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GENETIC PARTICULARS OF LEVIGATED CHERNOZEM IN THE NORTHERN MOLDOVA PLATEAU AREA

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Abstract

Nature gives the farmer a variety of soils in terms of agronomic fertility, depending on the type of natural vegetation. Different ways of soil formation and their fertility begin to merge into a single channel under agrocenoses due to the impact of cultivated plants on the soil and with the same direction of the biological cycle of substances. The results of research on the genetic peculiarities of leached chernozem in the Northern Plateau Area of Moldova are reported in this article. The authors describe the quality indicators of the researched soils and indicate the variety of physical, physico-chemical and chemical parameters. These soils cover an area of over 380 thousand ha. According to field research, the thickness of the humus profile is 93 cm, which is characterized as strong and deep. The results of laboratory analyzes indicate a humus content in the profile of arable leached chernozems varies from 3.90% in the Ahp horizon to the moderately humiferous class and decreases to 0.49% in the Ck horizon. Also, values of bulk density, texture, carbonates, pH, composition of exchangeable cations on the profile of the researched soil, etc. are determined. Leached chernozems are formed in the conditions of the mesophytic steppes of the forest-steppe zone. The profile is generally molic, leached, that is, completely devoid of carbonates (AmBm/l). Usually, the effervescence starts a little below the lower limit of the B horizon.

Key words*: genetic features, leached chernozem, Moldovan Northern Plateau Area.*

INTRODUCTION

The soil, according to Dokuchaev (1952) refers to open systems that exist under the conditions of an influx of matter and energy from outside. The stability of such a system largely depends on external conditions, despite the fact that soils are buffering. The soil is characterized by openness and the ability to produce bioproducts and specific organic matter, which determines its fertility. The destruction and creation of organic matter are the essence of soil formation.
A fundamentally important consequence follows from this well-known position - the ratio between the processes of mineralization and humification determines the balance in the soil. The balance of these processes reflects the essence of soil stability, and therefore the agroecosystem as a whole (Крупеников, 2005).
Involving the soil in agricultural production, man has always sought to cultivate the most valuable in terms of consumption, annual, mainly grain crops, which in turn led to soil plowing and a decrease in its fertility. The past three centuries of active land use have significantly affected the landscape: ecosystems have simplified everywhere, transforming into agro-ecosystems with a small set of cultivated and weed plants. This situation had a negative impact on the most fertile and ecologically stable soil - chernozem.
The modern development of soil science is characterized by an increase in interest in the processes of transformation of the soil cover. Soil degradation caused by agricultural impact has become one of the urgent problems of mankind (Козловский, 1991; Щеглов, 2004). Agricultural use of chernozems without appropriate compensation measures leads to significant, mostly negative changes, causes degradation and reduces fertility (Щеглов, 2004).
Long-term studies of chernozems were carried out in accordance with their agricultural use. At the same time, the route field study of chernozems was carried out on the basis of the combined use of profile-genetic and comparative-geographical methods. The obtained materials made it possible to establish

the main morphological features, to find out the spatial patterns in the distribution of chernozems and to trace their functional subordination with other soils (Гринченко, 1964).

Thus, chernozem soils, widely and for a long time used as part of arable land, deteriorate, primarily as a result of erosion, plowing and steppe processes (Лебедева, 1983; 1985; Танасиенко, 2003). Also, processes undesirable for land use are especially intensified, as is known, in conditions of monocultural (extensive) agriculture (Сиухина, 2011).

Under the influence of the washout of the upper soil horizons by melt and rain waters, the content and reserves of humus consistently decrease, its qualitative composition worsens (Танасиенко, 2003). In addition, the physical indicators of chernozems are being transformed. The content of clay and silty fractions of the granulometric composition decreases, the lumpiness of the soil structure increases, granular and lumpy aggregates are destroyed, replenishing the fraction of microaggregates due to their fragments. The number of water-resistant aggregates is reduced. Along with the deterioration of the structural state of soils, density naturally and in accordance with the degree of development of erosion processes increases, the porosity of aggregates and interaggregate space decreases and, as a result, the water permeability and water-retaining capacity of chernozems decrease (Саввинов, 1931; Сиухина, 2011).

Conducted modern research (Крупкин, 1991; Крупеников, 2000; Сиухина, 2009; 2010; 2011) confirm significant changes in morphological features, physicochemical, physical properties of chernozems during long-term agricultural use. When analyzing the literature data, the following features of the transformation of chernozem attract attention:

1. Changes in the morphological features of the soil profile.
2. Reducing the amount of humus, changing its composition.
3. Deterioration of physical and chemical properties.
4. Degradation of the structural-aggregate state.
5. Change in water-physical properties.

In different areas of the study, these changes occur differently and at different rates, which depends on the facies and provincial characteristics of the soil, the time of its use and the level of agricultural technology.

MATERIALS AND METHODS

The object of the research is a levigated chernozem from the area of the Northern Moldavian Plateau, 93 cm thick, which is characterized as strong deep, moderately humic, clay-loam. Based on the soil research, the sites of the soil profiles were established. The office work planned for the stage was carried out by applying the systemic physical-geographical methods of spatial positioning of the ground cover and the location of the profiles (Герасимов и др., 1960). Archival materials available from the Institute of Pedology were used as information "Nicolae Dimo" Agrochemistry and Soil Protection (IPAPS "N. Dimo"), its Institute of Land Use Planning and Organization (IPOT), such as digital maps of the soil cover, files of previous and recent pedological research in various fields. Morphological and analytical data on genetic horizons were introduced in the geoinformation system of the Soil Quality Database within the "Data of the Pedological Center" of IPAPS "N. Dimo" (http://gis.soil.msu.ru/soil_db/moldova/ and the SoilDB CPanel web application, http://gis.soil.msu.ru/soil_db/assessment/) of the Euro-Asian Soil Partnership under DO IT, office, field and laboratory research methods were used.

The works were carried out according to the "Methodology for the elaboration of pedological studies. Part I - Collection and systematization of pedological data. Part III - Ecopedological indicators" (Florea et al., 1987). The methods of investigations are accepted in ecopedological research.

The work program included the collection of soil samples in the field and analyzes in the laboratory, according to the methods known and widely exposed in published works: hygroscopic water - the method of drying the soil sample in the oven at temperature - 105°C for 5-6 hours; humus - Tiurin method in Simacov's modification; carbonates - gas volumetric method; adsorbed cations Ca, Mg - trilonometric method; pH, potentiometric method and other analyzes.

RESULTS AND DISCUSSIONS

Rational use of soil resources is based on detailed knowledge of the main natural and anthropogenic factors that influence their effective fertility and quality status.

The soil is a natural body, which was formed under the action of pedogenetic factors such as climate, relief, parent rocks, flora, fauna and time. Recently, the anthropogenic factor has a great influence on the properties of soils. Human society, now endowed with advanced technical means, advanced methodologies, contributes substantially to the increase or decrease of fertility.

The initiation of sustainable agroecosystems can be done by noting the factors and functional components at different levels, forms of organization and agricultural management. Research and evaluation of the fundamental component of agroecosystems - the biotope, represented by the soil, allows the identification of degradations caused by the application of agricultural technologies with the adaptation of soil remediation measures.

As a result of the work performed, new data were obtained regarding the current state of natural factors that influence the economic situation within the researched sector.

The agricultural lands that occupy the largest area of the researched territory exert an increased influence on the environment.

The results refer to the research of the ecological natural environment - the soil cover, the specificity of the clay-loamy levigated chernozems on the Northern Moldavian Plateau, a case study in Grinăuți commune, Ocnița district. In this area on the key polygon was researched profile No. 2. The profile of the arable land is located on a quasi-horizontal surface in the area of the Northern Moldavian Plateau. These soils cover an area of over 380 thousand ha. Morphometric indices include data on the thickness of soil genetic horizons. The researched arable levigated chernozem (Photo 1) are characterized by a profile of the type: Ahp1 - Ahp2 - Ah - Bhw1 - Bhw2 - BCk1 - BCk2 - Ck. In 20-30 percent of cases there are deeply leached profiles of these soils and then between the horizons Bhw2 and BCk1 the horizon BCw leached by carbonates is detected. With a humus content below 1.0% and brown color. The morphological description on the genetic horizons of the profile is given below.

Morphological description of Profile no. 2 - levigated chernozems, arable:

Ahp1 (0-29 cm) - recently dark gray arable layer with a faint brown tinge, clay-loamy, glomerular-lumpy structure, loose, very frequent medium and large pores, many organic residues, clear passage.

Ahp2 (29-37 cm) - dark gray postarable layer with a faint brown tinge, residue of the deep plowed layer in the 90^s, clay-loamy, glomerular - lumpy or prismatic, compact, medium and small pores, prismatic aggregates are very compact, no pores, frequent medium and thin roots, insect holes, clear passage.

Ah (37-51 cm) - the underlying layer of the arable, the continuation of the horizon of maximum accumulation of humus, dark gray with a slight brown hue, clay-loam, glomerular structure, weakly compact to compact, medium and small frequent pores, frequent thin roots and medium, larval nests, coprolites, gradual passage.

Bhw1 (51-71 cm) - continuation of the humiferous profile, the beginning of the cambic horizon and the transition to the parent rock after the humus content, dark brown with reddish hue, clay-loam, glomerular structure, large, compact aggregates, small and medium frequency pores, frequent thin roots, larval nests, coprolites, gradual passage.

Bhw2 (71-93 cm) - continuation of the humiferous profile, the lower part of the horizon of passage to the parent rock, brown - reddish, clay-loam, glomerular structure - poorly developed lump, compact, frequent small and fine pores, sparse thin roots, shrubs of larvae, gradual passage.

BCk1 (95-130 cm) - the upper part of the parent rock slightly modified by the pedogenesis process, yellow with a brown tinge, clay-loam, very poorly developed structure, compact, frequent fine pores, carbonates are present in the form of pseudomycella, rare roots very thin, larval nests, rarely crotovine, gradual passage.

BCk2 (130-160 cm) - the lower part of the parent rock slightly modified by the process of pedogenesis, yellow with a slight brown tinge, clay-loam, massive structure, compact, frequent fine pores, the horizon of maximum accumulation of carbonate neoformations in the form of pseudomycetes, crotovines are rare, gradual passage.

Ck (>164 cm) - yellow parent rock practically unchanged by the process of pedogenesis, compact, frequent fine pores.

The effervescence is recorded from 93 cm. In the profile of the researched soil, the carbonates are leached from the town. Ah and Bhw and accumulate in the horizon BCk and Ck, where they form an iluvial carbonate horizon.

The carbonate content in the BCk and Ck horizons varies within 10-22% (Figures 1-3).

Photo 1. Profile no. 2 of the levigated chernozem

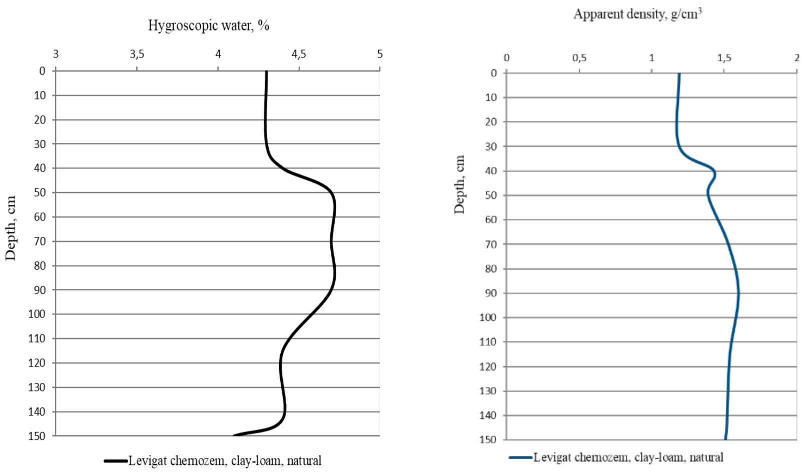

Figure 1. The values of the hygroscopic water, (%) and bulk density (g/cm^3)

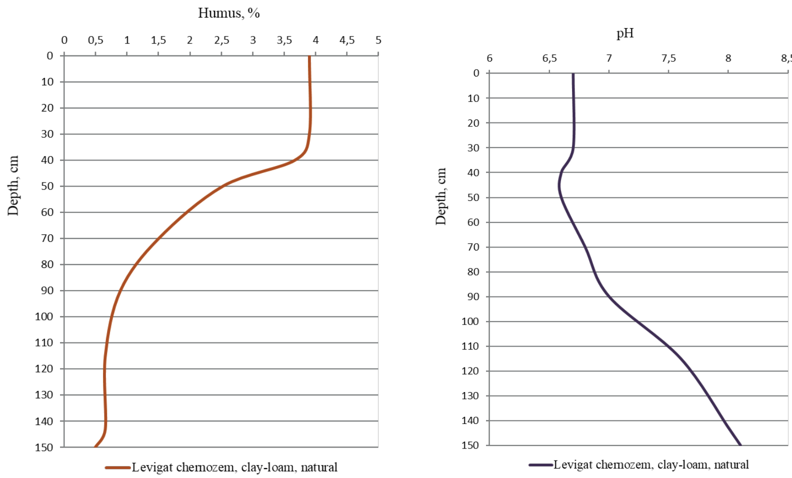

Figure 2. The values of the humus (%) and pH

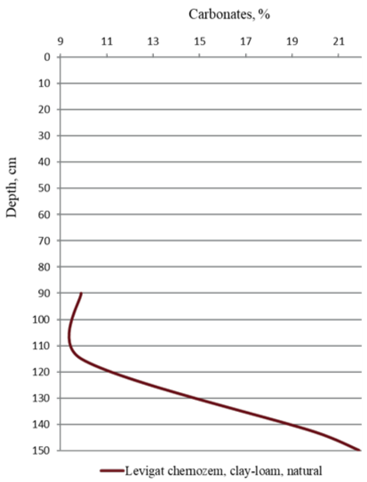

Figure 3. The values of the carbonates (%)

The thickness of the humiferous profile is 93 cm which is characterized as strong deep. The humus content in the profile of arabic leached chernozems varies from 3.90% in the Ahp horizon to the moderately humiferous class and decreases to 0.49% in the Ck horizon.

The pH values on the studied soil profile change from 6.6-6.8 with a weakly acidic reagent in the Ah and Bhw horizon, neutral 7.0 in the Bhw2 horizon, to weakly alkaline 7.6-8.1 in the BCk and Ck horizon characteristic of chernozems smooth.

The bulk density in the chernozem profile of arable leachate varies from 1.19 g/cm^3 in the arable layer to 1.60 g/cm^3 in the Bhw horizon. The arable layer is characterized by optimal values of bulk density, but the underlying postarable layer is compacted - 1.43 g/cm^3.

The composition of exchangeable cations in the adsorbent complex of the researched soils is typical for the chernozems of Moldova. The amount of exchange capacity for cations varies from 34 me/100 g of soil in the Ahp1 horizon to 27 me/100 g of soil in the Ck horizon corresponding to the large class (Table 1).

Table 1. Exchangeable cation content of the researched soils

No. profile	Name of the soil	Index	Depth, cm	Ca^{2+}	Mg^{2+}	K^+	Sum	Ca^{2+}	Mg^{2+}	K^+
				me/100 g sol				% of sum		
P2	Levigated chernozems, clay-loamy, arable	Ahp_1	0-29	29.4	4.2	0.8	34.4	86	12	2
		Ahp_2	29-37	27.8	4.1	0.7	32.5	85	13	2
		Ah	37-51	27.4	4.4	0.7	32.3	85	13	2
		Bhw_1	51-71	27.6	4.2	0.7	32.8	85	13	2
		Bhw_2	71-93	26.3	4.2	0.7	31.2	84	14	2
		BCk_1	93-115	25.2	4.0	0.7	29.9	84	14	2
		BCk_2	115-143	24.3	3.9	0.6	28.8	84	14	2
		Ck	>143	23.6	3.5	0.6	27.5	85	13	2

The researched soils are characterized by a comparatively homogeneous texture on the profile. On average, the content of physical clay is 60-62%, and of fine clay 37-39%. The high percentage of fine clay in the researched soils indicates that they have a defective object for performing the soil work. The soils are characterized by a fine medium texture and in case of low humus content they are arranged for destructuring and compaction (slitting). This phenomenon is widespread in the lower part of the arable layer (Ap2 - 29-37 cm) which is not currently plowed.

CONCLUSIONS

According to the data obtained, the humus content in the Ah horizon varies between 3.9% and 0.5% in the Ck horizon of natural soils.

The textural composition of the leached chernozem is characterized by a comparatively homogeneous texture on the profile.

On average, the content of physical clay is 60-62%, and of fine clay - 37-39%.

The high percentage of fine clay in the researched soils indicates that they have a defective object for performing the soil work.

This phenomenon is widespread in the lower part of the arable layer (Ap2 - 29-37 cm) which is not currently plowed.
The composition of exchangeable cations in the adsorbent complex of the researched soils is typical for the chernozems of Moldova.

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