

## *Longidorus litchii* n. sp. and *L. henanus* n. sp. (Nemata : Longidoridae) from China

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**Summary** — Two new species of *Longidorus* from China are described. *L. litchii* n. sp., a bisexual species, is characterized by the anteriorly broadly rounded and usually slightly offset lip region; very short and bluntly rounded tail [ $c' = 0.70$  (0.61-0.79)]; medium-sized body [4.56 (4.14-5.29) mm]; long odontostyle [155 (138-171)  $\mu\text{m}$ ] and extremely posteriorly located guide ring [90 (82.5-96.5)  $\mu\text{m}$ ]. *L. henanus* n. sp. is characterized by the broadly rounded, slightly offset or continuous lip region; bluntly conoid to almost hemispherical tail [ $c' = 0.93$  (0.86-1.02)]; asymmetrically bilobed amphids; long body [6.08 (5.11-6.99) mm] and medium-sized odontostyle [98 (97-103)  $\mu\text{m}$ ].

**Résumé** — *Longidorus litchii* n. sp. et *L. henanus* n. sp. (Nemata : Longidoridae) provenant de Chine — Deux nouvelles espèces de *Longidorus* provenant de Chine sont décrites. *L. litchii* n. sp., espèce bisexuelle, est caractérisé par une région labiale largement arrondie et généralement peu séparée du reste du corps; une queue très courte, obtuse [ $c' = 0,70$  (0,61-0,79)]; un corps de longueur moyenne [4,56 (4,14-5,29)  $\mu\text{m}$ ]; un long odontostyle [90 (82,5-96,5)  $\mu\text{m}$ ] et un anneau-guide situé très postérieurement [90 (82,5-96,5)  $\mu\text{m}$ ]. *L. henanus* n. sp. est caractérisé par une région labiale largement arrondie et légèrement séparée du reste du corps, ou continue avec celui-ci; une queue conoïde-obtuse à subhémisphérique [ $c' = 0,93$  (0,86-1,02)]; des amphibes bilobées asymétriques; un corps long [6,08 (5,11-6,99)  $\mu\text{m}$ ] et un odontostyle de longueur moyenne [98 (97-103)  $\mu\text{m}$ ].

**Key-words** : Nematodes, *Longidorus*, China.

During an investigation on plant parasitic nematodes of economic crops in various regions of China, two previously unrecorded species of *Longidorus* were found in association with litchi trees in Fujian Province, eastern China and grapevine in Henan Province, central China, respectively. They are described and illustrated here as *L. litchii* n. sp. and *L. henanus* n. sp. Specimens were killed by gentle heat in water and fixed in TAF. They were then processed to, and mounted in, glycerol using the slow method after Golden (*in* Hooper, 1970). All the measurements were made on specimens mounted in glycerol.

### *Longidorus litchii* n. sp. (Fig. 1)

#### MEASUREMENTS

Females, males and juveniles : see Table 1.

*Holotype* (female) : L = 4.40 mm; a = 77; b = 8.1; c = 165;  $c' = 0.67$ ; V = 50; odontostyle = 151  $\mu\text{m}$ ; odontophore = 93  $\mu\text{m}$ ; ant. end to guide ring = 90  $\mu\text{m}$ ; tail = 26.5  $\mu\text{m}$ ; anal body diam. = 40  $\mu\text{m}$ .

#### DESCRIPTION

*Female* : Body stout, tapering towards both ends, especially from oesophagus base onwards, assuming an

open "C" of varying degrees when relaxed by gentle heat. Cuticle finely striated, composed of three layers along most of the body, with the outer layer being the thinnest, but more layers are differentiated in the tail region; whole cuticle 3-3.5  $\mu\text{m}$  thick at mid-body, 4.5-6  $\mu\text{m}$  near the lip region and 8-10  $\mu\text{m}$  at the tail tip. Lateral chords prominent, occupying about 1/4 corresponding body width except in the oesophageal region where they gradually narrow down to thin lines. Pores : 70-85 lateral body pores on each side of the body; 10-14 lateral, 6-9 ventral and 2-3 dorsal pores present in the oesophageal region, of which 3-4 lateral, 1-2 ventral and 2 dorsal pores are located anterior to the guide ring and the first lateral pore is very close to the amphidial base. Lip region broadly rounded anteriorly, 12.5-14  $\mu\text{m}$  wide at the base, usually slightly set off from the body contour by a shallow depression. Amphids short, obscure, appearing symmetrically bilobed at the base; amphidial openings minute, difficult to see under the light microscope. Odontostyle typical of the genus with simple base, but odontophore base well swollen and provided with weakly developed flanges. Guide ring single, very posteriorly located, 90 (82.5-96.5)  $\mu\text{m}$  or 6.5 (6.0-7.0) times lip region width from the anterior end. Only one nerve ring present, situated about two body widths behind the odontophore base. Hemizonid in-

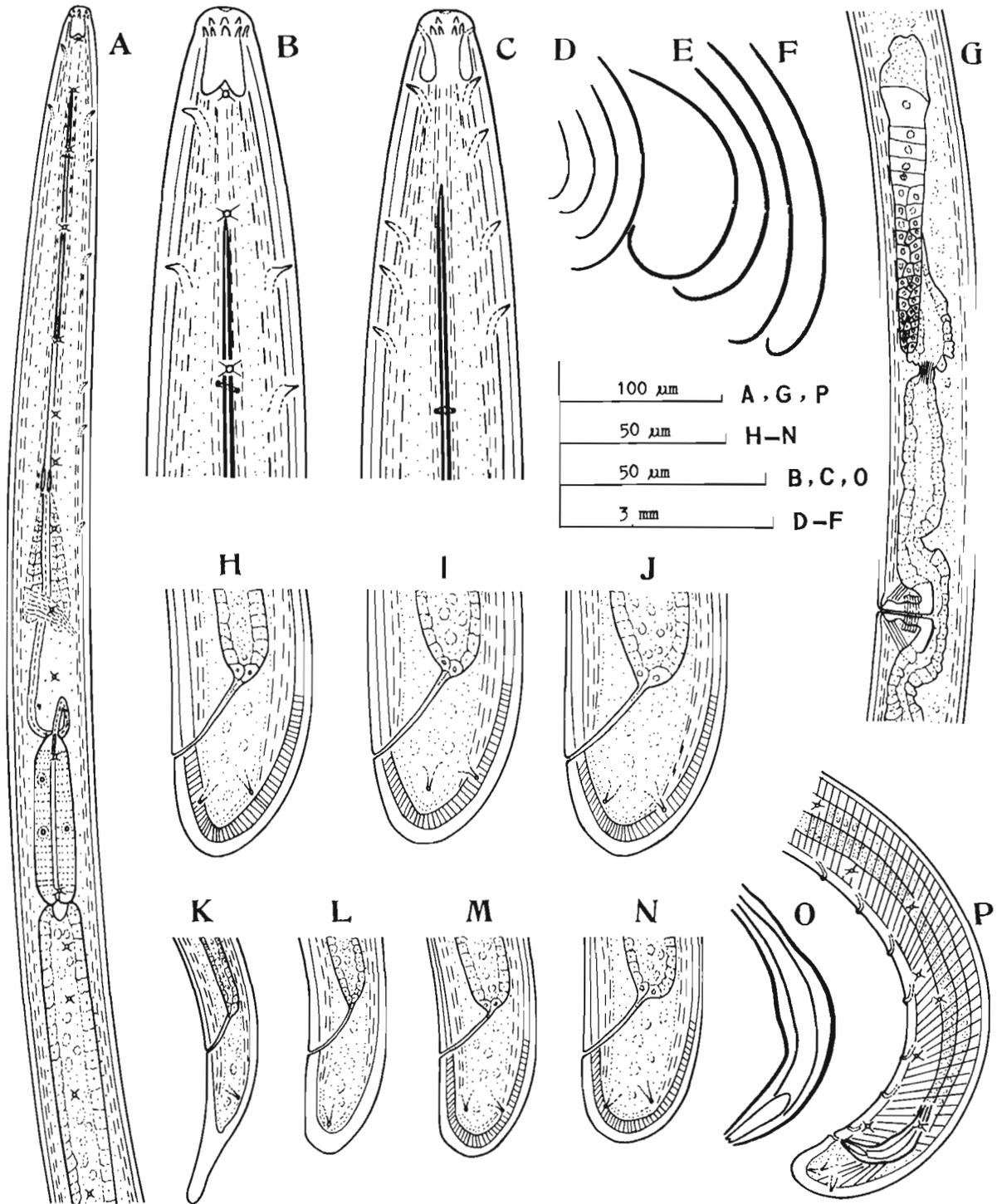
**Table 1.** Morphometrics of paratype females, males and juveniles of *Longidorus litchii* n. sp. (all measurements in  $\mu\text{m}$ , except L).

Stages	J1	J2	J3	J4	Females	Males
n	15	15	15	15	25	2
L (mm)	1.20 $\pm$ 0.34 (1.19-1.40)	1.87 $\pm$ 0.13 (1.61-2.08)	2.45 $\pm$ 0.14 (2.17-2.71)	3.58 $\pm$ 0.54 (2.91-4.70)	4.56 $\pm$ 0.35 (4.14-5.29)	4.54-5.11
a	53 $\pm$ 1.9 (51-58)	56 $\pm$ 2.6 (52-61)	62 $\pm$ 2.1 (59-67)	73 $\pm$ 2.6 (69-78)	78 $\pm$ 3.3 (72-84)	78-88
b	4.1 $\pm$ 0.47 (3.3-5.3)	5.8 $\pm$ 0.45 (4.9-6.7)	6.7 $\pm$ 0.69 (5.9-8.1)	8.2 $\pm$ 0.70 (6.9-9.3)	8.5 $\pm$ 1.00 (7.2-11.3)	9.6-10.0
c	26 $\pm$ 2.2 (22-30)	65 $\pm$ 7.8 (49-77)	89 $\pm$ 7.7 (77-107)	123 $\pm$ 10.4 (109-142)	163 $\pm$ 15.0 (139-197)	155-163
c'	3.13 $\pm$ 0.23 (2.72-3.42)	1.25 $\pm$ 0.17 (1.00-1.63)	0.97 $\pm$ 0.08 (0.81-1.10)	0.79 $\pm$ 0.05 (0.70-0.86)	0.70 $\pm$ 0.05 (0.61-0.79)	0.75-0.85
V	—	—	—	—	52 $\pm$ 1.3 (49-54)	—
G1	—	—	—	—	10.5 $\pm$ 1.50 (8.8-14.5)	—
G2	—	—	—	—	10.5 $\pm$ 1.30 (8.0-12.4)	—
Odontostyle	87 $\pm$ 3.7 (81-93)	98 $\pm$ 1.9 (95-100)	109 $\pm$ 5.8 (102-118)	131 $\pm$ 6.5 (122-145)	155 $\pm$ 8.1 (138-171)	151-169
Odontophore	52 $\pm$ 2.0 (48-55)	67 $\pm$ 5.1 (56-75)	76 $\pm$ 3.8 (70-85)	88 $\pm$ 4.4 (77-95)	95 $\pm$ 4.5 (88-107)	91-92
Total stylet	139 $\pm$ 4.7 (131-145)	165 $\pm$ 5.0 (156-174)	185 $\pm$ 6.9 (175-197)	219 $\pm$ 7.7 (207-236)	250 $\pm$ 9.2 (235-271)	243-260
Repl. odontostyle	100 $\pm$ 4.7 (93-107)	113 $\pm$ 5.4 (104-126)	135 $\pm$ 8.8 (128-164)	154 $\pm$ 5.7 (144-164)	—	—
GR*	41.0 $\pm$ 1.66 (38.5-43.0)	52.5 $\pm$ 5.13 (42.0-59.5)	63.5 $\pm$ 2.24 (58.5-68.5)	74.5 $\pm$ 4.32 (66.5-80.5)	90.0 $\pm$ 3.08 (82.5-96.5)	89.0-92.5
Tail	50.0 $\pm$ 3.87 (44.5-57.0)	29.0 $\pm$ 3.95 (23.0-33.5)	28.0 $\pm$ 2.60 (21.5-31.0)	30.0 $\pm$ 2.01 (26.0-33.0)	28.0 $\pm$ 1.66 (25.5-32.0)	28.0-33.0
Lip region width	8.0 $\pm$ 0.29 (7.5-8.5)	9.5 $\pm$ 0.58 (9.0-11.0)	11.0 $\pm$ 0.47 (10.0-11.5)	12.5 $\pm$ 0.62 (11.5-14.0)	13.5 $\pm$ 0.38 (12.5-14.0)	12.5-14.0
BWGR *	17.5 $\pm$ 0.38 (17.0-18.5)	22.0 $\pm$ 1.17 (19.5-23.5)	27.0 $\pm$ 0.95 (25.0-28.0)	32.5 $\pm$ 1.87 (29.0-36.0)	37.5 $\pm$ 1.30 (34.5-40.5)	35.5-37.0
BWOB *	24.0 $\pm$ 0.79 (23.0-26.0)	31.5 $\pm$ 2.15 (26.5-34.5)	38.0 $\pm$ 1.57 (35.5-40.5)	47.0 $\pm$ 3.72 (40.0-57.0)	53.5 $\pm$ 3.09 (49.0-61.0)	51.5-53.5
BWMB *	24.0 $\pm$ 0.93 (23.5-27.5)	33.0 $\pm$ 2.42 (28.0-36.0)	39.5 $\pm$ 2.40 (36.0-44.0)	50.0 $\pm$ 5.56 (40.5-66.0)	58.0 $\pm$ 3.60 (53.0-64.0)	58.5-59.5
Anal body diam.	16.0 $\pm$ 0.60 (15.0-18.0)	23.0 $\pm$ 1.59 (20.5-26.0)	29.0 $\pm$ 1.71 (25.5-32.0)	38.0 $\pm$ 3.23 (33.0-47.0)	40.0 $\pm$ 2.14 (36.0-44.0)	37.5-38.5

\* GR = anterior end to guide ring; BWGR = body width at guide ring; BWOB = body width at oesophagus base; BWMD = body width at mid-body.

distinct. “Mucro” easy to observe, 3.5 (3-5)  $\mu\text{m}$  long, wedged in the posterior half of the slender part of the oesophagus, also seen rarely outside the oesophagus. Oesophageal bulb cylindrical, 93-113  $\mu\text{m}$  long and 20.5-28  $\mu\text{m}$  wide. Arrangement of the oesophageal gland nuclei typical of *Longidorus*, i.e. : the dorsal nucleus located some distance behind the dorsal gland orifice

and in the anterior third of the bulb; the subventral nuclei more developed than the dorsal nucleus and located in the middle of the bulb. Cardia well developed, hemispherical. Vulva a transverse slit, vagina extending about half the corresponding body width. Genital branches paired, opposed and equally developed, devoid of any special differentiations; ovaries reflexed; oviduct



**Fig. 1.** *Longidorus litchii* n. sp. — Female : A : Oesophageal region (lateral); B : Head region (lateral); C : Head region (dorso/ventral); E : Habitus; G : Vulva and anterior genital branch; H-J : Tail. — Juveniles : D : Habitus of 1st, 2nd, 3rd and 4th stages; K-N : Tails of 1st, 2nd, 3rd and 4th stages. — Male : F : Habitus; O : Spicule; P : Posterior region (lateral).

separated from the uterus by a well developed sphincter. No sperm observed in the uteri. Prerectum 415-676  $\mu\text{m}$  long, or 10.5-18 times anal body diameter. Tail rather short, dorsally convex, tip bluntly rounded. Two caudal pores on each side.

*Male* : Body strongly curved ventrally in the posterior part when relaxed. Morphology of the anterior part similar to that of female. Testes paired and dorylaimoid. Sperm abundant, globulous (diam. = 4-5.5  $\mu\text{m}$ ). Spicules large, arcuate, measuring 68.5-71  $\mu\text{m}$  along the median line. Lateral guiding pieces 19.5-20.5  $\mu\text{m}$  long with bifurcate distal ends. Supplement consists of an adanal pair and a ventromedian series of 6-7. Tail bluntly conoid, dorsally convex, with three caudal pores on each side. Body pores arranged in two rows (subventral and lateral) anterior to the anus.

*Juveniles* : Four distinct stages were recognized. Juvenile tails gradually become relatively shorter and blunter as they progress to adulthood. Tail of J1 is characteristically elongate conoid with a long digitate tip. Lip region shape of all stages similar to that of adults.

#### TYPE MATERIAL

*Holotype* (female) : Deposited in the Nematology Laboratory of Nanjing Agricultural University, Nanjing, China.

*Paratypes* : Six females in the nematode collection of Rothamsted Experimental Station, Harpenden, England; three females in the nematode collection of Muséum National d'Histoire Naturelle, Paris, France; the remaining specimens with the holotype.

#### TYPE HABITAT AND LOCALITY

Light clay soil around roots of litchi trees (*Litchi chinensis* Sonn.) in Zhangzhou, Fujian Province, eastern China.

#### DIAGNOSIS AND RELATIONSHIPS

*Longidorus litchii* n. sp. is characterized by the anteriorly broadly rounded and usually slightly offset lip region; very short and bluntly rounded tail; medium-sized body; long odontostyle and extremely posteriorly located guide ring.

*L. litchii* n. sp. comes closest to *L. jonesi* Siddiqi, 1962, *L. macromucronatus* Siddiqi, 1962, *L. fangi* Xu & Cheng, 1991 and *L. himalayensis* (Khan, 1987) Xu & Hooper, 1990 in guide ring position and lip region and tail shape, but it can be easily distinguished from all these species by its much longer odontostyle [155 (138-171)  $\mu\text{m}$  vs 113 (107-120) in *L. jonesi*; 121 (117-128) in *L. macromucronatus*; 136 (124-144) in *L. fangi* and 115-125 in *L. himalayensis*], more posteriorly located guide ring [GR = 90 (82.5-96.5)  $\mu\text{m}$  vs 61.5 (57-66) in *L. jonesi*; 62.5 (58-68) in *L. macromucronatus*; 78.9 (69.5-86.6) in *L. fangi* and 55-60 in *L. himalayensis*] and presence of males. Furthermore, the new

species differs from *L. jonesi* in its longer and thinner body; from *L. macromucronatus* in its less expanded lip region and stouter body; from *L. fangi* in its less expanded lip region, stouter body and relatively shorter tail and from *L. himalayensis* in its longer and stouter body.

### *Longidorus henanus* n. sp.

(Fig. 2)

#### MEASUREMENTS

*Females* and *juveniles* of 1st, 3rd and 4th stages : see Table 2.

*Holotype* (female) : L = 6.44 mm; a = 121; b = 13.6; c = 158; c' = 0.95; V = 48; odontostyle = 100  $\mu\text{m}$ ; odontophore = 66  $\mu\text{m}$ ; ant. end to guide ring = 43  $\mu\text{m}$ ; anal body diam. = 42  $\mu\text{m}$ .

#### DESCRIPTION

*Female* : Body long and almost cylindrical, tapering towards both ends, habitus varying from hook shaped to C shaped when relaxed by gentle heat. Cuticle consisting mainly of two layers, outer layer very thin throughout the whole body, inner layer slightly widened near the lip region and strongly thickened and radially striated at the tail, tail tip area characteristically less striated compared to adjacent areas. Cuticle 4-5  $\mu\text{m}$  thick at mid body, 5-6  $\mu\text{m}$  near the lip region and 13-14  $\mu\text{m}$  at the tail tip. Lateral chords moderately developed, occupying about 1/3 corresponding body width but narrower in the oesophageal region. Body pores prominent, 100-130 lateral pores present on each side of the body with 10-14 situated in the oesophageal region, first lateral pore located anterior to the guide ring, usually followed by a second lateral pore about half a body diameter posterior to the guide ring; ventral pores 5-7 and dorsal pores 1-3; first ventral and dorsal pores usually close to the guide ring. Lip region broadly rounded, 15-16.5  $\mu\text{m}$  wide, slightly set-off by a shallow depression or continuous with the body contour. Amphids large, extending about half the distance from the anterior end to the guide ring, asymmetrically bilobed with the ventral lobe longer than the dorsal one. Amphidial openings minute, difficult to observe with the light microscope. Stylet typical of the genus with smooth odontostyle base. Guide ring single, 42 (38.5-45.5)  $\mu\text{m}$  or 2.7 (2.5-2.8) lip region widths from the anterior end. Two nerve rings present, situated about 1 and 2.5 body widths behind the odontophore base, respectively. Hemizonid 5-7  $\mu\text{m}$  long, located slightly anterior to the first nerve ring. "Mucro" short, 0.5-3  $\mu\text{m}$  long, wedged in the posterior half of the slender part of the oesophagus. Oesophageal bulb cylindrical, measuring 112-137  $\times$  22-25  $\mu\text{m}$ . Arrangement of the oesophageal gland nuclei typical of *Longidorus*. Cardia bluntly rounded. Vulva a transverse slit; vagina extending over half the corresponding body width; ovejector moderately developed. Genital branches

**Table 2.** Morphometrics of paratype females and juveniles of *Longidorus henanus* n. sp. (all measurements in  $\mu\text{m}$ , except L).

Stages	J1	J3	J4	Females
n	7	2	6	11
L (mm)	0.96 (0.91-1.01)	2.52-3.37	3.80 (3.38-4.32)	6.08 $\pm$ 0.62 (5.11-6.99)
a	51 (49-53)	76-77	91 (86-95)	112 $\pm$ 9.0 (99-127)
b	4.6 (4.1-5.2)	8.6-9.2	9.5 (8.6-10.3)	13.2 $\pm$ 0.97 (12.2-15.4)
c	29 (27-31)	66-88	102 (97-112)	168 $\pm$ 13.4 (154-194)
c'	2.47 (2.32-2.62)	1.13-1.50	1.15 (1.06-1.22)	0.93 $\pm$ 0.06 (0.86-1.02)
V	—	—	—	49 $\pm$ 1.2 (47-51)
G1	—	—	—	12.4 $\pm$ 1.78 (8.4-14.3)
G2	—	—	—	12.1 $\pm$ 1.78 (10.4-15.6)
Odontostyle	49 (48-50)	65-70	82 (78-88)	98 $\pm$ 2.1 (97-103)
Odontophore	36 (34-37)	50-64	63 (60-65)	70 $\pm$ 2.0 (66-74)
Total stylet	85 (84-87)	115-134	145 (141-149)	168 $\pm$ 2.6 (165-173)
Repl. odontostyle	54 (53-55)	74-83	98 (95-102)	—
GR *	21.0 (20.5-21.5)	29.0-33.5	36.5 (35.0-38.0)	42.0 $\pm$ 1.93 (38.5-45.5)
Tail	32.7 (31.0-34.5)	38.0-38.5	37.0 (33.0-39.5)	36.5 $\pm$ 4.26 (31.0-42.0)
Lip region width	8.0 (7.5-8.5)	11.5-12.5	13.5 (13.5-14.0)	16.0 $\pm$ 0.52 (15.0-16.5)
BWGR *	14.0 (13.5-14.5)	21.0-23.5	24.5 (24.0-25.5)	29.0 $\pm$ 0.99 (27.5-30.5)
BWOB *	19.0 (18.5-19.0)	31.0-38.0	38.5 (34.5-41.5)	46.5 $\pm$ 2.45 (43.0-49.5)
BWMB *	19.0 (18.5-19.0)	33.0-44.0	41.5 (37.0-45.5)	54.0 $\pm$ 3.61 (47.5-59.0)
Anal body diam.	13.0 (12.5-14.0)	25.5-33.5	32.5 (30.0-35.5)	39.0 $\pm$ 2.87 (35.5-43.0)

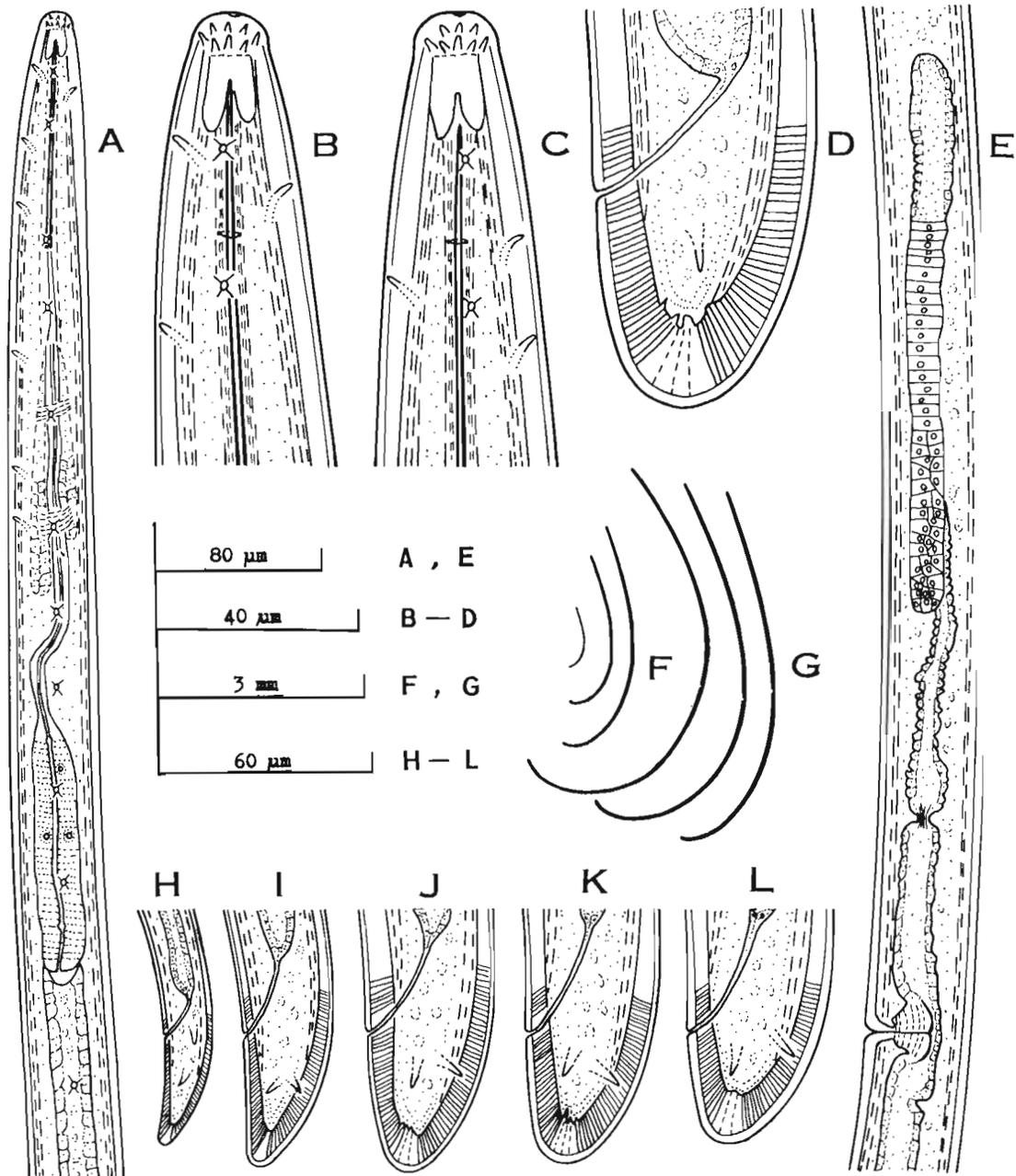
\* GR = anterior end to guide ring; BWGR = body width at guide ring; BWOB = body width at oesophagus base; BWMD = body width at mid-body.

paired, opposed and equally developed; uterus short, without special differentiations, connected with the narrow and long oviduct by a sphincter; ovaries reflexed and usually very long (even extending over the vulva in one specimen). Prerectum distinct, 241-434  $\mu\text{m}$  or 8-11 times anal body width long. Tail short, bluntly conoid to almost hemispherical, dorsally convex, gen-

erally less than one anal body width long. One or two caudal pores present on each side.

*Male* : Not found.

*Juveniles* (J1, J3 and J4 stages) : Tail shape changing from elongate conoid in J1 to short, bluntly conoid in J4, hence c' value becoming progressively smaller as juv-



**Fig. 2.** *Longidorus henanus* n. sp. — Female : A : Oesophageal region (lateral); B, C : Head region (lateral); D, K, L : Tail; E : Vulva and anterior genital branch; G : Habitus. — Juveniles : F : Habitus of 1st, 3rd and 4th stages; H-J : Tails of 1st, 3rd and 4th stages.

eniles develop towards adulthood. Lip region in all stages generally similar to that of female.

**TYPE MATERIAL**

*Holotype* (female) : Deposited in the Nematology Laboratory of Nanjing Agricultural University, Nanjing, China.

*Paratypes* : Two females each in the nematode collections of Rothamsted Experimental Station, Harpenden, England, Istituto di Nematologia Agraria, Bari, Italy and Muséum National d'Histoire Naturelle, Paris, France; the remaining specimens with the holotype.

## TYPE HABITAT AND LOCALITY

Loam soil around roots of grapevine (*Vitis vinifera* L.) in Linbao County, Henan Province, central China.

## DIAGNOSIS AND RELATIONSHIPS

*Longidorus henanus* n. sp. is characterized by the following characters: lip region broadly rounded anteriorly, slightly set off or continuous with the body contour; tail bluntly conoid to almost hemispherical, usually less than one anal body width long; amphids asymmetrically bilobed; body length around 6 mm and odontostyle length around 100  $\mu$ m.

By virtue of the above features, *L. henanus* n. sp. resembles most *L. apulus* Lamberti & Bleve-Zacheo, 1977, *L. iranicus* Sturhan & Barooti, 1983, *L. goodeyi* Hooper, 1961 and *L. crassus* Thorne, 1974. The new species differs from the former three species in having a more posteriorly located guide ring [GR = 42 (38.5-45.5)  $\mu$ m vs 31 (27-34) in *L. apulus*; 35 (33.5-36.5) in *L. iranicus* and 35 (30-40) in *L. goodeyi*]. *L. henanus* n. sp. is further differentiated from *L. apulus* by its stouter body [a = 112 (99-127) vs 139 (123-154)], larger and asymmetrically bilobed amphids, less expanded and anteriorly flattened lip region and more bluntly rounded tail; from *L. iranicus* by its shorter odontostyle [98 (97-103)  $\mu$ m vs 112 (106-118)], more deeply bilobed amphids and differently arranged oesophageal gland nuclei and from *L. goodeyi* by its more slender body [a = 85 (67-117) in *L. goodeyi*] and shorter, less unevenly bilobed amphids. The new species is different from *L. crassus* because of its shorter odontostyle (105-115  $\mu$ m in *L. crassus*) and differently shaped lip region (continuous and anteriorly truncate in *L. crassus*).

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