

Distribution and morphometrical characterization of *Xiphinema pachtaicum*, *X. simile* and *X. brevicollum* from Hungary

V. REPASI¹, A. AGOSTINELLI², P. NAGY^{1*}, M. I. COIRO², K. HECKER¹, F. LAMBERTI^{2†}

¹Szent István University, Department of Zoology and Ecology, Gödöllő, Hungary, *E-mail: nagy.peter@mkk.szie.hu,
fax number: +36-28-410-804; ²Istituto per la Protezione delle Piante, Sezione di Bari, C.N.R., Via G. Amendola 168/5,
70126 Bari, Italy

Summary

The distribution of species of the *Xiphinema americanum*-group in Hungary was studied by collecting 272 samples from 53 localities. Samples have been taken from soil in the rhizosphere of 70 plant species. In total, 12.86 % of the samples contained at least one species from the *Xiphinema americanum*-group. Three species were found: *Xiphinema brevicollum*, *X. pachtaicum* and *X. simile*. *Xiphinema brevicollum* occurred in 4.41 %, *X. pachtaicum* in 3.67 % and *X. simile* in 4.77 % of the samples. New data on plants associated with the reported species and developmental patterns for *X. brevicollum* and *X. pachtaicum* are also presented.

Keywords: distribution; host-range; Hungary; morphometrics; *Xiphinema americanum*-group

Introduction

Xiphinema is among the most important genera of plant nematodes causing direct and indirect damage to a wide variety of crops and ornamental plants worldwide. The number of species in the genus is well over 200 (Loof & Luc, 1990) and this number is expected to grow as research continues, completed with novel methods, such as molecular taxonomy (Molinari *et al.*, 1997, 2004; De Giorgi *et al.*, 1999). In Central and Eastern Europe, *Xiphinema* has been surveyed intensely only in some countries e.g. Serbia – Barsi (1994, 1996), Slovakia – Liskova (1992), Bulgaria – Choleva (1975) and Republics of the former Soviet Union located in Europe – Brown *et al.* (1990). In Hungary most of the published records are over 20 years old (Andrássy, 1979; Elekes & Valyi, 1980; Jenser, 1985). In 1990, Andrássy published a list of nematode species recorded from Hungary and, in 1999, Nagy reported the occurrence of *X. italiae* Meyl, 1953 and *Longidorus attenuatus* Hooper, 1961. *Xiphinema brevicollum* (Lordello &

Da Costa, 1961) Luc, Coomans, Loof & Baujard, 1998, reported as *X. brevicolle*, was found associated with raspberry (*Rubus idaeus*) and sour cherry (*Prunus avium*) (Andrássy, 1979, Jenser, 1985) while *X. pachtaicum* (Tulaganov, 1938) Kirjanova, 1951 was first mentioned to occur in Hungary, under its previous name *X. mediterraneum* Martelli & Lamberti, 1967, associated with raspberry (Andrássy, 1979). Later, Elekes and Valyi (1980) reported it from the soil of vineyards and Jenser (1985) found it associated with sour cherry, peach (*P. persica*), apricot (*P. armeniaca*) and cherry (*P. cerasus*). The occurrence of *X. simile* Lamberti, Choleva & Agostinelli, 1983 in Hungary was recently reported (Repasi *et al.*, 2006).

In order to acquire the knowledge on the distribution of *Longidorus* and *Xiphinema* species in Hungary, a Hungarian-Italian cooperation has been started. This work presents a detailed analysis of the distribution and morphometrical data and associated host plants of the *Xiphinema americanum*-group occurring in Hungary.

Material and methods

During a survey started in August 1998 and continued in 2004 (from June until November) and 2005 (from April until October), a total of 272 samples were taken from the vicinity of 53 localities, from the rhizosphere of 70 plant species. Soil samples were taken from the top 20–40 cm of soil using a spade of 25 cm in width. One bulk sample comprised of soil taken from around at least 2 plants. Nematodes were extracted from subsamples of 200 to approx. 500 g using decanting and sieving technique with 1010 and 100 µm sieves (Flegg, 1967). Longidorid nematodes were picked out from the suspensions, fixed in hot formalin or FP 4:1, processed and mounted in anhydrous glycerine. Measurements were made using a light microscope with a camera lucida.

Mean and range of the measured values were recorded for several morphometrical characters relevant for determination of the encountered species (e.g. Barsi, 1994; Kumari, 2006; Lamberti *et al.*, 2000, 2004; Luc *et al.*, 1998). The Hungarian specimens were compared with measurements of the topotypes of *X. brevicollum* (Luc *et al.*, 1998) and original type material of *X. pachtaicum* and *X. simile*. UTM maps were prepared with ArcView GIS Version 3.1 and scatterplot graphs created with Harvard Graphics 98 software.

Results

Species belonging to the *X. americanum*-group were present in the samples with the following proportions: *X. brevicollum* (4.41 %), *X. pachtaicum* (3.67 %) and *X. simile* (4.77 %). The distribution of these species is rather scattered throughout the country (Fig. 1).

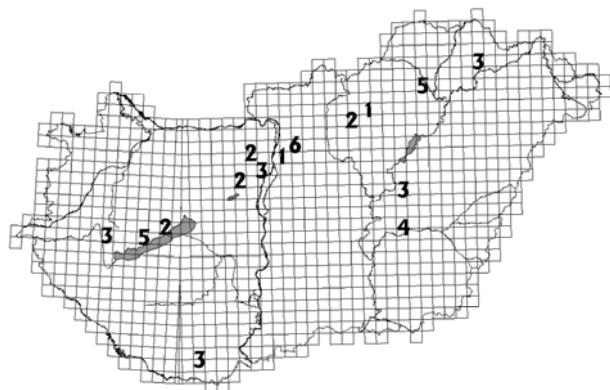


Fig. 1. UTM map to display occurrence data for species belonging to the *Xiphinema americanum* group (*Xiphinema brevicollum*, *Xiphinema pachtaicum* and *Xiphinema simile*) in Hungary.
1 - site infested with *Xiphinema brevicollum*; 2 - site infested with *Xiphinema simile*; 3 - site infested with *Xiphinema pachtaicum*; 4 - site infested with *Xiphinema brevicollum* and *Xiphinema simile*; 5 - site infested with *Xiphinema brevicollum* and *Xiphinema pachtaicum*; 6 - site infested with all the three species

Xiphinema brevicollum (Table 2)

Female: Habitus coiled in a closed C when killed; body robust, cylindrical, tapering gradually towards the extremities; cuticle very finely transversely striated. Labial region hemi-elliptical 5 – 5.5 µm high, separated from the rest of the body by a depression. Amphid stirrup-shaped; odontostyle robust 1.5 – 1.7 µm in diameter at the tip and 2.5 – 2.7 µm just above the forked junction with the well flanged odontophore; guiding ring typical of the genus; oesophagus dorylaimoid with the anterior part tubular, bearing refringent mucro at 52 – 55 µm from base of the odontophore; basal bulb approximately 1/3 of the total oesophagus length, containing three glandular nuclei. Female reproductive system amphidelphic with equally developed opposed branches; vulva slit-like; vagina occupying 1/3 of the corresponding body diameter; no spermatheca, ovaries reflexed. Tail short, conoid with rounded terminus and two pairs of caudal pores.

Male: one male was found in the Kisnána isolate. Male similar to females, but body more curved posteriorly. One adanal pair and 7 ventromedian precloacal supplements present. Spicules slightly curved, measuring 53.4 µm along the arch, lateral guiding pieces 14.5 µm long.

Juveniles: clearly separated into four stages based on the stylet measurements (Fig. 2) and morphologically similar to females but tails are longer and more tapering (Table 2).

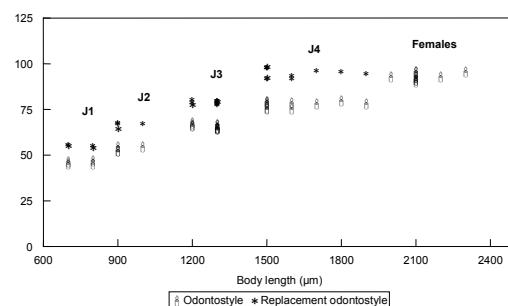


Fig. 2. Scatter diagram separating juveniles and females of *Xiphinema brevicollum*, in the function of the stylet measurements (µm)

Xiphinema brevicollum has been recovered from 12 samples in six localities (Fig. 1) Localities and plants associated are given in Table 1.

Xiphinema pachtaicum (Table 3)

Female: Habitus a single spiral or closed C when relaxed. Body gradually tapering towards the extremities; cuticle finely striated transversely. Labial region 3.5 – 4.0 µm high, expanded, frontally flattened, laterally rounded, separated from the rest of the body by a deep constriction. Amphid stirrup-shaped. Odontostyle, odontophore and guiding ring sheath typical of the genus. Oesophagus dorylaimoid. Oesophageal bulb 1/3 – 1/4 of total length. Vulva posterior to median position, between 52.5 – 58.5 %, vagina extending to 1/2 of corresponding body diameter. Gonads paired, opposed and reflexed; spermatheca and "Z" organ absent. Tail 28.7 – 33.3 µm long, conical, dorsally convex gradually tapering towards the extremity with pointed end. Two pairs of caudal pores.

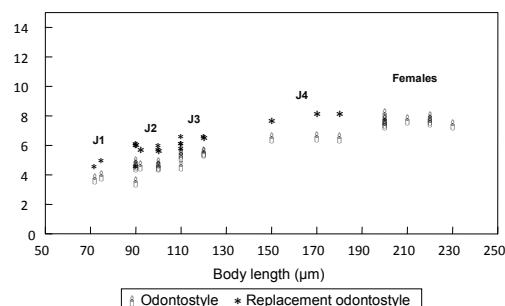


Fig. 3. Scatter diagram separating juveniles and females of *Xiphinema pachtaicum*, in the function of the stylet measurements (µm)

Table 1. The distribution (with UTM-codes in brackets) and plant associations of the *X. americanum* group species in Hungary

	<i>X. brevicollum</i>	<i>X. pachtaicum</i>	<i>X. simile</i>
<i>Vitis vinifera L.</i>	Badacsny (XM98), Kisnána (DU30)	Badacsny (XM98), Olaszliszka (EU 34), Villány (BR 98)	Telki (CT 36), Tordas (CT 24)
<i>Prunus armeniaca L.</i>	Gödöllő (CT 77), Kisnána (DU 30)		Tordas (CT 24)
<i>Prunus avium L.</i>	Gödöllő (CT77)	Felsőzsolca (DU 82), Nagykörű (DT 63)	Csopak (YN 10)
<i>Prunus cerasus L.</i>		Érd-Elviramajor (CT 35)	Tordas (CT 24)
<i>Prunus domestica L.</i>			Tordas (CT 24)
<i>Pyrus communis L.</i>	Gödöllő (CT 77)		
<i>Malus domesticus L. & Rubus caesius L.</i>	Felsőzsolca (DU 82)		
<i>Juglans regia L.</i>	Kisnána (DU 30)		
<i>Amygdalus communis L.</i>			Tordas (CT 24)
<i>Cydonia oblonga Miller</i>	Gödöllő (CT 77)		Gödöllő (CT 77)
<i>Rosa indica Lindl</i>	Budapest (CT 56)		
<i>Rosa canina L.</i>			Abasár (DT 29)
<i>Platanus sp.</i>	Gödöllő (CT 77), Szarvas (DS 69)		
<i>Acer sp.</i>		Gödöllő (CT 77)	Gödöllő (CT 77)
<i>Betula pendula Roth</i>			Gödöllő (CT 77)
<i>Pinus nigra Arnold</i>		Gödöllő (CT 77)	
<i>Robinia pseudo-acacia L.</i>		Érd-Elviramajor (CT 35), Zalaszántó (XM 69)	
<i>Sorbus torminalis L. (Cr.)</i>			Szarvas (DS 69)

Table 2. Morphometric data of a *Xiphinema brevicollum* isolate from Hungary. All measurements are in µm except for body length (L, in mm) and in the form: mean and range of the measured values.

Locality Host	Kisnána					
	Apricot (<i>Prunus armeniaca</i>)					
n	10 ♀	1 ♂	4 J1	4 J2	10 J3	10 J4
L	2.1 ± 0.07 2.0 – 2.3	2.1 0.72 – 0.83	0.77 ± 0.05 0.92 – 1.00	0.95 ± 0.04 1.2 – 1.3	1.3 ± 0.05 1.2 – 1.3	1.6 ± 0.16 1.5 – 1.9
A	47.7 ± 1.24 45 – 49.4	45.6 37.9 – 40.3	38.7 ± 1.06 36 – 41.7	38.7 ± 2.63 37.7 – 42.6	41.0 ± 1.50 40 – 49.3	44.4 ± 2.58
B	6.2 ± 0.34 5.7 – 6.9	6.6 3.8 – 4	4 ± 0.19 4.1 ± 0.33	5.2 ± 0.43 4.5 – 5.7	5.2 ± 0.34 4.8 – 5.8	
C	82.2 ± 5.62 71.8 – 90.5	76 19.5 – 22.7	20.7 ± 1.38 25.8 – 29.7	27.8 ± 1.58 30.2 – 41.8	37 ± 3.41 45.6 – 59.8	51.7 ± 4.99
c'	0.9 ± 0.03 0.9 – 1.0	0.9 2.8 ± 0.08	2.1 ± 0.14 2 – 2.3	1.6 ± 0.11 1.5 – 1.8	1.2 ± 0.10 1.1 – 1.4	
V	49.5 ± 1.09 47.4 – 50.7	---	---	---	---	---
Odontostyle µm	93.9 ± 2.08 90.8 – 96.6	96.6 46 – 47	46.6 ± 0.66 53 – 55	54 ± 1.33 63.2 – 68.4	66.4 ± 1.41 76 – 80.5	78.5 ± 1.56
Odontophore µm	58.2 ± 1.79 56.3 – 60.9	58 32.6 – 34.5	32.6 ± 1.36 37.4 – 42	38.8 ± 2.12 43 – 47	45 ± 1.39 50.6 – 51.7	51.5 ± 0.48
Replacement odontostyle	---	---	55.3 ± 0.55 54.6 – 55.7	66.8 ± 1.27 65 – 67.8	79 ± 0.99 77.6 – 80.5	95 ± 2.46 92 – 98.9
Oral aperture to basal guide ring	79 ± 1.12 77 – 81	77 36.2 – 38.5	37.2 ± 0.98 43.7 – 46	44.4 ± 1.09 51.7 – 55.7	54.5 ± 1.23 61 – 67.8	64 ± 2.41
Tail	25.8 ± 2.32 23.6 – 31.6	27.6 36.8 – 37	37 ± 0.33 33.3 – 35.6	34.2 ± 1.33 31.6 – 35.6	33.4 ± 1.42 28.7 – 31.6	30.9 ± 1.18
Hyaline portion of tail (J)	9.1 ± 0.89 7.5 – 10	7 6.3 – 7.5	6.8 ± 0.55 6.9 – 7.5	7.2 ± 0.33 8.0 – 9.8	8.8 ± 0.47 8.6 – 9.8	9.1 ± 0.50
Body diam. at lip region	13.3 ± 0.42 12.6 – 13.8	13.8 7.5 – 8	7.8 ± 0.33 8.6 – 8.6	8.6 ± 0.00 9.2 – 10	10.0 ± 0.40 10.9 – 12.6	11.4 ± 0.61
Body diam. at basal guide ring	31.2 ± 0.77 30.5 – 32.8	32.8 15.5 – 17	16.2 ± 0.72 18.4 – 19.5	19 ± 0.55 21.8 – 23.6	22.6 ± 0.55 24.7 – 30	27 ± 1.67
Body diam. at base of oesophagus	39.5 ± 1.32 37.4 – 42	40 17.8 – 19.5	18.5 ± 0.72 21.3 – 24.7	23 ± 1.41 27 – 30.5	28.5 ± 1.12 31.6 – 37.4	34.2 ± 2.20
Body diam. at mid-body or vulva	44.3 ± 1.35 42 – 46.6	46 19.0 – 20.7	19.8 ± 0.74 23 – 26.4	24.6 ± 1.44 28.7 – 32.8	30.5 ± 1.34 34.5 – 40	36.4 ± 2.25
Body diam. at anus	27.8 ± 2.12 26 – 32	29.3 13.2 ± 0.47	13.2 ± 0.47 16.2 ± 0.72	16.2 ± 0.72 20.5 ± 0.82	20.5 ± 0.82 25.3 ± 1.79	23.6 – 28.7
Body diam. at beginning of J	15.5 ± 0.98 13.8 – 16.7	14.5 5.3 ± 0.29	5.3 ± 0.29 6.3 ± 0.47	6.3 ± 0.47 8.5 ± 0.36	8.5 ± 0.36 12.8 ± 0.74	12.8 ± 0.74
Spicules		53.5				

n = number of specimens; A = body length / greatest body diameter; B = body length / distance from anterior to esophago-intestinal valve;
C = body length / tail length; c' = tail length/anal body diameter; V = % distance of vulva from anterior

Table 3. Morphometrics of three isolates of *Xiphinema pachtaicum* from Hungary. All measurements are in μm except for body length (L, in mm) and in the form: mean and range of the measured values.

Locality Host	Gödöllő Maple (<i>Acer sp.</i>)				Érd Sour cherry (<i>Prunus cerasus</i>)		- Grapevine (<i>Vitis vinifera</i>)
n	10 ♀	3 J1	8 J2	5 J3	3 J4	10 ♀	5 ♀
L	2.1 ± 0.13 2.0 – 2.3	0.79 ± 0.11 0.72 – 0.92	0.98 ± 0.06 0.92 – 1.1	1.2 ± 0.05 1.1 – 1.2	1.6 ± 0.18 1.4 – 1.8	1.8 ± 0.10 1.6 – 1.9	1.9 ± 0.11 1.7 – 2.0
A	65.7 ± 3.04 62.5 – 70.9	45.0 ± 3.41 41.7 – 48.5	47.6 ± 2.63 43.2 – 51.4	53.6 ± 2.98 48.8 – 55.7	62.7 ± 3.63 59.5 – 66.7	69.5 ± 3.24 64 – 74	66 ± 3.29 62.7 – 69.8
B	7.5 ± 0.95 6.2 – 8.9	4.8 ± 0.58 4.2 – 5.3	4.6 ± 0.55 4.0 – 5.5	5.2 ± 0.17 5.0 – 5.4	6.2 ± 0.23 6.0 – 6.5	6.4 ± 0.40 6 – 7	6.4 ± 0.62 5.5 – 7
C	68.5 ± 4.81 61.8 – 76	26.6 ± 4.74 23.2 – 32	28.8 ± 1.72 26.2 – 31	34.1 ± 1.49 32.3 – 36.4	47.4 ± 3.08 43.9 – 49.2	63.2 ± 4.15 55 – 69.8	59.4 ± 5.02 53.4 – 64.2
C'	1.7 ± 0.07 1.5 – 1.8	2.8 ± 0.03 2.8 – 2.8	2.5 ± 0.15 2.3 – 2.8	2.5 ± 0.13 2.3 – 2.6	2.0 ± 0.06 1.9 – 2.0	1.9 ± 0.10 1.7 – 2	1.8 ± 0.08 1.8 – 1.9
V	53 ± 0.81 52.5 – 55	---	---	---	---	55.6 ± 1.40 54 – 58.5	56.8 ± 0.92 56 – 58
Odontostyle	77.8 ± 2.38 74.7 – 82	38.3 ± 2.02 36.2 – 40	47.6 ± 1.21 46.6 – 50.0	55.9 ± 1.74 53.4 – 58.0	66.3 ± 0.33 66.1 – 66.7	79.2 ± 1.46 77.6 – 81.6	86.7 ± 1.49 85 – 89
Odontophore	51.6 ± 1.58 49.4 – 53	30.7 ± 2.02 28.7 – 32.8	36.9 ± 1.56 35.1 – 39.7	38.7 ± 1.44 37.4 – 40.2	48.1 ± 2.02 46.0 – 50.0	43 ± 0.90 42 – 44.8	48.3 ± 2.11 44.8 – 50
Replacement odontostyle	---	46.9 ± 2.65 45.4 – 50	59.1 ± 1.68 57 – 61.5	64.3 ± 2.52 61.5 – 66	80.7 ± 2.65 77.6 – 82	---	---
Oral aperture to basal guide ring	66.6 ± 0.96 64.9 – 67.8	32.6 ± 0.88 31.6 – 33.3	40.4 ± 1.01 38.5 – 42.0	49.4 ± 0.81 48.9 – 50.6	57.1 ± 0.88 56.3 – 58.0	68.8 ± 2.26 66 – 71.8	76 ± 2.01 74 – 79.3
Tail	30.8 ± 1.49 28.7 – 32.8	30 ± 1.85 28.7 – 32	34.0 ± 1.83 31.6 – 36.2	34.5 ± 2.19 31.6 – 36.8	34.7 ± 1.76 32.8 – 36.2	29 ± 0.82 27.6 – 30.5	31.6 ± 1.22 30.5 – 33.3
Hyaline portion of tail (J)	8.4 ± 0.50 7.5 – 9.2	5.0 ± 0.66 4.6 – 5.7	5.8 ± 0.20 5.7 – 6.3	5.2 ± 0.00 5.2 – 5.2	6.7 ± 0.33 6.3 – 6.9	8 ± 0.61 7 – 8.6	9.2 ± 0.41 8.6 – 9.8
Body diam. at lip region	9.5 ± 0.28 9.2 – 9.8	6.9 ± 0.00 6.9 – 6.9	7.5 ± 0.00 7.5 – 7.5	7.9 ± 0.48 7.5 – 8.6	8.6 ± 0.00 8.6 – 8.6	8.8 ± 0.29 8.6 – 9	8.5 ± 0.26 8 – 8.6
Body diam. at basal guide ring	21.6 ± 1.02 20 – 23.6	14.0 ± 0.33 13.8 – 14	15.4 ± 0.59 14.5 – 16.1	17.0 ± 0.51 16.7 – 17.8	18.8 ± 0.88 17.8 – 19.5	18.8 ± 0.75 17.8 – 20	21.3 ± 0.81 20 – 22.5
Body diam. at base of oesophagus	27.6 ± 1.03 25.9 – 28.7	16.3 ± 0.88 15.5 – 17	18.9 ± 0.65 17.8 – 19.5	20.2 ± 1.59 18.4 – 21.8	24.3 ± 2.02 22.5 – 26.4	22.5 ± 1.05 20.7 – 24	24.5 ± 1.61 23 – 26.5
Body diam. at mid-body or vulva	32.1 ± 1.14 31.0 – 34.5	17.6 ± 1.20 16.7 – 19	20.5 ± 0.67 19.5 – 21	22.0 ± 1.59 20.1 – 23.6	26.2 ± 2.32 24 – 28.7	26.4 ± 1.25 24.7 – 28.2	28.5 ± 2.65 26 – 31.6
Body diam. at anus	18.4 ± 0.69 17.8 – 19.5	10.7 ± 0.66 10 – 11.5	13.6 ± 0.68 12.6 – 14.5	13.7 ± 0.63 12.6 – 14.5	17.6 ± 1.45 16 – 19	15.7 ± 0.81 15 – 17	17 ± 0.26 16.7 – 17
Body diam. at beginning of J	8.2 ± 0.53 7.5 – 9	4.6 ± 0.57 4 – 5	5.0 ± 0.30 4.6 – 5.2	5.7 ± 0.00 5.7 – 5.7	7.1 ± 0.33 6.9 – 7.5	7 ± 0.35 6.5 – 7.5	7.6 ± 0.48 7 – 8

n = number of specimens; a = body length / greatest body diameter; b = body length / distance from anterior to esophago-intestinal valve;
c = body length / tail length; c' = tail length/anal body diameter; V = % distance of vulva from anterior

Male not found.

Juveniles resemble females except for body posture i. e. less ventrally curved than adults. Four juvenile stages were distinguished (Tab. 3, Fig. 3).

The three isolates of *X. pachtaicum* measured in details (Tab. 3) are basically similar for most morphological and morphometric characters. However, the Gödöllő isolate compared to the other two has longer body (2.1 mm vs 1.8 mm), shorter odontostyle (77.8 μm vs 79.2 – 86.7 μm), anterior V (V = 53 vs 56 – 57 %), more anterior position of guiding ring (66.6 μm vs 68.8 μm).

Xiphinema pachtaicum has been found in 10 samples from 8 known localities (Fig. 1) and one unknown locality.

Xiphinema simile (Table 4)

Female: Habitus a single spiral or closed C when killed; body tapering gradually towards the extremities; cuticle very finely striated transversely, 1 – 1.65 μm thick along the body. Labial region expanded, 3.5 to 4.6 high,

separated from the rest of the body by a deep constriction. Amphidial pouches stirrup-shaped. Odontostyle, odontophore and guiding sheath typical of the genus. Oesophagus dorylaimoid. Oesophagus basal bulb 72-86 μm long and 13 – 15 μm wide. Vulva shortly posterior to mid-body, 53 – 56 %; vagina about 1/2 to 1/3 of the corresponding body diameter. Gonads amphidelphic, reflexed with no particular characters in their components. Prerectum not visible; rectum 16 – 25 μm long i. e. similar to anal body diameter (17.2 – 20.0 μm). Tail conoid with subacute terminus. Two pairs of caudal pores.

Male not found.

Juveniles were not selected for measurements.

Most of the morphometric characters of *X. simile* (Table 4) found at Gödöllő in the rhizosphere of maple (*Acer sp.*) and in a grapevine sample from an unknown locality are biometrically identical.

Xiphinema simile has been recovered from 13 samples in six known localities (Fig. 1) and one unknown locality.

Table 4. Morphometrics of two isolates of *Xiphinema simile* from Hungary. All measurements are in μm except for body length (L, in mm) and in the form: mean and range of the measured values.

Locality	Gödöllő	
Host	Maple (<i>Acer</i> sp.)	Grapevine (<i>Vitis vinifera</i>)
n	10♀	10♀
L	2.3 ± 0.13 2.1 – 2.5	2.3 ± 0.09 2.1 – 2.4
A	78.8 ± 3.19 74 – 81	75.7 ± 3.15 71.3 – 79.8
B	8.4 ± 1.08 7.4 – 9.6	7.8 ± 0.28 7.4 – 8.3
C	77.3 ± 2.30 74 – 80	72.6 ± 4.39 67 – 79.8
c'	1.6 ± 0.09 1.5 – 1.8	1.7 ± 0.09 1.6 – 1.8
V	55 ± 0.75 54 – 56	55 ± 0.87 53 – 56
Odontostyle	67.5 ± 1.93 66.1 – 70	66.9 ± 1.39 64.4 – 68.4
Odontophore	44.1 ± 1.11 43.1 – 45.9	42 ± 1.88 38.5 – 44
Oral aperture to guide ring	60.2 ± 1.25 58.6 – 62	58 ± 2.19 54.6 – 61
Tail	29.6 ± 1.55 27.6 – 31.6	31 ± 0.99 29.3 – 32
Hyaline portion of tail (J)	6.2 ± 0.48 5.7 – 6.9	6 ± 0.67 5.2 – 6.9
Body diam. at lip region	9.4 ± 0.51 9.2 – 10	9 ± 0.40 8.6 – 9.8
Body diam. at guide ring	19.4 ± 0.75 18.4 – 20.1	19.4 ± 0.67 18.4 – 20.5
Body diam. at base of oesophagus	24.7 ± 0.70 23.6 – 25.3	25.4 ± 1.71 23 – 28.7
Body diam. at vulva	29.1 ± 1.12 27.6 – 30.5	29.8 ± 1.14 28.2 – 31.6
Body diam. at anus	18.2 ± 0.87 17.2 – 19.5	17.8 ± 0.96 17.2 – 20
Body diam. at beginning of J	7.8 ± 0.31 7.5 – 8	7.3 ± 0.47 7 – 8

n = number of specimens; a = body length / greatest body diameter;

b = body length / distance from anterior to esophago-intestinal valve;

c = body length / tail length; c' = tail length/anal body diameter;

V = % distance of vulva from anterior

Discussion

Xiphinema brevicollum

Xiphinema brevicollum was first described as *X. brevicolle* Lordello & Da Costa, 1961 and later synonymized with *X. taylori* Lamberti, Ciancio, Agostinelli & Coiro, 1991 by Luc *et al.* (1998) that have modified the specific epithete in *X. brevicollum*.

The morphometrics of the Hungarian isolate are in agreement with the original description of the species, but when compared with the topotypes (Luc *et al.*, 1998), this Hungarian isolate has a longer body (2.1 vs 1.9 mm); and higher 'c' values (82 vs 77), shorter odontostyle (94 vs. 101 μm), a more anterior position of guiding ring (79 vs 86 μm); and vulva (V=49.5 vs 53%). To resolve this contradiction, molecular methods (Lazarova *et al.*, 2006; Oliveira *et al.*, 2005) will have to be involved in future studies.

In agreement with Jenser (1985), we found *X. brevicollum*

on sour cherry. *Xiphinema brevicollum* was found associated with cherry, apricot, apple, quince, rose, sycamore and pear, representing new plant association records for Hungary.

Xiphinema pachtaicum

The three isolates of *X. pachtaicum* found in the rhizosphere of maple at Gödöllő, in the rhizosphere of sour cherry at Érd-Elviramajor and with grapevine from an unknown locality revealed some differences in the morphometric characters when compared with former descriptions. The Gödöllő isolate has a longer body (2.1 vs 1.8 and 1.9 mm resp.), shorter odontostyle, (77.8 vs 79.2 and 86.7 μm), more anterior vulva (V= 53 vs 55.6 and 56.87%) and guiding ring (66.6 vs 68.8 and 76.7 μm distance from anterior extremity). *X. pachtaicum* was thoroughly described and illustrated by Lamberti & Martelli (1971) and Lamberti & Bleve-Zacheo (1979).

In our studies, *X. pachtaicum* was found associated with several plant species. Of these, cherry and sour cherry were already reported (Jenser, 1985), while black locust, European black pine and maple are new host records for Hungary.

This species is widespread in Europe and it has been shown to occur in several countries of Central and Eastern Europe, such as Bulgaria (Choleva, 1975, Lamberti *et al.*, 1983), Croatia (Samota *et al.*, 1994), the Czech Republic (Kumari, 2004, Kumari *et al.*, 2005), Macedonia, Montenegro and Serbia (Barsi & Lamberti, 2002), Moldavia and Ukraine (Brown *et al.*, 1990) and Slovakia (Liskova, 1992, Lamberti *et al.*, 1999).

Xiphinema simile

Xiphinema simile found in the rhizosphere of maple and grapevine at Gödöllő and at an unknown locality respectively, are morphometrically similar.

The morphometrical characters of these isolates are consistent with the paratypes (Lamberti *et al.*, 1983), except in having longer body (2.3 vs 1.9 mm), higher values for all the ratios related to the body length and longer distance from anterior extremity to guiding ring (60.2 and 58 vs 51 μm).

The Hungarian isolates closely agree in measurements with populations from Bulgaria (Peneva & Choleva, 1992), Slovakia (Liskova & Brown, 1996; Lamberti *et al.*, 1999), former Yugoslavia (Barsi, 1994; Barsi & Lamberti, 2002, 2004), Czech Republic (Kumari, 2006) and Kenya (Coomans & Heyns, 1997), except for body length. However, mean body length of Hungarian isolates is similar to those of the Czech and Slovakian but longer than those of the Bulgarian and Kenian populations.

Data on the geographical distribution and associated hosts of *Xiphinema simile* are available from: Bajsa-Lipar and Zobnatica – grasses and hawthorn (*Crataegus monogyna*) (Barsi & Lamberti, 2002); Bosnia and Herzegovina – dogwood (*Cornus* sp.) and maize (*Zea mays*) (Barsi & Lamberti, 2004); Bulgaria - apple, apricot, black currant (*Ribes nigrum*), grapevine, quince, red oak (*Quercus rubra*),

white birch (*Betula alba*), and white poplar (*Populus alba*) (Lamberti *et al.*, 1983), Peneva & Choleva, 1992); Macedonia – sycamore; Serbia and Montenegro – *Carduus nutans*, *Euphorbia cyparissias*, *Euphorbia* sp., grapevine, *Pteridium aquilinum*, saliferous grassland, and *Trifolium campestre* (Barsi, 1994, 1996); Serbia (Neradin - Fruska Gora Mountain) – dog-rose (*Rosa canina*) (Barsi & Lamberti, 2002); Slovakia – grapevine, horse-chestnut (*Aesculus hippocastanum*), plum, poplar (*Populus* sp.), and rose (*Rosa* sp.) (Lamberti *et al.*, 1983, 1999, Liskova *et al.*, 1993); the Czech Republic – apple, apricot, sour cherry, and sweet cherry (Kumari, 2006). Outside Europe, until now this species has been found only in Kenya (Coomans & Heyns, 1997) in Gazi (along the Mara river, near Gouverno's Camp), on old baobab (*Adansonia digitata*) and white pepper tree (*Warburgia salutaris*).

Regarding plant-nematode associations, our results confirm the data from the literature in terms of occurrence on grapevine, cherry, apricot and plum. However, almond, quince, maple and birch are new plant association records for this species.

During the present survey, species of the *X. americanum*-group were not frequent. Therefore conclusions regarding their host plant preferences cannot be drawn. However, in terms of geographic distribution, these species appear to be spread across the country.

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References

- ANDRÁSSY, I. (1979): [Another 30 nematode species in the Hungarian fauna]. *Állattani Közlemények*, 66: 213-216
- ANDRÁSSY, I. (1990): [Free-living nematoda in the Hungarian fauna]. *Állattani Közlemények*, 57: 17-38
- BARSI, L. (1994): Species of the *X. americanum*-group (Nematoda, Dorylaimida) on the territory of the former Jugoslavia. *Nematol. Medit.*, 22: 25-34
- BARSI, L. (1996): Occurrence of *Xiphinema* species in the former Jugoslavia - Supplement to the "Atlas of plant parasitic nematodes of Jugoslavia". *Nematol. Medit.*, 24: 195-199
- BARSI, L., LAMBERTI, F. (2002): Morphometrics of three putative species of the *Xiphinema americanum* group (Nematoda: Dorylaimida) from the territory of the former Jugoslavia. *Nematol. Medit.*, 30: 59-72
- BARSI, L., LAMBERTI, F. (2004): *Xiphinema parasimile* sp.n. Serbia and *X. simile*, first record from Bosnia and Herzegovina (Nematoda, Dorylaimida). *Nematol. Medit.*, 32: 101-109
- BROWN, D. J. F., TAYLOR, C. E., CHOLEVA, B., ROMANENKO, N. D. (1990): The occurrence of Longidoridae (Nematoda: Dorylaimida) in Western USSR with further comments on longidorid nematodes in Europe and the Mediterranean basin. *Nematol. Medit.*, 18: 199-207
- CHOLEVA, B. (1975): Nematodes of the family Longidoridae in Bulgaria. In LAMBERTI, F., TAYLOR, C. E., SEINHORST, J. W. (Eds.): *Nematode vectors of plant viruses* (pp. 355-356) Plenum Press, London & New York
- COOMANS, A., HEYNS, J. (1997): Three species of the *Xiphinema americanum*-group (Nematoda: Longidoridae) from Kenya. *Nematologica*, 43: 259-274
- DE GIORGI, C., DE LUCA, F., VERONICO, P., CORTESE, M. R., DI VITO, M., LAMBERTI, F. (1999): Application of molecular biology in plant nematology. *Helminthologia*, 36: 171-173
- ERBENOVÁ, M. (1975): Ectoparasitic eelworms of the *Xiphinema Cobb* in the orchards of the C.S.R. Sb. *UVTL-Zahradnictví* (Praha), 2: 79-86
- ELEKES, A., VALYI, I. (1980): [A nematological survey on grapevine.] *Növényvédelem*, 16: 49-57
- FLEGG, J. J. M. (1967): Extraction of *Xiphinema* and *Longidorus* species from soil by a modification of Cobb's decanting and sieving technique. *Ann. Appl. Biol.* 60: 420-437
- JENSER, G. (1985): [Xiphinema species in Hungarian orchards] *Növényvédelem*, 21: 289-292
- KUMARI, S. (2004): The occurrence of *Xiphinema vittenezi*, *Xiphinema pachtaicum* and *Longidorus leptcephalus* (Nematoda: Dorylaimida) in the Central Czech Republic. *Helminthologia*, 41: 103-108
- KUMARI, S., POLÁK, J., CHOUTKA, R. (2005): Plant-parasitic nematodes of the genus *Xiphinema* (Nematoda: Longidoridae) in the vineyards of the Czech Republik. *Nematology*, 7: 81-93
- KUMARI, S. (2006): *Xiphinema simile* (Nematoda: Longidoridae) in Czech Republik and a note on other *Xiphinema* species. *Helminthologia*, 43: 43-50
- LAMBERTI, F., BLEVE-ZACHEO, T. (1979): Studies on *Xiphinema americanum* sensu lato with description of fifteen new species (Nematoda: Longidoridae). *Nematol. Medit.*, 7: 51-106
- LAMBERTI, F., MARTELLI, G. P. (1971): Notes on *Xiphinema mediterraneum* (Nematoda: Longidoridae). *Nematologica*, 17: 75-81
- LAMBERTI, F., CHOLEVA, B., AGOSTINELLI, A. (1983): Longidoridae from Bulgaria (Nematoda, Dorylaimida) with description of three new species of *Longidorus* and two new species of *Xiphinema*. *Nematol. Medit.*, 11: 49-72
- LAMBERTI, F., CIANCIO, A., AGOSTINELLI, A., COIRO, M. I. (1991): Relationship between *Xiphinema brevicolle* and *X. diffusum* with a redescription of *X. brevicolle* and descriptions of three new species of *Xiphinema* (Nematoda: Dorylaimida). *Nematol. Medit.*, 19: 311-326
- LAMBERTI, F., SABOVA, M., DE LUCA, F., MOLINARI, S.,

- AGOSTINELLI, A., COIRO, M. I., VALOCKA, B. (1999): Phenotypic variations and genetic characterization of *Xiphinema* populations from Slovakia (Nematoda: Dorylaimida). *Nematol. Medit.*, 27: 261-275
- LAMBERTI, F., MOLINARI, S., MOENS, M., BROWN, D. J. F. (2000): The *Xiphinema americanum*-group. I. Putative species, their geographical occurrence and distribution, and regional polytomous identification keys for the group. *Rus. J. Nematol.*, 8: 65-84
- LAMBERTI, F., HOCKLAND, S., AGOSTINELLI, A., MOENS, M., BROWN, D. J. F. (2004): The *Xiphinema americanum*-group. III. Keys to species identification. *Nemat. Medit.*, 32: 53-56
- LAZAROVA, S. S., MALLOCH, G., OLIVEIRA, C. M. G., HUBSCHEN, NEILSON, R. (2006): Ribosomal and mitochondrial DNA analyses of *Xiphinema americanum*-group populations. *Journal of Nematology*, 38(4): 404-410
- LIŠKOVÁ, M. (1992): Nematodes- virus vectors in the rhizosphere of tree species in Slovakia. *Int. Symposium at the occasion of the 100th Anniversary of the Arboretum Mlynany foundation 1892-1992.*, pp. 231-236
- LIŠKOVÁ, M., BROWN, D. J. F. (1996): Taxonomic validity and ecological relations of *Xiphinema pachtaicum* and *X. simile* (Nematoda: Dorylaimida), two members of the *X. americanum* group occurring in Slovakia. *Helminthologia*, 33: 137-142
- LIŠKOVÁ, M., LAMBERTI, F., SABOVÁ, M., VALOCKÁ, B., AGOSTINELLI, A. (1993): First record of some species of Longidorid nematodes from Slovakia. *Nematol. Medit.*, 21: 49-53
- LOOF, P. A. A., LUC M. (1990): A revised polytomous key for the identification of species of the genus *Xiphinema* Cobb, 1913 (Nematoda: Longidoridae) with exclusion of the *X. americanum*-group). *Systematic Parasitology* 16: 35-66
- LUC, M., COOMANS, A., LOOF, A. A., BAUJARD, P. (1998): The *Xiphinema americanum*-group (Nematoda: Longidoridae). 2. Observations on *Xiphinema brevicollum* Lollo & da Costa, 1961 and comments on the group. *Fund. Appl. Nematol.*, 21: 475-490
- MARTELLI, G. P., LAMBERTI, F. (1967): Le specie di *Xiphinema* Cobb, 1913 trovate in Italia e commenti sulla presenza di *Xiphinema americanum* Cobb (Nematoda, Dorylaimoidea). *Phytopathologia Mediterranea*, 6: 65-85
- MOLINARI, S., DE LUCA, F., LAMBERTI, F., DE GIORGI, C. (1997): Molecular methods for the identification of longidorid nematodes. *Nematol. Medit.*, 25: 55-61
- MOLINARI, S., LAMBERTI, F., DUNCAN, L. W., HALBRENDT, J., KOTCON, J., ABAWI, G. S., ROBBINS, R. T., NYCZEPIR, A. P., MCHENRY, M., MAGUNACELAYA, J. C., CROZZOLI, R., LEMOS, R. M., NAGY, P., MOENS, M., BROWN, D. J. F. (2004): SOD polymorphism in *Xiphinema americanum*-group (Nematoda: Longidoridae). *Nematology*, 6: 867-876
- NAGY, P. (1999): [First record of two virus-transmitting nematode species, *Longidorus attenuatus* and *Xiphinema italiae*.] *Növényvédelem*, 35: 15
- OLIVEIRA C. M. G., FENTON B., MALLOCH G., BROWN D. J. F., NEILSON R. (2005): Development of species-specific primers for the ectoparasitic nematode species *Xiphinema brevicolle*, *X. diffusum*, *X. elongatum*, *X. ifacolum* and *X. longicaudatum* (Nematoda: Longidoridae) based on ribosomal DNA sequences. *Annals of Applied Biology*, 146: 281-288
- PENEVA, V., CHOLEVA, B. (1992): Nematodes of the family Longidoridae from forest nurseries in Bulgaria. II. The genus *Xiphinema* Cobb, 1913. *Helminthology*, 32: 46-58
- REPASI, V., NAGY, P., COIRO, M. I., AGOSTINELLI, A., LAMBERTI, F. (2006): [Novel data on the distribution of dagger nematodes in Hungary.] *Növényvédelem*, 42: 655-661
- SAMOTA, D., IVEZIC, M., RASPUDIC, E. (1994): Ecology of *Xiphinema vuittenezi* and *Xiphinema pachtaicum* in vineyards of north-east Croatia. *Bulletin OEPP/EPPO Bulletin*, 24: 375-381

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