The dynamic of nematodes community in organic strawberry plantations is affected by the kind of fertilizers and soil conditioners applied

A. Chałańska[1], E. Malusá[1] and A. Bogumil[1]

Abstract

A field study on strawberry cv. Elsanta was conducted in 2010-2013 to monitor the structure of nematodes communities in response to the treatment with fertilizers and soil improvers from different origins (plant or vermicompost extracts, microbial inoculates and food processing waste). Soil samples were taken from the soil of the root zone before the application of the products and at the end of the growing season. Qualitative and quantitative analysis of the nematodes community was carried out, assigning them to one of five trophic groups. The changes in nematodes populations are suggesting that different organic fertilizers and soil improvers used in organic strawberry production may have additional benefits to soil quality which is ultimately affecting plant growth and health.

Keywords: nematodes, organic fertilizers, nutrients cycle, plant-soil microorganisms interaction

Introduction

Organic farming practices are affecting soil microbial activity. Consequently, the number of fungal and bacterial feeding nematodes tend to increase in organic managed soils (Ferris *et al*., 1999). However, since organic fertilizers and amendments differ in physical, chemical and microbiological composition, their effects on nematode communities could vary (Bulluck *et al*., 2002). A study has been conducted on organically grown strawberries to evaluate the effect of different organic fertilizers and amendments on the dynamic of nematode communities.

Material and Methods

The experiment was carried out with strawberry plants cultivar 'Elsanta' in four plots of 25 plants each in 2010-2013. Plots received 5 different treatments to soil or to both soil and leaves (manure, vermicompost extract, manure in association with microorganism consortium or seaweed extract or stillage from yeast production). Plants treated with a mineral fertilizer or not treated were used as controls. Soil samples were collected from soil of the root zone at spring time, before applying the products, and at the end of the growing season. Extraction of free living nematodes from soil was carried out with a Oostenbrink apparatus using a collecting mesh of 40 µm. Qualitative and quantitative analysis of the nematodes community was carried out, assigning them to one of five trophic groups (plant feeding, hyphal feeding, bacterial feeding, omnivorous and predators). On the basis of the average number of plant feeding nematodes, the effectiveness of the fertilizers and soil improvers was calculated, according to the Henderson-Tilton formula. Differences of treatments were statistically analysed by ANOVA and means separated by Duncan test with $p \leq 0.05$.

[1] Research Institute of Horticulture, Skierniewice, 96-100, Konstytucji 3 Maja 3/5, Poland, aneta.chalanska@inhort.pl

Results and Discussion

The number of bacterial feeders nematodes was increased (two- to five-fold) by the application of manure alone or with the addition of titanium, yeast stillage as well as after the application of a vermicompost extract and microbial inoculum containing both mycorrhizal fungi and plant growth promoting bacteria. On the other hand, the number of plant parasitic nematodes was decreased (up to 5-fold) after the application of several kinds of organic fertilizers and soil conditioners, including manure. The changes in the nematode population structure were quite consistent throughout the experiment, though the seasonal conditions were also affecting the results.

Table 1: Effect (%) of organic fertilizers on the reduction of plant feeding nematodes population in comparison with untreated control.

No.	Treatment	Year			
		2010	2011	2012	2013
1.	Mineral fertilizer	0.0 a	38.2 c	19.2 b	0.0 a
2.	Manure	23.6 b	0.0 a	50.3 d	0.0 a
3.	Microorganisms	64.4 c	9.0 b	25.6 b	39.5 c
4.	Vermicompost extract	64.5 c	5.9 ab	0.0 a	51.1 d
7.	Seaweed ext. + ½ manure	26.6 b	27.3 c	46.9 d	14.7 b
8.	Titanium + manure	56.6 c	75.7 d	37.9 c	61.0 d
9.	Yeast stillage +½ manure	0.0 a	0.0 a	0.0 a	76.6 e

On the other hand, the application of the different fertilizers and soil improvers did not induce significant changes in the number of nematodes of the other trophic groups (fungal feeders, omnivorous and predators). Only the microbial inoculum induced an increase of both bacterial and fungal feeding nematodes, which are groups able to migrate to places of high bacterial activity becoming important grazers of rhizobacteria (Bonkowski, 2004).

The positive effect of organic amendments on the population size of plant parasitic nematodes and in changing the structure of the nematodes' population with increase of fungal and bacterial feeding nematodes has been confirmed (Bulluck *et al*., 2002; Nahar *et al*., 2006). It is interesting to note that some products (i.e. seaweed extract and titanium) influenced the nematode community even if they were applied as foliar. This shall point to the fact that these products have affected the nematodes population through the plant.

Considering the impact of nematodes on N cycling, N availability and the role in the soil food web (Bonkowski, 2004), the results are suggesting that different organic fertilizers and soil improvers used in organic strawberry production may have additional benefits to soil quality which is ultimately affecting plant growth and health.

Acknowledgements

Work financed by EU Program of Regional Development – Operational Program „Innovation Economy", contract nr UDA-POIG.01.03.01-10-109/08-00.

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Citation of the full publication

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