deficient magnesium fertilization in managerial units that reflects a gradual exhaustion of the reserves of this nutrient, so essential to produce high quality leaves. This situation turns alarming in the specific case of tobacco growing since this element is imperative for the chlorophyl molecule formation to produce a good quality cigar, especially by achieving a gray to white burning. These results coincide with reports from other authors (2).

Ca/Mg ratio

The Ca/Mg relationship is the most important indicator for tobacco growing related to soil cations. The quality of the leaf and the cigar might depend from this valueB.

Table shows the variation of the Ca/Mg relationship for each of the production units of "Lázaro Peña" enterprise. In general, the Ca/Mg relationship increased reaching a magnitude of 12.70 as mean value, surpassing fair values (2). This phenomenon can be related to high calcium contents in the soils, a high hardness (2)[C]. These conditions pose a danger for tobacco production and some authors say that a Ca/Mg relationship above 8.0 requires an additional magnesium application to fertilizers formula[B].

These data confirm the results of other studies (2), where a Ca/Mg relationship of 11.78 was found as the medium value for this enterprise. These authors established as the main indicator of soil degradation status in this territory, the Ca/Mg relationship due to its considerable increase in a decade.

[B] Trémols, Joaquin. Informe sobre el análisis de los suelos tabacaleros de la Empresa "Lázaro Peña". Instituto de Investigaciones del Tabaco. 2010.

[C] Trémols, Joaquín.: Comunicación personal, 11 de septiembre del 2009.

Table. Ca/Mg relationship in soils of the "Lázaro Peña" Tobacco Growing Enterprise

Basic Cooperative Production Unit	Ca Mg
Batalla de las Guásimas	10,58
Felipe Herrera	10,54
Héroes de Yaguajay	19,14
5 de septiembre	10,38
Batalla de Palo Seco	16,76
Antonio Briones Montoto	12,14
Capitán San Luís	8,94
Fundora	10,71
La Reserva	12,44
La Terita	13,90
Simón Bolívar	12,51
Ubaldo Díaz	14,36
Empresa	12,70

Assimilable phosphorus and potassium

Assimilable phosphorus is the available quantity of this nutrient present in soils. Contrary to what is thought, excessive phosphorus values are very dangerous for tobbaco because they might interfere in the uptake and assimilation of other essential nutrients, particularly zinc[D].

Phosphorus content is high in all sampled tobacco plots with values from 38.65 mg 100 g^{-1} of soil and 95.41 mg 100 g^{-1} of soil (Figure 4). Such situation could be influenced by the frequent fertilization made prior to tobacco[E] and for the quantity of organic matter present in these soils that has favored the development of phosphorus-soluble microorganisms that act on the insoluble soil phosphates (13).

Assimilable phosphorus reserves are normal through an increasing trend could show up for this element. Mean values of this nutrient are high and are beneficial for the time being. Special attention deserves the results of soil analysis from the "Batalla de Palo Seco" Basic Cooperative Production Unit where phosphorus values are excessive.

In this territory it is necessary to monitor minor elements content in leaves to detect possible antagonisms caused by the excess of phosphorus.

As to assimilable potassium is concerned, it represents the availability present on soils. Exchangeable potassium contents as well as phosphorus reserves show adequate values for the crop except in the "Antonio Briones Montoto" Basic Cooperative Production Unit where this element is low while mean potassium values are of 11.32 mg 100 g^{-1}, considered low for tobacco productionC. This situation could well be the result of a faulty fertilization with this nutrient or it could be due to high pH values of these soils which negatively affect potassium availability (16).

[D] Frómeta, Enrique. Conferencia especializada "Las propiedades físicas de los suelos". UNAH. La Habana. 2000. 14 pp.

[E] Valiente, Carmen. Informe de clasificación de los cationes y otros compuestos principales del suelo, según metodología para el mapa nacional del suelo 1: 25000. 1986.

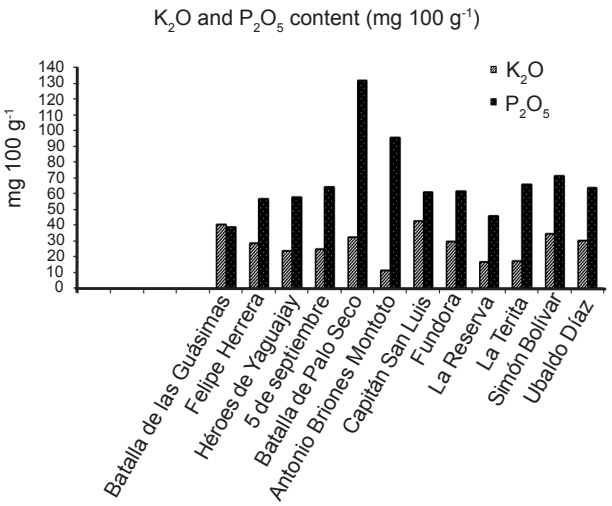

Figure 4. K_2O and P_2O_5 content in soils of the "Lázaro Peña" Tobacco Growing Enterprise

This phenomenon can be also monitored in the territory due to the importance this nutrient has to provide tobacco leaves with a better color, elasticity of cured leaves and burning (17).

CONCLUSIONS

- There are evident high pH values at the "Lázaro Peña" Tobacco Growing Enterprise which are a constraint for tobacco production due to the requirement of moderately acid soils for tobacco growing.
- There is an unfavorable Ca/Mg relationship associated to intensive and systematic tobacco growing under protected conditions in the soils of this enterprise.
- Organic matter contents are favorable with the consequent contribution to improve its fertility.
- The high calcium contents make difficult magnesium uptake due to the antagonic relationship of these elements.
- Assimilable phosphorus and potassium contents are found within adequate values for tobacco growing.

RECOMMENDATIONS

- To carry out chemical and physical-chemical soil analyses in order to determine their current conditions and propose an adequate management.
- To apply new improvement and conservation soil alternatives emphasizing on a reduction of pH values, Ca/Mg relationship and exchangeable calcium values.
- To continue with the application of previously stabilized organic ammendments at the rate of 10-20 t ha^{-1} to keep organic matter contents.

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