

## The genus *Xiphinema* (Nematoda: Longidoridae) in Guyane and Martinique

Antoinette SWART\* and Patrick QUÉNÉHERVÉ\*\*

\* National Collection of Nematodes, Biosystematics Division, Plant Protection Research Institute, Private Bag X134, Pretoria, 0001, South Africa, and \*\* ORSTOM, Laboratoire de Nématologie, B.P. 8006, 97259 Fort-de-France Cedex, Martinique

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**Summary** – This article presents the results of surveys conducted in Guyane and Martinique during 1994/1995. Seven species of *Xiphinema* (*X. americanum sensu lato*, *X. basiri*, *X. clavicaudatum*, *X. costaricense*, *X. filicaudatum labratum*, *X. longicaudatum*, and *X. oryzae*) are briefly described and illustrated. *X. basiri* and *X. longicaudatum* are described for the first time from South America. Three new *Xiphinema* species are described: *Xiphinema labiosum* n. sp. is characterised by peri-oral ring, small, crescent-shaped amphid aperture, lip region almost continuous with body outline, and weakly curved to almost straight habitus. *Xiphinema pseudokrugi* n. sp. is characterised by incomplete anterior reproductive branch, vulva situated almost at mid-body, slight cuticular ornamentations anterior and posterior of vulva, and a convex-conoid tail with a rounded or slightly bulging terminus. *Xiphinema seinhorsti* n. sp. is characterised by long, offset, caudal, finger-like projection on the ventral side of the tail, presence of a blind canal at the tail terminus, long odontostyle, and uterus with Z-differentiation consisting of a small number of granular bodies. © Orstom/Elsevier, Paris

**Résumé** – Le genre *Xiphinema* (Nematoda: Longidoridae) en Guyane et Martinique – Cet article présente les résultats de prospections conduites en 1994/1995 en Guyane et Martinique. Sept espèces de *Xiphinema* (*X. americanum sensu lato*, *X. basiri*, *X. clavicaudatum*, *X. costaricense*, *X. filicaudatum labratum*, *X. longicaudatum*, et *X. oryzae*) sont brièvement décrites et illustrées. *X. basiri* et *X. longicaudatum* sont signalés pour la première fois en Amérique du Sud. Trois nouvelles espèces de *Xiphinema* sont décrites: *Xiphinema labiosum* n. sp. est caractérisé par un anneau péri-oral, des ouvertures amphidiales petites en forme de croissant, la région labiale pratiquement continue avec le contour du corps et l'habitus de légèrement incurvé à pratiquement droit. *Xiphinema pseudokrugi* n. sp. peut être caractérisé par la branche génitale antérieure incomplète, la vulve située à mi-corps, de légères ornements cuticulaires en avant et en arrière de la vulve et la queue de forme convexe-conoïde avec une partie terminale arrondie ou légèrement renflée. *Xiphinema seinhorsti* n. sp. est caractérisé par une projection caudale longue, en forme de doigt, séparée du reste de la queue et située sur la face ventrale de celle-ci avec présence d'un canal aveugle, un long odontostyle et l'utérus avec une différenciation Z constituée d'un petit nombre de corps granuleux. © Orstom/Elsevier, Paris

**Keywords:** Guyane, Martinique, nematodes, *Xiphinema*.

Seventeen species of the genus *Xiphinema* found during surveys made in 1994/1995 by the second author in Guyane and Martinique are listed below. The species marked by an asterisk have already been described in the paper by Luc and Coomans (1992) on the genus *Xiphinema* in Martinique and Guyane. As there are no major morphological differences between the populations described by Luc and Coomans (1992) and the corresponding populations of the present study, these species will not be described again in the present paper. The numbers given after the names of the various species are those of localities (see below) in Martinique and French Guyane where each species was found during the present survey.

*X. americanum sensu lato*: Guyane (14), Martinique (2)

*X. basiri* Siddiqi, 1959: Martinique (2)

\* *X. brasiliense* Lordello, 1951: Guyane (6)

*X. clavicaudatum* Huang, Uesugi & Raski, 1987: Guyane (10)

*X. costaricense* Lamberti & Tarjan, 1974: Guyane (13, 17)

\* *X. ensiculiferum* (Cobb, 1893) Thorne, 1937: Guyane (12)

*X. filicaudatum labratum* Luc & Coomans, 1992: Guyane (3, 7, 10, 16)

\* *X. krugi* Lordello, 1955: Martinique (1)

*X. labiosum* sp. n.: Guyane (16)

*X. longicaudatum* Luc, 1961: Guyane (12)

\* *X. macrostylum* Esser, 1966: Guyane (6)

*X. oryzae* Bos & Loof, 1985: Guyane (3, 7, 11)

\* *X. parivaliae* Loof & Sharma, 1979: Guyane (9)

*X. pseudokrugi* sp. n.: Guyane (8, 10)

*X. seinhorsti* sp. n.: Guyane (4, 5, 7, 10)

\* *X. setariae* Luc, 1958: Guyane (5, 10)

\* *X. surinamense* Loof & Maas, 1972: Guyane (9, 13, 15, 16, 17)

## Materials and methods

Specimens were extracted from soil using the elutriation technique (Seinhorst, 1962), killed in water by gradual application of heat, fixed in TAF, and mounted in anhydrous glycerine between coverslip slides using the slow method of Hooper and Evans (1993). Measurements and drawings were made using a Nikon Labophot-2 research microscope equipped with a drawing tube. When necessary, the body diameter was corrected for flattening according to the formula  $d = \frac{1}{2}(h + v)$ , as given by Geraert (1961).

The following localities were sampled:

- Martinique:
  1. Rhizosphere of ferns, Rocher du Diamant
  2. Rhizosphere of ornamental plants, Didier
- Guyane:
  3. Rhizosphere of *Dicorynia guianensis* Amshoff, Station P6, Paracou
  4. Rhizosphere of *Dicorynia guianensis* Amshoff, Botanical Track (Sample 1), Paracou
  5. Rhizosphere of *Eperua grandiflora* (Aubl.) Benthams, Station P13, Paracou
  6. Rhizosphere of *Eperua grandiflora* (Aubl.) Benthams, Station P6, Paracou
  7. Rhizosphere of *Astrocaryum sciophilum* (Miguel) Pulle, Saut Brodel
  8. Rhizosphere of Marantaceae, Saut Brodel
  9. Rhizosphere of ferns, Rivière Comté
  10. Rhizosphere of *Dicorynia guianensis* Amshoff, Botanical Track (Sample 2), Paracou
  11. Rhizosphere of *Elingera eliator* (Jack.) R.M. Smith, Cacao
  12. Rhizosphere of *Dicorynia guianensis* Amshoff, Saül, Bois Diable
  13. Rhizosphere of *Dicorynia guianensis* Amshoff, Saül, Noubel
  14. Rhizosphere of *Aspidosperma* sp. Martius & Zuccarini, Saül, Mont de Boeuf Mort
  15. Rhizosphere of *Dicorynia guianensis* Amshoff, Saül, Mont de Boeuf Mort
  16. Rhizosphere of *Dicorynia guianensis* Amshoff, Saül, Cascade Sauveur
  17. Rhizosphere of *Dicorynia guianensis* Amshoff, Saül, Mont Galboa.

In the text of the article, localities are designated by their number (1-17) in the list above.

### *Xiphinema americanum sensu lato*

(Fig. 1)

#### MEASUREMENTS

*Female*: See Table 1.

#### DESCRIPTION

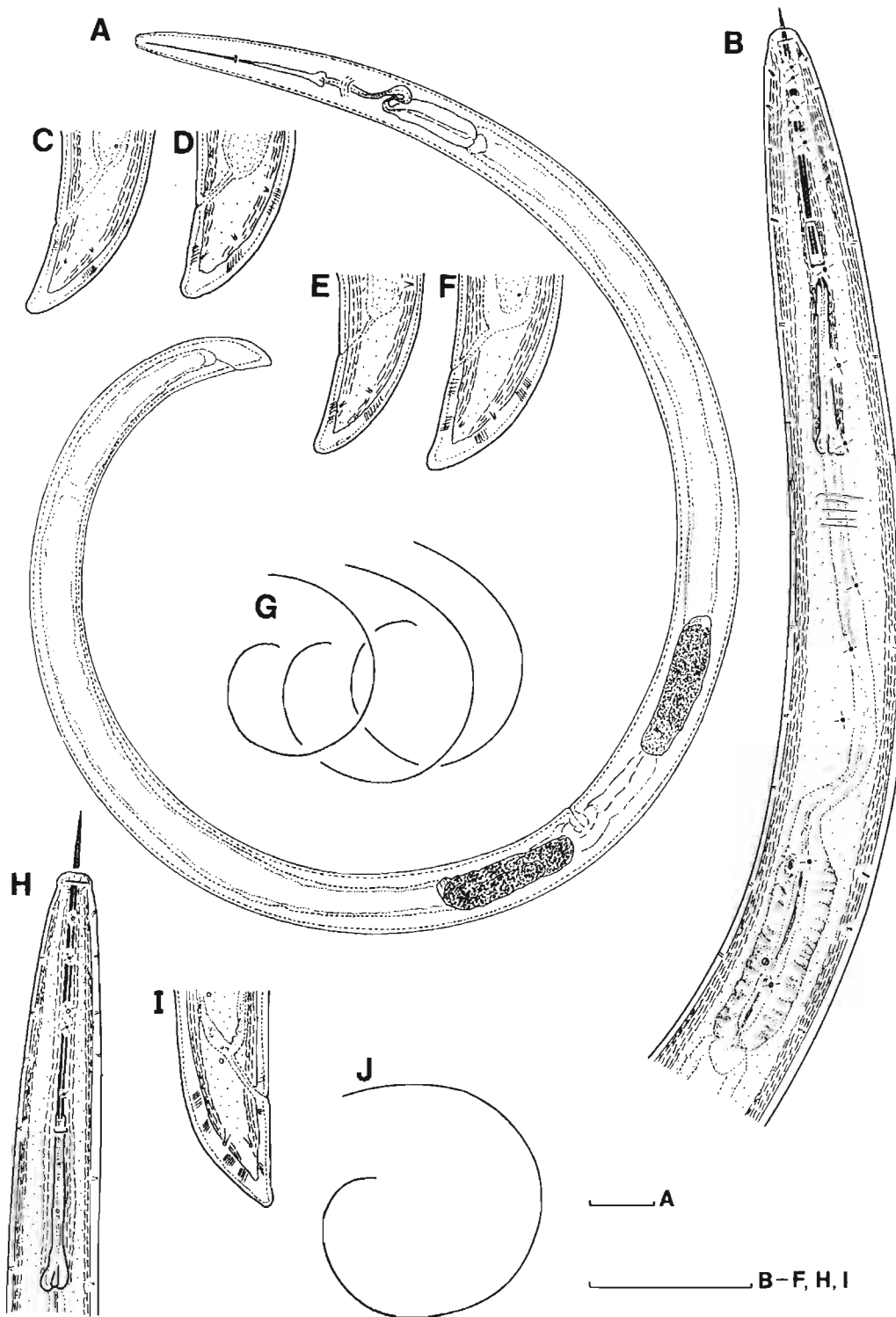
*Female*: Habitus spiral-shaped. Lip region 4-5 µm high, rounded, separated from rest of body by a shallow

**Table 1.** Morphometrics of females of *Xiphinema americanum* s. l. (all measurements in µm except L in mm).

Locality	Guyane 14	Martinique 2
n	7	1
L	1.7 ± 0.1 (1.5-1.8)	2.2
a	37.3 ± 1.9 (34.2-39.7)	54.9
b	6.2 ± 0.7 (4.8-6.9)	6.9
c	57.6 ± 5.9 (49.1-64.8)	66.6
c'	1.3 ± 0.1 (1.1-1.4)	1.3
V	52.5 ± 0.8 (52-54)	52
Tail	29.4 ± 2 (27-33)	33
Lip reg. diam.	10.4 ± 1 (9.5-11.5)	10.5
Odontostyle	88.8 ± 2.4 (86-92.5)	94.5
Odontophore	54.1 ± 1.3 (51.5-55.5)	54.5
Styilet	143 ± 3 (138-147.5)	149
Guid. ring	76.3 ± 2.7 (74.5-80)	80.5
Nerve ring	150.6 ± 10.8 (134-160)	144
Hemizonid	138.6 ± 9.7 (120-148.5)	159
h	9.5 ± 1.3 (7.5-11)	10
h%	32.3 ± 5.1 (26-38)	30

low depression. Amphid apertures 6-8 µm wide, occupying about 66 % of lip region width, 4-5 µm from anterior end. Body pores difficult to see; distribution in neck region appearing as (n = 4): nine to twelve laterally, nine to twelve ventrally, six to nine dorsally. Vestigium seen in one specimen, about 4 µm long. Basal flanges 9-11 µm wide. Cuticle 2.5-3 µm wide at mid-body, 5-6 µm on dorsal side of tail. Body diameter at cardia 35-38 µm, at mid-body 40-48 µm, at anus 21-27 µm, and at the beginning of the hyaline part of tail, 11-14 µm. Reproductive system amphidelphic, with both branches equally developed. Each branch composed of ovary, oviduct, obscure sphincter, and short uterus (35-40 µm long). Tail conoid, dorsally convex with rounded to slightly subdigitate terminus; two caudal pores. Rectum 18-23 µm long.

*Male*: Not found.



**Fig. 1.** A - J: *Xiphinema americanum sensu lato*, A - G: Guyane population. A: Entire female; B: Anterior body region; C - F: Tails of females; G: Habitus; H-J, Single female from Martinique. H: Anterior body region; I: Tail; J: Habitus. (Scale bars = 50  $\mu$ m.)

## REMARKS

According to the dichotomous key for the identification of species of the *X. americanum*-group (Lamberti & Carone, 1992), the specimens from Guyane belong to *X. incognitum* Lamberti & Bleve-Zacheo, 1979. To help with the identification of this difficult group, Lamberti and Ciancio (1993) subdivided it into five subgroups according to a combination of body length, position of vulva, and odontostyle length. According to this classification, the specimens from Guyane are closer to the *X. brevicollum*-subgroup (long odontostyle, relatively posterior position of vulva, and relatively short body) than to the *X. americanum*-subgroup to which *X. incognitum* belongs. Therefore, until more specimens can be obtained for measurement, we decided to regard this population as *X. americanum sensu lato*. The Guyane specimens differ from the type population of *X. incognitum* in lower a-value (34.2-39.7 vs 41-49) and slightly subdigitate tail terminus in some specimens (not so in the type population of *X. incognitum*). In shape of tail terminus, the Guyane specimens resemble *X. floridae* Lamberti & Bleve-Zacheo, 1979 and *X. peruvianum* Lamberti & Bleve-Zacheo, 1979. However, they differ from *X. floridae* in smaller lip region (9.5-11.5 vs 11.5-13.5 µm wide), lower a-value (34.2-39.7 vs 41-48), outline of anterior part of body (lip region separated from rest of body by shallow depression vs lip region separated from rest of body by an incisure), and tail shape (conoid with rounded to subdigitate terminus vs cuneiform tail). They differ from *X. peruvianum* in lower a-value (45-56 in *X. peruvianum*), longer odontophore (51.5-55.5 vs 46-52 µm), slightly lower c'-value (1.1-1.4 vs 1.4-1.9), and slightly different tail shape (conoid with rounded to slightly subdigitate terminus vs conoid elongated with subdigitate terminus).

The single female from Martinique is quite similar to the Guyane females but differs from them in body length (2.2 vs 1.5-1.8 mm), higher a-value (54 in female from Martinique), and clearly offset, almost button-like lip region. As it is virtually impossible to determine the species of a single female in the *X. americanum*-group, this specimen is also regarded, for the time being, as *X. americanum sensu lato*.

***Xiphinema basiri* Siddiqi, 1959**

(Fig. 2)

## MEASUREMENTS

*Female*: See Table 2.

## DESCRIPTION

*Female*: Habitus hook-shaped, more curved in posterior part. Lip region 6 µm high, rounded, slightly offset. Amphid apertures 8-8.5 µm wide, occupying about 70 % of lip region width, 4.5 µm from anterior

**Table 2.** Morphometrics of females of *Xiphinema basiri* (all measurements in µm except L in mm).

Locality	Martinique 2
n	2
L	3, 3.1
a	59.3, 55.5
b	7.5, 8.6
c	69, 70
c'	1.3, 1.3
V	51, 52
Tail	43, 45
Lip reg. diam.	12.5, 12.5
Odontostyle	119, 120
Odontophore	67.5, 68.5
Stylect	186.5, 188.5
Guid. ring	111.5, 107
Nerve ring	209, 175.5
Hemizonid	180,-
h	19, 21.5
h%	44, 48

end. Body pores conspicuous; distribution in neck region: thirteen to fifteen laterally, eleven ventrally, four dorsally. Vestigium (n = 1) 3.5 µm long. Basal flanges 11-12 µm wide. Cuticle 3.5 µm wide at mid body, 9 µm on dorsal side of tail, transversely striated at both extremities of body. Reproductive system with both branches equally and fully developed. Each branch consisting of ovary 65-87 µm long, oviduct 60-85 µm long, *pars dilatata oviductus* 24-38 µm long, sphincter, *pars dilatata uteri* 30-40 µm long, and long thin convoluted uterus, 160-165 µm long with Z differentiation occupying about 8 µm of the uterus near *pars dilatata uteri*. Ovejector about 50 µm long; vagina occupying about one half of corresponding body width. Z-differentiation consisting of three to four globular inclusions. No sperm cells observed in any part of reproductive system. Prerectum distinct, occupying 11.5-11.8 % of body length, about 10.5 times corresponding body diameter. Rectum about one anal body diameter in length. Tail short, conical, distinctly digitate.

*Male*: Not found.

## REMARKS

The two females from Martinique (Loc. 2) agree morphologically and morphometrically in every respect with the descriptions of the type and other populations. This is the first report of *X. basiri* from Martinique. This species was known previously from

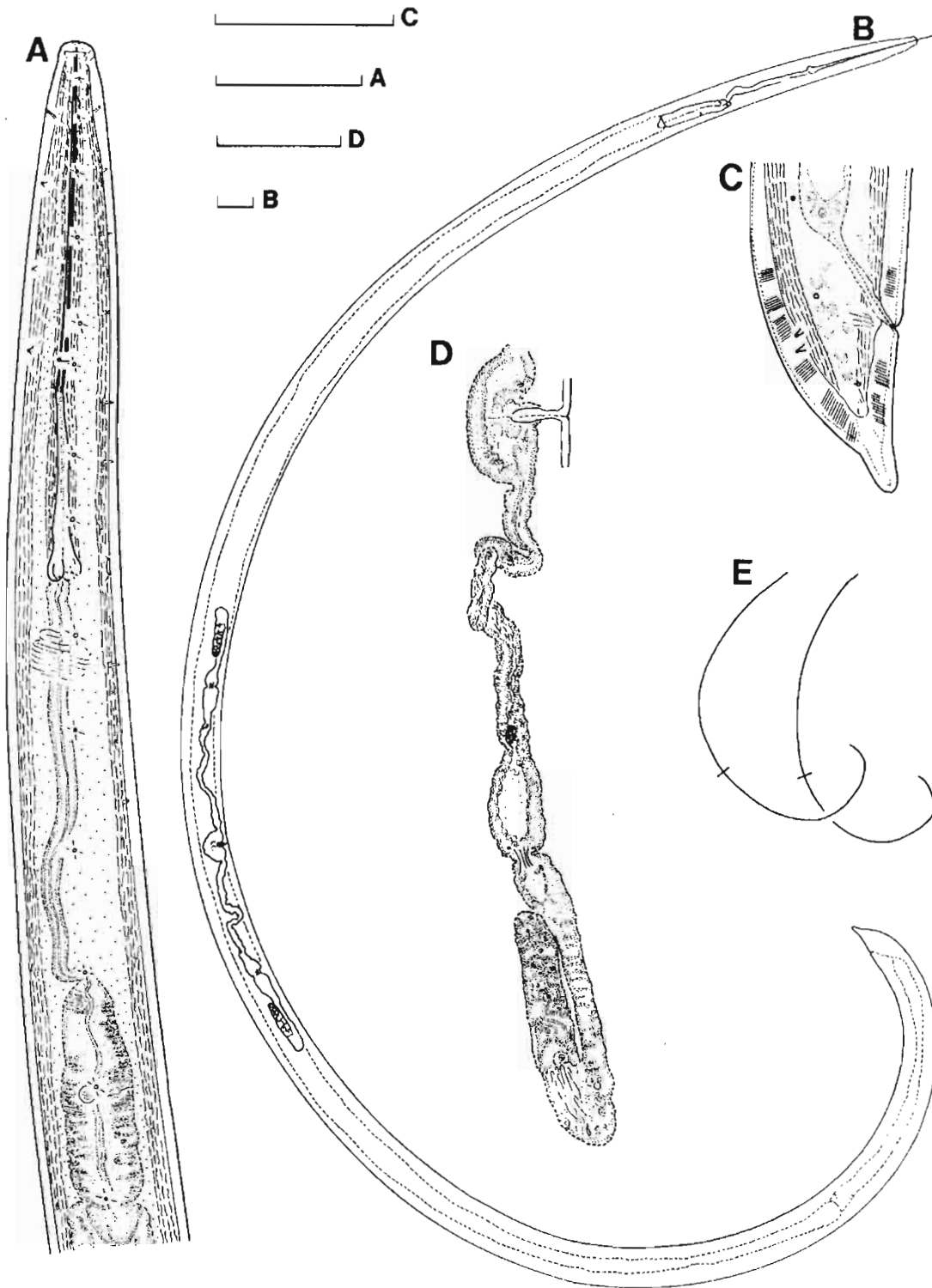


Fig. 2. *Xiphinema basiri* Siddiqi, 1959. A: Anterior body region; B: Entire female; C: Female tail; D: Posterior branch of reproductive system; E: Habitus. (Scale bars = 50  $\mu$ m.)

India (Siddiqi, 1959; Bajaj & Jairajpuri, 1979; Sharma & Saxena, 1981; Javed, 1983), Sudan (Loof & Yassin, 1971; Zeidan & Coomans, 1991), Nigeria, Sri Lanka, Mexico, and Zimbabwe (Cohn & Sher, 1972).

*Xiphinema clavicaudatum* Huang,  
Uesugi & Raski, 1987  
(Fig. 3)

MEASUREMENTS

Female: See Table 3.

DESCRIPTION:

Female: Habitus moderately curved to J-shaped, more curved in posterior third. Lip region rounded, about 7-9  $\mu\text{m}$  high, very slightly offset from rest of body. Amphid aperture 6-8  $\mu\text{m}$  wide, occupying about 45 % of body width. Body pore distribution in neck region: eleven to fourteen laterally, ten to twelve ventrally, five dorsally. Vestigium 2  $\mu\text{m}$  long. Basal flanges 14-15  $\mu\text{m}$  wide. Reproductive system with fully developed posterior branch and shorter, reduced anterior branch. Anterior reproductive branch consisting of

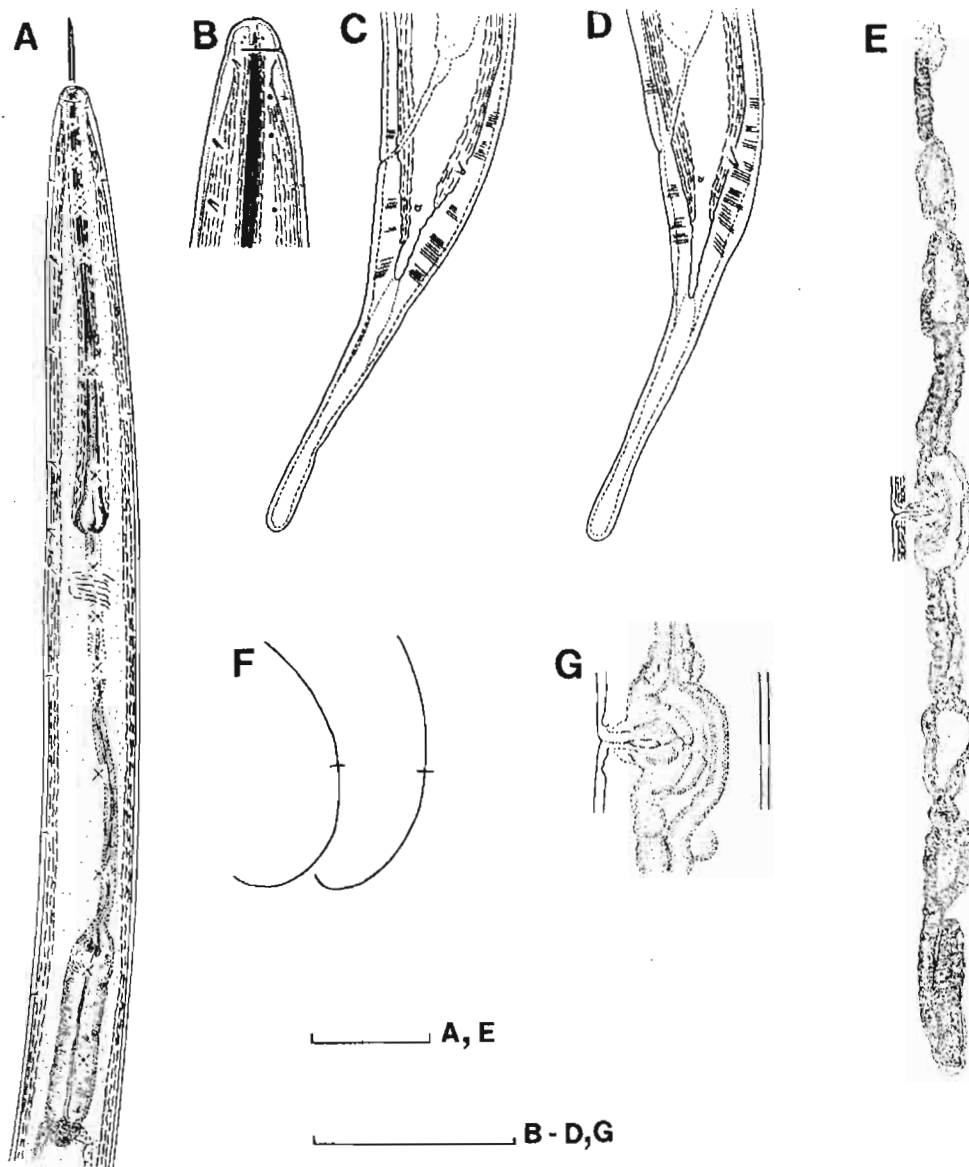


Fig. 3. *Xiphinema clavicaudatum* Huang, Uesugi & Raski, 1987. A: Anterior body region; B: Lip region, lateral view; C, D: Tail region of females; E: Reproductive system; F: Habitus; G: Vulval region. (Scale bars = 50  $\mu\text{m}$ .)

**Table 3.** Morphometrics of females of *Xiphinema clavicaudatum* (all measurements in  $\mu\text{m}$  except L in mm).

Locality	Guyane 10
n	5
L	2.2 $\pm$ 0.1 (2.1-2.3)
a	47.5 $\pm$ 3.5 (43.1-52)
b	5 $\pm$ 0.4 (4.7-5.6)
c	22.8 $\pm$ 1 (21.7-24.2)
c'	3.6 $\pm$ 0.2 (3.3-3.8)
V	41.8 $\pm$ 1.6 (40-44)
Tail	95.9 $\pm$ 3.4 (92.5-99.5)
Lip reg. diam.	13.9 $\pm$ 1 (13-15)
Odontostyle	136.5 $\pm$ 2.1 (135-140)
Odontophore	84.6 $\pm$ 1.7 (82-86)
Stylet	221.1 $\pm$ 3.4 (217-226)
Guid. ring	127.4 $\pm$ 2.1 (125-130)
Nerve ring	246.7 $\pm$ 21.7 (210-266)
Hemizonid	195.4 $\pm$ 7.6 (188-205)
h	65.3 $\pm$ 3.6 (62-69.5)
h%	68 $\pm$ 3.4 (63.3-72)

fully developed uterus with *pars dilatata uteri*, sphincter, *pars dilatata oviductus*, short part of the slender oviduct, and a small cell mass representing the ovary. No sperm cells observed in any part of the reproductive system. Ovejector symmetrical, blind extensions apparently present on both side of the ovejector in one specimen, in others inconspicuous. No Z-differentiation or uterine spines observed. Prerectum conspicuous, 475-620  $\mu\text{m}$  long, occupying about 25 % of body length. Rectum 30-35  $\mu\text{m}$  long. Tail slightly curved ventrad with hyaline portion straight. Tail terminus clavate. Two pairs of caudal pores present; one pair situated subdorsally, almost at level of anal opening; second pair laterally, a short distance posteriad from first pair.

*Male:* Not found.

#### REMARKS

The population from Guyane (Loc. 10) agrees with the original description of *X. clavicaudatum* in clavate tail terminus, c-value, c'-value, pseudomonodelphic reproductive system and V-value, absence of Z-differentiation and uterine spines, and rounded lip region, almost continuous with body outline. However, this population differs from the type population in a few characters: shorter body length (2.1-2.3 vs 2.96-4.42 mm), shorter tail (92.5-99.5 vs 124-248  $\mu\text{m}$ ), longer hyaline terminal part (63-72 vs 41-53 % of tail length), slightly shorter odontostyle (135-140 vs 140-186  $\mu\text{m}$ ), and degree of reduction of the anterior reproductive branch (part of oviduct still intact, ovary reduced to a small mass of cells vs absence of both ovary and slender part of oviduct, *pars dilatata oviductus* reduced to a mass of cells). However, there are more similarities than differences between the Guyane specimens and the type specimens and, at least for the moment, we decided to consider the two populations as conspecific. *X. clavicaudatum* seems to be native to South America: it was described from natural vegetation in Brazil (Huang *et al.*, 1987), collected again in the Brazilian Amazonia (Germani, 1989), and it is now found in Guyane, also on natural vegetation.

#### *Xiphinema costaricense* Lamberti & Tarjan, 1974 (Fig. 4)

#### MEASUREMENTS

*Female:* See Table 4.

#### DESCRIPTION

*Female:* Habitus weakly to moderately curved ventrally. Lip region 6-7  $\mu\text{m}$  high, slightly offset from rest of body. All specimens were flattened to various degrees, this possibly affecting the lip region shape and width. Amphid apertures 7-9  $\mu\text{m}$  wide, at 6-7  $\mu\text{m}$  from anterior end, occupying about 52 % of the lip region width. Body pores conspicuous; distribution in neck region: twelve to thirteen laterally, nine to ten ventrally, three dorsally. Vestigium small, 1.5  $\mu\text{m}$  long, difficult to see. Basal flanges 17.5-20.5  $\mu\text{m}$  wide. Reproductive system with anterior genital branch reduced and incomplete: ovary absent, oviduct reduced to a mass of cells (23-29  $\mu\text{m}$  long), sphincter, *pars dilatata uteri* (48-55  $\mu\text{m}$  long), and uterus (63-78  $\mu\text{m}$  long) recognisable but reduced. Posterior genital branch complete with ovary 73-83  $\mu\text{m}$  long, convoluted oviduct 40-48  $\mu\text{m}$  long, *pars dilatata oviductus* 37-43  $\mu\text{m}$  long, sphincter and uterus with *pars dilatata uteri* 28-33  $\mu\text{m}$  long, and uterus without Z-differentiation and with tubular part 138-175  $\mu\text{m}$  long. Ovejector 48-60  $\mu\text{m}$  long. In a few females, an accumulation of small rounded cells, reminiscent of sperm cells,

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

Locality	Guyane 13		Guyane 17	
	Female		Female	J4
n	2		8	1
L	2.6, 2.8		2.4 $\pm$ 0.1 (2.2-2.8)	2.1
a	53.6, 53.1		48.3 $\pm$ 3.5 (41.3-52.6)	45
b	4.8, 6		5.3 $\pm$ 0.6 (4.6-6.3)	2.7
c	81.1, 88.3		77.9 $\pm$ 8.8 (63.2-88.7)	58.6
c'	0.7, 0.6		0.7 $\pm$ 0.1 (0.6-0.8)	0.74
V	47, 46		45.1 $\pm$ 0.9 (44-46.4)	-
Tail	31.5, 31.5		31 $\pm$ 3.8 (27-37)	35
Lip reg. diam.	18, 18.5		15.5 $\pm$ 1.1 (14-17)	15
Odontostyle	151, 147		144.6 $\pm$ 5.4 (140-153.5)	132
Repl. od.style	-		-	149
Odontophore	86.5, 95		86.8 $\pm$ 2 (85-90)	82
Stylet	237.5, 242		231.3 $\pm$ 7.2 (225.5-242)	214
Guid. ring	148, 146		136.8 $\pm$ 4.5 (133-147)	127
Nerve ring	241, 266		252.9 $\pm$ 7.5 (247-264.5)	227
Hemizonid	226,-		214.1 $\pm$ 5.1 (207-224)	-
h	11, 10.5		9.3 $\pm$ 0.8 (7.5-10)	10.5
h%	35, 33		30.4 $\pm$ 4.7 (20-34)	30

present at the distal end of the posterior genital tract where the gonad reflexes (this may point to hermaphroditism in this species, but this needs confirmation). Tail tapering to broadly rounded terminus with main curvature on the dorsal outline. In some severely flattened specimens, the tail appearing almost hemispherical. Blind terminal canal absent. Two pairs of caudal pores clearly seen on tail, posterior to anal opening; one pair located laterally near tail terminus and one pair located almost at level of anal opening in a sublateral position.

*Male:* Not found.

*Juvenile.* General appearance as in female. Genital primordium  $52.5 \times 32 \mu\text{m}$

#### REMARKS

The Guyane population (Loc. 13 and 17) resembles the type population both morphologically and morphometrically, except for the vulva located more posteriorly than in the type population (44-47 vs 36.6-37.5 %). However, it is very close to a population from Ilha Carreiro, Brazilian Amazonia, where the V-value is given as 43.1-45.8 % for eleven females (Germani, 1989).

#### *Xiphinema filicaudatum labratum* Luc & Coomans, 1992 (Fig. 5)

#### MEASUREMENTS

*Female and males:* See Table 5.

*Juveniles:* See Table 6.

#### DESCRIPTION

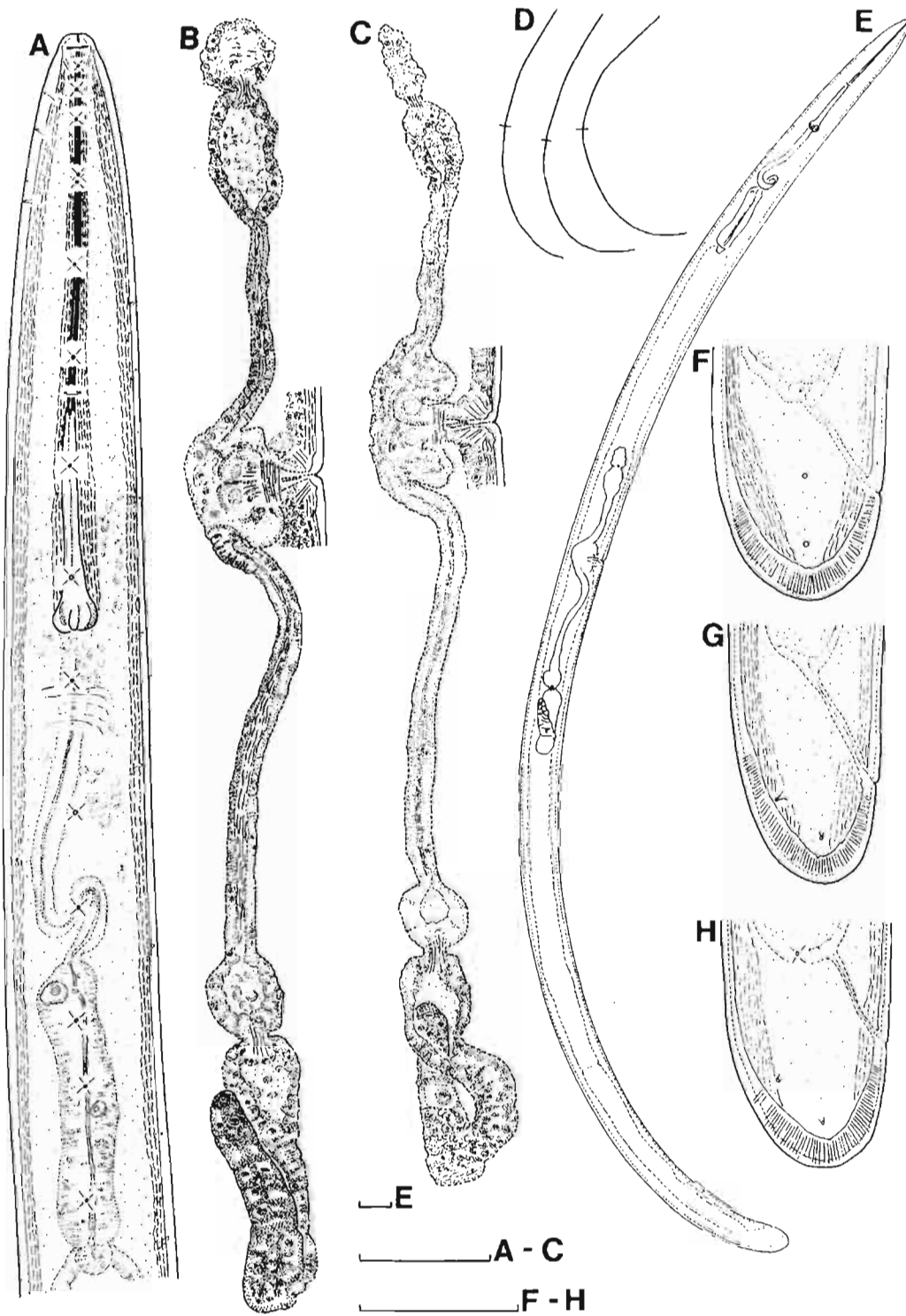
*Male* (n = 1): Habitus J-shaped. Lip region continuous with body outline, without peri-oral ring. Amphid opening short, crescent-shaped,  $4 \mu\text{m}$  long,  $7.5 \mu\text{m}$  from anterior end. Body pores conspicuous; distribution in neck region: thirteen situated laterally, seven dorsally, and about fourteen ventrally. Vestigium small,  $1.5 \mu\text{m}$  long. Spicules dorylaimoid,  $71 \mu\text{m}$  long, border of spicular pouch prominent. Lateral guiding pieces  $16.5 \mu\text{m}$  long, each with a distinct knob at distal end. One adanal pair and five supplements present, spaced 38-48  $\mu\text{m}$ , the posterior one situated 3.8 anal body diameters from anus.

#### REMARKS

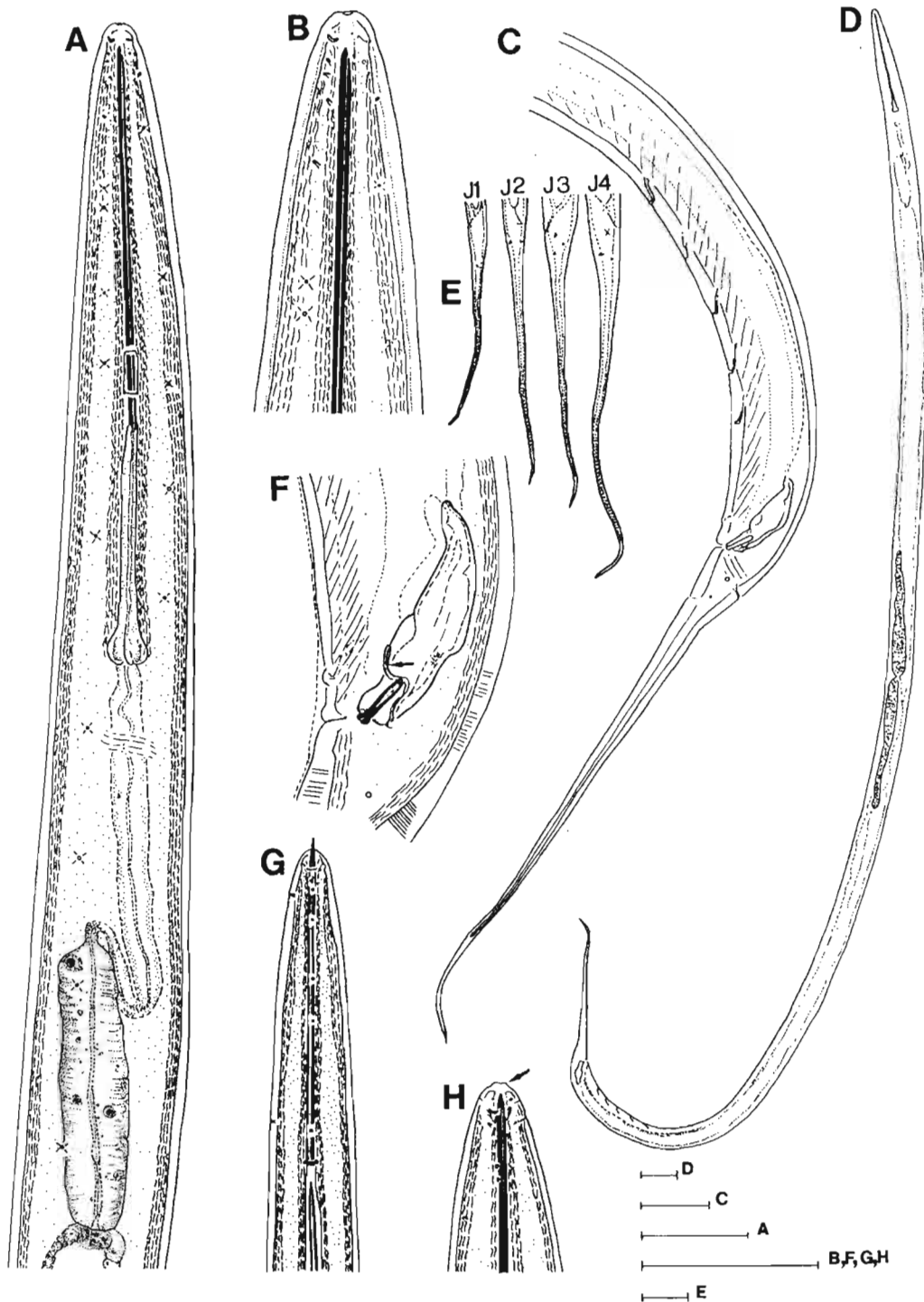
*X. filicaudatum labratum* was originally described from five females found in the rhizosphere of ferns and Marantaceae near Cayenne, Guyane (Luc & Coomans, 1992). This subspecies differs from *X. filicaudatum filicaudatum* Loof & Maas, 1972 mainly in presence of a peri-oral ring, different L and V values, and absence of males. In the present survey, a single male and several females and juveniles were found in four localities in Guyane (3, 7, 10, 16).

All females agree well morphologically and morphometrically with those of the type population. Juveniles are morphologically close to the females except for shorter bodies, shorter stylets, and under-developed gonads. The genital primordia of the J1, J2, J3, and J4 are 28, 34, 33-39, and 48-58  $\mu\text{m}$  long, respectively. Noteworthy is the fact that some juveniles, particularly some J1, J2 and J3 specimens have no or slightly developed peri-oral ring. The single male has no peri-oral ring and is on average longer than the females.





**Fig. 4.** *Xiphinema costaricense* Lambert & Tarjan, 1974. A: Anterior body region; B, C: Female reproductive system; D: Habitus; E: Entire female; F: Tail of severely flattened female; G: Tail of moderately flattened female; H: Tail of J4. (Scale bars = 50  $\mu$ m.).



**Fig. 5.** *Xiphinema filicaudatum labratum* Luc & Coomans, 1992. **A:** Anterior body region of male; **B:** Anterior region of male, sub-lateral view; **C:** Posterior region of male; **D:** Habitus of male; **E:** Tails of juvenile stages; **F:** Cloacal region showing border of spicular pouch (arrowhead); **G:** Anterior region of J1; **H:** Lip region of J4 showing well developed peri-oral ring (arrowhead). (Scale bars: D = 100  $\mu$ m; others = 50  $\mu$ m).

**Table 5.** Morphometrics of females and male of *Xiphinema filicaudatum labratum* (all measurements in  $\mu\text{m}$  except L in mm).

Locality	Guyane 3	Guyane 7		Guyane 10	Guyane 16
	Female	Female	Male	Female	Female
n	1	5	1	5	2
L	3.8	3.7 $\pm$ 0.1 (3.5-3.8)	4.1	3.6 $\pm$ 0.2 (3.2-3.8)	3.5, 3.9
a	50.7	56.4 $\pm$ 3.8 (52.3-61.5)	55.7	47.4 $\pm$ 1.2 (45.8-48.9)	49.6, 49.7
b	6.2	6.4 $\pm$ 0.4 (5.9-6.8)	7.4	6.6 $\pm$ 0.5 (6.2-7.4)	6.4, 6.4
c	6.9	9.8 $\pm$ 1.2 (8.9-11.6)	9.8	8.3 $\pm$ 1.6 (6.4-10.4)	7.2, 7.9
c'	13.7	9.6 $\pm$ 1.4 (8.1-11.1)	9.7	11.9 $\pm$ 2.9 (9.3-16.2)	10.9, 14.3
V/T	43	41.9 $\pm$ 1.3 (40.9-44)	37	42.4 $\pm$ 2.3 (39.4-44.8)	40.3, 40
Tail	548	381.2 $\pm$ 36.9 (323-413)	413	444.2 $\pm$ 81.9 (348-543)	490, 500
Lip reg. diam.	16.5	15 $\pm$ 1.3 (14-17)	15	16.6 $\pm$ 0.7 (16-17.5)	16, 15.5
Odontostyle	194	189.6 $\pm$ 3.3 (186-195)	176	188.9 $\pm$ 4.1 (184.5-193.5)	179, 179.5
Odontophore	124	119.6 $\pm$ 4.3 (114.5-125)	111	118.8 $\pm$ 11.8 (101-130)	125, 125
Stylet	318	309.2 $\pm$ 6.7 (303-320)	287	307.7 $\pm$ 15.1 (288-323)	304, 304.5
Guid. ring	186	185.6 $\pm$ 1.9 (183-187.5)	172	186.3 $\pm$ 8.7 (175.5-199)	169, 174
Nerve ring	342	341.3 $\pm$ 3.4 (338-346)	316.5	338 $\pm$ 10.6 (320-348)	300, 338
Hemizonid	267	256.9 $\pm$ 16.2 (242-280)	234.5	264.1 $\pm$ 5.8 (258-270)	257, 261.5
h	22	45.5 $\pm$ 7.2 (35-55)	46	16.5 $\pm$ 3.2 (12.5-20)	41.5, 70
h%	10	12.3 $\pm$ 2.8 (9.4-16.9)	11.1	11.1 $\pm$ 3.8 (7.7-15.5)	8.5, 14

However, its small crescent-shaped amphid aperture and lip region continuous with body outline points to *X. filicaudatum labratum*. No sperm was observed in females. In body length this male is near *X. filicaudatum filicaudatum* but the peculiar guiding pieces of the male of *X. filicaudatum labratum* were not mentioned in males of *X. filicaudatum filicaudatum*. The odontostyle is also shorter (287 vs 308-321  $\mu\text{m}$ ).

***Xiphinema labiosum*\* n. sp.**  
(Figs 6, 7A-C)

MEASUREMENTS

*Female*: See Table 7.

\* The species name *labiosum* refers to the prominent perioral ring.

DESCRIPTION

*Female*: Habitus weakly curved to nearly straight. Lip region with peri-oral ring, continuous with body outline. Peri-oral ring 7-7.5  $\mu\text{m}$  wide, 2-4  $\mu\text{m}$  high. Amphid aperture short, crescent-shaped, 3.5-4  $\mu\text{m}$  wide, 9-10.5  $\mu\text{m}$  from anterior end. Body pores inconspicuous; approximate distribution in neck region: sixteen laterally, eight dorsally, and ten ventrally. Vestigium 2-2.5  $\mu\text{m}$  long. Basal flanges 18-22  $\mu\text{m}$  wide. Cuticle 2.5-3.5  $\mu\text{m}$  wide at mid-body, 11-13  $\mu\text{m}$  at tail terminus. Reproductive system with anterior genital branch reduced and incomplete: ovary absent, oviduct reduced to a mass of cells (15-45  $\mu\text{m}$  long), sphincter, *pars dilatata uteri* (65-113  $\mu\text{m}$  long), and muscular uterus (50-93  $\mu\text{m}$  long) reduced in length compared to that of posterior branch. Posterior geni-

**Table 6.** Morphometrics of juveniles of *Xiphinema filicaudatum labratum* (all measurements in  $\mu\text{m}$  except L in mm).

Locality	Guyane 3			Guyane 7				Guyane 10	Guyane 16
	J2	J3	J4	J1	J2	J3	J4	J4	J4
n	1	2	1	2	2	7	6	1	4
L	1.7	2, 2.4	2.7	1.5, 1.6	1.4, 1.8	2.3 $\pm$ 0.1 (2-2.4)	2.8 $\pm$ 0.3 (2.4-3.2)	2.9	2.8 $\pm$ 0.1 (2.7-3)
a	42.6	52.1, 42.1	46.8	51.9, 50.7	45, 48.9	49 $\pm$ 3.4 (43.4-54.2)	52.6 $\pm$ 11.4 (35.3-64.6)	52.3	51.4 $\pm$ 2 (49.5-53.8)
b	4.3	4.5, 4.9	4.5	4.5, 4.8	3.9,-	4.9 $\pm$ 0.4 (4.6-5.8)	5.1 $\pm$ 0.8 (4-5.8)	5.1	5.1 $\pm$ 0.4 (4.7-5.6)
c	5.9	7.5, 6.7	6.1	6.6, 6.2	5.3, 6.3	7.1 $\pm$ 0.8 (6.2-8.2)	7.7 $\pm$ 1.7 (7.8-9)	9.1	7.1 $\pm$ 0.2 (6.7-7.2)
c'	16	10.9, 12.6	12.8	11.2, 11.6	12.3, 12	10.6 $\pm$ 2.4 (7.4-14.3)	9.4 $\pm$ 0.8 (8.6-10.6)	8.4	11.3 $\pm$ 0.6 (10.7-11.9)
Tail	289	268, 352	448	224, 254.5	270, 285	329.5 $\pm$ 41.2 (295-388)	374 $\pm$ 65.7 (328-490)	316	398.3 $\pm$ 23 (368-418)
Lip reg. diam.	10.5	11.5, 10.5	14	9.5, 9	9.5, 9.5	11.5 $\pm$ 0.9 (10.5-13)	13.6 $\pm$ 0.4 (13-14)	16	14.5 $\pm$ 0.4 (14-15)
Odontostyle	101	124, 122	154	94.3, 99	96, 96	127.4 $\pm$ 6 (121-136)	165.6 $\pm$ 3.1 (161-168)	172	160.5 $\pm$ 2.7 (157.5-164)
Repl. od.style	125	146.5, 154	194	106, 115	118.5, 120	158 $\pm$ 5 (150.5-171)	188.8 $\pm$ 2.5 (187-193)	195	180.5 $\pm$ 2.1 (178-183)
Odontophore	67	80, 85.5	107	57.5, 55.5	67, 69	86.2 $\pm$ 3 (82-90)	106 $\pm$ 4.5 (102-113)	107	106.1 $\pm$ 4.6 (101.5-111)
Stylet	168	204, 207.5	261	151.8, 154.5	163, 165	213.5 $\pm$ 7.6 (204.5-245)	271.6 $\pm$ 6.5 (264-281)	279	266.6 $\pm$ 5.4 (259-271.5)
Guid. ring	94	115, 118	150	85.3, 88	91, 89	123.4 $\pm$ 6.1 (114.5-130)	161.3 $\pm$ 3.4 (157-164)	162	150.1 $\pm$ 6.4 (141.5-157)
Nerve ring	203	235, 229	327	188, 196	204, 196	243.1 $\pm$ 10.6 (225-252.5)	290.4 $\pm$ 21.7 (260.5-312.5)	-	274.3 $\pm$ 21.2 (246-291)
Hemizonid	-	177, 190	222	141, 165	149, 152	203.8 $\pm$ 12.6 (168-223)	236.9 $\pm$ 9.4 (228.5-246)	242	224.8 $\pm$ 7.1 (217-231)
h	-	35, 37	44	27, 32	13, 35	35.6 $\pm$ 6.4 (29.5-44)	40.4 $\pm$ 10.3 (26-51.5)	15	63.8 $\pm$ 4.8 (59-70)
h%	-	13, 10.8	9.8	8, 20	4.8, 12.2	11 $\pm$ 2.2 (8.2-14)	13.4 $\pm$ 3.5 (8.6-16)	12	16.2 $\pm$ 1.6 (14.2-17.8)

tal branch complete with ovary 50-60  $\mu\text{m}$  long, slender oviduct 55-75  $\mu\text{m}$  long, *pars dilatata oviductus* 25-33  $\mu\text{m}$  long, sphincter, *pars dilatata uteri* 55-63  $\mu\text{m}$  long, and muscular uterus 137-188  $\mu\text{m}$  long. Genital tract without Z-differentiation. Ovejector bean-shaped to rounded, 50-58  $\mu\text{m}$  long. No sperm observed in any part of genital tract. Tail hemispherical with three pairs of caudal pores, one pair situated laterally and two pairs very near each other sublaterally. Blind terminal canal absent except in one specimen with a very faint terminal canal.

*Male:* Not found.

*Juvenile (J4):* General appearance as female except for tail, which is short, conical, and distinctly digitate with terminal peg and blind canal.

**TYPE HOST AND LOCALITY**

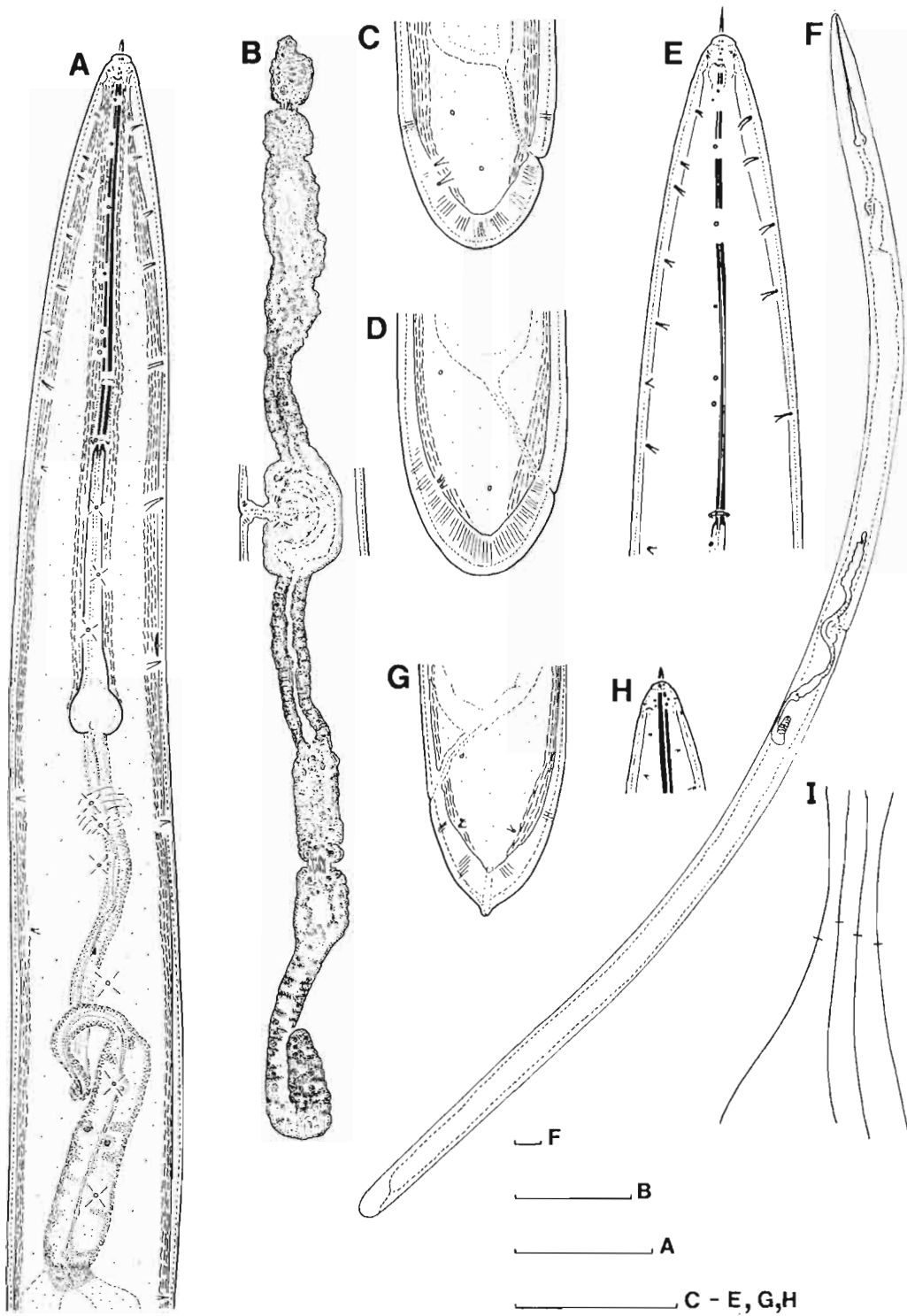
Loc. 16. Soil around the roots of *Dicorynia guianensis* Amshoff, Saül, Cascade Sauveur, Guyane (3°38' N, 53°12' W), collected by P. Quénéhervé and P. Topart in 1995.

**TYPE SPECIMENS**

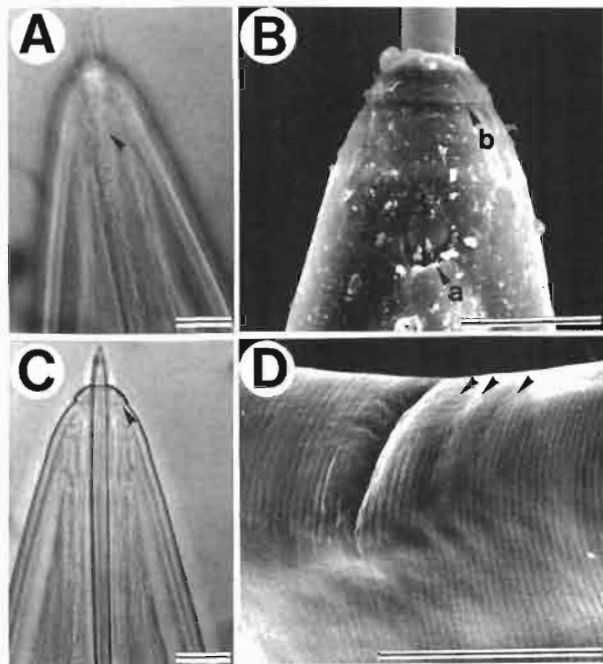
Holotype female on slide 31784; three paratype females and one juvenile on slides 31782 and 31783 deposited in the National Collection of Nematodes at the Plant Protection Research Institute, Pretoria, South Africa.

**DIAGNOSIS AND RELATIONSHIPS**

*X. labiosum* n. sp. has the following diagnostic characters: peri-oral ring present, amphid apertures small



**Fig. 6.** *Xiphinema labiosum* n. sp. A: Anterior body region; B: Reproductive system; C, D: Female tail; E: Anterior body region; F: Entire female; G: Tail of J4; H: Lip region of J4; I: Habitus. (Scale bars = 50  $\mu$ m.)



**Fig. 7.** *Xiphinema labiosum* n. sp. **A:** Lip region with light microscopy (LM), lateral view, showing small crescent-shaped amphid aperture (arrowhead); **B:** Lip region with scanning electron microscopy (SEM), lateral view, showing amphid aperture (arrowhead a) and peri-oral ring (arrowhead b); **C:** Lip region with LM, showing peri-oral ring (arrowhead) — *Xiphinema pseudokrugi* n. sp. **D:** Vulval region with SEM, showing slight cuticle ornamentation in the vicinity of the vulva (arrowheads). (Scale bars = 10 µm.)

and crescent shaped, lip region almost continuous with body outline, vulva anteriorly situated, anterior branch of genital tract incomplete, and tail short, hemispherical.

*X. labiosum* n. sp. is morphometrically close to *X. surinamense* Loof & Maas, 1972 but can be distinguished from it by the following morphological characters: peri-oral ring (distinct *vs* absent), amphid aperture (small, crescent-shaped *vs* slit-like, occupying about one-half of corresponding body diameter), lip region shape (almost continuous with body outline *vs* separated by weak depression from rest of body), habitus (weakly curved to almost straight *vs* weakly curved to C-shaped), number of caudal papillae (three *vs* two pairs), and tail shape of J4 (short, conical, distinctly digitate *vs* hemispherical). In the presence of a peri-oral ring, small crescent-shaped amphid apertures, and lip region continuous to almost continuous with body outline, *X. labiosum* sp. n. resembles only *X. filicaudatum labratum* Luc & Coomans, 1992. It is quite different from this species in tail shape (hemispherical *vs* filiform), shorter stylet

**Table 7.** Morphometrics of *Xiphinema labiosum* n. sp. (Loc. Guyane 16) (all measurements in µm except L in mm).

	Females		J4
	Holotype	Paratypes	
n	1	4	1
L	2.7	2.6 ± 0.1 (2.6-2.7)	2.5
a	66.1	63.1 ± 4 (56.9-66.9)	58.4
b	6.1	5.9 ± 0.1 (5.8-6.1)	5.5
c	109.2	98.8 ± 10.2 (85-109.2)	70.9
c'	0.6	0.6 ± 0.1 (0.6-0.7)	0.9
V	43	42.2 ± 1.6 (39.6-43.9)	—
Tail	25	27 ± 2.2 (25-30)	35
Lip reg. diam.	15	13.5 ± 1.8 (10.5-15)	12
Odontostyle	156.5	156 ± 2.2 (153-159)	132
Repl. od.	—	—	158
Odontophore	114	109.5 ± 3 (107-114)	101
Stylet	270.5	265.5 ± 3.1 (262.5-270.5)	233
Guid. ring	147	148.7 ± 3 (147-151.5)	132
Nerve ring	281	288.3 ± 4.7 (281-291.5)	—
Hemizonid	223	21701 ± 5 (212-223)	—
h	13	12.2 ± 0.8 (11-13)	14
h%	52	45.2 ± 4.3 (42-52)	40

(262.5-270.5 *vs* 294-314 µm), and shorter body (2.6-2.7 *vs* 3.27-3.76 mm).

*X. labiosum* is represented in the polytomous key of Loof and Luc (1990) by the following code: A2-B4-C7b(a); D6-E34-F3-G4-H1(2)-I12-J5a-K?-L?.

***Xiphinema longicaudatum* Luc, 1961**  
(Fig. 8)

MEASUREMENTS

*Female:* See Table 8.

**Table 8.** Morphometrics of females of *Xiphinema longicaudatum* (Loc. Guyane 10) (all measurements in  $\mu\text{m}$  except L in mm).

n	5
L	2.9 $\pm$ 0.1 (2.8-3)
a	65.3 $\pm$ 7.6 (59.8-74)
b	6 $\pm$ 0.4 (5.7-6.4)
c	10.2 $\pm$ 0.4 (9.7-10.7)
c'	8.2 $\pm$ 0.3 (7.9-8.5)
V	39.4 $\pm$ 0.3 (39-39.7)
Tail	284.8 $\pm$ 9.3 (275-295)
Lip reg. diam.	14.3 $\pm$ 0.5 (14-15)
Odontostyle	152.8 $\pm$ 2 (150-155.5)
Odontophore	93.7 $\pm$ 2.3 (90-96)
Stylet	246.5 $\pm$ 2.9 (243-249.5)
Guid. ring	137.2 $\pm$ 5.9 (130-146)
Nerve ring	229.5 $\pm$ 19.8 (210-263)
Hemizonid	188.7 $\pm$ 26.4 (167-218)
h	106 $\pm$ 3.9 (105-110)
h%	37.3 $\pm$ 1.7 (35-39)

#### DESCRIPTION:

*Female:* Habitus moderately ventrally curved, more curved in posterior third. Lip region rounded, slightly offset from rest of body. Amphid aperture 6.5-7  $\mu\text{m}$  wide, curved, occupying 46-50 % of lip region width, situated about 6  $\mu\text{m}$  from anterior end. Body pores conspicuous; distribution in neck region: ten to thirteen laterally, ten ventrally, three dorsally. Vestigium 3.5-5  $\mu\text{m}$  long. Basal flanges 16-17.5  $\mu\text{m}$  wide. Reproductive system with fully developed posterior branch and degenerate, much shorter anterior branch. Anterior branch with shorter tubular uterus, well-defined *pars dilatata uteri*, sphincter, oviduct and ovary represented by short mass of cells. Tail slightly ventrally curved with terminus bluntly pointed. Two caudal pores present.

*Male:* Not found.

#### REMARKS

*X. longicaudatum* has been described only from Africa, in Ivory Coast, Nigeria, and Cameroon (Luc, 1961; Luc & Hunt, 1978; Sakwe & Coomans, 1993, respectively). The specimens from Guyane (Loc. 10) agree well with the published descriptions of the species, except for longer tail (275-295 vs 166-241  $\mu\text{m}$ ) and shorter hyaline portion in relation to the tail length (35-39 vs 58-75 %). The amphid aperture is also slightly shorter compared to the lip region width (46-50 vs 55 % in *X. longicaudatum* from Cameroon) and the numbers of lateral and ventral pores in the neck region are different from those of specimens from Cameroon (ten to thirteen and ten vs 22 and seven). The only other species similar to the Guyane specimens is *X. filicaudatum filicaudatum* Loof & Maas, 1972. However, our specimens differ from that species in shape of lip region (slightly offset vs continuous), shorter stylet (243-249.5 vs 308-333  $\mu\text{m}$ ), shorter body (2.8-3 vs 4.6-4.70 mm), and shorter tail (275-295 vs 363-545  $\mu\text{m}$ ). In spite of the few minor differences with the African specimens, we consider the Guyane specimens as pertaining to *X. longicaudatum*.

#### *Xiphinema oryzae* Bos & Loof, 1985 (Fig. 9)

#### MEASUREMENTS

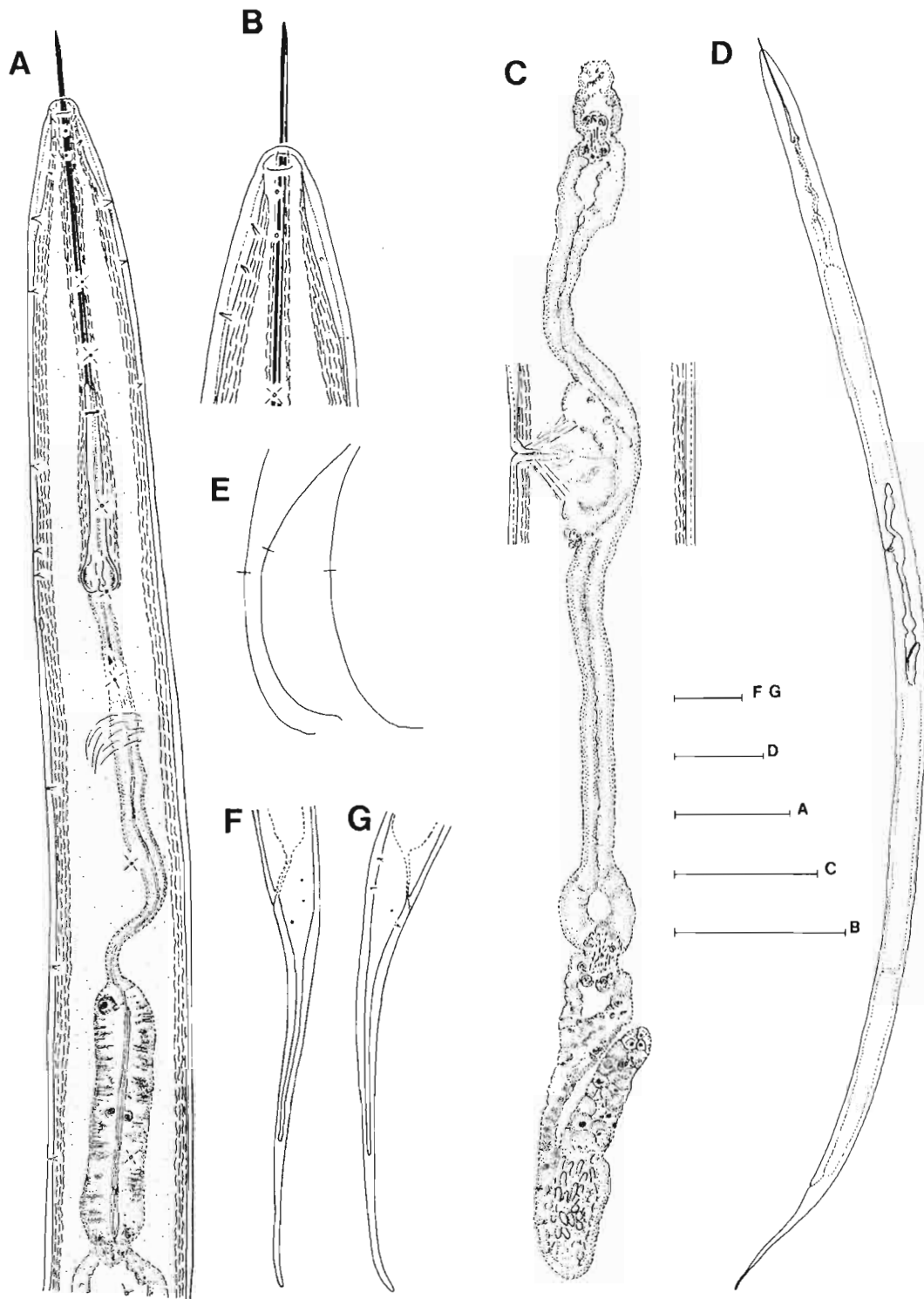
*Female, male and juvenile:* See Table 9.

#### DESCRIPTION

*Female:* Habitus weakly to moderately curved ventrally. Lip region 6-7  $\mu\text{m}$  high, rounded, slightly offset from rest of body. Amphid aperture 8-9  $\mu\text{m}$  wide, curved, occupying about 60 % of the lip region width, at 6-7  $\mu\text{m}$  from anterior end. Body pores conspicuous; distribution in neck region: fourteen to nineteen laterally, eight to ten ventrally, three to five dorsally. Vestigium 3-4  $\mu\text{m}$  long. Basal flanges 12-14  $\mu\text{m}$  wide. Reproductive system with two fully developed branches, sperm usually present in uterus. Z-differentiation consisting of numerous large angular to globular structures, adjacent to the *pars dilatata uteri*. Tail filiform, curved ventrally, terminus bluntly pointed. Two caudal pores present on either side of the tail.

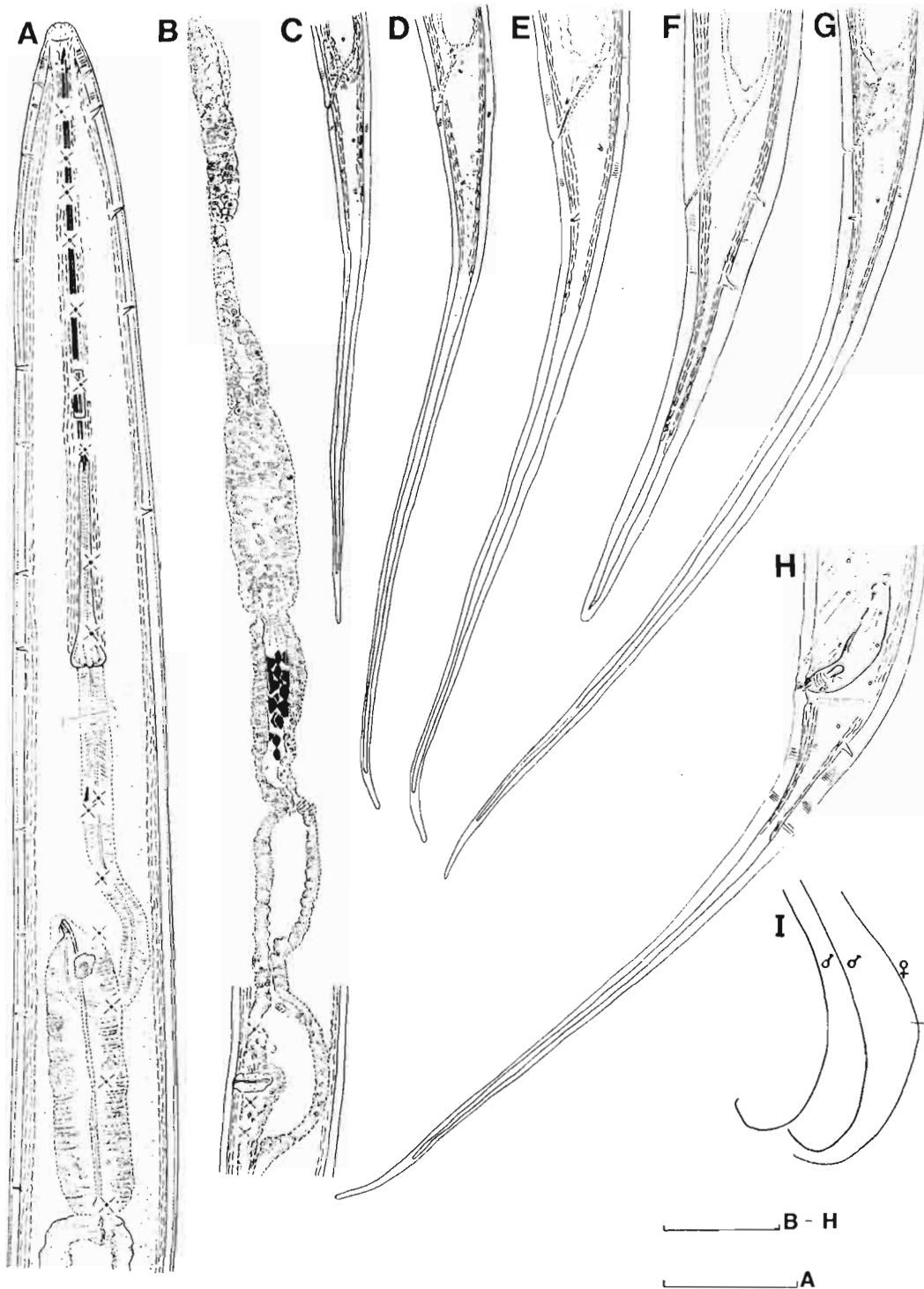
*Male:* General appearance as in female, with the following exceptions: Habitus ventrally curved into a J-shape. Spicules 58-59  $\mu\text{m}$  long; gubernaculum 19  $\mu\text{m}$  long. Supplements consisting of an adanal pair and two to four medioventral papillae. Three caudal pores present on either side of the tail.

*Juveniles:* General morphology as in females. Genital primordium in J2 and J4 23-27 and 36-53  $\mu\text{m}$  long, respectively.



**Fig. 8.** *Xiphinema longicaudatum* Luc, 1961. A: Anterior region; B: Anterior region, lateral view; C: Reproductive system; D: Habitus; E: Differences in habitus of three females; F, G: Tail region of two females. (Scale bars: D = 0.2 mm; others = 50  $\mu$ m).





**Fig. 9.** *Xiphinema oryzae* Bos & Loof, 1985. *A*: Anterior body region of male; *B*: Anterior genital branch; *C*: Tail of J2; *D*: Tail of J3; *E*: Tail of J4; *F*: Atypical female tail, presumably broken at some stage; *G*: Typical female tail; *H*: Male tail; *I*: Habitus. (Scale bars = 50  $\mu$ m.)

**Table 9.** Morphometrics of *Xiphinema oryzae* Bos & Loof, 1985 (all measurements in  $\mu\text{m}$  except *L* in mm).

	Guyane 3		Guyane 7			Guyane 11				
	Female	Male	Female	Male	J2	Female	Male	J2	J3	J4
n	1	1	2	1	1	1	1	2	3	5
L	–	3.4	3.7, 4.2	4	1.5	3.5	3.4	1.8, 2	2.3-2.4	2.9 $\pm$ 0.3 (2.6-3.2)
a	–	59.3	71.8, 72.4	82.4	48.2	45.9	53.3	52.4, 47.6	50.1-51.5	50.8 $\pm$ 0.7 (50.2-51.2)
b	–	8.9	7.8, 9.2	8.7	4.6	5.9	7.7	5.2, 6	5.3-6	7.3 $\pm$ 0.9 (6.6-8.5)
c	–	10.9	8.8, 10.5	11.3	12.4	8.1	10.9	7.1, 7.6	7.4-9	9.9 $\pm$ 1.8 (8.2-12.4)
c'	–	8	13.3, 12.6	9.7	6.3	10.5	7.3	13.2, 10.9	9.1-11.5	9.5 $\pm$ 0.7 (8.7-10.5)
V / T	–	–	41.8, 39.5	41	–	43	36	–	–	–
Tail	broken	312	415, 395	350	119	433	310	248, 260	253-303	299.5 $\pm$ 32.1 (261-335)
Lip reg. diam.	14.5	12.5	12.5, 14	14.5	–	13.5	13	9, 9.5	10-11.5	12
Odontostyle	166.5	154	152, 162.5	152	86.5	151.5	156	87, 88	106-111	129.1 $\pm$ 5.1 (123-135.5)
Repl. od.style	–	–	–	–	99	–	–	113, 119	128.5-135.5	150.5 $\pm$ 2.3 (147.5-153)
Odontophore	84	80	81.5, 84.5	81.5	51	75	78	52, 54	60-61	69.6 $\pm$ 1.8 (68-72)
Stylet	250.5	234	233.5, 247	233.5	137.5	226.5	234	139, 142	166-171	198.8 $\pm$ 4.8 (193-204)
Guid. ring	161	148	142, 158.5	147	82.5	138	150	78.5, 85.5	101-104	117.9 $\pm$ 5.1 (112-124.5)
Nerve ring	254	255	260,-	262	147	–	–	136.5, 146	177-198	203 $\pm$ 8.1 (193-211)
Hemizonid	222	–	223, 235	227	141	217	244	–, 140	169-179.5	198.1 $\pm$ 4.1 (193.5-201)
h	–	54	34, 42.5	37	23.5	46	36	22.5, 5	8.8-22.5	15.7 $\pm$ 8.7 (7.5-23.8)
h%	–	17	8, 10.8	10.6	19.7	10.6	11.6	9, 1.9	3.5-7.4	5.2 $\pm$ 2.9 (2.2-8.3)

## REMARKS

These specimens are similar to the *X. oryzae* specimen described by Luc and Coomans (1992) from Guyane. However, the two males from the present populations are the first to be described from South America. As noted by Luc and Coomans (1992) in the specimen they described, the present females of *X. oryzae* differ from those of the type population by longer body, much longer tail, difference in Z-differentiation, and longer odontostyle. Compared to the single male in the type population, the present males have longer body (3.4-4.0 vs 2.79 mm), longer tail (310-350 vs 155  $\mu\text{m}$ ), and longer odontostyle (233.5-234 vs 180  $\mu\text{m}$ ). No ventromedian supplements were visible in the males of the present populations from Guyane.

*Xiphinema pseudokrugi*\* n. sp.  
(Figs 10, 7D)

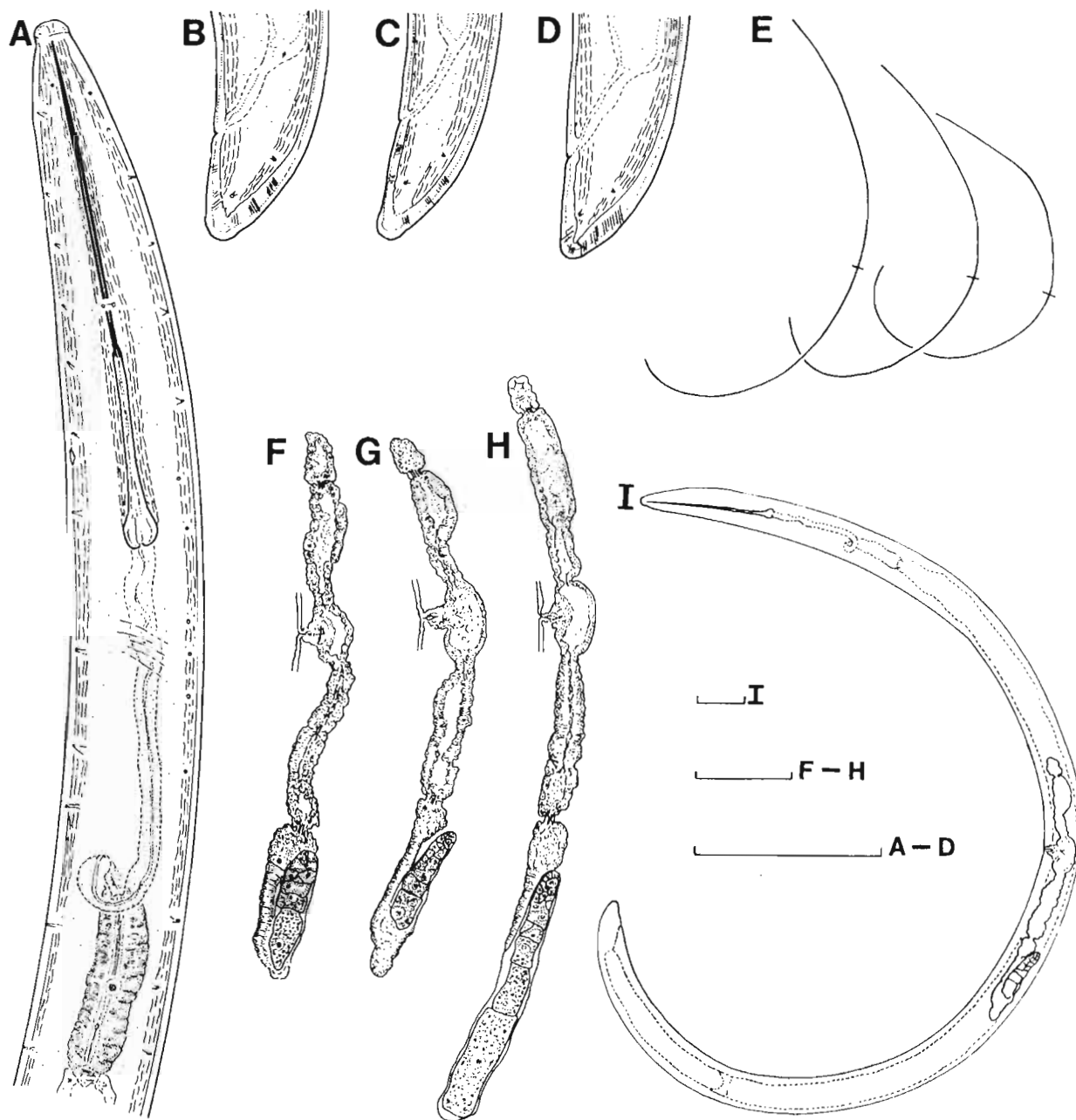
## MEASUREMENTS

*Female*: See Table 10.

## DESCRIPTION

*Female*: Habitus hook-shaped, curvature more pronounced in posterior one-third. Lip region 4.5-5  $\mu\text{m}$  high, rounded, offset from rest of body by a weak depression. Body tapering anteriorly; diameter at base of pharynx about four times width of lip region. Amphid aperture 6  $\mu\text{m}$  wide, occupying about 60 % of lip region width. Cuticle 1.5-2.5  $\mu\text{m}$  wide in mid-

\* The species name *pseudokrugi* refers to the resemblance to *X. krugi*.



**Fig. 10.** *Xiphinema pseudokrugi* n. sp. **A:** Anterior body region of holotype; **B - D:** Tail shape of three different females; **E:** Habitus; **F - H:** Reproductive systems of three different females; **I:** Entire holotype female. (Scale bars = 50  $\mu$ m.)

body, 3-4  $\mu$ m near lip region, 4.5-6  $\mu$ m on dorsal side of tail. Cuticle on tail and near lip region with faint radial striae. Body pores small, difficult to see; approximate distribution in neck region: fifteen laterally, thirteen ventrally, and three dorsally. Basal flanges 8.5-11  $\mu$ m long. Pharynx 274-336  $\mu$ m long,

basal bulb 55.5-60  $\times$  15-17  $\mu$ m. Pharyngeal glands and opening obscure: DO located at about 10 % of basal bulb length, DN at about 12 %, SN<sub>1</sub> and SN<sub>2</sub> at about 50 %, and SO at 70 %. Reproductive system with fully developed posterior branch and reduced, much shorter anterior branch with ovary absent, ovi-

**Table 10.** Morphometrics of females of *Xiphinema pseudokrugi* n. sp. (all measurements in  $\mu\text{m}$  except L in mm).

	Guyane 10		Guyane 8
	Holotype	Paratype	
n	1	1	5
L	1.4	1.4	1.5 $\pm$ 0.1 (1.4-1.6)
a	33.8	33.7	46.7 $\pm$ 3.7 (42.1-51.8)
b	5	4.5	4.7 $\pm$ 0.3 (4.2-5)
c	52.8	50.2	47.1 $\pm$ 1.9 (44.5-49.3)
c'	1.1	1.1	1.5 $\pm$ 0.1 (1.4-1.7)
V	47.1	48.2	49 $\pm$ 0.9 (47.6-50.1)
Tail	26.5	27.5	30.5 $\pm$ 2.9 (26.5-33.5)
Lip reg. diam.	10	10	10 $\pm$ 0.3 (9.5-10.5)
Odontostyle	86	88.5	100.1 $\pm$ 3.3 (95-102.5)
Odontophore	55	53	55 $\pm$ 1.6 (53.5-57.5)
Stylet	141	141.5	155.1 $\pm$ 4.5 (148.5-159)
Guid. ring	78	82.5	86.2 $\pm$ 2.2 (83-89)
Nerve ring	145.5	161	166 $\pm$ 9.6 (155-178)
Hemizonid	140	142.5	148.4 $\pm$ 5.7 (138.5-153)
h	6	5.5	5.6 $\pm$ 0.9 (4.5-7)
h%	23	20	18.1 $\pm$ 3.7 (13.8-23)

duct reduced to a small mass of cells, and sphincter and uterus recognisable but reduced. *Pars dilatata uteri* larger in the anterior than in the posterior branch, with large cells in one specimen (Fig. 10H). Dimensions of the reproductive system as follows: anterior branch: tubular uterus 22-34  $\mu\text{m}$ , *pars dilatata uteri* 34-62  $\mu\text{m}$ , oviduct reduced to a mass of cells 22-28  $\mu\text{m}$ , ovejector 28-39  $\mu\text{m}$ ; posterior branch: tubular uterus 45-67  $\mu\text{m}$ , *pars dilatata uteri* 22-25  $\mu\text{m}$ , *pars dilatata oviductus* 21-28  $\mu\text{m}$ , oviduct 45-53  $\mu\text{m}$ , ovary 70-146  $\mu\text{m}$ . Vagina reaching halfway across body. Slight cuticular ornamentation occurring anterior and posterior of the vulva. In most specimens, prerectum obscure, constituting 14 % of body length. Tail convex-conoid with main curvature on dorsal

outline, the ventral outline almost straight. Tail terminus varying from almost smoothly rounded to distinctly bulging. No terminal canal observed but outermost cuticular layer appearing disjointed at the tail extremity in most specimens. Two pairs of caudal pores observed; one pair near terminus in lateral position, one pair closer to anus, subdorsal in position.

*Male*: Not found.

#### TYPE HOST AND LOCALITIES

Loc.8: Rhizosphere of Marantaceae, Saut Brodel, Guyane (4°15' N, 52°40' W). Loc. 10: rhizosphere of *Dicorymia guianensis* Amshoff; Paracou, Guyane (5°20' N, 52°50' W). Collected by P. Quénéhervé and P. Topart in 1995.

#### TYPE SPECIMENS

Holotype female on slide 31795, six paratype females on slides 31794 and 31795 deposited in the National Collection of Nematodes, Plant Protection Research Institute, Pretoria, South Africa.

#### DIAGNOSIS AND RELATIONSHIPS

*X. pseudokrugi* n. sp. is characterised by incomplete anterior genital branch with oviduct reduced to a single mass of cells and sphincter and uterus recognisable but reduced; Vulva situated almost at mid-body, slight cuticular ornamentation anterior and posterior of vulva, tail convex-conoid with smoothly rounded to bulging terminus.

*X. pseudokrugi* n. sp. is most closely related to *X. krugi* Lordello, 1955. However, it differs from that species in position of vulva (V = 47.1-50.1 *vs* 28.6-36), slight cuticular ornamentation around vulva (absent in *X. krugi*), somewhat shorter odontostyle (86-103 *vs* 94-129  $\mu\text{m}$ ), shorter odontophore (53-57.5 *vs* 60-84  $\mu\text{m}$ ), shorter stylet (141-159 *vs* 154-207  $\mu\text{m}$ ), and shorter body (1.38-1.58 *vs* 1.55-2.59 mm). The morphometrics of *X. krugi* are based on the description of Luc and Hunt (1978). *X. pseudokrugi* n. sp. is also morphologically near to *X. paulistanum* Carvallo, 1965 but can be distinguished mainly by the following characters: position of vulva (V = 47.1-50.1 *vs* 41.5), tail shape (convex-conoid with terminus from smoothly rounded to distinctly bulging *vs* conical with short, thick terminal bulge), shorter odontostyle (122  $\mu\text{m}$  in *X. paulistanum*), shorter odontophore (60  $\mu\text{m}$  in *X. paulistanum*), and shorter body (1.76 mm in *X. paulistanum*). By stylet length, reduced anterior branch of reproductive system, and tail morphology, *X. pseudokrugi* n. sp. also resembles *X. llanosum* Siddiqi & Lenné, 1990. *X. pseudokrugi* n. sp. differs from *X. llanosum* in position of vulva (V = 42-47 in *X. llanosum*), degree of reduction of anterior reproductive branch (uterus and sphincter recognisable but reduced *vs* uterus and sphincter normal, as long as posterior branch), shorter body (2.3-2.7 mm in *X. llanosum*), lower c'-value (44.5-52.8 *vs* 86-114), and higher c'-value (1.1-1.7 *vs* 1-1.2).

*X. pseudokrugi* n. sp. belongs to Group 2 in the polytomous key of Loof and Luc (1990). Its code is: A2-B4-C6b-D45-E5(6)-F12-G12, H2-I3-J?-k?-L-?. It is close to *X. krugi*, but differs in E.

#### REMARKS

This is the first report of a *Xiphinema* sp. from South America with vulval ornamentation. The other five species with similar ornamentation are all described from South Africa (Swart, 1994) and are characterised by conical to long tails ( $c' = 2-7.8$  in these species).

#### *Xiphinema seinhorsti*\* n. sp. (Fig. 11)

#### MEASUREMENTS

*Female and juveniles:* See Table 11.

#### DESCRIPTION

*Female:* Habitus from weakly curved ventrad to J-shaped. Cuticle with two well-defined layers, thickened and striated towards both extremities. Cuticle thickness: 4.5-6  $\mu\text{m}$  in neck region just posterior of lip region, 3.5-5  $\mu\text{m}$  at mid-body, 11-13  $\mu\text{m}$  on dorsal side of tail. Lateral chord 14-18  $\mu\text{m}$  wide at mid-body. Body pores numerous and conspicuous; distribution in neck region: seventeen to 24 situated laterally, four to five situated dorsally, ten to fourteen ventrally. Lip region high, rounded when viewed dorso-ventrally; broadly rounded and set off from rest of body by a shallow depression when viewed laterally. Amphidial fovea stirrup-shaped; aperture occupying about 66 % of lip region width and situated at the level of the shallow depression. Odontostyle and odontophore well-developed; flanges well-defined, 12-15  $\mu\text{m}$  wide. Vestigium 1.5-4  $\mu\text{m}$  long, situated in anterior region of slender part of pharynx. Hemizonid well-defined, from slightly anterior to just posterior of flanges. Nerve ring surrounding anterior part of slender pharynx at a short distance behind the flanges. Basal bulb 97-126  $\times$  23-30  $\mu\text{m}$ . Ventrosublateral pharyngeal gland nuclei located at about mid-bulb, both on the same level or one slightly posterior to the other. Position of gland nuclei and gland outlets ( $n = 8$ ): DO = 4-6 %, DN = 4-10 %, SO =  $\pm 48$  %, SN<sub>1</sub> and SN<sub>2</sub> = 45-57 %. Ventrosublateral gland outlets obscure in most specimens. Cardia conical, sometimes flattened, surrounded by intestine. Prerectum difficult to measure in most specimens, 215-334  $\mu\text{m}$  long (6-9 % of body length) in six specimens. Rectum well-defined, 30-50  $\mu\text{m}$  or 0.8-1.2 times anal body diameters long. Tail short, convex-conoid with greater curvature dorsally, with exceptionally long finger-like projection or

peg, clearly offset from rest of tail and situated to ventral side of tail. Blind canal present at tail terminus (some specimens with shorter pegs, perhaps due to injury). Two pairs of caudal pores present: one pair situated in a subventral position, a short distance posterior of anus; second pair in subdorsal or sublateral position, slightly posterior of subventral pair (this pair absent or obscure in some specimens). Female reproductive system amphidelphic with the two genital branches equally developed. Each branch consisting of reflexed ovary (50-92  $\mu\text{m}$ ), slender part of oviduct (55-95  $\mu\text{m}$ ), *pars dilatata oviductus* (22-36  $\mu\text{m}$ ), sphincter, large *pars dilatata uteri* (54-69  $\mu\text{m}$ ), long, tubular, sometimes convoluted uterus (114-182  $\mu\text{m}$ ) containing a weakly developed Z-differentiation, well demarcated ovejector (60-80  $\mu\text{m}$ ), and vagina (29-34  $\mu\text{m}$ ) stretching about halfway across the body width. Z-differentiation consisting of three to four small granular bodies (2-5  $\times$  1-3  $\mu\text{m}$ ), situated 25-49  $\mu\text{m}$  from the *pars dilatata uteri*. In some specimens, the Z-differentiation is obscure and appears to consist of a few small granules. As the uterine wall enclosing the Z-differentiation is not particularly muscular or thickened, the differentiation represents a pseudo Z-organ (according to Loof & Luc, 1990). Vulva a transverse slit. Dimensions of one intra-uterine egg: 95  $\times$  22  $\mu\text{m}$ ; shell 1-3.5  $\mu\text{m}$  thick. No sperm found within reproductive system.

*Male:* Not found.

*Juveniles:* One third stage (J3) and one fourth stage (J4) juvenile found. The J3 has a fully developed replacement odontostyle, surrounded by a protective sheath. The developing gonad is a flattened structure (56  $\times$  7.7  $\mu\text{m}$ ) filled with several large cells with prominent nuclei. Also, the habitus is almost straight whereas the J4 has C-shaped body, which suggests that the J3 is moulting (see Samsoen & Barbez, 1982). The developing gonad of the J4 is a compact, roundish mass of cells (44  $\times$  27  $\mu\text{m}$ ) and the length of the replacement odontostyle corresponds well with that of the odontostyle of the adults. In both juveniles, the tail differs from that of adult females by being longer, elongate, and without an offset peg. The rest of morphology resembles that of adult females, except for a shorter body.

#### TYPE HOST AND LOCALITIES

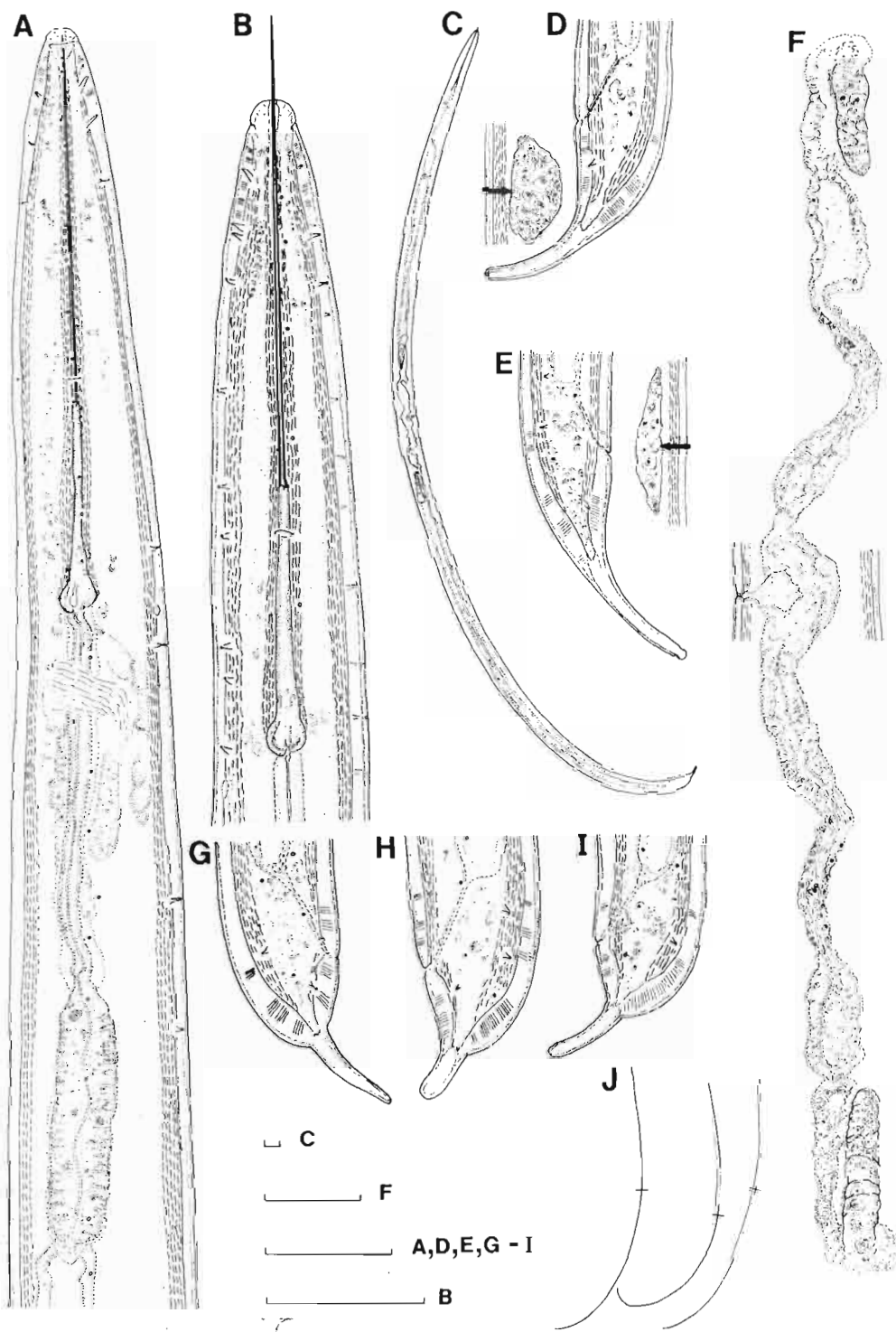
Loc. 10: Soil around roots of *Dicorynia guianense* Amshoff, Paracou, Guyane (5°20' N, 52°50' W). Collected by P. Quénehervé in 1994.

Other localities: Loc. 4, 5, and 7 (see above).

#### TYPE SPECIMENS

Holotype and three paratype females on slide 30844 and six paratype females and one juvenile on slides 30845 and 30846 deposited in the National Collection of Nematodes at the Plant Protection Research Institute,

\* The species name commemorates the late Dr J.W. Seinhorst.



**Fig. 11.** *Xiphinema seinhorsti* n. sp. A: Anterior body region, lateral view; B: Anterior region, dorso-ventral view; C: Entire female; D: J4, tail region and developing gonad (arrowhead); E: J3, tail region and developing gonad (arrowhead); F: Female reproductive system; G - I: Female tail regions; J: Habitus. (Scale bars = 50  $\mu$ m.)

**Table 11.** Morphometrics of *Xiphinema seinhorsti* n. sp. (all measurements in  $\mu\text{m}$  except L in mm).

	Guyane 4				Guyane 5	Guyane 7	Guyane 10
	Holotype female	Paratype female	J3	J4	Female	Female	Female
n	1	12			8	12	3
L	3.3	3.5 $\pm$ 0.3 (3.1-4.3)	2.9	2.8	3.5 $\pm$ 0.3 (3.1-4)	3.3 $\pm$ 0.2 (2.9-3.6)	3.1-3.3
a	51.4	68.1 $\pm$ 6.9 (57.5-82.1)	67	64.2	63.8 $\pm$ 9.5 (49-73.2)	67.5 $\pm$ 3.8 (62.6-74)	56-57.9
b	7.7	7.7 $\pm$ 0.9 (6.2-9.2)	9.9	6.4	7.9 $\pm$ 1 (7.1-10.4)	7.3 $\pm$ 0.4 (6.9-8.3)	6.7-7.5
c	57.2	63.7 $\pm$ 8.7 (46.6-76.4)	29.3	30.8	64.2 $\pm$ 10.1 (50.8-78.5)	67.9 $\pm$ 6.8 (58.3-77.3)	63.3-67.1
c'	1.4	1.4 $\pm$ 0.2 (1.2-1.6)	2.9	2.5	1.4 $\pm$ 0.2 (1.2-1.6)	1.2 $\pm$ 0.1 (1-1.4)	1.2
V / T	39.9	39.4 $\pm$ 1.9 (36.4-43.6)	-	-	40 $\pm$ 1 (39-41.5)	41.4 $\pm$ 1.1 (39.5-42.8)	36.9-41.5
Tail	58.5	56.2 $\pm$ 5.8 (49-67)	100	89.5	54.8 $\pm$ 6.3 (48-62)	47.9 $\pm$ 2.9 (42-51)	49-49.5
Lip reg. diam.	12.5	13.7 $\pm$ 0.7 (12.5-15)	12	12.5	13.5 $\pm$ 0.6 (13-14.5)	13 $\pm$ 0.7 (12-14)	13-15
Odontostyle	175.5	156.7 $\pm$ 7 (147.5-175.5)	137	135	150.2 $\pm$ 4.1 (145-156.5)	144.9 $\pm$ 5.9 (138 0-157.5)	150-155.5
Repl. od.style Odontophore	- 85	- 85.2 $\pm$ 2.7 (81.5-90)	147 78.5	161 76	83.3 $\pm$ 2.3 (80.5-87.5)	79.2 $\pm$ 1.5 (76.5-81.5)	84-88
Stylet	260.5	241.9 $\pm$ 8.2 (230-260.5)	215.5	211	233.5 $\pm$ 5 (228.5-243.5)	224.1 $\pm$ 6 (217-236.5)	234-240.5
Guid. ring	175	148.9 $\pm$ 10.1 (136.5-175)	96	124	144.5 $\pm$ 4.3 (137.5-149.5)	139.2 $\pm$ 9 (121-149)	146.5-161
Nerve ring	264	259.4 $\pm$ 10.8 (236.5-276)	152	225	255.4 $\pm$ 7.8 (244-265)	244.1 $\pm$ 21.1 (204-273)	238-241
Hemizonid	231	230.3 $\pm$ 8.3 (214-243)	143	203	223.8 $\pm$ 6.6 (217.5-233)	207.9 $\pm$ 14.5 (173-221)	200-219.5
h	29	32 $\pm$ 5 (22-40)	54.5	44	32.1 $\pm$ 5.3 (25-40)	24.6 $\pm$ 3.1 (20.5-29)	30-32
h%	50	56.9 $\pm$ 7.3 (44.4-61.8)	54.5	49	58.4 $\pm$ 4.3 (50-64.5)	51.4 $\pm$ 5.6 (40.2-56.9)	61.2-65.3

Pretoria, South Africa. Three paratype females and one juvenile deposited in the collection of the Muséum National d'Histoire Naturelle, Laboratoire de Biologie Parasitaire, Protistologie, Helminthologie, Paris, France.

#### DIAGNOSIS AND RELATIONSHIPS

*X. seinhorsti* n. sp. is characterised by a long caudal, offset, fingerlike projection located on the ventral side of tail, presence of a blind canal at the tail terminus, long odontostyle, long odontophore, and pseudo-Z-organ consisting of a small number of small granular bodies in the uterus.

*X. seinhorsti* n. sp. is closely related to four *Xiphinema* species: *X. imambaksi* Loof & Maas, 1972, *X. mammatum* Siddiqi, 1979, *X. stockeri* Kruger &

Heyns, 1985, and *X. manubriatum* Luc, 1975. The new species is closest to *X. imambaksi*, especially in the appearance of the peg, but it can be distinguished by the following characters: longer body (2.9-4.302 vs 2.5-3.2 mm), longer odontostyle (138-175.5 vs 119-136  $\mu\text{m}$ ), longer odontophore (76.5-90 vs 64-70  $\mu\text{m}$ ), longer peg (22-40 vs 18-20  $\mu\text{m}$ ), smaller number of caudal pores (two vs three pairs), Z-differentiation different (few small granular bodies vs distinct sclerotized apophysis), and vulva slightly more anterior (V = 36.4-43.6 vs 40-45). *X. seinhorsti* n. sp. differs from the female of *X. mammatum* mainly in longer odontostyle (110  $\mu\text{m}$  in *X. mammatum*), longer odontophore (73  $\mu\text{m}$  in *X. mammatum*), different kind of Z-differentiation (stellate uterine spines in *X. mammatum*),

longer peg, located on ventral side of tail (13 µm long peg, situated on central axis in *X. mammatum*), and J4 with longer tail (89.5-100 vs 49 µm). *X. seinhorsti* n. sp. can be distinguished from *X. stockeri* by longer odontostyle (98.3-105 µm in *X. stockeri*), longer odontophore (65-75 µm in *X. stockeri*), difference in position and length of peg (on central axis of body, 11-12.5 µm long in *X. stockeri*), longer tail (40-50 µm in *X. stockeri*), and difference in Z-differentiation (15-28 irregular granular bodies in *X. stockeri*). *X. seinhorsti* n. sp. differs from *X. manubriatum* mainly in longer body (1.77-2.23 mm in *X. manubriatum*), vulva more anterior (51.3-56.3 % in *X. manubriatum*), different kind of Z-differentiation (Z-organ present in *X. manubriatum*), and longer odontostyle and odontophore (132-144 and 61-70 µm, respectively, in *X. manubriatum*).

In the polytomous key of Loof and Luc (1990), *X. seinhorsti* n. sp. is represented by the following code: A4-B2-C5A-D(4)5-E34-F34-G34-H2-I23-J2-K?-L1. It is close to *X. imambaksi* but differs in c-value.

#### REMARKS

One Guyane specimen (Loc. 7) has smaller body (2.9 mm), odontostyle (138 µm), and odontophore (76.5 µm). Its lip region, tail, and reproductive system morphology agrees well with the description of the new species, which warrants its inclusion in this species.

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