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Original article

Surface area occupied by soils of the San Jose de las Lajas municipality, Mayabeque province, Cuba

Superficie que ocupan los suelos del municipio San José de las Lajas, provincia Mayabeque, Cuba

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ABSTRACT: This work was carried out in the soils of San José de las Lajas municipality, Mayabeque province, Cuba, which cover an area of 579.677 km^2, with the objective of determining the area occupied by the different soils at Grouping and Genetic Type level, according to the 1999 version of the Cuban Soil Classification and its correlation with the world classifications: *Soil Taxonomy* and *World Reference Base*. The data of the planimetry of the genetic map of soils of Cuba at a scale of 1:25.000 was taken as a basis for the study. The 43.36 % of the study area corresponds to Ferrallitic soils, being these the most extensive in the municipality, followed by the following soils: Humic Sialitic (27.61 %), Brown Sialitic (9.49 %), Fersialitic (5.90 %), Little Evolved (4.86 %), Fluvisol (1.94 %), Histosol (1.63 %), Ferritic (1.43 %) and Vertisol (0.78 %).

Key words: tropical soils, soil classification, soil mapping, soil correlation.

RESUMEN: Este trabajo se realizó en los suelos del municipio San José de las Lajas, provincia de Mayabeque, Cuba, los cuales abarcan una superficie de 579,677 km^2, con el objetivo de determinar el área que ocupa los diferentes suelos a nivel de Agrupamiento y Tipo Genético según la versión de Clasificación de los Suelos de Cuba de 1999 y su correlación con las clasificaciones mundiales: *Soil Taxonomy* y *World Reference Base*. Se tomó como base de estudio los datos de la planimetría del mapa genético de suelos de Cuba a escala 1:25.000. El 43,36 % del área de estudio corresponde a suelos Ferralíticos, siendo los más extensivos en el municipio y en menor cuantía los suelos: Húmico Sialítico (27,61 %), Pardo Sialítico (9,49 %), Fersialítico (5,90 %), Poco Evolucionado (4,86 %), Fluvisol (1,94 %), Histosol (1,63 %), Ferrítico (1,43 %) y Vertisol (0,78 %).

Palabras clave: clasificación de suelos, cartografía, suelos tropicales.

INTRODUCTION

Soil mapping and soil classification at a semi-detailed scale contribute to intensive agricultural land use decisions at the level of small regions and municipalities. Studies that relate aspects of the landscape to existing soils in a region will allow efficient and economical soil investigations (1). Soil taxonomy is a powerful tool for soil quality assessments and mitigation measures (2).

Modern soil classification systems have been influenced mostly by Dokuchaev, on this basis very different systems have been developed around the world (3). The two internationally recognized soil taxonomies are *World Reference Base*, WRB (IUSS Working Group WRB, 2015) and *Soil Taxonomy*, ST (Soil Survey Staff, 2014) (4). Cuba is among the few countries that have developed their own National System for the classification of tropical soils and, throughout history, this classification has undergone several revisions and updates. In general, six versions of classification have been created in the country, published in 1970, 1975, 1980, 1988, 1999 and 2015; this last one, elaborated according to the genetic-geographical Dokuchaevian principles (5).

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Due to the fact that the surface of the different soils of the Provincial Soil Directorates of Cuba was calculated according to the 1:25,000 soil map, in which the 1975 Cuban Soil Classification was applied (48 years ago), it is of provincial and national interest to update this information by the 1999 Classification, which is much more understandable and with more information than the previous one. Taking into account the preceding considerations, this work is carried out with the objective of quantifying the surface occupied by the different groupings and genetic types of soils of the San José de las Lajas municipality, according to the Cuban soil classification of 1999.

MATERIALS AND METHODS

To carry out the work, the study was based on the planimetric data of the cartographic sheet of the soil map scale 1:25,000 of the National Direction of Soils and Fertilizers of 1990 of the San José de las Lajas Municipality, which cover a surface of 579.677 km^2. The soil classification was initially updated, contour by contour, applying the "New Version of Genetic Classification of Cuban Soils" (1999) (6). In addition, it was correlated with the international classifications: Soil Taxonomy (7) and World Reference Base (8).

Subsequently, the area (in km^2) of each contour was quantified using the planimetric method. Finally, the area occupied by each Genetic Type and consecutively by the different Soil Groupings was calculated.

It is worth mentioning that, if the analytical data of the profiles of each contour had been available, the classification and correlation of the soils would have been more precise, as well as the area occupied by each soil. In addition, the soils would have been classified according to the latest edition of the Cuban soil classification, presented in 2015.

RESULTS AND DISCUSSION

Table 1 shows the area occupied by the Soil Groupings and Genetic Types in San José de las Lajas municipality. It can be seen that in the municipality under study there are nine different soil groupings: Ferritic, Ferrallitic, Fersiallitic, Brown Sialitic, Humic Sialitic, Vertisol, Fluvisol, Histosol and Little Evolved. The most extensive soil grouping is Ferrallitic, with 43.36 % of the total territory. This result could be related to the material of origin, which in this case is limestone, since it corresponds to the fact that in this municipality the most generalized material of origin is hard limestone from the Miocene, from which a process of peniplanation occurred from the end of the Tertiary (Mio-Pliocene) during the entire Quaternary period, possibly for more than 2 million years (9).

It is remarkable that only the Ferrallitic Red Ferrallitic soil is classified and neither the Ferrallitic Red Leached soil, nor the Ferrallic soils, which undoubtedly appear in this region, were classified (10-13), but since we do not have the analytical data of the profiles by contours, it is impossible to know if the soils are leached or not, or if they are Ferrallic or Ferrallitic, as they are described in the last version of the classification of the soils of Cuba (5, 14).

Within the area occupied by soils of the Ferrallitic Grouping, an extension of 54.836 km^2 is possessed by soils of the Ferrallitic Yellowish Leached type, mainly distributed in the Santa Coloma Valley, where there is a great incidence of hydration and gleyzation processes.

It is curious in this municipality that the grouping of Sialitic Brown soils, which are the most widespread in the country with 32.9 % (9), have an extension of only 54.991 km^2 (9.49 % of the total territory), which may be due to the fact that the igneous rocks that form these soils are not very present. Rather, they are extensive in the municipality of Jaruco, in the Jaruco - Campo Florido region, where the pedinaplanation processes have led to the appearance of older rocks, typical of the platform period (of the Paleogene) that are older, but are in young reliefs in which the ferralitization process has not yet occurred (9).

It is also worth mentioning the presence of ferritic soils in this municipality, which occupies only an area of 8.276 km^2 (1.43 % of the total), associated with serpentinite rock (ultrabasic) in a possibly premiocenic relief (15).

Lithosols (4.86 %) are more extensive than ferritic soils, related to the hard limestone hills (small hummocks) that occur in ´Escaleras de Jaruco´.

Table 1. Groupings, Genetic Types and approximate area occupied by the soils of San José de las Lajas and their correlation with the Soil Taxonomy and WRB classifications

Grouping	Genetic Type	Area (km^2)	Correlation with Soil Taxonmy	Correlation with WRB
Ferritic Soils (8.276 km^2)	Dark Red Ferritic	8.276	Rhodic Eutrudox	Ferritic, Rhodic, Eutric Ferralsol
Ferrallitic Soils (268.737 km^2)	Red Ferrallitic	213.901	Rhodic Eutrustox	Ferralic, Rhodic, Eutric, Clayey Nitisol
	Yellowish Ferrallitic Leachate	54.836	Xanthic Rhodustalf	Ferralix, Xanthic, Lixic, Eutric Nitisol
Fersiallitic Soils (34.205 km^2)	Fersiallitic Reddish-brown	34.205	Oxic Hapliustept	Chromic, Eutric Cambisol
Sialitic Brown Soils (54.991 km^2)	Brown	53.425	Typic Haplustept	Eutric Cambisol
	grayish brown	1.566	Typic Dystrupept	Dystric Cambisol
Sialitic Humic Soils (160.073 km^2)	Clayey Feozem	107.455	Typic Haplustoll	Calcaric, Clayey Feozem
	Red Rendzic	52.618	Lithic Haplustoll	Rendzic, Calcaric Feozem
Vertisols (4.522 km^2)	Pellic Vertisol	4.522	Typic Hasplustert	Pellic Vertisol
Fluvisols (11.233 km^2)	Fluvisol	11.233	Typic Ustifluvent	Eutric Fluvisol
Histosols (9.463 km^2)	Fibric Histosol	9.463	Typic Haplofibrist	Fibric Histosol
Poorly Evolved Soils (28.177 km^2)	Lithosol	28.177	Lithic Ustorthent	Lithic, Skeletic Lithosol

Vertisols (0.78 %), Fluvisols (1.94 %) and Histosols (1.63 %) are not very extensive. The low presence of these groupings can be attributed to the low clayey sedimentation with Smectites, which can form Vertisols, the absence of flowing rivers in the case of Fluvisols, and of swampy regions in the case of Histosols. It should be emphasized that any research on these soils in the municipality to look for management technologies could be unsuccessful, since they are not very extensive and it is not worthwhile to invest economically in them.

Finally, it should be noted that, from the point of view of agricultural production, this municipality has a great advantage, since it has a wide extension of Red Ferrallitic soil (213.901 km^2, 36.90 % of the provincial total), which is one of the most productive soils in Cuba. However, it is imperative to deepen in the problems of the change of the properties of these soils due to the continuous cultivation, together with the climatic change that are leading to the formation of a very compact anthropogenic-climatogenic structural body, which was initially denominated as “plow floor”, but which is a neoformation from the compacted Red Ferrallitic soils (16, 17).

CONCLUSIONS

In San José de las Lajas municipality soils, the area is quantified and nine groupings and twelve genetic types of soils are classified, according to the “New Version of Genetic Classification of the Soils of Cuba” of 1999. Ferrallitic soils (43.36 %) are the most extensive and, following in descending order: Humic Sialitic (27.61 %), Brown Sialitic (9.49 %), Fersialitic (5.90 %), Little Evolved (4.86 %), Fluvisol (1.94 %), Histosol (1.63 %), Ferritic (1.43 %) and Vertisol (0.78 %).

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