

Occurrence and geographical distribution of cyst nematodes in cereals and grassland in the Slovak Republic

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Summary

A study of occurrence and geographical distribution of cyst-forming nematodes in monocultural cereal fields and multispecies grassland vegetation in Slovak Republic revealed the presence of two species of *Heterodera*: *H. avenae* and *H. schachtii*. The frequency of occurrence of *H. avenae* was 37.8 % in cereal fields and 3.3 % in grassland. Cysts of *H. schachtii* were found only in cereal fields along with cysts of *H. avenae*, in the western part of country. The occurrence of other graminaceous cyst nematode species was not recorded.

Key words: *Heterodera*; cyst nematodes; grassland; cereals; occurrence; Slovak Republic

Introduction

The cyst forming nematodes belong to the commonest parasite of Poaceae, cereals and grass plants, of which perhaps the most notorious is the genus *Heterodera*, comprising several closely related species. *Heterodera avenae* is considered to be the principal species in cereals in temperate areas, but it has been also found in grasses as fescue, ryegrass, timothy, bent grasses and others (Evans *et al.*, 1993). Some other cyst nematodes also attack cereals, such as *H. latipons* (Franklin, 1969), *H. hordecalis* (Sturhan, 1982), *H. filipjevi* (Sturhan, 1996a), *H. iri* (Sturhan & Krall, 2002), *Punctodera punctata* (Decker, 1972). Grasses are also susceptible to other cyst nematode species such as *H. bifenestra*, *H. mani* and *P. punctata* (Mass and Brinckman, 1982), *H. graminis* (Stynes, 1971), *H. pratensis* (Gäbler *et al.*, 2000) and *H. hordecalis* (Sturhan, 1996b). Since 1977, *H. avenae* has also been studied in cereals and grasses in the Slovak Republic. The researches focused on occurrence (Sabová *et al.*, 1977; Valocká *et al.*, 1993), host specificity (Sabová *et al.*, 1989) damage and pathogenicity (Sabová *et al.*, 1986). However, until 2004 *H. avenae* was

the only species of cyst nematodes known as a parasite of cereals and grasses in the Slovak Republic. Sturhan and Lišková (2004) reported five other species of the genus *Heterodera* - *H. avenae*, *H. hordecalis*, *H. mani*, *H. ustinovii*, *H. bifenestra* and one species of the genus *Punctodera* - *P. stonei* known to parasitize Gramineae out of a total of 16 cyst nematode species found throughout the country.

In the Slovak Republic, more than 600 thousand hectares are cultivated to cereals, mostly in the western part of the country. On the contrary, grasslands (more than 200 thousand hectares) are concentrated in central and eastern parts, mainly in a mountainous area.

The aim of the study was to determine the occurrence and distribution of cyst nematodes in cereal fields and grassland throughout the area of the Slovak Republic.

Materials and Methods

The survey was undertaken during 2005 – 2007. A total of 143 localities with cereal fields and 123 localities with grassland were sampled throughout the country. Each soil sample (0.5 kg of soil) was a composite of 10 randomised sub-samples collected from the rhizosphere of the plants to a depth of 15 – 20 cm during August – September. Samples were slowly dried in the laboratory and cysts extracted from a 200 g sub-sample using the flotation method (Sabová & Valocká, 1980). The identification to species level was carried out in accordance with original descriptions and the most recent taxonomic revisions based on morphometrics of cysts and second stage juveniles. The identification of cysts was performed considering the size and shape of the cyst, its surface structure, perianal and perivulval fenestration (presence of bullae and underbridge) according to Wouts and Weisner (1977) and Hesling (1978).

Table 1. The occurrence and geographical distribution of cyst nematodes in cereals and grassland in the Slovak Republic

Orographic unit	Investigated locality	Positive locality	Cereals			Investigated locality	Grassland	
			Number of cysts				Positive locality	Number of cysts
			<i>Heterodera avenae</i>	<i>Heterodera schachtii</i>	Not identified species			
Western part of Slovak Republic								
Biele Karpaty		2	1	-	1		-	-
Hornonitr. kotlina		1	-	-	1		-	-
Hronská pahorkatina		1	1	-	-		-	-
Myj. pahorkatina		2	3	-	4		-	-
Nitr. pahorkatina		9	22	3	27		-	-
Podunajská rovina		14	46	2	31		-	-
Považský Inovec		1	1	-	-		-	-
Trnavská pahorkatina		9	23	-	9		-	-
Žitavská pahorkatina		5	58	10	11		-	-
Považské podolie		1	1	-	-		-	-
Sum of Western part	93	45	156	15	84	13	0	-
Central part of Slovak Republic								
Javorníky		-	-	-	-		1	1
Ipeľská kotlina		2	4	-	5		-	-
Považské podolie		-	-	-	-		1	2
Skorušinské vrchy		1	1	-	-		-	-
Stolické vrchy		1	1	-	-		-	-
Žilinská kotlina		1	-	-	1		-	-
Revúcka vrchovina		2	1	-	1		-	-
Sum of Central part	34	7	7	-	7	49	2	3
Eastern part of Slovak Republic								
Beskydské predhorie		1	1	-	-		-	-
Košická kotlina		1	1	-	-		-	-
Rožňavská kotlina		-	-	-	-		1	2
Spiš-šariš. medzihorie		-	-	-	-		1	1
Sum of Eastern part	16	2	2	-	-	61	2	3
Grand total	143	54	165	15	91	123	4	6

Results

The majority of investigated localities (93) were situated in the western part of Slovakia (WS), in the area with more intensive cultivation of cereals (Table 1). Of the soil samples, 45 were positive with a frequency (F) of *Heterodera* cyst occurrence of 48.4 %. Out of 255 cyst found, 156 were identified as *H. avenae*, 15 as *H. schachtii* and 84 were not identified. The majority of the sampled localities (27) were in the orographic units Podunajská rovina, of which 14 were positive (F = 51.9 %) for the presence of *H. avenae*, and 2 were also positive (F = 7.4 %) for the presence of *H. schachtii*. The cysts of *H. schachtii* were found solely together with cysts of *H. avenae*. The locality with

the highest recorded number of cysts of *H. avenae* (46) and of *H. schachtii* (10) was Zlaté Moravce in Žitavská pahorkatina orographic unit.

In the Central part of Slovakia (CS), 34 soil samples were collected in 16 orographic units of which 7 (F = 20.6 %) were positive. A total of 14 cysts were found, 7 were identified as *H. avenae* and 7 remained unidentified. All cyst of *H. avenae* were found in the southern part of central Slovakia bordering Hungary.

In Eastern Slovakia (ES), 16 soil samples were collected from of 8 orographic units and only two (F = 14.3 %) were positive. Only 2 cysts were isolated in cereal fields and identified as *H. avenae*.

The total frequency of occurrence of cysts nematodes in

cereal ecosystems was 37.8 % (54 soil samples). *Heterodera avenae* was found in all positive soil samples including three soil samples also positive for the presence of *H. schachtii*. Of the 271 cysts found in cereals, 165 were *H. avenae*, 15 *H. schachtii* and 91 cysts were not identified.

There were 123 soil samples collected from grassland in 31 orographic units (Table 1). Of them 61 were collected in ES, 49 from CS and 13 from WS. Only 3.3 % (4 soil samples) were positive for the occurrence of cyst nematodes in CS and ES. The 6 cysts found were identified as *H. avenae* and contained a low number of eggs and second stage juveniles.

Discussion

The survey of cyst forming nematodes in monoculture cereal fields and multispecies grasslands in the Slovak Republic revealed the occurrence of only two species, *H. avenae* (cereal, grasslands) and *H. schachtii* (cereals). Nevertheless, many cysts could not be identified due to the absence of juveniles and unclear morphology of the cysts.

The frequency of occurrence of *H. avenae* in cereal fields was 37.8 %, what is less than 53 % reported by Sabová *et al.* (1980), and 56 % and by Valocká *et al.* (1993). The frequency of occurrence of *H. schachtii*, a parasite of sugar beet and other plants mainly in the families Chenopodiaceae and Brassicaceae, was 2.1 %. Mixed populations of *H. avenae* and *H. schachtii* were found only in WS. Similarly, Renčo (2002) found mixed populations of these two species in sugar beet fields. In the past, several authors reported a high occurrence and distribution of these cyst nematodes in the Slovak Republic (Čuri, 1959; Sabová *et al.*, 1980). The presence of these mixed population results probably from the crop rotation used and agricultural practices. Sugar beet is cultivated between two cereal crops in a 5- year term crop rotation.

Out of the cyst nematode species known as parasite of grasses, only *H. avenae* was found in natural grassland with a low frequency of occurrence. The species of grass cyst nematodes known from the territory of Slovakia (Sturhan & Lišková, 2004), such as *H. bifenestra*, *H. hordecalis*, *H. mani* and *P. stonei* detected in soil samples collected in the rhizosphere of grasses near rivers, wet grassland and grasses under nut orchards were not detected during our study. The species of the cyst nematodes of *H. avenae* group, determined as the parasites of grasses, were found by Krall *et al.* (1999) in Estonia (*H. mani*, *H. hordecalis*, *H. arenaria*, *H. ustini*, *H. avenae*, *H. filipjevi*) and *Punctodera punctata* was recorded in Germany (Sturhan, 1982). According to Sturhan (1982), *H. avenae* is the most widely distributed heteroderid species, particularly in agricultural areas (93 % of all records), but while other mentioned species in grassland constituted 80 % of all records, *H. avenae* was only 20 %.

Our results showed that in Poaceae *H. avenae* is the most frequently occurring cyst nematode species of the genus *Heterodera*, particularly in monocultural cereal fields of south-western and south-central part of Slovak Republic.

Although Neubert (1972) confirmed that host plants of *H. avenae* and other species mentioned in the introduction are usually cultivated and weed grasses, in the territory of Slovak Republic we recorded a low occurrence of cyst nematodes of the genus *Heterodera* in natural grassland.

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