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The genus *Xiphinema* Cobb, 1913 (Nematoda: Longidoridae) in western Malaysia

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Summary – A survey for *Xiphinema* species in Serdang, the Puchong area and the Cameron Highlands (Malaysia) yielded eleven species, of which one new, described hereunder as *X. winotoi* n.sp. It is close to *X. radicicola*, differring mainly in the much longer and differently shaped tail. *X. franci* was found for the first time since its description from Madagascar; it has only three juvenile stages. Data are further given for *X. brevicolle*, *X. krugi*, *X. ensiculiferum*, *X. radicicola*, *X. cf. orthotenum*, *X. insigne*, *X. setariae*, *X. elongatum* and *X. cf. brasiliense*. The earlier literature reports on *Xiphinema* species from the region are reviewed. *X. monohysterum apud* Ahmad and Baqri (1987) is considered to be *X. radicicola*; *X. basilgoodeyi apud* Ahmad and Baqri (1987) differs from the original description in tail shape and might rather belong to *X. basiri*. © Orstom/Elsevier, Paris

Résumé – ***Le genre* Xiphinema *Cobb, 1913 (Nematoda : Longidoridae) dans l'ouest de la Malaisie*** - Une prospection visant les espèces de *Xiphinema* dans les régions de Serdang, Puchong et des Cameron Highlands (Malaisie) a permis de récolter onze espèces dont une nouvelle décrite comme *X. winotoi* n. sp. Cette espèces est proche de *X. radicicola* dont elle diffère essentiellement par une queue plus longue et de forme différente. *X. franci* retrouvé pour la première fois depuis sa description à Madagascar, ne possède que trois stades juvéniles. Des données sont présentées sur *X. brevicolle*, *X. krugi*, *X. ensiculiferum*, *X. radicicola*, *X. cf. orthotenum*, *X. insigne*, *X. setariae*, *X. elongatum* et *X. cf. brasiliense*. Les références antérieures concernant les *Xiphinema* de la région sont listées. *X. monohysterum apud* Ahmad et Baqri (1987) est considéré comme étant *X. radicicola* ; *X. basilgoodeyi apud* Ahmad et Baqri (1987) diffère de la description originale par la forme de la queue et pourrait être *X. basiri*. © Orstom/Elsevier, Paris

Key-words : new species, taxonomy, western Malaysia, *Xiphinema*.

From 1993 to 1995 the senior author collected many soil samples for *Xiphinema* from several localities, most from the campus of University Putra Malaysia (UPM) at Serdang, Selangor, Malaysia. The specimens were extracted by the modified Baermann technique, fixed in F.A.4:1, processed by the Seinhorst method and mounted in glycerin. Unless stated otherwise, the material is kept in the collection of the UPM, Serdang.

Earlier records of *Xiphinema* in Malaysia are:

X. ensiculiferum (Cobb, 1893) Thorne, 1937. Sauer and Winoto (1975); Winoto and Sauer (1982): States of Penang and Selangor; Ahmad and Baqri (1987): Penang (under the name of *X. ilyasi* Ahmad & Baqri, 1987, see Loof and Luc, 1993).

X. insigne Loos,1949. Winoto and Sauer (1982): Kelantan, Penang, Selangor and Trengganu.

X. elongatum Schuurmans Stekhoven & Teunissen, 1938. Loh and Ting (1970), Winoto and Sauer (1982): Kelantan.

X. orthotenum Cohn & Sher, 1972. Winoto and Sauer (1982): Johor and Perak.

X. rivesi Dalmasso, 1969. Winoto and Sauer (1982): Pahang.

X. radicicola Goodey, 1936: Loh and Ting (1970); McLeod & Khair (1971); Winoto and Sauer (1982): Johor, Kelantan, Pahang, Perak, Selangor and Trengganu; Karim Sidam and Rahman Razak (1991): Kelantan.

X. brevicolle Lordello & Da Costa, 1961; *X. basilgoodeyi* Coomans, 1965 and *X. monohysterum* Brown, 1968: all three reported by Ahmad and Baqri (1987) from Penang. The record of *X. basilgoodeyi* appears doubtful, tail shape is more like *X. basiri*, but no description of uterus structure was given and the specimen was not made available for study. Their *X. monohysterum* is considered to be *X. radicicola* (see under that species).

List and characterization of sampling sites

1. UNIVERSITY PUTRA MALAYSIA CAMPUS, SERDANG

– 1.1. Field 1, banana (*Musa acuminata* cv. Nangka). Samples taken from plants scattered around the staff residence. These plants are grown as subsistance

Table 1. *Dimensions of* Xiphinema insigne *female (all measurements in µm except L in mm).*

	Banana, Serdang (1.1; 1.3.2)	Royal palm (1.7)	
		Short-tailed	Long-tailed
n	7	26	9
L	2.37-2.53	2.33 (2.16-2.59)	2.29 (2.19-2.45)
a	56-68	57 (50-61)	59 (55-60)
b	6.5-7.0	6.5 (5.7-7.0)	6.4 (6.1-6.9)
c	17-22	21 (18-24)	16 (15-19)
c'	5.0-7.0	4.9 (4.3-5.4)	6.2 (5.6-6.9)
ABW	21-23	23 (22-27)	23 (22-25)
Tail	116-150	113 (98-127)	144 (132-153)
h'	6-10	5-12	3-10
V	31-33	34 (32-38)	33 (31-35)
LRW	10-11	12 (11-13)	12 (11-13)
GR	86-93	85 (79-89)	89 (84-92)
Od. style	92-99	92 (88-97)	96 (94-100)
Od. phore	57-64	57 (53-63)	56 (54-62)
Stylet	149-163	149 (143-157)	154 (148-160)
MBW	36-43	41 (37-52)	39 (37-43)
Neck	341-407	360 (340-387)	360 (335-377)

crop in the backyard of the houses of Field 1 and the visitor apartment; they have been there since 1970.

– 1.2. Field 2, coconut. Old coconut area, behind the Faculty of Veterinary Medicine and Animal Science, adjacent to the Brazil nut area. The palms are about 30 years old. Except for regular cutting of the grass under the palms, no other agronomic maintenance is given.

– 1.3. Field 5, orchard of mixed tropical perennial fruit trees. The area spreads over 75 hectares of flat and sloping terrain and is given appropriate agronomic management.

1.3.1. Avocado (*Persea americana* Mill.).

1.3.2. Banana (*Musa acuminata* cv.Rastali).

1.3.3. Durian (*Durio zibethinus* Murr.).

1.3.4. Nangka (*Artocarpus heterophyllus* Lam.).

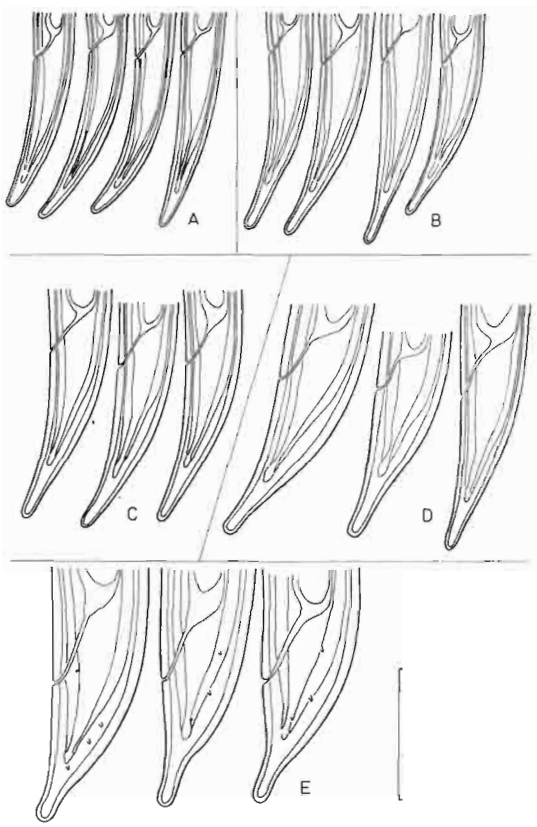

Fig. 1. Xiphinema radicicola, *tails of developmental stages. A: J1, B: J2; C: J3; D: J4; E: Female. (Scale bar = 50 µm).*

– 1.4. Field 7, mainly old rambutan trees of over 30 years, and 10 year old mango trees. There is no ground cover under the trees due to dense and close leaf canopy which cuts off the sunlight.

1.4.1. Rambutan (*Nephelium lappaceum* L.).

1.4.2. Mango (*Mangifera indica* L.).

– 1.5. Intercropping of cocoa (cv. Sabah mix) and coconut (mainly var.Mawar), planted in 1975 on a former rubber-tree area.

– 1.6 Rubber.

1.6.1. Young rubber nursery, close planting system.

1.6.2. Old rubber area, not maintained and covered with shrubs in the inner rows of the rubber trees; the area is now being cleared.

– 1.7. Royal palm (*Roystonea oleracea* (Jacq.) O.F.Cook), avenue planting near university's administrative building. Samples were taken from the root zone of palms showing general yellowing of the foliage.

– 1.8. Champaka (*Michaelia champaka* L.), avenue planting along the road to the farm office.

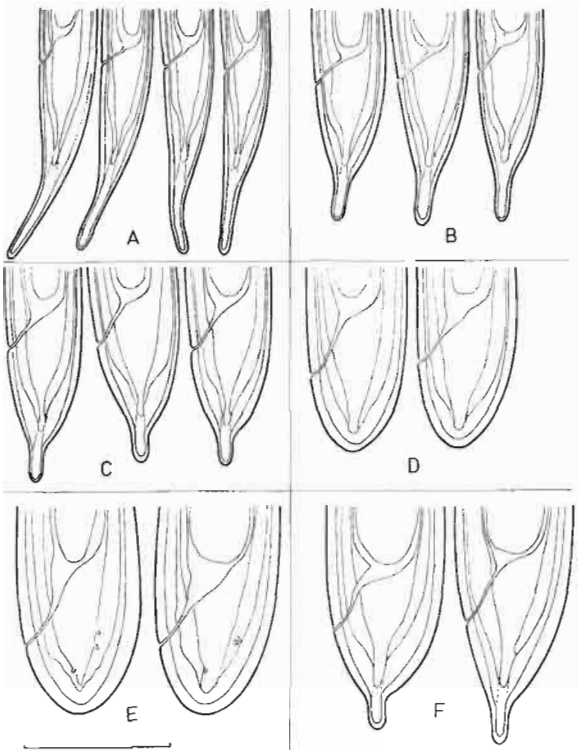

Fig. 2. Xiphinema ensiculiferum, *tails of developmental stages. A: J1; B: J2; C: J3; D: J4; E: Female. F: Tails of the two aberrant females in the Puchong population. (Scale bar = 50 µm).*

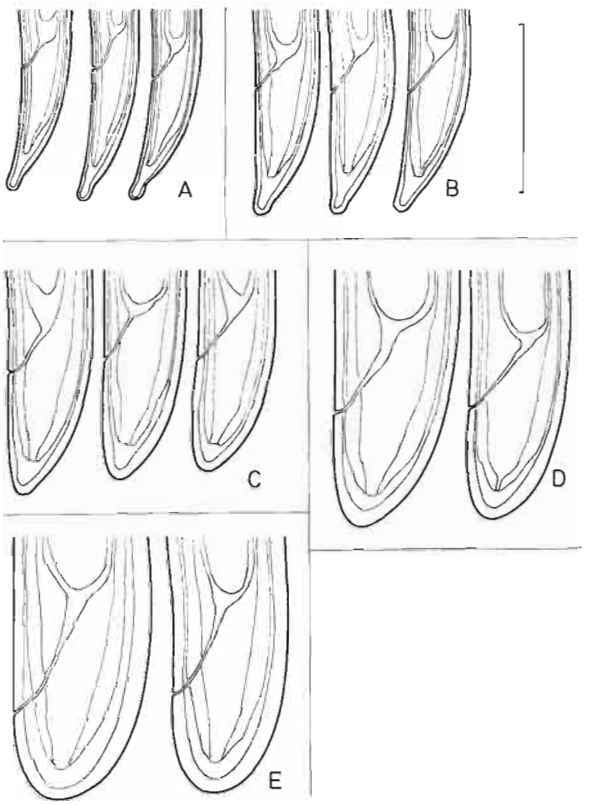

Fig. 3. Xiphinema krugi, *tails of developmental stages. A: J1; B: J2; C: J3; D: J4; E: Female. (Scale bar = 50 µm).*

2. FES (FEDERAL EXPERIMENTAL NURSERY UNIT, DEPARTMENT OF AGRICULTURE, SERDANG)

- 2.1. Dokong (*Lansium domesticum* Hutch.).
- 2.2. Durian (*Durio zibethinus* Murr.).
- 2.3. Belimbing (*Averrhoa carambola* L.).
- 2.4. Brazil nut (*Bertholletia excelsa* Humb. & Bompl.).
- 2.5. Mango (*Mangifera indica* L.).

3. MARDI (MALAYSIAN AGRICULTURAL RESEARCH AND DEVELOPMENT INSTITUTE), RESEARCH STATION, TANAH RATA, CAMERON HIGHLANDS, PAHANG STATE

Twenty year-old peach trees (var. Okinawa) on terrace about 1500 m above sea level; temperature in the highlands ranging from 10 to 23°C.

4. LOWLAND DIPTEROCARP FOREST (LOGGED AREA) RESERVE, PUCHONG.

Soil of a forest consisting of different monocotyledon (mainly palms) and dicotyledon plants.

X. insigne Loos, 1949
(Fig. 8F)

MEASUREMENTS

Females: See Table 1.

Male (n=1): L = 2.17 mm; a = 57; b = 5.6; c = 52; c' = 1.6; LRW = 10 µm; GR = 94 µm; odontostyle = 103 µm; odontophore = 62 µm; stylet = 165 µm; spicules = about 66 µm; ABW = 26 µm; tail = 42 µm; number of ventromedian supplements = 4.

NOTES

Found in samples 1.1 and 1.3.2, both banana.

Bajaj and Jairajpuri (1977) distinguished within this species two forms: the *indicum*-form with long odontostyle (94-110 µm), long odontophore (57-64 µm), GR = 92-110 µm, short tail (66-90 µm, c' = 3.0-4.3), and h' = 13-20, and the *insigne* form, with odontostyle 80-95 µm, odontophore 55-59 µm, GR = 80-93 µm, tail = 86-156 µm, c' = 4.4-8.0, and h' = 5-10. Our specimens resemble the *insigne* from in GR, tail

Table 2. *Dimensions of* Xiphinema radicicola, *population from coconut (1.2) and population from rambutan (1.4.1) (All measurements in µm except L in mm).*

	Coconut					Rambutan
	J1	J2	J3	J4	Females	Females
n	17	11	14	19	25	25
L	0.76 (0.69-0.82)	0.97 (0.85-1.11)	1.26 (1.06-1.46)	1.67 (1.41-2.12)	2.28 (1.97-2.69)	2.03 ± 0.157 (1.75-2.32)
a	39 (35-51)	42 (37-46)	44 (41-48)	50 (44-57)	55 (48-66)	52.3 ± 4.08 (45-61)
b	3.4 (2.6-3.8)	3.7 (3.5-4.2)	4.4 (3.5-5.2)	4.8 (4.0-5.8)	6.2 (5.0-7.1)	5.65 ± 0.48 (4.3-6.7)
c	11.6 (10.7-13.2)	14.2 (13.1-16.3)	19.4 (15.2-22.8)	28.3 (21.4-34.4)	45.9 (36.3-56.9)	36.2 ± 6.90 (27.4-49.1)
c'	5.3 (4.6-6.7)	4.3 (4.0-4.6)	3.4 (2.9-4.3)	2.7 (2.2-3.6)	1.9 (1.6-2.3)	2.59 ± 0.44 (1.9-3.5)
ABW	12.5 (11-14)	15.5 (14-18)	19 (16-23)	23 (19-25)	26 (22-30)	23.5 ± 1.50 (20-26)
Tail	66 (61-74)	68 (59-77)	65 (57-74)	60 (53-68)	50 (44-59)	57.9 ± 7.54 (46-74)
h	13 (10-15)	18 (14-23)	21 (18-26)	24 (20-26)	25 (21-29)	32.2 ± 8.15 (22-50)
h'	19 (16-22)	27 (23-30)	33 (27-39)	39 (27-46)	50 (42-58)	53.7 ± 8.74 (39-76)
Core	53 (46-61)	50 (45-54)	45 (35-51)	36 (29-48)	25 (19-29)	27.1 ± 5.02 (15-37)
V	-	-	-	-	26 (23-28)	26.4 ± 1.55 (23-29)
LRW	7	8.0-8.5	8-9	9-10	11-12	10-12
GR	40 (35-44)	54 (52-59)	68 (58-74)	84 (76-98)	100 (95-109)	100.3 ± 6.50 (89-118)
Od. style	49 (44-53)	62 (59-69)	77 (69-82)	94 (85-108)	111 (103-123)	112.5 ± 7.28 (98-122)
Od. phore	35 (33-37)	42 (40-43)	49 (43-52)	56 (52-62)	64 (60-66)	62.2 ± 2.28 (57-66)
Stylet	86 (77-90)	104 (101-109)	126 (112-135)	150 (139-167)	175 (167-188)	174.8 ± 8.48 (160-187)
Sp.odst.	62 (54-70)	76.5 (72-83)	90 (82-96)	110 (102-121)	-	
MBW	20 (18-22)	23 (20-26)	25 (24-31)	30 (29-40)	42 (39-45)	38.8 ± 1.64 (34-41)
Neck	223 (194-271)	261 (232-296)	292 (261-322)	344 (303-419)	365 (331-398)	359.3 ± 30.69 (311-448)

length, c' and h', and the *indicum*-form in length of odontostyle and odontophore. In these respects they resemble the Trinidad population described by Hunt and Singh (1984); also several of the populations examined by Luc and Southey (1980) show similar character mixtures. The male agrees well with those described by Phukan and Sanwal (1982), but it differs from that described by Hunt and Singh (1984): the latter has a much longer tail (78 *vs* 42 µm, c' = 3.0 *vs* 1.6, c = 29 *vs* 52).

In sample 1.7 we found a population consisting of 26 short-tailed females and nine long-tailed ones. The h' values are in both typical for the *insigne*-form. This population tends to bridge the gap between the *insigne*- and the *indicum*-form.

X. radicicola Goodey, 1936 = *X. monohysterum apud* Ahmad & Baqri (1987)

(Fig. 1)

MEASUREMENTS

Females: See Table 2.

Males: See Table 3.

Table 3. *Dimensions of males of* Xiphinema radicicola *(All measurements in µm except L in mm).*

	Loos (1949)	McLeod & Khair (1971)	Malaysia (orig.)
n	1	4	3
L	2.05	2.53-2.96	2.11-2.65
a	46	62-72	52-65
b	5.9	6.8-8.0	6.3-6.5
c	48	42-51	38-47
c'	1.7	1.7-2.0	1.7-2.0
ABW	24	32-33	31-34
Tail	42	55-63	55-62
* h	20	26-27	22-24
* h'	47	42-47	39-51
Core	22	30-36	33-38
LRW	13	11	11-12
GR	"79"	108-125	100-111
Od. style	-	121-129	109-119
Od. phore	-	69-73	62-67
Stylet	170	191-201	171-185
Spicules	54	49-53	64
MBW	45	38-48	36-41
Neck	347	335-402	334-407
VD	-	-	39-50
G-1	-	-	6-9
G-2	-	-	7-10

* h = length of the hyaline part of the tail in µm; h' = length of the hyaline part of the tail in % of tail length.

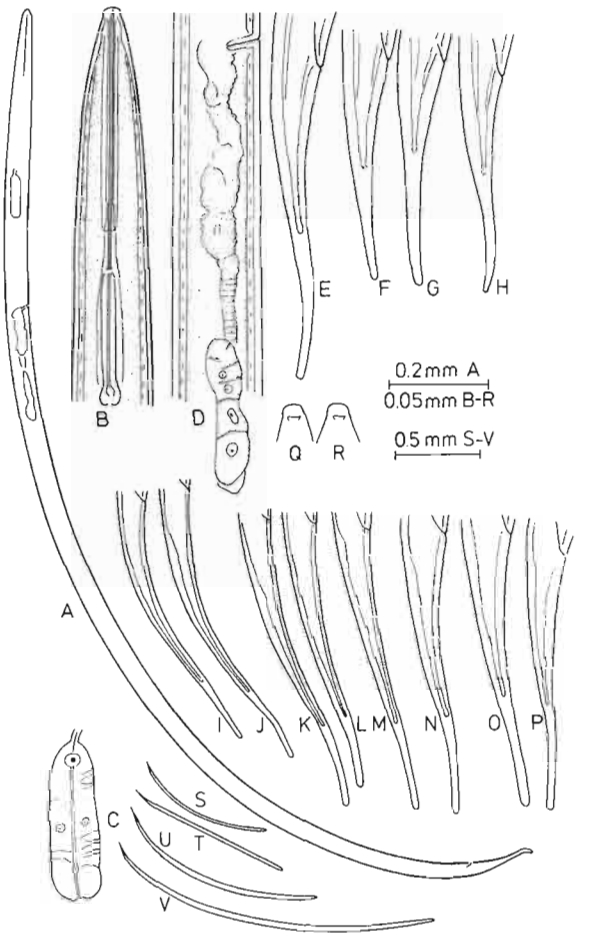

Fig. 4. Xiphinema winotoi *n. sp. A-H: Female. A: Whole specimen; B: Neck region; C: Pharyngeal bulb; D: Genital apparatus; E-H: Tails. I-P: Tails of juveniles: I,J: J1; K,L: J2; M,N: J3; O,P: J4; Q-R: Lip region of female (same specimen from two sides); S-V: Body attitude of J1, J2, J3 and J4.*

NOTES

This species appears very widespread in Malaysia. It was found in 14 out of the 20 samples, in all four main sites. Furthermore we found it in P. Pinang on *Araucaria* sp. See also above under Earlier records.

These populations have much longer odontostyles than that reported by Rahman *et al.* (1986); the differences in GR, length of odontostyle and total stylet are present in all developmental stages.

This species is very variable in its measurements. The rambutan population (1.4.1) – in which L is smaller than in the other populations – shows particular variance in tail length (Table 2), but the hyaline terminal part is always straight. One specimen has a very long pharynx, its base lying 2 µm posterior to the vulva.

Three males were found: one from durian (1.3.3.), one from banana (1.3.2.), one from coconut (1.2.), all on the UPM campus. So far only five males have been recorded: one from Sri Lanka (Loos, 1949) and four from Australia (McLeod & Khair, 1971, as *X. australiae*). In all three males found by us the anteriormost supplement is rudimentary; this was also mentioned by McLeod and Khair (1971).

Ahmad and Baqri (1987) reported *X. monohysterum* Brown, 1968 from *Artocarpus heterophyllus* Lamk. from Penang. However, their description and illustrations are at variance with the original description in several respects: lip region slightly offset *vs* strongly offset; h* = 21-40 *vs* 10-15 µm; h' = 35-49 *vs* 9-14. In all these respects, as well as in tail shape (the tail of *X. monohysterum* is more of the *elongatum*-type) their specimens correspond to *X. radicicola*, and we consider them to belong to that species.

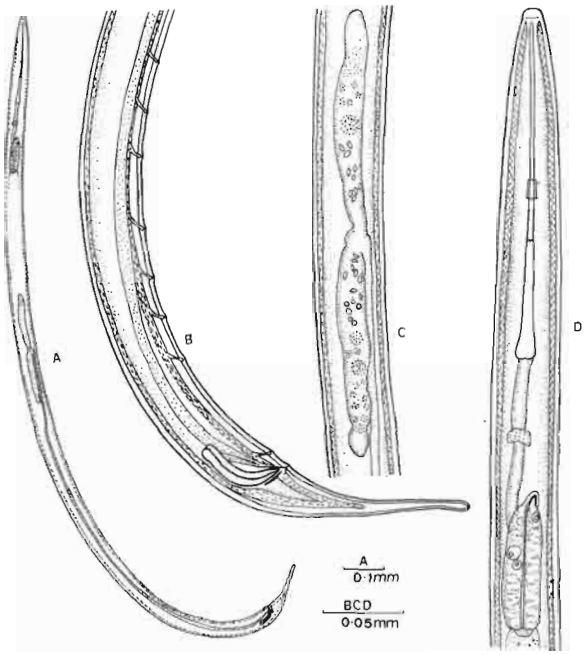

Fig. 5. Xiphinema winotoi *n. sp., males. A: Whole specimen; B: Posterior part of body; C: Testes; D: Neck region.*

X. ensiculiferum (Cobb, 1893) Thorne, 1937
(Fig. 2)

MEASUREMENTS

Females and *juveniles*: see Table 4.

NOTES

Found in samples 4 (numerous), 1.1 and 1.4.1.

The tail shape and length of the juvenile stages correspond well to the data given by Yeates (1973) as *X. ensiculiferoides*. The J3 tail shows the same shape as that of adult females of *X. brasiliense* Lordello, 1951. In the Puchong population (sample 4) two females were found showing this same tail shape. Logically, therefore, these females would have to be considered as belonging to *X. brasiliense* Lordello, 1951. However, examination of the numerous juvenile specimens gave no indications that more than one species was present. We wonder, therefore, whether these females could not be aberrant specimens of *X. ensiculiferum*, in which the tail peg has persisted into the adult stage. The specimens lie almost straight and are plump.

X. krugi Lordello, 1955
(Fig. 3)

MEASUREMENTS

Females and *juveniles*: see Table 5.

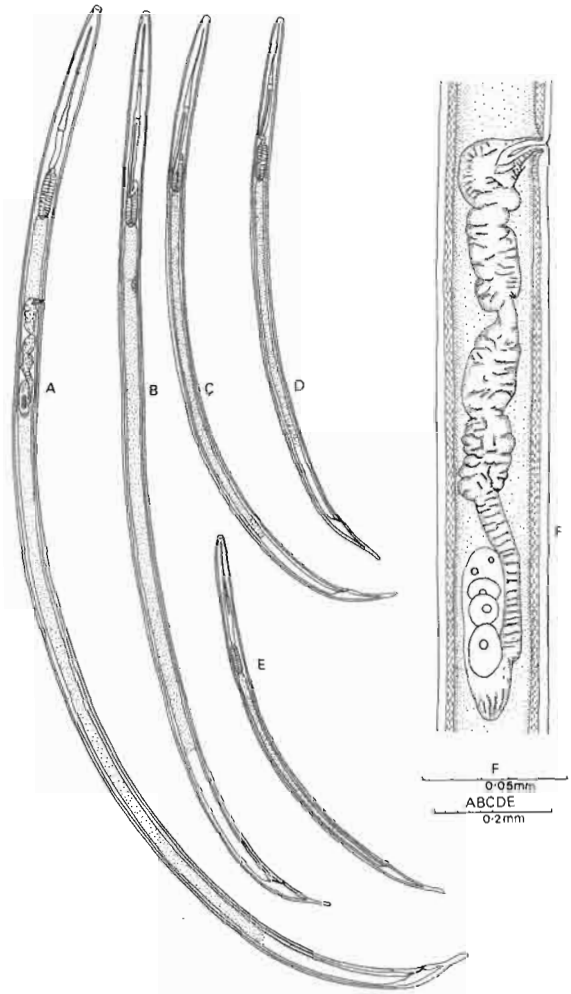

Fig. 6. Xiphinema winotoi *n. sp., short-tailed population. A: Whole female; B: J4; C: J3; D: J2; E: J1; F: Female, genital apparatus.*

NOTES

Two populations were found: 1.3.2. and 3. Since the dimensions are identical, we give here only those for the Tanah Rata population (3). The female tail shows at most a slight bulge, never a distinct peg as reported for a population from Surinam by Loof and Maas (1972), as *X. denoudeni*. The dimensions agree to those given by Loof and Sharma (1979), but in all stages the tail is shorter than reported by Luc and Hunt (1978) for a population from Paraguay; body length is also smaller except in the J4, and in the J1 also the odontostyle is shorter. In the J1 and J2 the tail shows a slightly offset, somewhat irregular terminal

Table 4. *Dimensions of* Xiphinema ensiculiferum *(All measurements in µm except L in mm).*

	J1	J2	J3	J4	Females	
					(round. tail.)	(peg. tail.)
n	9	4	2	11	19	2
L	0.61-0.68	0.78-0.87	1.05-1.14	1.26-1.65	1.56-1.91	1.39,1.59
a	28-34	29-33	30-33	31-42	30-40	26,33
b	2.7-3.2	2.6-3.5	2.9-3.1	2.9-4.1	3.1-6.4	4.6,5.2
c	9.3-10.9	16.1-18.2	24.5-27.3	44-58	57-82	34,47
c'	3.7-4.4	2.2-2.5	1.5-1.8	0.9-1.0	0.7-0.8	1.3,1.1
ABW	15-17	20-23	24-28	26-32	31-36	31,32
Tail	57-67	43-51	42-43	25-30	21-30	41,34
h	25-34	15-20	16-19	6-8	-	-
h'	39-52	35-39	38-44	21-29	-	-
V	-	-	-	-	30-34	35,31
LRW	7-8	9	10-11	12-13	13-14	13,14
GR	40-43	57-64	88-93	106-124	132-142	104,114
Od. style	51-53	66-73	99-109	118-134	138-154	118,147
Od. phore	33-38	46-51	59-62	66-75	69-84	73,71
Stylet	85-91	114-124	158-171	185-204	212-235	191,218
Sp. odst.	70-76	97-103	125-130	141-152	-	-
MBW	19-23	26-29	32-39	33-44	44-52	53,48
Neck	194-227	237-275	359-374	355-441	351-409	302,306

part; the J3 and J4 have plumper tails resembling those of adult females. In the juveniles the anus is very distinct. h is 8-12 µm in all stages.

X. elongatum Schuurmans Stekhoven & Teunissen, 1938

MEASUREMENTS

Females: see Table 5.

NOTES

Six females of this species, easily recognizable by the broad, flat, distinctly offset lip region (see Loof & Maas,1972) were found in samples 1.2., 1.4.1. and 1.8.

*X. winotoi** n.sp.
(Figs. 4-7)

MEASUREMENTS

Females, males and *juveniles:* see Tables 6 and 7.

DESCRIPTION

Female: body straight in anterior half, curved ventrad in posterior. Cuticle 2.0-2.5 µm wide in mid-body, increasing to 3.5 µm in anterior part of neck and to 7 µm on dorsal side of tail base; with thin, sharply demarcated outer layer. Lateral chord one-fourth to one-fifth of body diameter. Two dorsal cervical pores, seven to ten ventral and seven to nine lateral ones. Lip region rounded, offset by depression. Amphid aperture about half corresponding body diameter, located behind the depression. Behind the base of the odontophore the presence of numerous ganglial cells obscures the nerve ring. Pharyngeal bulb 77-81 × 21-23 µm; dorsal nucleus at 11-14%, dorsal orifice at 6-12%, ventrosublateral nuclei at 48-54%, ventrosublateral orifices at 46-52%. Cardia blunt, conoid, about 13 µm long and 11 µm wide. Vulva a transverse slit. Vagina bent posteriad. Anterior genital branch absent; posterior branch fully developed. Ovejector about 23 µm long. Uterus without special differentiations, without sperm. Ovary less than half the branch long. None of the females bearing eggs. Tail tapering gradually to narrow cylindrical terminal part, rounded at the tip which often is bent slightly dorsad; h = 62-

* Dedicated to the late Dr R.Winoto Suadmatji, in recognition of his valuable work on the plant parasitic nematode fauna of Malaysia.

Table 5. *Dimensions of juveniles and females of* Xiphinema krugi. *Dimensions of females of* X. elongatum *(All measurements in µm except L in mm).*

	X. krugi					*X. elongatum*
	J1	J2	J3	J4	Females	Females
n	21	8	3	2	8	6
L	0.60-0.69	0.79-0.88	1.06-1.12	1.48-1.68	1.84-2.09	2.04-2.55
a	30-38	34-37	36-41	41-44	40-47	55-61
b	2.5-3.3	2.9-3.1	3.2-3.4	3.5-4.0	4.5-5.2	5.9-6.5
c	15-18	21-25	29-35	45-53	62-76	34-46
c'	2.8-3.5	1.9-2.3	1.6-1.7	1.0-1.3	0.8-1.1	2.0-2.9
ABW	12-14	15-18	20-22	28-31	28-34	20-27
Tail	36-44	33-37	32-36	32-33	27-31	51-62
h	9-12	10-12	8-10	8	10-11	16-22
h'	22-31	29-33	25-31	28-30	33-39	28-39
Core	26-33	22-26	24-26	23	17-20	31-44
V	-	-	-	-	33-34	38-43
LRW	7-8	8-9	10	10-11	11-12	11-12
GR	35-41	52-56	68-74	85-95	107-122	79-96
Od. style	41-46	56-63	76-81	98-101	113-125	84-110
Od. phore	34-40	44-47	54-55	65-68	72-78	54-67
Stylet	75-85	102-108	130-136	163-169	185-203	138-177
Sp. odst.	57-63	74-80	94-100	122-123	-	-
MBW	18-20	22-24	28-30	36-39	41-48	35-37
Neck	206-235	253-286	326-353	421-426	389-422	334-389

74 µm; h' = 50-60, but in one female h exceptionally low (39 µm) with h' = 28. One subdorsal pair of pores anterior to the anus, one at about 12% and a sublateral pair at about 25% of the tail.

Males: Posterior part of body curved strongly ventrad. Testes filled with normal-looking sperm. Spicules 54-57 µm long. Lateral guiding pieces indistinct. Five to eight ventromedian supplements; about 45 copulatory muscles. Caudal pores: one lateral pair at level of anus; one lateral pair at about 60% of core length; between these three pairs of subdorsal pores.

Juveniles: Tail shape as in adult females. Absolute and relative length of the terminal hyaline part increasing slowly from J1 to J3, more strongly from J3 to adult female.

TYPE SPECIMENS

Holotype on slide MNT 1 in the collection of the UPM, Serdang, Malaysia. Paratypes: two males, five females and seven juveniles on slides MNT 2-9 in the same collection; one male, eight females and 21 juveniles on slides WT 3212-3228 in the collection of the Nematology Department, Agricultural University, Wageningen, The Netherlands; one female deposited at each of the following addresses: U.S.D.A., Beltsville, MD, USA.; University of California, Davis, CA, USA.; Instituut voor Dierkunde, Rijksuniversiteit, Gent, Belgium; Biologische Bundesanstalt für Land- und Forstwirtschaft, Münster, Germany; C.I.P., St. Albans, Herts., U.K.; Muséum National d'Histoire Naturelle, Paris, France; Istituto di Nematologia agraria, Bari, Italy; Randse Afrikaanse Universiteit, Johannesburg, South Africa.

TYPE LOCALITY AND HABITAT

UPM campus, Serdang, old rubber area, not maintained and covered with shrubs in the inner rows (1.6.2.); one female and three juveniles in young rubber nursery, UPM campus (in the latter mixed with *X. radicicola*); One female was found in a dipterocarp forest, Puchong (4).

DIAGNOSIS AND RELATIONSHIP

X. winotoi n.sp. is characterized by the monoopisthodelphic female genital system; V = 23-26; L = 2.0-2.8 mm; odontostyle = 125-148 µm, and elongate tail (107-160 µm, c = 15-27, c' = 4.6-6.6) with rounded terminus which often is slightly bent dorsad, and with long terminal hyaline part (h = 62-74 µm, h' = 41-62).

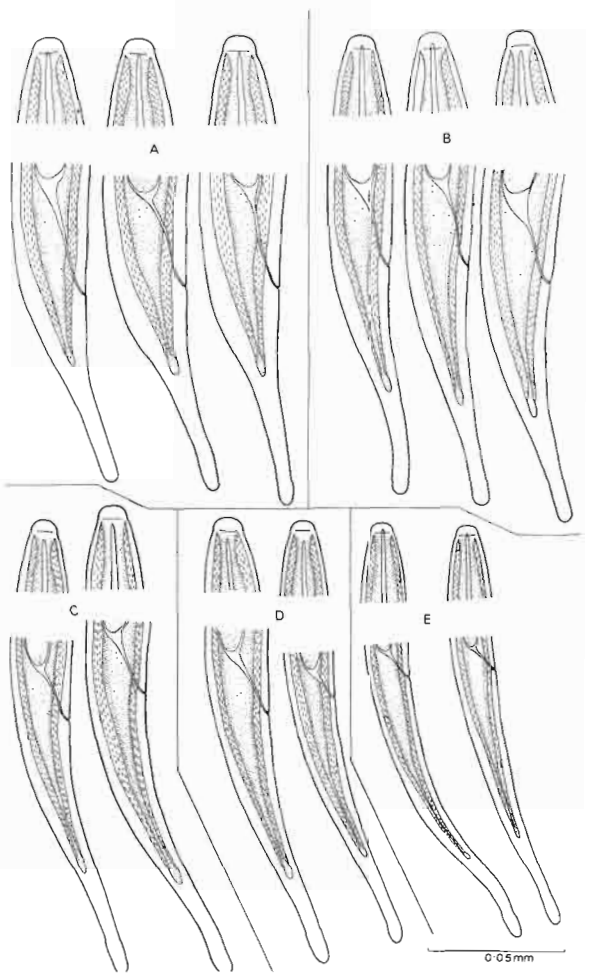

Fig. *7.* Xiphinema winotoi *n. sp., short-tailed population, head ends and tails. A: Female; B: J4; C: J3; D: J2; E: J1. (Scale bar = 50 mm).*

The code after Loof and Luc (1990) is: A 1 - B 4 - C 2 - D 2-3 - E 1 - F 2-3 - G (2)3 - H 2 - I 2-3 - J 2 - K 1 - L 2.

In lacking the anterior female genital branch *X. winotoi* n.sp. belongs in Group 1 of Loof and Luc (1990). This group contains seven nominal species of which three are long-tailed:

– *X. chambersi* Thorne,1939: in this species the lip region is flattened, distinctly offset; the tail is in all stages regularly bent ventrad and h is much shorter; finally *X. chambersi* has only three juvenile stages (Shishida,1983); by examination of another population from Japan we could confirm this.

– *X. orthotenum* Cohn & Sher,1972: in this species the body is straight from head end to anus; the lip region is continuous and the female tail is relatively and absolutely longer: 160-170 µm; c = 10-13, c' = 7.0-10.5.

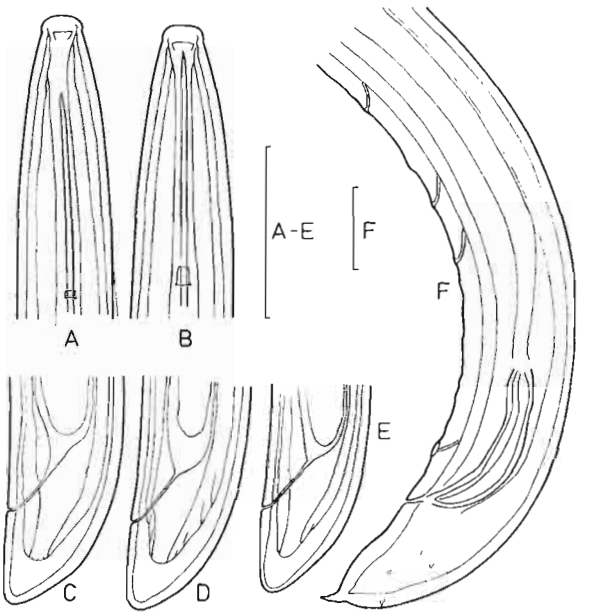

Fig. *8. A-E* Xiphinema brevicolle, *female. A-B: Anterior region; C-E: Tail.*—X. insigne. *F: Posterior part of male. (Scale bar = 50 µm).*

– *X. monohysterum* Brown 1968: the code is practically identical with that of *X. winotoi* n.sp. The lip region is strongly offset (it might be advisable to give *X. monohysterum* code H 3 instead of H 2); the female tail is shorter and much plumper, resembling that of *X. elongatum*: tail length = 70-96 µm; c = 25-34; c' = 2.6-3.5; h = 10-15 µm; V = 28-32; odontostyle = 94-105 µm.

In sample 1.4.1. a *Xiphinema* population was found agreeing with *X. winotoi* n.sp. in nearly every respect, especially tail shape, but differring by shorter tails in all stages (dimensions see Table 7). Provisionally we consider this population to represent a short-tailed variant of *X. winotoi* n.sp., though vulva position is identical. It is noteworthy that on another rambutan tree, no more than 10 m distant, only *X. brevicolle* was found.

X. brevicolle Lordello & Da Costa, 1961
(Fig. 8)

MEASUREMENTS

See Table 8.

Table 6. *Dimensions of* Xiphinema winotoi *n.sp., type population (All measurements in µm except L in mm).*

	J1	J2	J3	J4	Females	Holotype (Female)	Males
n	3	6	7	11	20		3
L	90 (0.88-0.94)	1.09 (0.99-1.16)	1.43 (1.33-1.48)	1.88 (1.62-2.20)	2.27 ± 0.164 (2.04-2.77)	2.34	1.96-2.19
a	42 (41-43)	44 (41-47)	45 (43-48)	51 (45-56)	52.4 ± 3.28 (45-58)	52	47-56
b	3.5 (3.4-3.8)	4.0 (3.6-4.5)	4.4 (3.8-4.9)	4.8 (4.4-6.0)	5.95 ± 0.38 (5.4-6.7)	6.0	5.2-5.9
c	6.6 (6.4-6.9)	8.3 (7.4-9.5)	10.7 (9.8-11.8)	14.0 (12.3-16.3)	18.6 ± 1.72 (15.3-21.7)	19	16-20
c'	10.0 (9.7-10.2)	8.7 (7.7-9.7)	7.4 (6.7-8.0)	6.1 (5.9-6.4)	5.2 ± 0.55 (4.6-6.6)	5.2	3.6-3.8
ABW	13.7 (13-14)	15.0 (14-16)	18.6 (18-19)	21.8 (20-23)	23.5 ± 1.46 (20-26)	23	30-32
Tail	136 (127-146)	132 (119-145)	134 (125-150)	134 (121-141)	123.0 ± 15.12 (107-160)	122	108-122
h	36 (33-39)	37 (25-46)	45 (41-47)	51 (45-58)	67.1 ± 3.8 (62-74)*	69	60-65
h'	27 (25-31)	29 (20-39)	33 (30-37)	38 (33-43)	55.7 ± 5.3 (41-62)*	57	53-56
Core	99 (88-109)	95 (73-105)	90 (79-104)	83 (69-93)	54.5 ± 14.0 (43-87)*	53	47-57
V	-	-	-	-	24.6 ± 0.89 (23-26)	25	-
G	-	-	-	-	8.8 ± 2.0 (6-15)	7	-
LRW	6.8 (6.5-7.0)	8.0 (7.0-8.0)	8.9 (8.5-9.0)	9.3 (9.0-10.0)	11 (10-12)	12	11-12
GR	49 (48-52)	68 (63-70)	83 (74-88)	92 (88-111)	123.7 ± 5.6 (110-132)	125	116-120
Od. style	57 (57-58)	78 (75-80)	97 (92-102)	117 (99-122)	139.3 ± 5.7 (125-148)	140	133-135
Od. phore	42 (41-42)	46 (43-48)	57 (54-59)	63 (56-68)	70.6 ± 3.1 (65-77)	74	68-72
Stylet	99 (98-100)	124 (121-128)	153 (146-159)	179 (155-18)	209.7 ± 7.4 (193-225)	214	201-207
Sp. odst.	79 (78-80)	95 (90-100)	116 (111-120)	135 (127-142)			
MBW	22 (21-23)	25 (23-26)	32 (30-34)	37 (31-42)	43.3 ± 3.2 (39-52)	45	40-42
Neck	252 (245-256)	277 (253-288)	328 (288-380)	388 (347-394)	381.9 ± 20.2 (344-420)	390	368-379

NOTES

Two small populations of this species were found: ten females and some juveniles in sample 1.4.1, and four females and some juveniles in sample 4.

According to Lamberti *et al.* (1992) these populations would rather have to be considered belonging to *X. diffusum* Lamberti & Bleve-Zacheo, 1979. The values of L, GR and c, and especially odontostyle length, overlap. It is not clear on which data the value 62 µm for GR of *X. diffusum* was based: the mean values given for three populations in their Table VI vary from 72.4 to 74 µm (70 µm in the original description), actual range being 60-95 µm. Moreover, h was said to range from 5 to 14 µm in the original description of *X. diffusum*. In our specimens, the offset of the lip region is clearly marked, more so than in Fig. 5 of Lamberti *et al.* (1992). We prefer, pending more detailed studies on the status of these two species, to regard our populations as representing *X. brevicolle*.

***Table** 7. Dimensions of the "short-tailed* Xiphinema winotoi*" (All measurements in µm except L in mm).*

	J1	J2	J3	J4	Females
n	20	22	21	21	37
L	0.75 (0.71-0.79)	0.94 (0.87-1.03)	1.22 (1.10-1.37)	1.60 (1.43-1.92)	2.01 (1.81-2.32)
a	37.5 (35-41)	40.0 (36-44)	41.9 (39-48)	46.6 (42-52)	50.0 (45-54)
b	3.4 (3.2-3.7)	3.7 (3.0-4.4)	4.1 (3.4-4.5)	4.6 (4.1-5.5)	5.8 (5.1-6.6)
c	7.4 (7.1-8.0)	9.7 (8.8-10.7)	12.7 (11.1-15.0)	18.0 (16.0-21.5)	26.8 (23.6-29.8)
c'	7.4 (7.1-8.5)	6.1 (5.1-6.9)	5.0 (4.4-5.8)	4.0 (3.5-4.7)	3.2 (2.7-3.8)
ABW	13.8 (13-15)	16.0 (15-18)	19.4 (18-22)	22.1 (21-27)	23.2 (21-27)
Tail	102.3 (93-108)	96.0 (86-105)	96.2 (85-105)	88.2 (76-100)	75.4 (64-86)
h	33 (32-43)	29 (17-34)	35 (29-40)	39 (31-47)	46 (39-52)
h'	33 (30-46)	30 (20-35)	36 (28-41)	41 (31-47)	61 (55-69)
core	68 (50-75)	66 (57-77)	62 (52-72)	52 (44-69)	28 (21-37)
V	-	-	-	-	24.5 (23-27)
LRW	8.0 (8-9)	8.3 (8-9)	9.3 (8-10)	10.1 (10-12)	10.8 (11-12)
GR	47.5 (46-51)	61.8 (59-65)	73.2 (60-84)	94.9 (88-98)	113.1 (106-128)
Od. style	55.1 (53-57)	68.4 (67-70)	85.5 (81-92)	103.7 (98-108)	121.2 (110-118)
Od. phore	36.1 (34-40)	44.3 (41-48)	52.1 (49-55)	59.4 (56-63)	65.1 (61-69)
Stylet	91.1 (88-95)	112.7 (111-116)	136.0 (132-145)	163.1 (157-169)	186.2 (172-196)
Sp. odst.	68.5 (66-73)	84.8 (80-87)	102.0 (99-109)	121.4 (117-128)	-
MBW	20.2 (19-22)	22.8 (21-27)	29.1 (27-33)	33.2 (31-41)	39.3 (35-47)
Neck	220.8 (207-232)	249.0 (227-298)	302.7 (257-350)	336.1 (286-404)	337.5 (318-377)

X. franci Heyns & Coomans, 1994
(Fig. 9)

MEASUREMENTS

Females and *juveniles*: see Table 8.

Male (n=1): L = 1.29 mm; a = 45; b = 4.4; c = 44; c' = 1.4; tail = 30 µm; ABW = 22 µm; LRW = 9 µm; GR = 78 µm; odontostyle = 91 µm; odontophore = 45 µm; stylet = 136 µm; spicules = 43 µm; supplement number = 7; VD = $^{8}40^{8}$.

DESCRIPTION

Females: Body small, stout, curved strongly ventrad. Lip region offset by slight depression. Tail conoid, often slightly subdigitate.

Male: Testes filled with sperm. The male was hitherto unknown.

Juveniles: The J1 tail is slender and often the tip is more broadly rounded than in later stages; with each moult the tail becomes less slender.

NOTES

Another species of the *X. americanum*-group was found near banana roots in samples 1.1., 1.2. and 1.3.2. After comparison with all nominal species descriptions we identified it as *X. franci*, known so far only from Madagascar. The original description of *X. franci* was based on females and the two last juvenile stages, considered J3 and J4 by Heyns and Coomans (1994). Our material shows that in this spe-

Table 8. *Dimensions of females of* Xiphinema brevicolle, *and of juveniles and females of* X. franci *(All measurements in µm except L in mm).*

	X. brevicolle	*X. franci*			
	Females	J1	J2	J3	Females
n	14	20	21	18	20
L	1.73 (1.51-2.03)	0.60 (0.55-0.68)	0.76 (0.69-0.84)	1.01 (0.80-1.10)	1.35 (1.16-1.58)
a	47.9 (44-52)	32.7 (30-35)	34.2 (31-37)	37.0 (33-39)	40.6 (36-44)
b	5.6 (4.3-6.9)	3.2 (2.7-3.8)	3.5 (2.9-4.2)	4.1 (3.0-4.6)	4.8 (4.1-6.2)
c	70.5 (56-84)	18.5 (17-23)	24.1 (22-27)	31.0 (24-34)	45.7 (39-54)
c'	0.99 (0.8-1.1)	2.6 (2.4-2.9)	2.1 (1.9-2.3)	1.8 (1.6-1.9)	1.4 (1.3-1.7)
ABW	24.9 (21-29)	12.1 (11-13)	15.0 (14-16)	18.7 (16-23)	20.8 (19-23)
Tail	24.7 (19-29)	31.3 (29-35)	31.6 (30-33)	32.7 (29-35)	29.8 (25-35)
V	52.6 (50-55)	-	-	-	55.0 (53-57)
LRW	11.0 (11-12)	7.4 (6.9-8.0)	8.0 (7.5-8.0)	8.7 (8.0-9.8)	9.0 (8.8-9.8)
GR	79.2 (75-84)	39.6 (38-46)	48.7 (46-51)	60.6 (55-63)	73.7 (70-82)
Od. style	97.9 (94-102)	47.1 (46-48)	56.5 (55-59)	72.0 (69-76)	92.0 (88-97)
Od. phore	51.6 (48-55)	32.0 (30-33)	35.2 (33-37)	40.2 (38-43)	45.7 (41-48)
Stylet	149.5 (142-157)	79.1 (77-80)	91.7 (90-93)	112.1 (108-118)	137.9 (130-145)
Sp. odst.		56.0 (53-57)	70.4 (69-74)	89.9 (87-92)	- -
MBW	36.2 (33-45)	18.4 (17-21)	22.2 (21-24)	27.4 (24-30)	33.3 (29-37)
Neck	314.3 (285-403)	188.0 (178-204)	219.0 (200-233)	250.0 (239-266)	281.0 (255-338)

cies there are only three juvenile stages. The dimensions of our J2 are identical to those of the J3 of Heyns and Coomans, 1994, of our J3 to those of their J4.

X. cf. orthotenum Cohn & Sher, 1972
(Fig. 10)

MEASUREMENTS

See Table 9.

NOTES

In sample 1.2 three females and one juvenile were found resembling *X. orthotenum*. To determine their status, paratypes of that species were loaned from Rothamsted, UK (two females, flattened, one with incomplete tail, anus not detectable in either) and Riverside, CA, USA (one female, flattened, and five juveniles – two J1, three J2 – in good condition). Contrary to the statement in the description, no paratypes are present in Israel (Orion, *in litt.* Feb. 27, 1996). The dimensions of the J1 and J2 are published here for the first time.

In general morphology the Malaysian specimens agree with *X. orthotenum*, except in:

– the tail of the adult female is much longer: 235-245 *vs* 169 µm (Riverside paratype); the description indicates a tail length of about 155-175 µm; another paratype female has a tail 185 µm long and h' = 51 (Coomans, *in litt.*).

– the distal part of the tail is not bent ventrad;

– the core is clavate which is not the case in *X. orthotenum* proper.

The Serdang juvenile might be a J2 (GR, odontostyle, stylet, neck) or a J3 (L, b, ABW, replacement odontostyle). If we consider its measurements, it is clear that the values of c and tail length disrupt the gradual transition shown by the other stages. Thus it is probable that the Malaysian specimens represent a different, undescribed species, but more material of this species, as well as better specimens of *X. orthotenum*, are needed for a decision.

X. orthotenum was reported from Malaysia by Winoto and Sauer (1982), but the slides could not be found any more: they are neither in Malaysia (as said in the publication), nor in Merbein, nor in Davis (where they had been deposited according to Sauer, *in litt.*).

X. cf. brasiliense Lordello, 1951
(Fig. 11)

MEASUREMENTS

See Table 10.

NOTES

In soil around roots of *Michaelia* (sample 1.8) a small population (three females, two J3 and seven J4) was found of a species resembling *X. brasiliense* but differing in some respects. The tail is more conoid than hemispherical and the peg is offset, though distinctly, less conspicuously. The body of J4 and females is curved only slightly (strongly in *X. brasiliense*), the c' value is 1.6-1.7 which is higher than usually found in *X. brasiliense* (0.9-1.4, rarely up to 1.6). The uterus

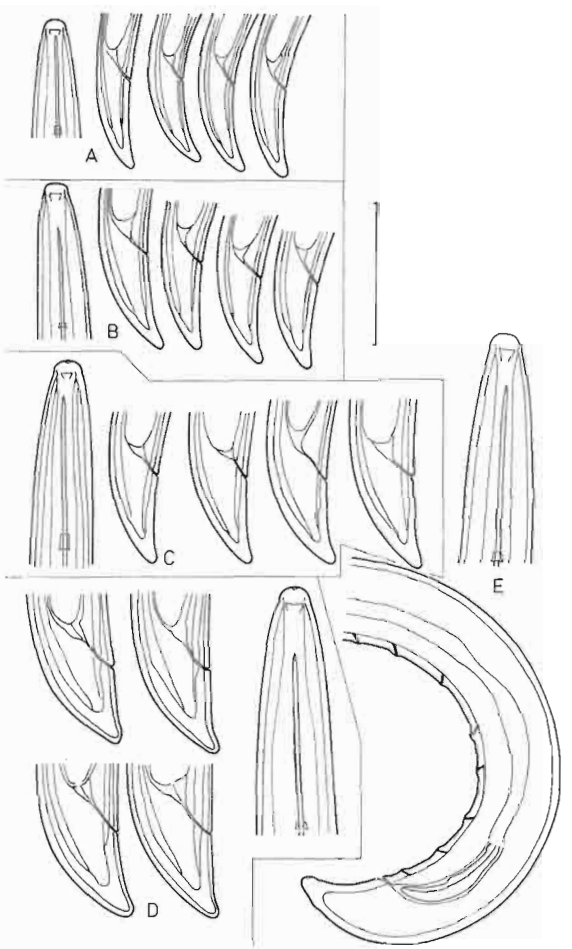

Fig. 9. Xiphinema franci. *A-D: J-1, anterior end and tails of developmental stages: A: J1; B: J2; C: J3; D: Female. E: Male, anterior end and posterior part of body. (Scale bar = 50 µm).*

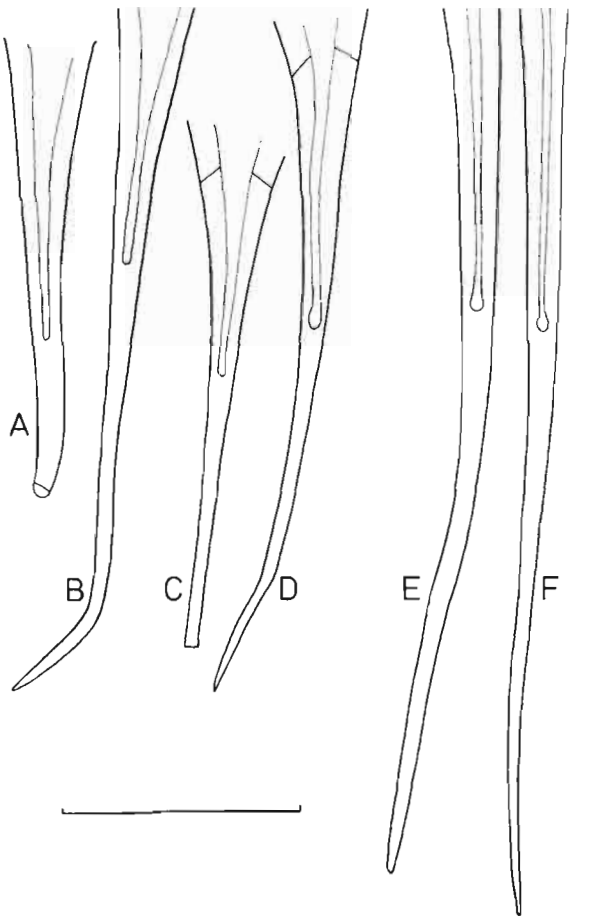

Fig. 10. *A-D:* Xiphinema orthotenum, *tails of paratype females: A,B: From Rothamsted, C,D: From Riverside. E,F:* X. cf. orthotenum *from Serdang (1.2.), distal part of female tail. (Scale bar = 50 µm).*

Table 9. *Dimensions of* Xiphinema orthotenum *paratypes (P) and of* X. cf.orthotenum *from Malaysia (M) (All measurements in µm except L in mm).*

	Females		J1	J2	?	J4
	P	M	P	P	M	P
n	3	3	2	3	1	1
L	2.04*	2.05-2.27	0.99-1.08	1.17-1.34	1.40	1.73
a	-	49-52	50.0	51-53	49	-
b	5.2-5.4*	5.3-6.0	3.8-3.9	3.6-4.1	4.7	4.6
c	12.1**	8.8-9.6	6.6-7.6	6.9-7.6	5.8	8.8
c'	8.2***	9-11	14.0	12-13	14	9.8
ABW	-	21-25	10-11	13-15	18	20
Tail	169**	235-245	143-157	162-196	240	196
h	87-98*	119-124*	37-41	35-47	58	59
h%	51**	51-56*	26-27	18-30	24	30
Core	82**	116-118*	106-110	115-161	182	137
V	25-26	25-26	-	-	-	-
LRW	9**	9-11	6.5	8.0	8	9
GR	113**	107-126	49-55	68-75*	76	87
Odst.	125-130	117-131	60-65	81-83	79	100
Odph.	70-74*	72-77	40-47	52-54*	57	61
Stylet	197-199*	189-208	100-112	135-136*	136	161
Sp. odst.	-	-	82-86	88-101	106	123
Neck	392-430*	374-377	278-294	285-339	300	376

* n = 2; ** n = 1; *** from Cohn and Sher (1969, Fig. 5C).

Table 10. *Dimensions of* Xiphinema cf. brasiliense *and* X. setariae *(All measurements in µm except L in mm).*

	X. cf. brasiliense			*X. setariae*
	J3	J4	Females	Females
n	2	7	3	9
L	0.87-0.94	1.07-1.12	1.51-1.55	2.55-2.73
a	28-30	30-36	31-35	51-61
b	3.4-3.5	3.0-3.9	4.0-4.7	5.9-7.1
c	16.1*	20-24	31-33	47-52
c'	2.1*	1.9-2.4	1.6-1.7	1.7-2.0
ABW	25*	22-25	29-31	25-29
Tail	54*	45-52	46-50	44-53
h	20*	17-21	19-22	17-21
h'	37*	33-40	41-46	33-34
Core	34*	27-35	26-29	30-45
V	-	-	32-34	39-41
LRW	9	10-11	13	12-14
GR	52-54	68-85	97-124	97-110
Od. style	64-67	84-92	118-132	111-116
Od. phore	47-49	56-59	73-77	69-72
Stylet	113-114	143-151	191-209	180-188
Sp. odst.	90-92	111-145	-	-
MBW	31	31-36	44-49	40-53
Neck	250-276	284-363	322-374	374-464

* n = 1.

shows a large chamber with cellular walls which was not illustrated in *X. brasiliense* by Loof and Sharma (1979) nor by Luc (1981). More material is needed to decide whether this population represents an undescribed species.

X. setariae Luc, 1958

MEASUREMENTS

See Table 10.

NOTES

Nine females were found in samples 2.1., 2.5. and 1.4.2. Shape of anterior end and tail wholly typical.

Acknowledgments

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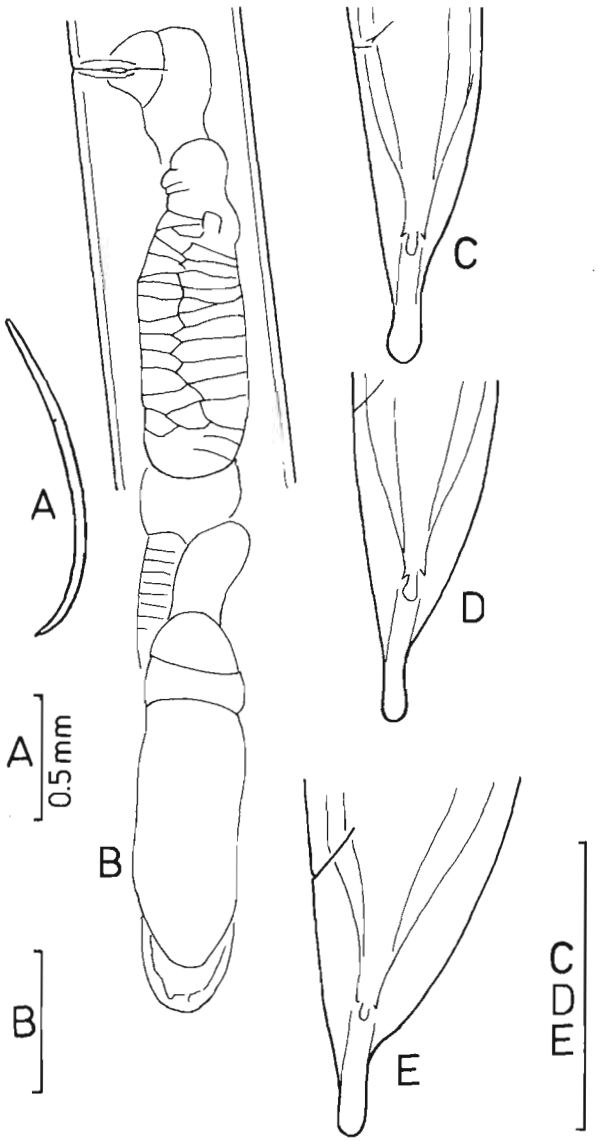

Fig. 11. Xiphinema cf. brasiliense *from* Michaelia *(1.8.). A: Whole female; B: Genital apparatus; C: Female tail; D: Tail of J4; E: Tail of J3. (Scale bar: A = 0.5 mm; B-E = 50 µm).*

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References

AHMAD, N. & BAQRI, Q.H. (1987). The species of the genus *Xiphinema* Cobb,1913 (Xiphinematidae: Dorylaimida) from Malaysia. *Bull. zool. Survey India*, 8: 143-148.

BAJAJ, H.K. & JAIRAJPURI, M.S. (1977). Variability within *Xiphinema insigne* populations from India. *Nematologica*, 23: 33-46.

COHN, E. & SHER, S.A. (1969). A contribution to the taxonomy of the genus *Xiphinema* Cobb, 1913. *J. Nematol.*, 4: 36-65.

HEYNS, J. & COOMANS, A. (1994). Four species of the *Xiphinema americanum* group (Nematoda: Longidoridae) from islands in the Western Indian Ocean. *Nematologica*, 40: 12-24.

HUNT, D.J. & SINGH, N.D. (1984). *Xiphinema costaricense* Lamberti & Tarjan, 1974 and *X. insigne* Loos, 1949 from Trinidad. *Revue Nématol.*, 7: 19-22.

KARIM SIDAM, A. & RAHMAN RAZAK, A. (1991). Nematod parasit tumbuhan pada tanaman tembakuau di Kelantan, Malaysia. *MARDI Res.J.*, 19: 77-84.

LAMBERTI, F., CIANCIO, A., AGOSTINELLI, A. & COIRO, M. (1992). 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(1991): 311-326.

LOH, C.F. & TING, W.P. (1970). A host list of plant parasitic nematodes in west Malaysia. *Min. Agric. Coop. Malaysia Bull.*, 123, 15 p.

LOOF, P.A.A. & LUC, M. (1990). A revised polytomous key for the identification of species of the genus *Xiphinema* Cobb, 1913 (Nematoda: Longidoridae) with exclusion of the *X. americanum*-group. *Syst. Parasit.*, 16: 35-66.

LOOF, P.A.A. & LUC, M. (1993). A revised polytomous key for the identification of species of the genus *Xiphinema* Cobb, 1913 (Nematoda: Longidoridae) with exclusion of the *X. americanum*-group: Supplement 1. *Syst. Parasit.*, 24: 185-189.

LOOF, P.A.A. & MAAS, P.W.T. (1972). The genus *Xiphinema* (Dorylaimida) in Surinam. *Nematologica*, 18: 92-119.

LOOF, P.A.A. & SHARMA, R.D. (1979). Plant parasitic nematodes from Bahia State, Brazil: the genus *Xiphinema* Cobb, 1913 (Dorylaimoidea). *Nematologica*, 25: 111-127.

LOOS, C.A. (1949). Notes on free-living and plant-parasitic nematodes from Ceylon. 5. *J. zool. Soc. India*, 1: 23-29.

LUC, M. (1981). Observations on some *Xiphinema* species with the female anterior genital branch reduced or absent (Nematoda: Longidoridae). *Revue Nématol.*, 4: 157-167.

LUC, M. & HUNT, D.J. (1978). Redescription of *Xiphinema longicaudatum* Luc, 1961 and observations on *Xiphinema krugi* Lordello,1955 (Nematoda: Longidoridae). *Nematologica*, 24: 1-18.

LUC, M. & SOUTHEY, J.F. (1980). Study of biometrical variability in *Xiphinema insigne* Loos, 1949, and *X. elongatum* Schuurmans Stekhoven & Teunissen, 1938; description of *X. savanicola* n.sp. (Nematoda: Longidoridae) and comments on thelytokous species. *Revue Nématol.*, 3: 243-269.

MCLEOD, R.W. & KHAIR, G.T. (1971). *Xiphinema australiae* n.sp., its host range, observations on *X. radicicola* Goodey, 1936 and *X. monohysterum* Brown, 1968 and a key to monodelphic *Xiphinema* spp. (Nematoda: Longidoridae). *Nematologica*, 17: 58-68.

PHUKAN, P.N. & SANWAL, K.C. (1982). Taxonomic studies on six species of *Xiphinema* from Assam. *J. Res. Assam Agric. Univ.*, 3: 67-83.

RAHMAN, M.F., BILGRAMI, A.L. & JAIRAJPURI, M.S. (1986). Studies on variability in *Xiphinema radicicola* Goodey, 1936 and *Xiphinema brasiliense* Lordello, 1951. *Helminthologia*, 23: 179-188.

SAUER, M.R. & WINOTO SUADMATJI, R. (1975). A note on *Xiphinema ensiculiferum*. *J. Nematol.*, 7: 313-314.

SHISHIDA, Y. (1983). Studies on nematodes parasitic on woody plants 2. Genus *Xiphinema* Cobb,1913. *Jap. J. Nematol.*, 12: 1-14.

WINOTO SUADMATJI, R. & SAUER, M.R. (1982). Plant parasitic nematodes associated with cultivated plants in Peninsular Malaysia. *Malaysian appl. Biol.*, 11: 5-17.

YEATES, G.W. (1973). Taxonomy of some soil nematodes from the New Hebrides. *N. Z. Jl Sci.*, 15: 673-697.