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## DYNAMICS OF *Opiliones* AND *Acarina* OCCURRENCE IN SOIL CONTAMINATED WITH OIL DERIVATIVES DURING BIOREMEDIATION PROCESS

### PRZEBIEG DYNAMIKI WYSTĘPOWANIA KOSARZY (*Opiliones*) I ROZTOCZY (*Acarina*) W GLEBIE SKAŻONEJ ROPOCHODNYMI W TRAKCIE PROCESU BIOREMEDIACJI

**Abstract:** The investigations were conducted to determine the effect of oil derivatives (petrol, diesel fuel and used engine oil) during the process of their bioremediation on dynamics of *Opiliones* and *Acarina* occurrence. No negative effect of applied oil derivatives on the occurrence of representatives of epigeal *Opiliones* or *Acarina* arachnid order on the soil surface was stated. Applied bioremediation of soil polluted with petrol contributed to a reduction in *Opiliones* occurrence, particularly during the first month after it was conducted, whereas a positive effect of this measure on the presence of epigeal *Acarina* was registered in the third month after soil contamination.

**Keywords:** oil derivatives, soil, bioremediation, *Opiliones*, *Acarina*

Arachnids are counted to animals which fast respond to all changes in the environment caused by human activity, therefore their role as potential bioindicators has been emphasized [1-4]. Important groups among *Arachnida* are *Opiliones* and *Acarina*. Both play a crucial role in organic matter decomposition in soil.

Natural ground reclamation in result of extremely serious pollution with oil derivatives may take between several to several hundred years. Application of modern biotechnological methods using selected microorganisms allows to shorten the time of reclamation to several months. Such acceleration of oil derivatives decomposition process may affect soil invertebrates.

The work aimed at investigating the effect of oil derivatives during the process of their bioremediation on dynamics of *Opiliones* and *Acarina* occurrence.

#### Materials and methods

The investigations were conducted at the Experimental Station of the University of Agriculture in Krakow situated in Mydlniki near Krakow. The experiment, conducted in four replications, comprised the following objects in two series (with bioremediation and without bioremediation): 1. Control - unpolluted soil (C); 2. Soil artificially polluted with petrol (P); 3. Soil artificially polluted with diesel fuel (DF) and 4. Soil artificially polluted with used engine oil (EO). In autumn 2009, the indigenous soil was placed in 1 m<sup>3</sup> (1 m/1 m/1 m) containers specially adapted for this purpose. The containers were dug into the ground. Doses of 6 000 mg of oil derivative per 1 kg soil d.m. were applied in June

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2010. After one week a half of the containers with experimental soil was subjected to bioremediation using a biopreparation containing selected prokaryotic microorganisms, mainly bacteria. Detailed description of experiment was presented in other paper [5]. During the period from June to October 2010, epigeal fauna was trapped using Barber's traps (a 0.9 dm<sup>3</sup> jar dug in level with the ground surface and covered against rainfall water by a plastic roof) placed in the central part of each container. The traps were emptied once a week. Statistical computations were conducted using Statistica 9.0 PL programme. Means were differentiated using LSD (*least significant differences*) Fisher test on significance level  $\alpha = 0.05$ .

### Results and discussion

*Opiliones* were the most rarely trapped in conditions of control soil on which biopreparation was used (Fig. 1). During the first month after the moment of soil contamination these arachnids were most frequently trapped in conditions of soil polluted with petrol, without bioremediation. Their number was significantly higher than on the unpolluted soil (both with and without biopreparation) and on the non-remediated soil contaminated with diesel fuel. Statistical analysis for the subsequent months passing from the moment of soil pollution did not reveal any marked effect of the analyzed pollutants or applied bioremediation on the occurrence of *Opiliones*. A higher average number of trapped *Opiliones* was registered for the whole period of the experiment in conditions of soil contaminated with petrol and diesel fuel without the use of bioremediation than in conditions of control soil on which the biopreparation was poured, however the differences were insignificant for the unpolluted soil without the biopreparation (Fig. 4). A decreased number of trapped *Opiliones* was noted in conditions of soil contaminated with petrol and subjected to bioremediation as compared with the same object without biopreparation applied.

Data on the effect of pollutants on these arachnids are diverse. The research on the influence of soil contamination with oil derivatives in result of a serious road accident revealed that three years after the moment of pollution, *Opiliones* were trapped in greater numbers in the polluted area [6]. On the other hand, pollution with oil derivatives, whose source were seasonal floodwaters of streams polluted with these substances, limited the numbers of both *Opiliones* and *Acarina* in the investigated area [7]. The differences may be due to the size of polluted area. In the presented investigations the soil was polluted with individual kinds of oil derivatives within a limited area, but usually soil pollution with oil derivatives are point source pollutions. In research on the effect of sulphur pollutants on soil invertebrates, the representatives of both *Opiliones* and *Acarina* caught using Barber's traps were classified to groups which did not show changes in their numbers under the influence of this factor [8].

*Acarina* occurred in greatest numbers in the initial period of the experiment, *ie* at the turn of June and July (Fig. 2). Later their number increased again in September. No significant effect of oil derivatives on epigeal *Acarina* occurrence was noticed for the two first months after the soil pollution (Fig. 3). Slightly bigger number was trapped on unpolluted soil but the differences fell within the range of experimental error. In the third month of the experiment more numerous *Acarina* presence was noticed in conditions of soil

contaminated with petrol and subjected to bioremediation than in the same object but without bioremediation.

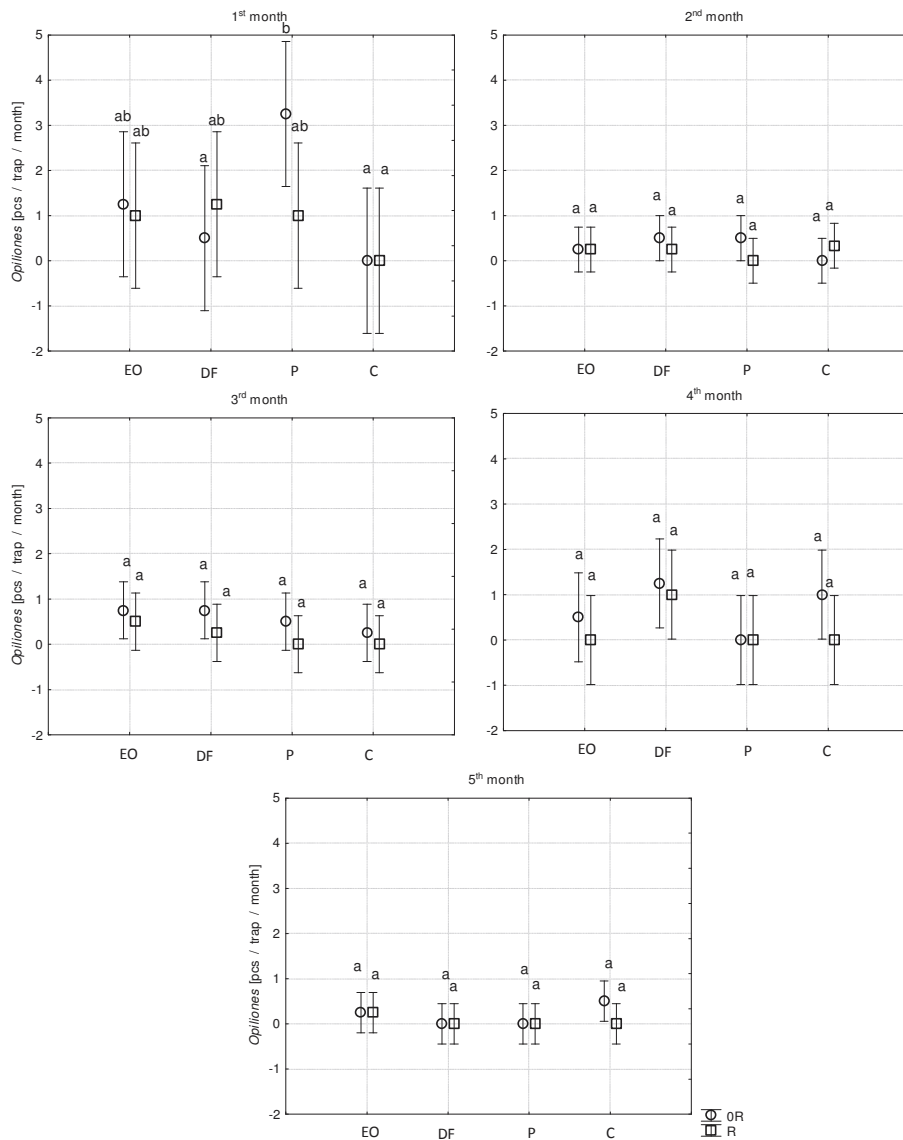


Fig. 1. Occurrence of *Opiliones* trapped using Barber's traps in individual months after soil contamination. EO - soil contaminated with used engine oil, DF - soil contaminated with diesel fuel, P - soil contaminated with petrol, C - unpolluted soil, OR - series without bioremediation, R - series with bioremediation. Means marked with the same letters do not differ significantly according to LSD test at  $\alpha = 0.05$ ; factors contamination x remediation.  $\perp$  Mean  $\pm$  0.95 confidence interval

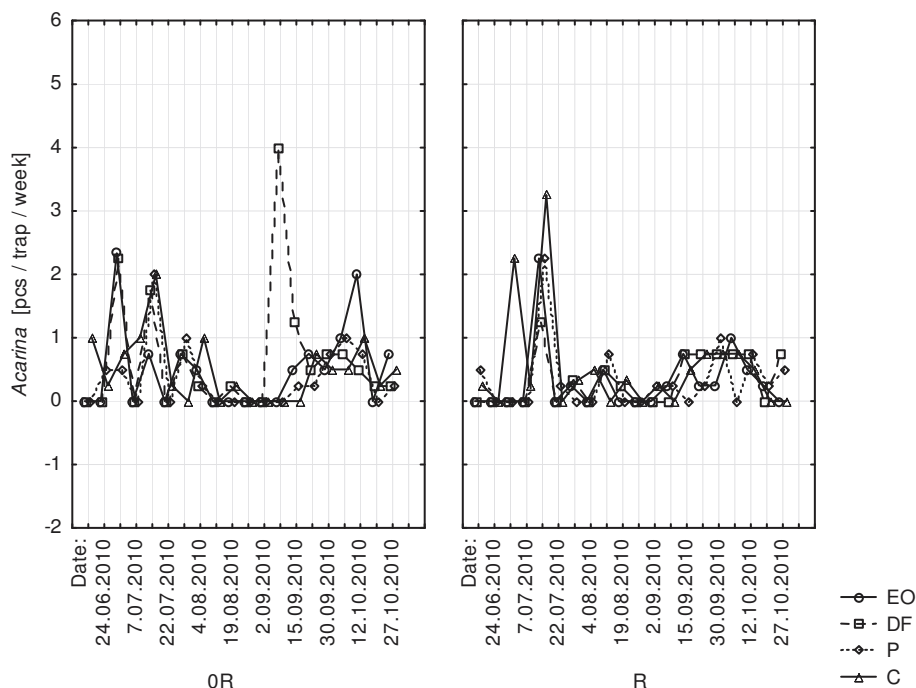


Fig. 2. Course of dynamics of *Acarina* occurrence trapped using Barber's traps. The symbols as in Figure 1

In the subsequent months number of *Acarina* in individual objects fluctuated, *ie* after 4 months the largest number of these invertebrates were spotted on soil contaminated with diesel fuel and non-remediated, while after 5 months on the soil contaminated with engine oil and also without bioremediation. On average for the whole investigated period significant differences in the number of trapped *Acarina* were registered only between the object where the soil was contaminated with engine oil, in the series subjected to bioremediation (the least number of *Acarina*) and the object with soil polluted with diesel oil, where bioremediation was not applied (the highest number of *Acarina*) (Fig. 4). *Oribatida* are one of the more numerous groups among soil *Acarina*. After 2 and 3 years from the moment of soil contamination with oil derivatives in result of road disaster slightly bigger number of these invertebrates were caught in the unpolluted area, although the differences were not statistically proved [6]. According to some authors [3, 9] use of oribatid mites as bioindicators in agroecosystems or polluted areas must incorporate information on life history traits and habitat profiles for species. Khalil et al [3] did not find relationship between metal pollution and total density of oribatids but there were differences in occurrence of selected species. Reports on the effect of various kinds of anthropogenic factors on the occurrence of soil *Acarina* are diversified. Research on the influence of various kinds of fertilization on soil *Acarina* presence demonstrated their increased number when low doses of liquid manure were applied but reduced occurrence at

too high doses, particularly if they contained sodium hydroxide and calcium hydroxide supplements [10].

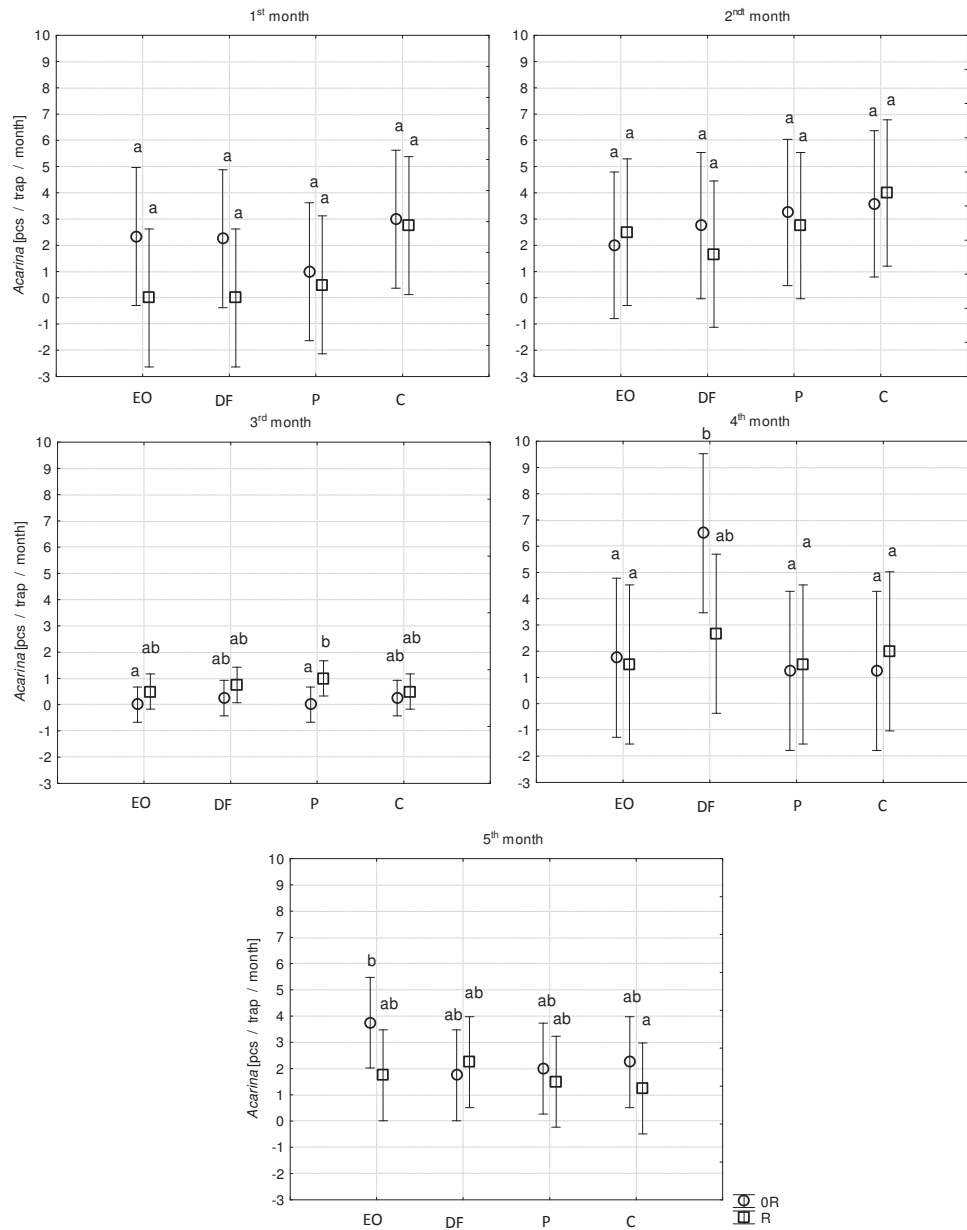


Fig. 3. Occurrence of *Acarina* trapped using Barber's traps in individual months after soil contamination. The symbols as in Figure 1

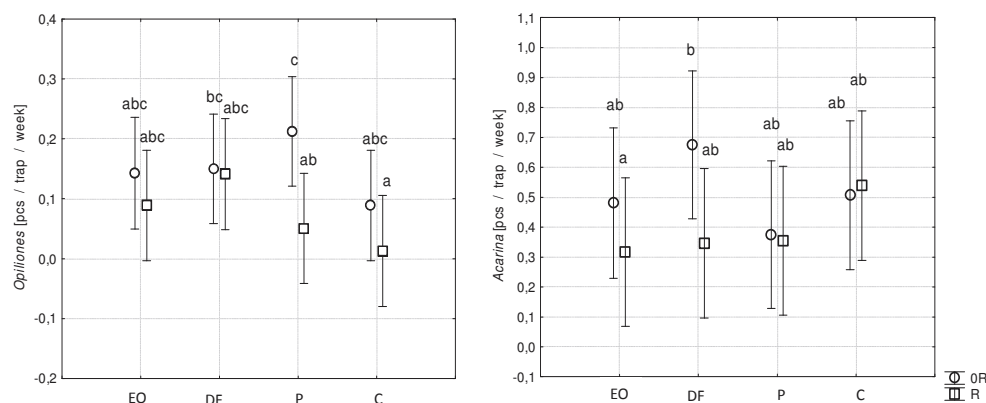


Fig. 4. Occurrence of *Opiliones* and *Acarina* trapped using Barber's traps mean during experiment. The symbols as in Figure 1

## Conclusions

1. No negative effect of applied oil derivatives on the occurrence of representatives of epigeal *Opiliones* or *Acarina* arachnid order on the soil surface was stated.
2. Applied bioremediation of soil polluted with petrol contributed to a reduction in *Opiliones* occurrence, particularly during the first month after it was conducted, whereas a positive effect of this measure on the presence of epigeal *Acarina* was registered in the third month after soil contamination.

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I ROZTOCZY (*Acarina*) W GLEBIE SKAŻONEJ ROPOPOCHODNYMI  
W TRAKCIE PROCESU BIOREMEDIACJI**

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**Abstrakt:** Celem pracy było zbadanie oddziaływania substancji ropopochodnych (benzyny, oleju napędowego, zużytego oleju silnikowego) w trakcie procesu bioremediacji gleby na przebieg dynamiki występowania kosarzy i roztoczy. Nie stwierdzono ujemnego wpływu zastosowanych substancji ropopochodnych na występowanie na powierzchni gleby przedstawicieli pajęczaków naziemnych z rzędu kosarze oraz roztocza. Zastosowana bioremediacja gleby zanieczyszczonej benzyną przyczyniła się do ograniczenia występowania kosarzy, szczególnie w ciągu pierwszego miesiąca po jej przeprowadzeniu, natomiast odnotowano korzystny wpływ tego zabiegu na obecność roztoczy naziemnych w trzecim miesiącu po skażeniu gleby.

**Słowa kluczowe:** ropopochodne, gleba, bioremediacja, *Opiliones*, *Acarina*