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EFFECT OF SOIL CONTAMINATION WITH PETROL, DIESEL OIL AND ENGINE OIL ON SURVIVAL RATE OF *Arionidae* REPRESENTATIVES UNDER LABORATORY CONDITIONS

ODDZIAŁYWANIE SKAŻENIA GLEBY BENZYNĄ, OLEJEM NAPĘDOWYM I OLEJEM SILNIKOWYM NA PRZEŻYWALNOŚĆ PRZEDSTAWICIELI *Arionidae* W WARUNKACH LABORATORYJNYCH

Abstract: The investigations aimed at an assessment of representatives of *Arionidae* sensitivity to soil pollution with oil derivatives from the perspective of their use as bioindicators. The laboratory experiment, conducted in 3 replications, comprised the following objects: soil contaminated with unleaded petrol; soil contaminated with diesel oil; soil contaminated with used engine oil; control. Doses of 3,000 mg and 10,000 mg of oil derivative per 1 kg soil d.m. were applied. Petrol revealed the most toxic effect on the tested invertebrates among all three applied pollutants. Slugs revealed the greatest sensitivity only to soil contamination with petrol dose of 10,000 mg · kg^{-1} soil d.m., which evidences their considerable resistance to soil contamination with oil derivatives.

Keywords: oil derivatives, soil pollution, slugs

Gastropoda are regarded as good bioindicators of the environmental contamination [1]. Research on the effect of oil derivative effect on *Gastropoda* focused mainly on the marine environment [2, 3]. *Gastropoda* were also indicated by some authors as possible bioindicators of soil pollution with heavy metals (Cu, Ni and Co), since they were trapped exclusively in the unpolluted soil [4].

The investigations aimed at an assessment of representatives of *Arionidae* sensitivity to soil pollution with oil derivatives from the perspective of their use as bioindicators.

Material and methods

The laboratory experiment, conducted in 3 replications, comprised the following objects:

1. Soil contaminated with unleaded petrol;
2. Soil contaminated with diesel oil;
3. Soil contaminated with used engine oil;
4. Control.

Doses of 3,000 mg (marked "I") and 10,000 mg (marked "III") of oil derivative per 1 kg soil d.m. were applied. The soil used for the experiment was degraded chernozem formed from loess, classified as the very good wheat complex and soil quality class. The soil was dried at 60ºC for 5 days in a dryer and then contaminated using a syringe with formerly calculated and precisely measured amount of oil derivatives. Slugs were gathered on 23 June 2009 in Polish Aviators' Park in Czyzyny (Krakow) and then cultured for two weeks in 500 cm^3 containers. Each container held 300 g of soil dry mass. The animals were fed with fresh leaves of lettuce or dahlia supplied to the soil surface every week or more

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frequently. Five adult specimens were put in each container. Containers were covered with gauze for good ventilation. Slugs were cultured at 20±2ºC. Each week slug weight was measured. Dead specimens were removed. If the soil in the containers dried, it was sprinkled with 20 cm^3 of distilled water. Statistical analysis comprised one-way ANOVA. Means were differentiated using LSD Fisher's test. All computations were conducted using "Statistica 8.0" programme.

Results and discussion

Petrol dose of 10,000 mg · kg^{-1} soil d.m. proved the most toxic for slugs. After one day from the beginning of the experiment all specimens in this object were dead (Fig. 1). For the first four days of culturing slug mortality rate was also significantly higher than in the control in the object with soil contaminated with petrol dose of 3,000 mg · kg^{-1} soil d.m. Soil contamination with diesel oil did not apparently affect slug viability over most of the experimental period. Only after 12 days a significant increase in these animals mortality rate was observed in the object with soil contaminated with diesel oil dosed 10,000 mg · kg^{-1} soil d.m. On the other hand, in the object where soil was contaminated with diesel oil dosed 3,000 mg · kg^{-1} soil d.m. survival rate was the highest among all objects, including the control. Soil contamination with used engine oil did not affect significantly slug mortality rate, either during the experiment duration.

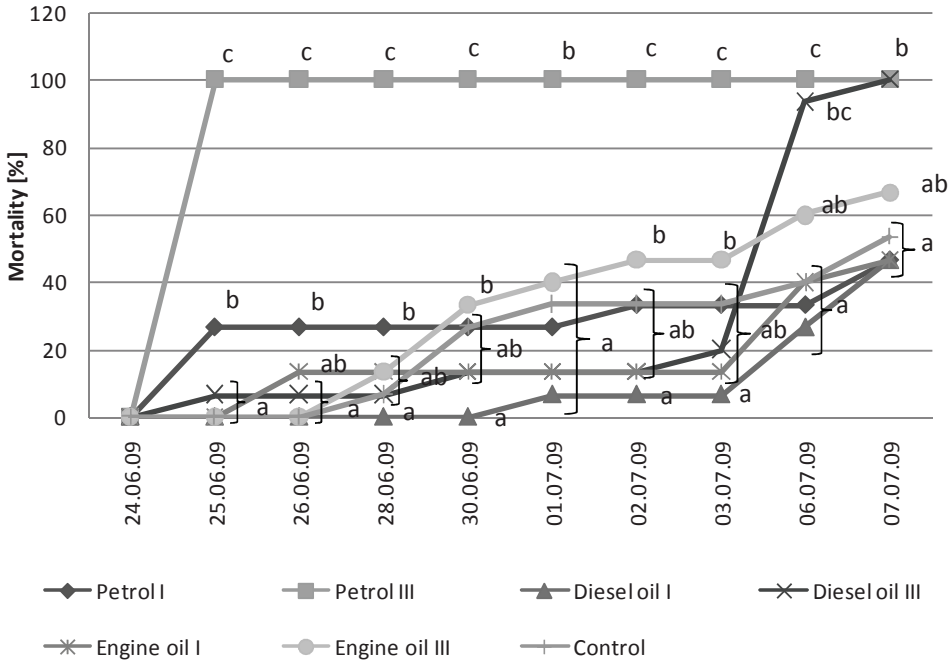

Fig. 1. Mortality rate of slugs [%] cultured in soil contaminated with oil derivatives. Means marked with different letters (a, b or c, etc) for individual dates of observation differ statistically at p = 0.05

Mean weight of live specimen during culturing was decreasing apparently in all investigated objects (Fig. 2). No statistically significant differences were noted between the analyzed objects. In long-term investigations on the occurrence of *Gastropoda* in soil contaminated with various oil derivatives the differences in the numbers of specimens trapped into pitfall traps in relation to the control were registered only after several months from the moment of soil pollution. Petrol had the least negative effect in this case, unlike under laboratory conditions. Petrol revealed the least negative effect also on the number of trapped *Hymenoptera*, *Formicidae* [5], *Coleoptera, Carabidae* [6] and *Collembola* [7]. It most probably results from its lower density and higher volatility than the other tested oil derivatives. It reveals high toxicity for a short time from the moment of pollution, which was clearly visible in the laboratory experiment. Field conditions (open space, air movement) facilitate evaporation of volatile fractions. There is a diversification between various slug species concerning their response to pollution with oil derivatives as was demonstrated by Lee et al [2] on an example of aquatic species. The authors explained the differences in sensitivity as dependant on various feeding habits. A detrivore species assimilated pollutants and was far more sensitive than herbivore species. It may also explain quite strong resistance to the applied pollutants revealed by slugs, which are herbivores, observed in the presented investigations. However, authors emphasize the advantages of slugs as indicators for testing environmental conditions, due to their abundance, ease for collection, wide distribution and sedentary nature.

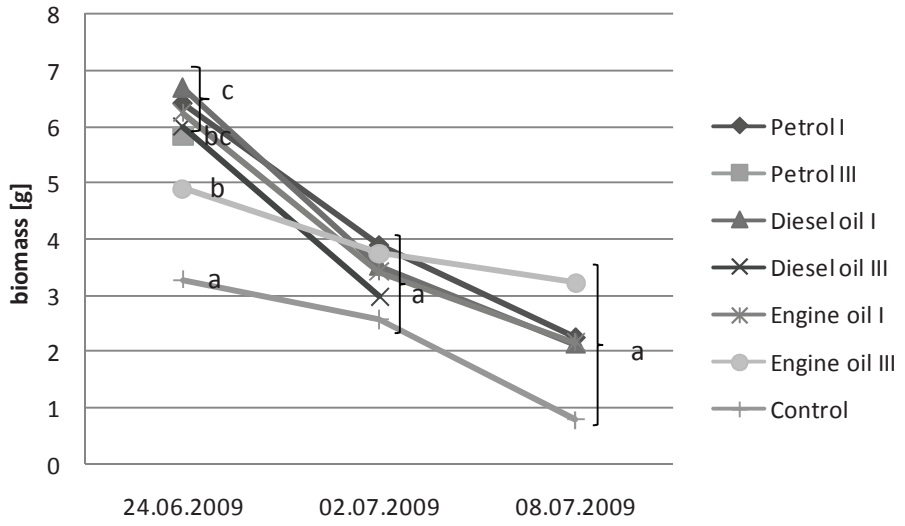

Fig. 2. Mean body weight of a single specimen of *Arionidae* cultured in soil contaminated with oil derivatives. Means marked with different letters (a, b or c, etc) for individual dates of observations differ statistically at p = 0.05

Conclusions

1. Petrol revealed the most toxic effect on the tested invertebrates among all three applied pollutants.

2. Slugs revealed the greatest sensitivity only to soil contamination with petrol dose of 10,000 mg · kg^{-1} soil d.m., which evidences their considerable resistance to soil contamination with oil derivatives.

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Abstrakt: Celem badań była ocena wrażliwości przedstawicieli *Arionidae* na zanieczyszczenia gleby substancjami ropopochodnymi pod kątem możliwości ich wykorzystania jako biowskaźników. Doświadczenie laboratoryjne przeprowadzono w 3 powtórzeniach i obejmowało ono następujące obiekty: gleba skażona benzyną bezołowiową, gleba skażona olejem napędowym, gleba skażona przepracowanym olejem silnikowym, kontrola. Zastosowano dawki 3000 i 10 000 mg substancji ropopochodnej na kg s.m. gleby. Benzyna charakteryzowała się najbardziej toksycznym efektem wobec badanych bezkręgowców spośród wszystkich trzech zastosowanych substancji ropopochodnych. Ślimaki wykazywały największą wrażliwość tylko na zanieczyszczenia gleby benzyną w dawce 10 000 mg · kg^{-1} s.m. gleby, co świadczy o ich dużej odporności na skażenie gleby substancjami ropopochodnymi.

Słowa kluczowe: ropopochodne, skażenie gleby, *Arionidae*