Description of *Xiphinema thorneanum* n. sp. and observations on some species of the genus (Nemata : Longidoridae)

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SUMMARY

Xiphinema thorneanum n. sp. (= *X. vuittenezi apud* Thorne, 1974) from South Dakota, USA, is described; it is characterized by long, distinct uterine spines and the peculiar tail shape, rounded and with, in both sexes, a short conical terminal mucro, unique in the genus. Examination or paratypes of *X. pararadicicola* Phukan & Sanwal, 1982 and of specimens of a population of *X. radicicola* Goodey, 1936 recorded by Loos (1949) from Sri-Lanka, led the authors to consider the former species as a junior synonym of the latter. Examination of paratypes of *X. hydrabadense* Quiraishi & Das, 1984 led the authors to consider this species as a junior synonym of *X. elongatum* Schuurmans Stekhoven & Teunissen, 1938. Additional observations on paratypes of *X. melitense* Lamberti, Bleve-Zacheo & Arias, 1982, particularly the female reproductive tracts, are also reported.

RÉSUMÉ

Description de Xiphinema thorneanum *n. sp. et observations sur quelques espèces du genre (Nemata : Longidoridae)*

Xiphinema thorneanum n. sp. (= *X. vuittenezi apud* Thorne, 1974), provenant du South Dakota, USA, est décrit; il est caractérisé par la présence de longues et fortes épines utérines et par la forme de la queue qui chez les deux sexes est arrondie et comporte un mucron terminal court et conique, unique dans le genre. L'examen de paratypes de *X. pararadicicola* Phukan & Sanwal, 1982 et de la population de *X. radicicola* Goodey, 1936 décrite par Loos (1949) du Sri-Lanka a conduit à considérer la première espèce comme un synonyme mineur de la seconde. L'étude de paratypes de *X. hydrabadense* Quiraishi & Das, 1984 a montré que cette espèce devait être considérée comme un synonyme mineur de *X. elongatum* Schuurmans Stekhoven & Teunissen, 1938. Des observations complémentaires, concernant principalement l'appareil génital femelle, sur des paratypes de *X. melitense* Lamberti, Bleve-Zacheo & Arias, 1982 sont également rapportées.

Xiphinema thorneanum n. sp.
= *X. vuittenezi apud* Thorne, 1974

(Figs 1, 2 & 3)

Thorne (1974) reported *Xiphinema vuittenezi* Luc *et al.*, 1964 from native prairie soil from three locations in South Dakota, USA. However, the description and illustrations of these populations contained some important differences when compared with the original description of *X. vuittenezi*, namely the reported presence of a Z organ, numerous males and the particular shape of the tail peg in both sexes.

Due to the courtesy of Dr. J. D. Smolik, reexamination of Thorne's material was possible. From observations made the authors do not consider these specimens to be *X. vuittenezi*, but to represent a new species described here as *Xiphinema thorneanum* n. sp.

MEASUREMENTS

Females :

(Cottonwood, type population; n = 14).
L = 3.47 mm ± 0.25 (2.94-3.83); a = 71.5 ± 3.11

* Nematologist from ORSTOM.

(66.9-76.6); b = 8.9 ± 1.02 (7.0-10.3); tail = 30.5 µm ± 3.15 (27-36); c = 115 ± 14.96 (91.9-133.6); c' = 1.0 ± 0.10 (0.9-1.1); V = 45.2 ± 0.86 (43.8-46.9); odontostyle = 98 µm ± 4.04 (89-105); odontophore = 64 µm ± 1.84 (61-67); stylet = 162 µm ± 4.18 (153-170).

(pop. Mobridge; n = 4).
L = 3.17 mm (2.81-3.49); a = 63.1 (57.4-74.3); b = 7.6 (6.5-8.7); tail = 30 µm (29-31); c = 105.6 (94.8-116.3); c' = 0.9 (0.9-1.0); V = 48.1 (46.6-49.3); odontostyle = 99 µm (95-102); odontophore = 65 µm (63-69); stylet = 164 µm (159-171).

(pop. Presho; n = 1).
L = 3.63 mm; a = 64.8; b = 9.3; tail = 27 µm; c = 134.4; c' = 0.8; V = 48.5; odontostyle = 101 µm; odontophore = 65 µm; stylet = 166 µm.

Males :
(Cottonwood, type population; n = 10).
L = 3.46 mm ± 0.25 (3.10-3.83); a = 76.1 ± 2.96 (72.9-82.6); b = 8.8 ± 0.66 (7.9-9.8); tail = 33.5 µm ± 1.26 (32-36); c = 103.3 ± 7.89 (95.3-114.9); c' = 0.9 ± 0.07 (0.9-1.1); odontostyle = 100 µm ± 3.49 (94-106); odontophore = 63 µm ± 3.65 (55-67); stylet = 163 µm ± 4.05 (156-169); spicules = 64.5 µm ± 1.57 (62-67); lat. guiding pieces = 11.5 µm (9-14).

(pop. Mobridge; n = 2).
L = 3.33, 3.37 mm; a = 79.1, 66.1; b = 8.1, 8.2; tail = 31, 37 µm; c = 107.4, 91.1; c' = 1.1, 1.0; odontostyle = 104, 102 µm, odontophore = 66, 64 µm; stylet = 170, 166 µm; spicules = 63, 65 µm; lat. guiding pieces = 8, 11 µm.
(pop. Presho; n = 1).
L = 3.45 mm; a = 70.4; b = 9.3; tail = 35 µm; c = 98.6; c' = 1.0; odontostyle = 97 µm; odontophore = 63 µm; stylet = 160 µm; spicules = 69 µm; lat. guiding pieces = 12 µm.

Juveniles st. 4 (pop. Cottonwood; n = 4).
L = 2.50 mm (2.45-2.61); a = 65.2 (62.1-70.0); b = 7.8 (7.0-8.4); tail = 37 µm (34-39); c = 67.8 (63.1-73.2); c' = 1.2 (1.1-1.3); odontostyle = 81 µm (77-86); odontophore = 54 µm (53-56); stylet = 135.5 µm (132-139); repl. odontostyle = 101 µm (100-102).

Holotype (female) :
L = 3.28 mm; a = 68.3; b = 8.9; tail = 27 µm; c = 121.5; c' = 0.9; V = 45.4; odontostyle = 99 µm; odontophore = 62 µm; stylet = 161 µm.

Description

Female : When heat-relaxed, body habitus from J shape to open spiral. Cuticle apparently composed of two layers, 4-4.5 µm thick at mid-body, 5-5.5 µm in the post-labial region. Lateral chord 9.5 µm (7-12) wide at mid-body, or 19.5 % (16-24) of the corresponding diameter. Body pores prominent; in the neck region 14-20 lateral pores starting as a single row becoming a staggered double row posterior to the nerve ring; 3-5 dorsal pores; 10-14 ventral pores. Lip region rounded, 12-13 µm in diameter, set off from the rest of the body by a very weak depression. Amphidial slit straight, large (62-69 % of the corresponding diameter), situated in front of the depression. Hemizonid flat, 5-9 µm wide, situated at 173 µm (165-186) from anterior end; hemizonion lenticular, 3-3.5 µm wide, situated at 232 µm (221-241) from anterior end. Stylet typical; basal flanges of odontophore 12 µm (10-13) wide. Stylet guiding apparatus appearing tubular; basal ring at 81 µm (73-90) from anterior end; length of the " tube " variable (5-32 µm), depending on retraction or protraction of the stylet. Pharyngeal bulb clearly demarcated at anterior end, cylindrical, measuring 78 × 22 µm (65-87 × 21-33); nuclei of ventrosublateral pharyngeal glands nearly as large as the nucleus of the dorsal gland; pharyngo-intestinal junction a conical valve. Vulva a transverse slit; vagina perpendicular to long body axis, reaching half or more of the corresponding diameter; vaginal sphincter crescent shaped in profile; two genital branches, with approximatively the same length and the same structure; ovejector symmetrical, muscularized; tubular portion of the uterus thin walled and provided with numerous distinct, straight, long spines, directed away from vulva; proximal part of this tubular portion (in vicinity of the uterine pouch) has a thicker wall, slightly muscularized and containing one to four opaque granules; this structure, which may be considered as a very slightly differentiated pseudo-Z-organ, is variable and may even be absent in some specimens; uterine pouch well developed, generally containing spermatozoa agglomerated in its distal portion; uterine pouch connected to the oviductal pouch by a prominent sphincter; this latter pouch, the cylindrical part of the oviduct as well as the ovary without any special features. Tail short, nearly hemispherical, with curvature essentially dorsal and ventral profile on the same line as body profile; with terminal conical peg, 3-5 µm long, clearly demarcated from tail profile; cuticle thickened (6-8 µm), about equally on ventral and dorsal side of tail; blind canal present; four or five caudal/adanal pores (exceptionally three).

Male : Curvature of posterior part of body more pronounced than in female. Lip region slightly more rounded than in female. Otherwise morphology and anatomy similar to those of female except genital apparatus and somatic structures associated with it. Spicules massive, curved, not cephalated, with a well developed central reinforcement; lateral guiding pieces straight, narrower at distal end. Precloacal double papilla

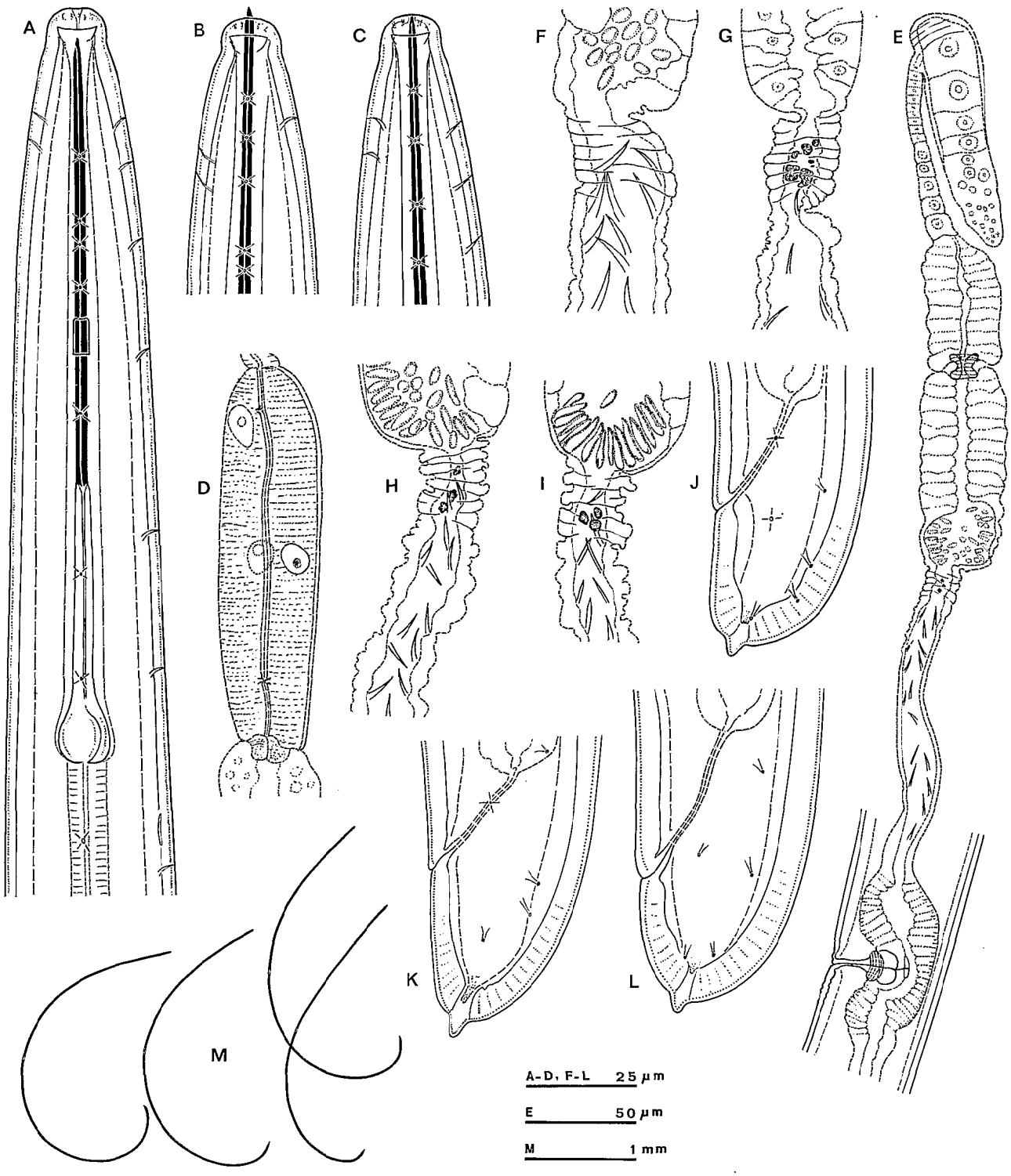

Fig. 1. *Xiphinema thorneanum* n. sp. Female. A, B, C : Anterior end; D : Pharyngeal basal bulb; E : Genital tractus; F, G, H, I : Z differentiation and uterine spines; J, K, L : Tail; M : Habitus.

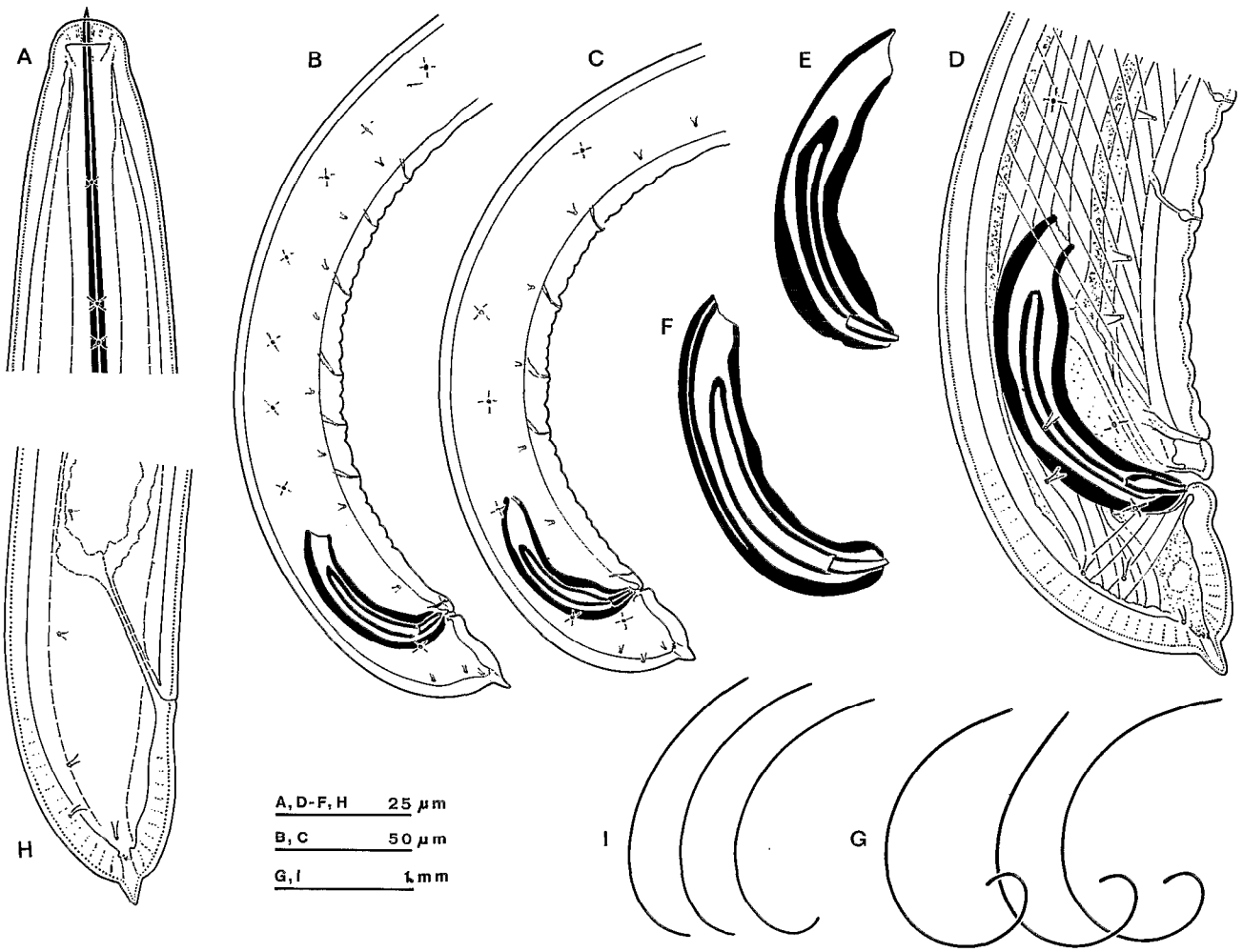

Fig. 2. *Xiphinema thorneanum* sp. A-G : Male. A : Anterior end; B, C : Posterior end; D : Spicular apparatus and tail; E, F : Spicules and accessory pieces; G : Habitus. H-I : Juvenile, st. 4; H : Tail; I : Habitus.

present; four to six ventral single supplements (position of double papilla and of single supplements as shown in Fig. 3); six to twelve pairs of prominent ventrosublateral pores in the area of the supplements. Tail similar to that of female, with a similar conical peg; four to six caudal/adanal pores.

Juveniles, st. 4. Habitus bracket- to open C-shaped. Tail slightly more elongated but similar in shape to that of adult, and with a similar terminal peg.

TYPE MATERIAL

Holotype : Female, slide 15797, deposited in the collection of Muséum national d'Histoire naturelle, Laboratoire des Vers, Paris, France.

Paratypes : Four females and four males deposited in the same collection. One female and one male distributed in the following collections : Instituut voor Dierkunde, Gent, Belgium; Laboratorium voor Nematologie, Landbouwhogeschool, Wageningen, Netherlands; USDA Collection, Beltsville, Md, USA; University of California, Davis, USA. Remaining material deposited at South Dakota St. Univ., Dept., Plant Science, Brookings, S.D., USA.

TYPE LOCALITY

Native Prairie Sod, Cottonwood Range Experiment Station, South Dakota, USA (*rec.* G. Thorne, June 1964).

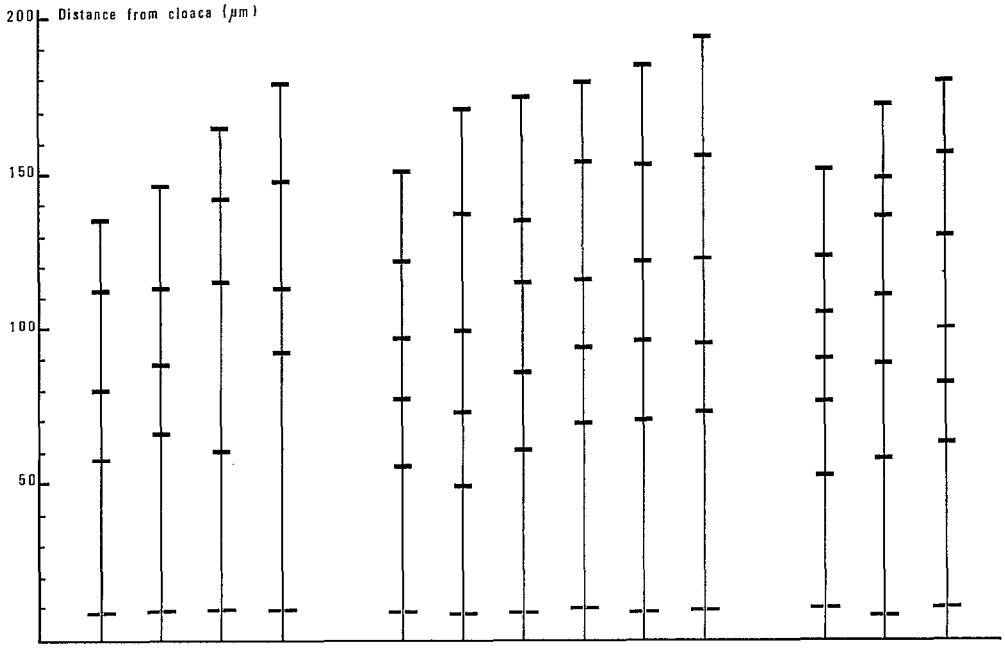

Fig. 3. *Xiphinema thorneanum* n. sp. Male. Diagram of the position of double cloacal papilla and of the ventromedian supplements.

OTHER LOCALITIES

Mobridge, Sitting Bull Grave, South Dakota, USA and Prairie Sod, A. Brakke Farm, Presho, South Dakota, USA.

DIAGNOSIS AND RELATIONSHIPS

Xiphinema thorneanum n. sp. is clearly different from all described species of the genus by the combination of two characters : *(i)* the presence of long, strong and numerous uterine spines; *(ii)* the very peculiar shape of the tail peg in both sexes which is short, conical and well demarcated from tail profile; such a tail shape appears unique in the genus.

Recorded for the first time in *X. spinuterus* Luc, 1973, uterine spines have been observed by various authors in the following species : *X. ingens* Luc & Dalmasso, 1963, *X. malagasi* Luc, 1973, *X. rarum* Heyns, 1979, *X. dimidiatum* Loof & Sharma, 1979, *X. mammatum* Siddiqi, 1979, *X. melitense* Lamberti, Bleve-Zacheo & Arias, 1982, *X. xenovariabile* Kruger & Heyns, 1984 and *X. barbercheckae* Coomans & Heyns, 1985.

All these species are clearly different from *X. thorneanum* n. sp.; *X. dimidiatum* is a pseudomonodelphic (no anterior ovary) and shorter species (L = 1.95-2.50 mm); *X. mammatum* presents stellate spines, and its hemispherical tail bears a long and cylindrical terminal peg; in *X. spinuterus* the tail is very elongated (c' = 9.6-12.5); *X. xenovariabile* has a conical-elongated tail (c' = 2.3-3.7) and the spines are only present in a short portion of the uterus; in *X. barbercheckae* the tail is conical digitate and the spines are only present in the proximal half of the uterus.

In none of these species mentioned in the previous paragraph has a Z differentiation been observed, not even of the weakest type. On the other hand, a Z differentiation or pseudo-Z-organ exists, as in *X. thorneanum* n. sp., in a second group of species, but they differ from *X. thorneanum* n. sp. by other characters : in *X. ingens* and *X. melitense* (see below) the spines are short and the tail is hemispherical or is provided with a very short bulge; the tail of *X. malagasi* is conical-elongated (c' = 3.9-4.8). In all these species (except *X. malagasi)* the pseudo-Z-organ is weakly differentiated. It is the case also for *X. thorneanum* n. sp. where the Z differentiation is often only visible by a slightly more muscular appearance of the uterine wall and the presence of a few refractive granules.

Xiphinema pararadicicola
Phukan & Sanwal, 1982

Xiphinema pararadicicola Phukan & Sanwal, 1982 was described from twenty females from the rhizosphere of bamboo at Karanga, Jorhat, Assam, India. Other

locations in Assam and possible hosts are also given. *X. pararadicicola* is said to be similar to the following monodelphic species : *X. radicicola* Goodey, 1936, *X. australiae* McLeod & Khair, 1971 (considered a junior synonym of *X. radicicola;* see Stegarescu, 1977), *X. chambersi* Thorne, 1939 and *X. monohysterum* Brown, 1968. *X. pararadicicola* is clearly different from the two latter species by the shape of the tail. But differences with *X. radicicola* appear to be less pronounced; they relate, following the authors, to the " smaller stylet and more anteriorly placed vulva (in *X. radicicola* stylet 180 µm (178-184) and V 27-29) ", whereas in the original descriptions of *X. pararadicicola* the corresponding values are : stylet = 154 µm (146-164) and V = 24 (22-26). These differences were investigated by examining three paratype female *X. pararadicicola.*

PARATYPES OF *X. PARARADICICOLA* (Fig. 4)

Measurements

L = 2.03, 2.28, 2.31 mm; a = 45.1, 53.0, 46.2; b = 7.5, 6.7, 6.8; tail = 60, 60, 62 µm; c = 33.8, 38.0, 37.3; c' = 2.4, 2.5, 2.5; V = 24.1, 23.3, 23.8; odontostyle = 96, 100, 100 µm; odontophore = 58, 57, 50 µm; stylet = 154, 157, 150 µm; h* = 31, 28, 33; h %* = 52, 47, 53.

Morpho-anatomy

Body ventrally curved, with major curvature in the posterior part; labial area anteriorly rounded, very slightly separated from the rest of the body by a shallow depression. Vagina perpendicular to long body axis; ovejector muscularized, nearly symmetrical; no anterior genital branch; posterior genital branch identical to that described for *X. radicicola* Goodey, 1936 (see Luc, 1981). Tail conical-digitate, extremity rounded, with a rather long hyaline terminal part; blind canal present but difficult to see.

Remarks

Examination of paratypes, therefore, confirmed the original description, including the two characters used to differentiate *X. pararadicicola* from *X. radicicola.* Other differences which may be cited are that in the type population of *X. radicicola* the habitus is more C-shaped, the labial area is flat rather than rounded, the hyaline part of the tail is somewhat shorter (h = 20 µm (19-22) and h % = 34 (31-35) see Luc, 1981). Consequently, *X. paradicicola* might be considered a valid species, close to but distinct from *X. radicicola*, if examination of specimens assumed to pertain to a population of *X. radicicola* reported by Loos (1949) from Sri-Lanka did not permit to solve the problem in a different way.

* h = length of the terminal hyaline part of the tail, in µm; h % = same data expressed as a percentage of tail length.

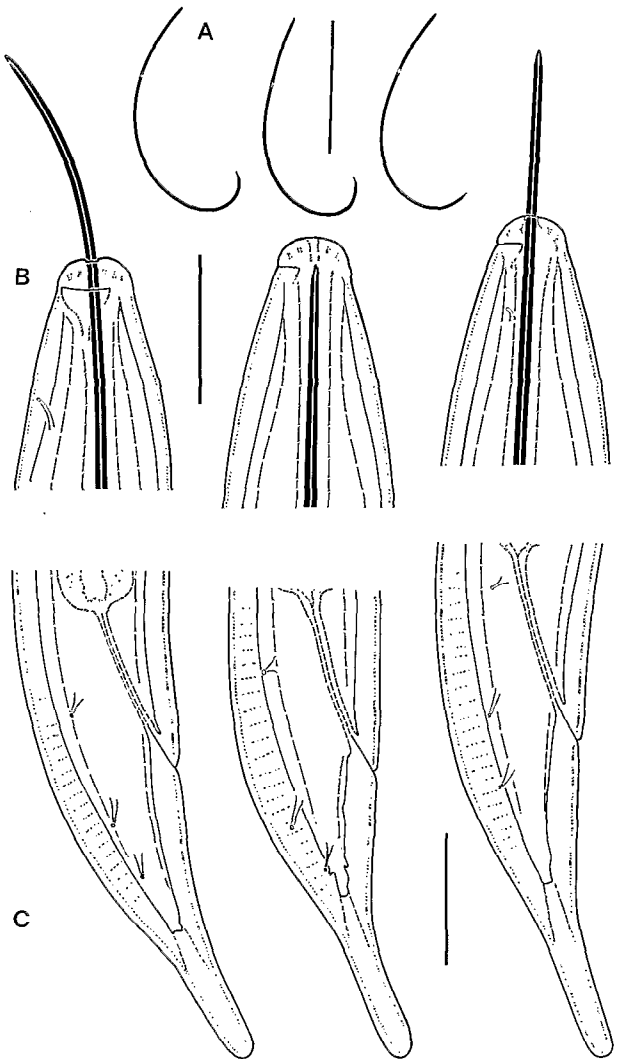

Fig. 4. *Xiphinema " pararadicicola "* Phukan & Sanwal, 1982. Female. A : Habitus; B : Anterior end; C : Tail. *(bars represent : A : 1 mm; B, C : 25* µm).

LOOS' POPULATION OF *X. RADICICOLA* (Fig. 5)

Loos (1949) described a population of *X. radicicola* from Ceylon (now Sri-Lanka) for which he gave no precise information concerning locality(ies) only reporting that specimens were found in " washing grass roots from Patna soils, Ceylon ". Three slides kept in the collection of the Department of Nematology, University of California, Riverside, USA, are assumed by A. H. Bell, who remounted them in 1961, to represent Loos' population. They contain six females each and are labelled " mixed grass, Kadienlena Estate, Katmale, Ceylon ". Examination of these specimens gave the following data :

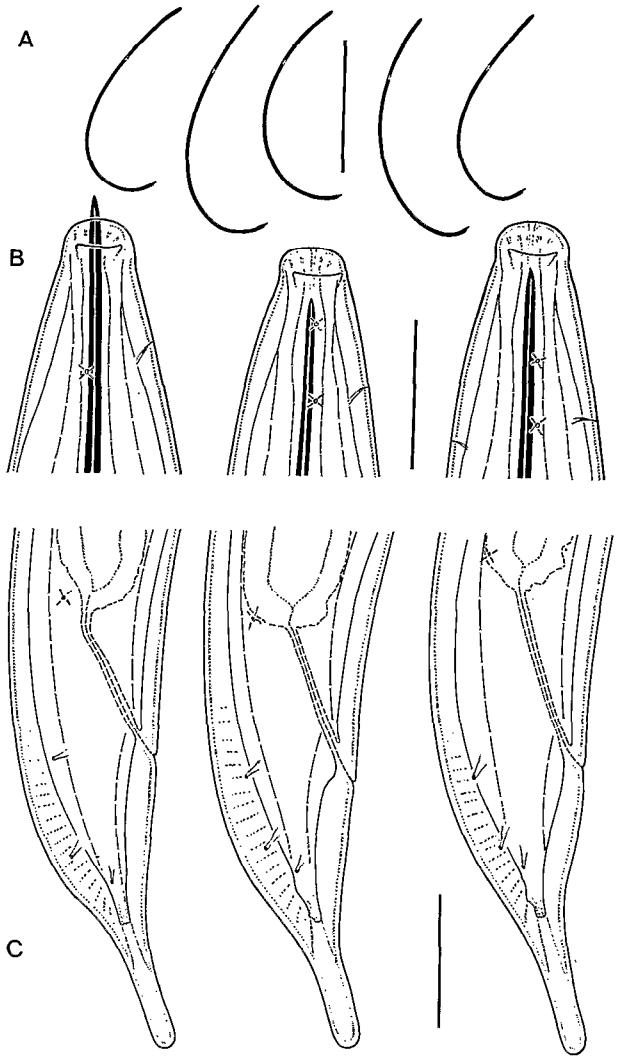

Fig. 5. *Xiphinema radicicola* Goodey, 1938 (Ceylon, Loos' (1949) population). Female. A : Habitus; B : Anterior end; C : Tail.
(*bars represent : A : 1 mm; B, C : 25* µm).

Measurements : (females; n = 18).

L = 2.12 mm ± 0.12 (1.84-2.36); a = 44.0 ± 5.37 (35.7-53.1); b = 6.1 ± 0.49 (5.3-6.9); tail = 48.5 µm ± 3.35 (41-54); c = 43.8 ± 3.35 (39.2-50.0); c' = 1.9 ± 0.16 (1.4-2.1); V = 25.3 ± 0.82 (23.6-27.2); odontostyle = 102 µm ± 2.45 (97-107); odontophore = 62.5 µm ± 2.45 (58-67); stylet = 164.5 µm ± 4.25 (158-174); h = 23.5 ± 1.71 (22-27); h % = 49.2 ± 3.73 (43.7-56.5).

Morpho-anatomy

Body ventrally curved, from open C-shape to J-shape; labial area flat or slightly rounded anteriorly, separated from the rest of the body by a weak depression; genital apparatus conforming to that of *X. radicicola* type (Luc, 1981); tail conical-digitate, with dorsal curvature; extremity rounded; hyaline terminal part well developed with an indistinct blind canal.

Remarks

This population represents an intermediate between *X. pararadicicola* and the data known for several populations of *X. radicicola* including the type (see Luc, 1981). Therefore in Loos' population : *(i)* the habitus varies from C- to J-shape, with all intermediate shapes, *(ii)* the labial area is not as rounded as in *X. pararadicicola* but more so than in the *X. radicicola* type population, *(iii)* the hyaline part of the tail which is 22-27 µm long links *X. radicicola* types (19-22 µm) with *X. pararadicicola* (28-33 µm) and, concerning the two most important characters for differentiation, according to the authors, *(iv)* the stylet length (158-174 µm) is intermediate between *X. pararadicicola* (146-164 µm) and *X. radicicola* type (178 µm), *(v)* V is also intermediate : 23.6-27.2 compared to 22-26 in *X. pararadicicola* and 27.8-29.4 in the *X. radicicola* type population.

Considering all these data, it is concluded that insufficient differences exist between *X. pararadicicola* and *X. radicicola* to justify separate species. Consequently *X. pararadicicola* is considered to be a junior synonym of *X. radicicola*, a species which has already been reported from India (Bajaj & Jairajpuri, 1979; Khan, 1981); what is more, the specimens studied by Bajaj and Jairajpuri (1979) have the same origin (Jorhat, Assam) as *X. pararadicicola*, and were found on the same host, sugar cane.

Xiphinema hydrabadense
Quraishi & Das, 1984

Xiphinema hydrabadense Quraishi & Das, 1984 (= *X. hydrabadensis* emend.) was described from eight females. It was claimed to differ from *X. elongatum* Schuurmans Stekhoven & Teunissen, 1938 by : *(i)* the amphidial apertures being broad, almost extending up to entire amphid (the meaning of this is not clear, and anyhow no statement was given regarding the amphid apertures in *X. elongatum*); *(ii)* the broader lateral hypodermal chords, viz. one-third body width (again it was not stated how broad they are in *X. elongatum*) and *(iii)* the protoplasmatic core not extending up to the tail tip. However, neither does the core extend so far in *X. elongatum*, and on comparison the tail shapes and structures of *X. hydrabadense* and *X. elongatum* were

found to be identical (note that authors gave no details about the origin of their information about *X. elongatum*).

Three paratypes were available for study (one of them labelled as paratype of *X. kosaigudense**.

MEASUREMENTS

L = 2.01, 2.26, 2.23 mm; a = 49, 54, 61; b = 6.4, 6.7, 6.5; tail = 56, 64, 66 µm; c = 36, 35, 34; c' = 2.6, 3.0, 2.5; V = 41, 41, 40; odontostyle = 97, 99, 98 µm; odontophore = 58, 63, 59 µm; stylet = 155, 162, 157 µm.

MORPHO-ANATOMY

The amphid apertures could not be clearly seen in two specimens, the anterior end being twisted to a sublateral position; in the third the aperture is identical to that in *X. elongatum*. The lateral chord measures 8-13 µm or one-third to one-fourth body width; similar values were found in *X. elongatum* specimens from Surinam and Kenya. Moreover, all the morphometric data fit conveniently with those reported in various populations of this latter species (Luc & Southey, 1980), which has been reported repeatedly from India.

It is concluded that the differential characters given by the authors are inapplicable, therefore *X. hydrabadense* is considered to be a junior synonym of *X. elongatum*.

Xiphinema melitense Lamberti, Bleve-Zacheo & Arias, 1982

(Fig. 6)

Observations were made on type specimens (four females, two J3 and two J4) of *Xiphinema melitense* mainly to get more precise information on the structure of the female genital tractus (uterine spines) and of the tail (blind canal).

The following complementary data were obtained.

FEMALE

Habitus ventrally curved with main curvature in posterior third, to loose spiral. Lip area anteriorly rounded, separated from the rest of the body a weak depression. Amphidial slit large, straight, situated in front of the depression. Pores of the neck region in four rows : dorsal : 5-6 pores (confined to odontostyle region); ventral : 16-18; lateral : 21-24. Pharyngeal bulb long and thin, well demarcated anteriorly, with prominent hemispherical pharyngo-intestinal valve. Vagina reaching half the body diameter; ovejector weakly muscularized; perivaginal sphincter conical-truncated; junction between ovejector and uterus weakly muscularized over a short distance; slender part of the uterus straight, thin walled and provided with irregularly distributed small spines directed away from the vulva; spines more numerous adjacent to the junction with the ovejector; pseudo-Z-organ very weakly differentiated, weakly muscularized and containing numerous spines and a few small granules; sphincter between uterus and oviduct very prominent; pouch of the oviduct much shorter and thinner than uterine pouch; thin and straight part of the oviduct and ovary without any special feature. No spermatozoa observed. Tail short, dorsally convex-conoid, with broadly rounded terminus, but with slight terminal outbulging; blind canal present, but difficult to see; three or four caudal/adanal pores.

JUVENILES

Generally similar to females. Body less curved. J4 tail very similar to that of female; J3 tail slightly more elongated and provided with more pronounced terminal bulge.

ACKNOWLEDGMENTS

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* *X. kosaigudense* Quraishi & Das, 1984 (= *X. kosaigudensis* emend.) is described in the same publication. This species obviously pertains to the so-called " *americanum* group ". Its status will be examined in a further publication devoted to this group.

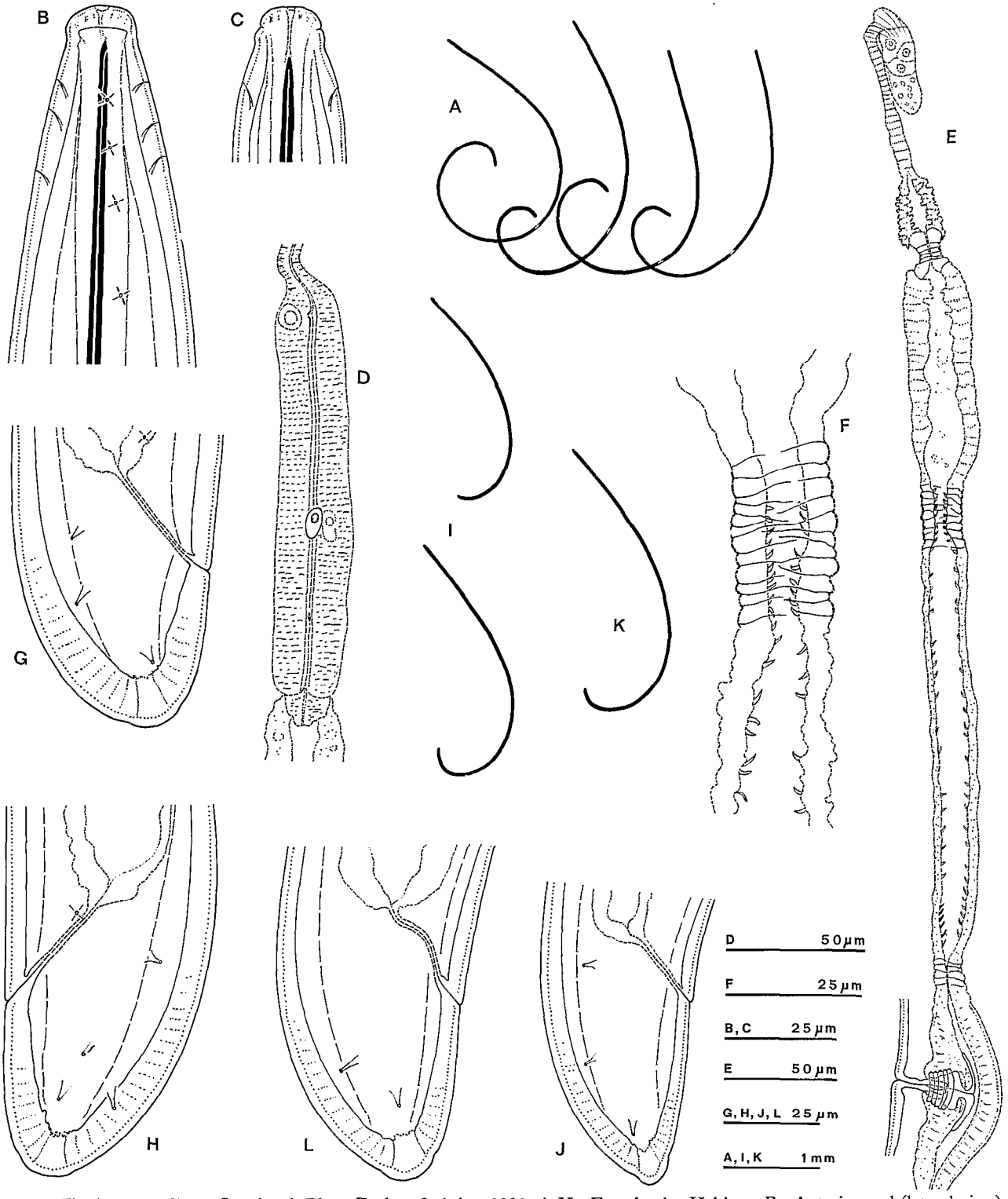

Fig. 6. *Xiphinema melitense* Lamberti, Bleve-Zacheo & Arias, 1982. A-H : Female. A : Habitus; B : Anterior end (lateral view); C : Anterior end (ventro-dorsal view); D : Pharyngeal basal bulb; E : Genital tractus; F : Pseudo-Z-organ; G, H : Tail. I-J : Juvenile, st.3, I : Habitus; J : Tail. K-L : Juvenile, st.4, K : Habitus; L : Tail.

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Note added in proof

Since this manuscript was submitted two new *Xiphinema* species have been described with spines in the uterus : *X. loteni* Heyns, 1986 and *X. coomansi* Kruger & Heyns, 1986. The first of these species differs from *X. thorneanum* n. sp. in its longer stylet (187-227 µm in *X. loteni*), more developed pseudo-Z-organ and only three (exceptionally four) ventromedian supplements. The second species differs from *X. thorneanum* n. sp. by its longer and differently shaped tail (tail 44-59 µm; c = 51-74 in *X. coomansi*), longer uterus with large number (more than 200) of long spines and by the absence of a Z-differentiation.

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