



Occurrence of *Heterodera schachtii* in the Sugar Beet Growing Areas of Vojvodina, Serbia

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received: 30 November 2012, accepted: 29 April 2013

published online: 28 May 2013

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doi: 10.5937/ratpov50-3003

Summary: The survey on the occurrence of the sugar beet cyst nematode *Heterodera schachtii* Schmidt 1871 was performed from November 2006 until June 2012 in the sugar beet growing areas of the Serbian northern Province of Vojvodina. The soil samples were taken from 55 beet fields and analyzed for number of viable eggs or juveniles in the soil. In total, 1387 soil samples were collected from 20 sugar beet producers and 3 seed fodder beet producers. Fenwick can and electric device for crushing cysts were used in order to determine the presence of cysts and population density. *Heterodera schachtii* occurred in 36.36 % of beet fields with population density ranging from 13 to 1591 eggs and second-stage juveniles in 100 cm³ of soil. The area with the most infested fields was the district of Bačka. Only in the district of Banat *H. schachtii* was not detected. Current occurrence of *H. schachtii* in the sugar beet growing areas of Vojvodina indicates that this pest is most frequently found near old sugar beet factories in the districts of Bačka and Srem as a result of intensive sugar beet cultivation with narrow crop rotation.

Key words: *Beta vulgaris*, *Heterodera schachtii*, population density, Vojvodina

Introduction

The sugar beet nematode *Heterodera schachtii* Schmidt 1871 is a major parasite of sugar beet which is distributed worldwide (Ferreira & Boley 1993). It causes significant yield loss especially in the conditions of intensive sugar beet production with narrow crop rotation. Yield reduction can be up to 50% when population densities are high (Ferreira & Boley 1993).

Sugar beet (*Beta vulgaris* L.) is cultivated in the northern part of Serbia, in the autonomous Province of Vojvodina, covering about 61,000 ha (last three years average, Republic of Serbia 2012). The investigation of the occurrence of *H. schachtii* dates since the 1970s. This pest was the most frequent in the sugar beet growing areas of Vojvodina (Krnjaić et al. 1981).

The basic strategy in fighting sugar beet cyst nematode is to keep the nematode population below the economic threshold. The most useful ways to achieve this is crop rotation (Greco 1983)

and use of tolerant beet varieties (Wauters et al. 2010). The crop rotation period is usually more than once in 5 years and regular soil surveys for monitoring population densities (counts of viable cysts) are necessary (OEPP/EPPO 1994). Actual nematode tolerant varieties have been tested and are available in the recent years in Serbia (Bačić et al. 2007).

Many beet producers from this region have been reporting wilting and early death of beet in the last six years. This survey was performed as a result of long-term cooperation between Agricultural Extension Service Institute Tamiš and farmers reporting the yield reduction. In order to offer the farmers the proper recommendation on how to control sugar beet cyst nematode, it is necessary to have information about the number of viable eggs and juveniles in the soil before planting which was the aim of this study.

Materials and Methods

The survey of the occurrence of *H. schachtii* was carried out in the period between November 2006 and June 2012. In total, 1387 soil samples were collected from 20 sugar beet producers and 3 seed fodder beet producers. The samples were

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Legend:  Locations where soil samples were taken
 Sugar beet factories

Figure 1. Map of Vojvodina province with locations where soil samples were taken and marked sugar beet factories

Slika 1. Mapa AP Vojvodine sa mestima gde su uzeti uzorci zemljišta i označenim fabrikama šećera

taken from 55 beet fields in Vojvodina during six years. It involved soil samples from 46 fields with symptoms of wilting and localized areas of poor growth during previous vegetations, 4 fields for testing tolerant beet varieties and 5 fields for planting seed fodder beet (Fig. 1). Producers were labelled with the letters (A, B, C) and their fields with the numbers (1, 2, 3), thus A-1 denotes the first field of producer A, etc.

One composite soil sample was collected per 1 ha. It consisted of 50 sub-samples from different points sampled on the depth of 10 cm with a special stick-auger 1 cm wide. Samples were processed in order to determine presence of cysts and population density of *H. schachtii*. Organic soil particles including cysts from soil samples were extracted on 250 μm sieve using Fenwick can and transferred on filter paper for binocular inspection as described by Turner (1998). The

species to which the cysts belonged were identified morphologically by the original description of vulval cone and second-stage juveniles (Franklin 1972).

For determination of cysts content, the method suggested by KWS SAAT AG Company was performed (Stephani 2006, personal communication). An electric device was used to crush cysts extracted from 100 cm^3 of soil. An estimation of number of eggs and second-stage juveniles (J2) in homogenized solution was done using a microscope and counting chamber. Population density in 100 cm^3 of soil was calculated by multiplying the number of viable eggs and J2 in 1 ml of solution with the number of ml in the cylinder. Data on population density on beet fields (average number of cysts and average number of eggs and J2 in 100 cm^3 of soil) are presented as mean (M) \pm standard deviation (SD).

Results and Discussion

The current occurrence of *H. schachtii* in Vojvodina is shown in Table 1 (districts of Banat and Srem) and Table 2 (district of Bačka). In total, vital cysts occurred in 36.36% of beet fields. Cysts without vital content were in 5.45% of fields. The sugar beet nematode was not detected in soil from seed fodder beet fields and 28 sugar beet fields. The area with the most infested soil (80% of fields) was in the district of Bačka-localities of Crvenka, Kula, Vrbas, Sivac and Novi Bečej. In the western part, in the district of Srem, 20% of infested fields were found (localities of Vojka and Stara Pazova). Only in the district of Banat *H. schachtii* was not detected.

The average number of eggs and J2 in 100 cm³ of soil ranged from 13 to 1591. The lowest (Q-1) and the highest abundance (I-6) were observed in the same area in the northern part of Vojvodina. Low incidence of the parasite below 150 eggs and J2 was found in 30% of fields. The population density at mid-level from 150 to 300 eggs and J2 was detected in 20% of fields. Relatively high incidence with density from 300-800 eggs and J2 was observed in 10% of fields. The highest density above 800 eggs and J2 was found in 40% of beet fields.

Today, distribution of the sugar beet nematode in Serbia, compared to data from the 1970s is

different because sugar beet has been planted only in the province of Vojvodina for the last decade. Current occurrence of vital cysts in 20 of 55 beet fields (36.36%) in Vojvodina indicates the use of narrow, mostly 2-year crop rotation (wheat or corn/beet) as a consequence of the lack of available fields. Cysts without vital content found in 5.45% of fields confirm the use of proper crop rotation. The sugar beet nematode was not detected in soil from seed fodder beet fields. The number of these fields is much smaller than the number of sugar beet fields in Vojvodina.

A survey conducted in 2005 (238 fields) and 2006 (237 fields) revealed that 42% of the sugar beet area in the Netherlands was infested with *Heterodera schachtii*. Beet cyst nematode was most abundant in the South West of the Netherlands, a region with a long history of sugar beet cultivation (Schneider & Wevers 2007). In Netherlands, eleven percent of the area was infested with at least 300 eggs and larvae per 100 ml soil (Schneider & Raaijmakers 2008). In the sugar beet production area of Vojvodina, the region with the most infested fields was the district of Bačka. In this district, sugar beet is the most intensively cultivated crop. This area is one of the oldest sugar beet growing areas with the most numerous sugar beet factories.

In the Austrian sugar beet production area, 29 out of the 48 selected plots in 2008 and 19 out of

Table 1. Occurrence of *Heterodera schachtii* in the sugar beet growing areas of the districts of Banat and Srem

Tabela 1. Prisustvo *Heterodera schachtii* u regionima gajenja šećerne repe Banata i Srema

Locality	Producer- Sugar beet field	Average number of cysts/100 cm ³ of soil M ± SD	Average number eggs and J2/100 cm ³ of soil M ± SD
District of Banat			
Zrenjanin	A-1	0.00	0.00
Zrenjanin	A-2	0.00	0.00
Zrenjanin	A-3	0.00	0.00
Zrenjanin	B-1	0.00	0.00
Kovin	C-1	0.00	0.00
District of Srem			
Vojka	D-1	29.66 ± 16.81	1126.66 ± 607.70
Vojka	D-2	37.00 ± 1.41	1070.00 ± 98.88
Vojka	D-3	36.50 ± 6.50	1280.00 ± 28.28
Stara Pazova	E-1	11.75 ± 1.89	400.00 ± 107.08
Stara Pazova	F-1	0.00	0.00
Sremska Mitrovica	G-1*	0.00	0.00

Key: * seed fodder beet

Table 2. Occurrence of *H. schachtii* in the sugar beet growing areas of the district of BačkaTabela 2. Prisustvo *Heterodera schachtii* u regionima gajenja šećerne repe Bačke

District of Bačka	Producer-	Average number of	Average number eggs and J2/100
Locality	Sugar beet field	cysts/100 cm ³ of soil	cm ³ of soil
		M ± SD	M ± SD
Crvenka	H-1	0.00	0.00
Crvenka	I-1	5.85 ± 6.22	138.57 ± 176.57
Crvenka	I-2	13.11 ± 7.59	154.71 ± 176.57
Crvenka	I-3	0.00	0.00
Crvenka	I-4	0.00	0.00
Crvenka	I-5	0.00	0.00
Crvenka	I-6	12.25 ± 5.41	1591.66 ± 588.52
Crvenka	I-7	18.77 ± 12.00	976.66 ± 734.59
Crvenka	I-8	0.00	0.00
Crvenka	I-9	0.00	0.00
Crvenka	I-10	0.00	0.00
Crvenka	I-11	0.00	0.00
Crvenka	I-12	0.52 ± 1.18	0.00
Crvenka	I-13	0.00	0.00
Crvenka	I-14	0.66 ± 1.07	0.00
Crvenka	I-15	0.00	0.00
Crvenka	I-16**	14.00 ± 5.65	250.00 ± 70.71
Crvenka	I-17	5.60 ± 4.47	119.40 ± 159.22
Crvenka	I-18	0.00	0.00
Kula	J-1	17.66 ± 9.91	946.66 ± 447.90
Sivac	K-1	1.05 ± 1.89	0.00
Sivac	K-2	0.00	0.00
Sivac	K-3	0.00	0.00
Sivac	K-4	0.00	0.00
Sivac	L-1	22.75 ± 7.93	630.00 ± 373.98
Vrbas	M-1	9.50 ± 5.04	247.50 ± 142.60
Vrbas	M-2	8.55 ± 6.93	128.00 ± 139.98
Vrbas	N-1	7.66 ± 2.62	17.00 ± 11.04
Vrbas	O-1**	14.50 ± 6.32	225.00 ± 186.48
Vrbas	O-2**	22.33 ± 6.18	1540.00 ± 381.92
Novi Bečej	O-3**	69.00 ± 25.45	1380.00 ± 509.11
Bački Brestovac	P-1	0.00	0.00
Bačka Moravica	Q-1	7.66 ± 2.62	13.00 ± 11.04
Bačka Moravica	Q-2	0.00	0.00
Bačka Moravica	Q-3	1.91 ± 2.78	26.25 ± 65.21
Mali Idoš	R-1	0.00	0.00
Kneževac	S-1	0.00	0.00
Kneževac	S-2	0.00	0.00
Stanišić	T-1	0.00	0.00
Sombor	U-1	0.00	0.00
Sombor	V-1*	0.00	0.00
Karavukovo	W-1*	0.00	0.00
Karavukovo	W-2*	0.00	0.00
Karavukovo	W-3*	0.00	0.00

Key: * seed fodder beet, ** beet varieties trial

35 in 2009 were found not to be infested with *H. schachtii*. In total, 16 of these showed only slight infestation (up to 500 J2/100 g of soil) in 2008 as well as 14 in 2009 (Sigl et al. 2010). In the sugar beet production area of Vojvodina, 11 selected plots were slightly infested.

The international economic thresholds for this pest are different. The average threshold in western Nebraska was 2.8 eggs or juveniles/cm³ of soil. Initial soil population density of approximately 3 eggs, range between 2 and 4 juveniles in 1 cm³ of soil may result in yield loss (Gray et al. 1992).

The weather conditions in Vojvodina during 2007 and 2012 with rainy spring and dry summer were very favourable for nematodes. The follow-up on this study will be determination of the thresholds in sugar beet growing areas in Vojvodina in order to give proper recommendation of crop rotation to farmers.

Conclusions

The findings from previous six years indicate that *H. schachtii* is most frequently found near old sugar beet factories in Vojvodina. This became a problem in the sugar beet growing areas of the districts of Bačka and Srem as a result of intensive sugar beet cultivation with narrow crop rotation. In order to get more stable yields on farms, it is necessary to monitor *H. schachtii* in sugar beet fields before planting. This research is a basis for further investigations of real damaging levels and influence of tolerant beet varieties on nematode population in these areas.

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Prisustvo *Heterodera schachtii* u regionima gajenja šećerne repe Vojvodine

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Sažetak: Istraživanje prisustva repine nematode *Heterodera schachtii* Schmidt 1871 u regionima gajenja šećerne repe Vojvodine sprovedeno je u periodu od novembra 2006. do juna meseca 2012. godine. Uzorci zemljišta su uzeti i analizirani poreklom sa 55 parcela. Ukupno je sakupljeno 1387 uzoraka zemljišta kod 20 proizvođača šećerne repe i 3 proizvođača semenske stočne repe. U cilju određivanja prisustva cista i gustine populacije korišćeni su Fenwick flotacioni aparat i električna mehanička mešalica za gnječenje cista. *Heterodera schachtii* je utvrđena na 36,36% parcela sa gustinom populacije u rasponu od 13 do 1591 jaja i jedinki drugog juvenilnog stadijuma u 100 cm³ zemljišta. Najveći broj zaraženih parcela konstatovan je u regionu Bačke. Samo u regionu Banata *H. schachtii* nije konstatovana. Sadašnja saznanja o prisustvu *H. schachtii* u regionima gajenja šećerne repe Vojvodine ukazuju da je pojava ove štetočine najučestalija blizu starih fabrika šećera u regionima Bačke i Srema kao posledica intenzivnog gajenja šećerne repe i primene uskog plodoreda.

Ključne reči: Beta vulgaris, gustina populacije, *Heterodera schachtii*, Vojvodina