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RESEARCH ON POSSIBILITY OF USING POTATO BEETLE (*LEPTINOTARSA DECEMLINEATA* SAY) AS A BIOINDICATOR OF SOIL POLLUTED BY LEAD

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Abstract: The bioindicative research conducted in 1998 concerned the soil polluted by lead in the region of Glass Factory in Krosno. Potato beetle larvae descending to soil for pupation were the soil bioindicator. Samples of soil were collected in the distance of 500 to 1,000 m from the factory emitters, and later the lead content was determined in the Chemical Agricultural Station in Rzeszów. The lead level in the 1st pollution zone was 200.0 mg Pb/kg while in the 2nd zone 70.0 mg/kg, and in the soil sample from the control field the level was 12.0 mg/kg. The obtained results of the analysis conducted in the laboratory of the Regional Experimental Station did not show any significant differences between both the beetle mass which emerged from the soil, and their number from the control field and the experimental one.

Key words: lead, agroecosystem, Colorado beetle

INTRODUCTION

Lead, similarly to mercury and cadmium, belongs to the most toxic elements causing serious environmental pollution (Zommer-Urbańska and Kukliński 1985). This metal cumulates in the surface levels of soil undergoing sorption through organic and mineral soil elements. In comparison to lead contamination caused by vehicles that comprises large areas of the country, the environmental pollution caused by this metal comprises only small area around the factory (Strusiński 1978). A large density of this element in soil can negatively influence the correct biological activity of soil and consequently lead to flora impoverishment on the contaminated area. Taking into consideration that soil is also the ecosystem for micro and mega-fauna and is the source of nutrition elements for them as well, we must acknowledge that destabilisation can bring negative consequences in the development of these organisms. This phenomenon can concern potato beetle whose one particular development stage takes place in soil. The aim of this research was to de-

termine whether and in which degree the soil contaminated by lead causes negative phenomena among the larvae of this insect that undergo pupation.

MATERIAL AND METHODS

The bioindicative research of soil contaminated by lead was conducted in 1998 in the laboratory of Regional Experimental Station in Rzeszów. The method did not differ from that applied to that time in this kind of research (Przybylski 1994). Potato beetle larvae in stage L_4 descending to soil for pupation were the bioindicator of the contaminated soil. For the purpose of the research the soil from plant plantation in the region of Glass Factory in Krosno was designated, where the production started twenty years ago. Considering the frequency of the blowing wind, the soil samples were collected in the north-east of the factory emitters. The area from which the samples were collected was divided into two zones, the first in the distance of 500 m and the second zone from 500–1,000 m from the emitters. The collected samples were transferred to the Regional Chemical-Agricultural Station in Rzeszów, where the chemical analysis on the lead content was conducted. Afterwards vases were half filled with this soil and they were placed on the laboratory table. The control treatment was the soil from the phenological garden of the Regional Plant Protection Inspectorate in Rzeszów. While the larvae were descending into the soil for pupation, they were collected from one potato plantation not being treated with plant protection products and located away from the factories. Before putting them in vases (20 individuals in each vase) they were weighed in order to obtain the average beetle larva mass for each treatment. Beetles emerging from the soil were treated similarly, i.e. both larvae and beetles were not fed during the experiment. The experimental design was completely randomized with 4 replications. The obtained results were analyzed statistically and presented in tables 1–3.

RESULTS

The results of chemical analysis of soil for the level of its contamination caused by lead were the basis for undertaking bioindicative research. The obtained data showed that the content of this metal in soil was much above the average one noted near big city agglomerations. In the sample collected in the distance to 500 m from the emitters 200.0 mg Pb/kg was determined and in the distance of 500 to 1,000 m – 70.0 mg/kg. The average content of lead in soil from the phenological garden in Rzeszów was 12.0 mg/kg. The average potato beetle larva body mass placed in the vase filled with soil from the 1st zone was 0.160 g and in the vase filled with soil from the 2nd zone – 0.161 g. In the control vase it was 0.159 g. The statistic calculations did not show any significant difference between particular treatments in the average larva body mass.

The emerging of beetles from soil of the particular treatments after pupation was on the 12th day from the complete descent of larvae to soil. The insects were weighed in a similar way in order to obtain the average insect body mass for each treatment. Similarly, in this instance, the difference in the average body mass of

Table 1. The average body mass of potato beetle before placing them in vases of particular experimental treatment

Test location Distance from emitters	Mass in g
Zone 1st – to 500 m	0.160
Zone 2nd – from 500 to 1,000 m	0.161
Control	0.159

Table 2. The average body mass of potato beetle, which emerged from the soil after pupation

Test location Distance from emitters	Mass in g
Zone 1st – to 500 m	0.103
Zone 2nd – from 500 to 1,000 m	0.106
Control	0.104
LSD (0,05)	0.0083

Table 3. The number of beetles, which emerged from the soil in particular experimental treatment

Test location	Number of beetles
Zone 1st – to 500 m	13.25
Zone 2nd – from 500 to 1,000 m	13.75
Control	15.00
LSD (0,05)	4.60

this insect was statistically insignificant and was for the 1st zone – 0.103 g, the 2nd one – 0.106 g and the control treatment – 0.104 g. Attention was also paid to the number of beetles which emerged from soil in experimental treatments. In the control treatment 15 insects were noted, in the other ones the number was close to that and in the 1st zone of pollution it was 13.25 individuals and in the 2nd zone 13.75 individuals. The statistic calculations did not show any significant difference in the number of beetles between the treatments.

CONCLUSIONS

1. Grounds in the region of Glass Factory in Krosno have the soil heavily contaminated by lead. This phenomenon concerns the soil located in the distance to 500 m from the emitters in which the content of this metal is nearly 20 times higher than in the soil collected for the control treatment.
2. The soil contaminated by lead did not cause any significant decrease in the average body mass of the beetle in comparison to the body mass of this beetle from the control treatment.
3. No statistically significant difference was noted in the number of the potato beetle, which emerged in the experimental treatment.
4. Potato beetle larvae are not a good bioindicator of the soil contaminated by lead.

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POLISH SUMMARY

BADANIA NAD MOŻLIWOŚCIĄ WYKORZYSTANIA STONKI ZIEMNIACZANEJ (*LEPTINOTARSA DECEMLINEATA* SAY) JAKO BIOINDYKATORA GLEBY ZANIECZYSZCZONEJ OŁOWIEM

Badania bioindykacyjne gleby zanieczyszczonej ołowiem, do którego wykorzystano larwy stonki ziemniaczanej schodzące do gleby na przepoczwarczenie, wykonano w 1998 roku. Glebę zawierającą ołów pobrano w rejonie huty szkła koło Krosna w odległości do 500 m i od 500 do 1000 m od emitorów huty. Dla obiektu kontrolnego próby gleby pobrano w ogródku fenologicznym Wojewódzkiego Inspektoratu Ochrony Roślin w Rzeszowie. Analizy chemiczne gleby w zakresie zawartości ołowiu wykonała Okręgowa Stacja Chemiczno-Rolnicza w Rzeszowie. Próby gleby pobrane w odległości do 500 m od emitorów zawierały 200,0 mg Pb/kg, od 500 do 1000 m – 70,0 mg/kg, natomiast gleba dla obiektu kontrolnego – 12,0 mg/kg. Otrzymane wyniki badań bioindykacyjnych opracowanych statystycznie nie wykazały istotnych różnic między poszczególnymi obiektami zarówno w masie ciała chrząszczy, które wyszły z gleby po przepoczwarczeniu się larw, jak i ich liczby.