

CURRENT STATE OF HUMUS IN ARABLE CHERNOZEMS OF MOLDOVA

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Abstract

The paper aimed to present current state of humus in arable typical chernozems from the Republic of Moldova. They occupy a significant area in the country's land fund, about 70%. The research was conducted in the North of Moldova. Typical chernozems in natural state are the most fertile soils from our country. They have a very deep humus profile. Soils in natural state are very rich in humus that decreases gradually with depth, in our case from 6.86% in upper horizon to 0.12% in Ck horizon. Humus reserves of typical fallow chernozem are 472 t/ha in humiferous profile.

Long-term involvement in agriculture, furthermore, insignificant and insufficient fertilization with organic fertilizers since '90 years, led to their degradation and negative humus balance. According to our research, these soils lost about 2.12% of humus from 0-25 cm layer that represents 34 percent from its initial amount. Humus reserves of arable typical chernozem decreased by 52 t/ha in comparison with fallow soil.

Analysis of humus composition of researched soils revealed that fallow and arable typical chernozems possess humus of humate type that is characteristic for this soil type. Therefore, agricultural use did not change the humus type of soils.

Key words: humus, humic acid, fulvic acid, soil quality, typical chernozem.

INTRODUCTION

The main natural resource of the Republic of Moldova is soil cover. In its composition, chernozems are predominant soils (70%). Inefficient use of these resources has led to degradation of physical, physico-chemical and biological properties of soils used in agriculture.

In the last 20 years, the amount of organic fertilizers introduced into the soils reduced dramatically. As a result, humus balance in arable soils became negative. Humus reserves reduces annually by 1 tonne per hectare (Ursu, 2015).

At the same time, humus plays an essential role for soil fertility, soil water and air regimes, soil properties such as structure, bulk density, porosity; it is the main source of nutritive elements for plants growing etc.

In this context, the paper presents a study of humus state of typical chernozems in the Northern part of the Republic of Moldova in order to reveal actual problems and find possibilities of its remediation.

Typical chernozems occupy 282,000 ha or 8.34% of the territory of the country. The characteristic areal of the soils is northern part

of Moldova (forest-steppe region) with altitudes about 180 - 200 m, but also they are found in the central part of Moldova with altitudes 160 - 220 m (Ursu, 2011).

MATERIALS AND METHODS

The research was conducted in the Northern part of the Republic of Moldova – the region characteristic for typical chernozems, with moderately warm, semi humid climate, number of sunny days per year – 290 - 300, average annual temperature – 8 - 8.5°C, average annual precipitation – 550 - 600 mm, evaporability – 700 - 800 mm, growing season – 167 - 176 days.

The object of study was arable loamy-clayey typical chernozem used in agriculture for a long time (Figure 1). Coordinates of the main soil profile: latitude - 47°51.288'; longitude - 27°073', absolute altitude - about 212 m.

Arable soil was compared with a fallow chernozem never used in agriculture, situated on a slope about 5 - 10 (Figure 2). Coordinates of the main soil profile: latitude - 47°51.313'; longitude - 27°45.266', absolute altitude – 176 m.

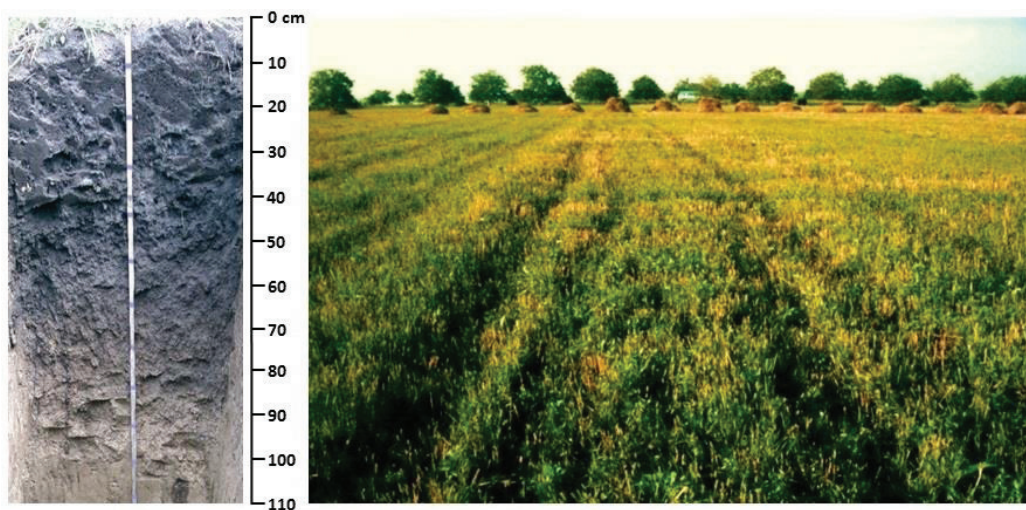


Figure 1. Soil profile of arable loamy-clayey typical chernozem and its agroecosystem

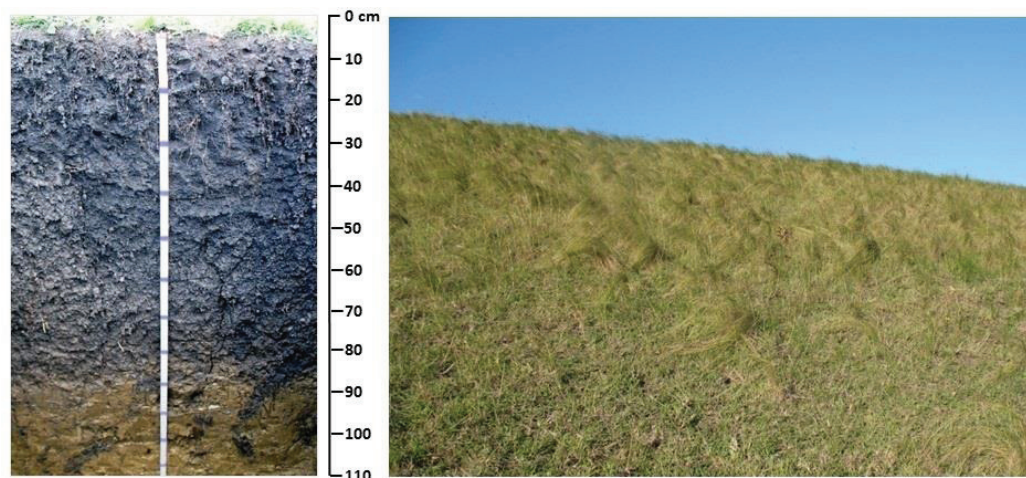


Figure 2. Soil profile of fallow loamy-clayey typical chernozem and its natural ecosystem (steppe)

In the field, for each studied variant, were set up five profiles in the form of a square with sides of 50 m with a main profile in the center and four secondary profiles at the peaks of the square.

Laboratory tests were performed according to the standard methods approved in the Republic of Moldova: particle size analysis by Kacinski method; organic matter content by Tiurin method; humus reserves by calculus; soil bulk density by core method. Humus composition was determined in two characteristic profiles of arable and fallow chernozems by Kononova and Belicikova method.

RESULTS AND DISCUSSIONS

Natural conditions in the North of Moldova contributed to formation of very rich, fertile soils in this area – typical chernozems.

Typical chernozems in natural state are characterized by a high humus content and a thick humus-rich profile.

Arable typical chernozem studied in the research was formed on loamy-clayey loess deposits and inherited their loamy-clayey texture from mother rock (Figure 3).

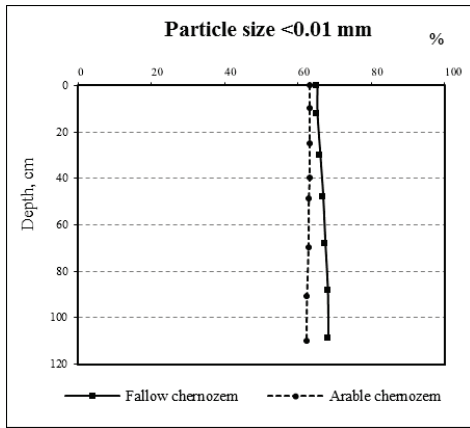


Figure 3. Soil texture of arable and fallow chernozems

Fallow typical chernozem also formed on loamy-clayey loess deposits up to 80 - 90 cm, situated deeper on compacted marine clay. That specific feature influenced thickness of soil profile in negative way, as a result it is by 3 - 4 cm thinner than at arable soil and makes in average 88 cm.

Arable typical chernozem is characterized by a very deep humus profile, with an average thickness of 91 cm (Figure 4).

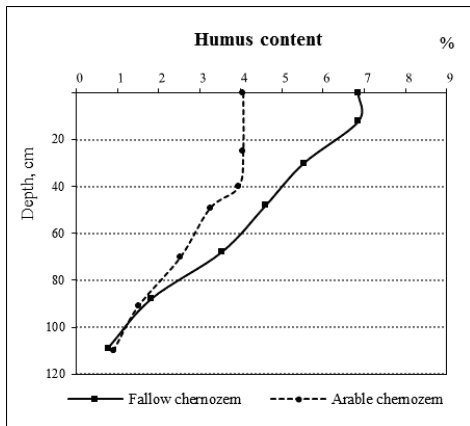


Figure 4. Humus content in arable and fallow chernozems

Variation curve of humus content corresponds to the soil type (Figure 4). Humus decrease in soil profile is gradual: in arable chernozem from $4.05 \pm 0.13\%$ in Ahp1 layer to 0.46% in Ck horizon; in fallow chernozem from $6.86 \pm 0.57\%$ in Aht1 horizon to 0.12% in Ck horizon.

Because of use in agriculture, arable typical chernozem lost 2.12% of humus from 0 - 25 cm layer or 1.60% from 0 - 50 cm layer. Humus content in the 0-25 and 0 - 50 cm layers of arable soil, compared to the fallow soil, reduced respectively by 34 and 29 percent from initial amount.

According to the classes of humus content used in the Republic of Moldova (Andries, 2007), humus content in the layers 0 - 25 cm and 25 - 50 cm of arable chernozem is moderate. Fallow chernozem is characterized by high humus content in upper horizons.

Humus reserves in soil humiferous profile (soil horizons with humus content higher than 1%) of fallow chernozem are 472 t/ha. It should be remarked that 67% of humus reserves are concentrated in the first 50 cm of typical chernozems. Long-term use of arable chernozem in crop rotations with a high proportion of row crops and the lack of organic fertilizers conducted to decrease of humus reserves in soil humiferous profile. Now humus reserves of arable chernozem are 375 t/ha, that is 52 t/ha lesser in comparison with the fallow soil. It is not possible to determine exactly the period of time when arable chernozem from our research lost that amount of humus. But it is known that since 1990 the amount of organic fertilizers introduced into the soils of our country decreased dramatically and since 1993 humus balance in soils is negative (Cerbari, Taranu, 2015).

Analysis of humus composition of researched soils (Table 1) reveals that fallow and arable typical chernozems possess humus of humate type (the humic acid/fulvic acid ratio > 1), that is characteristic for this soil type.

Therefore agricultural use did not change the humus type of soils.

The obtained data are similar with results obtained by Evdokimova's and Tișchina, 1999 and Cernova et al., 2003.

Comparatively small value of ratio HAs: FAs in Aht1 horizon (0-10 cm) of fallow typical chernozem can be explained by the presence in this layer of a large amount of organic matter half humificated with a higher content of fulvic acids.

Table 1. Humus composition of fallow and arable typical chernozems

Genetic horizon and depth, cm	Total C, %	Humic substances	Humic acids (HAs)	Fulvic acids (FAs)	Humin	HAs:FAs
Arable loamy-clayey typical chernozem						
Ap1 (0-21 cm)	2.30	<u>1.11</u> 48.3	<u>0.73</u> 31.8	<u>0.38</u> 16.5	<u>1.25</u> 51.7	1.9
Ah (40-49 cm)	1.80	<u>0.82</u> 45.6	<u>0.51</u> 28.3	<u>0.31</u> 17.3	<u>0.98</u> 54.4	1.7
Bh1 (49-70 cm)	1.50	<u>0.63</u> 42.0	<u>0.39</u> 26.0	<u>0.23</u> 16.0	<u>0.87</u> 58.0	1.7
Fallow loamy-clayey typical chernozem						
Aht1 (0-10 cm)	3.58	<u>1.71</u> 47.8	<u>1.02</u> 28.5	<u>0.69</u> 19.3	<u>1.87</u> 52.2	1.5
Aht1 (10-30 cm)	3.14	<u>1.40</u> 44.6	<u>0.88</u> 28.0	<u>0.52</u> 16.6	<u>1.74</u> 55.4	1.7
Ah (30-50 cm)	2.48	<u>1.09</u> 44.0	<u>0.67</u> 27.0	<u>0.42</u> 17.0	<u>1.38</u> 56.0	1.6
Bh1 (50-70 cm)	2.06	<u>0.93</u> 44.2	<u>0.57</u> 27.7	<u>0.36</u> 16.5	<u>1.13</u> 55.8	1.6

CONCLUSIONS

Typical chernozems of the Republic of Moldova have a very deep humus profile. Soils in natural state are very rich in humus that decreases gradually with depth, in our case from 6.86% in upper horizon to 0.12% in Ck horizon. Humus reserves of typical fallow chernozem are 472 t/ha.

Long-term involvement of soils in agriculture in combination with lack of organic fertilizers

conducted to decrease of humus content in arable soils. Arable typical chernozem lost 2.12% of humus from 0 - 25 cm layer, that represents 34 percent from its initial amount. Humus reserves of arable typical chernozem decreased by 52 t/ha in comparison with fallow soil.

Humus composition was not affected by use in agriculture and significant changes were not registered.

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