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INFLUENCE OF GRAY-BROWN SOILS CONTAMINATED WITH WASTE OF SUMGAYIT SYNTHETIC RUBBER PLANT ON LIFE ACTIVITY OF EARTHWORMS

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Abstract. Soil invertebrates are one of the most important components of most biogeocenoses and are sensitive indicators of environmental changes due to their high ecological and species diversity, close connection with the soil, low migration activity, high sensitivity and fairly rapid response to changes in environmental parameters. The occurrence of certain species can be an indicator of the humidity or dryness of the habitat.

Keywords: *soil, soil formation, invertebrates, earthworms, gray-brown soils, soil properties, mechanicalcomposition, reaction of the medium (pH),the composition of salts in the grey-brown soils*

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1. Introduction

Soil is an integral, most important component of the biosphere, both in terms of its spatial position and in terms of numerous processes that are part of the biogeochemical cycles and determine the conditions for the preservation and normal course of life on Earth. The soil is richly populated by numerous representatives of different groups of animals, for which it is not only a habitat, but also the result of their combined activities. Soil-dwelling organisms decompose plant residues, transform organic material and mineral components, form the humus horizon, and regulate the cycles of biogenic elements. Soil animals take part not only in the formation of a homogeneous humified layer on the soil surface, they play a major role in the distribution of organic matter along the soil profile

The activity of soil biota to a greater extent defines the parameters for the functioning of terrestrial ecosystems, such as the speed of destruction the level of biological productivity, and thus directly affects the rate of biological cycle and the formation of promajority relations between soil and ground layer ecosystems.

The life of soil dwellers is closely related to the environment in which they live. Depending on the environmental factors, a certain complex of soil animals is formed in each biocenosis. Soil animals must interact with other organisms and other components of their environment for a long-term existence. Factors of such interaction include food, humidity, temperature, physical substrate, biocompetition, developmental stages , soil and substrate processes (Venette & Ferris, 1998). In turn, all factors affecting soil invertebrates can be divided into three main types: abiotic, biotic, and anthropogenic. Of the abiotic factors, the most influential are temperature, which determines the intensity

of the processes, vital activity, humidity of the habitat, as well as edaphic factors such as soil type, acidity, organic matter content, soil air composition, and others.

During the transformation of natural ecosystems as a result of the impact of industrial enterprises, deforestation, fires, plowing of land, overgrazing of livestock, the restructuring of biotic communities in most cases goes towards reducing the species diversity and simplifying the structure of zoocenoses.

Soil invertebrates are sensitive indicators of soil moisture. The occurrence of certain species can be an indicator of the humidity or dryness of the habitat. Many researchers consider mesofauna to be one of the best bioindicators, since all actively moving species react to the slightest change in the environment by varying the number and violation of the ratios of trophic groups. To determine the main trends in soil dynamics using soil invertebrates in gray-brown soils, such indicators as the quantitative ratio of individual groups, changes in the structure of the dominant representatives of the trophic structure, and distribution over the soil profile are of primary importance.

Soil invertebrates are characterized by significant taxonomic diversity, high abundance, relatively long periods of embryonic and postembryonic development, the absence of sharp fluctuations in the abundance of mature forms, low mobility (Krivolutskiy, 1964). Soil animals are extremely sensitive to fluctuations in natural factors and various external influences on the soil and vegetation, to environmental pollution; therefore, they can be effective bioindicators of the state and dynamics of soil cenoses. As bioindicators, it is particularly convenient to use large soil invertebrates (mesofauna), which can be easily taken into account by manual disassembly of soil samples. They react to changes in the external environment, first of all, changes in the nature of localization within the habitat, concentrating in the most favorable areas. For determining the main tendencies of soil dynamics with the help of animals, such indicators as the quantitative ratio individual groups, changes in the structure of dominance, trophic structure, distribution along the soil profile (Striganova, 1994).

The most convenient test objects are earthworms, click beetles and their larvae, large ground beetles, some species of woodlice, darkling beetles and their larvae (Zakharov & Byzova, 1989). More than 100 years ago, Charles Darwin (1882), pointing to the enormous work of worms, wrote: "... there are hardly any other animals that would play such a big role in the history of the world as earthworms". A very imaginative and profound characterization of the activity of earthworms was given by the Russian soil scientist N.A. Dimo (1938), who wrote that under the influence of worms, from year to year, from millennia to millennia, the features of biogenic composition and structure, specific biochemical properties, which are not reproduced by any other agent of nature, accumulate in soils.

Earthworms are a faunal group that dominates in their biomass among the soil invertebrates of many terrestrial ecosystems, including agricultural ecosystems. In the digestive tract of earthworms, undigested food residues are mixed with mineral particles, glued together by the mucous secretions of the intestinal walls, compressed and thrown into the soil in the form of coprolites. In their intestines, many soil minerals are destroyed to form soluble compounds. Thus, such elements necessary for plants as potassium, magnesium, and phosphorus are released from basalt grains. The coprolites of worms and their passages in the soil are enriched with ammonia nitrogen, which is produced by the intestinal walls and the surface of the body (Striganova, 1980). Worms stimulate the development of certain groups of microorganisms, which contributes to

the enrichment of the soil with various enzymes, the activation of a number of important plant nutrition elements (Striganova, 1982). The impact of earthworms on soil microorganisms can be direct and indirect. Direct effects include the direct absorption and digestion of microorganisms by worms which causes modification of their populations (Bityutsky *et al*., 2007). An example of indirect influence is the modification of the microbial habitat by earthworms: changes in the soil structure and the concentration of biogenic elements, hormone-like effects, relocation of microorganisms, redistribution of organic matter along the soil profile, etc. ((Striganova, 1980; Scheu, 1987; Hodge *et al*., 2000; Oleinik & Byzov, 2008; Dempsey *et al*., 2011; Groffman *et al.*, 2015)

The distribution and abundance of earthworms are influenced by certain soil properties: mechanical composition, environmental reaction (pH), as well as geographical and climatic conditions (Atlavinite, 1975; Pollastrini *et al*., 2016).

The optimal pH values of the soil for the vital activity of earthworms differ depending on the type of these animals and the type of soil. The absence of earthworms in saline soils is explained not so much by the negative effect of the reaction of the soil solution, but by the presence of soluble salts in it in high concentrations. At the same time, the concentration and composition of salts have a negative effect on worms (Zrazhevsky, 1957; Owojori & Reinecke, 2013).

The mechanical composition of the soil is an important factor affecting the vital activity of earthworms. the main reason for the absence of earthworms in peaty soils is the lack of mineral particles necessary for worms to crush food. Mechanical tillage significantly affects the life activity of earthworms, their number and population structure (Atlavinite, 1975; Ernst & Emmerling, 2009).

2. Materials and methods

The research was carried out in gray-brown soils of the city of Sumgait. Natural biotopes of wormwood-ephemeral vegetation were selected as control sites. Also, test sites were laid on the territory contaminated with waste from the Sumgayit Synthetic Rubber Plant. Soil invertebrates were counted at each of the selected plots in 10 replicates; all specimens were fixed in glass bottles with 3% formalin. The total number of replicates was 50. The selection of soil invertebrates and their subsequent determination was carried out according to the generally accepted method of M.S. Gilyarov.

3. Result and discussion

Earthworms are very sensitive to changes in ambient temperature. A rapid change in the temperature regime, regardless of its direction, was accompanied by a decrease in the body weight of the lumbricids (Kudryasheva & Meshkova, 1992). The optimal temperature for the growth and maintenance of the mass of A. caliginosa and L. terrestris is 20°C (Barry & Jordan, 2001; Whalen & Eriksen-Hamel, 2006). A particularly important condition for the vital activity of worms is sufficient moisture of the substrate. In a drought, they go into deeper and moistened layers to a depth of 150-200 cm or fall into a state of diapause, curling up in a ball to prevent excessive moisture loss.

As mentioned above, the vital activity of earthworms depends on the soil moisture. In natural biocenoses of gray-brown soils under sagebrush-ephemeral vegetation, a limited amount of precipitation determines the non-leaching type of water regime. Gray-brown soils experience a sharp shortage of moisture. Even in the spring, the reserves of productive moisture are very small. Weak seepage of the profile leads to the development of such properties of gray-brown soils as carbonation and salinity. Earthworms are negative indicators of saline soils, do not tolerate even a small salinity.

Figure 1. Salt content and composition in gray-brown soils under sagebrush-ephemeral vegetation of Sumgait Synthetic Rubber Plant

№	Name of the soil depth cm.	CO^{3-}	HCO^{3-}	Cl^{-}	$SO4^{2-}$	Ca^{2+}	Mg^{+}	Na^{+} K^{+}	The dry residue	Total salt	CO_2%	$CaCO_3$%
	Synthetic Rubber Plant											
1	Sample1 0-10	-	0,015 0,25	0,084 2,40	0,502 5,16	0,077 3,83	0,020 1,68	0,053 2,30	0,773	0,75	7,65	17,38
2	Sample 1 10-20	-	0,031 0,50	0,021 0,60	0,090 0,93	0,016 0,79	0,004 0,34	0,021 0,90	0,208	0,183	13,50	30,67
3	Sample2 0-10	-	0,040 0,65	0,070 2,00	0,148 1,52	0,020 1,01	0,004 0,34	0,065 2,82	0,353	0,347	9,90	22,49
4	Sample 2 10-20	-	0,034 0,55	0,035 1,00	0,058 0,60	0,014 0,68	0,003 0,23	0,029 1,25	0,183	0,173	12,15	27,60
5	Sample 3 0-10	-	0,031 0,50	0,033 0,95	0,029 0,60	0,018 0,90	0,003 0,23	0,025 1,07	0,158	0,148	6,75	15,34
6	Sample3 10-20	-	0,031 0,50	0,021 0,60	0,060 0,62	0,018 0,90	0,003 0,23	0,04 0,59	0,158	0,147	14,85	33,74

Gray-brown soils from a depth of 30-40 cm have constant signs of salinity, which are usually clearly manifested in the first half meter. Among the salts, sulfates and calcium predominate. Gray-brown soilsbelong to the chloride-sulfate type of salinization.

Plant residues are completely mineralized in one season, so very little humus is formed here. In the summer, very hot and dry period, biological processes in the soil are damped. The weak accumulation of humus in desert soils and their almost universal salinity are also due to the peculiarities of the biological cycle of substances. According to L. E. Rodina and N. I. Bazilevich (1965), the total amount of organic matter contained in the above-ground and underground organs of plants in the most common desert communities of the grey - brown soils, on average about 10 t/ha, i.e. several times less than in the steppes.

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