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LONGIDORIDAE FROM BULGARIA (NEMATODA, DORYLAIMIDA)
WITH DESCRIPTION OF THREE NEW SPECIES OF *LONGIDORUS*
AND TWO NEW SPECIES OF *XIPHINEMA*

by

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Information on the presence of longidorid nematodes in Bulgaria are scanty and incomplete (Stoyanov, 1964; Choleva, 1975a, 1975b and 1976; Katalan-Gateva, 1980). Therefore, we thought it useful to report here the results of an extensive survey of species belonging to the family Longidoridae carried out in this country in the period 1972-1981, to contribute to the knowledge on the geographical distribution of species of *Longidorus*, *Paralongidorus* and *Xiphinema* in Europe and in the Mediterranean Region.

MATERIALS AND METHODS

Over 1000 soil samples were collected in different seasons from the rhizosphere of various cultivated and spontaneous plant species. Each sample consisted of 1 to 2 kg of soil, collected in fields, orchards and natural habitats from various districts of Bulgaria and kept in plastic bags. Nematodes were extracted by the Cobb wet sieve technique from aliquots of about 500 ml soil after mixing the whole sample. They were then fixed either in 5% hot formalin or TAF and processed to glycerin by the slow method. Permanent mounts, on nematology slides, were measured with the aid of a camera lucida.

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RESULTS

Four species of *Longidorus*, *L. euonymus*, *L. distinctus* sp. n., *L. latocephalus* sp. n., and *L. moesicus* sp. n., one species of *Paralongidorus*, *P. maximus* and nine species of *Xiphinema*, *X. brevicolle*, *X. diversicaudatum*, *X. index*, *X. italiae*, *X. pachtaicum*, *X. turcicum*, *X. vuittenezi*, *X. incertum* sp. n., and *X. simile* sp. n. were found during our survey. Their description with comments on morphometric variations and geographic distribution are here given.

LONGIDORUS EUONYMUS Mali *et* Hooper, 1973 (Fig. 1; A and B)

The morphometric characters of a population collected from the rhizosphere of poplar trees at Kostinbrod, near Sofia, are (n = 11 ♀ ♀): L = 6.9 (6-7.8) mm; a = 166 (144-186); b = 17.7 (15.4-22.8); c = 152 (134-171); c' = 1.3 (1.2-1.5); V = 51 (50-53); odontostyle = 84 (81-88) μ m; odontophore = 60 (59-62) μ m; oral aperture to guiding ring = 28 (26-31) μ m; tail = 46 (41-48) μ m; J = 12 (11-15) μ m; body diam at lip region = 14 (13-14) μ m; body diam at guiding ring = 19 (18-21) μ m; body diam at base of oesophagus = 35 (33-38) μ m; body diam at vulva = 42 (39-47) μ m; body diam at anus = 34 (31-39) μ m; body diam at beginning of J = 22 (19-24) μ m.

Description: habitus as more or less open c to single spiral when killed; body slender, cylindrical for almost its whole length, tapering very gradually toward the anterior extremity; glandular structures are well evident in the lateral chords. Cuticle very finely striated transversely, marked by shallow fasciations on the subventral and subdorsal regions; the cuticle is 2 μ m thick along body except in the labial and vulvar regions where it is 3 μ m thick and in the caudal region where, at its beginning is 4 μ m thick on either side, to become thicker in its distal portion. The labial region, 4-5 μ m high, is slightly expanded, rounded laterally and flat frontally. Amphidial pouches more or less asymmetrically bilobed. Odontostyle, odontophore and guiding sheath typical of the genus. Oesophagus dorylaimoid with the basal bulb occupying about 1/4 of the total length of the oesophagus; muscular bulb 100-130 μ m long and 15-25 μ m wide. Oesophageal intestinal valve of variable shape and size. Vulva equa-

torial, slit like; vagina occupying more or less 1/2 of the corresponding body diameter. Gonads amphidelphic, reflexed with very long uteri (280-300 μm), separated from the oviduct sac by a robust sphincter. Prerectum around 250 μm long; rectum almost equal to the body diameter at anus. Tail conical with more or less widely rounded terminus, bearing 2 pairs of caudal pores.

The Bulgarian population of *L. euonymus* does not differ morphometrically from the original description (Mali and Hooper, 1973).

Longidorus euonymus seems to be widely distributed in Bulgaria (Fig. 4). At Kostinbrod it was recovered also from samples collected from the rhizosphere of grasses, corn, strawberry, carrot, blackberry, black currant, rose and nettle, but it was present

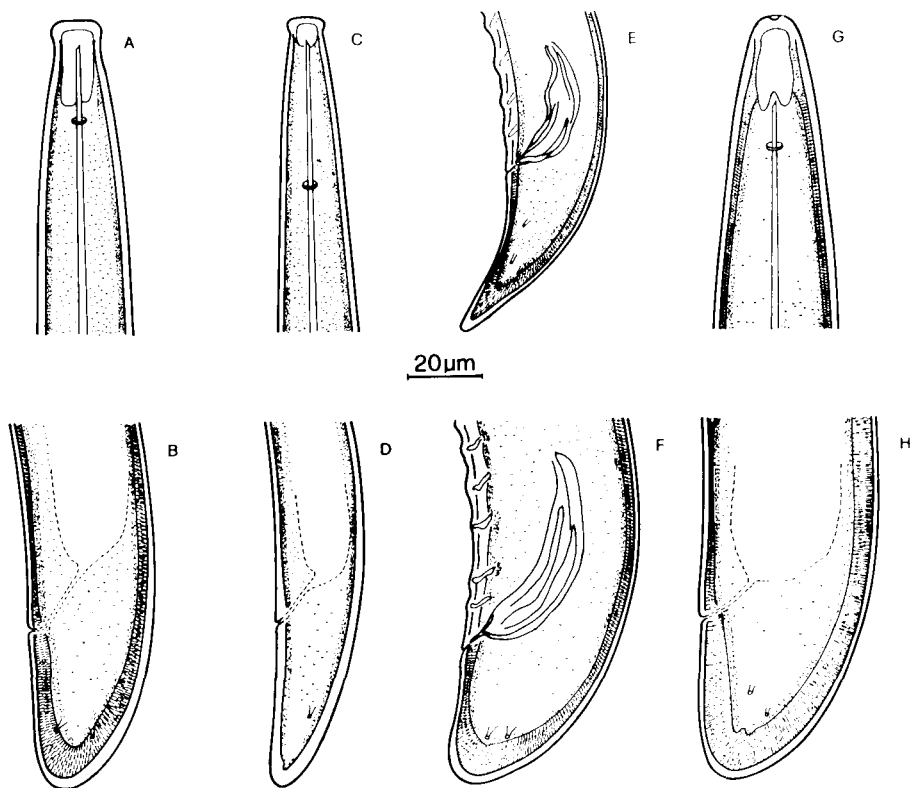


Fig. 1 - Anterior (A) and posterior (B) regions of female of *Longidorus euonymus*; anterior (C) and posterior (D) regions of female and posterior (E) region of male of *L. latocephalus* sp. n.; posterior (F) region of male and anterior (G) and posterior (H) regions of female of *L. moesicus* sp. n.

in various districts such as Petrich, in the south west of the country, in association with grapevine, peach and tobacco; Varna, in the east, in association with rose and grapevine; Nova Zagora and Brestnik (Plovdiv), in the centre, with grapevine; and moreover at Galata, with grapevine; Kovachitsa, with grapevine, quince and willow; Kostenetz, with black currant; Krivnya, with grapevine; Kulata, with tobacco; Marikostinovo, with grapevine; Pazardjik Strelcha, with rose; Razlag, with apple; Sungurlare, with grapevine; Zmeevo, with grapevine and walnut; and Zvetino, with *Pinus nigra*.

LONGIDORUS DISTINCTUS sp. n.

(Fig. 2; A - D)

Holotype female: L = 4.1 mm; a = 90; b = 11.5; c = 67; c' = 2.2; V = 47; odontostyle = 79 μ m; odontophore = 55 μ m; oral aperture to guiding ring = 28 μ m; tail = 61 μ m; J = 13 μ m; body diam at lip region = 12 μ m; body diam at guiding ring = 19 μ m; body diam at base of oesophagus = 40 μ m; body diam at vulva = 45 μ m; body diam at anus = 28 μ m; body diam at beginning of J = 10 μ m.

Paratypes: (14 females): L = 4.6 (3.6-5.3) mm; a = 100 (85-127); b = 13.6 (10.1-16.9); c = 78 (54-88); c' = 2 (1.7-2.4); V = 46 (44-48); odontostyle = 80 (71-84) μ m; odontophore = 53 (48-55) μ m; oral aperture to guiding ring = 30 (28-33) μ m; tail = 58 (53-65) μ m; J = 14 (10-18) μ m; body diam at lip region = 12 (12-12) μ m; body diam at guiding ring = 19.5 (18-20) μ m; body diam at base of oesophagus = 38 (34-47) μ m; body diam at vulva = 46 (39-56) μ m; body diam at anus = 30 (27-33) μ m; body diam at beginning of J = 11.5 (9-13) μ m.

Allotype male: L = 4.4 mm; a = 99; b = 13.3; c = 71; c' = 1.9; odontostyle = 72 μ m; odontophore = 54 μ m; oral aperture to guiding ring = 30 μ m; tail = 61 μ m; J = 17 μ m; spicules = 59 μ m; body diam at lip region = 12 μ m; body diam at guiding ring = 19 μ m; body diam at base of oesophagus = 38 μ m; body diam at middle body = 44 μ m; body diam at anus = 32 μ m; body diam at beginning of J = 12 μ m.

Description: habitus as single spiral when killed; body cylindrical, tapering very gradually toward the extremities; glandular structures are evident in the lateral chords. Cuticle very finely striated posteriorly

with fasciations in the subventral region; the cuticle is 2-2.5 μm thick along body except immediately behind the labial region where it is 1.5-2 μm thick and in the vulvar and anal region where it is 3-4 μm thick. Labial region slightly expanded, rounded laterally and flat at the extremity, 5-6 μm high. Amphidial pouches irregularly bilobed. Odontostyle, odontophore and guiding ring typical of the genus; oesophagus dorylaimoid, with basal portion occupying 1/3 to 1/4 of the oesophagus total length; the muscular bulb is 80-90 μm long and 20 μm wide. Oesophagus intestinal valve triangular. Vulva almost equatorial, slit like; vagina occupying 1/2 of the corresponding body diameter. Gonads amphidelphic reflexed with uteri 120-140 μm long;

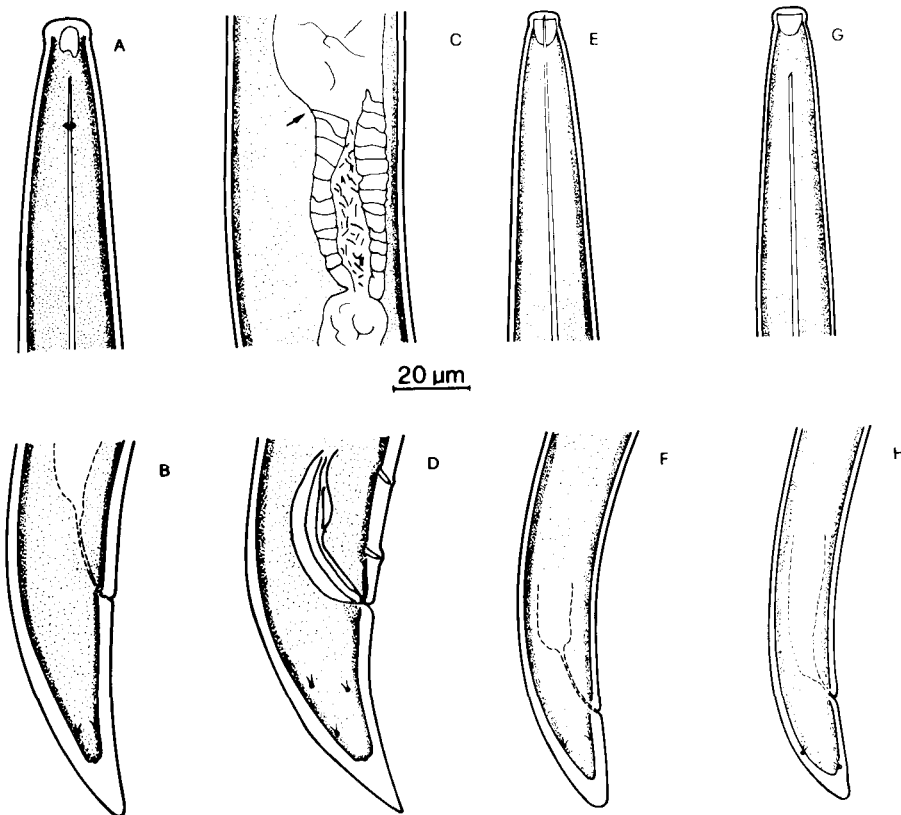


Fig. 2 - Anterior (A), posterior (B) and uterine (C) regions of female and posterior (D) region of male of *L. distinctus* sp. n.; anterior (E) and posterior (F) regions of female of *Xiphinema incertum* sp. n.; anterior (G) and posterior (H) regions of female of *X. simile* sp. n.

the uteri are formed by two distinct parts of almost equal length: one proximal to the vagina without particular characters and the other portion of denser structure, containing granular and crystal like material; sometimes the two portions are separated by a more or less pronounced constriction or indentation. This structure, however, does not have the appearance of a vestigial Z organ. The uteri are connected with the oviduct chamber by a sphincter. Prerectum indistinct; rectum equal to the body diameter at anus. Tail elongate, conoid dorsally convex and ventrally slightly concave, bearing two pairs of caudal pores.

Male body more coiled in the posterior region; testes rudimentary and not functional; spicules faint; the adanal pairs of supplements is preceded by 11 supplements.

Type material: holotype, 10 paratype females and allotype male in the collection of the Istituto di Nematologia Agraria del Consiglio Nazionale delle Ricerche, Bari, Italy; 2 paratype females, Nematology Department, Rothamsted Experimental Station, Harpenden, Herts, England; and 2 paratype females, Plant Nematology Collection, United States Department of Agriculture, Beltsville, Maryland, U.S.A.

Type habitat and locality: in the rhizosphere of walnut (*Juglans regia* L.) and quince (*Cydonia oblonga* Mill.) trees at Kovachitsa, Bulgaria.

Differential diagnosis: *Longidorus distinctus* sp. n. is similar to *L. sylphus* Thorne, 1939 and *L. juvenilis* Dalmasso, 1969. However, it differs from the first in having a more expanded labial region and a more elongate and much longer tail, and from the second by its larger body, longer odontostyle and larger number of supplements in the male (1 + 11 viz 1 + 6).

The measurements of four paratype females of *L. sylphus* are reported here for comparison: L = 4.1 mm; a = 88; b = 10.9; c = 86; c' = 1.7; V = 47; odontostyle = 76 μ m; odontophore = 35 μ m; oral aperture to guiding ring = 24 μ m; tail = 47 μ m.

Specimens of *L. distinctus* were found in the rhizosphere of apricot at Kovachitsa and in another 21 localities distributed throughout the country: Balchik (apple), Bolyartsi (apple), Brestovitsa (grapevine), D'bovo (rose), Gara Pirin (almond, grapevine), Harmanli (apple, mulberry), Hisar (grapevine), Kostinbrod (black currant, maize, poplar),

Jambol (wheat), Lom (apple), Marikostinovo (grapevine), Negovan (rose), Pamidovo (grapevine), Pazardzhik (grapevine, tulip), Petrich (alfalfa, grapevine, peach, tomato), Starchevo (grapevine), Septemviri (grapevine), Simitli (grapevine, tobacco, tomato), Tr'nchovitsa (plum), Varna (grapevine, peach, potato), and Vidin (cherry).

LONGIDORUS LATOCEPHALUS sp. n.

(Fig. 1; C - E)

Holotype female: L = 4.1 mm; a = 142; b = 12.6; c = 103; c' = 2.1; V = 49; odontostyle = 81 μ m; odontophore = 48 μ m; oral aperture to guiding ring = 42 μ m; tail = 40 μ m; J = 6 μ m; body diam at lip region = 11 μ m; body diam at guiding ring = 17 μ m; body diam at base of oesophagus = 27 μ m; body diam at vulva = 29 μ m; body diam at anus = 21 μ m; body diam at beginning of J = 10 μ m.

Paratypes (18 females): L = 4.1 (3.6-4.6) mm; a = 136 (123-144); b = 12.5 (11-14.4); c = 98 (82-108); c' = 2 (1.9-2.3); V = 49 (48-51); odontostyle = 79 (75-83) μ m; odontophore = 49 (47-51) μ m; oral aperture to guiding ring = 43 (39-45) μ m; tail = 42 (37-45) μ m; J = 5 (4-6) μ m; body diam at lip region = 11 (10-11) μ m; body diam at guiding ring = 18 (17-19) μ m; body diam at base of oesophagus = 27 (23-32) μ m; body diam at vulva = 31 (28-37) μ m; body diam at anus = 21 (18-23) μ m; body diam at beginning of J = 9 (8-11) μ m.

Description: habitus as more or less open c when killed; body slender, tapering very gradually toward extremities; glandular structures are evident in the lateral chords, especially in the posterior region. Cuticle very finely striated transversely, 1.5-2 μ m thick along body. Labial region 5-6 μ m high, greatly expanded, almost elliptical. Amphidial pouches small not lobed. Odontostyle, odontophore and guiding ring typical of the genus; the odontostyle is very slender. Oesophagus dorylaimoid with basal portion occupying 1/4 to 1/5 of the oesophagus total length; the muscular bulb is 50-60 μ m long and 12-16 μ m wide. Oesophagus intestinal valve hemispherical. Vulva equatorial slit like; vagina occupying 1/2 of the correspondent body diameter. Gonads amphidelphic, reflexed, with uteri 120-160 μ m long, separated from the oviduct by a small sphincter. Prerectum around

250 μm long, containing granular bodies of various shape as reported by Heyns and Jacobs (1982) for *L. pisi* (*L. siddiqii*); rectum equal to the body diameter at anus. Tail elongate subconical with rounded terminus and bearing one pair of caudal pores.

Male: L = 6.2 mm; a = 195; b = 16.8; c = 125; c' = 2.0; odontostyle = 76 μm ; odontophore = 44 μm ; oral aperture to guiding ring = 22 μm ; tail = 50 μm ; J = 15 μm ; spicules = 41 μm ; body diam at lip region = 12 μm ; body diam at guiding ring = 15 μm ; body diam at base of oesophagus = 28 μm ; body diam at middle body = 32 μm ; body diam at anus = 25 μm ; body diam at beginning of J = 9 μm .

The male was found in the rhizosphere of a tomato plant at Petrich, the type locality. It is morphologically similar to female, but is much longer, more coiled in the posterior region and the guiding ring is anteriorly situated. Testis rudimentary with no sperms inside; the adanal pair of supplements is preceded by a ventromedian row of 13 supplements.

Type material: holotype and 12 paratype females in the collection of the Istituto di Nematologia Agraria del Consiglio Nazionale delle Ricerche, Bari, Italy; 3 paratype females, Nematology Department, Rothamsted Experimental Station, Harpenden, Herts, England; and 3 paratype females, Plant Nematology Collection, United States Department of Agriculture, Beltsville, Maryland, U.S.A.

Type habitat and locality: in the rhizosphere of grapevine (*Vitis* sp.) at Petrich, Bulgaria.

Differential diagnosis: *Longidorus latocephalus* sp. n. is similar to *L. pisi* Edward, Misra et Singh, 1964, but differs from this species because of its longer body and odontostyle, posterior guiding ring and more expanded labial region.

Longidorus latocephalus was detected in samples collected from 12 localities: the type locality Petrich (in the rhizosphere of grapevine, tomato, tobacco, apple, peach, corn and alfalfa) and Blagoevgrad (tomato); Burgas near Pomorie (grapevine); Chuchuligovo (tobacco); Kapatovo (grapevine); Kostinbrod (black currant); Marikostinovo (grapevine); Pripechene (tobacco); Sandaniski (grapevine); Starchevo (grapevine); Varna (peach); and Zlatarevo (apple, corn, watermelon, alfalfa).

LONGIDORUS MOESICUS sp. n.

(Fig. 1; F-H)

Holotype female: L = 7.7 mm; a = 147; b = 16; c = 174; c' = 1; V = 54; odontostyle = 119 μ m; odontophore = 62 μ m; oral aperture to guiding ring = 35 μ m; tail = 44 μ m; J = 12 μ m; body diam at lip region = 12 μ m; body diam at guiding ring = 25 μ m; body diam at base of oesophagus = 51 μ m; body diam at vulva = 52 μ m; body diam at anus = 43 μ m; body diam at beginning of J = 29 μ m.

Paratypes (10 females): L = 7.2 (6.4-8.0) mm; a = 120 (96-147); b = 15.8 (13.8-18.8); c = 170 (146-186); c' = 1 (0.8-1.2); V = 53 (50-54); odontostyle = 119 (115-124) μ m; odontophore = 63 (59-66) μ m; oral aperture to guiding ring = 34 (32-38) μ m; tail = 43 (40-49) μ m; J = 13 (12-13) μ m; body diam at lip region = 12 (11-13) μ m; body diam at guiding ring = 25 (24-26) μ m; body diam at base of oesophagus = 50 (45-61) μ m; body diam at vulva = 61 (52-71) μ m; body diam at anus = 42 (39-49) μ m; body diam at beginning of J = 27 (24-30) μ m.

Description: habitus as more or less open c to single spiral when killed; body robust, tapering gradually toward the anterior extremity. Glandular structures are evident in the lateral chords, especially in the anterior region. Cuticle finely striated transversely, marked by fasciations on the subventral and subdorsal regions; the fasciations are usually deeper in the median portion of the body; the cuticle is 2 to 4 μ m thick along body except in the caudal region where at its beginning is 6-7 μ m thick on either side. Labial region subacute, 4-5 μ m high, continuous with the rest of the body. Amphidial pouches more or less asymmetrically bilobed. Odontostyle, odontophore and guiding ring typical of the genus. Oesophagus dorylaimoid with basal portion occupying 1/4 to 1/5 of the oesophagus total length; the muscular bulb is 120-130 μ m long and 20-25 μ m wide. Oesophagus intestinal valve large of irregular shape. Vulva equatorial, slit like; vagina occupying more or less 2/3 of the correspondent body diameter. Gonads amphidelphic, reflexed with uteri 120-160 μ m long separated from the oviduct by a sphincter. Prerectum over 400 μ m long, rectum equal to 3/4 of the body diameter at anus. Tail conoid, with narrowly rounded terminus, bearing two pairs of caudal pores.

Male: L = 6.2 mm; a = 120; b = 15.8; c = 164; c' = 1; odontostyle = 90 μ m; odontophore = 59 μ m; oral aperture to guiding ring = 34 μ m; tail = 28 μ m; J = 11 μ m; spicules = 69 μ m; body diam

at lip region = 11 μ m; body diam at guiding ring = 24 μ m; body diam at base of oesophagus = 46 μ m; body diam at middle body = 52 μ m; body diam at anus = 39 μ m; body diam at beginning of J = 24 μ m.

The male was found in the rhizosphere of an apple tree at D'Lgopol (Varna). It is morphologically similar to female, although smaller in size, with a shorter odontostyle and more coiled in the posterior region. Testis very long and well developed with sperms inside, spicules conspicuous, heavily sclerotized, adanal pair of supplements preceded by a ventromedian row of 17 supplements.

Type material: holotype and 6 paratype females in the collection of the Istituto di Nematologia Agraria del Consiglio Nazionale delle Ricerche, Bari, Italy; 2 paratype females, Nematology Department, Rothamsted Experimental Station, Harpenden, Herts, England; and 2 paratype females, Plant Nematology Collection, United States Department of Agriculture, Beltsville, Maryland, U.S.A.

Type habitat and locality: in the rhizosphere of black currant (*Ribes nigrum* L.) at Kostinbrod, near Sofia, Bulgaria.

Differential diagnosis: *Longidorus moesicus* sp. n. resembles *L. goodeyi* Hooper, 1961 and *L. fasciatus* Roca et Lamberti, 1981. It differs, however, from *L. goodeyi* by its more rounded and acute labial region, longer odontostyle and higher value of the ratios 'a' and 'c'. *L. moesicus* differs from *L. fasciatus* in having a less rounded labial region and tail terminus, a posterior vulva (45% in *L. fasciatus*), shorter tail and odontophore and a shorter distance anterior extremity to guiding ring (28 μ m in *L. fasciatus*).

Longidorus moesicus was detected in the samples collected from eight other localities beside Kostinbrod, the type locality, where it was found in association with black currant, corn and rose. The other localities are: D'Lgopol (rhizosphere of apple); Dolna Banya (black currant); Krivnya (grapevine); Petrich (grapevine); Razgrad (grapevine); Shumen Dragoevo (grapevine); Travnovo (plum); and Varna (rose).

PARALONGIDORUS MAXIMUS (Buetschli, 1874) Siddiqi, 1964

Three females, one male and a few juvenile stages were found in the rhizosphere of grapevine rootstocks at Galata, near Varna. The

measurements of the adult specimens are: females (3 n); L = 9.8 (8-11.4) mm; a = 133 (122-139); b = 15.8 (15.3-16.2); c = 272 (223-316); c' = 0.7 (0.6-0.8); V = 42 (41-43); odontostyle = 187 (185-189) μm ; odontophore = 62 (55-67) μm ; oral aperture to guiding ring = 42 (41-43) μm ; tail = 36 μm ; J = 13 (10-15) μm ; body diam at lip region = 32 (30-33) μm ; body diam at guiding ring = 38 (36-42) μm ; body diam at base of oesophagus = 65 (51-75) μm ; body diam at vulva = 74 (58-82) μm ; body diam at anus = 54 (43-59) μm ; body diam at beginning of J = 39 (26-46) μm . Male, L = 10.8 mm; a = 131; b = 15.6; c = 263; c' = 0.7; odontostyle = 192 μm ; odontophore = 62 μm ; oral aperture to guiding ring = 39 μm ; spicules = 103 μm ; tail = 41 μm ; J = 10 μm ; body diam at lip region = 30 μm ; body diam at guiding ring = 37 μm ; body diam at base of oesophagus = 66 μm ; body diam at middle body = 70 μm ; body diam at anus = 56 μm ; body diam at beginning of J = 32 μm .

Table I - *Morphometric characters of three populations of Xiphinema brevicolle from different Bulgarian localities.*

Locality and host	Varna, grapevine	Archar, (Kovachitsa) grapevine	Pazardzhik, (Plovdiv) grapevine
n	11 ♀	9 ♀	5 ♀
L mm	2 (1.8-2.1)	2 (2-2.1)	2 (1.9-2.1)
a	44 (40-49)	44 (42-48)	50 (46-52)
b	6.2 (5.4-7.8)	6.7 (6-7.3)	6.5 (6.0-6.8)
c	73 (62-88)	82 (74-93)	79 (75-80)
c'	1 (0.9-1)	0.9 (0.8-0.9)	0.9 (0.9-1)
V	49 (48-52)	50 (48-51)	50 (50-50)
Odontostyle μm	87 (83-92)	94 (93-96)	89 (86-92)
Odontophore μm	56 (54-58)	53 (52-54)	56 (56-57)
Oral aperture to guiding ring μm	72 (63-75)	68 (63-73)	62 (60-65)
Tail μm	27 (26-30)	25 (23-27)	25 (24-27)
J μm	9 (7-10)	11 (9-13)	12 (11-12)
Body diam at lip region μm	13 (12-13)	12 (12-12)	12 (12-13)
Body diam at guiding ring μm	30 (27-31)	29 (27-30)	27 (27-29)
Body diam at base of oesophagus μm	40 (36-43)	40 (38-43)	36 (34-39)
Body diam at vulva μm	45 (40-49)	46 (45-48)	40 (38-44)
Body diam at anus μm	27 (25-30)	28 (25-31)	26 (25-27)
Body diam at beginning of J μm	14 (13-16)	19 (18-21)	16.5 (16-17)

This population does not differ much from other European populations (Heyns, 1975), except in having a slightly longer odontostyle (187 viz 171 μm) and a slightly posterior vulva (42 viz 37-40). In the male testes are well developed and full of large sperms and the adanal pair of supplements is preceded by a row of 9 ventromedian supplements.

Paralongidorus maximus was found only in two samples at the same locality (Galata, Varna).

XIPHINEMA BREVICOLLE Lordello *et* Da Costa, 1961

The morphometric characters of three populations of *Xiphinema brevicolle* are given in Table I. They were collected all from around the roots of grapevines, one in north western Bulgaria, at Archar, one in the centre at Pazardzhik, near Plovdiv, and the last at Varna, in the eastern part of the country. These populations are almost identical except for the tail which is slightly longer in the Varna population and the odontostyle which is remarkably longer in the Archar specimens. The morphometrics of the Bulgarian populations of *X. brevicolle* generally agree with those of populations from other eastern European countries (Lamberti and Bleve Zacheo, 1979). Conversely, they have a slightly smaller body size compared to the western European populations (Martelli and Lamberti, 1967).

Xiphinema brevicolle was found in Bulgaria in eight localities: Archar (in the rhizosphere of grapevine); Dolna Banya (black currant); Galata (grapevine); Kostinbrod (black currant); Kozlodui (grapevine); Krivnya (grapevine); Pazardzhik (grapevine); and Varna (grapevine and *Robinia* sp.).

XIPHINEMA DIVERSICAUDATUM (Micoletzky, 1927) Thorne, 1939

The morphometric characters of two females and one male of *Xiphinema diversicaudatum* from Dolna Banya, are: females (2 n); L = 3.9 mm; a = 68; b = 7.6-7.8; c = 77-79; c' = 1.4; V = 43-44;

odontostyle = 128-136 μm ; odontophore = 63-79 μm ; oral aperture to guiding ring = 118 μm ; tail = 50-51 μm ; J = 18 μm . Male, L = 4.5 mm; a = 75; b = 11.7; c = 88; c' = 1.2; odontostyle = 127 μm ; odontophore = 80 μm ; oral aperture to guiding ring = 122 μm ; tail = 51 μm ; J = 13 μm ; spicules = 87 μm .

The populations of *X. diversicaudatum* almost always consisted of a single adult and a few juveniles. Therefore, due to the scarcity of material it is difficult to identify it with certainty. However, it might be assumed that the Bulgarian populations of this species are morphometrically very close to the Italian ones, which are smaller in size compared to those from central and northern Europe (Martelli and Lamberti, 1967).

Xiphinema diversicaudatum was found in four samples each collected from a different locality: Brezovo (grapevine); Dolna Banya (black currant); Pazardzhik (rose); and Perustitsa (grapevine).

Table II - Morphometric characters of two populations of *Xiphinema index* from Bulgaria.

Locality and host	Pomorie, grapevine	Plovdiv, grapevine
n	10 ♀	10 ♀
L mm	3 (2.7-3.2)	3.2 (3-3.4)
a	57 (50-62)	61 (58-64)
b	7.2 (6-8.2)	7 (6.8-7.5)
c	81 (72-95)	84 (73-93)
c'	1 (0.8-1.1)	1.1 (1-1.1)
V	40 (39-42)	41 (39-42)
Odontostyle μm	130 (124-133)	126 (124-133)
Odontophore μm	74 (71-78)	75 (69-80)
Oral aperture to guiding ring μm	108 (91-118)	119 (110-124)
Tail μm	37 (33-42)	38 (34-42)
J μm	14 (10-17)	15 (11-18)
Body diam at lip region μm	12 (12-13)	13 (13-13)
Body diam at guiding ring μm	38 (35-39)	37 (36-38)
Body diam at base of oesophagus μm	48 (43-55)	45 (41-50)
Body diam at vulva μm	53 (49-61)	53 (48-57)
Body diam at anus μm	38 (37-42)	36 (34-38)
Body diam at beginning of J μm	22 (21-26)	18 (16-20)

Table III - *Morphometric characters of five populations of Xiphinema pachtaicum from Bulgaria.*

Locality and host	Vidin, walnut	Varna, apricot	Plovdiv, grapevine	Petrich, grapevine	Levski, plum
n	9 ♀	10 ♀	10 ♀	10 ♀	10 ♀
L mm	2 (1.9-2)	1.9 (1.7-2)	2 (1.8-2.1)	1.8 (1.7-2)	1.8 (1.7-2)
a	67 (62-71)	63 (57-68)	70 (65-77)	65 (60-70)	63 (61-68)
b	6.5 (6.2-7.6)	6.6 (6.1-7.2)	7 (6.2-7.9)	6 (5.3-6.3)	6.4 (6-7.4)
c	69 (63-72)	64 (57-71)	67 (62-72)	64 (57-70)	63 (58-67)
c'	1.7 (1.6-1.8)	1.8 (1.6-1.8)	1.7 (1.6-1.8)	1.7 (1.6-2)	1.7 (1.6-1.9)
V	56 (54-58)	55 (54-56)	56 (54-57)	56 (55-57)	56 (54-57)
Odontostyle μm	86 (84-89)	85 (83-87)	88 (84-91)	85 (78-88)	85 (78-89)
Odontophore μm	47 (44-50)	46.5 (46-47)	50 (49-52)	46 (44-48)	46 (42-50)
Oral aperture to guiding ring μm	69 (66-74)	75 (72-77)	79 (78-81)	76 (74-78)	64 (58-70)
Tail μm	29 (28-29)	29 (29-31)	30 (29-32)	28 (27-32)	29 (27-32)
J μm	10 (9-12)	8.5 (8-10)	7 (6-9)	9 (8-10)	9.5 (9-11)
Body diam at lip region μm	8 (8-9)	8.5 (8-9)	9 (9-9)	8 (8-9)	8 (8-9)
Body diam at guiding ring μm	21 (20-22)	20.5 (20-23)	21 (20-22)	21 (20-23)	19.5 (18-21)
Body diam at base of oesophagus μm	26 (24-30)	26 (25-29)	26.5 (26-29)	25 (24-26)	26 (25-28)
Body diam at vulva μm	29 (28-34)	30 (28-33)	29 (28-32)	28 (26-30)	28.5 (28-32)
Body diam at anus μm	17 (16-18)	16.5 (16-18)	17 (16-20)	16 (15-17)	17 (16-18)
Body diam at beginning of J μm	8 (8-9)	7.5 (7-9)	7 (6-8)	7 (6-8)	8.5 (7-10)

XIPHINEMA INDEX Thorne *et* Allen, 1950

The morphometric characters of two populations of *Xiphinema index* are given in Table II. They differ slightly in the length of the body, length of the odontostyle, position of the fixed guiding ring and position of the vulva. However, they both fall in the range of the Italian and Californian populations (Martelli and Lamberti, 1967).

Xiphinema index was detected in 16 localities: Asenovgrad (in the rhizosphere of grapevine); Balchik (apple); Boliartzi (grapevine); Brestnik (grapevine); Brestovitsa (fig; grapevine); Brezovo (grapevine); Hisar (grapevine); Krichim (grapevine); Perustitsa (grapevine); Plovdiv (grapevine); Pomorie (almond, grapevine, peach), Popovitsa (grapevine); Starchevo (grapevine); Septemviri (grapevine); Ustina (grapevine); and Zlatitrap (grapevine).

XIPHINEMA ITALIAE Meyl, 1953

The morphometric characters of a female of *Xiphinema italiae* found in the rhizosphere of grapevine at Varna are: L = 2.7 mm; a = 76; b = 7.3; c = 30; c' = 4.3; V = 43; odontostyle = 90 μ m; odontophore = 54 μ m; oral aperture to guiding ring = 78 μ m; tail = 90 μ m; J = 10 μ m.

Juveniles of *X. italiae* were also found at Kozlodui (grapevine); Krivnya (grapevine); and Sadovo (grapevine, grass, rose).

XIPHINEMA PACHTAICUM (Tulaganov, 1938) Kirjanova, 1951

The morphometric characters of five populations of *Xiphinema pachtaicum* collected from the rhizosphere of different plants in Bulgaria are given in Table III. Although these populations have different geographical origins and grew in different environmental conditions, they are almost identical and, moreover, do not differ from other populations of *X. pachtaicum* from various regions such as the Mediterranean, Central Asia and Central Europe (Lamberti and Bleve-Zacheo, 1979).

This species is distributed throughout the country. In fact, it

was found in over 100 localities in association with various trees, vines and shrubs. Sometimes, but rarely, it was found also in the rhizosphere of herbaceous plants, annuals, such as tomato and watermelon, or perennials, such as alfalfa, grasses and strawberry.

XIPHINEMA TURCICUM Luc et Dalmasso, 1963

The morphometric characters of two Bulgarian populations of *Xiphinema turcicum* are given in Table IV. They generally fit with the original description for this species (Luc and Dalmasso, 1963), except for the odontostyle, which in the Bulgarian populations is slightly shorter, and in the shape of tail, which in the Bulgarian

Table IV - *Morphometric characters of two populations of Xiphinema turcicum from Bulgaria.*

Locality and host	Pomorie, almond, peach, grapevine	Kostinbrod, black currant
n	9 ♀	4 ♀
L mm	4 (3.3-4.4)	4.1 (4-4.2)
a	64 (60-66)	71 (70-72)
b	8 (7-9)	7 (6.8-7.2)
c	122 (101-130)	134 (130-137)
c'	0.7 (0.7-0.7)	0.7 (0.6-0.7)
V	50 (48-52)	48 (48-48)
Odontostyle μm	149 (145-152)	146 (144-147)
Odontophore μm	95 (89-99)	93 (92-94)
Oral aperture to guiding ring μm	139 (128-146)	145 (144-147)
Tail μm	33 (32-35)	31 (30-32)
J μm	12 (11-14)	12 (10-12)
Body diam at lip region μm	12 (12-12)	12 (12-12)
Body diam at guiding ring μm	47 (44-50)	47 (45-49)
Body diam at base of oesophagus μm	60 (55-64)	60 (58-61)
Body diam at vulva μm	63 (55-69)	60 (58-61)
Body diam at anus μm	47 (45-49)	42 (42-43)
Body diam at beginning of J μm	36 (34-38)	35 (33-35)

populations is more broadly rounded at terminus and more symmetrical. No spines were observed in the uteri of females belonging to Bulgarian populations, while the Z pseudoorgan was clearly visible in all.

Xiphinema turcicum was found in three localities: Pomorie (in the rhizosphere of almond, peach and grapevine); Kostinbrod (black currant); and Vinarevo (wheat).

XIPHINEMA VUITTENEZI Luc, Lima, Weischer *et* Flegg, 1964

The morphometric characters of a population of *Xiphinema vuittenezi* collected from around the roots of poplar trees at Kostinbrod, near Sofia, are: (8 females): L = 3.1 (3-3.2) mm; a = 62 (55-64); b = 7.3 (6.6-7.7); c = 89 (84-97); c' = 0.9 (0.8-1); V = 50 (49-50); odontostyle = 120 (118-124) μ m; odontophore = 74 (73-76) μ m; oral aperture to guiding ring = 88 (80-104) μ m; tail = 34 (30-36) μ m; J = 12 (10-13) μ m; body diam at lip region = 13 (12-13) μ m; body diam at guiding ring = 33 (31-35) μ m; body diam at base of oesophagus = 43 (41-46) μ m; body diam at vulva = 49 (46-52) μ m; body diam at anus = 36 (34-39) μ m; body diam at beginning of J = 22 (18-27) μ m.

These values are in the range of those reported for various European populations in the original description of the species (Luc, *et al.*, 1964), except for the odontostyle and the distance of the fixed guiding ring from the oral aperture, which in the Bulgarian populations are slightly shorter.

Xiphinema vuittenezi was found at Kostinbrod also in association with apple, black currant, cherry, grass, corn, peach, pear and rose. It was also found at Bukyovtsi (in the rhizosphere of grapevine); Dolna Banya (black currant); Godech (apple); Kostenez (black currant); Kozlodui (rose); Nova Zagora (grapevine); Prolesha (apple); and T'rnovo (grapevine).

XIPHINEMA INCERTUM sp. n.

(Fig. 2; E and F)

In each of five localities was found a single female of a nematode resembling *X. pachtaicum*. However, each of these specimens had the

odontostyle longer than that of *X. pachtaicum* and the tail differently shaped compared to *X. pachtaicum*. We believe, therefore, that these individuals might belong to a different species which is here described as new.

Holotype female: L = 1.7 mm; a = 54; b = 5.3; c = 64; c' = 1.5; V = 56; odontostyle = 88 μ m; odontophore = 51 μ m; oral aperture to guiding ring = 77 μ m; tail = 27 μ m; J = 7 μ m; body diam at lip region = 8 μ m; body diam at guiding ring = 23 μ m; body diam at base of oesophagus = 30 μ m; body diam at vulva = 32 μ m; body diam at anus = 18 μ m; body diam at beginning of J = 10 μ m.

The females, whose measurements are here given, were collected in the rhizosphere of grapevine at Pomori and Schumen Osmar, of apple at Zvanichevo and of peach at Petrich. Females (n = 4): L = 1.9 (1.8-2.0) mm; a = 57 (54-64); b = 6.4 (5.9-6.8); c = 69 (62-78); c' = 1.5 (1.4-1.7); V = 57 (56-58); odontostyle = 92 (87-97) μ m; odontophore = 51 (50-54) μ m; oral aperture to guiding ring = 71 (64-82) μ m; tail = 28 (26-32) μ m; J = 7 (6-9) μ m; body diam at lip region = 9 (8-9) μ m; body diam at guiding ring = 22 (20-27) μ m; body diam at base of oesophagus = 29 (25-33) μ m; body diam at vulva = 34 (29-37) μ m; body diam at anus = 19 (18-19) μ m; body diam at beginning of J = 10 (9-10) μ m.

Description: habitus as single spiral when killed; body tapering gradually toward the extremities; cuticle smooth, 1.5 μ m thick along body, except in the vulvar and caudal regions where it is 3 μ m thick. Labial region expanded, 5 μ m high. Amphidial pouches stirrup shaped. Odontostyle, odontophore and guiding sheath typical of the genus; the two rings are 7 μ m apart. Oesophagus dorylaimoid, with the posterior enlarged part occupying 1/4 of the oesophagus total length; muscular oesophageal bulb measuring 70 μ m long and 12 μ m wide. Oesophagus intestinal valve heart-shaped. Vulva a transverse slit like; vagina occupying 1/2 of the corresponding body diameter. Gonads amphidelphic reflexed, with no particular characters in their components. Prerectum 100 μ m long; rectum equal to body diameter at anus. Tail conoid, with narrowly rounded terminus, bearing 2 pairs of caudal pores.

Male: not found.

Type material: holotype in the collection of the Istituto di Nematologia Agraria del Consiglio Nazionale delle Ricerche, Bari, Italy.

Type habitat and locality: in the rhizosphere of grapevine plants (*Vitis sp.*) at Varna, Bulgaria.

Differential diagnosis: *Xiphinema incertum* sp. n. resembles *X. pachtaicum* (Tulaganov, 1938) Kirjanova, 1951 and *X. opisthohysterum* Siddiqi, 1961. However, it differs from both in having a longer odontostyle and a more rounded tail terminus.

XIPHINEMA SIMILE sp. n.

(Fig. 2; G and H)

Holotype female: L = 1.9 mm; a = 75; b = 7.3; c = 67; c' = 1.6; V = 53; odontostyle = 67 μ m; odontophore = 38 μ m; oral aperture to guiding ring = 50 μ m; tail = 29 μ m; J = 7 μ m; body diam at lip region = 9 μ m; body diam at guiding ring = 18 μ m; body diam at base of oesophagus = 24 μ m; body diam at vulva = 29 μ m; body diam at anus = 17 μ m; body diam at beginning of J = 6 μ m.

Paratypes (9 females): L = 1.9 (1.7-2.1) mm; a = 71 (63-77); b = 7.2 (6.6-7.6); c = 67 (61-70); c' = 1.7 (1.6-1.8); V = 53 (51-54); odontostyle = 66 (62-69) μ m; odontophore = 39 (35-42) μ m; oral aperture to guiding ring = 51 (49-53) μ m; tail = 29 (27-30) μ m; J = 7 (6-8) μ m; body diam at lip region = 9 (9-9) μ m; body diam at guiding ring = 18 (18-19) μ m; body diam at base of oesophagus = 24 (22-25) μ m; body diam at vulva = 27 (24-29) μ m; body diam at anus = 17 (16-19) μ m; body diam at beginning of J = 8 (6-9) μ m.

Description: habitus as single spiral when killed; body tapering gradually toward the extremities; cuticle very finely striated transversely, 1-1.5 μ m thick along body. Labial region expanded, 5 μ m high. Amphidial pouches stirrup shaped. Odontostyle, odontophore and guiding sheath typical of the genus; the two rings are 6-7 μ m apart. Oesophagus dorylaimoid with the posterior enlarged part occupying 1/3 of the oesophagus total length; muscular oesophageal bulb measuring 80 μ m long and 15 μ m wide. Oesophageal intestinal valve from hemispherical to dish like. Vulva a transverse slit like; vagina occupying 1/2 to 2/3 of the corresponding body diameter. Gonads amphidelphic, reflexed, with no particular characters in their components. Prerectum 140-180 μ m long; rectum equal to body diameter at anus.

Tail conoid with subacute terminus, but not subdigitate or digitate; the tail bears two pairs of caudal pores.

Male: not found.

Type material: holotype and 5 paratype females in the collection of the Istituto di Nematologia Agraria del Consiglio Nazionale delle Ricerche, Bari, Italy; 2 paratype females, Nematology Department, Rothamsted Experimental Station, Harpenden, Herts, England; and 2 paratype females, Plant Nematology Collection, United States Department of Agriculture, Beltsville, Maryland, U.S.A.

Type habitat and locality: in the rhizosphere of poplar trees (*Populus alba* L.) at Kovachitsa, Bulgaria.

Differential diagnosis: *Xiphinema simile* sp. n. resembles *X. pachtaicum* (Tulaganov, 1938) Kirjanova, 1951, *X. opisthohystrum* Siddiqi, 1961, *X. californicum* Lamberti et Bleve-Zacheo, 1979, and *X. intermedium* Lamberti et Bleve-Zacheo, 1979. However, it differs: from *X. pachtaicum* in having a shorter odontostyle, an anterior vulva and a differently shaped tail; from *X. opisthohystrum* because of its anterior vulva and differently shaped tail and from *X. californicum* and *X. intermedium* in its shorter odontostyle, posterior vulva, less expanded lip region and slenderer body.

Xiphinema simile was found in the type locality, Kovachitsa, also in the rhizosphere of apricot and quince trees. Specimens of this species were found in samples collected from around the roots of black currant at Kostinbrod, grapevine at Petrich, and apple at Pomorie.

DISCUSSION

Longidorid nematodes are well represented in Bulgaria with 14 species within 3 genera (*Longidorus*, *Paralongidorus* and *Xiphinema*). In fact, of a total of 1042 samples examined, 618 contained members of the family Longidoridae, which seem to be almost equally distributed between woody (57% of the samples contained one or more species of Longidoridae) and herbaceous plants (60% of the samples contained Longidoridae).

The commonest species was, as expected *X. pachtaicum*, very widely distributed and found in the rhizosphere of many different plants (Fig. 3).

Longidorus euonymus and *L. distinctus* were the second com-

★ *X. pachtaicum*

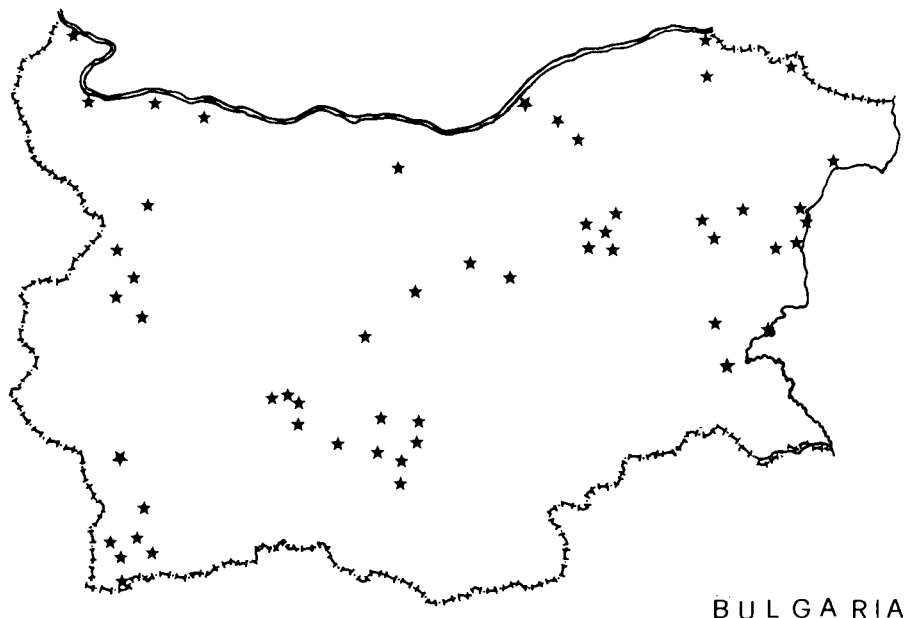


Fig. 3 - Distribution of *Xiphinema pachtaicum* in Bulgaria.

monest species of our survey (Fig. 4), while after them the most frequent appeared to be *L. latocephalus* (Fig. 4) and *X. index* (Fig. 5). All these four species seem to have a countrywide distribution in Bulgaria, but *X. index* is prevalently associated with grapevine.

Less widely distributed, although sometimes frequent in some localities, was *X. vuittenezi* (Fig. 5).

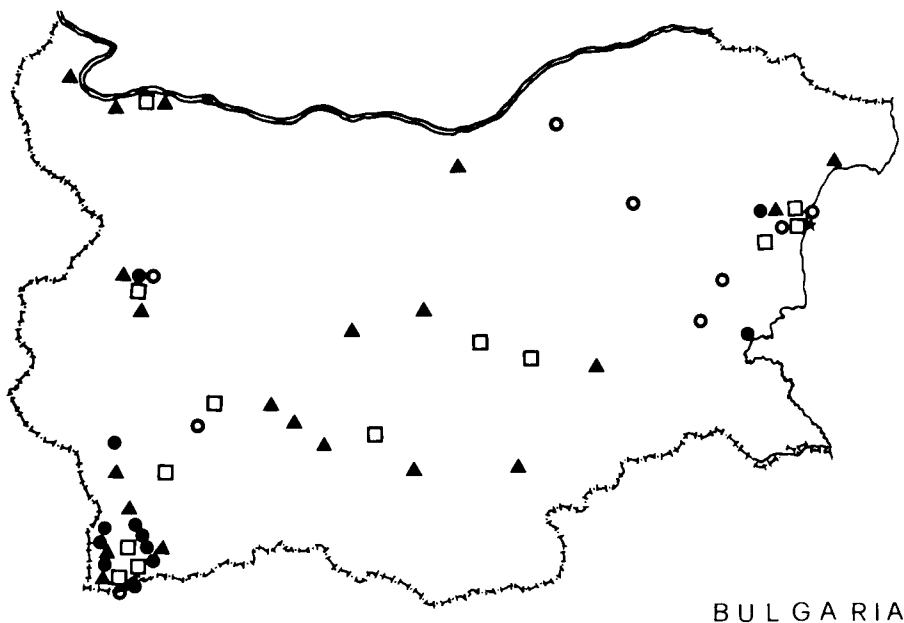
Longidorus moesicus and *X. brevicolle* occurred in a limited number of samples and seem to have a restricted distribution (Figs. 4 and 5).

Local importance and narrow distribution seem to have *X. diversicaudatum*, *X. italiae*, *X. turcicum*, *X. simile* and *Paralongidorus maximus* (Figs. 5 and 4).

Xiphinema incertum might be more widespread than suspected because it usually occurs in very low populations (Fig. 5).

Other species of Longidoridae reported from Bulgaria are: 1) *L. closelongatus* Stoyanov, 1964; *L. goodeyi* Hooper, 1961; *X. opistho-*

- *L. euonymus*
- ▲ *L. distinctus*
- *L. latocephalus*
- *L. moesicus*
- ★ *P. maximus*



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Fig. 4 - Distribution of species of *Longidorus* and *Paralongidorus* in Bulgaria.

hysterum Siddiqi, 1961 (by Stoyanov, 1964); II) *L. attenuatus* Hooper, 1961, *L. closelongatus*, *L. profundorum* Hooper, 1965, *L. siddiqii* Aboul-Eid, 1970, *L. vineacola* Sturhan et Weischer, 1964, *X. neovuittenezi* Dalmasso, 1969 (by Choleva, 1975a); III) *L. elongatus* (by Choleva, 1975b); IV) *L. closelongatus*, *L. siddiqii*, *L. sylphus* Thorne, 1939 (by Katalan-Gateva, 1980).

We thought that *L. closelongatus* was a misidentification for *L. euonymus*. However, we have compared our populations of *X. euonymus* with a paratype female of *L. closelongatus* and concluded that the two species are definitely different, the latter having a much longer odontostyle, a less expanded labial region and a slightly anterior vulva. Therefore, *L. closelongatus*, never found during our extensive survey, is probably a rare species.

- ▲ *X. brevicolle*
- ◻ *X. diversicaudatum*
- *X. index*
- ★ *X. italiae*
- ▴ *X. turcicum*
- *X. vuittenezi*
- *X. incertum*
- *X. simile*

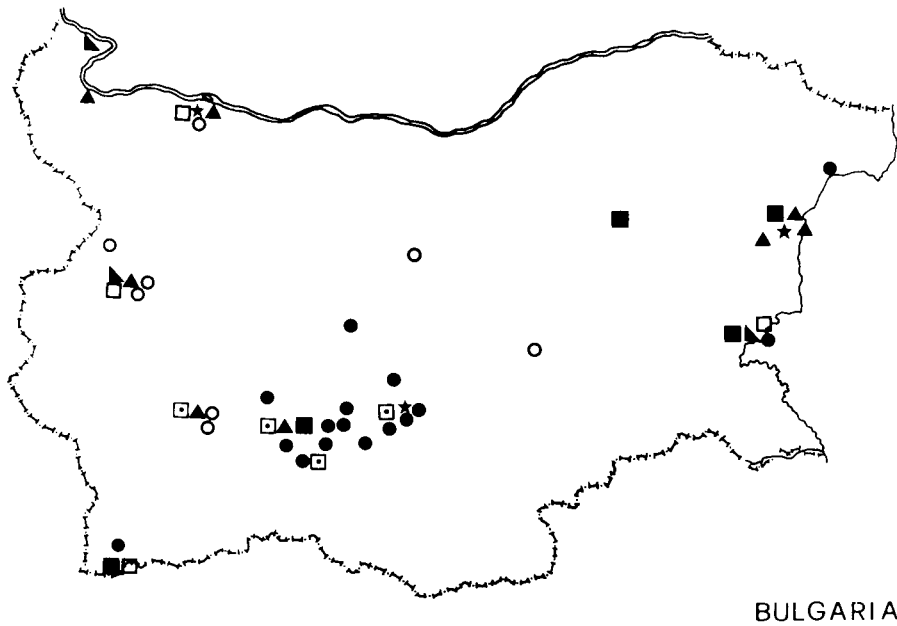


Fig. 5 - Distribution of species of *Xiphinema* in Bulgaria.

Longidorus goodeyi is described here as *L. moesicus* sp. n., *L. siddiqii* as *L. latocephalus* sp. n., and *L. sylphus* as *L. distinctus* sp. n., having distinctive characters from these species.

Longidorus attenuatus was also, probably, erroneously identified in the place of *L. moesicus*.

Longidorus profundorum, *L. vineacola* and *X. neovuittenezi* were never detected in our samples.

S U M M A R Y

A survey of Longidorid nematodes was carried out in 1972-1981 in Bulgaria. Fourteen species were found: *Longidorus euonymus* Mali et Hooper, *L. distinctus* sp. n., *L. latocephalus* sp. n., *L. moesicus* sp. n., *Paralongidorus maximus* (Buetschli) Siddiqi, *Xiphinema brevicolle* Lordello et Da Costa, *X. diversicaudatum* (Micoletzky) Thorne, *X. index* Thorne et Allen, *X. italiae* Meyl, *X. pachtaicum* (Tulaganov) Kirjanova, *X. turcicum* Luc et Dalmasso, *X. vuittenezi* Luc, Lima, Weischer et Flegg, *X. incertum* sp. n., and *X. similis* sp. n. *Xiphinema pachtaicum* was the commonest species, broadly distributed and found in the rhizosphere of various different plants. On a total of 1042 samples examined 618 resulted to contain one or more species of Longidoridae which were present in 57% of the samples collected from woody and 60% of the samples collected from herbaceous plants.

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