

# The occurrence of *Xiphinema sphaerocephalum* Lamberti et al. and *X. hispanum* Lamberti et al. (Nematoda : Longidoridae) in Portugal with descriptions of *X. lanceolatum* sp. n. and *X. lapidosum* sp. n.

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**Summary** – Results are reported on *Xiphinema* species found during a survey carried out in Portugal. *X. sphaerocephalum* Lamberti, Castillo, Gomez-Barcina & Agostinelli, 1992, *X. hispanum* Lamberti, Castillo, Gomez-Barcina & Agostinelli, 1992 and two undescribed species were found. They are *X. lanceolatum* sp. n. and *Xiphinema lapidosum* sp. n. The former, found in the rhizosphere of grapevine in a field with some dispersed apple and pear trees at Quinta dos Bairros, Alenquer, Lisboa, is distinguishable from the species recently described by Lamberti et al. (1992) in having a longer odontostyle and an anteriorly situated vulva. It is similar to *X. coronatum* Roca, 1991, *X. macroacanthum* Lamberti, Roca & Agostinelli, 1990, *X. melitense* Lamberti, Blevé-Zacheo & Arias, 1982 and *X. smoliki* Luc & Coomans, 1988. The second, found in the rhizosphere of broad-beans and peas at Quinta do Rogelo, Silves, Faro, is similar to *X. hardingi* Joubert, Kruger & Heyns, 1988, *X. jomercium* Joubert, Kruger & Heyns, 1988, *X. majus* Bos & Loof, 1985, *X. tenue* Joubert, Kruger & Heyns, 1988, *X. transkeiense* Joubert, Kruger & Heyns, 1988 and *X. turcicum*, Luc & Dalmasso, 1964.

**Résumé – Présence de *Xiphinema sphaerocephalum* Lamberti et al. et de *X. hispanum* Lamberti et al. (Nematoda : Longidoridae) au Portugal et description de *X. lanceolatum* sp. n. et de *X. lapidosum* sp. n.** – Une enquête conduite au Portugal a révélé la présence de *X. sphaerocephalum* Lamberti, Castillo, Gomez-Barcina & Agostinelli, 1992, *X. hispanum* Lamberti, Castillo, Gomez-Barcina & Agostinelli, 1992 et de deux nouvelles espèces, décrites ici sous les noms de *X. lanceolatum* sp. n. et *X. lapidosum* sp. n. La première a été trouvée dans un vignoble, comprenant également des pommiers et des poiriers, à Quinta dos Bairros, Alenquer, Lisboa; elle se distingue des espèces récemment décrites par Lamberti et al. (1992) par un odontostyle plus long et une vulve plus antérieure; elle est proche de *X. coronatum* Roca, 1991, *X. macroacanthum* Lamberti, Roca & Agostinelli, 1989, *X. melitense* Lamberti, Blevé-Zacheo & Arias, 1982 et *X. smoliki* Luc & Coomans, 1988. *X. lapidosum* sp. n., trouvée dans la rhizosphère de fèves et de pois à Quinta do Rogelo, Silves, Faro, est proche de *X. hardingi* Joubert, Kruger & Heyns, 1988, *X. jomercium* Joubert, Kruger & Heyns, 1988, *X. majus* Bos & Loof, 1985, *X. tenue* Joubert, Kruger & Heyns, 1988, *X. transkeiense* Joubert, Kruger & Heyns, 1988 et *X. turcicum* Luc & Dalmasso, 1964.

**Key-words :** taxonomy, *Xiphinema*.

A survey of Longidoridae carried out in Portugal by Dr. Bravo some years ago revealed the presence of *Xiphinema* species previously identified as *X. turcicum* Luc & Dalmasso, 1963. The material collected in various localities of Portugal from the rhizosphere of several hosts was recently sent to the Istituto di Nematologia Agraria di Bari for a collaborative study. The examination of populations revealed the presence of amphimictic and presumed parthenogenetic species. The amphimictic ones were identified as *X. sphaerocephalum* Lamberti, Castillo, Gomez-Barcina & Agostinelli, 1992 and as an undescribed species : *Xiphinema lapidosum* sp. n., found in the rhizosphere of broad-beans and peas at Quinta do Rogelo, Silves, Faro. Among the presumed

parthenogenetic populations, one was identified as *X. hispanum* Lamberti, Castillo, Gomez-Barcina & Agostinelli, 1992, and the other two, differing morphologically and biometrically from the former and from those reported by Lamberti et al. (1992), are identified as an undescribed species. It is *Xiphinema lanceolatum* sp. n. found in the rhizosphere of grapevine in a field with some dispersed apple and pear trees at Quinta dos Bairros, Alenquer, Lisboa. This last new species is regarded as parthenogenetic, since several gravid females, without sperm in the uteri, were found in one of the two populations.

Nematodes were extracted from soil samples by Cobb's wet sieve technique, killed and fixed in hot 5 %

formaldehyde and mounted in glycerin by the slow method.

***Xiphinema hispanum* Lamberti, Castillo,  
Gomez-Barcina & Agostinelli, 1992**

(Fig. 1 B, E, F, G)

MEASUREMENTS

*Females* (population from Herdade da Revilheira, Evora) : see Table 1.

DESCRIPTION

The Portuguese population is morphologically and biometrically identical with the type Spanish population. The lateral body pores, six in the range of the odontostyle, are arranged in a single row in the neck region and in a double row in the rest of the body, distributed irregularly along the dorsal and ventral sides of the lateral cords; five ventral and six dorsal body pores are visible in the range of the odontostyle. In the reproductive system of the females from Evora population an indistinct pseudo-Z-organ is identifiable as small granules located in the lumen of the tubular portion of the uterus close to the *pars dilatata uteri*, mixed with dilated spines or crystalline structures (Kruger, 1988). Some granular bodies, rare but distinguishable, are visible in the lumen along the entire tubular portion of the uterus and they are numerous in the vicinity of the ovejector. No dilated spines were observed in the *pars dilatata uteri*, in which a spermatheca is distinguishable without sperms inside. Small protrusions of the muscle cells (Coomans *et al.*, 1992) are visible on the external wall of the uterus. Tail convex-conoid without any evident blind canal, bearing three caudal pores on each side.

Males and juveniles not found.

***Xiphinema sphaerocephalum* Lamberti, Castillo,  
Gomez-Barcina & Agostinelli, 1992**

(Fig. 1 A, C, D, H-L)

MEASUREMENTS

Females, males and juveniles, population from Estação Vitivinícola Nacional, Dois Portos, Torres Vedras, Lisboa : see Table 2.

Females and males of the populations from Quinta do Paco, Arruda dos Vinhos, Lisboa and Quinta do Marquês, Oeiras, Lisboa : see Table 1.

DESCRIPTION

The Portuguese populations are morphologically and biometrically identical with the type Spanish population. The lateral body pores, seven in the range of the odontostyle, are arranged in a single row in the neck region and in a double row in the rest of the body, distributed irregularly along the dorsal and ventral sides of the lateral cords; four ventral and three dorsal body pores are visible in the range of the odontostyle. In the original description Lamberti *et al.* (1992) report that no « Z »

differentiation is evident in the uterus. As in the Portuguese population of *X. hispanum*, small granules are present in the lumen of tubular portion near the *pars dilatata uteri*, mixed with dilated spines. The granules are not evident in the lumen of tubular portion of the uterus nor in the vicinity of the ovejector, in which dilated spines are rarefied or absent just anterior to the constriction. Tail convex-conoid with terminal bulge and with an indistinct blind canal, bearing three body pores on each side.

Males of the population from Dois Portos generally conform to the original description, but the precloacal pair of papillae is preceded by four or five ventral supplements. Distances of preanal supplements are given in Table 3. The tail shows a mammillate projection at the terminus and an indistinct blind canal, not reported in the original description nor in the illustration, and it bears four caudal pores on each side.

Juveniles of the population from Dois Portos are morphologically similar to adult females but smaller; the tail of first stage is elongate conoid with digitate terminus, bearing two caudal pores on each side.

***Xiphinema lanceolatum* sp. n.**

(Fig. 2)

MEASUREMENTS

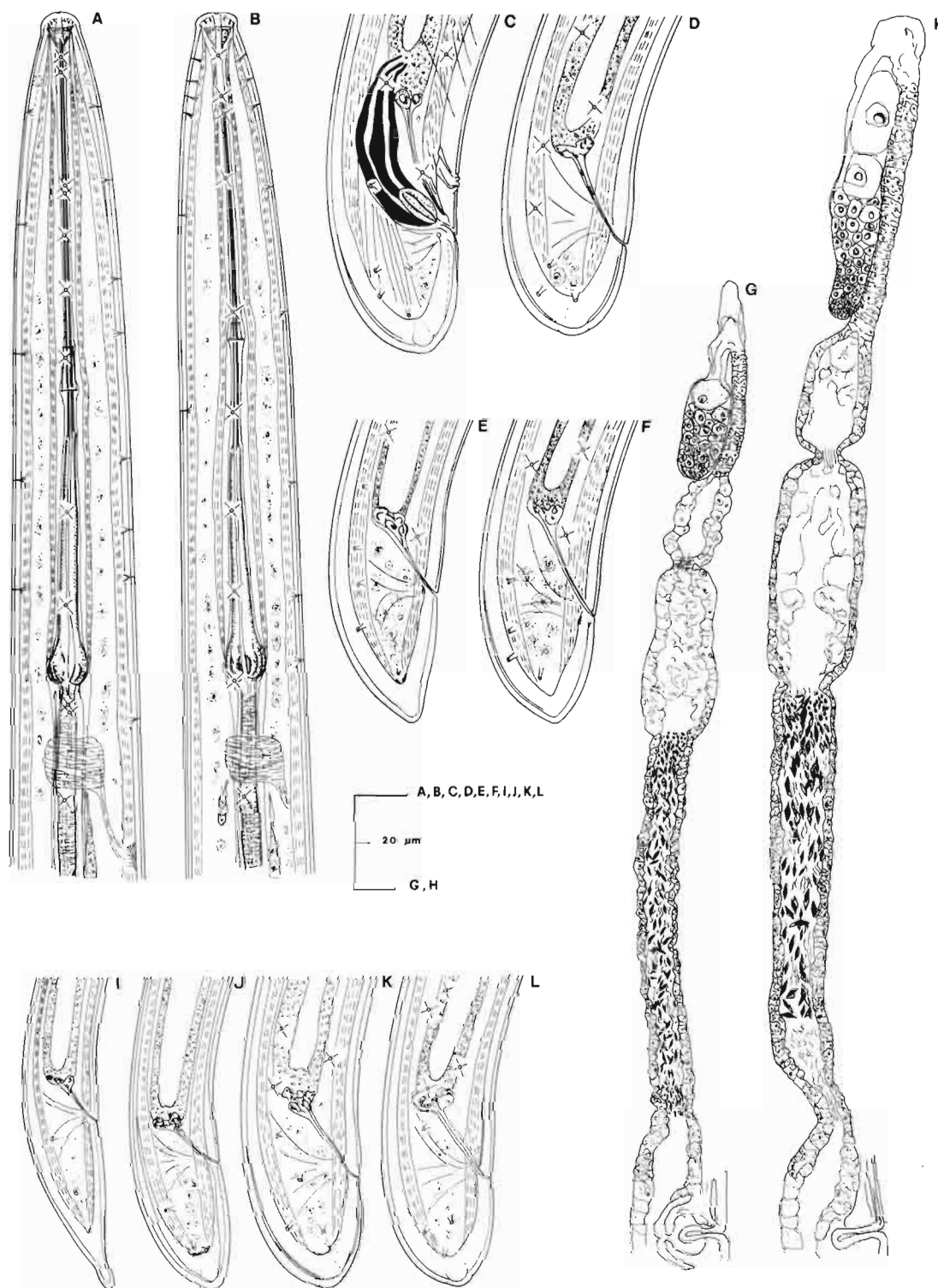
*Female* (holotype and paratypes) : see Table 4.

DESCRIPTION

*Female* : Habitus in specimens killed by gentle heat as open C, more curved behind vulva, with increasing curvature towards the posterior extremity, occasionally single spiraled; body cylindrical, tapering very gradually towards the anterior extremity. Cuticle with very fine transverse striations, 4-4.5  $\mu\text{m}$  thick along the body, more thickened in the neck region, where it measures 6-6.5  $\mu\text{m}$  at the base of the lip region, and in the caudal region where it is 9.5-10.5  $\mu\text{m}$  ventrally and 11.5-12.0  $\mu\text{m}$  dorsally in the post anal region. Lateral hypodermal cords readily visible throughout the length of the body, 16-16.5  $\mu\text{m}$  wide at mid body or 29-29.5 % of the corresponding body diameter. Lateral body pores, ten in the range of the odontostyle, arranged in a single row in the neck region and in a double row in the rest of the body, distributed irregularly along the dorsal and ventral sides of the lateral cords; six ventral and five dorsal body pores in the range of the odontostyle. Labial region almost hemispherical, widely rounded laterally and less so frontally, offset from the rest of the body by a shallow depression; amphids stirrup-shaped, with aperture a wavy, transverse slit, occupying slightly less than four fifths or 72 % of the lip region width, situated on the lip region just above the corresponding depression. Odontostyle 2-2.5  $\mu\text{m}$  in diameter; odontophore well developed with large basal flanges; guiding "tube" variable

**Table 1.** Biometrical data of *Xiphinema sphaerocephalum* and *X. hispanum* populations (all measurements in  $\mu\text{m}$ , except L).

	<i>X. sphaerocephalum</i>				<i>X. hispanum</i>
	(pop. Arruda)		(pop. Oeiras)		(pop. Evora)
	Females	Males	Females	Males	Females
n	5	2	10	10	12
L (mm)	4.5 $\pm$ 0.16 (4.4-4.8)	4.5 3.8	3.9 $\pm$ 0.19 (3.6-4.2)	3.9 $\pm$ 0.29 (3.3-4.3)	4.5 $\pm$ 0.4 (3.9-5.0)
a	73.5 $\pm$ 3.4 (68.0-77.0)	77.5 66.0	68.5 $\pm$ 3.52 (62.0-74.5)	70.5 $\pm$ 3.78 (63.5-76.5)	84.0 $\pm$ 6.55 (73.5-92.5)
b	7.7 $\pm$ 0.31 (7.4-8.2)	8.1 6.5	7.5 $\pm$ 0.35 (6.9-8.0)	7.2 $\pm$ 0.32 (6.8-7.7)	8.5 $\pm$ 0.61 (7.5-9.5)
c	132.5 $\pm$ 8.76 (121.3-143.8)	119.0 85.5	99.2 $\pm$ 8.47 (85.5-110.5)	88.2 $\pm$ 7.91 (73.5-102.5)	118.7 $\pm$ 12.71 (96.0-137.5)
c'	0.75 $\pm$ 0.06 (0.7-0.8)	0.8 1.0	0.93 $\pm$ 0.08 (0.8-1.0)	0.97 $\pm$ 0.07 (0.8-1.05)	0.95 $\pm$ 0.09 (0.83-1.17)
V	48.7 $\pm$ 0.86 (47.5-49.5)		50.0 $\pm$ 1.8 (47.0-53.2)		49.8 $\pm$ 1.22 (47.5-51.5)
Lip reg. diam.	14.5 $\pm$ 0.67 (13.5-15.5)	14.5 13.5	15.0 $\pm$ 0.74 (14.0-16.0)	15.0 $\pm$ 0.4 (14.5-16.0)	14.5 $\pm$ 0.91 (13.0-16.0)
Lip reg. height	7.8 $\pm$ 0.41 (7.5-8.5)	8.8 7.6	5.5 $\pm$ 0.3 (5.5-6.0)	5.5 $\pm$ 0.56 (5.0-7.0)	7.5 $\pm$ 0.32 (7.0-8.5)
Odontostyle	162.0 $\pm$ 3.36 (158.0-164.5)	156.5 160.5	153.5 $\pm$ 3.63 (150.0-162.5)	155.5 $\pm$ 6.78 (144.5-166.5)	137.0 $\pm$ 3.34 (132.0-143.5)
Odontophore	85.5 $\pm$ 1.1 (84.0-86.5)	84.0 85.5	85.5 $\pm$ 3.09 (82.0-90.5)	86.0 $\pm$ 2.62 (82.5-91.0)	78.5 $\pm$ 4.05 (71.5-85.5)
Stylet	247.5 $\pm$ 2.74 (242.0-250.5)	240.5 246.0	239.0 $\pm$ 4.24 (232.5-246.0)	241.5 $\pm$ 7.6 (229.5-251.0)	215.5 $\pm$ 5.4 (204.5-228.5)
Flanges width	16.0 $\pm$ 1.31 (15.0-17.0)	15.5 15.5	14.5 $\pm$ 1.07 (13.0-17.0)	15.5 $\pm$ 0.64 (14.5-16.5)	17.0 $\pm$ 0.52 (15.5-18.5)
Guide ring	145.0 $\pm$ 4.72 (141.5-153.0)	141.5 147.0	127.0 $\pm$ 5.99 (112.0-133.0)	132.5 $\pm$ 5.34 (125.5-141.0)	112.5 $\pm$ 7.68 (106.0-131.0)
Guide sheath	19.5 $\pm$ 2.05 (16.0-21.0)	17.5 13.5	12.5 $\pm$ 1.79 (10.5-16.0)	14.0 $\pm$ 3.11 (12.0-22.0)	8.5 $\pm$ 2.0 (4.5-12.5)
Phar. bulb length	142.5 $\pm$ 7.24 (134.0-151.0)	131.5 146.0	115.0 $\pm$ 6.39 (102.0-124.5)	118.5 $\pm$ 4.64 (111.5-127.5)	156.0 $\pm$ 10.38 (146.0-181.5)
Phar. bulb diam.	24.5 $\pm$ 1.48 (22.5-26.5)	22.5 27.0	26.5 $\pm$ 1.34 (24.5-28.5)	25.0 $\pm$ 1.08 (23.5-26.5)	25.0 $\pm$ 1.1 (23.5-27.0)
Ant. gen. br.	700.0 $\pm$ 48.86 (647.0-776.5)		586.0 $\pm$ 45.75 (500.0-664.5)		456.5 $\pm$ 44.3 (347.0-506.0)
Post. gen. br.	737.5 $\pm$ 31.02 (694.0-770.5)		544.5 $\pm$ 46.33 (482.5-623.5)		431.0 $\pm$ 34.4 (364.5-494.0)
Ant. gen. br. (%)	15.5 $\pm$ 0.72 (14.5-16.5)		15.0 $\pm$ 1.03 (13.0-17.0)		10.0 $\pm$ 1.17 (8.8-11.9)
Post. gen. br.	16.0 $\pm$ 0.8 (15.0-17.0)		14.0 $\pm$ 1.26 (12.0-16.0)		9.6 $\pm$ 1.13 (8.3-11.7)
Body diam. (mid-body)	61.5 $\pm$ 2.74 (58.0-64.5)	57.5 57.0	57.0 $\pm$ 2.83 (51.5-57.5)	54.5 $\pm$ 2.04 (52.0-57.5)	53.5 $\pm$ 5.25 (44.0-62.5)
Body diam. (anus level)	46.0 $\pm$ 1.22 (44.5-47.5)	45.5 44.0	43.0 $\pm$ 1.9 (40.5-46.5)	45.5 $\pm$ 1.44 (43.0-48.5)	40.0 $\pm$ 3.63 (32.5-46.0)
Rectum	40.0 $\pm$ 2.3 (38.0-44.0)	17.0 14.5	33.0 $\pm$ 3.69 (29.5-42.5)	51.0 $\pm$ 0.63 (50.0-52.5)	37.0 $\pm$ 2.9 (33.5-43.5)
Tail	34.5 $\pm$ 2.37 (30.5-37.0)	37.5 44.0	39.5 $\pm$ 3.52 (33.5-44.5)	44.0 $\pm$ 3.18 (37.0-48.5)	38.0 $\pm$ 4.21 (32.5-48.5)
Hyaline tail tip	12.5 $\pm$ 1.18 (10.5-13.5)	11.0 11.5	13.0 $\pm$ 1.36 (10.5-15.5)	11.5 $\pm$ 1.01 (10.0-13.5)	12.5 $\pm$ 1.3 (10.0-14.0)
Prerectum	704.5 $\pm$ 80.7 (576.5-776.5)	506.0 500.0	593.0 $\pm$ 63.65 (511.5-705.5)	677.0 $\pm$ 74.79 (553.0-764.5)	768.0 $\pm$ 210.1 (512.0-1306.0)
Spicules		83.5 84.5		91.0 $\pm$ 5.04 (84.0-100.5)	
Lat. guid. piece		15.5 13.5		17.0 $\pm$ 1.59 (14.5-19.5)	



**Fig. 1.** *Xiphinema sphaerocephalum* Lamberti *et al.*, 1992. A : Anterior region of the female; C : Posterior region of the male; D : Posterior region of the female; H : Anterior branch of the female genital tract; I-L : Posterior region of juveniles, J1-J4 respectively – *X. hispanum* Lamberti *et al.*, 1992. B : Anterior region of the female; E, F : Posterior region of the female; G : Anterior branch of the female genital tract.

**Table 2.** Morphometrics of *X. sphaerocephalum* population from Dois Portos (all measurements in  $\mu\text{m}$ , except L).

	Females (n = 22)	Males (n = 18)	J1 (n = 12)	J2 (n = 16)	J3 (n = 10)	J4 (n = 10)
L (mm)	4.3 $\pm$ 0.24 (3.8-4.8)	4.2 $\pm$ 0.21 (3.7-4.5)	1.6 $\pm$ 0.23 (1.3-1.9)	2.2 $\pm$ 0.16 (2.0-2.5)	3.0 $\pm$ 0.24 (2.5-3.3)	3.3 $\pm$ 0.16 (3.1-3.6)
a	68.4 $\pm$ 4.77 (58.0-78.0)	76.8 $\pm$ 3.91 (67.1-83.9)	52.6 $\pm$ 5.0 (43.3-61.2)	58.0 $\pm$ 2.27 (54.0-62.0)	63.5 $\pm$ 5.9 (50.6-71.9)	67.0 $\pm$ 3.61 (60.0-71.5)
b	7.4 $\pm$ 0.63 (6.3-9.0)	7.5 $\pm$ 0.41 (6.8-8.2)	4.3 $\pm$ 0.4 (3.7-4.9)	5.0 $\pm$ 0.45 (4.4-5.7)	5.9 $\pm$ 0.26 (5.4-6.2)	6.3 $\pm$ 0.42 (5.6-6.8)
c	121.0 $\pm$ 11.18 (103.5-145.9)	100.9 $\pm$ 9.26 (86.2-116.3)	23.0 $\pm$ 4.86 (17.0-30.0)	55.5 $\pm$ 9.64 (41.0-75.5)	88.7 $\pm$ 7.83 (76.4-97.7)	86.5 $\pm$ 9.25 (74.5-103.5)
c'	0.8 $\pm$ 0.08 (0.6-0.9)	0.9 $\pm$ 0.09 (0.7-1.0)	3.0 $\pm$ 0.61 (2.3-3.9)	1.2 $\pm$ 0.2 (0.9-1.7)	0.9 $\pm$ 0.06 (0.8-1.0)	0.9 $\pm$ 0.08 (0.8-1.0)
V	48.5 $\pm$ 2.04 (42.5-51.7)					
Lip reg. diam.	15.0 $\pm$ 0.65 (13.5-16.0)	15.0 $\pm$ 0.85 (13.5-16.0)	9.5 $\pm$ 0.77 (8.0-10.5)	11.5 $\pm$ 0.53 (10.5-12.5)	12.5 $\pm$ 0.59 (11.5-13.5)	13.0 $\pm$ 0.26 (12.5-13.5)
Lip reg. height	6.5 $\pm$ 6.59 (6.0-7.5)	7.5 $\pm$ 0.75 (6.0-8.5)	4.0 $\pm$ 0.75 (3.0-5.5)	5.0 $\pm$ 0.55 (4.0-6.0)	5.5 $\pm$ 0.87 (4.0-6.5)	5.5 $\pm$ 0.83 (3.5-6.0)
Odontostyle	158.0 $\pm$ 3.94 (149.5-164.5)	157.0 $\pm$ 5.31 (147.0-170.0)	82.0 $\pm$ 8.13 (69.5-90.5)	111.0 $\pm$ 3.6 (106.0-117.5)	128.5 $\pm$ 3.02 (123.0-131.0)	134.0 $\pm$ 2.84 (131.0-140.0)
Odontophore	90.5 $\pm$ 3.6 (84.5-97.5)	89.0 $\pm$ 3.88 (84.5-96.0)	54.0 $\pm$ 5.16 (46.5-62.5)	69.0 $\pm$ 2.91 (64.0-75.5)	76.5 $\pm$ 3.73 (69.5-81.0)	78.0 $\pm$ 2.77 (75.5-84.0)
Styler	248.5 $\pm$ 4.78 (239.5-259.0)	246.0 $\pm$ 7.7 (232.5-263.5)	136.0 $\pm$ 12.6 (117.0-152.5)	180.0 $\pm$ 5.26 (170.5-193.0)	205.5 $\pm$ 3.88 (200.5-211.0)	212.0 $\pm$ 3.86 (207.0-217.5)
Repl. odontost.			102.5 $\pm$ 13.9 (86.0-123.0)	136.5 $\pm$ 6.05 (128.5-147.0)	156.0 $\pm$ 2.37 (150.5-158.0)	164.5 $\pm$ 4.9 (159.0-174.5)
Flanges width	15.5 $\pm$ 0.72 (14.0-16.0)	16.0 $\pm$ 1.36 (13.0-19.0)	9.5 $\pm$ 0.92 (7.5-10.5)	11.5 $\pm$ 0.98 (10.0-13.5)	15.0 $\pm$ 0.64 (13.5-15.5)	14.5 $\pm$ 0.99 (13.5-16.5)
Guide ring	143.5 $\pm$ 3.98 (133.5-152.5)	142.5 $\pm$ 6.64 (130.0-152.5)	68.5 $\pm$ 8.31 (54.5-76.5)	94.5 $\pm$ 3.0 (88.0-99.0)	113.0 $\pm$ 6.23 (99.0-119.5)	117.5 $\pm$ 3.25 (114.0-124.0)
Guide sheath	14.5 $\pm$ 4.09 (8.5-28.0)	15.5 $\pm$ 4.51 (10.0-30.0)	6.0 $\pm$ 1.51 (3.0-8.5)	9.5 $\pm$ 0.97 (7.5-10.5)	12.0 $\pm$ 1.99 (9.5-15.5)	13.0 $\pm$ 1.3 (10.5-15.5)
Phar. bulb length	146.5 $\pm$ 10.4 (124.5-167.5)	137.0 $\pm$ 8.79 (120.0-151.0)	89.5 $\pm$ 6.16 (78.5-97.5)	105.5 $\pm$ 6.0 (94.5-115.5)	122.5 $\pm$ 7.84 (110.5-134.0)	121.0 $\pm$ 8.05 (107.0-131.0)
Phar. bulb width	26.0 $\pm$ 1.41 (23.0-27.5)	25.5 $\pm$ 1.28 (23.5-28.5)	15.5 $\pm$ 1.58 (13.0-19.0)	19.0 $\pm$ 1.19 (17.0-21.5)	23.0 $\pm$ 1.56 (21.0-25.5)	23.0 $\pm$ 1.2 (20.0-24.0)
Ant. gen. br.	606.5 $\pm$ 66.43 (511.5-776.5)					
Post. gen. br. (%)	585.0 $\pm$ 71.91 (506.0-829.5)					
Ant. gen. br. (%)	14.2 $\pm$ 1.51 (12.0-18.0)					
Post. gen. br. (%)	13.7 $\pm$ 1.91 (10.6-19.8)					
Body diam. (mid-body)	63.0 $\pm$ 4.34 (57.0-74.0)	54.5 $\pm$ 2.75 (48.5-60.5)	30.0 $\pm$ 4.32 (23.5-39.0)	38.5 $\pm$ 3.38 (34.5-44.5)	48.0 $\pm$ 1.29 (45.5-50.0)	48.5 $\pm$ 2.6 (44.0-53.0)
Body diam. (anus level)	45.0 $\pm$ 1.55 (42.5-48.0)	47.5 $\pm$ 1.96 (43.5-51.0)	23.5 $\pm$ 3.27 (19.5-29.5)	33.5 $\pm$ 2.01 (30.5-37.5)	39.5 $\pm$ 1.58 (37.5-42.5)	41.5 $\pm$ 1.06 (40.0-43.5)
Rectum	41.5 $\pm$ 4.46 (32.5-49.0)	49.0 $\pm$ 4.51 (42.0-56.0)	18.0 $\pm$ 2.63 (13.5-22.0)	25.0 $\pm$ 2.51 (22.5-33.0)	31.5 $\pm$ 3.46 (27.0-39.5)	33.5 $\pm$ 2.91 (28.0-37.0)
Tail	35.5 $\pm$ 3.57 (29.5-43.0)	41.5 $\pm$ 4.15 (33.0-46.5)	69.0 $\pm$ 5.12 (59.0-76.5)	41.5 $\pm$ 5.56 (33.0-53.5)	34.5 $\pm$ 3.21 (31.0-40.0)	38.0 $\pm$ 2.76 (34.0-41.0)
Hyaline tail tip	13.5 $\pm$ 1.22 (12.0-16.0)	12.0 $\pm$ 1.0 (9.5-13.5)	22.5 $\pm$ 1.81 (20.5-26.0)	11.0 $\pm$ 1.11 (9.5-13.0)	10.5 $\pm$ 0.93 (9.5-11.5)	11.0 $\pm$ 1.41 (8.0-12.5)
Prerectum	683.5 $\pm$ 131.11 (464.5-1117.5)	699.5 $\pm$ 59.7 (553.0-776.5)	267.5 $\pm$ 106.02 (106.0-400.0)	464.5 $\pm$ 45.59 (394.0-564.5)	493.0 $\pm$ 44.1 (411.5-553.0)	474.0 $\pm$ 93.29 (364.5-623.5)
Spicules		88.0 $\pm$ 4.58 (82.5-99.0)				
Lat. guid. piece		18.5 $\pm$ 1.8 (14.5-22.0)				

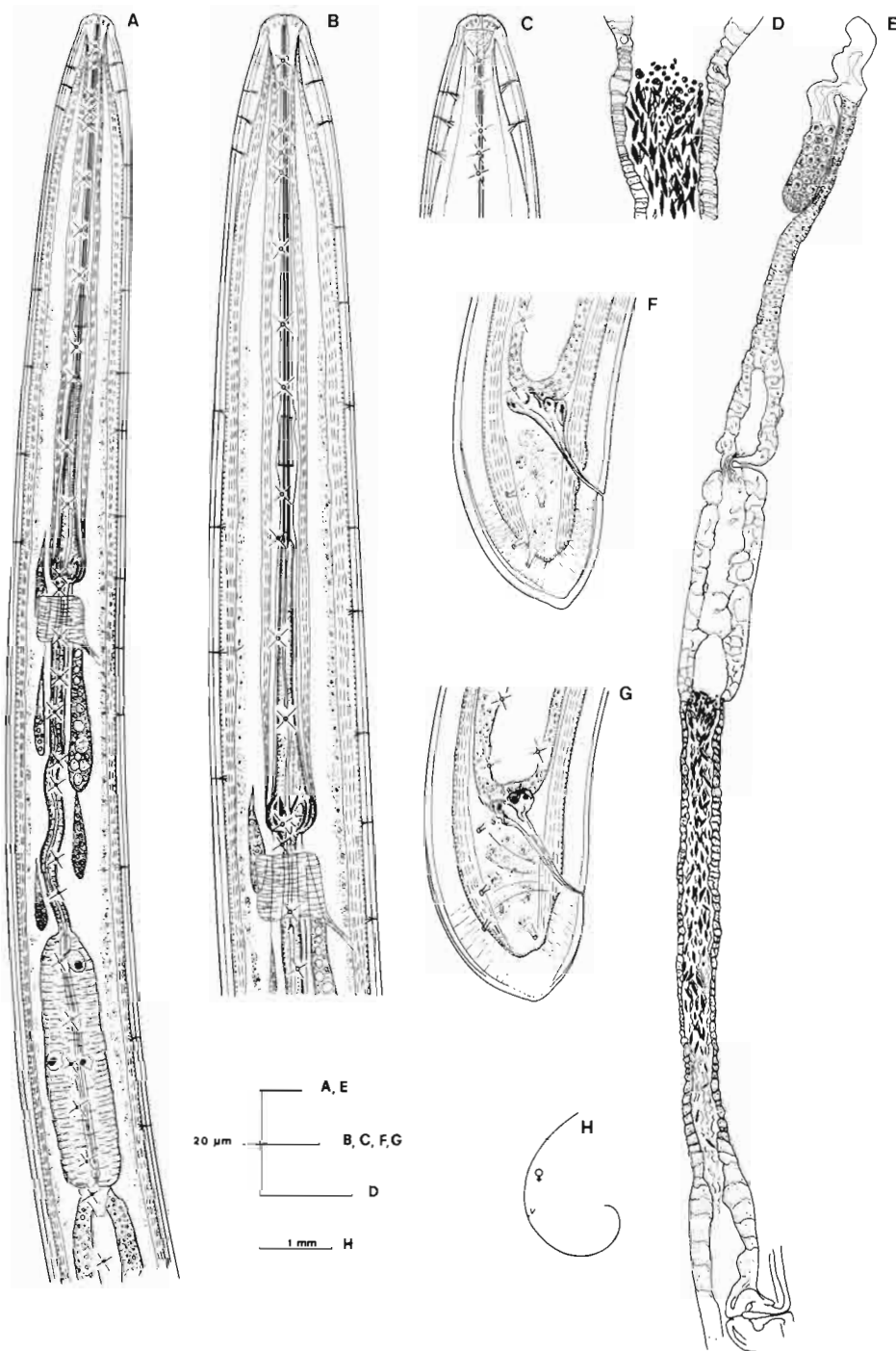
**Table 3.** Distances of the preanal supplements in eighteen males of *X. sphaerocephalum* population from Dois Portos (in  $\mu\text{m}$ ).

N	Cloaca- Double pap.	Double pap. S1	S1-S2	S2-S3	S3-S4	S4-S5
1	19.0	60.0	44.0	76.5	64.0	...
2	20.5	66.0	41.0	45.5	36.5	32.0
3	19.5	64.5	49.0	51.0	47.0	52.0
4	18.5	66.5	48.5	41.0	57.0	...
5	17.5	75.5	39.0	53.0	61.0	...
6	17.5	69.0	47.0	44.5	48.5	...
7	17.5	62.5	36.0	59.5	46.0	34.0
8	17.0	57.5	44.0	50.0	57.5	...
9	19.0	59.0	64.5	41.0	45.5	40.5
10	19.0	80.5	38.5	46.0	43.5	...
11	16.0	76.5	39.5	49.0	45.5	...
12	16.5	74.5	53.0	53.5	38.5	...
13	17.0	70.5	51.0	36.5	44.0	...
14	17.5	69.5	35.5	53.5	46.5	...
15	18.5	62.5	44.5	38.5	44.5	...
16	17.0	66.0	29.5	60.5	52.0	35.5
17	16.0	77.5	32.5	40.0	46.5	45.5
18	17.0	57.5	44.0	39.0	43.5	36.5

in length with guiding ring 5.5–6  $\mu\text{m}$  wide. Oesophagus dorylaimoid with the anterior part tubular, oesophageal bulb containing three nuclei: the dorsal one located at the beginning, the two subventral ones almost at the middle; oesophageal-intestinal valve inconspicuous, pear-shaped, surrounded by intestinal tissue. Reproductive system amphidelphic, with both genital branches equally developed and reflexed; ovary occupying one fourth to one fifth of the entire genital branch; oviduct with a slender part consisting of discoid cells, and a *pars dilatata oviductus* separated from the uterus by a conspicuous sphincter muscle; uterus consisting of a very wide and long *pars dilatata uteri*, a tube and an ovejector, separated by a slight constriction. In the lumen of the tubular portion of the uterus there are differentiations resembling a lance point without the flattened base, the name *lanceolatum* refers to this. They apparently are not attached to the uterine wall, are oriented preferably along the axis of the uterus and are numerous in the lumen of uterine tubular portion, less so towards the ovejector. The length of single refractive structure varies from 3 to 10  $\mu\text{m}$ . Similar differentiations were previously described as dilated spines or crystalline structures (Kruger, 1988). In the uterine portion close to *pars dilatata uteri* in which generally is located the «Z» differentiation, a variable number of small granular bodies is visible, mixed among the uterine differentiations. They are generally rounded, 2  $\mu\text{m}$  in diameter or less. No protruding cell bodies are observed on the uterine wall.

**Table 4.** Morphometrics of *Xiphinema lanceolatum* sp. n. (all measurements in  $\mu\text{m}$  except L).

	Pop. Alenquer		Pop. Sesimbra
	Holotype	Females (n = 13)	(Females; n = 4)
L (mm)	4.1	4.2 $\pm$ 0.32 (3.6-4.8)	4.4 $\pm$ 0.19 (4.1-4.6)
a	62.0	59.3 $\pm$ 4.15 (50.5-64.5)	64.0 $\pm$ 7.63 (58.5-75.5)
b	7.2	7.8 $\pm$ 0.63 (6.5-8.5)	8.4 $\pm$ 0.33 (7.9-8.6)
c	94.2	97.2 $\pm$ 6.51 (84.5-105.5)	126.5 $\pm$ 11.04 (111.0-135.0)
c'	0.89	0.87 $\pm$ 0.04 (0.82-0.94)	0.74 $\pm$ 0.08 (0.67-0.84)
V	43.9	45.0 $\pm$ 0.79 (43.5-46.0)	49.5 $\pm$ 0.38 (49.0-50.0)
Lip reg. diam.	17.5	17.5 $\pm$ 0.53 (16.5-18.0)	15.5 $\pm$ 0.48 (14.5-16.0)
Lip reg. height	7.5	8.0 $\pm$ 0.65 (7.5-8.5)	8.0 $\pm$ 0.54 (7.5-8.5)
Odontostyle	172.5	178.5 $\pm$ 4.34 (170.5-185.5)	172.0 $\pm$ 5.12 (165.5-177.0)
Odontophore	94.5	94.5 $\pm$ 2.31 (91.0-98.0)	94.5 $\pm$ 3.37 (90.0-98.0)
Stylet	267.0	273.5 $\pm$ 5.74 (264.5-283.0)	266.5 $\pm$ 7.4 (255.5-271.0)
Flanges width	14.5	16.5 $\pm$ 0.93 (15.0-17.5)	16.5 $\pm$ 1.31 (15.0-17.5)
Guide ring	149.0	155.5 $\pm$ 3.01 (150.5-161.0)	128.0 $\pm$ 15.68 (106.0-140.0)
Guide sheath	15.5	16.0 $\pm$ 2.3 (11.5-19.5)	14.5 $\pm$ 3.67 (10.5-19.5)
Phar. bulb length	127.0	122.5 $\pm$ 5.01 (115.5-130.0)	106.0 $\pm$ 11.17 (96.0-122.0)
Phar. bulb diam.	26.5	33.0 $\pm$ 2.5 (28.5-36.0)	31.0 $\pm$ 4.91 (24.0-35.5)
Ant. gen. br.	611.5	710.5 $\pm$ 89.05 (600.0-870.5)	748.5 $\pm$ 92.03 (635.5-988.0)
Post. gen. br.	611.5	759.5 $\pm$ 98.1 (611.5-964.5)	732.5 $\pm$ 81.6 (659.0-841.0)
Ant. gen. br. (%)	15.0	16.5 $\pm$ 1.57 (14.5-19.5)	17.0 $\pm$ 3.74 (14.5-22.5)
Post. gen. br. (%)	15.0	17.5 $\pm$ 1.84 (14.5-21.5)	17.0 $\pm$ 2.31 (14.5-19.5)
Body diam. (mid-body)	65.5	72.0 $\pm$ 7.23 (60.0-84.0)	69.0 $\pm$ 10.12 (54.5-76.5)
Body diam. (anus level)	48.5	50.5 $\pm$ 2.21 (47.0-54.0)	47.0 $\pm$ 2.65 (44.0-49.5)
Rectum	33.0	36.0 $\pm$ 2.78 (31.0-40.0)	33.0 $\pm$ 0.68 (32.5-33.5)
Tail	43.0	44.0 $\pm$ 2.73 (40.0-49.0)	34.5 $\pm$ 1.73 (33.0-37.0)
Hyaline tail tip	11.5	12.5 $\pm$ 1.3 (10.5-15.5)	14.0 $\pm$ 1.56 (11.5-15.5)
Prerectum	459.0	70.5.0 $\pm$ 83.29 (588.0-841.0)	660.5 $\pm$ 53.2 (529.5-823.5)



**Fig. 2.** *Xiphinema lanceolatum* sp. n. A, B : Female, anterior region; C : Head end (surface view); D : Pseudo-Z-organ; E : Posterior branch of the genital tract; F, G : Female, posterior region; H : Posture of the female.

In several females an egg was found in the uterine tubular portion near the ovejector, but no sperms were observed inside the uteri. Prerectum well visible; rectum one body width long or slightly more. Tail convex-conoid with rounded terminus to almost hemispherical, with inconspicuous terminal bulge, generally in line with the body axis or slightly ventrally directed and without a distinct blind canal; three to four body pores are visible on each side of the tail.

*Male and juveniles* : not found.

#### TYPE HOST AND LOCALITY

Rhizosphere of grapevine in a field with some dispersed apple and pear trees at Quinta dos Bairros, Alenquer, Lisboa, Portugal. Sampling carried out during 1980.

#### OTHER HABITATS AND LOCALITIES

Rhizosphere of grapevine in a field with some dispersed apple and pear trees at Sesimbra, Setubal, Portugal. Sampling carried out during 1978.

#### TYPE SPECIMENS

Holotype and seven paratype females, in the Collection of the Istituto di Nematologia Agraria del Consiglio Nazionale delle Ricerche, Bari, Italy; two paratype females in the following collections : Muséum National d'Histoire Naturelle, Paris, France; Entomology and Nematology Department, Rothamsted Experimental Station, Harpenden, Herts, England; Plant Nematology Laboratory Collection, United States Department of Agriculture, Beltsville, Maryland, USA.

#### DIAGNOSIS AND RELATIONSHIP

*Xiphinema lanceolatum* sp. n. is characterized by two female genital branches equally developed, vulva anterior to the mid-body, an indistinct pseudo-Z-organ, crystalline structures (or dilated spines) in the uterus, and tail rounded-conoid to almost hemispherical, with an inconspicuous bulge at the terminus.

*X. lanceolatum* sp. n. may be differentiated from the species described by Lamberti *et al.* (1992) mostly by the longer odontostyle and anteriorly situated vulva. Furthermore, being parthenogenetic, the new species is distinguished easily from *X. sphaerocephalum* by the absence of the males. From *X. hispanum* and *X. nuragicum* the new species differs in shape of tail, anterior end of the body and lip region; from *X. cohni* and *X. adenoysterum* in having differently shaped uterine differentiations, and from *X. macrogastrum* by the shape of tail and less numerous differentiations in the uterine lumen.

The code in the polytomous key (Loof & Luc, 1990) is the following : A4, B2 + 3, C5a, D6, E4/5, F4/5, G4, H2, I3, J?, K?, L2.

By the presence of an indistinct pseudo-Z-organ and uterine differentiations, the new species belongs to the

group 5 in Loof and Luc (1990), among whose species it closely resembles *X. coronatum* Roca, 1991, *X. macroacanthum* Lamberti, Roca & Agostinelli, 1989, *X. melitense* Lamberti, Bleve-Zacheo & Arias, 1982 and *X. smoliki* Luc & Coomans, 1988. *X. lanceolatum* sp. n. differs from *X. coronatum* in having longer odontostyle and total spear length (170.5-185.5 *vs* 147.1-154.1  $\mu$ m and 264.5-283 *vs* 238.8-253.5  $\mu$ m, respectively), more robust body ("a" value 50.5-64.5 *vs* 65.5-75.5), more anteriorly situated vulva (V = 43.5-46 *vs* 47.1-51.8) and differently shaped uterine differentiations (spines are smaller and not distributed in the entire uterine lumen, but in the vicinity of pseudo-Z-organ and ovejector only, in *X. coronatum*), from *X. macroacanthum* in having shorter and more robust body (L 3.6-4.8 *vs* 4.3-5.7 mm; "a" value 50.5-64.5 *vs* 63-81), longer odontostyle (170.5-185.5 *vs* 145.8-169.4  $\mu$ m) an indistinct pseudo-Z-organ (well differentiated in *X. macroacanthum*) and differently shaped uterine differentiations (as true spines attached to the uterine wall in *X. macroacanthum*); from *X. melitense* in having longer odontostyle (170.5-185.5 *vs* 132-168  $\mu$ m), anteriorly situated vulva (V = 43.5-46.0 % *vs* 50-53 %) and differently shaped "globules" of pseudo-Z-organ and uterine differentiations (as very small spines in *X. melitense*); from *X. smoliki* in having longer odontostyle (170.5-185.5 *vs* 108-115  $\mu$ m), odontophore (91-98 *vs* 65-74  $\mu$ m) and tail (40-49 *vs* 25-36  $\mu$ m), more robust body ("a" value 50.5-64.5 *vs* 67-85), differently shaped "globules" of pseudo-Z-organ and uterine differentiations (as true long spines attached to the uterine wall in *X. smoliki*).

Similarities with species with uterine differentiations, belonging to the same group, are observed. Among those the most significant are *X. loteni* Heyns, 1986 and *X. thorneanum* Luc, Loof & Coomans, 1986 from whose *X. lanceolatum* sp. n. differs, beside the uterine differentiations, also in tail shape, with inconspicuous bulge in the new species and peg in the others. Furthermore, *X. lanceolatum* sp. n. differs from *X. loteni* in having longer body (L 3.6-4.8 *vs* 2.7-3.5 mm), longer odontostyle (170.5-185.5 *vs* 108-131  $\mu$ m) and longer distance of oral opening to guiding ring (150.5-161 *vs* 92-113  $\mu$ m), and from *X. thorneanum* in having longer body (L 3.6-4.8 *vs* 2.9-3.8 mm), more robust body ("a" value 50.5-64.5 *vs* 66.9-76.6), longer odontostyle (170.5-185.5 *vs* 89-105  $\mu$ m), odontophore (91-98 *vs* 61-67  $\mu$ m) and tail (40-49 *vs* 27-36  $\mu$ m).

#### *Xiphinema lapidosum* sp. n.

(Fig. 3)

#### MEASUREMENTS

*Females* (holotype and paratypes) : see Table 5.

*Male* : see Table 5.

#### DESCRIPTION

*Female* : In specimens killed by gentle heat habitus usually almost straight anterior to the vulva, more

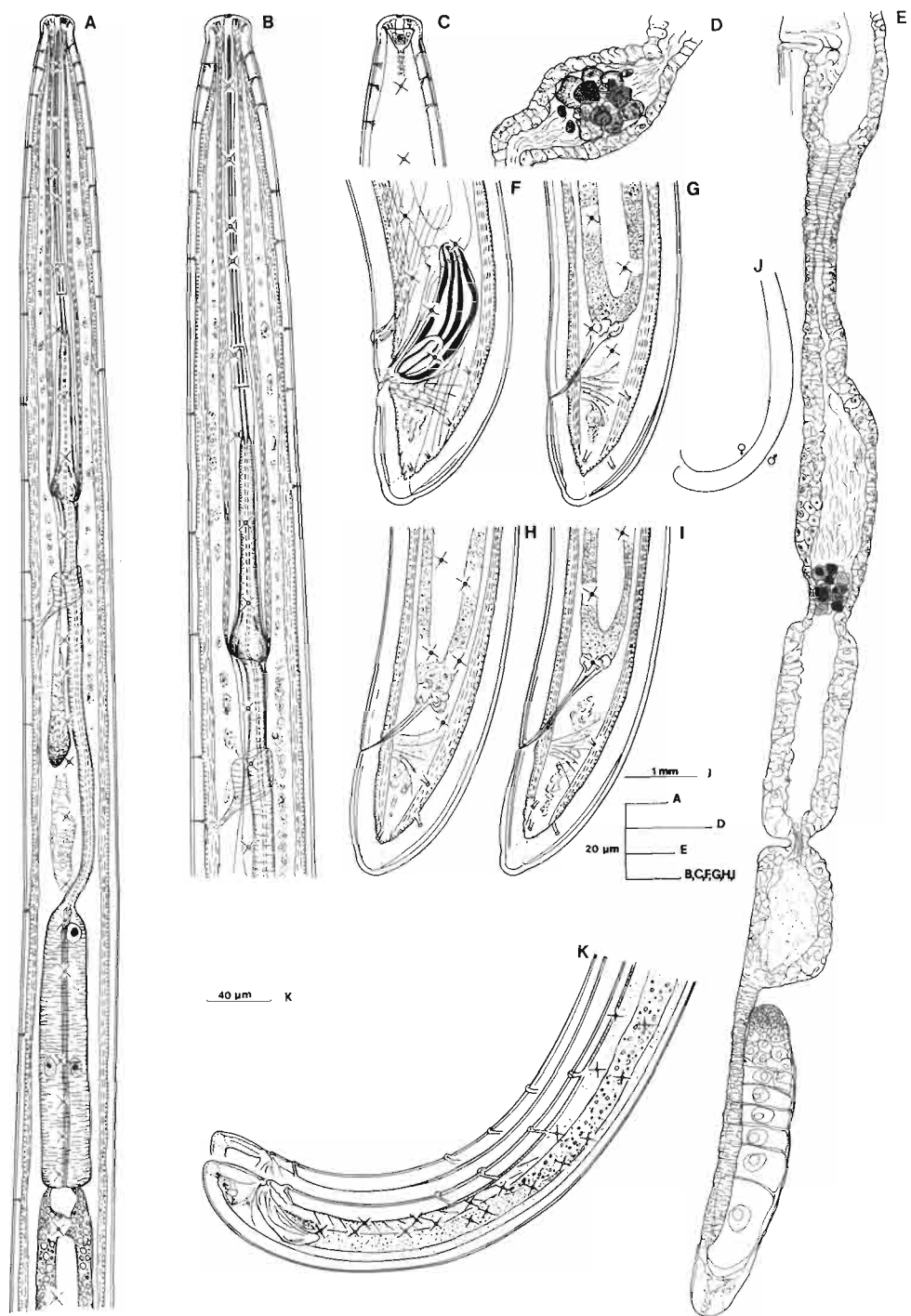


**Table 5.** Morphometrics of *Xiphinema lapidosum* sp. n. (all measurements in  $\mu\text{m}$  except L).

	Holotype (♀)	Allotype (♂)	Females (n = 14)	Males (n = 7)
L (mm)	3.9	4.2	4.3 ± 0.34 (3.7-4.6)	4.3 ± 0.31 (3.9-4.8)
a	73.5	81.5	80.0 ± 5.3 (70.4-88.2)	85.0 ± 6.46 (75.5-95.5)
b	8.5	9.0	9.5 ± 0.83 (7.8-10.7)	9.0 ± 0.85 (7.5-10.0)
c	99.5	118.5	110.0 ± 12.16 (92.0-132.0)	113.2 ± 9.73 (101.5-130.0)
c'	1.08	0.97	1.04 ± 0.07 (0.92-1.13)	0.99 ± 0.07 (0.92-1.09)
V	44.0	...	43.4 ± 1.28 (41.0-46.0)	...
Lip reg. diam.	15.5	14.5	15.0 ± 0.60 (14.0-16.0)	15.0 ± 0.31 (14.5-15.5)
Lip reg. height	5.5	5.5	6.0 ± 0.44 (5.5-6.5)	6.0 ± 0.65 (5.5-7.0)
Odontostyle	131.5	136.0	134.5 ± 3.71 (124.5-139.5)	136.0 ± 3.88 (130.5-142.5)
Odontophore	71.5	71.0	71.5 ± 1.39 (69.0-73.5)	71.5 ± 2.67 (67.5-74.5)
Stylet	203.0	207.0	205.5 ± 4.69 (194.5-212.0)	207.5 ± 4.24 (202.5-213.5)
Flanges width	11.5	13.0	12.5 ± 0.57 (11.5-13.5)	12.5 ± 0.71 (11.0-13.5)
Guide ring	113.5	116.5	116.5 ± 7.03 (97.5-127.5)	121.5 ± 5.94 (115.5-130.5)
Guide sheath	10.0	11.0	11.5 ± 2.53 (7.5-18.0)	11.0 ± 2.8 (8.0-16.0)
Phar. bulb length	120.5	123.0	122.5 ± 8.97 (99.5-134.0)	127.0 ± 4.95 (122.5-135.5)
Phar. bulb diam.	22.5	21.5	23.5 ± 1.42 (21.0-26.5)	22.0 ± 0.68 (20.5-22.5)
Ant. gen. br.	300.0	...	448.5 ± 79.77 (294.0-564.5)	...
Post. gen. br.	358.5	...	525.0 ± 70.91 (429.5-653.0)	...
Ant. gen. br. (%)	7.8	...	10.5 ± 1.74 (6.5-13.0)	...
Post. gen. br. (%)	9.3	...	12.5 ± 1.25 (11.0-14.5)	...
Body diam. (mid-body)	52.5	51.5	53.0 ± 3.36 (48.5-59.0)	51.0 ± 1.21 (49.5-53.0)
Body diam. (anus level)	36.0	36.5	37.5 ± 1.72 (35.5-40.5)	38.5 ± 1.61 (36.5-41.5)
Rectum	34.0	35.5	34.5 ± 4.45 (26.5-44.0)	39.0 ± 3.4 (34.0-42.5)
Tail length	39.0	35.5	39.0 ± 2.04 (34.0-41.0)	38.5 ± 2.77 (35.4-43.0)
Hyaline tail tip	10.0	10.5	11.5 ± 1.8 (9.0-15.5)	11.0 ± 1.59 (8.5-13.0)
Prerectum	582.5	623.5	502.5 ± 74.79 (394.0-623.5)	528.5 ± 83.5 (429.5-647.0)
Spicules	...	65.0	...	64.5 ± 3.02 (60.0-68.0)
Lat. guid. piece	...	15.5	...	15.5 ± 1.55 (13.5-18.0)

curved behind the vulva, with increasing curvature towards the tail end, occasionally C-shaped; body cylindrical, tapering very gradually towards the anterior extremity. Cuticle apparently smooth, 3.5-4.5  $\mu\text{m}$  thick along the body, more thickened in the neck region, where it measures 5-5.5  $\mu\text{m}$  at the base of the lip region, and in the caudal region where it is 8-8.5  $\mu\text{m}$  ventrally and 9.5-10  $\mu\text{m}$  dorsally in the post anal region. Lateral hypodermal cords not well visible throughout the length of the body, more evident in the caudal region, 11.5-12  $\mu\text{m}$  wide at mid body or 28-28,5 % of the corresponding body diameter. Lateral body pores, 6 in the range of the odontostyle, arranged in a single row in the neck region and in a double row in the rest of the body, distributed irregularly along the dorsal and ventral sides of the lateral cords; six ventral and seven dorsal body pores in the range of the odontostyle. Labial region offset from the rest of the body by a shallow depression, rounded laterally and less so frontally; amphids stirrup-shaped, with aperture a straight, transverse slit, occupying slightly more than three fifths or 63 % of the lip region width, situated on the lip region at just more than half lip region height from the anterior end. Odontostyle 1.5-2  $\mu\text{m}$  in diameter; odontophore well developed with large basal flanges; guiding "tube" variable in length with guiding ring 4.5-5  $\mu\text{m}$  wide. Oesophagus dorylaimoid with the anterior part tubular, bulb containing three nuclei: the dorsal one located at the beginning, the two subventral ones almost at the middle; oesophageal-intestinal valve inconspicuous, pear or heart shaped, surrounded by intestinal tissue. Reproductive system amphidelphic, with both genital branches equally developed and reflexed; ovary occupying one fourth to one fifth of the entire genital branch; oviduct with a slender part consisting of discoid cells, and a *pars dilatata oviductus* separated from the uterus by a conspicuous sphincter muscle; uterus consisting of a very wide *pars dilatata uteri*, a pseudo-Z-organ, a dilated portion (almost half of the rest of the uterus), a tubular portion (more restricted in size) and an ovejector. Pseudo-Z-organ consisting of a variable number (generally 15-20) of granular bodies, generally rounded, from 0.5 to 1.5  $\mu\text{m}$  in diameter. No spines or other differentiations in the uterus. Protruding cell bodies of the muscles (Coomans *et al.*, 1992), are visible on the external wall of the uterus. Prerectum well visible; rectum one body width or often less long. Tail conoid, convex dorsally and less so ventrally, with terminal bulge, not very evident in some specimens, generally directed ventrally in respect to the body axis and with an indistinct blind canal; three body pores on each side of the tail.

*Male*: general appearance similar to female with posterior part of the body more curved. Morphology and anatomy similar to female except in the genital apparatus and the somatic structures associated with it; testis well developed; spicules curved, not cephalated; lateral guiding pieces well sclerotized, almost straight, slightly



**Fig. 3.** *Xiphinema lapidosum* sp. n. A, B : Female, anterior region; C : Head end (surface view); D : Pseudo-Z-organ; E : Posterior branch of the genital tract; F : Male, posterior region (allotype); G-I : Female, posterior region (G, holotype); J : Posture of adult stages; K : Posterior body region of male.

rounded proximally and bifid at distal end. Preloacal pair of papillae preceded generally by three, exceptionally four, ventral supplements. Distances of preanal supplements are given in Table 6. Tail similar to that of female, with the terminal bulge ventrally located in relation to the body axis; three, exceptionally four, caudal body pores are visible on each side of the tail.

**Table 6.** Distances of the preanal supplements in eight paratype males of *Xiphinema lapidosum* sp. n. (in  $\mu\text{m}$ ).

N	Cloaca- Double pap.	Double S1	S1-S2	S2-S3	S3-S4
1*	13.5	100.0	32.5	36.0	...
2	14.0	95.5	44.5	39.5	...
3	14.5	101.5	31.0	40.0	...
4	16.0	106.0	42.5	26.5	...
5	16.0	83.0	38.5	30.0	...
6	14.5	141.0	37.0	31.5	...
7	15.5	96.0	31.0	41.0	43.5
8	15.5	107.0	36.5	41.0	...

\* Allotype.

*Juveniles* : not available.

#### TYPE HOST AND LOCALITY

Rhizosphere of broad-beans and peas at Quinta do Rogelo, Silves, Faro, Portugal. Sampling carried out during 1980.

#### TYPE SPECIMENS

Holotype, allotype, eleven paratype females and three paratype males in the Collection of the Istituto di Nematologia Agraria del Consiglio Nazionale delle Ricerche, Bari, Italy; six paratype females and three paratype males in the Estação Agronómica Nacional, I.N.I.A., Oeiras, Portugal; one paratype female and one paratype male in the following collections: Muséum National d'Histoire Naturelle, Paris, France; Entomology and Nematology Department, Rothamsted Experimental Station, Harpenden, Herts, England; Plant Nematology Laboratory Collection, United States Department of Agriculture, Beltsville, Maryland, USA.

#### DIAGNOSIS AND RELATIONSHIPS

*Xiphinema lapidosum* sp. n. is characterized by two female genital branches equally developed, vulva situated anteriorly to mid-body, pseudo-Z-organ, and tail conoid, convex dorsally and less so ventrally, with bulge at the terminus.

The code in the polytomous key (Loof & Luc, 1990) is the following: A4, B2, C5a, D6, E5, F4, G3, H2, I3, J?, K?, L2.

The new species belongs to the group 5 in Loof and Luc (1990), among whose species it resembles *X. hard-*

*ingi* Joubert, Kruger & Heyns, 1988, *X. jomercium* Joubert, Kruger & Heyns, 1988, *X. majus* Bos & Loof, 1985, *X. tenue* Joubert, Kruger & Heyns, 1988, *X. transkeiense* Joubert, Kruger & Heyns, 1988 and *X. turcicum* Luc & Dalmasso, 1964. *X. lapidosum* sp. n. differs from *X. hardingi* in having longer odontostyle (124.5-139.5 vs 107-120  $\mu\text{m}$ ), shorter odontophore (69-73.5 vs 76-79  $\mu\text{m}$ ), slender body ("a" value 70-88 vs 48-68), lower "c" value (92-131 vs 127-140), higher "c'" value (0.9-1.1 vs 0.6-0.77), longer tail (34-41 vs 26.3-30  $\mu\text{m}$ ) and more anteriorly situated vulva (V = 41-46 vs 49-51); from *X. jomercium* in having longer and slender body (L = 3.7-4.6 vs 3.2-3.85 mm; "a" value 70-88 vs 59-80), longer odontostyle and tail (124.5-139.5 vs 103-113  $\mu\text{m}$  and 34-41 vs 26.3-32.5  $\mu\text{m}$ , respectively); from *X. majus* in having shorter odontostyle and odontophore (124.5-139.5 vs 155-179  $\mu\text{m}$  and 69-73.5 vs 79-91  $\mu\text{m}$ , respectively), more anteriorly situated vulva (V = 41-46% vs 47-51%) and a distinct pseudo-Z-organ, not reported in the original description of *X. majus* (Bos & Loof, 1985) or very weakly developed (Loof & Luc, 1990); from *X. tenue* in having longer body, odontostyle, odontophore and tail (L = 3.7-4.6 vs 2.96-3.65 mm; 124.5-139.5 vs 78-85  $\mu\text{m}$ ; 69-73.5 vs 54-59  $\mu\text{m}$  and 34-41 vs 25-33.8  $\mu\text{m}$ , respectively); more anteriorly situated vulva (V = 41-46% vs 52.9-54.9%) and lower "c'" value (0.9-1.1 vs 1.1-1.5); from *X. transkeiense* in having longer and more slender body (L = 3.7-4.6 vs 2.6-3.1 mm; "a" value 70-88 vs 44-63), longer odontostyle (124.5-139.5 vs 120-133  $\mu\text{m}$ ), shorter odontophore (69-73.5 vs 75-88  $\mu\text{m}$ ), longer tail (34-41 vs 21.3-26.3  $\mu\text{m}$ ) and higher "c'" value (0.9-1.1 vs 0.53-0.74) and from *X. turcicum* in having shorter odontostyle (125-140 vs 152-161  $\mu\text{m}$ ), shorter odontophore (69-74 vs 86-99  $\mu\text{m}$ ), more anteriorly situated guiding ring (98-128 vs 132-157  $\mu\text{m}$ ), higher "c'" value (0.9-1.1 vs 0.7-0.9), different tail shape (more rounded in *X. turcicum*) and higher frequency of males.

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