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Features of the Formation of Biological and Cellulosolytic Activity in Soils of Anthropogenous Transformed Ecosystems

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Abstract

It was found that among the studied monitoring sites in terms of biological activity, the microbial communities of primitive undeveloped soils on sandstone and ordinary chernozem were the least susceptible to the negative influence of environmental factors. The most significant increase in cellulosolytic activity is characteristic of primitive sedimentary undeveloped soils and chernozem usual medium-thick loamy, which indicates a more active activity of microorganisms, and hence a greater availability of elements of mineral nutrition for plants.
Key words: *Biological and cellulolytic activity of soils, monitoring site, edaphotope, technogenous ecotope, soil respiration*

Аннотация

Установлено, что среди изученных мониторинговых участков по показателю биологической активности наименее подверженными негативному влиянию экологических факторов были микробные сообщества примитивных неразвитых почв на песчанике и чернозема обыкновенного. Наиболее существенное возрастание целлюлозолитической активности характерно для примитивных седиментационных неразвитых почв и чернозема обыкновенного среднемощного суглинистого, что свидетельствует о более активном функционировании микроорганизмов, а, следовательно, и о большей доступности элементов минерального питания для растений.
Ключевые слова: *биологическая и целлюлозолитическая активность почв, мониторинговый участок, эдафотоп, техногенный экотоп, почвенное дыхание.*

Introduction

The level of anthropogenous load on the vegetation and soil cover is currently high. The technogenous impact slows down the development and further formation of the soil cover, and therefore, in the conditions of technogenesis, we often deal with an undeveloped soil cover, in which all its main elements are disturbed, and the amount of mineral nutrition elements and organic matter is reduced to critically low values.

The study of soils in technogenous landscapes, namely, the mechanisms of their functioning and evolutionary paths, are becoming the subject of close attention of soil scientists. In accordance with the profile-genetic classification of soils of technogenous landscapes (Гаджиев, Курачев, Рагимзаде, 1992), the technogenous landscape can be considered as a kind of ecocline embedded in natural landscapes. The technogenous landscape, in contrast to natural landscapes formed under the influence of all factors of the geographic environment, is characterized by an extreme degree of disturbance in the relationship of all constituent elements. Rarely, these relationships are so disturbed that the soils of technogenous ecotopes can be considered as a special category of soils that only superficially resemble real soils, both in the formation of the soil horizons, a number of physical and chemical properties, and in the content of elements vital for plant growth.

It is a well-known fact that the stable functioning of natural biocenoses is largely determined by the stability of biogenic exchange of chemical elements (both natural and anthropogenic), an important part of which is the mineralization of organic matter in soils. The activity of microflora

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largely determines the morphology of the soil profile, the physical and chemical properties of the soil, the intensity of its biochemical processes and the rate of circulation of substances (Богородская, Краснощёкова, Трефилова, 2010). In this regard, it is relevant to study the microbiological state of soils under conditions of intense anthropogenic impact.

Soil respiration is one of the key components of the carbon cycle, so there is a natural interest in studying its changes under the influence of various environmental factors. Respiration rate refers to labile indicators, but at the same time it is closely related to the total biological activity and is an informative indicator of changes in the rates of processes in seasonal dynamics with changes in meteorological conditions, as well as with soil pollution, etc. (Заварзин, Кудеяров, 2006; Степанов, 2011; Luo, Zhou, 2006). The parameters of soil respiration give an idea of the microbiological activity, nutrient reserves and the stability of the microbial pool system, thereby making it possible to determine the ecological state of soils and establish a list of measures for its fastest and most effective recultivation (Ананьева, Благодатская, Демкина, 2002; Благодатская, 1996; Anderson, Domsch, 1990).

In connection with all of the above, the aim of the work was to study the respiratory activity of microbocenosis and cellulolytic activity of soils of technogenous transformed ecosystems in seasonal dynamics.

Research methods

The object of the research is the edaphotopes of technogenous ecosystems of the Donetsk-Makeevka industrial agglomeration. The studies were carried out at monitoring sites located in the southwestern part of the Donetsk-Makeevka industrial agglomeration (within the Gornyatsky administrative district of Makeevka and adjacent territories).

The description of the soil cuts was carried out according to generally accepted methods (Методические рекомендации по морфологическому описанию почв, 1999; Розанов, 1983). The selection of soil samples was carried out on soil horizons (Методы почвенной микробиологии и биохимии, 1991).

Determination of the intensity of basal and substrate-induced soil respiration was carried out according to the Galstyan method. Microbial respiration coefficient (Qr) was determined by the Vbasal/Vsir ratio (Благодатская, 1996; Казеев, 2003).

When studying the microbocenosis of different soil horizons, samples were taken from a freshly dug soil cut. Soil samples taken for microbiological analysis were dispersed by grinding the soil, and plant roots and inclusions were removed. For sowing, a soil suspension was prepared (10 g of soil in 100 ml of sterile tap water). Then the dilution necessary for sowing was prepared. The soil suspension was plated on Hutchinson agar with filter paper as a cellulose source. Colonies were counted on days 7-10 of the study. After counting the number of colonies on 5 parallel plates, recalculation was made per 1 g of soil (Методы почвенной микробиологии и биохимии, 1991; Руководство к практическим занятиям по микробиологии, 1995).

The determination of the cellulosolytic activity of the soil was carried out by the application method. A sterile glass slide was sheathed with a sterile cotton cloth and a slide with a sheet was applied to the vertical soil surface in the prepared soil cut and pressed with soil so that the upper edge of the glass protruded about 1 cm. Once a month the sheets were carefully removed, washed from soil, half-life products, dried and weighed ourselves. The intensity of the cellulosolytic activity of the soil is judged by the difference in the mass of the web that was not introduced into the soil and the webs of the same size that were removed from the soil. Activity is expressed as a percentage (Казеев, 2003).

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Statistical processing of the experimental data was carried out according to generally accepted methods of parametric statistics at the 95% significance level (Доспехов, 1985; Приседський, 1999).

Below is a description of the monitoring sites where soil studies were carried out.

Monitoring site № 1. A decommissioned sludge storage facility (Gornyatsky district of Makeevka), with poor vegetation cover and dominance in the plant group *Phragmites australis* (Cav.) Trin. ex Steud., with a total projective cover (TPC) of 100%.

Soil cut №. 1-s. Substrate (black sandy sludge) with signs of soil formation. Black, structureless, densely packed, primary aggregation is observed on the roots of plants, the accumulation of humus has no morphological expression due to the weak development of the clay component. No inclusions, passages and pores of zoogenic nature were found. The selection of soil samples was carried out in layers of 0-10 cm, 10-20 cm and 20-30 cm.

Monitoring site № 2. A decommissioned quarry for the extraction of building stone (Kalinovaya gully, Gornyatsky district, Makeevka). The vegetation cover is highly mosaic; there are spots of both weed-ruderal species and species of the steppe coeno-element. TPC (minus the surface of the coarse stone) 70-80%. The plant groupings include the following species: *Echium vulgare* L., *Sideritis montana* L., *Stachys transsilvanica* Schur, *Anisantha tectorum* (L.) Nevski, *Calamagrostis epigeios* (L.) Roth, *Poa compressa* L., *P. bulbosa* L., *P. angustifolia* L., *Galium humifusum* M. Bieb., *Daucus carota* L., *Achillea pannonica* Scheele, *Artemisia absinthium* L., *A. austriaca* Jacq., *Centaurea diffusa* Lam., *Senecio jacobaea* L., *S. vernalis* Waldst. & Kit., *Linaria maeotica* Klokov, *Elytrigia repens* (L.) Nevski (soc), *Verbascum lychnitis* L. *Cirsium acanthoides* L., *Centaurea diffusa* Lam., *Chondrilla juncea* L., *Cirsium setosum* (Willd.) Besser, *Lactuca tatarica* (L.) C.A. Mey., *Picris hieracioides* L., *Taraxacum officinale* Wigg., *Convolvulus arvensis* L., *Linaria maeotica* Klokov, *Reseda lutea* L., *Euphorbia virgata* Waldst. & Kit., *Berteroa incana* (L.) DC., *Hieracium virosum* Pall., *Melandrium album* (Mill.) Garcke, *Tragopogon dasyrhynchus* Artemcz., *Falcaria vulgaris* Bernh., *Phalacroloma annuum* (L.) Dumort s.l., *Ambrosia artemisiifolia* L., *Medicago romanica* Prodan, *Tanacetum vulgare* L. *Tussilago farfara* L., *Hyoscyamus niger* L., *Oberna behen* (L.) Ikonn., *Camelina microcarpa* Andrz.

Soil cut №. 1-q. Primitive undeveloped soils on sandstone.

A – 0 – 5 cm. Black, densely penetrated with plant roots. The structure is finely powdered, aggregates are 2 mm in diameter. The transition to horizon C is clear in color, structure, and density. There are zoogenic passages, salt efflorescence (pinkish). Stony – 5%.

C – Light brown, sandstone metamorphic products. Stony – 20%, permeated with plant roots. Traced to a depth of 20 cm.

Monitoring site № 3. The slope of the dump of the Lenin's mine southern exposition (Gornyatsky district, Makeevka). In the middle part of the slope, the angle of the surface is about 30º, so the TPC reaches only 20-30%. Dominated *Echium vulgare*, also represented *Picris hieracioides* L., *Senecio vernalis* Waldst. & Kit., *Linaria maeotica* Klokov, *Reseda lutea* L., *Oberna behen* (L.) Ikonn., from woody plants surrounded by the monitoring site and singly on the monitoring site are found *Robinia pseudoacacia* L., *Acer negundo* L., *Juglans regia* L.

Soil cut №. 1-d-s. Substrate with signs of soil formation.

A – 0 – 15 cm. Brown, loose, fine-grained, dryish. Stony – 5%. The transition to horizon C is gradual, in color – streaks.

C – fawn, traced to a depth of 30 cm. Stony – 15%.

Monitoring site № 4. Zone of flattening of the slope of the southern exposure at the base of the dump of the Lenin's mine (Gornyatsky district, Makeevka). Phytocenosis presented by *Echium vulgare* L., *Sideritis montana* L., *Stachys transsilvanica* Schur, *Anisantha tectorum* (L.) Nevski, *Calamagrostis epigeios* (L.) Roth, *Poa compressa* L., *P. bulbosa* L., *Galium humifusum* M. Bieb.,

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Daucus carota L., *Achillea pannonica* Scheele, *Artemisia absinthium* L., *A. austriaca* Jacq., *Centaurea diffusa* Lam., *Senecio vernalis* Waldst. & Kit., *Linaria maeotica* Klokov, from below vegetatively penetrates *Phragmites australis*, TPC is 50-60%, there are not overgrown clearings, the dominance of certain species is not expressed, from woody plants *Robinia pseudoacacia* L., *Fraxinus pennsylvanica* Marsh, *Acer negundo* L., *Ulmus pumila* L., *Juglans regia* L.

Soil cut №. 1 f-s. Primitive sedimentary undeveloped soils.

A – 0 – 10 cm. Brown, relatively compacted, fine-grained, dryish. Stony – 5%. Densely penetrated with plant roots.

C – Dark gray, metamorphosed shale, lamellar, dry, permeated with plant roots. Stony – 30%. Traced to a depth of 30 cm.

Monitoring site № 5. Abandoned field (Zelenyi microdistrict, Gornyatsky district, Makeevka). Dendrochronologically, according to grown woody plants, the period of stopping plowing can be estimated at 7 – 8 years. The TPC is 80 – 100%. Dominated *Elytrigia repens* (L.) Nevski (soc), *Achillea pannonica* Scheele (cop). Quite a lot in places *Artemisia absinthium* L., *Verbascum lychnitis* L., *Cirsium acanthoides* L., absentmindedly meet *Centaurea diffusa* Lam., *A. austriaca* Jacq., *Chondrilla juncea* L., *Poa compressa* L., *Cirsium setosum* (Willd.) Besser, *Erigeron acris* L., *Lactuca tatarica* (L.) C.A. Mey., *Picris hieracioides* L., *Senecio jacobaea* L., *S. vernalis* Waldst. & Kit., *Taraxacum officinale* Wigg., *Convolvulus arvensis* L., *Linaria maeotica* Klokov, *Reseda lutea* L., *Euphorbia virgata* Waldst. & Kit., *Vicia cracca* L., *Daucus carota* L., *Berteroa incana* (L.) DC., *Hieracium virosum* Pall., *Melandrium album* (Mill.) Garcke, *Tragopogon dasyrhynchus* Artemcz., *Silene dichotoma* Ehrh., *Falcaria vulgaris* Bernh., *Phalacroloma annuum* (L.) Dumort s.l., *Ambrosia artemisiifolia* L. From woody plants grow scattered *Ulmus pumila* L., *Fraxinus pennsylvanica* Marsh., *Quercus robur* L.

Soil cut №. 1 -ch. Chernozem usual medium-thick loamy.

A – 0 – 62 cm. Black, fresh, solid-grain, moderately dense, medium-lumpy structure. Densely penetrated with plant roots. The horizon contains an insignificant number of zoogenic passages. Boils from the surface to a depth of 50 cm from 10% HCl. The transition to horizon B is gradual, in color, with streaks.

B – 62 – 80 cm. Dense, medium-lumpy, light brown.

C – parent rock (fawn loess-like loam) 80 cm and below.

Results and discussion

When studying the intensity of basal respiration of microorganisms in anthropogenous transformed ecosystems in the spring period of research, its highest values were recorded for chernozem usual (over 60 mg CO_2/100 g of soil per day). A similar trend was observed in the study of substrate-induced respiration, however, the values of the calculated coefficient of microbial respiration indicate a weak level of disturbance in the stability of the soil microbial community (Table 1). Primitive undeveloped soils on sandstone were also characterized by a low degree of disturbance in the functioning of the microbial community (Qr = 0.28-0.3), and the level of microbial respiration exceeded similar indicators of the substrate of the sludge storage by 3.4-10.2 times. In the genetic horizons of the waste dump areas, the intensity of the basal respiration of microorganisms did not exceed 30 mg CO_2/100 g of soil per day, and the addition of an additional substrate led to a 2 – 4 times increase in the values of substrate-induced respiration compared to the soil layers of monitoring site № 1.

Along with this, rather harsh edaphic conditions do not allow the formation of a stably functioning cenosis of microorganisms, the stability of which is estimated as average by the coefficient of microbial respiration. The low supply of mineral and organic compounds to the

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substrate, the pH level and the high degree of salinity have led to the formation of a pioneering microbial community in the substrate of the sludge storage, the functional characteristics of which are distinguished by the lowest values, which leads to a strong degree of disturbance of the stability of the microbial community.

The functional activity of the microbial cenosis of the soils of the monitoring sites in the summer due to low soil moisture caused by high air temperatures and low precipitation levels decreased compared to the previous stage of research (Table 1). Moreover, the process of decrease in functional activity most significantly affected the substrate of the sludge storage. Microbial communities of site № 2 and № 5 were least susceptible to the negative influence of environmental factors, in the genetic horizons of soils of which the indicators of microbial respiration exceeded similar values in the substrate of the sludge storage facility by 3.5 – 6.5 and 7.6 – 18.7 times for the basal and substrate-induced respiration, respectively. Despite this, the degree of disturbance in the stability of the microbial community of these soils increased to average. Characterizing the microbial community of edaphotopes of the waste dump, it should be noted that, although the values of the coefficient of microbial respiration, and, consequently, the degree of community stability, practically did not change compared to the previous period of studies, the intensity of soil respiration decreased.

With an increase in the duration of monitoring studies, we noted a gradual restoration of both the actual and potential functional state of the communities of microorganisms in the soils of practically all the studied areas, since the intensity of microbial respiration approached the values recorded in the spring period (Table 1). Most likely, the data obtained are due to both an improvement in edaphic conditions (a decrease in temperature and an increase in humidity) and the presence of an organic substrate available for microbiological transformation (fresh portions of litter and root litter). A decrease in stress tension led to the stabilization of the stability of the microbocenosis, however, if in chernozem usual and primitive undeveloped soils on sandstone, according to the calculated Qr values, the degree of disturbance was practically absent, then in the remaining areas it decreased compared to the summer period of research, but still it remained at a fairly high level.

Table 1. Indicators of microbiological activity of soils of anthropogenous transformed ecosystems by the intensity of CO_2 emission (mg/100 g of soil per day)

Таблица 1. *Показатели микробиологической активности почв антропогенно трансформированных экосистем по интенсивности выделения CO_2 (мг/100 г почвы за сутки)*

Site, horizon	Basal soil respiration (Vbasal)		Substrate-induced soil respiration (Vsir)		Qr
	M ± m	%	M±m	%	
Spring					
№ 1 0-10 cm	12,0 ± 1,15	–	16,1 ± 1,08	–	0,75
№ 1 10-20 cm	11,7 ± 0,45	–	15,3 ± 1,25	–	0,76
№ 1 20-30 cm	10,3 ± 0,84	–	14,0 ± 1,03	–	0,74
№ 2 A	46,0 ± 4,36*	383,3	165,0 ± 5,77*	1024,8	0,28
№ 2 C	35,3 ± 1,45*	342,7	118,3 ± 8,82*	845,0	0,3
№ 3 A	22,7 ± 3,38*	189,2	45,0 ± 5,03*	279,5	0,5
№ 3 C	16,3 ± 1,2*	158,2	30,7 ± 2,6*	219,3	0,53
№ 4 A	31,0 ± 2,08*	258,3	63,7 ± 0,88*	395,6	0,49
№ 4 C	20,3 ± 2,04*	197,1	45,0 ± 1,53*	321,4	0,45
№ 5 A	62,0 ± 3,79*	516,7	228,0 ± 2,65*	1416,1	0,27
№ 5 B	54,7 ± 2,6*	467,5	189,3 ± 4,33*	1237,2	0,29
№ 5 C	42,3 ± 1,45*	410,7	168,7 ± 2,6*	1205,0	0,25

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Table 1. continued

Summer					
№ 1 0-10 cm	5,3±0,18	–	5,7±0,29	–	0,94
№ 1 10-20 cm	4,0±0,15	–	5,3±0,88	–	0,75
№ 1 20-30 cm	4,7±0,28	–	6,3±0,52	–	0,74
№ 2 A	32,7±3,28*	616,9	106,7±3,53*	1871,9	0,31
№ 2 C	27,3±3,93*	580,8	74,0±2,0*	1174,6	0,37
№ 3 A	11,3±0,83*	213,2	22,3±1,76*	391,2	0,51
№ 3 C	6,32±0,58*	134,5	11,7±1,45*	185,7	0,54
№ 4 A	17,0±3,06*	320,7	36,0±1,0*	631,6	0,47
№ 4 C	10,3±0,82*	219,1	22,3±0,88*	354,0	0,46
№ 5 A	34,7±6,17*	654,7	86,7±2,85*	1521,0	0,4
№ 5 B	24,1±3,26*	602,5	74,0±2,31*	1396,2	0,32
№ 5 C	16,3±2,96*	346,8	47,7±1,76*	757,1	0,34
Autumn					
№ 1 0-10 cm	10,7±1,76	–	11,0±1,15	–	0,97
№ 1 10-20 cm	8,3±0,67	–	11,3±1,2	–	0,74
№ 1 20-30 cm	7,3±0,88	–	10,0±0,58	–	0,73
№ 2 A	25,3±2,33*	237,5	139,7±2,6*	1269,7	0,18
№ 2 C	12,7±0,67*	172,7	61,7±1,2*	616,7	0,21
№ 3 A	20,7±2,03*	193,5	52,0±0,58*	472,7	0,4
№ 3 C	14,3±1,45*	195,9	31,0±2,08*	310,0	0,46
№ 4 A	22,3±2,4*	208,4	46,3±1,76*	420,9	0,48
№ 4 C	17,7±1,2*	242,5	36,0±1,15*	360,0	0,49
№ 5 A	31,7±1,45*	296,9	145,3±1,67*	1321,2	0,22
№ 5 B	27,0±1,15*	325,3	127,0±0,58*	1120,6	0,21
№ 5 C	22,3±2,4*	305,5	97,3±0,88*	973,3	0,23

Note. Qr (microbial respiration coefficient) = Vbasal/Vsir

One of the indicators of the biological activity of the soil is its cellulose-breaking capacity, which indicates the rate of transformation of plant residues in the soil. Analysis of the data in table 2 made it possible to establish that the block of cellulose-destroying microorganisms is the least represented in the microbocenosis of the soils of the monitoring sites.

Table 2. The number of cellulose-destroying microorganisms (thousand CFU/g of soil) in soils of anthropogenous transformed ecosystems

Таблица 2. Численность целлюлозоразрушающих микроорганизмов (тыс. КОЕ/ г почвы) почв антропогенно трансформированных экосистем

Site, horizon	Spring		Summer		Autumn	
	M ± m	%	M ± m	%	M ± m	%
№ 1 0-10 cm	0,06±0,004*	–	0,04±0,009	–	0,05±0,003	–
№ 1 10-20 cm	0,03±0,008*	–	0,02±0,003	–	0,02±0,001	–
№ 1 20-30 cm	0,01±0,003*	–	0,01±0,002	–	0,01±0,001	–
№ 2 A	0,47±0,07*	783,3	0,25±0,01*	625,0	0,29±0,002*	580,0
№ 2 C	0,39±0,06*	3900,0	0,3±0,008*	3000,0	0,27±0,03*	2700,0
№ 3 A	0,12±0,05*	200,0	0,07±0,003*	175,0	0,09±0,004*	180,0
№ 3 C	0,08±0,01*	800,0	0,04±0,001*	400,0	0,06±0,002*	600,0
№ 4 A	0,25±0,004*	416,7	0,13±0,01*	325,0	0,18±0,02*	360,0
№ 4 C	0,16±0,007*	1600,0	0,09±0,004*	900,0	0,12±0,01*	1200,0
№ 5 A	0,31±0,06*	516,7	0,23±0,006*	575,0	0,26±0,03*	520,0
№ 5 B	0,17±0,04*	566,7	0,09±0,005*	450,0	0,14±0,009*	700,0
№ 5 C	0,09±0,007*	900,0	0,04±0,004*	400,0	0,08±0,004*	800,0

Note. % – the percentage of exceeding the values in relation to similar soil horizons of site № 1, * – the differences are statistically significant at $p < 0.05$

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Along with this, the substrate of the sludge storage was characterized by minimal indicators of the number of microorganisms – cellulose destructors, which practically did not change in the soil layers during all periods of research. In the soils of areas with a pronounced humus-accumulating horizon, the number of cellulose-destroying microorganisms exceeded those of the upper layer of the sludge storage substrate by 3.6 – 7.8 times.

On the whole, in terms of the number of cellulose-destroying microorganisms, the soils of the monitoring sites are located in the following decreasing row: primitive undeveloped soils on sandstone > chernozem usual medium-thick loamy > primitive sedimentation undeveloped soils > substrate with signs of soil formation on the slope of the waste dump > substrates with signs of soil formation of the sludge storage.

Along with the plate method for determining the cellulose-destroying capacity of soils, the application method is also used, based on measuring the microbiological decomposition of tissue over a certain time period. The analysis of the results obtained indicates the highest level of cellulosolytic activity of primitive sedimentation undeveloped soils in the zone of flattening of the waste dump, reaching up to 60% (Fig. 1).

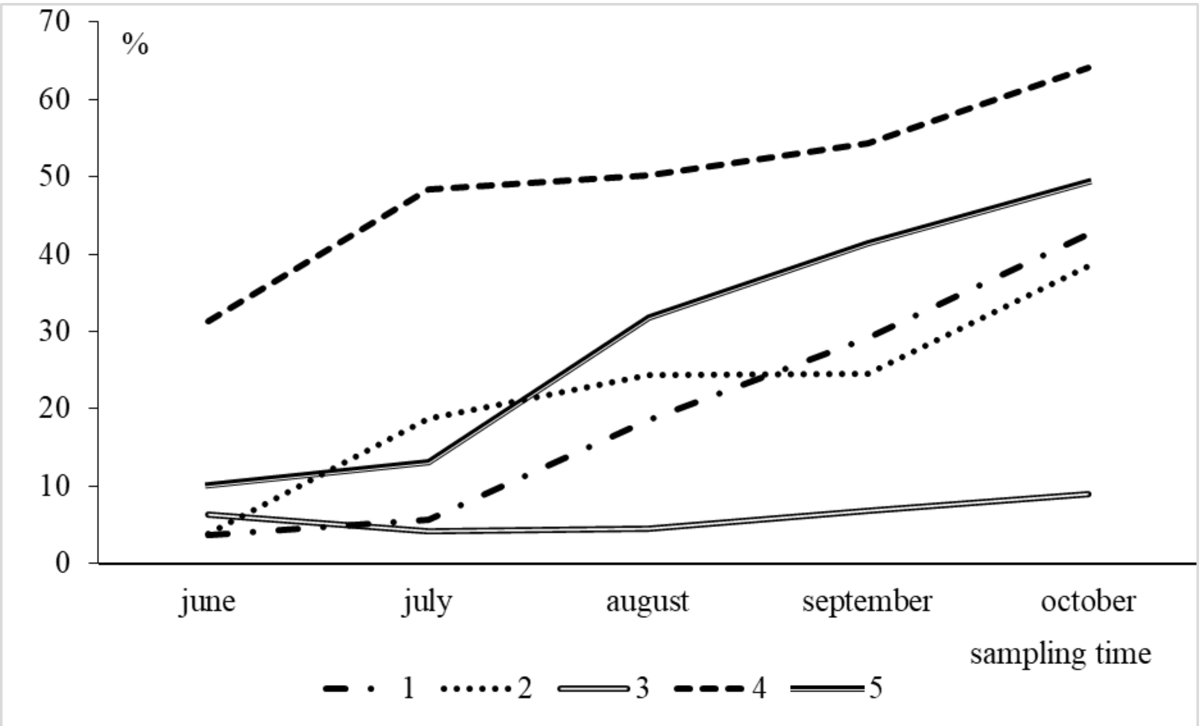

Fig. 1. Intensity of cellulosolytic activity of soils (%). 1 – site № 1, 2 – site № 2, 3 – site № 3, 4 – site № 4, 5 – site № 5.

Рис. 1. Интенсивность целлюлозолитической активности почв (%). 1 – участок № 1, 2 – участок № 2, 3 – участок № 3, 4 – участок № 4, 5 – участок № 5.

Studies of the seasonal dynamics of changes in activity in the studied edaphotopes show that the lowest level of cellulosolytic activity of microorganisms was found in June in all studied soil cuts. An increase in cellulosolytic activity was observed already in July and was ambiguous at different monitoring sites. So, if in the substrate of the sludge storage and in chernozem usual, an almost linear dependence was observed, then in the soils of other areas the noted increase in activity alternated with outcrops to plateaus. The most significant increase in cellulosolytic activity is characteristic of sites № 4 and 5, which indicates a more active activity of microorganisms, and hence a greater availability of mineral nutrition elements for plants.

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Conclusions

Thus, according to the results of the studies carried out, it can be argued that among all the studied sites in terms of biological activity, the microbial communities of primitive undeveloped soils on sandstone and chernozem usual were least susceptible to the negative influence of environmental factors, in the genetic horizons of these soils the indicators of microbial respiration were 4 – 19 times higher similar values in the substrate of the sludge storage. According to the number of cellulose-destroying microorganisms, the soils of the monitoring sites are located in the following decreasing row: primitive undeveloped soils on sandstone > chernozem usual medium-thick loamy > primitive sedimentation undeveloped soils > substrate with signs of soil formation on the slope of the waste dump > substrate with signs of soil formation of the sludge storage. The lowest level of cellulosolytic activity of microorganisms at all monitoring sites was established in June. The most significant increase in cellulosolytic activity is characteristic of sites № 4 and № 5, which indicates a more active activity of microorganisms, and hence a greater availability of mineral nutrition elements for plants.

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Особенности формирования биологической и целлюлозолитической активности почв антропогенно трасформированных экосистем

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Резюме

При изучении интенсивности базального дыхания микроорганизмов антропогенно трансформированных экосистем в весенний период исследований зафиксированы наибольшие его значения для чернозема обыкновенного (свыше 60 мг CO2/100 г почвы за сутки), в генетических же горизонтах участков породного отвала интенсивность базального дыхания микроорганизмов не превышала 30 мг CO2/100 г почвы за сутки. Функциональная активность микробоценоза почв мониторинговых участков в летний период вследствие низкой влажности почвы, обусловленной высокими значениями температуры воздуха и малым уровнем атмосферных осадков, снизилась по сравнению с предыдущим этапом исследований, при этом наиболее существенно процесс снижения функциональной активности затронул субстрат шламохранилища. С увеличением длительности мониторинговых исследований было отмечено постепенное восстановление как актуального, так и потенциального функционального состояния сообществ микроорганизмов в почвах практически всех исследованных участков.

При изучении целлюлозоразрушающей способности почв мониторинговых участков установлено, что блок целлюлозоразрушающих микроорганизмов является наименее представленным в микробоценозе почв мониторинговых участков. По количеству целлюлозоразрушающих микроорганизмов почвы мониторинговых участков располагаются в следующем убывающем ряду: примитивные неразвитые почвы на песчанике > чернозем обыкновенный среднемощный суглинистый > примитивные седиментационные неразвитые почвы > субстрат с признаками почвообразования на склоне породного отвала > субстрат с признаками почвообразования шламохранилища. Исследования сезонной динамики изменений активности в исследованных эдафотопах показывают, что самый низкий уровень целлюлозолитической активности микроорганизмов установлен в июне во всех исследованных почвенных разрезах. Возрастание целлюлозолитической активности наблюдалось уже с июля и на разных мониторинговых участках имело неоднозначный характер. Наиболее существенное возрастание целлюлозолитической активности характерно для участков № 4 и № 5, что свидетельствует о более активной деятельности микроорганизмов, а значит – и о большей доступности элементов минерального питания для растений.

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