BIOLOGICAL DIVERSITY OF NEMATODE COMMUNITIES IN CONVENTIONAL AND ORGANIC OLIVE FARMING

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Abstract. The main objective of managing agricultural soil is maintaining soil fertility, in order to stimulate biological activity in the soil. The aim of this study was to determine variability in the presence and number of genera of nematodes, trophic structure and indices of biodiversity in the soil under conventional and organic olive farming. Research was conducted in the area of Porec in Istria, Croatia, through 5 years (from 2007 to 2011) in conventional and organic olive farming system. Total of 49 nematode genera were established in this study, 42 genera in conventional and 44 in organic farming system. Average number of genera over the investigated period in 100 g of soil were 14 in conventional and 17.10 in organic farming system and differ significantly in between. Trophic group analyses showed the dominance of plant parasitic nematodes in the conventional olive farming, and bacterivorous feeding nematodes in organic olive farming. Biological diversity indexes (H', N1 and λ) didn't differ significantly between conventional and organic farming.
Keywords: *nematodes genera, conventional and organic farming, Rhabditis, Tylenchus***,** *olives*

Introduction

Soil fertility is the base for determinate productivity of all agricultural production aspects and it is defined as soil possibility to provide nutriment for crops (Watson et al., 2002). Poor soil management practies have degraded soil and only way to ensure future food demands is that producers must improved management prectices (Kapp et al., 2014). Different production strategies reflect soil fertility by stimulating biological activity which ensures the stability of ecological processes and conditions in the soil. Organic farming maintains favorable conditions for the development of soil organisms that are essential for processes such as regulation, availability and circulation of nutrients (Blumenthal et al., 2003) and improves soil structure (Caravaca et al., 2006). Differences of nematodes community in soil between organic and conventional farming are higher in autumn compare to summer period (Neher, 1999). Rasmann et al (2012) predicted that nematodes of different feeding guilds use host-specific cues for chemotaxis. Abundance and biomass of individual species of bacterivorous in organic farming of tomatoes vary during the growing season (Ferris et al., 1996). Landa et al.

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(2014) have evaluated the effects of soil type and different soil management systems in commercial organic olive orchards in the structure and diversity of bacterial communities. Palomares-Rius et al. (2015) established high diversity of plan-parasitic nematodes associated to olive that can exert different damage to olive roots depending on the olive variety and their abundance.

The aim of study was to determine whether there is variability in the presence and abundance of nematode genera, trophic structure and indices of soil biodiversity under conventional and organic farming systems in the olive production.

Material and methods

The study was conducted in the Porec area (45°13'33" N and 13°35'38" E) in region Istria, Croatia, over 5 years (from 2007 to 2011) in conventional and organic olive plantation. Olive plantation in conventional farming system is located on the site of St. Anne, in the area Cervar`s, Porec. It was planted in 1980 and 1981. Planting distances within rows and between rows are 7 x 5 m. Plantation included three varieties of olives: Picholine, Leccino and Pendolino. Olive plantation in organic farming system is located on the Larun, near Porec, planted in 1960. with planting distances within rows and between rows are 6 x 4 m. Plantation included two varieties of olives: Leccino and Pendolino. Growth form is multi-conical shape on ruddle soil.

Soil samples were collected in conventional and organic farming system in the following periods: June 2007, October 2008, April 2009, February 2010 and January 2011. Treatments of the study are marked as conventional farming (Con07, Con08, Con09, Con10, Con11) and organic farming (Org07, Org08, Org09, Org10, Org11). The main reason for sampling in different seasons throught years was the fact that the aim of investigation was to compare different farming system (organic and conventional), not to compare differences between years. Soil samples were collected in four replications, each on Leccino cultivar, for each treatment and the 40 soil samples were examined. Laboratory analysis of samples of nematode communities was carried out in the Laboratory of Entomology and Nematology, Faculty of Agriculture in Osijek, Croatia.

Extractions of nematodes from soil was carried by Erlenmeyer method (Seinhorst, 1956). Determination of nematodes according to the morphological characteristics to the genera level is determined according to: Andrassy 1984, 1988, 1993; Bongers, 1994; Hunt, 1993; Mai and Lyon, 1975 and Zullini, 1982. Number of genera, trophic groups (Yeates et al., 1993), indices of soil biodiversity: Shannon-Weaver index of diversity (Shannon and Weaver, 1949), Hill index - N1 (Neher et al., 2004) and Simpson index - λ (Simpson, 1949) were analized. Analysis of variance (ANOVA) was preformed using the program Statistics 6.

Result and discussion

Total of 49 nematode genera were found in this study. In the conventional olive farming were established 42 and in organic olive farming 44 different nematode genera. Average number of genera occurred in 100 g of soil was 14 and 17.10, in conventional and organic farming respectively.

Statistical analyse of nematode genera showed significant differences between conventional and organic olive farming ($p<0.05$, 2.4023).

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Most dominant genera in conventional and organic farming system were Rhabditis and Tylenchus.

The list of nematode genera occurred in both, conventional and organic farming systems were: Acrobeloides, Acrolobus, Alaimus, Anatonchus, Aphelenchoides, Aphelenchus, Apocerlaimellus, Clarkus, Criconema, Dipterophora, Ditylenchus, Enchodelus, Eucephalobus, Eudorylaimus, Fictor, Filenchus, Helicotylenchus, Heterocephalobus, Malenchus, Mesodorylaimus, Metateratocephalus, Microdorylaimus, Monhystera, Mylonchulus, Ogma, Panagrolaimus, Paramphidelus, Paratylenchus, Plectus, Pratylenchus, Prionchulus, Prismatolaimus, Psilenchus, Rhabditis, Rotylenchus, Tylenchorynchus, Tylenchus, while Basiria, Crossonema, Rhabdolaimus, Trypilla, Xiphinema occurred just in conventional olive farming and Ciloplacus, Panagrobelus, Prodorylaimus, Pungentus, Turbatrix, Tylencholaimellus, Tylopharinxs occurred just in organic olive farming.

In conventional farming system plant parasitic nematodes was dominant group, while in organic farming system bacterivorous and fungal feeding nematode dominated (*Table 1.*)

Table 1. *Statistical analyses of nematode community trophic structure under conventional and organic olive farming (2007-2011).*

	Bacterial feeding %	Plant parasitic feeding %	Fungal feeding %	Omnivorous %	Predators %
Lsd test	(p<0.05, 9.7921)	(p<0.05, 10.455)	(p<0.05, 6.1558)	(p<0.05, 5.0184)	(p<0.05, 1.6451)
Conventional	24,3 a*	51,6 a	16,6 a	5,6 a	1,9 a
Organic	34,7 b	30,2 b	23,8 b	8,7 a	2,6 a

* Values marked by different letters in the column are statistically different (P <0.05, LSD)

Differences in the way of farming can lead to different nematodes communities that are prevalent in the soil (Sanchez-Moreno et al., 2006). Briar et al. (2007) reported a higher proportion of bacterial feeding nematodes in organic production, while fungal feeding nematodes, omnivores and predators were significantly different between organic and conventional farming only in a certain period of investigation.

Similar proportion of nematode trophic groups in organic and conventional farming of asparagus in Greece was reported by Tsiafouli et al. (2005). In our study fungal feeding nematodes were represented in higher percentage in organic olive farming. Similar results report other researchers (Girvan et al., 2004, Liu et al., 2007), although some authors observed the opposite results (Clark et al., 1998, Berkelmans et al., 2003).

Analysis of biodiversity in conventional and organic olive farming was conducted by using Shannon-Weaver index (H'), the number of abundant genera (N1) and the index of dominance (λ) (*Table 2*).

Shannon-Weaver index (H') in organic olive farming through the investigation period showed less fluctuations of biodiversity in compare to conventional olive farming.

Statistical analysis of the H', N1 and λ indexes showed no significant differences between conventional and organically olive farming (*Table 2.*). Van Diepeningen et al. (2006) established similar results with no statistically significant differences between indices of biodiversity between conventional and organic farming.

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Table 2. *Statistical analyses of nematode under conventional and organic olive farming (2007-2011) by community index H', N1 and λ.*

	H'	N1	λ
Lsd test	(p<0.05, 0.1180)	(p<0.05, 0.2813)	(p<0.05, 0.0705)
Conventional	1.025 **a***	2.864 **a**	0.411 **a**
Organic	1.127 **a**	3.110 **a**	0.360 **a**

* Values marked by different letters in the column are statistically different (p<0.05, LSD)

Similar results of diversity indices were obtained in Spain in the production of olives in conventional and organic farming (Garcia-Ruiz et al., 2009). Neher (1999) concludes that the best time to measure the trophic diversity between conventional and organic agricultural farming is in the autumn, because then the differences are the most obvious.

Conclusion

Number of genera and trophic group structure proved to be an excellent bioindicator of difference between conventional and organic olive farming. Both parameters statistically distinguished differences between production systems. Diversity indices (H', N1 and λ) did not differ significantly between conventional and organic olive farming in this specific investigation, but still have to be consider as important in future similar research.

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