

EFFECT OF CHEMICAL TREATMENTS ON SOIL NEMATODE COMMUNITY IN WINTER WHEAT FIELD

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Abstract: Nematode communities were used as bioindicators of changes in agroecosystems caused by anthropogenic factors. The aim of this study was to examine the impact of chemical disturbances on nematode communities in the soil in winter wheat fields. The sampling was done three times, before disturbances, after fertilization and third time was after insecticides applications. Number of genera significantly decreased after disturbances caused by chemical application, while total number of nematodes did not change significantly in numbers. Maturity index (MI) showed significant differences between first and last sampling, as well as PPI/MI. Plant parasitic index (PPI) did not differ significantly between sampling periods.

Keywords: nematode community in the soil, bioindicators

Introduction

In numerous studies, nematode communities showed possibilities to be good indicators of different kind of disturbances in ecosystems. Some groups of nematodes can survive under disturbed environmental conditions such as global climate change which also in the last decades influenced the water regimes of soil, which is crucial for a nematode survival (Mikulec & Stehlova, 2006, Vago et al., 2006). There are differences in feeding behavior (Yeats et al., 1993), and predominantly, omnivore and predators have great sensitivity to disturbances. Nematodes can be classified upon many different criteria, but the development of Maturity index (MI) (Bongers, 1990) presents a significantly advanced tool for predicting ecological processes in soil ecosystems what is very important, since the soil health is the most important national resource (Várallyay, 2006). Above that, they play a great role in soil nutrition cycle, especially free-living nematodes. For those reasons nematode communities have potential to serve as very good biotic indicators of soil processes (Sohlenius & Wasilewska, 1984). Structure of nematode communities can reflect differences in agroecosystem conditions (Ivezic et al., 2000; Brmez, 2007), organic adding (Goede, 1993), heavy metal compounds (Korthals, 1997), soil tillage system (Freckman & Ettema, 1993), air pollution (Zullini & Peretti, 1986) river pollution (Zullini, 1976), and different kind of environmental monitoring (Bongers & Ferris, 1999). The objective of this investigation was to determine if the nematode communities in the soil could serve as bioindicators of chemical inputs into the soil.

Materials and methods

Research was conducted in 2001, in Kneževo, Baranya County, Croatia (45°32'N, 18°44'E). The nematode communities in the soil were investigated in winter wheat field which was sampled three times, before and after disturbances caused by chemical input into the soil. Each sampling was done in four replications.

1. Sampling was done on 12 of March 2001, before any chemical disturbances in soil.
2. Sampling was done on 24 of April 2001, after KAN application (KAN was applied on 6 of April, 2001 in dosages of 100 kg ha⁻¹).

3. Sampling was done on 17 of May 2001, after KAN and herbicide Sansac application (against *Oulema melanopus* L). Herbicides were applied in recommended dosage of 1 l ha⁻¹.

The soil type was calcic chernozem, with the following characteristic: pH(H₂O) = 8.6; pH(KCl) = 7.53; Al(P₂O₅) = 18.7mg/100 g of soil; Al(K₂O) = 28.42 mg/100 g of soil; CaCO₃ = 2.12 and an organic content of 2.61%. The arable treatments had been in place for at least 50 years before nematode sampling began, and all received similar fertilizers applications. Standard tillage regimes included deep plowing on 30 cm and harrowing. Sampling was done using a corer Ø 2 cm, to a depth of 20 cm. Nematodes were extracted from 100 g subsamples of soil by the Seinhorst method (Seinhorst, 1956), at the Faculty of Agriculture in Osijek, in Laboratory of Entomology and Nematology. Identification was done according to Bongers (1994), Mai & Lyon (1975) and Andrassy (1984). Total number of nematodes and number of genera were determined and compared between sampling periods, as well as Maturity index (MI), Plant parasitic index (PPI) and PPI/MI (Bongers, 1990). Trophic structure was determined according to Yeates et al. 1993. The data were analyzed statistically, using ANOVA and LSD test on computer program Statistica by Vukadinović (Vukadinović, 1985)

Results and discussion

Nematode communities in the soil showed statistically significant differences between numbers of genera occurred in each sampling period, while total number of nematode did not differ significantly between treatments (Table 1.). Total number of nematodes and number of genera are shown in Figure 1.

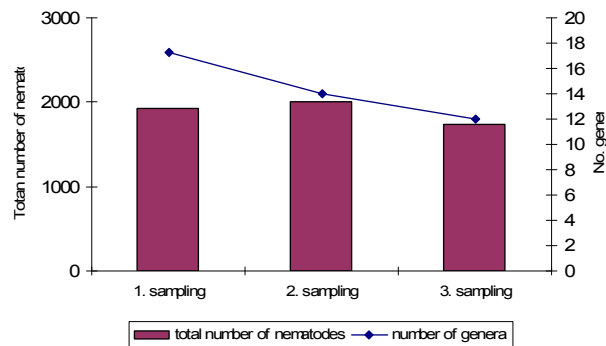


Figure 1. Total number of nematodes and number of genera in each sampling period

Total number of nematodes was similar in all sampling periods. Number of genera decreased throughout sampling periods such as chemical input in the soil increased. Some genera of nematodes showed tolerance to chemical treatments and increased in numbers (*Aphelenchoides*), some showed tolerance without increasing in numbers (*Tylencholaimellus*, *Mylonchulus*, *Clarkus*), while some genera decreased in number or disappeared with increasing of chemical disturbances (*Alaimus*, *Discolaimus*).

Trophic structures of nematode communities are shown in Figure 2.

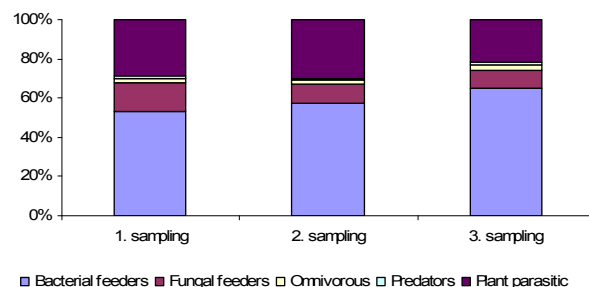


Figure 2. Trophic structure per each sampling period

Trophic structure analyses showed similar patterns in all treatments investigated. Five trophic groups occurred (bacterivorous, fungivorous, plant-feeding nematodes, omnivorous and predators) in each sampling period.

Results of MI, PPI and PPI/MI analyses, average abundance, average genera richness, as well as statistic analyses are presented in Table 1.

Table 1. Average of MI, PPI, PPI/MI, total number of nematodes and number of genera with LSD test
n.s. not statistically different

Tretments	Average MI	Average PPI	Average PPI/MI	Average Total no. nematodes	Average no. genera
1 sampling	1.725	2.575	1.5	1922	17,25
2 sampling	1.725	2.725	1.6	2006	14
3 sampling	1.475	2.8	1.85	1742	12
Lsd 0,05	0.2013	n.s.	0.2557	n.s.	1.9038
Lsd 0,01	n.s.	n.s.	n.s.	n.s.	2.7353

Significant differences occurred between first and last sampling period for MI and PPI/MI, while PPI did not differ significantly between sampling periods. MI and PPI/MI showed greatest disturbances in third sampling period, when nematode communities were most disturbed and affected by fertilization and insecticidal application.

Conclusions

Nematode communities in winter wheat field showed characteristic that made them suitable bioindicators of chemical disturbances in the soil, especially in number of genera, MI and PPI/MI. Tolerance to chemical disturbance showed following genera: *Tylencholaimellus*, *Myonchulus*, *Clarkus* and *Aphelenchoides*, while *Alaimus* and *Discolaimus* appeared to be sensitive to chemical disturbances in the soil ecosystem.

Acknowledgements

Authors wish to express their gratitude to the production farm "Knezevo". This research had been sponsored by the Ministry of Science and Technology of the Republic of Croatia.

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