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THE INFLUENCE OF SOIL TILLAGE ON THE TEXTURE OF CHERNOZEM CAMBIC FROM MOLDOVA

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Abstract

The paper aimed to present the some aspects on changing the pedomorphological and physical indicators of upper profile of cambic chernozem under soil tillage in a period of 60 years. Soil tillage have directly influence on the size composition of it's, both arable layer and in the immediate vicinity layer. Content of 1.0-0.05 mm fraction in the horizon A of fallow soil is 2.2 times higher, in horizon B - 2.5 times higher, than in arable soil. Cambic chernozem from forest belt in the fallow condition has remediated the original textural properties within a period of 60 years. Using in the arable the tillage of chernozem cambic led to argillisation of upper layer. Content of fraction <0.01 mm constitutes in the horizon A - 60.2%, in horizon B - 59.7%. Soil texture is a quality virtually unchanged, so agricultural and reclamation technologies must adapt to the textural specifics of soils. Role of the soil texture is apparent from the characterization of particle size fractions.

Key words*: arable, cambic chernozems, follow, physical properties, tillage.*

INTRODUCTION

Intensive farming of the land results in land degradation and reduction of soil production capacity. Soil tillage has the greatest influence on its physical properties. Tillage applied to the soil causing mechanical damage of soil structure and priority of macro-aggregates, which leads to changing in the volume of solid faze and porous space, which involves changing in the water and heat systems and finally on their chemical and biological properties (Budoi and Penescu, 1996).

In Republic of Moldova the soil tillage conventional system based on annual ploughing had the effect of decreasing the content and reserves of humus, through intensification of organic matter mineralization, due to increasing macro porosity of soil arable layer, reducing hydro stability of structural aggregates, increasing vulnerability to degradation by soil compaction, erosion etc. (Cerbari, 2011).

MATERIALS AND METHODS

The research was conducted on experimental fields of Institute of Soil Science, Agrochemistry and Soil Protection "Nicolae Dimo", located within the village Ivancea, district Orhei, Central zone of Moldova.

The study objects: chernozems cambic (leachate): I - fallow soil for 60 years (forest strip); II - arable soil, used under field crops.

In performing the research were used approved methods for conducting study in the field and laboratory. Description of soil profiles were made based on the pedomorphological indicators approved by methodology of pedological studies.

RESULTS AND DISCUSSIONS

Cambic chernozems from central part of Moldova are polygenetic soils of origin. Arable cambic chernozems were formed by the following pedogenesis phases: under forest vegetation → under steppe vegetation during the great migrations of people → under ploughing since 1850. In the soil forming phase under forest vegetation the combination of eluvial-illuvial process of clay migration with alteration process *"in situ"* of mineral part of these soils, led to the textural differentiation of their profile (Cerbari, 2010).

Contemporary arable cambic chernozems of Central Moldova inherited from the pedogenesis stage influenced by forest vegetation a textural differentiated profile, with high content of fine clay with predominantly colloidal fraction. In terms of the existing system of agriculture these soils have undergone to intensive dehumification and accelerated destructuration of arable layer.

High content of clay, humus content reduction and structure deterioration have accelerated the secondary compaction of arable layer. Non fertilization of cambic chernozems with organic fertilizers, inadequate use of fertilizers, strong secondary compaction of arable layer leads to decreasing in their production capacity.

In order to study comparative physical properties of cambic chernozem fallow and arable were placed two soil profiles. Period of 60 years is sufficient to restore the initial parameters of chernozems properties under steppe vegetation in the forest belts in terms of not using of grassy vegetation air mass (Cerbari, Balan, 2010).

Profile I. Cambic Chernozem clay-loamy, fallow. At the foundation of forest strips the soil was sloppy. The horizons Ahb1 and Ahb2 were formed on the basis of soil material of former arable layer, buried by sloppy at the depth of 25-60 cm. Soil performed on loess clay-loamy deposits of alluvial Pliocene-Pleistocene rocks deeper than 130 cm. Carbonates is leached from soil profile until BCk horizon, depth of 95 cm. Cambic chernozem clay-loamy, fallow 60 years, has the type of profile: Ahţ1→Ahţ2→Ahb1→Ahb2 →Bhw1→Bhw2→ BCk1→BCk2→Ck.

Profile II. Cambic Chernozem loamy-clay, arable. Profile of arable chernozem was located on the experimental field. In the 2014 on the field was sown winter wheat. After harvesting the soil was performed stubble disking at the 8-12 cm depth (agronomic operation to perform stubble-turning). Cambic arable chernozem is characterized by the profile type: Ahp1→Ahp2 →Ahb1 → Bhb2 → Bhw1 → Bhw2→BCk1→ BCk2→C. The thickness of the genetic horizons of the studied profiles is shown in Figure 1.

Soil texture. Findings of the structure is made taking into account the structural aggregates shape, their size and the structuring degree of the soil mass. Structure formation process is long and complex and is going under the action of various factors, and de-structuring process takes place under the anthropogenic influence.

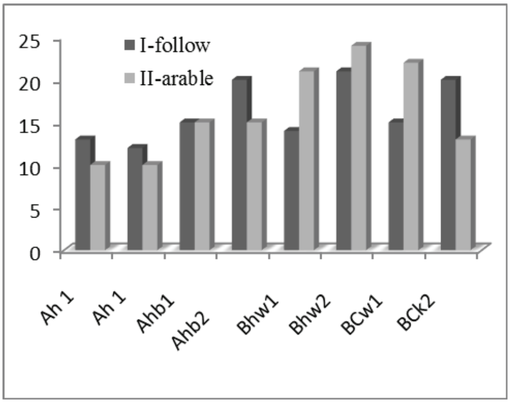

Figure 1. The thickness of the soil genetic horizons

Fallow cambic chernozem is characterized with clay-loamy texture throughout the whole profile and cambic process pronunciation in the horizons Bhw1 and Bhw2. The content of the physical clay on the soil profile ranges from 51% in the fallow layer, up to 55% in the cambic horizons and clay content at the same time - from 35% to 38%.

As a result of soil sloppy 60 years ago to the founding of forest belt, the horizon Ahp of former arable soil was buried at 25-40 cm depth, and at the land surface was removed horizon Bhw, weakly humiferous, brown colour and nuts-prismatic structure. Soil being fallow over a period of 60 years, under the influence of herbaceous vegetation has evolved in the direction of restoring the state's initial grubbing according to texture.

Arable cambic chernozems have a loamy-clay texture, the physical clay content in the humiferous profile - 60-61%, in the BC and C horizons - 56-58%. The clay content in the horizons A and B ranges between 39-40%, in BC and C - within 56-57% (Table 1).

Argillisation is a translocation process, which consists of enriching the horizon with clay formed "*in situ*" by altering the silicates primary and formation the secondary silicates or clay minerals. This process is characteristic of soils formed in the sylvo-steppe zone or forest area. From this process forms the cambic horizon, noted B.

Clay has the main role in the formation of a significant number of physical and chemical properties of soil. First, the clay content, plus the humus depends on water adsorption, cation exchange and nutrients, adhesion, plasticity, shrinkage and swelling.

Coefficient of argillisation of soil is the ratio of physical clay (<0,001) content in genetic horizons and parental rock (Крупеников, Скрябина, 1976). The coefficient of argillisation is presented in the Figure 2.

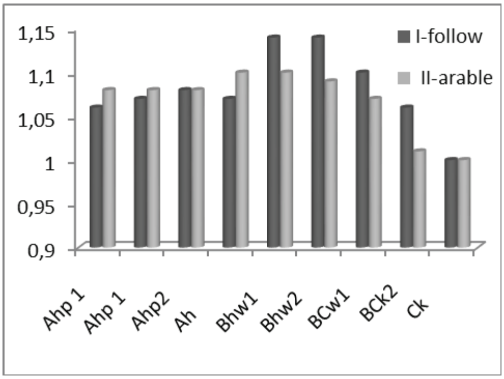

Figure 2. Coefficient of argillisation of soils

Argillisation of the upper part of these profiles is due to changes of hydrothermal regime of soils after grubbing and agricultural using in the arable land.

Texture as the main physical feature of soil plays an important role in determining of the most physical and chemical properties (Canarache, 1999). The production capacity depends on the size composition of the soil's characteristics, agronomic and ameliorative properties, and higher recovery technology. Soil texture is a quality virtually unchanged, so agricultural and ameliorative technologies will be must adapt to the textural specifics of soil. Role of texture is apparent from the characterization of particle size fractions (Canarache, 1990).

Investigated chernozems, as mentioned, are characterized by high content of fine clay which, under the processes of dehumification and destructuration of their arable layer is arranged to strong secondary compaction. Cambic chernozem compaction is a process caused by anthropogenic causes, after which greatly increases the apparent density, the total porosity and respiration indicator falls below normal values (Cerbari, 2010).

Table 1. Texture of cambic chernozems, fallow and arable

Horizon and depth, cm	Size fractions, mm; content, % g/g						
	1.0-0.25	1.0-0.05	0.05-0.01	0.01-0.005	0.005-0.001	<0.001	<0.01
Profile I. Chernozem cambic clay-loamy, fallow							
Ahţ 1 0-13	0.4	13.4	35.6	4.9	10.5	35.2	50.6
Ahţ 2 13-25	0.6	14.6	33.2	5.3	10.8	35.5	51.6
Ahb1 25-40	0.6	14.5	32.4	6.5	10.4	35.6	52.5
Ahb2 40-60	0.5	14.2	32.2	6.8	10.3	35.5	52.6
Bhw1 60-74	0.4	14.4	30.9	6.4	10.1	37.8	54.3
Bhw2 74-95	0.4	12.3	32.1	7.1	10.3	37.8	55.2
BCk1 95-110	0.5	11.9	32.5	7.7	10.9	36.5	56.1
BCk2 110-130	0.3	11.6	32.0	7.3	13.6	35.2	56.1
Ck 130-150	0.4	12.4	32.2	6.3	15.6	33.1	55.0
Profile II. Chernozem cambic loamy-clay, arable							
Ahp 1 0-10	0.7	5.1	34.0	7.5	13.5	39.2	60.2
Ahp 2 10-20	0.7	6.9	32.2	7.6	13.6	39.0	60.2
Ahp1 20-35	0.8	6.8	32.0	7.8	13.4	39.2	60.4
Ahp2 35-50	0.5	6.7	32.8	7.1	13.2	39.7	60.0
Bhw1 50-71	0.4	7.4	32.1	8.4	11.9	39.8	60.1
Bhw2 71-95	0.6	5.6	33.6	8.3	12.4	39.5	60.2
BCk1 95-117	0.5	5.1	36.0	7.7	12.0	38.7	58.4
BCk2 117-130	0.5	5.0	38.1	7.4	12.4	36.6	56.4
Ck 130-150	0.5	5.1	38.3	7.5	12.5	36.1	56.1

The main cause of the decrease the resistance to compaction of arable layer of investigated cambic chernozem is insufficiently flow of organic matter in the soil. Along 25 years in agricultural soils the organic fertilizers have not been applied. The quantities of chemical fertilizers used to fertilize crops, are small and do not provide a equilibrated balance of nutrients in the soils. Secondary production from harvesting crops usually not incorporated into the soil or used for other purposes and burned on the fields.

The clay-loamy and clay soils is characterized by large and very large amounts of inaccessible water, mechanical and thermal properties less favorable, have great capacity for swelling and shrinkage, but have favorable chemical properties (cationic exchange capacity, high buffering and humus content). Other features of these soils vary considerably depending on their structural status.

The production capacity of soils with fine textures, depending on the circumstances described above, varies generally, from medium to small. These soils must be worked in optimal epoch, which is short, are generally receptive to deep tillage, seedbed required quality is achieved with greater difficulty than other soils. Hence, that arable cambic chernozems researched are a means of production in agriculture fairly difficulties.

A long-term favorable state of the physical quality of the soil arable layer can be created by a permanent flow of organic matter in degraded soils and creating a system of minimal tillage.

CONCLUSIONS

The degradation process of soil structure affects mainly the upper horizon, the one used for agricultural cultivation. Degradation occurs mechanically by tillage, influencing some morphological and physical properties. The tillage layer 0-35 cm of arable cambic chernozem on the experimental field, under the action of the soil tillage and other human activity has degraded over a period of 60 years; the structure was destroyed, the resistance for compaction was lost.

The measures that can be taken regarding degradation properties of soils counteract the negative effects of different agricultural practices. The most used measures to improve the soil texture are agricultural tillage at optimal humidity, remediation of degraded physical properties, and application of mineral and organic fertilizers, combating degradation processes of arable soils.

ACKNOWLEDGEMENTS

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