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INFLUENCE OF THE HEAVY METALS POLLUTING THE SOIL ON THE DENSITY AND DIVERSITY OF THE SOIL FAUNA

WPLYW METALI CIĘŻKICH ZANIECZYSZCZAJĄCYCH GLEBĘ NA ZAGĘSZCZENIE I RÓŻNORODNOŚĆ FAUNY GLEBOWEJ

Abstract: Three, following areas were chosen to the research: the lawn near noisy street at the Vistula river, the lawn in the park situated 300 m from the noisy road and the lawn in the Mogilski Grove. The researches were conducted in 2007 and 2008 in the spring. The density and the diversity of the soil fauna as well as the content of metals in the soil and the humidity, temperature and pH reaction in the soil were analyzed. The relation between the content of Cd, Pb, Zn and Ni and the density and diversity of pedofauna was detected. In the area with the highest content of the metals cited above the density and the diversity of pedofauna were the lowest, whereas in the soil with the lowest concentration of these metals the parameters determined were the highest.

Keywords: heavy metals, soil fauna, diversity, density

The means of transport are the common sources of the environmental contamination. The diesel engines expel many toxic elements such as for example the heavy metals that are the parts of fumes and dusts [1, 2]. The lead compounds (toxic lead(IV) chloride) are the most important among them as well as Zn, Cd and Ni that get into the environment as a result of the consuming of the fuels, rubbing of the tyres and other vehicles parts [3]. Moreover among the roads the grease used in the vehicles can be the sources of the Cd contamination. The areas the most exposed to the transport contamination are urbanized ones as well as the areas situated near roads with heavy traffic. The risk generated by engine fumes is even higher when their toxic elements are expelled to the atmosphere on the densely populated areas, where the buildings make the natural air exchange difficult. As a result, the accumulation of these contaminations in the environment, especially in the soil appears. Because of the fact that the heavy metals migrate in the soil very slowly, they are its most durable pollutions [4]. It is

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particularly harmful, because the soil is the important part of the elements circulation and is the basic link of the trophic chain that reach also the man. Taking up the heavy metals from the soil by the organisms is conditioned by many factors such, as for example: pH of the soil, its humidity, the content of organic matter, the presence of other metals and the forms in which they appear in the soil.

Disregarding their origin, the heavy metals in excessive amount generate serious risk for plants, animals and man. Therefore there is a need for the current evaluation of their content in the areas exposed to the influence of the transport contaminations.

The aim of the research was the evaluation of the influence of the heavy metals – Cd, Pb, Zn and Ni on the density and diversity of the soil fauna.

Materials and methods

The researches were conducted in 2007 and 2008 in the spring, following three areas were chosen to the research:

- Locality I – the lawn near noisy street at the Vistula river,
- Locality II – the lawn in the park situated 300 m from the noisy road,
- Locality III – the lawn in the Mogilski Grove.

The density and the diversity of the soil fauna as well as the content of metals in the soil and the humidity, temperature and pH reaction in the soil were analyzed.

The way of taking up the samples, theirs number, methods of scampering away the pedofauna and the way of evaluation of the Cd, Pb, Zn and Ni content is described in the separated article [5].

Results and discussion

The anthropogenic soils analyzed were characterized by the slightly alkaline reaction in the interval of 7.13–7.2 pH. It is widely known that acidic pH of the soil considerably increase the assimilability of the heavy metals by the soil organisms. Due to the high pH, the reaction did not increase the mobility of the metals in the soil analyzed (Table 1).

Table 1

The features of the soil in the areas analyzed in Kraków (the means from 2007–2008)

Selected parameters	Locality I	Locality II	Locality III
Soil moisture [%]	16.32	15.93	14.80
Soil pH	7.13	7.16	7.20
Area temperature [°C]	16.20	10.05	13.80
Soil temperature [°C]	11.55	8.85	12.75

Locality I – the lawn near noisy street at the Vistula river; Locality II – the lawn in the park situated 300 m from the noisy road; Locality III – the lawn in the Mogilski Grove.

The important differences concerning the humidity and temperature of the soil were not detected (Table 1). However, the clear differences in the Cd, Pb, Zn and Ni content

were noted. The important differences concerned both the density and diversity of the mesofauna.

According to Kabata-Pendias et al [6] the highest admissible content of the metals in the soils that contain anthropogenic pollutions can be 1 mg Cd · kg, 70 mg Pb, 150 mg Zn. The Minister of Environment [7] order concerning the standards of the quality of the soil allows 15 mg Cd, 600 mg Pb, 1000 mg Zn in the top levels of the industrial and communication areas (group C).

The results of the research concerning Cd exceed the highest admissible content indicated by Kabata-Pendias. In the location I small exceeding of the limit was detected, in the location II the exceeding amounts more then two times and in the location III nearly seven times (Table 2).

Table 2

The density and diversity of the pedofauna in the areas analyzed (the mean from 2007–2008)

Selected parameters	Locality I	Locality II	Locality III
Density of pedofauna (sp.no. per m ²)	2296	1437	1277
Diversity (number of taxonomic group)	17	10	9

The highest contents of the others metals analyzed were detected in the location III as well, but only the content of the Pb (153.13 mg/kg) exceeded more than two times the highest possible content mentioned above (Table 3). The content of the metals analyzed in each particular location correlated closely with the number and diversity of the pedofauna. In the location that was characterised by the highest concentration of the Cd, Pb, Ni and Zn, almost two times higher density of the soil organisms analyzed and almost two times lower diversity in comparison with the location I (with the lowest concentration of the metals) were detected (Table 2, 3).

Table 3

The content of the heavy metals in the soils on the areas analyzed in mg/kg (mean from 2007–2008)

Metal	Locality I	Locality II	Locality III
Cd	1.770	2.489	6.97
Pb	46.788	64.480	153.13
Ni	10.710	15.857	20.80
Zn	10.390	17.080	39.37

Conclusions

1. The areas adjacent to the traffic, densely build-up and with the small number of trees and bushes are characterized by several times higher contamination of the soil by the heavy metals than the park and grove areas remote around 300 m from the street.

2. The high content of Cd, Pb, Ni and Zn have the influence on the reduction of the pedofauna density and diversity.

Referens

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Abstrakt: Do badań wybrano trzy stanowiska: 1) trawnik nad Wisłą w pobliżu ruchliwej ulicy, 2) trawnik w parku miejskim usytuowany w odległości ok. 300 m od ruchliwego traktu komunikacyjnego oraz 3) trawnik w Lasku Mogiłskim. Badania prowadzono w latach 2007–2008 w okresie wiosennym. Określono zagęszczenie i różnorodność fauny glebowej, zawartość metali w glebie, jej wilgotność, temperaturę i odczyn pH. Stwierdzono związek między zawartością Cd, Pb, Zn i Ni a zagęszczeniem i różnorodnością pedofauny. Na stanowisku o największej zawartości wyżej wymienionych metali zagęszczenie i różnorodność fauny glebowej było najmniejsze, natomiast w glebie o najmniejszej koncentracji tych metali badane parametry osiągnęły największą wartość.

Słowa kluczowe: metale ciężkie, fauna glebowa, zagęszczenie i różnorodność