Cultivos Tropicales, Vol. 45, No. 4, October-December 2024, e-ISSN: 1819-4087, p-ISSN: 0258-5936, https://ediciones.inca.edu.cu

Cu-ID: https://cu-id.com/2177/v33n4e14

Original article

Impact of the anthropogenic factor on the soil properties of "El Pitirre" Farm

Impacto del factor antrópico en las propiedades de los suelos de la Finca “El Pitirre”, Pinar del Río

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ABSTRACT: An edaphological study of "El Pitirre" Farm, in Pinar del Rio Province, was carried out by applying the genetic - geographic dokuchaevian method, with the objective of quantitatively evaluating the man impact in the change of edaphological properties to obtain basic information that allows achieving adequate yields in protein and medicinal plants, maintaining an adequate fertility in the soils. For this purpose, soil types and their distribution were diagnosed and characterized, and physical and chemical classification and analysis were carried out. The main genetic types diagnosed are Lixiviated Red Fersialitic (LRFrs) and Humic Gleysol (HG). The LRFrs soil has several subtypes; in conserved areas the LRFrs humic and mollic soil is present in the higher parts of the relief. In lower regions, LRFrs gleyic soil is formed. In addition, due to soil loss due to anthropogenic causes, the subtypes LRFrs erogenic and LRFrs erogenic and gleyic are classified. For the HG soil, the subtype HG haplic was found in the conserved areas and the HG erogenic for the anthropized areas. Two small areas were diagnosed, one of an erogenic brown soil and the other of a chromic Vertic Gleysol. The soils in general have a medium organic matter content. They have a neutral to slightly acid reaction on the surface, but become more acidic towards the middle part of the profile. They also have a very low content of assimilable phosphorus and potassium.

Key words: anthropogenic soils, soil erosion, degradation.

RESUMEN: Se realizó un estudio edafológico de la UBP “El Pitirre”, en la provincia Pinar del Río, mediante la aplicación del método genético - geográfico dokuchaeviano, con el objetivo de evaluar cuantitativamente el impacto del hombre en el cambio de las propiedades edafológicas para obtener información básica que permita lograr rendimientos adecuados en las plantas proteicas y medicinales, manteniendo una adecuada fertilidad en los suelos. Para ello se diagnosticó y caracterizó los tipos de suelos y su distribución, se efectuó la clasificación y el análisis físico y químico. Los principales tipos genéticos diagnosticados son el Fersialítico Rojo Lixiviado (FrsRL) y el Gleysol Húmico (GH). El suelo FrsRL tiene varios subtipos; en áreas conservadas se presenta el suelo FrsRL húmico y mullido en las partes altas del relieve. En regiones más bajas se forma el suelo FrsRL gléyico. Además, debido a la pérdida de suelo por causas antrópicas, se clasifican los subtipos FrsRL erogénico y FrsRL erogénico y gléyico. Para el suelo GH se encontró el subtipo GH háplico en las áreas conservadas y el GH erogénico para las antropizadas. Se diagnosticaron dos áreas pequeñas, una de un suelo Pardo erogénico y otra de un Gleysol Vértico crómico. Los suelos en general son de contenido mediano en materia orgánica. Tienen reacción de neutra a ligeramente ácida en superficie, pero resulta más ácida hacia la parte media del perfil. Además, poseen un contenido muy bajo en fósforo y potasio asimilables.

Palabras clave: suelos antropogénicos, erosión, degradación.

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Received: 18/12/2022

Accepted: 08/02/2024

Conflict of interest: The authors declare that they have no conflict of interest.

Authors' contribution: Conceptualization- Greter Carnero-Lazo. Research- Greter Carnero-Lazo, Alberto Hernández-Jiménez, Elein Terry Alfonso. **Methodology-** Greter Carnero-Lazo, Alberto Hernández-Jiménez. **Supervision-** Greter Carnero-Lazo. **Initial draft writing, final writing and editing, and data curation-** Greter Carnero-Lazo.

INTRODUCTION

Since the 1960s, a high-input agriculture began to develop in the world, which was called the Scientific and Technical Revolution in Agriculture or Green Revolution, with the aim of achieving increases in food production. This type of agriculture brought with it the excessive application of agrochemicals (fertilizers and pesticides), mechanization and irrigation, which caused major problems for the environment, mainly the deterioration of soil properties.

In 1990, during the World Soil Congress in Kyoto, Japan, Dutch specialists presented the results of the GLASOD (Global Assessment Soil Degradation) project, i.e. the Global Assessment of Soil Degradation in the World, and, as a result, awareness of this problem began to be raised. According to the results of this project, soil degradation was only 6% between 1900 and 1945, whereas after the World War (1945 to 1990), it increased considerably and reached a world average of 17 % (1).

Subsequently, during the Earth Summit in Rio de Janeiro in 1992, there was greater awareness of the disproportionate activity of man in his development, with the increase of Greenhouse Gas (GHG) emissions into the atmosphere, which is leading to Climate Change, being the problem of Land Use Change and Intensive Agriculture, together with the immoderate consumption of fossil fuels, the main causes of these environmental imbalances that today threaten health and food worldwide (2).

One of the causes of these problems is the improper management of soils, with changes in their properties due to intensive agricultural use and the change from forests to cultivated areas, and from this arises the concept of “Global Soil Changes”, which are due to the effect of Climate Change, the Concentration of GHG, continued cultivation in agriculture and the combination of the above factors (3). Human-induced processes, also called anthropic processes, lead to different transformations in soil properties, which also influence soil fertility and productivity (4).

Later, in 1997, the Kyoto Protocol was signed internationally, which deals with the reduction of GHG emissions that cause global warming, and a policy was agreed upon to reduce these emissions with programs for mitigation and adaptation to climate change.

Taking into account the above, numerous investigations have been carried out in relation to the deterioration of soil properties due to the influence of losses of organic matter and carbon, due to the management practices of a high-input and/or continuous agriculture (5-8).

It should be noted that Russian-Soviet soil science has been presenting results on the change of soil properties due to anthropogenic action for 40-50 years. This problem led to the need to include in the classification of soils the changes in their properties due to anthropogenic action, denominating soils at the subtype level as agrogenic and erogenic (9). These concepts were applied in the New Russian Soil Classification (10).

On the other hand, different soil classifications are compared in which these principles begin to be applied, such as the soil classification of Russia, China, World Reference Base and French Pedological Reference (11).

Thus, in the World Soil Classification of the World Reference Base (WRB), the agric qualifier is applied to different Soil Reference Groups with indicators of changes in soil properties due to anthropogenic action (12). In the China Soil Classification, classification categories are presented: Soil Order Anthrosol, with two Suborders, Stagnic Anthrosol and Optic Anthrosol. In addition, within these Suborders there are separate Soil Groups, four for each Suborder. Agric Subgroups are presented within six Soil Groups. For the specific case of soils under rice cultivation, there is the Antrostratic Subgroup when the properties change due to this crop (13). In the French Pedological Referential, qualifiers such as: amended, anthropic, transformed, eroded are used for different Soil Referential Groups (14).

In addition, in the Russian Soil Classification and Diagnostics with agrogenic and erogenic subtypes for different genetic types of soils, the former for changes in soil properties due to continued cultivation on flat reliefs and the latter for changes caused by erosion in soils on undulating, hilly and mountainous reliefs (10). The update of the Russian soil classification system, as a preliminary procedure for the development of its new version, proposed to expand the set of man-modified horizons by introducing technogenic horizons, to add a special chernozemic horizon (like the chernic horizon in the WRB) and, to separate the mesotrophic peat horizon from the eutrophic horizon and oligotrophic peat horizons (15).

Taking into account that soil classification criteria are beginning to be incorporated in the world due to the change of its properties by human action, the current version of the Cuban Soil Classification was elaborated, which includes subtypes of agrogenic and erogenic soils (16).

The Productive Base Unit (UBP) “El Pitirre” is one of the agricultural units that make up the Science, Technology and Innovation Entity (ECTI) “Sierra Maestra”, which is foreseen for the production of protein and medicinal plants, ostrich breeding and animal husbandry. In addition, it is evident that human action is very marked in the change of soil properties, mainly due to the fact that in this agro-ecosystem the initial vegetation was marabú (*Dichrostachys cinerea* L.) and that in the clearing to establish crops, a large part of the A horizon was lost, especially due to the conditions of the undulating hilly relief. Taking into consideration the above, the objective of this research is to quantitatively evaluate the area degraded by the anthropogenic impact on soil management in the UBP “El Pitirre” in order to obtain basic information that allows achieving adequate yields of protein and medicinal plants, while maintaining adequate soil fertility.

MATERIALS AND METHODS

The research was carried out in the UBP “El Pitirre” located in the western region of Cuba, in Pinar del Río province, 10 km north of Los Palacios municipality (between the coordinates of Latitude: 317, 319 N and Longitude: 269, 271 E, of the North Cuba System, Lambert Conformal Conic projection), in the period of February - March 2019. The interests of the UBP are the planting of protein plants (moringa, mulberry, tithonia and cratylia) for livestock feed. The promotion of plants for medicinal purposes (mulberry, stevia, Jamaica flower, acerola and turmeric); as well as the cultivation of sacha inchi. In addition, ostrich breeding and animal husbandry (poultry, rabbits, rams and buffaloes). In summary, its objective is to generate studies of plants linked to human and animal nutrition, and to the development of products of interest for the pharmaceutical, biotechnological and cosmetic industries.

For the diagnosis, seven soil profiles were taken, according to the relief forms (high, middle and low parts) in an area of 93.36 ha. The description and morphological characterization of the soil profiles was carried out according to the guidelines of the Manual for Soil Cartography and Description of Soil Profiles, as well as the classification of the degree of erosion of the area based on the intensity values presented: Very strong (loss of the A horizon and losses of the B horizon between 25-75 %), Strong (losses of the A horizon from 75 to 25 % of the B horizon), Medium (losses of the A horizon between 25 and 75 %), Little (loss of the A horizon less than 25 %) and No erosion (17).

The soils were classified according to the current version of the Cuban Soil Classification (16), since it presents, for the first time, attributes that correspond to the action of man in the change of soil properties and the World Reference Base for Soil Resources (WRB) (12).

The analyses were carried out in the soil physics and chemical analysis laboratory of the Biofertilizer and Plant Nutrition Department of the National Institute of Agricultural Sciences (INCA). The evaluations and analytical methods used were the following (18):

- Mechanical composition: by the modified Bouyoucos method, using sodium pyrophosphate to eliminate organic matter and sodium hexametaphosphate as a dispersant.
- Texture: determined using the textural triangle.
- Color: according to the Munsell Table.
- pH in water: according to the Potentiometric method, soil: water ratio 1:2.5.
- Organic matter: by the Walkley and Black method.
- Assimilable phosphorus: Oniani method.
- Assimilable potassium was calculated from the results obtained for exchangeable potassium.

RESULTS AND DISCUSSION

Soil morphological characteristics

It is important to point out that, in the formation and distribution of soils in the area under study, there are two different types of relief and soil formations. This makes it possible to differentiate two landscape forms with different soil formations: Landscape I with strongly undulating relief, with slopes of 6-12 %, dissected by some streams that cross it, and Landscape II with undulating relief forms on slopes of 2-5 % with fluvial terrace formations and elevations towards the dam.

Table 1 presents the morphological characteristics of the soils. Based on the analysis of the morphology of the profiles, four soil subtypes were classified: Fersialitic Red Leached Lixiviated Humic Mellow Red (FrsRLmh), Fersialitic Red Leached Erogenic Leached (FrsRLer), Fersialitic Red Leached Gleyitic (FrsRLg), Gleysol Humic Erogenic Humic (GHer) and Gleysol Vertic Chromic (GVc).

The Fersialitic Red Leached Lixiviated mellow humic soil (FrsRLmh): Represented by profiles 1 and 4, it is located in the high and stable part of the relief with preserved vegetation, either grassland or pasture between established groves. The topography of the surrounding terrain is strongly undulating, with slopes where both profiles were taken: less than 2 and 3 %, respectively. They have well-drained surface and internal drainage.

As can be seen in the description, these soils are of Amh-Btfrs-CRca profile or type and occupy an area of 5 ha. They are well marked reddish-brown in color in the Bt horizon and moderately deep with an underlying horizon rich in hard, rounded limestone rocks at 45-50 cm depth.

From the morphological descriptions of both profiles, it is shown that these were formed on sediments of the ancient Quaternary that was very rainy, the underlying material is hard limestone pebbles and on top of it, later transported materials were deposited with fragments of basic and ultrabasic rocks, possibly serpentinized basalt that were covered by the limestones and that come to the surface in the slopes cut by the rivers that were formed later. Independently that this is a characteristic that is diagnosed by the soil survey, in a certain way this coincides with the soil separated in the genetic map of soils of Cuba, where it is referred to as less evolved Latosolic formed of materials transported from igneous rocks (19).

According to the results of the mechanical analysis and the determination of the texture, it is presented as sandy clay loam to sandy clay loam in the A horizon and more clayey in the Bt horizon. The structure is very good in the A horizon, of the granular type, so among other characteristics it is classified as mellow (16) and red Luvisol, clayey, humic (12).

The erogenous leached red fersialitic soil (FrsRLer): It is represented by profiles 2, 5 and 6. It is located in the slope phase or in a high and stable part, under recent sowing with very little vegetation cover or it is prepared for sowing, without vegetation cover. In the process of

Table 1. Morphological characteristics of the soil profiles of the UBP "El Pitirre"

Horizons	Depth (cm)	Textural class	Structure	Color (dry/wet)	Consistency
			Profiles 1 and 4 (FrsRLmh)		
A_{11}mh	0 - 14	Sandy clay	Granular	(5YR3/3) Dark reddish brown	Friable
ABtmh	14 - 29	Clayey	Granular	(5YR3/4) Dark reddish brown / (5YR3/3 Dark reddish brown	Friable
Btfrs	29 - 41	Clayey	Small subangular blocks that disintegrate to nuciform	(2,5YR3/3) Dark reddish brown	Friable
BCgr	41 - 54	Clayey	Not defined	(2,5YR3/4) Dark reddish Brown	Compacted
CRca	54 - 69	Sandy clay	Not defined	(5YR8/2) Pink	Compacted
Rca	> 69	Not defined	Not defined	(5YR8/2) Pink	Compacted
			Profiles 2, 5 y 6 (FrsRLer)		
Aer	0 - 13	Clayey	Subangular blocks	(5YR3/3) Dark reddish Brown	Friable
B_1	13 - 24	Clayey	Subangular blocks	(5YR3/4) Dark reddish brown / (5YR4/3) Reddish brown	Compacted
B_{21}	24 - 43	Clayey	Fine polyhedral	(2,5YR3/4) Dark reddish brown / (2,5YR3/6) Dark red	Compacted
B_{22}t	43 - 71	Clayey	Polyhedral	(2,5YR3/6) Dark red / (2,5YR4/6) Red	Compacted
B_3gr	71 - 85	Clayey	Not defined	(5YR4/6) Yellowish red / (5YR4/4) Reddish brown	Slightly compacted
			Profile 7 (FrsRLer and gleyic)		
A	0 - 21	Clay loam	Granular	(10YR4/3) Brown	Friable
B(g)	21 - 40	Clayey	Subangular blocks	(10YR5/3) Brown	Slightly compacted
BCggr	40 - 46	Clayey	Subangular blocks	(10YR4/3) Brown	Compacted
Cgr	> 46	Not defined	Not defined	Not defined	Compacted
			Profile 3 (GHer)		
Aper	0 - 14	Sandy clay loam	Poorly structured	(10YR5/3) Brown / (10YR3/3) Dark brown	Friable
B(g)	14 - 29	Sandy clay	Subangular blocks	(10YR5/4) Yellowish brown / (10YR4/4) Yellowish brown	Friable to slightly compacted
C_1g	29 - 50	Clayey	Subangular blocks	(7,5YR4/4) Brown / (7,5YR4/3) Brown	Compact and somewhat plastic
C_2G	50 - 76	Sandy clay	Prismatic blocks	(7,5YR5/4) Brown / (10YR4/6) Dark yellowish brown	Compact and somewhat plastic

clearing *D. cinerea* for planting, soil losses of about 20 cm occurred, which are still evident in very recent plantations (one year or less) due to the little vegetation cover between the bushes. The topography of the surrounding terrain is strongly undulating, the slopes where the profiles were taken are: 10-12, 9-10 and 8 % respectively. They present an excessively drained superficial and internal drainage.

As can be seen in the descriptions, the slightly eroded ones are of profile or Aer-Bt-B3gr-CRca type and the strongly eroded ones are of profile or BA-Bt-Bgr-CRca type and occupy an area of 68.77 ha. They are deeper than the previous ones, reaching a depth of 80-85 cm if the B3gr horizon is included. In the results of the mechanical analysis and the determination of the texture, they have a clayey to clayey sandy horizon on the surface, which passes to a Bt horizon, with well-differentiated cutans.

Due to erosion losses, they are classified as erogenous soil subtypes. Profiles 2 and 5 are little eroded, while profile 6 is strongly eroded, as it lost a large part of the A horizon and part of the B horizon, with a BA horizon emerging at the surface. Recent studies have shown that progressive climate change and agricultural intensification accelerate erosion processes (20, 21).

Fersialitic soils are more vulnerable to erosion and degradation due to the combination of several factors, since they have been subjected to degradation processes of natural or anthropogenic origin. Their physical properties are usually affected, with effects on plant growth, yield and crop quality, increasing vulnerability to erosion. This is due to the type of clay mineral (2:1), since clays, although they are found forming soil aggregates, when wetted they expand and tend to disperse, so they are easily washed away by rainfall or irrigation water. This particularity is more accentuated when in the B horizon these soils present vertic properties, or the argillic horizon (22). In the specific case of the farm's red ferric soils, they are leached by the presence of the argillic horizon. Due to the above, these soils are easily eroded and, in this case, are eroded by anthropogenic influence; that is why they are classified as erogenic (16) and Red Luvisol (12).

Fersialitic Red Leached erogenic and gleyic soils (FrsRLer and g): They are represented by the description of profile 7 reconstructed by the micromonolith, without analytical data. They are mainly located in landscape II, on the fluvial terraces towards the dam. The topography of the surrounding terrain is undulating with formation of alluvial terraces, the slope where the profile was taken is 4 %. They have moderately drained surface and internal drainage. For their agricultural use it is important to take into account the slope, since some of them are located in the intermediate part between the slope and the lower part near the streams.

Despite the fact that this soil is located in a relatively high part of the relief there are symptoms of gleyzation in it, as a result of a formation with more influence of excess moisture than at present. This situation is changing as the relief was ascending by the neotectonic movements in the Quaternary period and does not have such a marked influence as occurs in the lower parts of the relief where the gleyzation is present.

The soil subtype Gleysol Humic erogenic humic (GHer): It is represented by profile 3, located in the lower parts of the relief. The site where the profile was characterized is planted with one-year-old mango (*Mangifera indica* L.), in poor condition as a result of poor drainage. The topography of the surrounding terrain is strongly undulating, with slopes where the profile was taken 2 %. They have imperfectly drained surface and internal drainage. As can be seen in the description, these soils are of profile or type (Aper-C1g-C2G) and occupy an area of 13.69 ha.

Their formation is conditioned to two determining factors; on the one hand, they have alluvial - deluvial transported materials, that is, it is subject to sedimentary materials and, on the other hand, they present a marked hydromorphic formation in the upper thickness of the soil at a depth of less than 50 cm. The hydromorphism is reflected by reduction, gray and greenish stains and, above all, black ferromanganic formations that, at times, are a little hardened and give it the character of Ferruginous Nodular. The soil in natural conditions was a humic haplic Gleysol (with good humification), which has been changed as a result of anthropogenesis in the clearing of *D. cinerea*, with losses of soil and organic matter, so it should be classified as erogenic subtype.

The presence of ferromanganic stains is the result of oxidation and reduction processes that occur in the soil due to poor drainage and characterizes soils that are classified as Gleysol when they occur above 50 cm depth (16) and fluvic, eutrophic Gleysol (12).

It is formed from sediments from the upper parts, so the differences in texture along the profile are due to the differentiated sedimentation of the particles from the higher parts. For this reason, the assimilable phosphorus and potassium contents are very low, as are the soils of the higher elevations (23, 24).

The pH is more acidic than in the other soils (23, 24), especially in the middle and lower part of the profile where hydromorphism is evident. This acidity is caused by the sedimentary materials of the upper parts that have a certain acidity and also by the reduction of iron due to hydromorphism. When iron is reduced, it gains an electron and causes acidity (25).

In spite of the erogenic action of *D. cinerea* in the clearing, this soil does not have a low organic matter content, since it is 3.88 % in the A horizon (23, 24), relatively high for a soil of the erogenic subtype. This shows that its initial formation was of the humic subtype and that organic matter was reduced by human action (erogenous formation). Therefore, the OCR are relatively high, with contents very close to those of the humic subtype of the Red Leached Fersialitic soils.

The soil classified as Chromic Vertic Gleysol (GVc): was identified at the end of landscape II and, towards the dam, has a vegetation of grasslands and shrubs and is characterized by a marked gleyzation and in the upper horizon has a very clayey texture rich in clay minerals of the 2:1 type, with a structure of medium prismatic blocks with sliding faces, which is identified as vertic characteristics. It presents many surface cracks due to the vertic character. It occupies an area of 2.78 ha.

This soil should not be used in the sowing of protein and medicinal plants due to the manifestation of the gleyzation process, which is negative to crops due to excess moisture in poorly drained conditions. It would be very suitable for the cultivation of flooded rice due to its capacity to retain water.

Soil classification in the study region

Table 2 shows that there are three different soil groupings in the study area: Fersialitic, Brown sialitic and Gleysols. In general, the level of erosion varies in all cases, ranging from mild to medium, due to the fact that throughout the region, most of which was previously occupied by *D. cinerea,* the clearing of this vegetation apparently led to the obvious loss of a large part of the A horizon, which was humified. In slope conditions, part of this horizon was lost by clearing and erosion, so the term erogenous applies. The same occurs in plains in soils classified as Gleysols.

This soil should not be used for planting protein and medicinal plants due to the manifestation of the gleyzation process, which is negative for crops due to excess moisture in poor drainage conditions. It would be very suitable for the cultivation of flooded rice due to its capacity to retain water.

It can be seen that the predominant soil is of the Fersialitic Grouping and within it the Leached Red Fersialitic Genetic Type, which occupies almost 80 % of the mapped territory; in second place, there is the Gleysol Grouping, with the Humic Gleysol Genetic Types (17.25 %) and a small area of Vertic Gleysol soil (2.98 %).

Under natural conditions, the interaction of soil formation factors gives rise to the formation processes of: fersialitization, leaching, gleyzation and humification, giving rise to four soil types (Red Leached Fersialitic, Brown, Humic Gleysol and Vertic Gleysol); but the clearing of natural vegetation led to the loss of much of the A horizon, not only in slope conditions but also in more stable reliefs. In other words, the anthropogenic factor originates the erogenic soil subtypes according to the 2015 Cuban soil classification (16). These occupy an area of 83.17 ha which represents 89.09 % of the total.

Therefore, when applying the 2015 version of the Cuban soil classification (Table 2) in this work, erogenous soil subtypes appear. However, this study diagnoses soils that are not found in the new version of soil classification of Cuba, nor in previous versions, such as the Fersialitic Red Leached soil type (24). In addition, the erogenous Humic Gleysol is also classified, which is not found in this classification. These aspects can enrich the classification of Cuban soils in the next update.

Impacts of human action on soil properties

In this edaphological study carried out in the UBP "El Pitirre", it is clear that human action is very marked in the change of soil properties, mainly because in this agroecosystem, the initial vegetation was of *D. cinerea*, a non-native invasive tree species, and that in the clearing to establish crops, a large part of the A horizon was lost, especially due to the conditions of the undulating hilly relief. In this sense, there are authors who suggest that man is a sixth factor in soil formation, although man actually receives the soil formed in the different terrestrial ecosystems (26-28).

In edaphological studies nowadays, the influence of man on soil properties is recognized, especially when it is overexploited for agricultural production (29-32).

In the studies carried out in this research, the loss of the A horizon could cause an alteration in the stability of microbial populations, decreasing the biological diversity that influences the reduction of environmental services such as moisture retention, water purification and carbon sequestration, in addition to favoring soil degradation, which has repercussions on its low fertility. There are authors who refer to the current state of knowledge on soil organic carbon (SOC) mineralization and sequestration in erosion sites, as well as the impacts of erosion-induced soil decomposition and aggregate formation. In addition, they provide an overview of the conceptual relationships between soil biological properties and SOC mineralization and sequestration in eroded agroecosystems (5).

When studying soil losses for the period of intensive agriculture on arable land in the forest-steppe and steppe zones of European Russia and Siberia, the results obtained constitute an example of man-made soil deterioration (33).

In the case of the area under study, in the face of degradation due to the loss of the superficial horizon, some techniques can determine the adequate management of the agroecosystem to ensure soil conservation, for example, appropriate tillage, fertilization, crop rotation and residue management; with these alternatives, the effect caused by man could then be attenuated in order to increase crop production.

Table 3 shows that the soils generally have a slightly acid reaction, with 51.43 % of the area; the predominant organic matter content is medium, with 57.68 % of the area; and very low assimilable phosphorus and potassium values, with 93.78 and 75.14 % of the area, respectively. The deficiency of these elements, as well as the tendency to acidity, are characteristics of the natural formation of the soil. However, the medium organic matter contents could be attributed to the fact that in most of the cultivated areas about 15-20 cm of the upper soil thickness has been lost as a result of the elimination of *D. cinerea*, so that high organic matter contents are not found.

Similarly, in Cuba, similar results have been obtained in Fersialitic soils on granitoids, where the change of use of *D. cinerea* ecosystems to crop systems is responsible for the loss of more than 50 % of organic carbon, decrease of assimilable phosphorus contents and total porosity. In addition, the evaluation of the soil quality index showed that there was a degradation in soil properties due to the change of use of *D. cinerea* systems for agricultural use 34.

Table 2. Classification and extent of soils in the UBP "El Pitirre"

Grouping	Genetic type	Subtype	Genre	Specie	Area (%)	% of total
Fersialitic Soil	Leached Red fersialitic	Humic and mellow	Eutric	Soft and moderately eroded Predominantly medium deep species	5.00	79.02
		Erogenic	Eutric		45.34	
		Erogenic and glyenic	Eutric	Mildly eroded	23.43	
Sialitic Brown Soil	Brown	Erogenic	Carbonated	Heavily eroded, shallow and stony	0.71	0,76
Gleysol	Humic Gleysol	Erogenic	Eutric	Mildly eroded	13.69	17,25
		Haplic	Eutric	No erosion, humified and deep	2.41	
	Vertic Gleysol	Chromic	Eutric	Deep and clayey species predominate	2.78	2,98
Total					**93.36**	**100.00**

Table 3. General chemical characteristics of the soils at "El Pitirre" farm

Property	Content	Category	Quantity of plots	Average values	Hectares (ha)	% of area
pH (H_2O)	6.1 - 6.5	Slightly acidic	21	6.3	48.01	51.43
OM (%)	3.0 - 3.9	Medium	24	3.4	53.85	57.68
P_2O_5 (mg $100g^{-1}$)	< 15	Very low	35	8.1	87.56	93.78
K_2O (mg $100g^{-1}$)	< 10	Very low	27	6.6	70.15	75.14
Total			**39**		**93.36**	**100.00**

CONCLUSIONS

Under preserved conditions the soil develops a humic and mellow A horizon. However, under cultivated conditions this type of horizon is absent, due to the erosive process that has taken place due to the partial or total loss of the A horizon as a result of the clearing of *D. cinerea*. Therefore, be careful in the process of eliminating *D. cinerea* because it can lead to the loss of the upper horizon (A) and, consequently, losses of organic matter and therefore in soil organic carbon stocks (OCS). Due to the loss of soil due to anthropogenic causes, the subtypes FrsRL erogenic and FrsRL erogenic and gleyic are classified. For the GH soil, the subtype GH haplic was found in the conserved areas and the Gleysol Humic erogenic for the anthropized areas. Soils are deficient in phosphorus and potassium contents and have a slightly acid reaction.

RECOMMENDATIONS

To take into consideration the results obtained in this research to evaluate the inclusion of a new Erosol soil grouping, as well as the genetic type of Fersialitic Red Leached and Humic Erogenic Gleysol in the next version of the Cuban Soil Classification.

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