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SPECIES COMPOSITION OF PLANT PARASITIC NEMATODES *PRATYLENCHUS* SPP. IN CONVENTIONAL AND ORGANIC PRODUCTION OF RASPBERRIES

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Abstract

The sustainable organic production involves a lot of difficulties in pest control. Plant-parasitic nematodes of the genera Pratylenchus cause significant economic damage to raspberry production. To study the species composition of root-lesion nematodes of Pratylenchus spp., observations were carried out of raspberry plants in conventional and organic cultivation systems. The species composition of the established nematodes by different farming technologies was similar. In the conventional production, the species composition of nematodes was relatively homogeneous, as the number of established Pratylenchus species was 4, while, in the organic production, the species composition of nematodes is characterized by variety, but their number was 6. The number of individuals of the Pratylenchus species in conventional cultivation was significantly higher.

Key words: *root-lesion nematode Pratylenchus spp., raspberry, organic production.*

INTRODUCTION

Raspberry-growing is currently occupying an important place in the fruit production in many European countries, which creates new jobs in the agriculture sector and delivers food products and raw materials for the food industry. Maintaining a healthy and productive raspberry plantations for years creates significant difficulties and efforts are directed to a preliminary assessment of the overall process. The economic damage is considerable in the infested soil with plant-pathogenic nematodes. The yield can be completely lost in heavily infested fields, and the presence of certain species of Nematoda restricts the growing of a range of crops in the contaminated areas (Nicol et al., 2011).

The worldwide damage caused by root lesion nematodes of the genus *Pratylenchus* (Filipjev, 1936) increased, and thus the interest in them. In the most regions, the root lesion nematode *Pratylenchus penetrans* continues to be a major limiting factor in the production of raspberries. This species is endoparasitic, destroyes the root tissue, reduces the flow of water from the soil into the roots and the transport of nutrients. In many cases in the field, there are mixed populations of plant- parasitic nematodes, rather than individually occurring species.

This study of the species composition of plant parasitic nematodes in conventional and organic systems of production of raspberries based on a comparative assessment will be achieved not only to determine the effectiveness of the methods and means of plant protection and will ensure the plant health and the growth potential.

The aim of this work was to investigate the qualitative and quantitative structure of root lesion nematodes in the genus *Pratylenchus* in different growing technologies.

MATERIALS AND METHODS

Characteristics of experimental fields

The study was conducted in two raspberry plantations near the town of Kostinbrod (GPS: 42°49'5.80"N; 23°13'30.54"E). The plants are planted at a distance of 2.50 x 0.50 m or 88

plants/ha. Two growing systems were tested conventional growing and organic growing. The test plot was 25 m^2, four replications of sequences of time.

Sampling methods

The plant health condition of the fields has been satisfactory; there were zones of reduced plant growth and plant damage.

According to the meteorological data, abiotic factors, which could cause these symptoms, are excluded. The period of sampling of plant and soil samples was consistent with that recommended by Knuth et al. (2003). In order to determine the increase or decrease of density of the populations, the samples were taken depending on the season, during no-vegetation and vegetation period. The soil samples were taken randomly from 15 – 25 cm depths and then transferred in plastic bags to the laboratory.

Extraction of the nematodes

The methods for the extraction of the nematodes from the soil and roots and their subsequent mounting on permanent slides for identification are according to the Baermann pan method described by Townshend (1963). Species characterization and identification were based on morphology of various life stages (Loof, 1978; Bongers, 1988; Handoo and Golden 1989).

Statistical analysis

The statistical analysis was carried out using Statistica 99 Edition statistical package.

RESULTS AND DISCUSSIONS

The established species of the genus *Pratylenchus* in different cultivars and variations of fertilization are shown in Tables 1 and 2.

Besides the most commonly found species of *P. crenatus*, *P. neglectus* and *P. pratensis*, two species of this genus: *P. thornei* and *P. sonvallariae* were isolated in organic growing. Although the species of *P. penetrans* was established, its presence in both fields was sporadic.

During the first year of investigations (2011), symptoms of plant damage and the increased density of nematodes of this genus were not observed.

But in 2012, the density of species of the genus *Pratylenchus* was increased during fruiting seasons in the conventional growing systems compared to the organic growing.

During the investigation of the samples (soil and plant), a total number of individual nematodes of the genus *Pratylenchus* was 620; 384 individuals in the conventional framing of the genus *Pratylenchus* and 236 individuals in the organic growing.

The highest density was recorded in September 2012- 74 individuals in conventional growing, and lowest in the organic growing in August 2012-9 individuals. Throughout the research period in 2012, the total number of isolated nematodes of the genus *Pratylenchus* did not confirm the increase of their density in the organic growing.

It should be noted that the number of species of the genus *Pratylenchus* is difficult to predict, since they are located at a specific moment in the soil and the roots.

Figure 1 and 2 present the percentage of the number of species and their density in the conventional and the organic growing during the study.

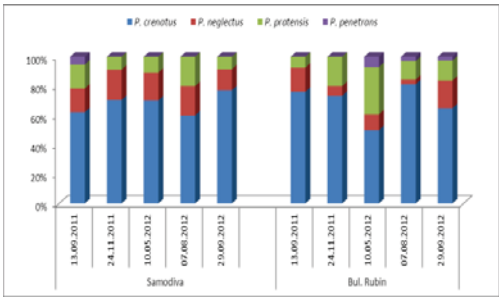

Figure 1. Percentage of species of the genus *Pratylenchus*, extracted from soil and plant samples in conventional growing of raspberry

Throughout the study period from the total number of samples infected with *Pratylenchus* spp., these species were isolated: in the conventional growing: the species *P. crenatus* was 69.7%, *P. neglectus*- 13.4% and *P. pratensis*- 14.7%; in the organic growing: *P. crenatus* was found 48.7%, *P. neglectus*- 29.3%, *P. pratensis* 14.5%, *P. thornei* 3.4% and *P. sonvallariae* 2.5% (Figure 1 and 2).

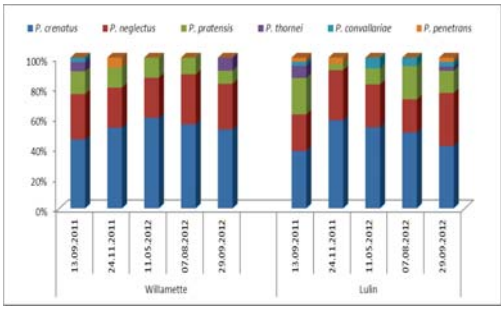

Figure 2. Percentage of species of the genus *Pratylenchus*, extracted from soil and plant samples in organinc growing of raspberry

Postive significant correlations (R=0.15; P <0.05) between the different variants of fertilisation and the density of nematodes were found in the conventional growing. Correlation between nematodes of the genus *Pratylenchus* and variants of fertilization (R=-0.06; P>0.05) was not demonstrated in the organic growing.

The population density of *Pratylenchus* spp. was negatively correlated with the total density of the migratory root nematodes (R=-0.26; P <0.01).

The sum of the number of individuals of the species *P. crenatus* was 38 individuals, which is indication of the most common species in the organic growing. *P. neglectus*, especially in the autumn of 2012, was 1.5 times more common species than other species of the genus *Pratylenchus*.

Table 1. Species of root lesion nematodes of the genus *Pratylenchus*, extracted from fields with conventional growing of raspberry

sampling time/cultivar	*P. crenatus*	*P. neglectus*	*P. pratensis*	*P. penetrans*	undetermined species
		13.09.2011			
Samodiva	*V2-9 V3-14	V0-1 V1-1 V2-2 V3-3	V0-2 V3-4	V1	V3-1
Bul. Rubin	V0-12 V1-13 V2-10 V3-26	V0-2 V1-4 V2 - 5	V0-2 V2-1 V3-2		
		24.11. 2011			
Samodiva	V0-1 V1-2 V2-10 V3-11	V0-2 V2-1 V3-4	V0-1 V3-3		V0 -1
Bul. Rubin	V0-11 V3-11	V3-2	V0-1 V2-1 V3-4		V1 -1
		10.05.2012			
Samodiva	V0-4 V1-9 V3-13	V0-1 V2-3 V3-3	V0-1 V1-1 V3-2		
Bul. Rubin	V0-1 V1-4 V2-2 V3-7	V1-1 V2-1 V3-1	V0-2 V2-4 V3-3	V3-3	
		07.08.2012			
Samodiva	V0-2 V1-0 V3-4	V2-1 V3-1	V2-1 V3-1		V3-1
Bul. Rubin	V1-1 V2-13 V3-12	V3-1	V0-2 V2-1 V3-1		
		29.09.2012			
Samodiva	V0-1 V1-4 V2-10 V3-12	V0-1 V1-1 V2-1 V3-2	V0-1 V1-1 V3-1		
Bul. Rubin	V0-10 V1-14 V3-24	V0-3 V1-1 V3-7	V0-1 V1-2 V2-2 V3-5	V0-2	V2 -1

*V- variants of experiment (various fertilization) and number of established nematode species

Table 2. Species of root lesion nematodes of the genus *Pratylenchus*, extracted from fields with organic growing of raspberry

sampling time/cultivar	*P. crenatus*	*P. neglectus*	*P. pratensis*	*P. thornei*	*P. convallariae*	*P. penetrans*	undetermined species
			13.09.20111				
Willamette	*V0-5 V1-3 V2-2 V3-5	V3-10	V1-1 V2-1 V3-3	V0-2	V2-1		
Lulin	V0-7 V1-2 V3-5	V2-2 V3-5	V1-2 V2-3 V3-4	V0-3	V3-1	V3-1	
			24.11.2011				
Willamette	V2-4 V3-4	V2-1 V3-3	V2-1 V3-1			V3-1	V3-1
Lulin	V0-4 V1-2 V2-2 V3-6	V2-5 V3-3	V2-1			V0-1	
			11.05.2012				
Willamette	V0-3 V1-4 V3-4	V0-2 V1-2 V3-5	V2-1 V3-1				V3-1
Lulin	V1-3 V2-5 V3-7	V0-4 V2-2 V3-2	V0-2 V1-1		V0-1 V1-1		V2-1 V3-1
			07.08.2012				
Willamette	V1-2 V2-1 V3-2	V0-3	V0-1				
Lulin	V0-1 V1-2 V2-3 V3-3	V0-1 V1-2 V3-1	V0-1 V1-3		V3-1		
			29.09.2012				
Willamette	V0-4 V1-3 V3-5	V0-2 V1-2 V2-2 V3-1	V3-2	V3-2	V3-2		
Lulin	V0-1 V1-2 V2-6 V3-5	V0-2 V1-4 V2-2 V3-3	V3-5	V0-1	V0-1	V3-1	

*V- variants of experiment (various fertilization) and number of established nematode species

Many authors reported that the species *P. thornei* and *P. convallariae* were isolated from heavy soils (Whish et al., 2014).

Despite their differences in preferences for the type of soil (Sturhan, 2014), the species *P. crenatus* and *P. neglectus* were found in joint populations in both growing technologies. The frequent occurrence of these two together is reported by Kleynhans et al. (1996) Kruse (2006), Söğüt et al. (2014) and Esteves et al. (2015) in various agricultural ecosystems.

As regards the reaction of the soil it has been found that the population density of *P. crenatus* and *P. neglectus* was significant different. The species *P. crenatus* prevailed in the soil with slightly alkaline reaction, pH ± 8. This species was present 1.5-2.5 times more than in the soil with a neutral to slightly acid, pH 7.5–6.0 (organic growing). The species *P. neglectus* was detected in significantly less samples of the organic growing soil with low pH values.

Larvae of genus *Pratylenchus* were isolated more frequently from the samples, thus so that making it difficult to determine or its determination could not be carried out. The prevalence of *Pratylenchus* spp. is higher in regions with extensive agriculture (Vrain and Dupré, 1982; Vrain and Rousselle, 1980). Kimpinski (1985), Bélair (1991), Zasada and Moore (2010) demonstrate that the significant increase in population density of *Pratylenchus* spp. requires soil treatment in raspberry fields with nematicides.

The root lesion nematode, *Pratylenchus penetrans*, is a production-limiting pest in red raspberry, *Rubus idaeus*. Nowadays authors continue searching for genetic resistance, as a tool to manage *P. penetrans* in raspberries. This would reduce the impact of this nematode on raspberry productivity as well as reduce the plant chemical treatments to keep populations in control (Zasada and Moore, 2014).

These results indicate that more research is needed to learn about the relationship between fertilization, cultivars and root lesion

nematodes of genus *Pratylenchus* in different growing technologies.

Given that the culture practices within each field remained almost unchanged for 10 years, this study provides a current representation of the distribution of nematode populations of small areas in the conventional and the organic production of raspberries.

It should be noted that a redistribution of certain species of plant-parasitic nematodes stays possible.

CONCLUSIONS

The species of the genus *Pratylenchus* were dominant in both of growing technologies, as *P. crenatus* and *P. neglectus* are occurred most often.

The number of identified species of the genus *Pratylenchus* in the conventional growing was 4 and 6 in the organic growing.

Although the number of established species of the genus *Pratylenchus* in the conventional production was smaller, the number of individuals of each species was significantly higher.

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