

Soils of Polissia Opillia (loessial islands) with humus degraded arable layer under wood plantings

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The purpose. To draw attention to dark soils with *humus degraded* arable layer. To study regenerative process of natural properties of degraded chernozem with ancient *humus degraded* arable layer on loessial rocks under the influence of phytomelioration. **Methods.** Field, morphological-genetic, comparative-analytical, agroanalytical. **Results.** Dark soils with *humus degraded* arable layer are described. They are not reflected in materials of past diagnostic study of soils of Ukraine though contain in tillable layer of humus horizon on 20 – 30% less humus than in under-arable. It is shown that degraded chernozem with powerful, fertile, mycorrhized turfy-humus horizon generated under 70-years broad-leaved wood plantings. However the deep ploughing of soils on loessial islands with non-resistant humus which is easily mineralized, has led to humus degradation of arable layer. On an instance of detailed profiling of degraded chernozem with ancient *humus degraded* arable layer on loessial breeds they described influence of broad-leaved woody vegetation on restoration of its primary (natural) properties. It is offered to include into the new nomenclature list of soils of Ukraine soils with *humus degraded* horizon. Use on such soils of specific agrotechniques and their cartographical reflection is also justified. **Conclusions.** *Humus degraded* arable layer, which has originated in some soils of Polissia loessial islands under the influence of deep plowing, rebuilds under broad-leaved wood plantings very slowly — within many decades. In farming agriculture on such soils it is necessary to take special measures enriching their humus by the use of organic fertilizers, green manure crops, etc. These soils should also be reflected in map materials.

Key words: *humus degraded plough layer, Opillia, loessial islands, Polissia, phytomelioration.*

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Introduction. By studying the dark-colored soils of the loessial islands in Polissia (the soils of the forest-steppe Opillia) us were found and studied among the backgrounds chernozems leached and podzolic chernozem with a humus-degraded arable layer, inherited from the deep plowing in the past. Morphologically, this layer is clearly distinguished (especially in a dry state) from illumination. Such soils are confined to flat-level terrain, with barely noticeable small grooves and small hollows, that is, to the places of the largest flushing and thus the formation of less stable, labile humus.

Unfortunately, they remained left unattended in general survey and mapping of the soils of Ukraine from 1957 to 1961 and their later correction, they are not reflected in the last list of soils - in the Field Identifier of Soils of Ukraine, 1981. There are no Chernozems with a humus-degraded horizon. on the ground plans of farms, although they have large areas and require some kind of improvement.

An analysis of recent research and publications on the topic under study. These soils are characterized by increased and high acidity, higher unsaturation on the calcium and magnesium, in comparison with chernozems leached and podzolic chernozem, contain in the upper layer 1,5-3% less fraction 0,001 mm [1, 2].

The profound loosening that was practiced in prewar and postwar years, caused increased aeration, activating microbiological processes and, consequently, more intensive mineralization of humus. This horizon has a depth of 25 - 32 cm, containing 20-30% less humus than below the arable horizon. By the

way, the him L.P. Rubtsova [3] defined in the northern dark-colored soils of Russia as the second humus, relic horizon. But it is separated by a line of plowing. so the location is associated with plowing.

They are particularly widespread in the most humid Novgorod-Seversky Opil and on north in Mglinsk (Belarus). In the latter, they were described by Ya. N. Afanasyev [4], coinciding with the numerous, in this flat-level region, the closed depressions. Widespread soils with degraded arable layer (gray forest soils) in Volodymyrsky (Yurii-Poland) Opilia in Russia [5].

The purpose of research — to draw attention to dark-colored soils with humus-degraded arable layer, which are not reflected in the materials of the past survey of soils of Ukraine, although they contain in the arable part of the humus horizon 20 to 30% less humus than below the arable horizon. By an example of a detailed analysis of the profile of chernozem podzolized agro-forest with a long-lived humus-degraded arable layer on the loessial rocks, it was decided to carefully study the influence of broadleaf tree vegetation on the long-term restoration of its primary (natural) properties.

Objects and methods of research. The work was carried out in July 2017. The object of research is the black soil of podzolized agro-forest on light loams with ancient humus-degraded arable layer on the loessy rocks. The pit is located within the warm Chernigov Opilia, in 5 km from the eastern outskirts of Chernihiv, aligned with barely visible small grooves of the plateau of the right shore of the valley of the Desna River, 145 m above sea level, the forest protection strip, Oak (*Quercus robur* L) about 70 years old, 1st grade bonite, single robinia pseudoacacia (*Robinia pseudoacacia*) and birch (*Betula verrucosa* Ehrh.), Herbal cover is sparse. 51.558207 N, 31.331779 E.

Description of profile: **H₀**, 5 - 0 cm — semi-decomposed oak leaves. **H_d**, 0-16 cm - sod-humus, dark gray, fresh, powdery-grainy-lumpy, intensely permeated mycorrhiza, powdery-lumpy, loose, transition is short. **He**, 17 - 30 cm — humus weakly eluviation, markedly lit dark-gray, fresh, powdery-lumpy, noticeable horizontal divisibility, light loams, separated from the lower ancient arable line and noticeable degradation of humus, obtained under the influence of long-standing use in arable land with deep plowing. **Hie**, 31 - 46 cm — humus with signs of illusion and eliuovovannosti, noticeable horizontal division, a little darker than the previous, fresh, powdery-lumpy, loose-buckthorn, short transition. **NRi**, 47-62 cm. **Rhipf**, 63-84 cm. **P**, 85-130 cm. The bleached-browned-felled breed with a single, thin pseudophyberum, is a leached loessed loam.

Samples from depths 0 - 16, 17 - 30, 35 - 45 cm were taken from 4 digging points (pit + 3 half a pits), the table shows the average data.

Laboratory tests were carried out according to standard methods in the approved laboratories of the Kharkiv branch of State Institution «Soils ProtectionInstitute of Ukraine» and of the National Scientific Center «Institute of Soil Science and Agrochemistry Research named after O. N. Sokolovskyi». The granulometric composition by method of the pipette in modification Kachinsky, the humus was determined according to DSTU 4289: 2004, the hydrolytic acidity by the Kappen method in modification CINA0; pH - in aqueous suspension, pH saline and exchange cations - by CINA0 methods. Movable forms of phosphorus and potassium in chernozems were determined using the modified Chirikov method (DSTU 4115-2002 - Soils); Nitrogen that is easily hydrolysed - by the Kornfield method.

Research results.

As we can see from the description of the soil profile under the 70 years old broadleaf forests formed a powerful fertile mycorrhizal sod-humus horizon. But despite this, the lower lighted part of the humus-degraded arable layer is preserved. In general, the profile has a typical eluvialn-ileuvialn differentiation for chernozems of podzolized . A feature is the lower part of the illuvial horizon imbued with black pseudophybrs. Such pseudophytes, according to our observations, in contrast to the typical rusty-ohrists, inherent in the podzolic process, are commonly characteristic ofr arable the closed depressions and small grooves of loessial islands. In them, labile humus is formed and its vertical movement is

observed. This process is not related to forest vegetation, but is borned by activated restorative processes in conditions of enhanced moisture.

Laboratory and analytical data are presented in the table. It can be seen that the humus content is confirmed by the presence of past losses of humus in the newly formed sod-humus horizon. We observe it at a depth of 17 - 30 cm, in the lower part of a aforetime arable horizon. That degradation is already largely offset by the long-standing phytomeliorative effect of broadleaf forest vegetation. Now the difference between the deep layer, untouched by anthropogenic influence, is only 0.4%. According to our earlier studies [1, 2], losses in arable land wich degraded arable layer make up 0.9-1.5%, or 21-32% of the total.

At the same time, along with the above agrarian-forest soils in the forest protection strip, the content of humus is also determined in the arable land. In the upper humus-degraded layer 0 - 28 cm, it was 21% less than below the arable horizon.

Table. Physico-chemical and agrochemical indices of chernozem of podzolized agrarian-forest with the ancient humus-degraded arable layer

Genetic horizons	Depth, cm	Humus, %	Fiz. clay, %	pHwater.	pH salt	exchange-absorbed		Hydrolytic acidity	Saturation on the cations, %	N by Korn fildom	P ₂ O ₅	K ₂ O
						Ca ²⁺	Mg ²⁺				moving	
						mg-eq /100 g soil				mg/kg soil		
Chernozem podzolized agro-forest with a long-lived humus-degraded arable layer on the loessial rocks (70-year-old the forest protection strip)												
Hd	0-16	5,0	22,7	5,4	4,6	9,1	0,94	6,8	59,5	205	85	205
He	17-30	2,4	21,2	5,5	4,5	7,8	0,77	6,6	56,6	137	37	109
He(i)	35-45	2,8	19,4	5,5	4,6	10,4	0,76	7,0	60,2	141	39	45
Phi	50-60	1,4	22,4	5,6	4,5	8,3	0,44	4,6	65,4	-	-	-
Phpf	70-80	0,5	25,3	5,7	4,0	-	-	-	-	-	-	-
P	100-110	-	14,3	5,8	4,0	-	-	-	-	-	-	-

Hence, deep plowing of soils in loessial islands with unstable humus, which is relatively easy to mineralize, in the past caused great negative consequences. Lost amount of humus under the influence of phytomelioration can be restored only after many decades. Such soils should be distinguished and it is necessary to concentrate on them in agrotechnologies certain measures for the restoration of humus content. Therefore, we consider that the proposed inclusion of varieties with humus-degraded horizons in the northern forest-steppe landscapes of the Polissya loessial islands is proposed in the new nomenclature list of Ukrainian soils. Especially since soils with lighted humus and degraded arable layer occur in oral reports and in the Chernivtsi wet at Carpathian forest-steppe.

By values of pH under the forest protection strip, the general high acidity remained, and the level of hydrolytic acidity increased markedly (by 1.5 mg-eq). Almost twice increased the number of movable potassium (the effect of high acidity), significantly decreased the content of phosphorus. The latter is obviously due to the cessation of phosphorus fertilization within the forest protection strip.

At the end, note near the soil with a clearly-lit, degraded horizon, which we find in arable land, meet under the forest protection strip, and, of course, manifests itself and less noticeable morphologically degradation. Such soils do not distinguish among the backgrounds, because there is no point in developing a special agrotechnology for them.

Conclusions

Humus-degraded arable layer, which emerged in some soils of the Polissya loessial islands under the influence of deep plowing, is restored under broad-leaved forest plantations very slowly over many decades. In agriculture on such soils, it is necessary to concentrate special measures on their enrichment with humus. These soils should be displayed on cartographic materials.

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