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# ASSESSMENT OF THE GENETIC CONDITION OF THE ORDINARY CHERNOZEM IN THE AREA OF THE STEP OF THE SOUTH PLAIN, IN NATURAL AND AGRICULTURAL REGIME

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***Abstract***

*Chernozems have been and will continue to be the main base of agricultural production. The statements of the founder of soil science, Dokuchaev V.V., that chernozems are and will be the breadwinner and the main breadbasket of mankind, remain truly modern. Fertile chernozem is the main base for agricultural and crop production. Soil scientists consider it the main granary of mankind, the king of soils). The main purpose of the research is the comparative analysis of the genetic peculiarities of chernozems evolved in natural and arable regime, the appreciation of the indices modified by the agropedogenetic process in the Steppe Area of the Southern Plain of the Republic of Moldova. In the laboratory it was determined: the hygroscopic water content, the density of the solid phase of the soil; particle size and microaggregate composition; hygroscopicity coefficient; humus content; carbonate content; soluble salt content; current reaction (pH); the content of exchangeable cations, etc. A detailed study of morphogenetic properties showed that chernozems under natural vegetation have: a powerful, well-developed soil profile; dark, almost black color, gradually weakening with depth; a well-defined granular structure in most of the humus strata; weakly compacted composition, gradually increasing in the lower horizons; the absence of noticeable signs of eluvial-illuvial differentiation of the soil profile; uneven, lingual boundary of the transition of the humus horizon into the parent rock; the presence of a carbonate horizon, confined, as a rule, to the lower boundary of the humus stratum and characterized by various forms of carbonate neoformations. The thickness of the natural soil profiles (profile 13) and arable soil (profile 14) up to the parent rock varies from 160 cm to 151 cm accordingly and is certified as strong deep. The soil corresponds to the non-carbonate class, the carbonates being absent in horizon A. The maximum content of carbonates is registered in the BC horizon and constitutes 11.9% in the natural one and 10.7% in the arable one.*

***Key words***: *ordinary chernozem, genetic condition, natural and agricultural regime, Steppe Area of the Southern Plain.*

## INTRODUCTION

It would be a huge mistake to think that soil fertility is constant over time, that it is a certain statistical value. Generalizations made in different countries confirm that the condition of the soil cover has deteriorated in the last decade. Every educated person understands that to obtain today's crops, nutrients were used that accumulated in the soil after the mineralization of plants growing on them and from other sources over several millennia. We are pleased with the growth in yields, but along with the growth in yields, soil depletion also increases, which is associated with an increase in the removal of nutrients from it. In the minds of many people, including experts in the field of agriculture, there is an opinion about the extremely high fertility of chernozem soils. This idea has evolved over the centuries. But chernozem soils contain in their composition a relatively small amount of mobile forms of nutrients (Виноградов, 1969).

The significance of chernozem is far from being exhausted solely by its agricultural value. Chernozem soil is an excellent habitat for a huge variety of animals, plants, microorganisms. Therefore, the degradation, and even more so the destruction of chernozems, leads to a reduction in the biological diversity of the living world of the Earth, to the irretrievable loss of part of its genetic fund, created by the evolution of life on our planet over many millennia (Афанасьева, 1966; Докучаев, 1952; Савич, 2014).

Compared to other types of soils, chernozems are characterized by an ideal balance of all factors of soil formation. However, despite the natural perfection, chernozems inevitably evolve under the influence of natural and, especially, anthropogenic factors. It is assumed that the increasing anthropogenic load on soils will lead to qualitative and quantitative changes in the state of chernozems. In this regard, knowledge of the direction of changes in the modern soil-forming process is undoubtedly relevant. Without this, it is difficult to imagine the future state of not only soils, but nature as a whole (Лыков, 1985; Шевченко, 1984).

In arable chernozems, a significant transformation of the morphological and morphogenetic properties of soils is noted. Changes here acquire a directed, irreversible character. At the first stages of development, these transformations are localized in the upper part of the soil stratum; subsequently, they spread in depth, covering, depending on the duration of soil use, the entire profile (Докучаев, 1952; Шишов et al., 2004).

Morphological features of soils reflect the intensity of processes and regimes occurring in soils. However, at present they do not have an exact quantitative assessment, the relationship between them is not described by certain mathematical equations. This reduces the accuracy of assessing the fertility and degradation of soils by their morphological properties, reduces the objectivity of assigning soils to certain types and taxonomic units of a lower hierarchical level (Байбеков, 2007; Орлов, 2001; Савич, 2006).

In modern agriculture, the most important task is to preserve and expand the reproduction of soil fertility. It is due to the fact that the intensification of agriculture is accompanied by an increase in crop yields, which dramatically increases the removal of nutrients from the soil, increases the decomposition of humus, and reduces its content and soil fertility (Гришина, 1973; Лыков, 1985; Шевченко, 1984). Humus is the most important indicator of soil fertility, a source of nutrients for plants.

In the practice of soil science, the humus content and its constituent components are generally expressed as a percentage of the soil mass. However, this indicator does not reflect the peculiarities of the agricultural use of soils, primarily because of the unequal, often significantly different, values of their bulk density. As a result, for a correct and reliable comparison of genetically similar soil varieties in the virgin-arable land system, it is necessary to operate with data on humus reserves, the calculation of which takes into account not only changes in the humus content, but also the density of soil composition. With long-term plowing of chernozems, the humus content decreases, but their bulk density increases markedly. Therefore, real (in terms of reserves, t/ha) and apparent (in % of mass) humus losses in soils during their long-term plowing can differ significantly. However, at present, there is not enough data in the scientific literature on a comparative assessment of the long-term dynamics of the humus of agrochernozems, expressed as a percentage of the soil mass and reserves in t/ha (Сапожников, 1994; Шишов et al., 2004).

The plowing of virgin chernozems on upland and their long-term agricultural use is accompanied by a significant decrease in the humus content within a 1.5-meter soil layer. At the same time, the most noticeable losses of humus occur in the upper part of the humus horizon of soils, and further down the profile, the differences gradually smooth out. Thus, in the 0-10 cm layer of arable chernozems, compared to virgin areas, the humus content decreased by 2.15-2.35%, or in relative units, by 25-26%. Thus, plowing and long-term agricultural use of ordinary chernozems in agricultural production leads to dehumification.

## MATERIALS AND METHODS

The ordinary chernozem research was located in Cahul district, Ursoaia village under steppe vegetation. These soils occupy an area of about 650 thousand ha. The pedological study in the field was carried out by placing two main soil profiles (profile 13 - natural and profile 14 - agricultural). From the soil profiles, 12 samples identified on genetic horizons were taken for laboratory analysis. 2 geodetic pickets were fixed for the spatial positioning of the soil profiles. The works were carried out in the WGS-84 coordinate system, later transferred to the national coordinate system MoldRef-99. The actual material was obtained by averaging large arrays of stock, literature and own experimental data for each taxon. Only sections laid down in landscape and ecological conditions typical for chernozem formation were taken into consideration, namely: upland areas of watersheds; automorphic conditions of soil formation; well-preserved meadow-steppe vegetation, rich in species composition; carbonate loess-like rocks, clayey and heavy loamy granulometric composition; absence of visible signs of manifestation of erosion processes.

According to the pedagogical district, the researched territory falls within the Southern Plain Steppe Zone (III), the Bessarabian Southern Plain Steppe district (13) with carbonate and common chernozems. Through field pedological research, laboratory and office work, it was found that the soil cover on the researched sector is represented by the subtype of clay-clayey carbonate chernozem on clay, natural (profile 13) and clay-clay carbonate chernozem on clay, agricultural (profile 14). 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). 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.

## RESULTS AND DISCUSSIONS

Thus, as a result of modern agricultural use in chernozems, the following phenomena are observed:

1. Transformation of the humus profile, which manifests itself in a change in color, thickness, content and quality of humus;
2. Transformation of the carbonate profile, fixed in a change in its thickness, depth of occurrence, forms of newly formed carbonates, and the nature of migration processes;
3. Formation of neohorizons of agrogenic nature: compacted ("plow sole") - in the lower part of the arable layer, textured clayey - in the sub-humus part, iron segregation zone - in the lower part of the profile;
4. Changes in the structural organization of the humus strata of the profile, manifested in the deformation of the shapes, sizes, faceting of peds, their packaging, etc.;
5. Transformation of the composition of the soil mass, expressed in a change in the density of the composition, the density of the solid phase of the soil, porosity, etc.;
6. The appearance (especially in old-arable chernozems) of silty-clay-humus film formations - cutan on the faces of peds in horizons AB and B.

Profile no. 13 were placed under shrub vegetation. The object is located on a quasi-horizontal terrain with a degree of inclination of up to 1 ° (Photo 1) at an altitude of 170.4 m on a south-westerly exposure. The effervescence is recorded from 47 cm. The morphological description of the profile is presented below.

Photo 1. The profile of the ordinary chernozem (natural)

Morphological characteristic of Profile no. 13. Ordinary chernozem:

***Aț (0-8 cm)*** - gray, dry, loose, glomerular-grainy structure, finely porous with very frequent pores, abundant shrub and grassy roots, clay-loamy texture, gradual passage.

***A (8-47 cm)*** - gray color with a brown tinge, dry, compact, glomerular structure, fine porous with very frequent pores, grass roots and trees, clay-loamy texture, clear passage.

***B1k (47-64 cm)*** - brown, dry, compact, glomerular-lumpy structure, porous with frequent pores, pseudomycelias, shrub roots, clay-loamy texture, clear passage.

***B2k (64-96 cm)*** - dark yellow, dry, compact, massive lumpy structure, fine and frizzy pores, carbonate pseudomycelias, crotovina, roots, clay-loamy texture, clear passage.
***B2kCk (96-160 cm)*** - yellow with white, dry, compact, unstructured, finely porous, pseudomycelias and carbonate concretions, beloglasca, roots, clay-loamy texture, clear passage.
***Ck (160-175 cm)*** - yellow, dry, compact, unstructured, roots, clayey texture.
Profile no. 14 was placed on a quasi-horizontal ground with a degree of inclination of up to 1 ° (Photo 2) at an altitude of 170.7 m with a south-western exposure. The category of land use is agricultural. The effervescence on the profile appears from 48 cm.

Photo 2. The profile of the ordinary chernozem (agricultural)

The morphological description of Profile no. 14 ordinary chernozem (agricultural) is presented below.
***Ap (0-31 cm)*** - gray color, dry, loose, glomerular structure, fine porous with very frequent pores, roots, clay-loamy texture, clear passage.
***A (31-48 cm)*** - gray color with a brown tinge, dry, slightly compact, glomerular-Bulgarian structure, fine porous with frequent pores, roots, clay-loamy texture, clear passage.
***B1k (48-66 cm)*** - brown, dry, compact, glomerular-lumpy structure, porous with frequent pores, pseudomycelium, roots, clay-loamy texture, clear passage.
***B2k (66-93 cm)*** - dark yellow, dry, compact, lumpy structure, fine pores and freckles, carbonate pseudomycetes, crotovina, roots, clay-loamy texture, clear passage.
***B2kCk (93-151 cm)*** - yellow with white, dry, compact, unstructured, finely porous, pseudomycelias and carbonate concretions, beloglasca, roots, clay-loamy texture, clear passage.
***Ck (151-170 cm)*** - yellow, dry, compact, unstructured, roots, clayey texture.
The thickness of the natural soil profiles (profile 13) and arable soil (profile 14) up to the parent rock varies from 160 cm to 151 cm accordingly and is certified as strong deep. The soil corresponds to the non-carbonate class, the carbonates being absent in horizon A. The maximum content of carbonates is registered in the BC horizon and constitutes 11.9% in the natural one and 10.7% in the arable one.
After morphogenetic characterization, the state of natural soil settlement is loose at the surface and compact in depth, with glomerular-grainy and grainy structure in horizons A, followed by glomerular-lumpy and lumpy structure in horizon B, and in the horizon and transitional horizon solification (C) is unstructured. In the profile of agricultural soil, the state of settlement is loose on the surface, compact in depth. The arable profile has a glomerular structure in the first horizon, glomerular-lumpy to the B1k horizon, lumpy in B2k and unstructured in depth.
The thickness of the humus layer places soils in the class with a strong deep humus profile (96-93 cm). The humus content in the natural surface layer is 6.26%, which corresponds to the humiferous class, moderately humiferous (3.25%) for horizon A.
At a depth of 96 cm it decreases to 1.35% and at a depth of 0.88-0.36%. The humus content in the Ap horizons of the agricultural profile has a moderately humiferous class containing 3.12%. For horizons A and B1k it varies between 2.87% and 2.31%. At a depth of 93 cm the content decreases to 1.33% and at a depth of 0.66-0.57%.
The apparent density in the natural soil varies from 1.11 g/cm$^3$ in the superficial horizon the value increasing in depth up to 1.46 g/cm$^3$, and in the agricultural one 1.14 g/cm$^3$ in the arable horizon increasing in depth up to 1.44 g/cm$^3$. The natural soil in the first two horizons has a neutral current reaction at (pH ($H_2O$) = 7.10),

and at a slightly alkaline depth at (pH ($H_2O$) = 8.05-8.35). The agricultural soil in profile has a low alkaline current reaction (pH ($H_2O$) = 7.67-8.30).

The physical, physico-chemical and chemical parameters of the researched soils are shown in Figures 1-3.

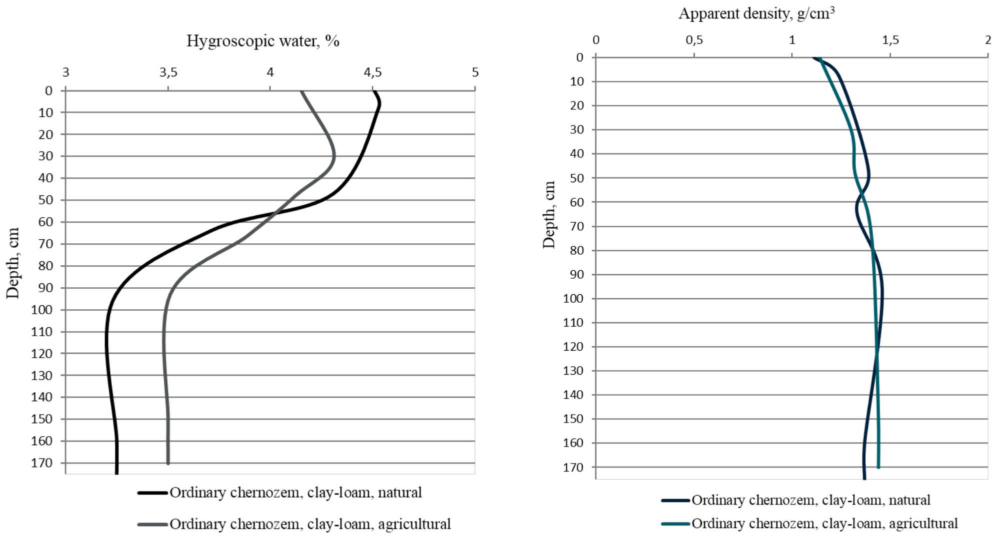


Figure 1. The values of the hygroscopic water, (%) and bulk density (g/cm$^3$)

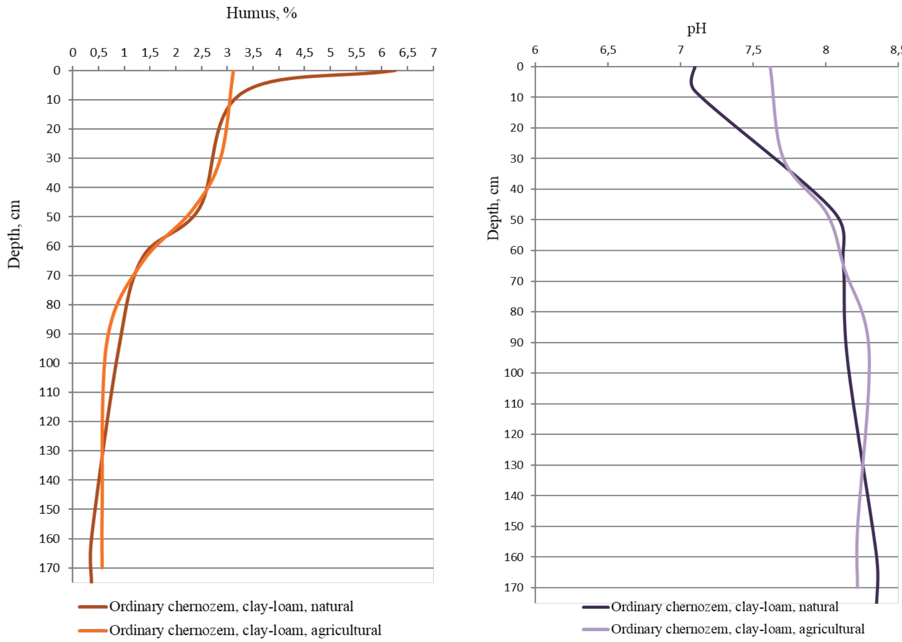


Figure 2. The values of the humus (%) and pH

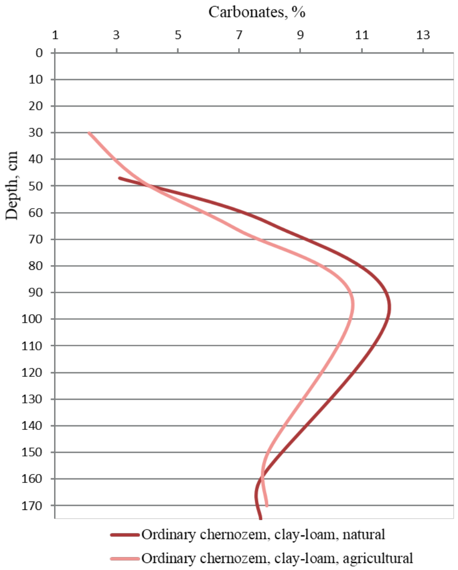


Figure 3. The values of the carbonates (%)

The sum of exchangeable cations varies on the natural profile from the large class (∑cat. 32.32-30.26 me/100 g soil) in the Aț, A and middle horizons (∑cat. 16.64-22.34 me/100 g soil) in depth. Arable soil corresponds to the large class (∑cat. 28.94-26.93 me/100 g soil) in the first two horizons Ap and A and middle (∑cat. 15.87-20.62 me/100 g soil) in depth. The adsorbent complex of the soil has the degree of calcium saturation 88-72% in profile 13 and 87-77% profile 14, the relative magnesium content is 12-25% and 12-21% respectively, and the exchangeable sodium makes 1-2% for both profiles. The soils are unaltered, and the ratio of calcium to magnesium is 7:1 in the first two surface horizons for both profiles (Table 1).

Table 1. Exchangeable cation content of the researched soils

| No. profile | Name of the soil | Index | Depth, cm | $Ca^{2+}$ | $Mg^{2+}$ | $Na^{+}$ | Summ | $Ca^{2+}$ | $Mg^{2+}$ | $Na^{+}$ |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | me/100 g soil | | | | % of summ | | |
| P13 | P13 Ordinary chernozem (natural) | Aț | 0-8 | 28.21 | 3.94 | 0.17 | 32.32 | 87 | 12 | 1 |
| | | A | 8-47 | 26.53 | 3.56 | 0.17 | 30.26 | 88 | 12 | 1 |
| | | B1k | 47-64 | 18.76 | 3.41 | 0.17 | 22.34 | 84 | 15 | 1 |
| | | B2k | 64-96 | 12.90 | 3.34 | 0.40 | 16.64 | 78 | 20 | 2 |
| | | BCk | 96-160 | 12.62 | 4.51 | 0.39 | 17.52 | 72 | 26 | 2 |
| | | Ck | 160-175 | 12.36 | 4.15 | 0.39 | 16.9 | 73 | 25 | 2 |
| P14 | P14 Ordinary chernozem (agricultural) | Ap | 0-31 | 25.29 | 3.48 | 0.17 | 28.94 | 87 | 12 | 1 |
| | | A | 31-48 | 23.42 | 3.34 | 0.17 | 26.93 | 87 | 12 | 1 |
| | | B1k | 48-66 | 17.09 | 3.36 | 0.17 | 20.62 | 83 | 16 | 1 |
| | | B2k | 66-93 | 13.30 | 3.42 | 0.41 | 17.13 | 78 | 20 | 2 |
| | | BCk | 93-151 | 13.04 | 3.44 | 0.42 | 16.90 | 77 | 20 | 2 |
| | | Ck | 151-170 | 12.17 | 3.28 | 0.42 | 15.87 | 77 | 21 | 3 |

The dry residue from natural profile 13 includes values of 0.039-0.052%, and in profile 14 agricultural it increases varying between 0.066 and 0.073%. All the highlighted horizons are free of soluble salts. The anionic part is clearly predominated by $HCO_3^-$ with a content of 0.22-

0.90 me/100 g and $SO_4^{2-}$ with 0.07-0.34 me/100 g, and in the cationic part of $Ca^{2+}$ and $Mg^{2+}$ with a content of 0.38-0.60 and 0.07- 0.30 me/100 g accordingly. The chemistry of the surface soil layer is sulfate-hydrocarbonate/ carbonate in the surface layers and hydrocarbonate/carbonate in depth (natural profile) and for the arable one hydrocarbonate-chloride-sulfatic/carbonate (see Table 2).

Table 2. The chemical composition of the aqueous extract of the researched soils

| No. profile | Name of the soil | Index | Depth, cm | Dry residue, % | $HCO_3^-$ | $Cl^-$ | $SO_4^{2-}$ | $Ca^{2+}$ | $Mg^{2+}$ | $Na^+$ |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | me/100 g soil | | | | | |
| P13 | P13 Ordinary chernozem (natural) | Aț | 0-8 | 0.048 | 0.30 | 0.13 | 0.34 | 0.60 | 0.12 | 0.05 |
| | | A | 8-47 | 0.039 | 0.22 | 0.08 | 0.29 | 0.48 | 0.07 | 0.04 |
| | | B1k | 47-64 | 0.04 | 0.48 | 0.10 | 0.11 | 0.38 | 0.27 | 0.04 |
| | | B2k | 64-96 | 0.042 | 0.52 | 0.09 | 0.07 | 0.58 | 0.04 | 0.06 |
| | | BCk | 96-160 | 0.048 | 0.50 | 0.10 | 0.18 | 0.55 | 0.14 | 0.09 |
| | | Ck | 160-175 | 0.52 | 0.55 | 0.08 | 0.24 | 0.45 | 0.30 | 0.12 |
| P14 | P14 Ordinary chernozem (agricultural) | Ap | 0-31 | 0.067 | 0.42 | 0.23 | 0.18 | 0.68 | 0.11 | 0.04 |
| | | A | 31-48 | 0.066 | 0.48 | 0.26 | 0.15 | 0.72 | 0.11 | 0.06 |
| | | B1k | 48-66 | 0.071 | 0.52 | 0.21 | 0.30 | 0.79 | 0.19 | 0.05 |
| | | B2k | 66-93 | 0.073 | 0.53 | 0.23 | 0.35 | 0.92 | 0.13 | 0.06 |
| | | BCk | 93-151 | 0.067 | 0.48 | 0.24 | 0.23 | 0.70 | 0.20 | 0.05 |
| | | Ck | 151-170 | 0.072 | 0.48 | 0.26 | 0.42 | 0.90 | 0.19 | 0.07 |

The texture of the natural soil in the Aţ horizon is loamy (physical clay content 39.24%), followed by clay-loamy (physical clay content 47.14-51.51%), and in the parent rock loamy (physical clay content 42.83%). In the arable one up to the Bck passage horizon, the textural class is clay-clay with a physical clay content varying from 47.8% to 50.70%. In the parent rock it is clayey, the physical clay content is 44.00% (Tables 3 and 4).

Table 3. Soil texture

| Horizon | Depth, cm | Content of fractions (%) with diameter (mm) | | | | | | | Kd |
|---|---|---|---|---|---|---|---|---|---|
| | | 1-0.25 | 0.25-0.05 | 0.05-0.01 | 0.01-0.005 | 0.005-0.001 | <0.001 | ∑<0.01 | |
| P13. Ordinary chernozem (natural) | | | | | | | | | |
| Aț | 0-8 | 8.09 | 15.03 | 37.64 | 6.61 | 4.76 | 27.87 | 39.24 | 4 |
| A | 8-47 | 0.48 | 7.57 | 44.52 | 8.31 | 11.00 | 28.12 | 47.43 | 4 |
| B1k | 47-64 | 0.17 | 8.00 | 44.69 | 6.53 | 12.51 | 28.10 | 47.14 | 4 |
| B2k | 64-96 | 0.12 | 5.37 | 43.00 | 7.72 | 18.97 | 24.82 | 51.51 | 9 |
| BCk | 96-160 | 1.31 | 7.52 | 41.10 | 9.42 | 14.69 | 25.96 | 50.07 | 10 |
| Ck | 160-175 | 0.29 | 8.70 | 48.10 | 7.53 | 10.66 | 24.64 | 42.83 | 9 |
| P14. Ordinary chernozem (agricultural) | | | | | | | | | |
| Ap | 0-31 | 0.6 | 7.6 | 45.9 | 10.2 | 8.2 | 27.5 | 45.9 | 6 |
| A | 31-48 | 0.3 | 9.2 | 44.7 | 8.1 | 9.7 | 28.0 | 45.8 | 7 |
| B1k | 48-66 | 0.2 | 4.3 | 44.7 | 8.3 | 14.2 | 28.2 | 50.7 | 7 |
| B2k | 66-93 | 0.3 | 8.3 | 42.8 | 8.4 | 11.4 | 27.5 | 48.7 | 7 |
| BCk | 93-151 | 0.2 | 7.4 | 45.2 | 9.0 | 12.1 | 26.8 | 47.2 | 7 |
| Ck | 151-170 | 0.3 | 8.2 | 47.4 | 7.5 | 9.1 | 27.4 | 44.0 | 6 |

Table 4. Microaggregate composition of the soil

| Horizon | Depth, cm | Content of fractions (%) with diameter (mm) | | | | | |
|---|---|---|---|---|---|---|---|
| | | 1-0.25 | 0.25-0.05 | 0.05-0.01 | 0.01-0.005 | 0.005-0.001 | <0.001 |
| P13. Ordinary chernozem (natural) | | | | | | | |
| Aț | 0-8 | 8.58 | 41.71 | 37.76 | 5.29 | 3.51 | 1.15 |
| A | 8-47 | 0.59 | 32.53 | 46.94 | 7.72 | 9.02 | 1.16 |
| B1k | 47-64 | 0.26 | 38.89 | 43.46 | 6.40 | 7.97 | 1.02 |
| B2k | 64-96 | 0.31 | 36.45 | 40.40 | 7.56 | 13.01 | 2.27 |
| BCk | 96-160 | 1.39 | 28.07 | 45.56 | 8.59 | 10.68 | 2.71 |
| Ck | 160-175 | 0.52 | 29.63 | 51.30 | 5.70 | 7.55 | 2.30 |
| P14. Ordinary chernozem (agricultural) | | | | | | | |
| Ap | 0-8 | 0.7 | 30.2 | 51.9 | 9.1 | 6.5 | 1.6 |
| A | 8-47 | 0.2 | 28.4 | 52.4 | 8.9 | 8.1 | 2.0 |
| B1k | 47-64 | 0.1 | 25.7 | 51.1 | 10.9 | 10.1 | 2.1 |
| B2k | 64-96 | 0.2 | 26.9 | 51.3 | 8.6 | 11.1 | 2.0 |
| BCk | 96-160 | 0.2 | 30.6 | 55.0 | 7.6 | 5.7 | 1.9 |
| Ck | 160-175 | 0.2 | 31.1 | 54.4 | 7.2 | 5.8 | 1.7 |

As is known, particles of silt and coarse dust predominate in the composition of the granulometric fractions of these varieties. Then, in descending order, follow: fine, medium dust and fine sand fractions. The absolute minimum falls on coarse and medium sand. In the genetically conjugated series from podzolized to ordinary chernozems, a heavier particle size distribution is clearly seen, accompanied by an increase in the content of silt, fine dust and a decrease in the amount of coarse silt particles. As a result, in this series there is a change in the ratio of the two dominant fractions: silt and coarse dust. In ordinary chernozems, silty and then coarse silt particles predominate.

Inside the profile distribution of these fractions is characterized by an increase in the proportion of silt and a relative decrease in the silt fraction from top to bottom. The noted quantitative changes in the content of fractions in the series under consideration are due, in our opinion, to differences in the intensity of the soil-forming process and the migration of silt along the profile. This is confirmed by the data on the granulometric composition of arable chernozems, where the balance of silt in relation to the parent rock is even more shifted to the negative side compared to virgin analogues.

The use of chernozems in agricultural production leads to an increase in the proportion of aggregates over 10 mm, a decrease in granular and dusty fractions, and a decrease in the water resistance of structural elements. In general, the analysis of the physical and water-physical properties of virgin and arable chernozems showed that there is a correlative relationship between the humidization of the water regime and the deterioration of the physical properties of chernozems.

Studies of the hydrological regime have established that in virgin chernozems, the greatest amount of moisture, as a rule, is observed in the spring after snowmelt. During the growing season, moisture consumption by virgin vegetation is carried out mainly from the upper meter layer, where the greatest seasonal changes in humidity are observed. Summer precipitation mainly moistens the uppermost soil layer to a depth of 20–30 cm.

In arable chernozems, the water regime develops differently. In the first half of the growing season, the change in humidity in arable chernozems is quite close to that in chernozems under natural vegetation.

Differences are observed in the second half of summer. During this period, on the virgin lands, the vegetation continues to vegetate and, consequently, consume moisture, while on the arable land, the desuctive consumption of moisture stops after harvesting and it is lost from the soil only as a result of physical evaporation. “Underutilization” of moisture at the end of summer, as well as a lower consumption by cultivated vegetation during the growing season, determine here the annual increment of moisture in comparison with the steppe by an average of 20–40 mm with a fluctuation range of 10–140 mm.

The annual underutilization of moisture leads to an increase in the depth of spring moisture and more frequent through wetting of the soil profile than on virgin lands. i.e., the water regime of arable chernozems, although it remains periodically leaching, is shifting to a more humid side in terms of quantitative indicators. In the steppe chernozems - ordinary chernozems - shifts towards the humidification of the water regime during plowing are even more pronounced, due to the fact that the place of xerophytic steppe vegetation is occupied by mesophytic cultivated plants.

## CONCLUSIONS

Under the influence of long-term cultivation of ordinary chernozems, processes of anthropogenic degradation develop in them. The properties of old-arable ordinary chernozems are currently deteriorating significantly.

Degradation processes are clearly diagnosed by morphological changes in the structure, overconsolidation, deficient balance of macro- and microelements, erosion and other characteristics.

Given that at present the use of organic and mineral fertilizers is carried out in minimal volumes, it is not necessary to expect a significant improvement in the agrophysical and agrochemical properties of soils under modern conditions.

To stop the further development of the soil dehumification process, it is necessary to use crop residues and straw as organic fertilizers as widely as possible, as well as introduce green manure fallow and post-stubble green manure into production.

The texture of the natural soil in the Aţ horizon is loamy (physical clay content 39.24%), followed by clay-loamy (physical clay content 47.14-51.51%), and in the parent rock loamy (physical clay content 42.83%). In the arable one up to the Bck passage horizon, the textural class is clay-clay with a physical clay content varying from 47.8% to 50.70%. In the parent rock it is clayey, the physical clay content is 44.00%.

The dry residue from natural profile 13 includes values of 0.039-0.052%, and in profile 14 agricultural it increases varying between 0.066 and 0.073%. All the highlighted horizons are free of soluble salts. The anionic part is clearly predominated by $HCO_3^-$ with a content of 0.22-0.90 me/100 g and $SO_4^{2-}$ with 0.07- 0.34 me/100 g, and in the cationic part of $Ca^{2+}$ and $Mg^{2+}$ with a content of 0.38-0.60 and 0.07-0.30 me/100 g accordingly. The chemistry of the surface soil layer is sulfate-hydrocarbonate/carbonate in the surface layers and hydrocarbonate/carbonate in depth (natural profile) and for the arable one hydrocarbonate-chloride-sulfatic/carbonate.

It has been established that the structure of the soil cover of the studied area is composed of ordinary chernozem, medium-thick, medium-humus, ordinary chernozem, medium-thick, low-humus, ordinary calcareous, medium-thick, low-humus.


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