Nematol. medit. (1993), 21: 215-225

[1] *Istituto di Nematologia Agraria, C.N.R. Bari, Italy and*
[2] *Centro de Sistematica e Ecologia, Departamento de Zoologia, Universidade de Coimbra, Portugal*

THE *XIPHINEMA AMERICANUM* - GROUP IN THE VINEYARDS OF THE DÃO AND DOURO REGIONS (PORTUGAL) WITH DESCRIPTION OF TWO NEW SPECIES (NEMATODA, DORYLAIMIDA)

by

F. LAMBERTI [1], R. M. LEMOS [2], A. AGOSTINELLI [1] and T. D'ADDABO [1]

Summary. A nematode survey with the aim of determining the specific composition of the *Xiphinema americanum* – group in the vineyards of the Dão and Douro Regions in Portugal revealed the presence of five species. *Xiphinema madeirense* Brown *et. al., X. duriense* sp.n. and *X. santos* sp.n. occurred in the Dão Region and *X. madeirense, X. pachtaicum* (Tulaganov) Kirjanova, *X. pachydermum* Sturhan and *X. duriense* sp.n. in the Douro Region. *X. duriense* differs from *X. opisthohysterum* Siddiqi in the higher a and c' values and in the posterior vulva and basal guiding ring; *X. santos* differs from *X. tenuicutis* Lamberti *et* Bleve-Zacheo in the lower c value, the higher c' value, the posterior basal guiding ring and the longer tail. It is hypothesized that *X. duriense* is conspecific with the *X. opisthohysterum* reported from Portugal in 1983 by Sturhan.

Populations of the *Xiphinema americanum* – group are common in Portugal in the important viticultural areas of the Dão and Douro Regions. Many of them were collected by one of us (R.M. Lemos) in recent years and when identified, seemed to fall within two of the subgroups proposed by Lamberti and Ciancio (1993).

The identification process, according to the dichotomous key prepared by Lamberti and Carone (1991), led us to *X. tenuicutis* Lamberti *et* Bleve-Zacheo, 1979 for a group of populations nevertheless with some differences, falling within the *X. americanum* sub-group (Lamberti and Ciancio, 1993); a number of populations were identified as *X. madeirense* Brown, Faria, Lamberti, Halbrendt, Agostinelli *et* Jones, 1992, also falling as *X. madeirense* in the *X. pachtaicum* sub - group; other populations resembled to *X. pachtaicum* (Tulaganov, 1938) Kirjanova, 1951, to *X. pachydermum* Sturhan, 1983 and to *X. opisthohysterum* Siddiqi, 1961, previously reported from Portugal (Sturhan, 1983), all belonging to *X. pachtaicum* sub - group (Lamberti and Ciancio, 1993). However, while the populations identified as *X. madeirense, X. pachtaicum* and *X. pachydermum* showed only minor differences from the type population and are considered to be within intraspecific variation, major differences occurred between the type population of *X. opisthohysterum* and a group of Portuguese populations.

It was thought that the importance and the significance of these differences, as well as the relationships among all the populations considered, could be focused and clarified by means of principal component and hierarchical cluster analysis (Lamberti *et al.*, 1991, Lamberti and Ciancio, 1993). The results of such analysis are reported in this paper.

Material and methods

Nematodes were collected from the rhizosphere of grapevines (*Vitis* spp.) in representative vineyards of the Dão and Douro regions, extracted by means of Cobb's wet sieving technique, killed and fixed in hot 5% formalin and processed to anhydrous glycerol. Measurements were taken with the aid of a camera lucida, and compared with those given in the original descriptions of *X. pachydermum* (Sturhan, 1983), *X. madeirense* (Brown *et al.*, 1992) and *X. tenuicutis* or by Lamberti and Bleve-Zacheo (1979) for *X. opisthohysterum* and by Lamberti and Martelli (1971) for *X. pachtaicum.*

Principal component analysis (PCA) was performed using the average values of 11 characters (Table II) and the resulting correlation matrix. PCA was followed by hierarchical cluster analysis (HCA) using as input all the variables selected. Multivariate statistics were accomplished using the programme SAS-rel. 6.03 (SAS Institute, 1985).

Results and discussion

The correlation coefficients among the original variables and the eigenvalues of eigenfactors of the correlation matrix are reported in Tables III and IV, respectively.

A total of 25 populations was analysed (Table I), 12 from the Dão and 13 from the Douro Region, respectively.

As shown on the dendrogram (Fig. 1) and in the scatterplot (Fig. 2) HCA indicated the occurrence of five main groups: the rather uniform group of *X. madeirense*, which comprises eight populations from the Dão region, and four populations from the Douro Region; the *X. pachtaicum* group found only in the Douro Region, from which the Italian population (p) is slightly separated; the group including the type population of *X. tenuicutis* from which the three Portuguese populations, all occurring in the Dão Region, are clearly distinct; the *X. pachydermum* group constituted by the type population and a single population from the Douro region which, however, presents some differences from the type population that cannot be taken into consideration because of the scarcity of material, only two females; and finally the *X. opisthohysterum* group comprising one population from the Dão Region and four from the Douro Region which are all clearly distinct from the type population.

The two groups of Portuguese populations similar to *X. opisthohysterum* or to *X. tenuicutis* in our opinion represent two undescribed species for which the names *X. duriense* and *X. santos*, respectively, are proposed.

TABLE I - *Populations of* Xiphinema *selected for principal component analysis.*

Population codes	Village	Locality	Town	Identification	
				Preliminary	Proposed after PCA
			DÃO REGION		
I	Alcafache	Casal Mendo	Mangualde	*X. madeirense*	*X. madeirense*
B	Cabanas de Viriato	Travança de S. Tomé	Carregal do Sal	*X. madeirense*	*X. madeirense*
C	Cabanas de Viriato	Cabanas	Carregal do Sal	*X. madeirense*	*X. madeirense*
P	Cabanas de Viriato	Cabanas	Carregal do Sal	*X. opisthohysterum*	*X. duriense* sp.n.
U	Cativelos	Aljão	Gouveia	*X. tenuicutis*	*X. santos* sp.n.
E	Lagarinhos	Lagarinhos	Gouveia	*X. madeirense*	*X. madeirense*
L	Lagiosa	Lagiosa	Tondela	*X. madeirense*	*X. madeirense*
N	Pindo	Jadão	Penalva do Castelo	*X. madeirense*	*X. madeirense*
T	S. João de Lourosa	Vila Nova	Viseu (type pop.)	*X. tenuicutis*	*X. santos* sp.n.
H	S. João de Lourosa	Oliveira	Viseu	*X. madeirense*	*X. madeirense*
V	S. João de Lourosa	Oliveira	Viseu	*X. tenuicutis*	*X. santos* sp.n.
M	Silgueiros	Paços	Viseu	*X. madeirense*	*X. madeirense*
			DOURO REGION		
W	Cambres	Quinta (Q.) da Pacheca	Lamego	*X. pachtaicum*	*X. pachtaicum*
Z	Carrazeda de Anciães	Q. das Vareiras	Carrazeda de Anciães	*X. pachydermum*	*X. pachydermum*
Y	Godim	Q. do Paço	Peso da Régua	*X. pachtaicum*	*X. pachtaicum*
X	Gouvães	Q. do Vesúvio	Sabrosa	*X. pachtaicum*	*X. pachtaicum*
A	Sanhoane	Q. da Raposeira	Sta. Marta de Panaguião	*X. madeirense*	*X. madeirense*
S	Sanhoane	Q. da Raposeira	Sta. Marta de Panaguião	*X. opisthohysterum*	*X. duriense* sp.n.
D	Vila Real	Q. do Sogrape	Vila Real	*X. madeirense*	*X. madeirense*
Q	Valdigem	Q. do Cabo	Lamego (type pop.)	*X. opisthohysterum*	*X. duriense* sp.n.
G	Vale de Figueira	Q. de Vargelas	S. João de Pesqueira	*X. madeirense*	*X. madeirense*
R	Vale de Figueira	Q. de Vargelas	S. João de Pesqueira	*X. opisthohysterum*	*X. duriense* sp.n.
F	Valença do Douro	Q. do Retiro	Tabuaço	*X. madeirense*	*X. madeirense*
O	Valença do Douro	Q. do Retiro	Tabuaço	*X. opisthohysterum*	*X. duriense* sp.n.
J	Valença do Douro	Q. do Retiro	Tabuaço	*X. pachtaicum*	*X. pachtaicum*
d			paratypes	*X. pachydermum*	
m			paratypes	*X. madeirense*	
o			paratypes	*X. opisthohysterum*	
P	after Lamberti and Martelli, 1971, from Italy			*X. pachtaicum*	
t			paratypes	*X. tenuicutis*	

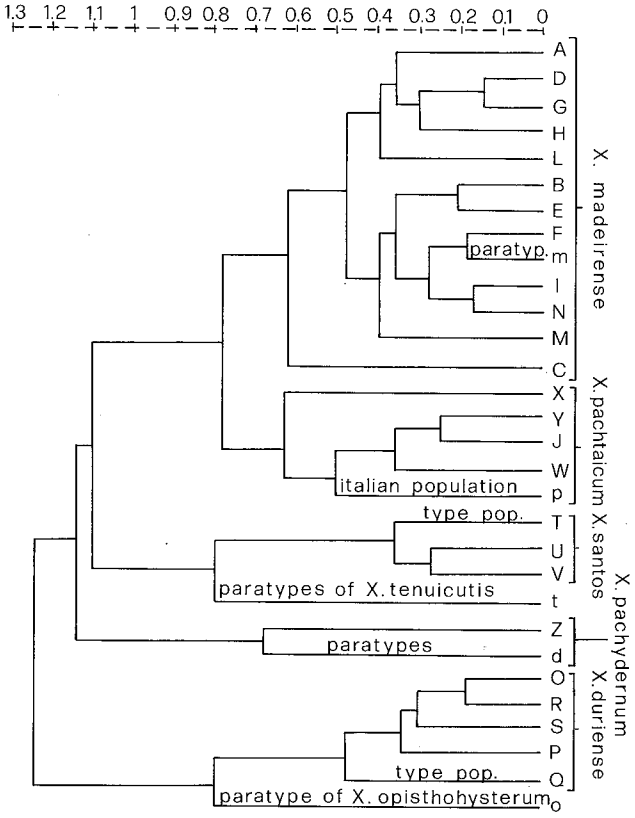

Fig. 1 - Dendrogram showing the clustering of populations of *Xiphinema americanum*-group species from Portugal analyzed by hierarchical analysis of morphometrics variables. Population codes as indicated in Table I.

Descriptions

XIPHINEMA DURIENSE SP. N.

(Figs. 3 and 4; Table V)

Holotype female: L = 1.8 mm; a = 81, b = 6.0; c = 64; c' = 2.0; V = 61; odontostyle = 69 µm; odontophore = 38 µm; oral aperture to guiding ring = 61 µm; tail = 28 µm; J (hyalin portion of tail) = 6,5 µm; body diameter at lip region = 8 µm; body diameter at guiding ring = 17 µm; body diameter at base of oesophagus = 20 µm; body diameter at vulva = 22 µm; body diameter at anus = 14 µm; body diameter at beginning of J = 6 µm.

Female *habitus* coiled in a more or less open C when killed by heat; body cylindrical, tapering gradually towards the extremities; cuticle smooth 1-1.5 µm thick along the body. Lip region 3.5 µm high, almost elliptical, expanded, offset from the rest of the body by a distinct depression. Amphids large, stirrup shaped, with slit like aperture. Odontostyle 1.5 µm in diameter at its base, odontophore strongly flanged. Guiding tube typical of the genus, with only the basal ring readily visible. Oesophagus dorylaimoid, with the enlarged basal portion 70 µm long and 12 µm wide, containing three nuclei and occupying about 1/4 of the total oesophagus length. Oesophageal - intestinal valve heart-shaped. Reproductive system amphidelphic with equally developed branches; vulva slit like, definitely posterior to mid body; vagina occupying about 1/2 corresponding body width; uteri not clearly separated from the oviduct; no spermatheca nor any "Z" differentiation visible; ovaries reflexed. Prerectum not defined; rectum slightly

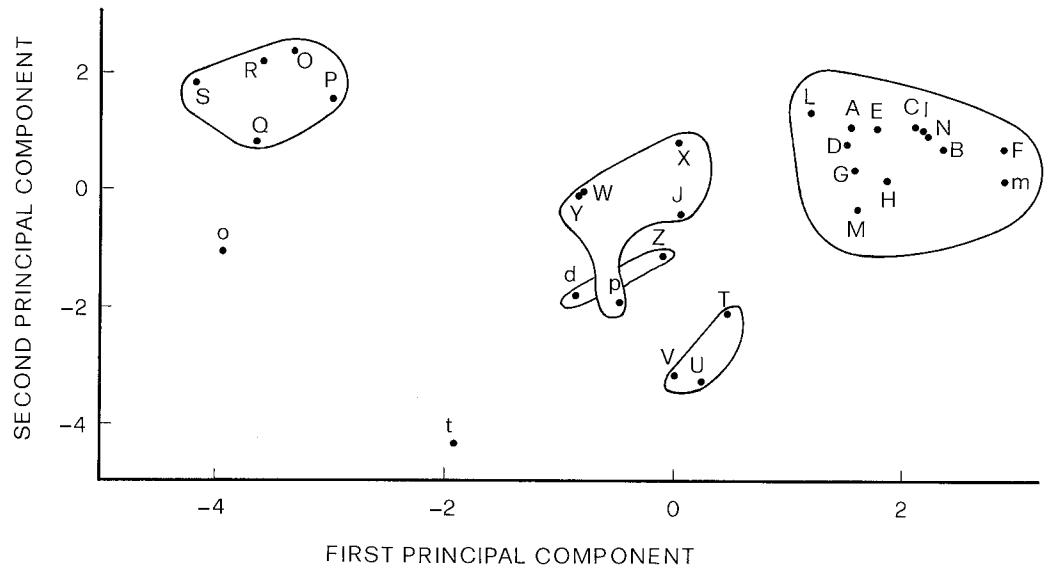

Fig. 2 - Scatterplot of populations of *X. americanum*-group species from Portugal on the first and second component axis. (Population codes as indicated in Table I).

longer than body diameter at anus. Tail conoid with pointed terminus, slightly curved ventrally and bearing two caudal pores on each side.

Male not found.

Diagnosis

Xiphinema duriense sp.n. is characterized by body length around 1.8 mm, elliptical expanded lip region, odontostyle lengh 70 µm, post-equatorial vulva, amphidelphic with equally developed branches of the reproductive female system and conoid with pointed terminus tail.

X. duriense is similar to *X. opisthohysterum* Siddiqi, 1961, *X. pachtaicum* (Tulaganov, 1938) Kirjanova, 1951 and to *X. pachydermum* Sturhan, 1983. However, from *X. opisthohysterum* it differs in a greater a value (74 vs. 59), posterior vulva (V = 60 vs. 57), longer odontostyle (70 vs. 66 µm), posterior basal guiding ring (61 vs. 49 µm) and shorter (31 vs. 33 µm) and less curved tail. *X. duriense* differs from *X. pachtaicum* in the higher a value (74 vs. 64), higher c' value (2.1 vs 1.6), posterior vulva (V = 60 vs. 56), shorter odontostyle (70 vs. 86 µm) and anterior basal guiding ring (61 vs. 77 µm from anterior extremity). Finally, compared with *X. pachydermum*, *X. duriense* has a shorter body (1.8 vs. 2.2 mm), lower c value (58 vs. 72), shorter odontostyle (70 vs. 84 µm), higher c' value (2.1 vs. 1.5) and less pointed and more gradually tapering tail.

Type material

Holotype and four paratype females in the collection of the Istituto di Nematologia Agraria del Consiglio Nazionale delle Ricerche, Bari, Italy; two paratype females in the Entomology and Nematology Department, Rothamsted Experimental Station, Harpenden, England, United Kingdom; two paratype females in the Plant Nematology Laboratory Collection, United States Department of Agriculture, Beltsville, United States of America, and two paratype females in the Departamento de Zoologia, Universidade de Coimbra, Portugal.

Type locality

Rhizosphere of *Vitis* sp. at Valdigem, Quinta do Cabo, Lamego, in the Douro Region, Portugal.

TABLE II - *Morphometrics of the populations used in the principal component analysis.*

Populations codes	No. of specimens	L	A	B	C	CIP	V	STY	EST	AG	TAL	Y
A	5	1.9 (1.9-2.0)	64 (62-66)	5.4 (5.0-6.3)	54 (51-61)	2.1 (1.8-2.3)	56 (53-58)	103 (103-104)	51 (50-53)	89 (88-90)	36 (33-38)	9 (9-10)
B	5	2.1 (1.9-2.3)	68 (63-71)	6.0 (5.6-6.5)	55 (51-57)	1.9 (1.8-2.2)	55 (57-58)	107 (101-111)	51 (49-53)	93 (86-95)	38 (35-40)	9 (9-9)
C	2	1.9 (1.8-2.0)	64 (62-66)	5.7 (5.3-6.2)	49 (42-55)	2.1 (1.9-2.3)	55 (55-55)	104 (101-107)	49 (47-51)	88 (83-93)	39 (36-41)	11 (11-11)
D	3	2.0 (1.8-2.1)	69 (65-74)	6.0 (5.2-7.5)	56 (54-59)	2.0 (1.8-2.2)	56 (55-57)	105 (103-106)	51 (49-54)	90 (89-92)	35 (31-39)	9 (8-10)
E	5	2.1 (2.1-2.2)	68 (66-70)	6.2 (5.7-6.9)	56 (50-60)	2.1 (2.0-2.2)	55 (52-57)	105 (104-106)	51 (50-53)	89 (81-93)	38 (36-42)	8 (8-9)
F	3	2.2 (2.1-2.3)	70 (69-72)	6.3 (5.8-6.7)	57 (55-59)	1.9 (1.8-2.0)	56 (55-57)	106 (105-109)	53 (50-55)	94 (91-98)	39 (37-41)	10 (9-10)
G	3	2.0 (2.0-2.1)	67 (62-71)	6.0 (6.0-6.0)	59 (56-62)	1.9 (1.8-2.1)	56 (55-57)	104 (103-106)	50 (49-52)	94 (93-96)	35 (32-38)	9 (8-9)
H	3	2.0 (1.9-2.0)	68 (66-71)	5.5 (5.3-5.6)	58 (57-59)	1.9 (1.8-1.9)	54 (53-55)	104 (102-106)	50 (49-52)	89 (88-89)	34 (33-35)	10 (9-10)
I	5	2.1 (1.9-2.1)	68 (65-71)	6.0 (5.3-7.1)	55 (52-58)	2.0 (1.9-2.1)	57 (57-58)	103 (100-108)	51 (47-53)	90 (86-93)	38 (36-41)	10 (9-11)
L	5	2.0 (1.9-2.1)	68 (65-70)	5.6 (5.4-5.8)	56 (51-64)	2.0 (1.8-2.1)	57 (53-58)	103 (100-107)	51 (49-52)	89 (86-94)	36 (33-40)	7 (7-8)
M	5	2.0 (1.8-2.1)	62 (58-64)	6.5 (5.8-7.2)	56 (52-61)	1.9 (1.8-2.0)	55 (52-58)	104 (102-108)	50 (48-51)	87 (76-95)	36 (33-38)	10 (8-11)
N	5	2.1 (2.1-2.2)	69 (65-74)	6.4 (5.8-8.3)	56 (53-61)	2.0 (2.0-2.2)	57 (54-59)	107 (105-110)	51 (48-53)	93 (91-95)	38 (36-39)	10 (10-11)
O	5	1.8 (1.4-1.8)	80 (77-81)	6.5 (5.8-7.0)	54 (49-56)	2.3 (2.1-2.4)	61 (58-63)	71 (68-75)	39 (37-41)	61 (58-64)	33 (32-34)	7 (6-8)
P	5	1.8 (1.6-1.8)	73 (71-75)	6.1 (5.4-6.4)	54 (51-56)	2.3 (2.2-2.4)	59 (57-61)	71 (70-74)	39 (39-40)	57 (56-58)	32 (31-33)	8 (7-9)
Q	5	1.7 (1.6-1.9)	72 (68-75)	6.0 (5.4-6.4)	58 (53-68)	2.0 (1.9-2.2)	60 (56-62)	70 (68-71)	37 (35-39)	60 (56-63)	30 (28-32)	7 (6-8)
R	5	1.7 (1.5-1.9)	76 (70-82)	6.6 (5.7-7.0)	53 (48-56)	2.4 (2.2-2.6)	60 (58-61)	72 (69-75)	38 (37-40)	61 (58-63)	33 (28-35)	7 (6-8)
S	4	1.6 (1.5-1.8)	74 (69-78)	6.6 (5.7-7.7)	53 (45-59)	2.4 (2.1-2.5)	60 (60-61)	70 (69-75)	38 (38-38)	58 (55-63)	31 (29-33)	7 (6-8)
T	5	1.8 (1.8-1.9)	51 (48-53)	6.1 (5.8-6.5)	51 (48-54)	1.7 (1.6-1.8)	51 (50-53)	82 (79-84)	49 (48-50)	69 (68-71)	36 (33-38)	10 (9-11)
U	5	1.8 (1.6-1.8)	49 (47-51)	6.5 (6.0-8.5)	53 (49-57)	1.6 (1.5-1.8)	50 (50-50)	81 (79-85)	49 (48-51)	67 (65-71)	33 (32-35)	11 (8-12)
V	5	1.8 (1.8-1.8)	49 (48-53)	6.0 (6.0-6.0)	56 (54-60)	1.6 (1.4-1.7)	50 (50-50)	78 (75-80)	49 (48-52)	67 (66-68)	32 (30-33)	10 (9-11)
Z	2	2.0 (2.0-2.0)	68 (65-71)	6.2 (6.2-6.3)	69 (61-77)	1.6 (1.5-1.8)	60 (60-60)	91 (91-92)	49 (48-51)	78 (77-78)	29 (26-29)	10 (9-10)
X	5	1.9 (1.8-2.0)	74 (68-81)	5.7 (5.3-6.2)	59 (56-65)	2.0 (1.8-2.0)	58 (56-60)	92 (91-92)	47 (46-49)	82 (81-84)	31 (29-33)	10 (9-12)
Y	5	1.8 (1.8-1.9)	68 (66-69)	7.0 (6.0-8.0)	57 (56-60)	2.0 (1.9-2.1)	58 (55-60)	86 (82-94)	47 (45-50)	75 (73-79)	33 (30-35)	10 (9-11)
W	5	1.9 (1.7-2.1)	70 (68-73)	6.7 (5.1-8.1)	60 (55-65)	2.0 (1.9-2.1)	57 (54-60)	84 (80-88)	47 (45-49)	75 (72-79)	32 (31-36)	9 (9-9)
J	4	1.9 (1.8-2.0)	66 (62-71)	7.2 (5.9-8.0)	57 (54-62)	2.0 (1.9-2.2)	57 (55-60)	91 (88-97)	48 (46-51)	79 (75-86)	34 (32-35)	11 (11-11)
d		2.2 (2.0-2.4)	66 (62-70)	7.0 (6.7-7.9)	72 (61-81)	1.5 (1.3-1.6)	59 (53-60)	84 (79-87)	48 (45-50)	68 (64-72)	31 (28-34)	7
m		2.2 (2.0-2.4)	69 (63-75)	6.3 (5.1-7.8)	59 (52-67)	1.9 (1.8-2.2)	55 (52-57)	105 (100-109)	53 (49-55)	90 (82-98)	38 (32-44)	11 (10-12)
o		1.8 (1.8-1.8)	59 (56-63)	7.4 (7.4-7.5)	56 (50-62)	1.9 (1.9-2.0)	57 (56-59)	66 (64-68)	36 (34-38)	49 (48-51)	33 (30-36)	6 (6-7)
p		1.9 (1.7-2.1)	64 (59-71)	7.0 (5.4-7.9)	63 (52-71)	1.6 (1.5-2.1)	56 (53-58)	86 (71-90)	48 (44-51)	77 (68-83)	31 (23-36)	9
t		1.8 (1.6-1.9)	46 (40-53)	7.3 (6.0-8.0)	61 (58-65)	1.5 (1.4-1.7)	51 (47-52)	76 (73-80)	45 (38-46)	60 (55-64)	29 (26-32)	8 (6-10)

L = body length (mm); A, B, C, V = de Man's a, b, c, v ratios; CIP = c'; STY = odontostyle length (µm); EST = odontophore length (µm); AG = distance of the guiding ring from the anterior extremity (µm); TAL = tail length (µm); Y = length of the hyalin portion of tail (µm). Population codes as indicated in Table I.

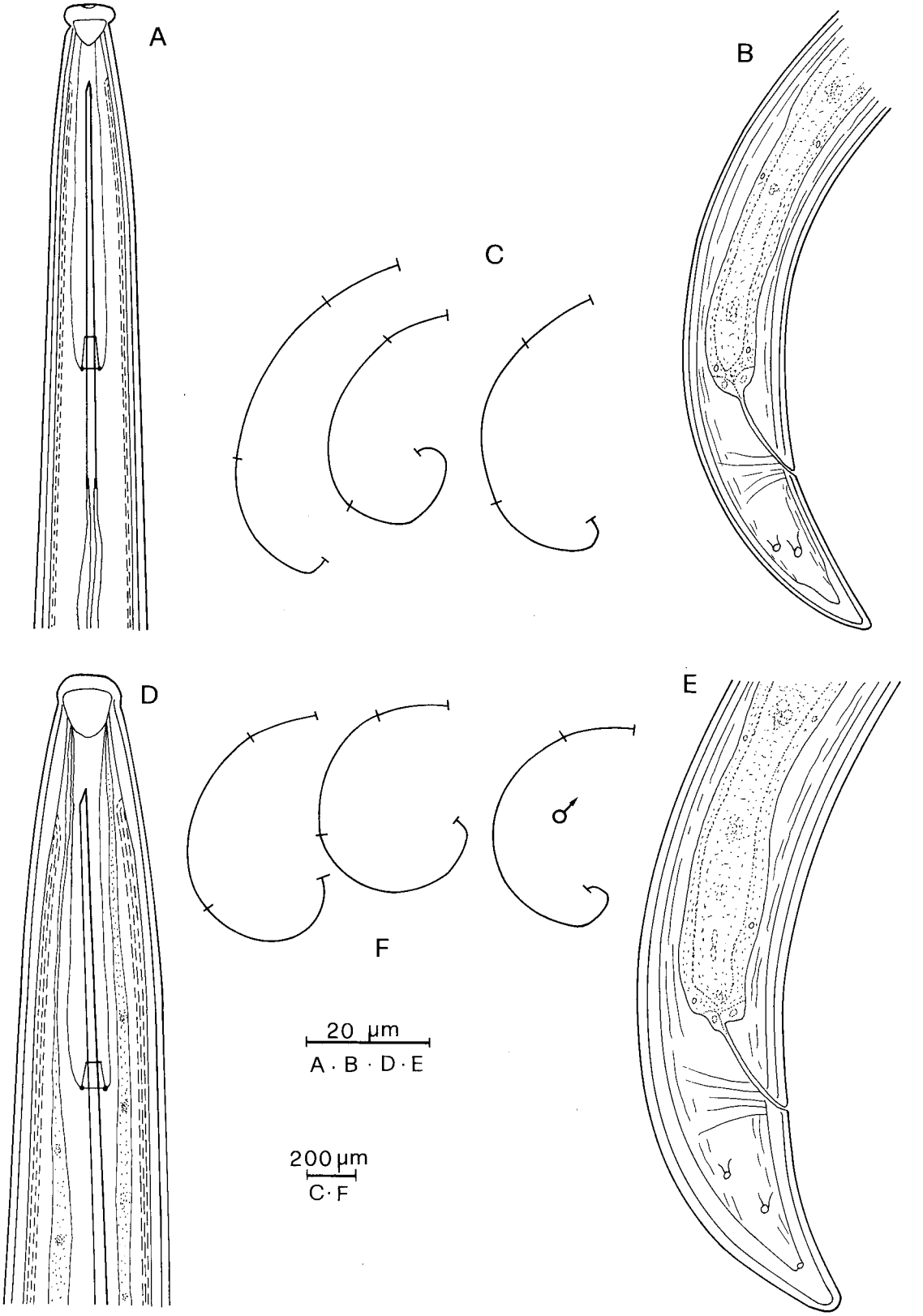

Fig. 3 - *Xiphinema duriense* sp.n. female; A, anterior region; B, posterior region; C, *habitus*. *X. santos* sp.n. female: D, anterior region; E, posterior region; F, female and male *habitus*.

XIPHINEMA SANTOS SP.N.

(Figs. 3 and 4; Table V)

Holotype female: L = 1.9 mm; a = 53; b = 6.2; c = 55; c' = 1.6; V = 53; odontostyle = 81 µm; odontophore = 51 µm; oral aperture to guiding ring= 69 µm; tail = 35 µm; J (hyaline portion of tail) = 11 µm; body diameter at lip region = 10 µm; body diameter at guiding ring = 25 µm; body diameter at base of oesophagus = 32 µm; body diameter at vulva = 36 µm; body diameter at anus = 21 µm; body diameter at beginning of J = 11 µm.

Female *habitus* coiled in an open C when killed by heat; body cylindrical, tapering gradually towards the extremities, but abruptly in the extreme anterior and posterior regions, cuticle smooth, 2-2.5 µm thick along the body; lip region hemielliptical, offset from the rest of the body by a shallow depression. Amphids large, stirrup shaped, with slit-like apeture. Odontostyle 2.2 µm in diameter at its base, odontophore strongly flanged. Guiding tube typical of the genus, with only the basal ring readily visible. Oesophagus dorylaimoid, with the enlarged basal portion 70-75 µm long and 17-22 µm wide, containing two nuclei and occupying about 1/3 of the total oesophagus length. Oesophageal intestinal valve hemielliptical. Reproductive system amphidelphic with equally developed branches, vulva slit-like, almost at mid-body; vagina occupying about 1/3 corresponding body width; uteri not clearly separated from the oviduct; no spermatheca nor "Z" differentiation visible; ovaries reflexed. Prerectum 85-90 µm long; rectum as long as body diameter at anus. Tail conoid with subacute terminus, curved ventrally and bearing two caudal pores on each side.

Male (only one specimen occurred in one collection) similar to female but more coiled in the posterior region, bearing 8 ventromedian supplements preceeding the adanal pair.

TABLE III - *Correlation coefficients among the variables used for the principal component analysis.*

	L	A	B	C	CIP	V	STY	EST	AG	TAIL	J
L	1.000										
A	0.1153	1.0000									
B	-0.1937	-0.1969	1.0000								
C	0.3852	0.0228	0.3105	1.0000							
CIP	-0.2881	0.7273	-0.2263	-0.5857	1.0000						
V	-0.0831	0.8667	0.0835	0.2217	0.5809	1.0000					
STY	0.7912	0.0927	-0.5031	-0.0136	-0.0647	-0.2161	1.0000				
EST	0.7619	-0.2410	-0.3698	0.1380	-0.4189	-0.4934	0.8756	1.0000			
AG	0.7604	0.1598	-0.5205	-0.0032	-0.0358	-0.1660	0.9850	0.8681	1.0000		
TAIL	0.5804	0.0845	-0.3852	-0.4948	0.2407	-0.2310	0.7444	0.5828	0.7125	1.0000	
J	0.3301	-0.2924	-0.1976	-0.0861	-0.3214	-0.4897	0.5321	0.6846	0.5488	0.3644	1.0000

TABLE IV - *Principal Component Analysis: Eigenvalues of the correlation matrix.*

	Eigenvalue	Difference	Proportion	Cumulative
PRIN 1	4.8443	2.0987	0.4404	0.4404
PRIN 2	2.7456	0.9350	0.2496	0.6900
PRIN 3	1.8106	1.1141	0.1646	0.8546
PRIN 4	0.6965	0.1399	0.0633	0.9179
PRIN 5	0.5566	0.3878	0.0506	0.9685
PRIN 6	0.1688	0.0921	0.0153	0.9838
PRIN 7	0.0766	0.0311	0.0070	0.9908
PRIN 8	0.0456	0.0084	0.0041	0.9950
PRIN 9	0.0371	0.0233	0.0034	0.9983
PRIN 10	0.0138	0.0093	0.0012	0.9996
PRIN 11	0.0045		0.0004	1.0000

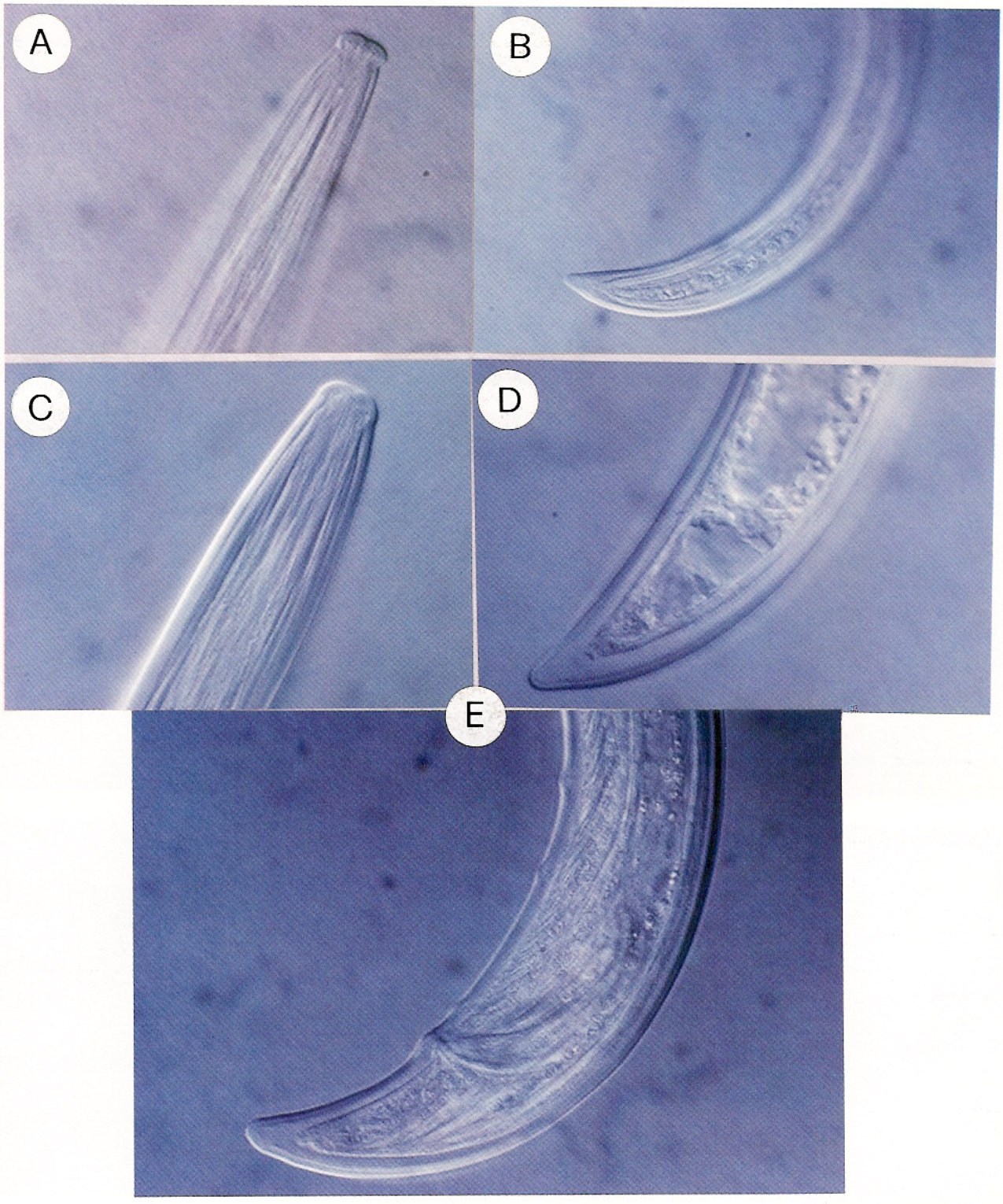

Fig. 4 - Photomicrographs of *X. duriense* sp.n.: female A, anterior and B, posterior regions and *X. santos* sp.n.: female C anterior and D, posterior regions and male E, posterior region.

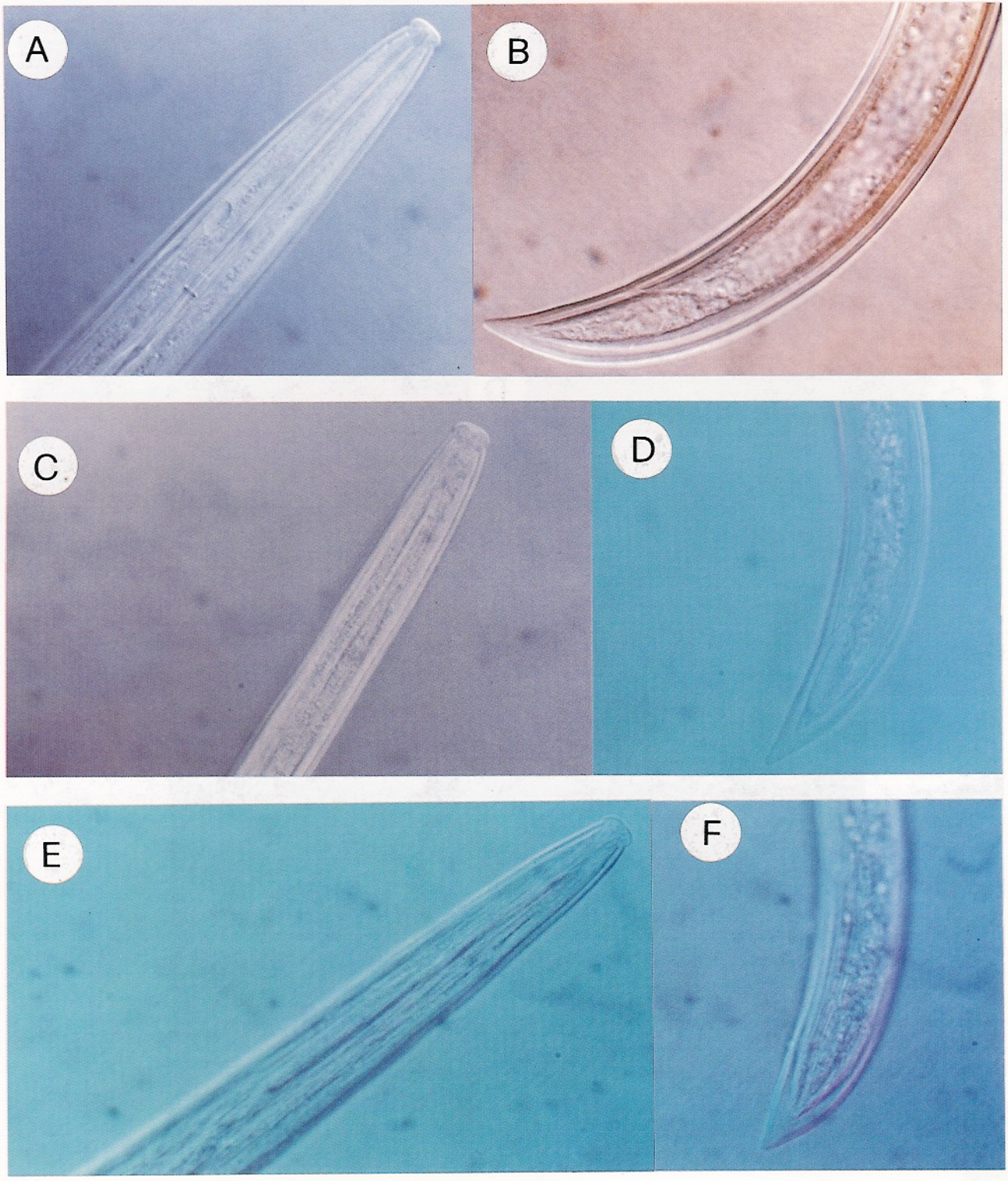

Fig. 5 - Photomicrographs of Portuguese females of *X. madeirense* (A, anterior; B, posterior regions); *X.* pachtaicum (C, anterior; D, posterior regions) and *X. pachydermum* (E, anterior; F, posterior regions).

Diagnosis

Xiphinema santos sp.n. (after Prof. M. Susana N. De A. Santos) is characterized by body length of about 1.8 mm, hemielliptical lip region offset by shallow depression from the rest of body, odontostyle length of 83 µm, vulva situated at mid-body, amphidelphic with equally developed branches of the female reproductive system and conoid with sub acute terminus tail.

Xiphinema santos is similar to *X. tenuicutis* Lamberti *et* Bleve-Zacheo, 1979 and to *X. pachydermum* Sturhan, 1993. However, it differs from *X. tenuicutis* in having a lower c value (54 vs. 61), higher c' value (1.7 vs. 1.5), longer odontostyle (83 vs. 76 µm) and odontophore (50 vs. 45 µ), posterior basal guiding ring (67 vs. 60 µm from anterior extremity) and longer tail (34 vs. 29 µm). Compared with *X. pachydermum*, *X. santos* has a less expanded lip region, lower a value (54 vs. 66), lower c value (54 vs. 72), higher c' value (1.7 vs. 1.5), anterior vulva (V = 51 vs. 59) and longer tail (34 vs. 31 µm).

Type material

Holotype, 14 paratype females and 1 paratype male in the collection of the Istituto di Nematologia Agraria del Consiglio Nazionale delle Ricerche, Bari, Italy; two paratype females in the Entomology and Nematology Department, Rothamsted Experimental Station, Harpenden, England, U.K.; two paratype females in the Plant Nematology Laboratory Collection, United States Department of Agriculture, United States of America, and two paratype females in the Departamento de Zoologia, Universidade de Coimbra, Portugal.

Type Locality

Rhizosphere of *Vitis* sp. at Vila Nova, Sao Joao de Lourosa, Viseu, Dão Region, Portugal.

The morpho-biometric characters of the Portuguese populations of *X. madeirense* (Fig. 5, A, B) and *X. pachtaicum* (Fig. 5 C, D) are within the limits of their intraspecific variation. Descriptions are therefore omitted; however, it is thought useful to report (Table V) the biometrics of the most representative populations.

The two females identified as *X. pachydermum* (Fig. 5 E, F), compared with the original description have longer odontostyle (91 vs. 84 µm) and no males were found in the single sample which contained them. However, the scarcity of material does not permit any conclusion. Nevertheless, their biometrics are reported in Table V.

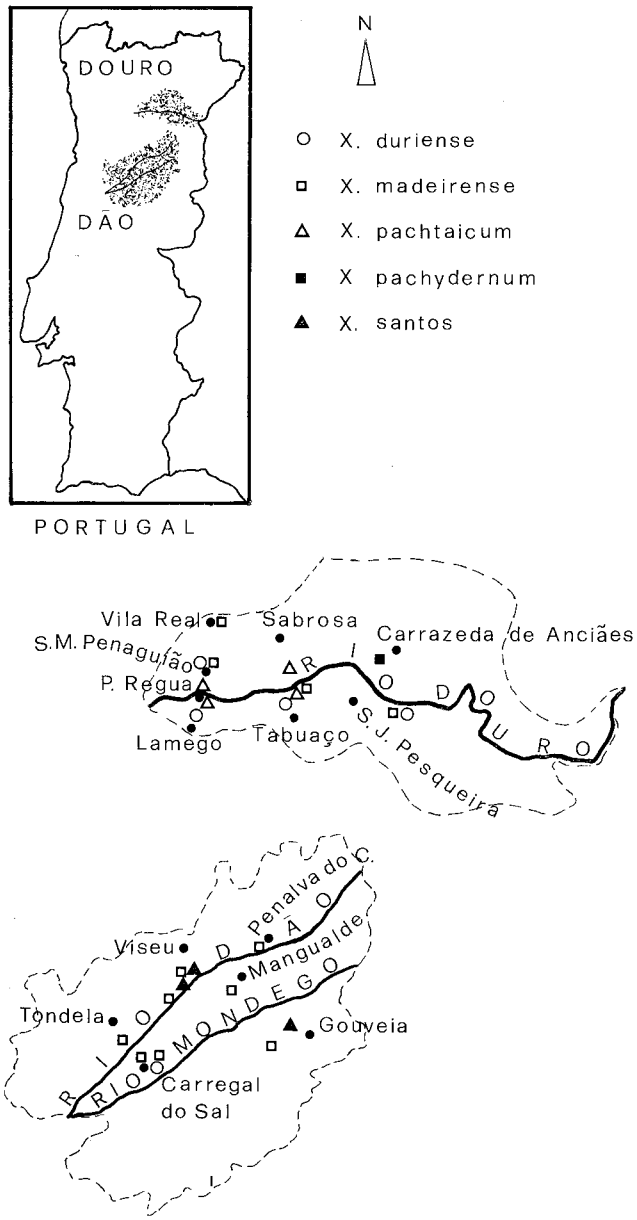

Fig. 6 - Distribution of *X. americanum*-group species in the Dão and Douro Regions in Portugal.

Conclusions

A total of five species falling within the *X. americanum* group were found during our survey in the Dão and Douro Regions. Of the 25 populations studied 12 were identified as *X. madeirense*, 5 as *X. duriense* sp.n., 4 as *X.*

TABLE V - *Biometrics of Portuguese populations of species of* Xiphinema *within the* X. americanum *group.*

Characters	Locality:	*X. duriense* (paratypes) Quinta do Cabo 10 ♀♀	*X. santos* (paratypes) Vila Nova 20 ♀♀	1 ♂	*X. pachtaicum* Q. do Vesúvio 10 ♀♀	*X. madeirense* Paços 10 ♀♀	*X. pachydermum* Q. das Vareiras 10 ♀♀
Body length	mm	1.8±0.1 (1.6-2.0)	1.8±0.8 (1.7-2.0)	1.7	1.9±0.1 (1.8-2.0)	2.0±0.9 (1.8-2.1)	2.0 (2.0-2.0)
a		74±3.9 (68-81)	54±2.3 (54-59)	52	74±4.1 (68-81)	62±3.7 (57-68)	68 (65-71)
b		6.0±0.4 (5.4-6.7)	6.0±0.4 (5.1-6.7)	5.5	6.1±0.5 (5.3-6.8)	6.3±0.4 (5.8-7.2)	6.2 (6.2-6.3)
c		58±5.0 (53-67)	54±3.1 (51-65)	48	61±4.0 (56-68)	55±3.0 (51-61)	69 (61-77)
c'		2.1±0.1 (1.9-2.3)	1.7±0.8 (1.5-1.8)	1.7	2.0±0.2 (1.7-2.2)	1.9±0.1 (1.8-2.0)	1.5 (1.3-1.8)
V		60±1.9 (56-63)	51±1.7 (48-53)	–	59±2.4 (56-65)	55±1.7 (52-58)	60 (60-60)
Odontostyle	µm	70±1.4 (68-72)	83±2.3 (79-88)	82	92±1.6 (88-94)	104±2.3 (101-108)	91 (91-92)
Odontophore	µm	37±2.2 (33-41)	50±1.4 (48-53)	44	48±1.3 (46-49)	49±1.9 (47-52)	49 (48-51)
Anterior to guide ring	µm	61±2.7 (56-64)	67±1.8 (65-72)	69	82±2.7 (76-85)	88±4.5 (76-95)	78 (77-78)
Tail length	µm	31±2.4 (28-35)	34±1.5 (32-37)	38	32±1.9 (29-35)	36±1.6 (33-39)	29 (26-32)
Tail hyaline length (J)	µm	7.3±0.8 (5.9-8.2)	10±0.7 (9-11)	8	10±1.0 (9-11)	9.5±1.0 (8.2-10.6)	10.0 (8.8-11.2)
Body diameters: Lips	µm	8.1±0.2 (7.6-8.2)	10±0.2 (9-11)	10	8.6±0.3 (8.2-8.8)	8.7±0.3 (8.2-8.8)	8.8 (8.8-8.8)
Guide ring	µm	17±0.8 (16-18)	25±0.7 (23-26)	25	20±1.5 (17-22)	23±0.6 (22-24)	21 (21-21)
Base of oesophagus	µm	21±0.8 (20-22)	32±1.3 (29-34	30	24±1.7 (21-26)	28±1.7 (25-29)	26 (25-26)
Mid body or vulva	µm	24±1.4 (22-26)	35±2.2 (31-39)	35	26±1.1 (24-27)	32±1.9 (29-35)	29 (28-31)
Anus	µm	14±0.8 (13-16)	20±1.2 (18-23)	23	16±1.2 (14-18)	18±0.9 (17-20)	19 (18-19)
Beginning of tail hyaline	µm	6.4±0.6 (5.9-7.1)	9.8±0.7 (8.8-11.8)	9	7.9±0.9 (7.1-10.0)	7.0±0.4 (6.5-7.6)	9.4 (9.4-9.4)
Spicules	µm			50			

pachtaicum, 3 as *X. santos* sp.n. and only 1 as *X. pachydermum*. *X. madeirense* and *X. duriense* occurred in both Regions, while *X. pachtaicum* and *X. pachydermum* occurred only in the Douro region and *X. santos* only in the Dão region (Fig. 6).

It is interesting to note that *X. madeirense*, a species only recently described from the island of Madeira where it seems to occur in natural habitats (Brown *et al.*, 1992), is the most common and widespread species in the vineyards of northern Portugal, whereas *X. pachtaicum*, an endemic species and a common inhabitant of the grapevine rhizosphere in all the areas with mediterranean climate, and *X. pachydermum*, a species originally described from northern Portugal, were never detected in the Dão Region. The latter, moreover, generally appeared to be rare in northern Portugal.

Finally we suggest that *X. duriense* is conspecific with the population from Portugal identified by Sturhan (1983) as *X. opisthohysterum*.

Acknowledgment. The authors are grateful to Mr. V. Radicci, for preparing the figures, to Mr. F. Zacheo, for mounting the nematodes and to Prof. M.S.N. De A. Santos for her help in preparation of the data and interest in the work.

Literature cited

BROWN D. J. F., FARIA A., LAMBERTI F., HALBRENDT J. M., AGOSTINELLI A. and JONES A. T., 1992. A description of *Xiphinema madeirense* sp.n. and the occurrence and virus vector potential of *X. diversicaudatum* (Nematoda: Dorylaimida) from Santana, Madeira. *Nematol. medit.*, *20*: 251-259.

LAMBERTI F. and BLEVE-ZACHEO T., 1979. Studies on *Xiphinema americanum sensu lato* with descriptions of fifteen new species (Nematoda, Longidoridae). *Nematol. medit.*, *7*: 51-106.

LAMBERTI F. and CARONE M., 1991. A dichotomous key for the identification of species of *Xiphinema* (Nematoda: Dorylaimida) within the *X. americanum* - group. *Nematol. medit.*, *19*: 341-348.

LAMBERTI F. and CIANCIO A., 1993. Diversity of *Xiphinema americanum* - group species and hierarchcal cluster analysis of morphometrics. *J. Nematol.*, *25*: 332-343.

LAMBERTI F., CIANCIO A., AGOSTINELLI A. and 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. and MARTELLI G. P., 1971. Notes on *Xiphinema mediterraneum* (Nematoda: Longidoridae). *Nematologica*, *17*: 75-81.

STURHAN D., 1983. Description of two new *Xiphinema* species from Portugal, with notes on *X. pachtaicum* and *X. opisthohysterum* (Nematoda, Longidoridae). *Nematologica*, *29*: 270-283.

SAS INSTITUTE, 1985. *SAS user's guide. Statistic version* 5ed; SAS Institute, Cory N.C.

Accepted for publication on 10 June 1993.