

## Change of organic matter of recultivated soils at long agricultural use

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**The purpose.** To determine influence of duration agricultural use of technogenic soils, formed of potentially fertile rock formations, upon rates humus accumulation. **Methods.** Field, laboratory. **Results.** At long agricultural use of recultivated lands the basic process of pedogenesis is accumulation of humus which speed depends on edaphic characteristics of technogenic soils, bioclimatic potential of terrain, and saturation with phytomelioration agro-ecosystems. **Conclusions.** The amount and quality of plant residues arriving in technogenic soils is the basic power and matter material for humification and accumulation of humus. The speed-up of processes of accumulation of humus is possible owing to saturation of crop rotations with perennial legume and legume-cereal agro-ecosystems.

**Key words:** *recultivation of lands, technogenic soils, accumulation of humus, phytomelioration.*

**Actuality.** It is well-known that humus is a colossal biological battery of solar energy and a depositor of biofilic elements, which leads to the defective properties of the soil and, above all, to the fertility [2, 3, 4]. Therefore, the study of factors influencing changes in the state of organic matter, its transformation into humus, as well as the ability to control these processes, are important theoretical issues of soil formation [5, 6]. Particularly relevant they acquire during the reclamation of technogenically disturbed lands on the stagesformation of young soils from different varieties of lithogenic composition of potentially fertile rocks, which, when mining methods are applied to the daily surface and become maternal rocks of modern soilogenesis.

**The purpose of the study** - in the conditions of a long-term field experiment, is to determine the factors that determine the amount of organic matter entering the techno-sciences formed from potentially fertile rocks of different lithological composition for their long-term agricultural use, as well as to study the processes of humus accumulation and transformation of phytomass plants into organic matter on the first stages of biological development of reclaimed soils.

**Object and methods of research.** The research was carried out at a research centre of land reclamation, near the city of Ordzhonikidze of the Dnipropetrovsk region (Southern Steppe). In many years of field stationary experiments during 1971-2015 biennium on three models of technozems, formed: 1- forest-like loams; 2 - a mixture of red-brown clay and loam; 3 - gray-green marl clay, the same method studied the productivity of agrocenoses with different alternatives alternating agricultural crops over time. Edaphic characteristic of the investigated models of technozems is given in publications [6, 7]. Annually records of the above-ground phytomass amount of organic matter entering the techno and is the main source of replenishment of organic matter. Variants of experiment had the following alternation of agricultural crops over time:

- agrosuccession 1 - alfalfa sown 4 years → spring barley → sandstone 5 years → spring barley → bean-cereal mix 9 years → pure soil → winter wheat → bean-cereal mix 23 years;

- agrosuccession 2 - alfalfa sown 4 years → pure soil → spring barley → spring barley → pure soil → winter wheat → spring barley → pure soil → winter wheat → spring barley → corn → peas → spring barley → peas → spring barley → peas → spring barley → pure soil → winter wheat → winter wheat → bean-cereal mixture 22 years.

That is, in agro-succession 1 over 45 years, perennial bean and bean-cereal agrocenoses were grown for 41 years (91% of the time), another 3 years (7%) - annual grain crops, one year, technozems were

clean soil (2% ) In agro-succession, the ratio of agrocenoses was as follows: perennial bean grasses and leguminous grass mixtures - 26 years (55% of the time), annual grain and leguminous crops - 15 years (35%), pure steam - 4 years (10%). Thus, the significant difference between the variants of the experiment (agro-successions) is their saturation with perennial bean and bean-and-cereal agrophytocenoses, which have a much larger phytomelioration effect in comparison with one-year agrocenoses, especially cereal crops.

In the experiments were used methods commonly used in soil science. For analytical studies, individual samples were taken from three sections of the section in layers 0-5, 5-20, 20-40 sm according to generally accepted methods described in the literature and in accordance with DSTU 4287: 2004, DSTU ISO 10381-1: 2004, DSTU ISO 10381 -2: 2004, DSTU ISO 10381-3: 2004, DSTU ISO 10381-4: 2005. In samples of rocks, the granulometric composition was determined (DSTU 4730: 2007); the content of general humus by the Tyurin method in Simakov's modification (DSTU 4289: 2004). The content of energy in the organic matter of technosms was determined by GOST-147-74. The calculation of the phytomass of agrocenoses was carried out by Dospikhov [8].

**Research results and its discussion.** Having the results of the productivity of phytomassia-agrocenoses for the 42-year period of agricultural development of technosemes, it became possible to determine changes in the content of humus in various technosomes since the time of their formation - "zero-moment" in soil-genesis -1971 year. Data on the yield of phytomass agricultural crops from the beginning of the biological development of technosms (for the period of 1971-2009) are given from works [9,10].

According to the data of the table № 1, the total productivity of phytomassia-agrophytocenoses (overground and underground phytomass) during the period of their biological development substantially depended on both agro-succession and the substrate from which the technology was formed. In order to study the process of humus accumulation, we primarily are interested in the performance of underground phytomass (the mass of roots) as the main source of fresh organic matter and energy in technosomes

In agro-succession, where perennial agrocenoses (agrosuccession 1) prevailed, the amount of root mass was significantly higher in comparison with agro-succession 2 on all studied models of technos. In the 45-year period, this difference ranged from 46.6 to 48.9 t / ha depending on the technosome, indicating that it is possible to control the process of humus-accumulation by selecting plants with a pronounced phytomelioration capacity.

**Table 1. Productivity and energy content in phytomass of agricultural crops since the beginning of biological development of technosies (1971-2015).**

Variant	Total productivity, t/ha			Accumulated Energy kj/ha		
	overground phytomass	underground phytomass	Total	overground phytomass	underground phytomass	Total
Technosem, formed from loamy loam						
1	127,2	223,1	350,3	2226	3904,3	6130,3
2	122,4	174,2	296,6	2142	3048,5	5190,5
Technozem, formed from a mixture of red-brown clays and loams						
1	119,6	258,4	378	2093	4522	6615
2	111,5	111,8	223,3	1951,3	1956,5	3907,8
Technozem, formed of gray-green marl clay						

1	129,1	242,7	371,8	2259,3	4247,3	6506,5
2	121,5	195,6	317,1	2126,3	3423	5549,3

The largest amount of formed root phytomass for the whole period of observations was recorded on technosem from a mixture of red-brown clays and loam. That is, on the less fertile substrate (as evidenced by the data of the productivity of above-ground phytomass and the results of previous studies [2, 3]), plants form a large mass of root systems, thereby ensuring the replenishment of the edafotop with a greater amount of phytomass, and hence the energy material for humus formation and humus accumulation.

In table № 2 summarizes the transformation of phytomasses of agricultural crops over a 45-year period, depending on the lithological basis of technosems and the saturation of agro-successions with phytomeliorative agrocenoses (ratios of one-year-perennial, legume-cereal crops).

## 2. Indicators of the transformation of phytomass into humus, depending on the lithological basis of technosems and the saturation of agro-succession phytomeliorative agrocenoses (field long-term experiments, 1971-2015).

Indexes	Technosems					
	LC		RBCL		GGMC	
	Agosuccession					
	1	2	1	2	1	2
Total productivity of phytomass in the 45-year period, t / ha	350,3	296,6	378	323,3	371,8	317,1
Amount of phytomass fed to the edible phytomass with biomass of root and post-dormancy remnants, t / ha	223,1	174,2	258,4	211,8	242,7	195,6
Received energy in the food phytomass, GJ / ha	3904,3	3048,5	4522	3706,5	4247,25	3423
Humus content in 0-20 cm layer, %						
• At the beginning of biological development	0,4		0,2		0,18	
• after 45 years	1,4	1,15	0,99	1,22	1,31	1,38
Humus reserves in the layer 0-20 cm, t / ha						
• at the beginning of biological development	9,6		4,8		4,3	
• after 45 years	34,2	27,5	23,9	29,2	29,9	33,1
Humus is accumulated in the layer 0-20 cm, t / ha						
• for the entire period of development	24,6	17,9	19,1	24,4	25,6	28,8
• on average per year	0,55	0,40	0,42	0,54	0,57	0,64

Data of table № 2 indicate that in the edafotopes got a different amount of energy material in the form of plant residues, which influenced the indicators of humus formation and humus accumulation. Consequently, the processes of accumulation and transformation (including humification) of organic matter in rocks during agricultural use in the first stages occur at a relatively fast pace, despite the

heterogeneity and heterogeneity of their material composition and some edaphic factors limiting vegetation of plants.

### **Conclusions**

For the agricultural development of technosomes, the main process of primary genesis of soil is the humus accumulation, the rate of which depends not only on the edaphic characteristics of technosomes and the bioclimatic potential of the territory, but also on the phytomelioration potential of agricultural crops.

The quantity and quality of plant remains, which enter the technosomes, is the main energy and material for humus formation and humus accumulation. Acceleration of humus accumulation processes is possible due to the saturation of crop rotation with phytomeliorative bean and bean-cereal long-term agrocenoses.

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