

Cyst nematodes in the Slovak Republic

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Summary

Ten cyst-forming nematode species, *Heterodera bifenes-tri*, *H. cruciferae*, *H. hordecalis*, *H. mani*, *H. ripae*, *H. salixophila*, *H. trifolii*, *H. urticae*, *Globodera achilleae* and *Punctodera stonei*, are reported in the Slovak Republic for the first time, increasing the number of cyst nematode species known to occur in the country to a total of 17.

Key words: Cyst nematodes; *Globodera*; *Heterodera*; Heteroderidae; *Punctodera*; Slovak Republic

Introduction

Cyst-forming nematodes of the family Heteroderidae are obligate, highly adapted root-parasites, only a few having a wide range of hosts in various plant families and orders, the majority of species being highly specialised to certain closely related plants. Several species of the genera *Heterodera* and *Globodera* are among the most important plant-parasitic nematodes, causing significant damage to many crops and being responsible for economic losses also due to strict quarantine regulations. However, most of the species, are not known to cause visible damage to their hosts or are known from "wild" plants only. Many heteroderid species have a world-wide distribution; several of these were dispersed by man's activities, such as the potato cyst nematodes (*Globodera rostochiensis* and *G. pallida*). Quarantine regulations require precise species identification which is also essential for agricultural measures such as crop rotation or the use of resistant varieties. Because of their economic significance, cyst nematodes are among the most intensively studied nematodes worldwide.

Knowledge on presence and distribution of these nematodes in the Slovak Republic is still limited. In the course of our studies on occurrence and distribution of various taxa of plant-parasitic nematodes in Slovakia, also heteroderid juveniles and cysts were occasionally extracted from soil

samples. The nematodes were killed and fixed with hot TAF, transferred to pure glycerine, and cyst cones and second-stage juveniles were mounted on permanent slides for microscopical studies and measurements. The little material available so far, was used in this preliminary study on the presence of Heteroderidae in the Slovak Republic. Determination of the species was mostly possible only when both cysts and second-stage juveniles were available for identification. Previous records for Slovakia and our new findings of cyst nematodes are briefly compiled and presented in this paper. Voucher specimens are deposited in the German Nematode Collection (DNST), Biologische Bundesanstalt für Land- und Forstwirtschaft, Münster, Germany.

Previously reported species

According to the list of soil nematodes of the Slovak Republic presented by Šály (1983), the following six species of cyst-forming nematodes have been recorded from the territory of the Slovak Republic: *Heterodera avenae* Wollenweber, 1924; *H. carotae* Jones, 1950; *H. galeopsidis* Goffart, 1936; *H. humuli* Filipjev, 1935; *H. schachtii* Schmidt, 1871; *Globodera rostochiensis* (Wollenweber, 1923) Behrens, 1975. Sabová *et al.* (1993) mentioned no additional Heteroderidae species for Slovakia. Recently, Sturhan and Krall (2002) reported *H. ustynovi* Kirjanova, 1969 (= *H. iri* Mathews, 1971) from two grassland sites with *Agrostis* spp. in the most eastern region of the country close to the village Zboj.

According to Sabová *et al.* (1990), the oat cyst nematode *H. avenae* appears to be quite common in Slovakia and was also identified in our present studies. The beet cyst nematode *H. schachtii* was found by us mainly in garden soil at various locations in the country. We isolated the hop cyst nematode *H. humuli* surprisingly from a soil sample

collected from a grassy slope (without wild or cultivated hop growing there) at the edge of a forest in the Beskid mountains close to the village Kolbasov, but *Urtica* species are also known as hosts of this species. The identification of this population was confirmed by molecular data (Subbotin, pers. comm.).

Newly recovered species

Besides the three *Heterodera* species mentioned above, which had been reported previously from the territory of the Slovak Republic, we identified a total of ten species of the genera *Heterodera*, *Globodera* and *Punctodera*, which are “new” to the nematode fauna of Slovakia. They are reported thereafter.

Heterodera bifenestra Cooper, 1955. Found in sandy soil at river banks in Trebejov and Slovenská Ľupča and in wet grassland at Hrušov.

Heterodera cruciferae Franklin, 1945. Isolated from soil samples from two gardens with various vegetables grown in rotation at the localities Čáry and Ľubietová.

Heterodera hordecalis Andersson, 1975. The species appears to be widespread in the country. It was found by us at six sites in meadows (Krásnohorská Dlhá Lúka, Zboj), under grasses growing along a river (Trebejov, several places), at the edge of a forest (Hrušov), under grasses in a nut orchard (Slanec) and once also in field soil (Hrušov); at all localities in sandy soil.

Heterodera mani Mathews, 1971. A few second-stage juveniles with robust, strongly concave stylet knobs and general characters of species of the *H. avenae* complex (lens-like phasmids, only the inner two lines in the lateral field well developed) were isolated from a soil sample taken from around grass roots at river Ondava, close to the town Stropkov.

Heterodera ripae Subbotin, Sturhan, Rumpfenhorst et Moens, 2003 (= nom. nov. for *H. riparia* Subbotin, Sturhan, Waeyenberge et Moens, 1997). This species is quite widespread in the country along rivers, where its type host *Urtica dioica* is mostly common (Trebejov, Horovce, Streda nad Bodrogom, Svinica, Slanec, Pod Soroškou, Krásnohorská Dlhá Lúka, Bohúňovo, Banská Belá, Podzámok, Slovenská Ľupča, Kriváň, Hamuliakovo, Štúrovo). Because only very little material was available for identification from several of the sites, it cannot be excluded that some of the records refer to the morphologically similar species *H. humuli*.

Heterodera salixophila Kirjanova, 1969. Also this species was found on river banks, where its hosts *Salix* spp. are growing. There are records from five sites from various regions of the country (Trebejov, Nižná Myšľa, Slovenská Ľupča, Pastovce, Gajary).

Heterodera trifolii Goffart, 1932. The clover cyst nematode appears to be widespread in Slovakia. We isolated it from soil samples originating from fields, gardens, meadows and river banks. For one of the populations the identification was confirmed by molecular studies (Subbotin, pers. comm.).

Heterodera urticae Cooper, 1955. This member of the *H. goettingiana* species group was recovered from soil samples originating from river bank vegetation with *Urtica dioica* at three locations (Trebejov, Slovenská Ľupča, Dojč).

Globodera achilleae (Golden et Klindic, 1973) Behrens, 1975. A spheroid cyst, isolated from vegetation close to the Hornád river at Trebejov near Košice, showed a cyst wall pattern changing at some distance from the vulval fenestra from a rugose latitudinal type to a longitudinal wavy-line type, as described for *G. achilleae* in the original description of this species (Golden and Klindic, 1973). The fenestra was 35 µm wide and the distance to anus 21 µm, giving a Granek's ratio (distance from anus to nearest edge of fenestra divided by diameter of fenestra) of only 0.6. Second-stage juveniles, from cysts isolated from Ipeľ river bank vegetation at Kubáňovo, closely agreed in morphometrics and other morphological characters with the original description of the species and the description given by Brzeski (1998). The morphometrics of the second-stage juveniles (n = 10) were: L = 490 (445 – 515) µm, stylet = 25 (24.5 – 25.5) µm, tail = 52.5 (50 – 60) µm, hyaline tail part = 23 (20.5 – 28) µm, a = 23 (21 – 25), c = 9.3 (8.6 – 9.9), c' = 3.8 (3.6 – 4.3). The tail shape mostly resembled that figured by Brzeski (1998), but the stylet knobs were more rounded and only occasionally slightly concave anteriorly. The phasmids were distinct and slightly more than one anal body width behind the anus, the hyaline portion of the tail was always shorter than half of the total tail length.

A spheroid cyst isolated from a soil sample from riverbank vegetation with *Salix*, *Rubus*, *Artemisia vulgaris* and other plants from Pastovce (river Ipeľ, sandy soil) had an oval, 39 µm long fenestra and a Granek's ratio of 3. Second-stage juveniles in this sample, which we considered as members of *Globodera*, were essentially morphologically similar to those of *G. achilleae* mentioned above, but the measurements differed slightly. They were (n = 10): L = 460 (435 – 470) µm, stylet = 23.5 (22.5 – 24.5) µm, tail = 45 (41 – 48) µm, hyaline tail part = 21 (18 – 23) µm, a = 24 (24 – 25), c = 10.1 (9.8 – 10.2), c' = 3.6 (3.2 – 3.9).

Other heteroderid second-stage juveniles of unknown identity, occurring in the same sample, had a more slender tail, with a hyaline tail portion longer than half of the tail length, stronger and slightly concave stylet knobs and the following dimensions: L = 390 – 420 µm, stylet = 24 – 25 µm, tail = 43 – 46 µm, hyaline tail portion = 23 – 25 µm.

Punctodera stonei Brzeski, 1998. A few empty *Punctodera* cysts were isolated from a soil sample from a field at Hrušov, from grassland at two sites in the north-eastern part of the country, and some cysts containing juveniles from soil samples collected along the Hornád river at Trebejov near Košice. The second-stage juveniles closely agreed in measurements and other morphological characters with *P. stonei* recently described by Brzeski (1998) from Poland. The morphometrics of 10 juveniles of this population were: L = 535 (495 – 570) µm, stylet = 26.5 (25.5 – 27.5) µm, width of stylet base = 6.3 (5.8 – 6.8) µm, tail = 84 (80 – 91) µm, hyaline tail part = 51 (49 – 56) µm, a = 25 (24 – 27), c = 6.4 (6.0 – 6.7), c' = 5.8 (5.4 – 6.2). In cyst cones, only ex-

ceptionally weak bullae-like structures were observed, also in cysts collected at Zboj in the north-eastern part of the country.

At several sampling sites mixtures of cyst-forming species were found. Thus, *H. bifenestra* and *H. avenae*, *H. bifenestra* and *H. ripae*, *H. ripae* and *H. urticae*, *H. ripae* and *H. hordecalis*, *H. hordecalis* and *H. trifolii*, *H. hordecalis* and *H. ustinovii*, *H. bifenestra* + *H. ripae* + *H. salixophila*, *H. hordecalis* + *H. ustinovii* + *P. stonei* co-occurred. Along the Hornád river at Trebejov, where several soil samples had been collected from around the roots of various plants, even seven different cyst nematode species were found: *H. bifenestra*, *H. hordecalis*, *H. ripae*, *H. salixophila*, *H. urticae*, *G. achilleae* and *P. stonei*.

Conclusion and Discussion

The present study has increased the number of cyst nematodes known from Slovakia, from seven previously reported species, by ten additional species and has considerably extended the range of known distribution of certain species in Europe, particularly of *H. ripae*, *H. salixophila*, *H. urticae*, *G. achilleae* and *P. stonei*. The taxonomic status of the previously reported *H. galeopsidis*, which is mostly considered to be synonymous with *H. trifolii*, is still uncertain. *Heterodera latipons* Franklin, 1969, which was recorded previously for the territory of the Czech Republic (Sabová *et al.*, 1988), was not found in the Slovak Republic. This species is also not known from, for instance, Poland (Brzeski, 1998) and Germany (Sturhan, 1996), and there appear to be no reliable records for other central and northern European countries. Also, the two "greenhouse species" *Heterodera fici* Kirjanova, 1954 and *Cactodera cacti* (Filipjevi et Schuurmans Stekhoven, 1941) Krall et Krall, 1978 are not known for Slovakia so far, as well as the white potato cyst nematode *Globodera pallida*, which has been reported for the Czech Republic (Zouhar *et al.*, 2003).

Of the cyst nematode species known from adjoining countries, in particular, the cereal cyst nematode *H. filipjevi* (Madzhidov, 1981) Stelter, 1984 and the pea cyst nematode *H. goettingiana* Liebscher, 1892 are expected to be present in the Slovak Republic. Also, the lucerne cyst nematode *H. medicaginis* Kirjanova et Krall, 1971, known from Ukraine, may occur in the neighbouring Slovak Republic. However, these three species were not encountered during

our study.

Six of the 16 recognised cyst nematode species (without *H. galeopsidis*) now known to occur in Slovakia are specialised to Poaceae (Gramineae): *H. avenae*, *H. bifenestra*, *H. hordecalis*, *H. mani*, *H. ustinovii* and *P. stonei*. The species *H. humuli*, *H. ripae* and *H. urticae* have only Urticaceae as hosts. Also *H. carotae*, *H. cruciferae* and *H. salixophila* have narrow host ranges, whereas *H. trifolii* and, in particular, *H. schachtii* parasitise a wide range of plants from various families and even orders. *Globodera achilleae* has certain Compositae as hosts, while *G. rostochiensis* is specialised to potatoes and other Solanaceae. In particular, the potato cyst nematode *G. rostochiensis*, the beet cyst nematode *H. schachtii* and the oat cyst nematode *H. avenae* are of economic significance as pests of agricultural crops.

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