

XIPHINEMA AMARANTUM SP. NOV.
(NEMATODA: DORYLAIMIDAE)

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SUMMARY

XIPHINEMA AMARANTUM sp. nov. (Nematoda: Dorylaimidae)

The author describes a new species of *Xiphinema* from Portugal; *X. amarantum* sp. nov.

The nearest relatives species are *X. basiri* Siddiqi and *X. diversicaudatum* (Micoletzky, 1927) Thorne 1939. *X. amarantum* differs from *X. basiri* in the longer body, the more anterior position of the vulva, the greater ratio of the tail length to the anal body, the longer stylet, the larger uterine chamber and the abundance of males. From *X. diversicaudatum* it differs by its shorter body length, smaller basal portion of the stylet, the shorter stylet of the females, the shorter anal body length and greater ratio of the tail length to the anal body and the less offset tail peg. In the females, widest cuticle on dorsal side of tail expressed as a percentage of anal body width is 18.3-37.6% ($\bar{x}$ = 28.1%) while for *X. diversicaudatum* is 18-22% ($\bar{x}$ = 20%).

In many soil samples from forest nurseries of six "Administrações Florestais da Circunscrição Florestal do Porto" at Minho District (Portugal North-west) a *Xiphinema* species was present showing close affinities to *X. bakeri* Williams 1961, *X. basiri* Siddiqi 1959, *X. basilgoodeyi* Coomans 1964, *X. diversicaudatum* (Micoletzky, 1927) Thorne 1959, *X. index* Thorne & Allen 1959, *X. mammillatum* Schuurmans Stekhoven & Teunissen, 1938 and *X. vuittenezi* Luc *et al.* 1964.

A comparison of the eight species revealed several and constant differences among them so the species from Minho District is considered to be new and is described here as *X. amarantum* sp. nov.

MATERIALS AND METHODS

X. amarantum sp. nov. is described and figured from species associated with forest plant roots from nurseries of several localities:

Population A (Type population):

Thirteen males, eleven females and fourteen larvae collected about the roots of *Betula alba* L. at Amarante nursery ("Administração Florestal de Amarante").

Population B:

One female collected about the roots of *Cupressus lusitanica* Mill. at Amarante nursery ("Administração Florestal de Amarante").

Population C:

One male and one female collected about roots of *Pseudotsuga Douglasii* (Lind.) Carr. at Amarante nursery ("Administração Florestal de Amarante").

Population D:

One male and one female collected about the roots of *Pinus corcicana* Loud. at Amarante nursery ("Administração Florestal de Amarante").

Population E:

One male, one female and one larva collected about the roots of *Pinus radiata* D. Don at Amarante nursery ("Administração Florestal de Amarante").

Population F:

Two females and one larva collected about the roots of *Pinus sylvestris* L. at Amarante nursery ("Administração Florestal de Amarante").

Population G:

Two males, three females and three larvae collected about the roots of *Chamaecyparis lawsoniana* (A. Murr.) Parl. at Amarante nursery ("Administração Florestal de Amarante").

Population H:

One male, one female and three larvae collected about the roots of *Sorbus* sp. at Vidoeiro nursery ("Administração Florestal do Gerez").

Population I:

One male, two females and three larvae collected about the roots of *Pinus laricio* Poir at Vidoeiro nursery ("Administração Florestal do Gerez").

Population J:

One female collected about the roots of *Thuja* sp. at Vidoeiro nursery ("Administração Florestal do Gerez").

Population K:

One female collected about the roots of *Pseudotsuga* sp. at Vidoeiro nursery ("Administração Florestal do Gerez").

Population L:

One male, one female and one larva collected about the roots of *Quercus lusitanica* Lam. at Veiga nursery ("Administração Florestal de Cabeceiras de Basto").

Population M:

One female collected about roots of *Quercus* sp. at Veiga nursery ("Administração Florestal de Cabeceiras de Basto").

Population N:

Four females and one larva collected about the roots of *Abies pectinata* D. C. at Prado (Lordelo) nursery ("Administração Florestal de Monção").

Population O:

Three females collected about the roots of *Pinus sylvestris* L. at Prado (Lordelo) nursery ("Administração Florestal de Monção").

Population P:

Three females and eleven larvae collected about the roots of *Picea alba* Link. at Prado (Lordelo) nursery ("Administração Monção"). Florestal de

Population Q:

Two females and two larvae collected about the roots of *Cedrus atlantica* Michx. at Prado (Lorde-lo) nursery ("Administração Florestal de Monção").

Population R:

One female collected about the roots of *Quercus robur* L. at Lamas-de-Mouro nursery ("Administração Florestal de Monção").

Population S:

One female collected about the roots of *Betula alba* L. at Vilar-Chão nursery ("Administração Florestal de Vieira-do-Minho").

Population T:

One female collected about the roots of *Quercus robur* L. at Serradela nursery ("Administração Florestal de Vieira-do-Minho").

Population U:

One male and female collected about the roots of *Pinus sylvestris* L. at Serradela nursery ("Administração Florestal de Vieira-do-Minho").

Population V:

One female collected about the roots of *Eucalyptus globulus* Labill. at Cabo nursery ("Administração Florestal de Viana-do-Castelo").

Measurements and drawings were made from specimens killed, fixed and mounted in glycerine according to Seinhorst's technique (Goodey, 1963).

Slide numbers refer to the collection of the Laboratório de Patologia Florestal, Oeiras. The description is as follows:

XIPHINEMA AMARANTUM SP. NOV.

(Fig. 1)

Measurements are given in tables I and II

Holotype ♀ (Population A)

L = 3.82 mm; a=76; b=8.8; c=87; v=44¹⁰;
odontostyle = 128 μ , spear extension = 67 μ , tail = 44 μ ; tail
peg = 9 μ ; tl/tw (1) = 1.3

Allotype ♂ (Population A): L=4.13 mm; a=83; b=9.4; c=99;
odontostyle = 122 μ ; spear extension = 72 μ ; tail = 42 μ ; tail
peg = 10 μ ; spicules = 61 μ ; tl/tw (1) = 1.2

Description of type population (Population A)

Body long and cylindrical regularly tapering towards the extremities. Amphids stirrup-shaped, as broad as the lip region. Cuticle apparently two-layered, being its thickness 4-5.6 μ ($\bar{x}$ = 4.5 μ) on dorsal of head, 2-7.2 μ ($\bar{x}$ = 4.3 μ) around midbody and 7.2-12.8 μ ($\bar{x}$ = 9.4 μ) on dorsal side of tail. Width of lip region 12-15 μ ($\bar{x}$ = 14 μ) which is only slightly marked off from the body. Odontostyle 124-140 μ ($\bar{x}$ = 129 μ) long, spear extension 62-76 μ ($\bar{x}$ = 69 μ) and total spear length 188-212 μ ($\bar{x}$ = 198 μ). Flanges well-developed, 10-14 μ ($\bar{x}$ = 12 μ) wide. Basal ring of guiding apparatus situated 70-116 μ ($\bar{x}$ = 99 μ) from anterior end, its position depending on the extent to which the spear is extruded. Nerve ring about 200-236 μ ($\bar{x}$ = 218 μ) from anterior end. Hemizonid situated 186-222 μ ($\bar{x}$ = 206 μ) from front end. Hemizonion situated about 64.8 μ posterior to hemizonid.

The slender portion of the oesophagus usually shows a small cuticularized structure (mucro) (4.8 μ) resembling the apex of the spear, found close behind the nerve ring. Basal bulb 76-116 μ ($\bar{x}$ = 92 μ) long, 18-30 μ ($\bar{x}$ = 23 μ) wide which forms just less than half the total oesophageal length; the base of the bulb flat with rounded edges. Cardia little developed, almost conical.

Intestinal cells packed with granules of various sizes. Lateral fields begin narrowly at the level on the front end of the posterior

(1) Ratio of tail length to anal body width.

part of the oesophagus, then widen gradually becoming about one fourth of the body width at midbody.

Prerectum and rectum together comprising 11-17, 2% ($\bar{x}$ = 13.4%) of the total body length, marked off from the intestine by a lesser diameter.

The tail of both sexes is dorsally convex-conoid with a short peg which is 6-14 μ ($\bar{x}$ = 10 μ) long.

Male tail 37.2-48 μ ($\bar{x}$ = 43 μ) long and anal body diameter 32-41.3 μ ($\bar{x}$ = 35 μ) long. Tail length (including peg) divided by anal body diameter is 1-1.5 ($\bar{x}$ = 1.2).

Female tail 40-54 μ ($\bar{x}$ = 45 μ) long and anal body diameter 34-48 μ ($\bar{x}$ = 38 μ) long. Tail length (including peg) divided by anal body diameter 1-1.6 ($\bar{x}$ = 1.2).

In most females there are ventral pores about 60: 7 situated from the anterior end of body to the flanges, 7 from the flanges to oesophago-intestinal junction, 16 from oesophago-intestinal junction to vulva and 30 from vulva to anus. Dorsal pores about 6 situated from anterior end to flanges. Lateral pores about 158: 11 situated from anterior end to flanges, 14 from flanges to oesophago-intestinal junction, 37 from oesophago-intestinal junction to vulva and 96 from vulva to anus. Female tail with 4 pairs of caudal pores.

In most males there are ventral pores about 37: 6 from anterior end to flanges, 8 from flanges to oesophago-intestinal junction, 23 from oesophago-intestinal junction to anus. Dorsal pores about 7 from anterior end to flanges. Lateral pores about 152: 8 from anterior end to flanges, 12 from flanges to oesophago-intestinal junction and 132 from oesophago-intestinal junction to anus. Male tail with 5 pairs of caudal pores.

Female gonads paired with essentially the same structure present (Didelphic condition); one of these extends anteriorly, the other posteriorly (amphidelphic). Each gonad consisting of ovary (dorsally to the oviduct), reflexed oviduct, convoluted uterus and ovijector. The oviduct, with the *dilatata oviducti*, is separated by a narrower par funnel-shaped from the enlarged distal end of the uterus; uterus long often convoluted and without Z organ. The median differentiation of the uterus seems to be accompanied by the presence of sclerotised bodies within the lumen of the median differentiation. Oöcytes mostly arranged irregularly.

Close to the vagina the uterus enlarges and together with the same region of the other gonad, forms an ovijector (uterine chamber) with typically arranged musculature. Uterine chamber is 96-129 μ ($\bar{x}$ = 114 μ) long with thick muscular walls and enclosing a prominent lumen. Female with median vulva, a transverse slit on the surface but vagina, thick-walled, just below it becomes cross-shaped. Vulva a transverse slit about one-third the corresponding body diameter in width.

Spicules 56-76.2 μ ($\bar{x}$ = 62 μ) long, measured along the curved median line. Lateral guiding pieces about 12 μ long.

Supplements consisting of an adanal pair and a ventromedian series of three to four.

Larvae (Pop. A, E, F, G, H, I, N, P and Q)

The measurements are given in Table II.

The larva is recognisable by two spears, one in the normal position and a developing one in a cell situated in the anterior part of the oesophagus.

The spear lengthens during each moult and by measuring both spears the larval stage can be determined. Coupled with this difference in spear lengths are differences in tail shape, only the male pre-adult larva have tails similar to those of the adults. Earlier stages without the offset peg. The first stage larvae (L1) and female pre-adult larvae were not observed.

Differential diagnosis:

Seven species have similarities with *X. amarantum* (Table III). The closest are *X. basiri* Siddiqi 1959 and *X. diversicaudatum* (Micoletzky, 1927) Thorne 1939, the others being *X. bukeri* Williams 1961, *X. basilgoodeyi* Coomons 1964, *X. index* Thorne & Allen 1950, *X. mammillatum* Schuurmans Stekhoven & Teunissen 1938 and *X. wittenezi* Luc *et al.* 1964.

From *X. basiri* it can be distinguished by its longer body, the more anterior position of the vulva, the greater ratio of the tail length to the anal body, the longer stylet, the larger uterine chamber and the abundance of males.

From *X. diversicaudatum* it differs by its shorter body length, smaller basal portion of the stylet, the shorter stylet of the females, the shorter anal body length and greater ratio of tail length to the

anal body and the less offset tail peg. In the females, widest cuticle on dorsal side of tail (not at the level of the peg) expressed as a percentage of anal body width is 18.3-37.6 % ($\bar{x}$ = 28.1%) while for *X. diversicaudatum* is 18-22% ($\bar{x}$ = 20%) as described Luc. et al. (1964).

From *X. bakeri* can be distinguished as having a more posterior position of the vulva, the 4 pairs of caudal pores (female) (2 for females in *X. bakeri*), smaller basal portion of spear and the abundance of males.

From *X. basilgoodeyi* it differs by its greater length, a more slender body, the more anteriorly placed vulva, the female with greater tail, the greater ratio of the tail length to the anal body diameter, the number of caudal pores (female) and by the abundance of males. The external cuticle layer in the middle of the body is thinner than the internal.

From *X. index* it can be distinguished by the slightly greater body length of the female, by slightly marked off lip region, the smaller width of females; the longer tail, the greater ratio of the tail length to the anal body diameter and the abundance of males.

From *X. mammillatum* it differs by the much greater body length, the smaller width of the body, the more posterior position of the vulva, the longer tail, and the greater ratio of the tail length to the anal body diameter, by the longer tail peg, form of its tail and the abundance of males.

It is distinguished from *X. vuittenezi* by the larger body length, the smaller width of the female body, the more anterior position of the vulva, the greater tail and the greater ratio of the tail length to anal body diameter, the longer tail peg, the males are more numerous and with longer spicules.

Holotype: Female collected by the author, March 1967. Slide 179-1, Nematode collection: Laboratório de Patologia Florestal, Oeiras, Portugal.

Allotype:

Male, same date as holotype. Slide 179-la, Nematode collection: Laboratório de Patologia Florestal, Oeiras, Portugal.

Paratypes:

Slides núms. 37, 37a, 37b, 37c, 37d 37e, 37f, 113-1, 122-1a, 133-1, 133-2a, 153-1, 157-1, 157-1b, 157-2, 162-1a, 164-1a, 166-1, 174-2a, 175-2b, 177-2, 178-1b, 178-2, 178-3, 179-1, 179-2, 179-2a, 179-3, 179-3a, 180-1, 180-1a, 181-1a, 181-2, 181-3, 204a, 208, 208a, 210-a, 211, 214, 221, 223, 224, 225, 225b, 225c, 225d, 228, 229a.

Type habitat:

Holo-, allo- and paratypes collected around of *Betula alba* L.

§Other specimens collected around the roots of *Abies pectinata* D. C., *Cedrus atlantica* Michx., *Chamaecyparis lawsoniana* (A. Murr.) Parl, *Cupressus lusitanica* Mill., *Eucalyptus globulus* Labill., *Picea alba* Link., *Pinus corcicana* Loud., *P. laricio* Poir., *P. radiata* D. Don, *P. sylvestris* L., *Pseudotsuga* sp., *P. Douglasii* (Lind.) Carr., *Quercus* sp., *Q. lusitanica* Lam., *Q. robur* L., *Sorbus* sp. and *Thuja* sp.

Type locality:

Amarante nursery ("Administração Florestal de Amarante"), Amarante, Portugal.

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SUMARIO

El autor describe una nueva especie de Xiphinema, encontrada en Portugal: *X. amarantum* sp. nov.

Las especies con las que está más estrechamente relacionada son: *X. basari* Siddiqi y *X. diversicaudatum* (Micoletzky, 1927) Thorne 1939.

X. amarantum difiere de *X. basari* por su cuerpo más largo, la posición más anterior de la vulva, la mayor proporción de la longitud de la cola con el diámetro anal, estilete más grande, cámara uterina también más grande y abundancia de machos.

Se diferencia de *X. diversicaudatum* por su cuerpo más corto, porción basal del estilete más pequeña, estilete más pequeño en las hembras, diámetro anal más pequeño, mayor proporción de la longitud de la cola con el diámetro anal y menor diferenciación del mamelón caudal. En las hembras, mayor espesor de la cutícula en la parte dorsal de la cola, que expresado como porcentaje del diámetro anal es de 18,3-37,6 % ($\bar{x}$ = 20 %).

RÉSUMÉ

XIPHINEMA AMARANTUM sp. nov. (Nematoda: Dorylaimidae)

L'auteur donne la description d'une nouvelle espèce de *Xiphinema*, *X. amarantum* sp. nov. provenant du Portugal.

X. amarantum est très proche du *X. basiri* Siddiqi et *X. diversicaudatum* (Micoletzky, 1927) Thorne 1939.

X. amarantum diffère du *X. basiri* par son corps plus long, par la position antérieure de la vulve, plus grand rapport de la longueur de la queue au diamètre anal, stylet plus grand, chambre utérine plus grande et par l'abondance de mâles.

Elle diffère du *X. diversicaudatum* par son corps plus court, plus petite partie basale du stylet, stylet plus petit des femelles, diamètre anal plus court, plus grand rapport de la longueur de la queue au diamètre anal différentiation plus petite du mucron caudal. Sur les femelles l'épaisseur maximale de la cuticule sur la face dorsal de la queue exprimée en pourcentage du diamètre anal est en effet de 18.3-37.6% ($\bar{x}$ = 28.1%) tandis qu'au *X. diversicaudatum* est de 18-22% ($\bar{x}$ = 20%).

REFERENCES

- COOMANS, A. (1964).—*Xiphinema basilgoodeyi* n. sp. with observations on its larval stages (Nematoda: Dorylaimina). *Nematologica* 10: 581-593.
- COOMANS, A. (1964).—Structure of the female gonads in members of the Dorylaimina. *Nematologica* 10: 601-622.
- GOODEY, J. B., PEACOCK, F. C. & PIRCHER, R. S. (1960).—A redescription of *Xiphinema diversicaudatum* (Micoletzky, 1923 & 1927) Thorne, 1939 and observations on its larval stages. *Nematologica* 5: 127-135.
- GOODEY, T. (1963).—*Soil and freshwater nematodes*. Revised by J. B. Goodey. London, Methuen, 544 pp.
- LUC, M. (1961).—Structure de la gonade femelle chez quelques espèces du genre *Xiphinema* Cobb, 1913 (Nematoda, Dorylaimoidea). *Nematologica* 6: 144-154.
- LUC, M. & TARJAN, A. C. (1963).—Redescription de *Xiphinema rotundatum* Schuurmans Stekhoven & Teunissen, 1938 et de *Xiphinema mammillatum* Schuurmans Stekhoven & Teunissen, 1938 (Nematoda: Dorylaimidae). *Nematologica* 9: 116-124.
- LUC, M., M. B. LIMA, B. WEISCHER & J. J. M. FLEGG (1964).—*Xiphinema vuittenezi* n. sp. (Nematoda: Dorylaimidae). *Nematologica* 10: 151-163.
- SIDDIQI, R. M. (1959).—Studies on *Xiphinema* spp. (Nematoda: Dorylaimoidea) from Aligarh (North India), with comments on the genus *Longidorus* Micoletzky, 1922. *Proc. Helminthol. Soc. Wash.*, D. C. 26: 151-163.
- THORNE, G. (1961).—*Principles of Nematology*. New York, McGraw-Hill.
- WILLIAMS, T. D. (1961).—*Xiphinema bakeri* n. sp. (Nematoda: Longidorinae) from the Fraser River Valley, British Columbia, Canada. *Can. J. Zool.* 39: 407-412.

sp. P	Pop. Q	Pop. R	Pop. S	Pop. T	Pop. U	Pop. V
♂ 2 99-4.11 (4.05) 70-73 (72) 1.1-9.4 (9.5) 15-103 (94) — 60-64 (62) 3-4	♀ 3 3.51-3.99 (3.75) 79-85 (82) 8.2-10.3 (9.3) 86-88 (87) 12 13 43-44 10 11 (13.4 12) — — —	♀ 1 3.36 78 9.8 71.0 1047 11 — — —	♀ 1 4.28 75 10.9 86 1240 18 — — —	♀ 1 3.36 70 7.6 71 1544 14 — — —	♀ 1 3.99 71 9.8 100 1447 — 80 4	♂ 1 3.92 71 8.5 63 1240 14 — — —
32-132 (132) 64-76 (70) 96-203 (202) 10-12 (11) 6-119.2 (118) 16-225 (206) × 111-1 × 116) 1-15.1 (15) 1-46.8 (44) 8-12 (10) 1.4-28 (34) 2-1.3 (1.3) 4-4.8 (4.4) 4-4 (4) 7.2-8 (7.6) — — — —	114-120 (117) 66-70 (68) 184-186 (185) 10.4-12 (11) 80-89 (85) 212-214 (213) 18-22.4 × 84-106 (20 × 95) 12 40.8-45.2 12-12 (12) 30-30.4 (30.2) 1.4 2.4-3.2 (2.8) 2-3.2 (2.6) 8-8 (8) 100-110.4 (105.2) 20-20 (20) 44-46 (45)	114 68 182 10.4 86 188 16 × 112 12 47.2 12 30 1.6 4 3.2 8 114 18 40	148 72 220 11.2 107.2 226 22 × 76 13.6 50 12 38 1.3 4.4 4.4 10 102.8 22 56	116 68 184 11.2 98 209.2 20 × 98 12.4 47.2 14 32 1.5 3.2 4.4 8 94 20.8 44	117 66 183 11.2 96 192 20 × 114 10.4 40 9.2 32 1.3 3.2 3.2 9.6 114 20 50	146 80 226 12 100 246 28 × 88 13.2 60 16 48 1.3 4.4 3.2 8 — — — 50

	Pop. A) (Type population)		Pop. B	Pop. C		Pop. D		Pop. E		Pop. F	Pop. G
	♀	♂	♀	♀	♂	♀	♂	♀	♂	♀	♂
n	10	12	1	1	1	1	1	1	1	2	3
L (mm)	3.34-4.19 (3.81)	3.35-4.35 (3.91)	4.45	3.88	3.82	4.08	3.53	3.93	3.81	4.02-4.62 (4.32)	3.53-4.09 (3.74)
a	56-79 (66)	60-91 (71)	75	76	87	68	59	76	79	77-79 (78)	74-76 (75)
b	7.6-9.6 (8.8)	7.7-10.6 (9.1)	10.5	8.6	8.6	12.4	7.6	8.7	7.8	9.4-11.1 (10.3)	8.3-10.2 (8.9)
c	73-96 (86)	80-103 (92)	101	76	87	70	63	98	85	80-94 (87)	78-88 (84)
V (%)	7 ¹⁶ 40-47 ⁹ 16 (144 ¹³)	—	1346 ¹⁰	145 ¹²	—	2039 ¹⁵	—	1544 ¹²	—	19 ¹² 45-47 ¹⁶ 12 (1246 ¹¹)	11 ¹⁶ 42-46 ¹⁰ 11 (144 ¹²)
Spicules (μ)	—	56-67.2 (62)	—	—	60	—	76	—	68	—	—
Number of ventromedial supplements	—	3-4	—	—	5	—	4	—	4	—	—
Odontostyle (μ)	124-130 (126)	124-140 (132)	136	130	134	114	148	126	127	131-132 (132)	118-130 (125)
Spear extension (μ)	66-76 (70)	62-72 (67)	66	66	68	74	74	72	66	76-76 (76)	68-76 (71)
Total spear length (μ)	192-200 (197)	188-212 (199)	202	196	202	218	222	198	193	207-208 (208)	186-204 (197)
Width of flanges (μ)	10-13.6 (12)	10-12.4 (11)	12.8	9.2	10.8	12	11.6	10.4	12	12-13.6 (13)	11.2-12 (11)
Basal guiding ring to front end (μ)	70-108 (96)	90-116 (101)	90	95.2	94	124	107.2	100.8	108.8	104-108 (108)	90-108 (99)
Nerve ring to front end (μ)	208-224 (217)	200-236 (218)	216	226.4	214	184	232	232.8	220	223.2-228 (226)	204.230.4 (214)
Size of basal bulb (μ)	20-30 × 76-104 (24 × 89)	18-28 × 86-116 (22 × 95)	24 × 92	20.4 × 88	24 × 84	28 × 80	26 × 80	20 × 108	21.2 × 88	20-20.8 × 92-112 (21 × 102)	20-22.4 × 88-104 (21 × 98)
Width of lip region (μ)	13.2-14 (14)	12-15 (13)	15.2	13.2	14	14	14	15.2	14	14-14 (14)	14-14 (14)
Length of tail (μ)	40-54 (45)	37.2-48 (43)	44	51.2	44	58	56.4	40	44.8	49.2-50 (50)	40-48 (45)
Length of peg (μ)	6-12.4 (10)	8-14 (9.9)	10	8	8	12	8	8.8	12.4	10-12 (11)	10-12 (11)
Anal body diameter (μ)	34-48 (38)	32-41.3 (35)	34	32	36	41.6	42	35.2	34	38-38 (38)	32-35.2 (34)
Tail length divided by anal body diameter	1-1.6 (1.2)	1-1.5 (1.2)	1.3	1.6	1.2	1.4	1.3	1.1	1.3	1.3-1.3 (1.3)	1.3-1.4 (1.3)
Width of cuticle on dorsal of head (μ)	4-5.6 (4.7)	3.2-5.6 (4.3)	4	4.4	4.8	5.2	4.8	4.5	4	4.4-4.8 (4.6)	4-5.2 (4.4)
Width of cuticle around midbody (μ)	2-5.6 (3.9)	4-7.2 (4.6)	4	4	4	4	4	4.8	4.4	4-4.8 (4.4)	4-4 (4)
Width of cuticle on dorsal side of tail (μ)	7.2-12.8 (9.9)	7.2-12 (8.9)	12	11.2	7.2	9.6	8	8-10	8.8	11.2-12 (12)	8.8-12 (10.3)
Uterine chamber (μ)	96-128.8 (114)	—	97.5	116.4	—	130	—	114	—	120-124 (122)	118-128 (123)
Vulva transversal long (μ)	18-23.2 (19)	—	16.5	19.2	—	22.2	—	20	—	20-24 (22)	16-24 (19)
Vulval body diameter (μ)	48-66 (56)	—	60	50	—	60	—	52	—	52.4-58.8 (56)	47.2-52 (49)

Measurements of several populations of *Xiphinema amarantum* sp. nov.

Pop. G	Pop. H	Pop. I	Pop. J	Pop. K	Pop. L	Pop. M	Pop. N	Pop. O	Pop. P	Pop. Q	Pop. R	Pop. S	Pop. T	Pop. U	Pop. V					
♀ 3	♂ 2	♀ 1	♂ 1	♀ 2	♂ 1	♀ 1	♂ 1	♀ 1	♂ 1	♀ 4	♂ 3	♀ 3	♂ 2	♀ 1	♂ 1	♀ 1	♂ 1	♀ 1	♂ 1	
3.53-4.09 (3.74)	3.99-4.11 (4.05)	3.14	3.31	4.28-4.57 (4.42)	3.88	3.25	3.48	3.03	3.43	3.34	3.34-3.68 (3.57)	3.34-3.65 (3.52)	3.48-3.82 (3.75)	3.51-3.99 (3.75)	3.36	4.28	3.36	3.99	3.68	3.92
74-76 (75)	70-73 (72)	55	53	64-72 (68)	55	74	85	66	45	62	69-79 (75)	73-85 (78)	78-83 (80)	79-85 (82)	78	75	70	71	54	71
8.3-10.2 (8.9)	9.1-9.4 (9.5)	6.9	6.2	8.4-10.3 (9.4)	11.9	8.8	9.1	7.4	7.4	8.2	8-11.6 (9.2)	8.7-9.9 (9.3)	7.5-8.6 (8.1)	8.2-10.3 (9.3)	9.8	10.9	7.6	9.8	7.2	8.5
78-88 (84)	85-103 (94)	59	63	71-88 (80)	78	62	76	69	64	73	82-91 (85)	73-85 (78)	79-92 (84)	86-88 (87)	71.0	86	71	100	61	63
1642-46 ^{10 11} (1441 ¹²)	—	1242 ¹⁰	—	6 1139-41 ^{1 19} (1040 ¹¹)	—	1144 ¹⁷	1645 ⁸	1044 ¹¹	—	1942 ¹⁰	19 1242-44 ^{9 12} (143 ¹⁰)	1142-45 ¹¹ (143 ¹¹)	1243-45 ¹² (144 ¹²)	12 1343-44 ^{10 11} (144 ¹²)	1047 ¹¹	1140 ¹⁸	1544 ¹¹	1447	—	1240 ¹¹
—	60-64 (92)	—	80	—	72	—	—	—	84	—	—	—	—	—	—	—	—	—	80	—
—	3-4	—	4	—	3	—	—	—	3	—	—	—	—	—	—	—	—	—	4	—
118-130 (125)	132-132 (132)	138	155	142-160 (151)	147	112	150	112	144	108	116-144 (124)	112-122 (118)	112-118 (115)	114-120 (117)	114	148	116	117	146	128
68-76 (71)	64-76 (70)	72	74	74-78 (76)	71	64	68	64	78	64	64-66 (65)	54-62 (59)	66.8-68 (68)	66-70 (68)	68	72	68	66	80	76
186-204 (197)	196-203 (202)	210	229	220-234 (227)	218	176	218	176	222	172	180-210 (189)	116-182 (177)	178.8-136 (133)	184-186 (185)	182	220	184	183	226	204
11.2-12 (11)	10-12 (11)	11.6	12	11.2-11.6 (12)	10	9.4	8.8	8	13.6	10	10-12 (11)	10-12 (11)	10-11.2 (10)	10.4-12 (11)	10.4	11.2	11.2	11.2	12	10
90-108 (99)	116-119.2 (118)	95.2	98	120-140 (130)	108	115.2	109.2	82	106.8	100	84-108 (92)	82-87.6 (84.5)	86-108 (95)	80-89 (85)	86	107.2	98	96	100	118
204.230.4 (214)	186-225 (206)	230	268	246-280 (263)	222	212	222.4	195	238	196	210-224 (218)	188-204 (195)	184-195.2 (180)	212-214 (213)	188	226	209.2	192	246	228.4
22.4 × 88-104 (21 × 98)	20-22 × 111-120 (21 × 116)	24 × 72	22.4 × 96	22.4-24 × 90-108 (23 × 99)	27.2 × 70	20 × 106	20 × 114	20 × 88	27.2 × 88.8	19.2 × 124	20-20 × 92-96 (20 × 94)	19.2-20 × 82-100 (19.4 × 94)	20-21.6 × 100-112 (21 × 104)	18-22.4 × 84-106 (20 × 95)	16 × 112	22 × 76	20 × 98	20 × 114	28 × 88	22 × 76
14-14 (14)	14-15.1 (15)	12.4	13.6	14-14 (14)	13.6	11.2	12	12	14	10.8	12-13.3 (13)	12-14 (13)	11.6-12 (12)	12	12	13.6	12.4	10.4	13.2	14
40-48 (45)	40-46.8 (44)	53.1	52.4	52-60 (56)	50	52	46	44	53.6	46	40-44 (42)	42-47.6 (45.2)	38-43 (43)	40.8-45.2	47.2	50	47.2	40	60	62
10-12 (11)	8-12 (10)	12	10	4-12 (8)	13.2	10.8	10.8	12	12	12	8-12 (10.1)	10.4-12 (11.4)	12-12 (12)	12-12 (12)	12	12	14	9.2	16	14
32-38.2 (34)	30.4-38 (34)	42	46.2	44-46 (45)	44.8	30	30	30	46	32	30-32.8 (31)	30-30 (30)	31.2-34 (32.4)	30-30.4 (30.2)	30	38	32	32	48	38
1.3-1.4 (1.3)	1.2-1.3 (1.3)	1.3	1.2	1.3-1.3 (1.3)	1.1	1.7	1.5	1.5	1.2	1.4	1.3-1.5 (1.4)	1.4-1.6 (1.5)	1.1-1.5	1.4	1.6	1.3	1.5	1.3	1.3	1.6
4-5.2 (4.4)	4-4.8 (4.4)	5.8	4	5.6-6 (5.8)	3.2	4.4	4	4	4	4	2.8-4 (3.5)	2.4-3.2 (2.9)	3.2-4 (3.7)	2.4-3.2 (2.8)	4	4.4	3.2	3.2	4.4	5.2
4-4 (4)	4-4 (4)	4	4	5.6-6 (5.8)	4	4	2	2	6.4	3.2	2.4-6 (4.1)	2.4-2.4 (2.4)	0.6-3.2 (2.3)	2-3.2 (2.6)	3.2	4.4	4.4	3.2	3.2	4
8.8-12 (10.3)	7.2-8 (7.6)	12	8	10-10.8 (10.4)	8	10	8.8	10	10	8	8-10 (9.4)	8.8-10 (9.2)	7.2-10 (8.9)	8-8 (8)	8	10	8	9.6	8	8
118-128 (123)	—	104	—	114-114 (114)	—	87.2	128	115	—	107.2	88-116 (102)	72-96 (84)	100-135.2 (118)	100-110.4 (105.2)	114	102.8	94	114	—	88
16-24 (19)	—	28	—	20.8-24.8 (23)	—	14	18	18	—	18	16-21.6 (19)	20-22 (21)	18-20 (19)	20-20 (20)	18	22	20.8	20	—	24
47.2-52 (49)	—	56.8	—	56-72 (64)	—	40	42	46	—	52	42-48 (45)	41.2-46.8 (44.5)	43.2-44.8 (44)	44-46 (45)	40	56	44	50	—	50

TABLE II
Lengths of larval stages and of the spears they bear

Larval stages	L1	L2					L3								L4		
Populations		Pop. A	Pop. E	Pop. H	Pop. P	Pop. Q	Pop. A	Pop. F	Pop. G	Pop. H	Pop. I	Pop. L	Pop. N	Pop. Q	Pop. I	Pop. A	
n	—	3	1	1	2	1	10	1	3	2	2	1	1	1	1	—	1
L (mm)	—	1.71-1.89 (1.80)	1.72	1.77	1.65-2.20 (1.93)	1.50	2.24-2.94 (2.60)	2.45	2.65-2.82 (2.72)	2.36-2.59 (2.48)	2.39-2.71	2.48	2.51	2.28	2.99	Pre ♀	Pre ♂ 3.54
a	—	50-55 (52)	54	61	61-69 (65)	42	44-67 (61)	69	51-58 (55)	54-74 (64)	54-56 (55)	48	68	52	58	—	61
b	—	5.1-5.7 (5.3)	4.6	5.5	5.6-5.9 (5.8)	3.8	5.9-7.7 (6.8)	6.1	6.2-8 (6.8)	6-6.4 (6.2)	6-6.3 (6.2)	5.9	5.2	6.7	6.2	—	8.4
c	—	33-36 (34)	27	29	26-43 (34)	28	46-60 (53)	51	49-55 (51)	41-44 (43)	44-45 (45)	43	39	42	50	—	80
Spear (μ)	—	80-84 (81)	96	77	78-96 (87)	94	90-111 (103)	110	104-108 (106)	94-114 (104)	108-112 (110)	119	72	92	124	—	126
Developing spear (μ)	—	101-104 (103)	114	96	92-112 (102)	114	120-132 (126)	136	124-132 (128)	115-136 (126)	132-132 (132)	142	112	114	140	—	140

TABLE III
Biometrical characters of females of similar *Xiphinema* species

	<i>X. bakeri</i>	<i>X. basilgoodeyi</i>	<i>X. basiri</i>	<i>X. diversicaudatum</i>			<i>X. index</i>		<i>X. mammillatum</i> Congo	<i>X. vuittenezi</i>	<i>X. amarantum</i>
				England Goodey, Peacock & Pitcher 1960	U.S.A.	Deutschland Sturhan 1963	U.S.A. Torne & Allen, 1950	Coomans, 1964	Luc & Tarjan, 1963	Luc et al., 1964	(Including all populations)
n	—	35	35	43	5	19	—	20	4	—	43
L (mm)	3.70-4.74	2.53-3.3 (2.93)	2.65-3.44 (3.1)	4-5.5 (4.9)	3.3-4.9 (4.2)	3.6-4.8 (4.22)	— (3.4)	2.7-3.45 (3.09)	2.5-2.9 (2.74)	2.6-3.8 (3.23)	3.03-4.62 (3.73)
a	59.7-98.8	46-59 (53.0)	57.3-71.9 (61.7)	57-92 (74)	54-80 (68)	69-77 (72.5)	— (58)	57-69 (61.1)	43-51 (46)	50-81 (64.6)	55-85 (73)
b	7.1-11.4	6.0-7.7 (6.9)	6.4-8 (7.6)	6.6-11.4 (9.1)	6.9-9.4 (8.3)	7.5-9.3 (8.2)	— (7.6)	5.9-8.0 (7.1)	5.3-5.8 (5.6)	5.4-9.0 (6.9)	6.9-12.4 (9.1)
c	55.6-83.1	57-93 (77.3)	61.8-80 (69)	61-134 (78)	54-120 (90)	77-97 (87.5)	— (76)	—	77-89 (82)	70-139 (93)	59-101 (79)
V (%)	28-34	43.5-50 (47.5)	49.1-52.6 (50.7)	39-46 (43)	43-49 (45)	40-45 (42.5)	— (38)	38.5-42.5 (40.1)	38-42 (39)	46-56.6 (50.4)	39-47 (43)
Odontostyle length (μ)	— (142)	116-138 (128.5)	111-125 (119)	130-157 (143)	116-142 (131)	131-145 (137)	— (130)	119-134 (127.9)	127-132	115-137 129.5	108-160 (127)
Basal portion of spear (μ)	— (77)	66-82 (73.7)	57-83 (68.6)	70-97 (85)	80-93 (86)	79-87 (83)	— (74)	65-76 (71.1)	74-78	61-80 (74.3)	54-78 (68)
Total spear length (μ)	213-226 (219)	185-220 (202)	— (179.6)	— (228)	— (217)	214-232 (220)	— (190)	192-208 (198.8)	190-210 (202)	183-212 (199.8)	166-234 (196)
Tail length (μ)	—	29-51 (38.4)	—	— (52)	— (50)	45-49 (50)	— (34)	—	28-38 (34)	25-42 (34.6)	38-62 (47.7)
Anal body width (μ)	—	—	—	— (50)	— (47)	—	— (36)	—	39-50 (43)	31-43 (36.4)	30-48 (34.4)
Tail length/anal body width	—	0.85-1.3 (1.0)	—	— (1.04)	— (1.06)	—	— (0.94)	—	0.7-0.8 (0.73)	0.7-1.2 (0.94)	1-1.7 (1.4)
Tail peg (μ)	—	6-13 (8.5)	—	0-16 (9.6)	6-10 (7.5)	6.5-11.5 (8.5)	— (8)	2.5-7 (5.2)	3-8 (5)	0-6 (3.05)	4-14 (10.9)
Caudal pores	2 pairs	2 pairs or 2 (left side) + 3 (right side)	4 pairs	2-4 pairs	2-4 pairs	—	4 pairs	—	3 pairs	3-4 pairs	4 pairs
Sexes known	♀ ♀ + 1 ♂	♀ ♀ + 1 ♂	♀ ♀ + 1 ♂	♀ ♀ + ♂ ♂	♀ ♀ + ♂ ♂	♀ ♀ + ♂ ♂	♀ ♀ + 1 ♂	—	♀ ♀	♀ ♀ + ♂ ♂	♀ ♀ + ♂ ♂

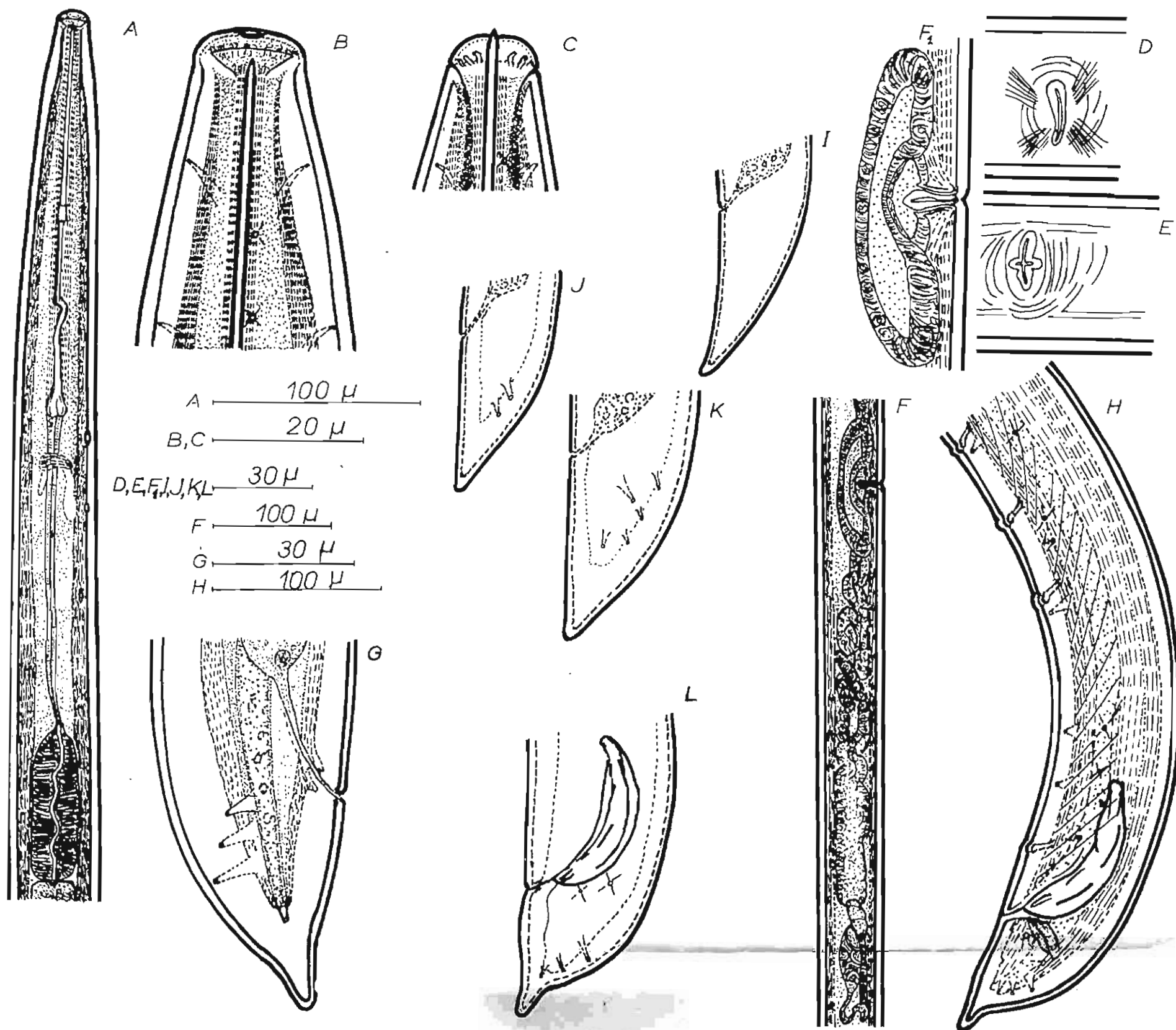


Fig. 1

Fig. 1 *Xiphinema amarantum* sp. nov.

- A (holotype): Anterior part of female.
- B (holotype), C: Head lateral and dorso-ventral.
- D: Superficial view of the vulva.
- E: Cross-shaped lumen of the vagina.
- F (holotype): Female gonad.
- G (holotype): Ovijector, vagina and vulva in lateral view.

Fig. 1

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- D: Superficial view of the vulva.
- E: Cross-shaped lumen of the vagina.
- F (holotype): Female gonad.
- Fl (holotype): Ovijector, vagina and vulva in lateral view
- G (holotype): Tail of female.
- H (allotype): Posterior part of male.
- I, J, K, L: Larval tails (L2, L3, L4, L4-preadult ♂).