

The impact of different organic fertilizers on the soil nematode assemblages in an organic apple orchard

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Abstract

A trial testing different regionally available organic fertilizers (vinassa, clover pellets, horn shavings, biodigestate and manure) was established in 2018 in an organic apple orchard and their effect on soil nematodes biodiversity was assessed by determining the composition of trophic groups and calculating some diversity indexes. Microbial feeding nematodes reacted rapidly to introduction of organic fertilizers due to the likely stimulation of bacteria and fungi activity. Manure induced the highest increase in bacteria feeders and Vinassa on fungal feeders and omnivores. The biodigestate promoted the plant feeders. Considering the biodiversity indexes, the greatest maturity and structure indexes were found in soil fertilized with Vinassa and biodigestate, while the lowest resulted in soil fertilized with horn shavings and manure. The different characteristics of the applied fertilizers (e.g. physical status, N mineralization rate, nutrient content, etc.) could be taken into consideration when assessing the effect on individual trophic groups of soil nematodes and on their community composition.

Keywords: Organic Fertilizers, Soil Nematodes, Soil Biodiversity.

Introduction

Developing optimal fertilization methods that connect plant nutrient requirements and maintaining soil biodiversity is a challenge for organic agriculture. Properly developed methods should increase nutrient efficiency and improve nutrition and health of cultivated plants and soil.

Soil nematodes play a significant role in decomposition of soil organic matter, mineralization and nutrient cycling (Ingham et al., 1985). Therefore, the trophic and genera structure of nematode populations can provide an indication of biodiversity and various ecosystem disturbances (Yeates, 2003).

Material and Methods

The trial was carried out in 2018-2019 in an experimental apple orchard located near Skierniewice (Central Poland). Different types of new fertilizers (vinassa – a stillage from yeast production, clover pellets, horn shavings manure and biodigestate) were evaluated and compared to unfertilized or dry granulated manure application (standard fertilizer) under a complete random block design with three repetitions per treatment. The fertilizers were applied to the field once a year, in springtime (May), in an amount to ensure the same level of supplied nitrogen (70 kg N/ha = 40 g N/tree).

Soil samples for nematodes analyses were collected 5 times in 2018 and a subsample of 250 ml soil was used to extract nematodes using Oostenbrink elutriator method (van Bezooijen, 2006). Which were fixed using TAF (Courtney et al., 1955). The effect of the fertilizers on soil nematodes biodiversity was assessed by determining the composition of trophic groups and calculating some diversity indexes.

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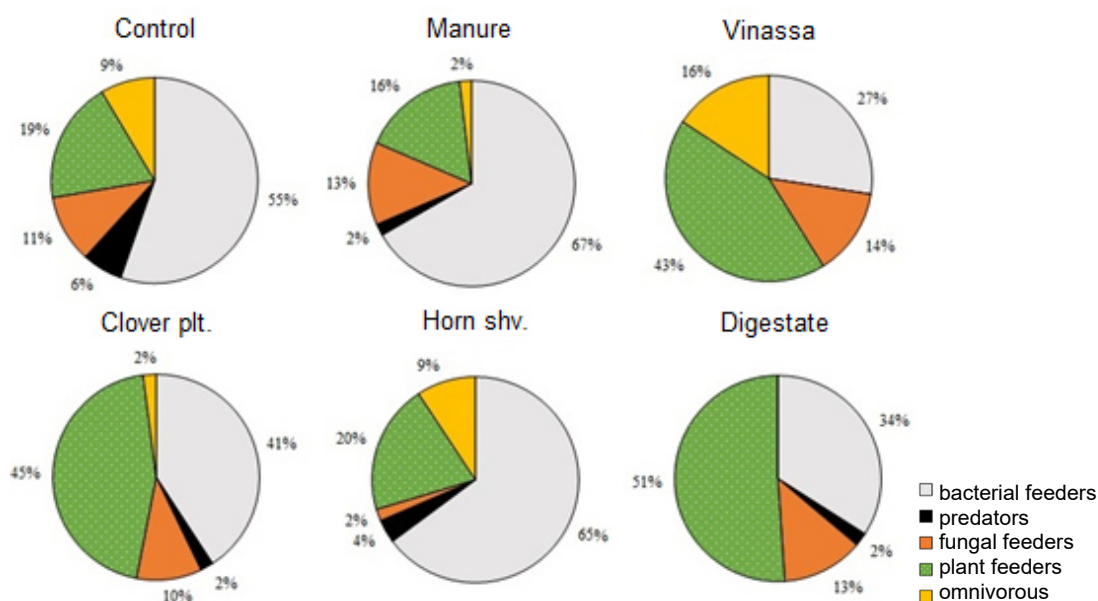


Figure 1. Effect of different organic fertilizers on soil nematodes trophic structure (%).

Tab. 1. Effect of different organic fertilizers on the Maturity Index (MI - Bongers, 1990) and Structure Index (SI - Ferris et al., 2001) of soil nematodes communities.

MI	Control	Manure	Vinassa	Clover plt	Horn shv.	Digestate
21.05.2018	1.89	1.62	2.45	1.89	1.88	1.70
25.09.2018	2.12	2.29	2.29	1.58	1.83	2.11
\bar{x}	2.15	1.95	2.02	1.89	1.78	1.96
SI						
21.05.2018	71.60	26.67	72.09	45.10	71.28	23.53
25.09.2018	80.27	72.33	83.08	46.27	71.76	76.32
\bar{x}	70.39	49.49	62.23	52.83	55.13	64.99

Results and Discussion

The different types of organic fertilizers modified the trophic groups of soil nematodes (Fig. 1). Microbial feeding nematodes reacted rapidly to introduction of organic fertilizers due to the likely stimulation of bacteria and fungi activity. Bacterial feeders increased the most in soil affected with manure, fungal feeders after Vinassa. Plant feeders were promoted by the application of the biodigestate. Predators and omnivores represent the highest trophic level amongst soil microfauna. They are highly dependent on soil properties and very sensitive to pollutants. The highest share of omnivores was observed in soil fertilized with Vinassa, and of predators in control (Fig. 1).

The different types of fertilizers also affected the composition of the soil nematodes communities as revealed by the biodiversity indexes (Tab.1). The greatest maturity and structure were found in soil fertilized with Vinassa (MI=2.02, SI=62.23) and biodigestate (MI=1.96, SI=64.99), while the lowest resulted in soil fertilized with horn shavings (MI=1.78) and manure (SI=49.49).

Organic fertilizers have different dynamics of soil nutrient availability (Moritsuka et al., 2001), which can also affect soil fauna abundance and structure (Hole et al., 2005). The preliminary results presented here indicate that the different characteristics of the applied fertilizers (e.g. physical status, N mineralization rate, nutrient content, etc.) could be taken into consideration when assessing the effect on individual trophic groups of soil nematodes and also on their community composition, i.e. the biodiversity status of these organisms.

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