

INTENSIVE AGRICULTURE INFLUENCE ON QUALITY OF TYPICAL CHERNOZEM FROM MOLDOVA

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Abstract

In the paper comparative data are presented on change the characteristics of typical chernozem influenced by intensive agriculture for 130 years. Research results have shown that the properties of typical chernozem are satisfactory. Factors limiting productivity of typical chernozem are: strong compaction postarable layer, low content of organic matter and nutrients.

INTRODUCTION

In order to assess the anthropogenic impact on the quality status of the typical chernozems from North-East part of Moldova under the influence of agriculture's conditions, in Napadova, Floresti was founded regular monitoring polygon for comment on changes over time of physical and chemical indices of these soils. The object of study is interesting in that fact, the typical chernozem on the fallow field was studied in 1877 by genetic fonder of Pedology V.V. Dokuceaev [1]. Later in 1960 these soils has been studied by I. Krupenikov, A. Ursu, in 2003 by Institute of Geography, in 2007 by the “Nicolae Dimo” Institute of Soil Science, Agrochemistry and Soil Protection [2].

MATERIAL AND METHODS

The studied soil cover is composed by typical chernozems with whole clay-loam profile. Chernozem profiles are characterized as: Ahp1-Ahp2-Ahk-Bhk1-Bhk2-Bck1-Bck2-Ck. Effervescence at the depth of 70 cm. Pseudomycelia carbonates within the 80-200 cm of profile. In the horizon Bck2 is highlighted rarely de mesh of bieloglasca carbonates. The lower part of profile (Bck) is considerable modified by krotovines.

The natural factors of soil degradation are not highlighted. Anthropogenic factors of soil degradation are: dehumification, de-structuring and strong secondary compaction of the soil postarable layer as a result of intensive agricultural exploitation, unreasonable, insufficient of soil nutrients which ensure the soil fertility.

RESULTS AND DISCUSSION

Mechanical composition of the studied soil is typical for formation of loess deposit under the common influence of the global and local process of wind deposits accumulation. The percentage of fine sand and dust in the soil is high, because these particles were made by local winds on the sand banks formed by deposits with easily texture of alluvial ancient meadow. High content of fine sand and dust of investigated chernozem is a factor both positively and negatively. Due to lower cohesion between the particles of dust and sand at the humidity of physical maturity these soils are worked comparatively easily, even if their natural structure is damaged. But loamy clays are very susceptible to compaction. Being compacted, they have big retention capacity of plant available water and lower permeability, poor aeration and less mechanical properties, in special the resistance for tillage.

The Ah subarable horizon unchanged by plowing kept natural grain-granulometric structure at good to very good quality level. This soil structure described 130 years ago V.V. Docuceaev. But this structure had a layer thickness of 60 cm. Now, as a result of agricultural use the arable and postarable layers of researched typical chernozem lost practically their natural structure.

Generally, typical chernozem is characterized by satisfactory values of physical properties, except for postarable stratum 22-36 cm, which is compacted. The state of physical quality of this layer is unsatisfactory and has a negative affect on all soil regimes. Periodic mechanical destruction of practically monolithic structure of this layer by plowing to a depth of 35 cm (depth of prevision plowing) or through polishing is absolutely necessary.

The researched soil is characterized by lightly acid reaction in Ah (pH 6.5-6.7) and weakly alkaline in carbonatic horizon (pH 7.7-8.1). These pH values can be considered as optimal for plant growth and development of culture. Distribution of carbonates in the studied soil profile is typical for chernozems. Depth of carbonates occurrence, in dependence of soil humidity regime, may be within 50-70 cm from the surface of the soil. The carbonate content varies from 5-7% in the horizon Bh2 to 13-20% in BC and C horizons (Table 1).

Mobile forms of nitrogen is contained in medium quantities in Ahp1 horizon (1.22 ± 0.42 mg/100g soil) and low in underlying horizons. Total phosphorus content of studied arable soil layer is small ($0.11 \pm 0.01\%$), the degree of assurance with mobile forms of phosphorus is low (1.2 ± 0.4 mg/100g soil). The soil studied is relatively assured in optimal mobile potassium (23 ± 1.3 mg/100g soil).

Cations exchange amount is comparatively small and consists 26-27 me/100 g in humus horizons containing more than 1.00% and 22-24 me for parental rock. Values ratio $Ca^{++} : Mg^{++}$ are within 7-8. Hydrolytic acidity is 2.6-2.3 in Ah and 1.7-1.1 me in Bhk (Table 2).

Statistical average data of humus content in the investigated soil humus layer varies from $3.25 \pm 0.14\%$ in the horizon Ahp1 up to $1.35 \pm 0.28\%$ in horizon Bh2. The comparatively low humus content for typical chernozem from Napadova commune is caused by inadequate use of intensive agriculture and sand-dust texture of soil.

Table 1

Average statistical parameters ($\bar{X} \pm s$) of physic-chemical indexes of soil

Horizon and depth, cm	pH	CaCO ₃ , %	Humus, %	Mobile forms, mg/100 g soil		
				N-NO ₃	P ₂ O ₅	K ₂ O
Ahp1 0-22	6.5±0.1	0	3.25±0.14	1.22±0.42	1.2±0.4	23±1.3
Ahp2 22-36	6.6±0.1	0	2.97±0.13	0.69±0.32	0.7±0.3	19±2.0
Ah 36-49	6.7±0.1	0	2.60±0.13	0.48±0.14	0.5±0.1	14±0.5
Bhk1 49-70	7.0±0.3	0	2.13±0.29	-	-	-
Bhk2 70-96	7.7±0.2	5.4±2.2	1.35±0.28	-	-	-
BCK1 96-111	8.0±0.2	13.0±3.8	0.86±0.08	-	-	-
BCK2 121-130	8.1±0.1	15.0±3.5	0.68±0.01	-	-	-

Table 2

Average statistical parameters ($\bar{X} \pm s$) of physical-chemical indexes of soil

Horizon and depth, cm	Ca ⁺⁺	Mg ⁺⁺	Suma	Hydrolytical acidity
	me/100g sol			
Ahp1 0-22	22.9±1.7	2.9±0.4	25.8±2.1	2.6±0.2
Ahp2 22-36	23.4±2.0	2.9±0.5	26.3±1.7	2.3±0.2
Ah 36-49	23.9±1.4	3.1±0.6	27.1±0.5	1.7±0.1
Bhk1 49-70	24.1±1.1	3.1±0.8	27.2±0.8	1.1±0.1
Bhk2 70-96	22.6±2.7	2.7±0.6	25.3±2.2	-
BCK1 96-111	21.0±2.0	2.7±0.8	23.7±1.4	-
BCK2 121-130	19.7±1.7	2.4±0.6	22.0±6.8	-

Research conducted by Dokuceaev in 1877 determined that the humus content of this soil was 5.718%. In 1960, as a result of repeated study by A. Ursu and I. Krupenikov established that the content of humus decreased to 3.675%, the losses accounted for 2.04% or 36% of initial content of humus (Table 3).

The comparison of typical chernozem humus content in the clay-loamy (almost loamy) sand-dust typical chernozem initially fallow near the commune Napadova investigated in the years 1877, 1960 and 2007 showed that the thickness of horizon A decreased in 130 years with 15 cm (from 61 cm in 1877 up to 46 cm in 2007).

During the 130 years (1877-2007) humus content in arable layer of typical chernozem in result of agriculture use fell by 2.47% or 43 percent of the initial content of fallow soil (1877), speed humus reduction was 0.019% annually.

Table 3

Morphological indexes and humus content of typical chernozems

Indexes		1877-steppe Docuceaev	1960-arable Krupenikov, Ursu	2003-arable Institute of Geography	2007-arable Institute of Pedology
Horizon, cm	A	0-61	0-44	0-50	0-48
	B	62-91	45-92	51-98	49-95
	C	92	93	99	96
	Effervescence		65	70	70
Humus, %	A 0-61	5.718%	-	-	-
	Ahp1 0-22		3.60	3.32	3.25±0.14
	Ahp2 22-36		3.30	3.15	2.97±0.13
	Ah 36-49		-	-	2.60±0.13
	Bhk1 49-70		2.73	1.94	2.13±0.29
	Bhk2 70-96		1.57	1.68	1.35±0.28

During the years 1960-2007 (47 years), humus content was reduced under the influence of intensive agriculture in this chernozem by 0.54% or 34 percent, reduction rate - 0.016% of humus annually. Humus content in the soil samples collected in 2003 and 2007 is about the same, with some minor changes.

CONCLUSIONS

1. Comparing the characteristics of the past fallow soil, studied in 1877, with the arable soil characteristics studied on the same field in 2007 gives opportunity to assess the degree of recent degradation of typical chernozem as a result of long use in agriculture. Factors limiting productivity of these chernozems are compaction of postarable layer, low content of humus and nutrients.
2. Changing the technological process of growing plants should be directed towards increasing the content of organic matter and nutrients in soil and implement a rational system of tillage would conduct in loosening of compacted soil layer. Keeping highlighted annual reduction rates of the humus content has a significant economic and ecological danger.

REFERENCES

1. Крупеников И., 1967. *Черноземы Молдавии*. Карта молдовеняскэ, Кишинев, (pp. 194-204).
2. Ursu A., A. Overcenco, I. Marcov, 2003. *Cernoziomul de la Soroca - 125 de ani după Docuceaev*. Buletinul AŞM, 2 (291), Chişinău (pp. 120-123).