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HELICOTYLENCHUS FROM SUDAN, WITH DESCRIPTIONS OF TWO NEW SPECIES (NEMATODA: TYLENCHIDA)

by
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Summary. Species of *Helicotylenchus* from Sudan are described. *H. babikeri* sp. n. has a unique head shape which is constricted behind the basal framework; also it has the smallest stylet ever recorded for the genus (16-17.5 μm). *H. abuharazi* sp. n. has a double row of oocytes in the elongate ovaries, a stylet 21-24 μm long, a short tail with a small, ventral, annulated projection. *H. digitatus* and *H. microcephalus* are recorded for the first time from Sudan. *H. conicephalus*, *H. dihystera*, *H. egyptiensis* and *H. multicinctus* have been recorded before.

Nine species belonging to the genus *Helicotylenchus* were formerly recorded from Sudan; two species (*H. abunaami* and *H. conicephalus*) were reported by Siddiqi (1972) from Abu Naama, Northern Fung Area, Central Sudan; seven species (*H. digonicus*, *H. dihystera*, *H. egyptiensis*, *H. exallus*, *H. multicinctus*, *H. varicaudatus* and *Helicotylenchus* sp.) were reported by Decker *et al.* (1980) from Northern, Central and Eastern Sudan.

Over one hundred root and soil samples were collected during June 1987 from the rhizosphere of cultivated and ornamental plants in different localities in Central Sudan (Wadmedani, Abu Haraz, Hantoub and Hillat Hassan) and in Eastern Sudan (Kassala). Fifty of the samples contained *Helicotylenchus*. Their identification presented some problems as several of the identified species were rather similar and often occurred in mixed populations. Apart from the well known *H. multicinctus* and *H. dihystera*, all other species are described and figured and the main differentiating characteristics are given in this paper.

Materials and methods

Identification and description of species were done in the Zoology Department, State University of Gent. Nematodes were processed to anhydrous glycerine by a modified Seinhorst method (De Grisse, 1969).

Descriptions

HELICOTYLENCHUS BABIKERI sp. n. (Fig. 1: A-J; Table I)

Female: short and thin [19 μm ± 2 (16-21) wide]. Body spirally curved when relaxed; cuticle finely striated with 1-1.5 μm wide annuli. Lip region 5.5 μm wide and 3 μm high, conical in shape, with well developed labial framework and 3-5 indistinct annuli. Head widens gradually posteriorly to the basal head framework which occupies about two annuli, followed by a distinct constriction after which the body widens again to a more or less uniform width for the rest of the body. Cephalids indistinct. Stylet short [17 μm ± 1 (16-17.5) long] with conical part longer than shaft. Basal knobs, 2.5-3.5 μm wide, rounded to slightly anteriorly indented. Dorsal oesophageal gland opening 6.5 μm ± 0.5 (5.5-7) posteriad to basal knobs. Oesophagus 109 μm ± 8 (99-119) long with well developed oval metacorpus and oesophageal glands overlapping intestine ventrally and dorsally. The nerve ring encircles isthmus at 62 μm ± 2 (61-67) from anterior body end. Hemizonid about two annuli wide and situated at 0 to 3 annuli anterior the excretory pore which was observed at 74 μm ± 2 (71-77) from anterior body end. Lateral field four lines occupying about one fourth of corresponding body diameter; the inner two incisures fuse for a short distance near the tail terminus. Phasmids pore-like and situated from one annulus posterior to anus to five annuli anterior to it and located on the centre between the inner incisures or more closer to the ventral inner line (Fig. 1: B-D). Female reproductive system didelphic, amphidelphic; spermatheca axial and non-functional. Oocytes arranged in a single file. Vagina 8 μm ± 1 (7-9.5) long and vulva a transverse slit. Tail 14 μm long, conical in shape with 8-12 ventral annuli with a conical or slightly pointed tail tip without annulation.

Male: not found.

Juveniles: body shape similar to that of females with clear genital primordia. Tail 12-14 μm long with 10 annuli.

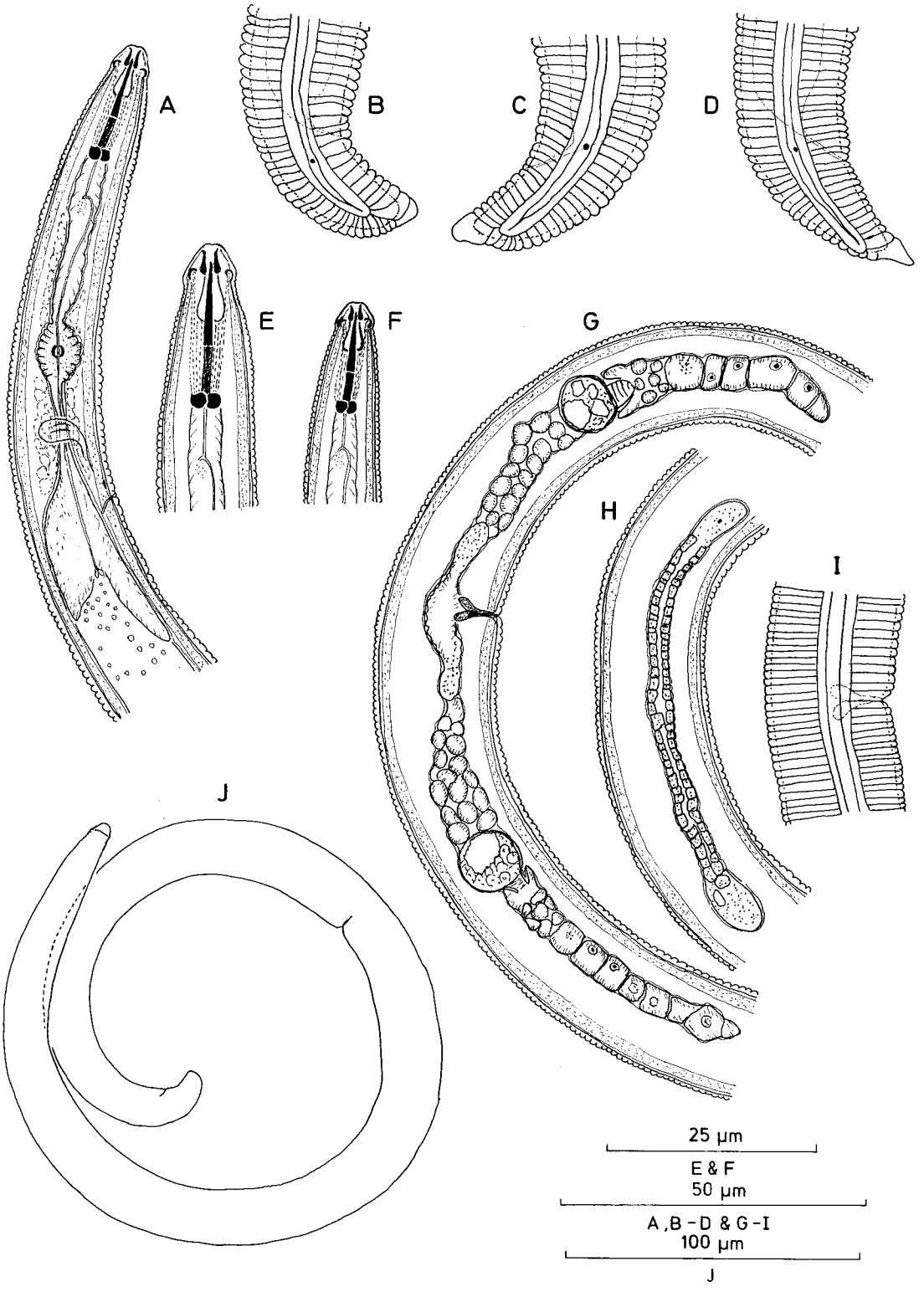

Fig. 1 - *Helicotylenchus babikeri* sp. n.: A, female oesophageal region; E, female anterior body end; B-D, female tails showing variation of phasmid position; G, reproductive system; I, lateral field; J, entire body; F and H, anterior body end and genital primordium of juveniles.

TABLE I - *Measurements of* Helicotylenchus babikeri *sp. n.*

	Holotype Female	Paratype	
		Females	Juveniles
n		5	2
L mm	0.542	0.482 ± 0.047 (0.404 – 0.513)	0.374 – 0.429
a	27	25 ± 4 (21 – 30)	24 – 25
b	6.7	5.3 ± 0.5 (4.4 – 5.8)	5.4 – 5.8
b'	5.7	4.4 ± 0.5 (3.7 – 4.8)	4.3 – 4.8
c	39	34 ± 3 (29 – 39)	31
C'	1.2	1.5 ± 0.2 (1.3-1.6)	1.3 – 1.5
V	62	65 ± 3 (62 – 69)	–
m	57.5	54 ± 3 (51 – 57)	56
o	34.0	37 ± 4 (31 – 42)	38
Head diameter	5.5	5.5 ± 0.3 (5.0 – 5.5)	4.5 – 5.0
Head height	3.0	3.0 ± 0.5 (2.5 – 3.5)	2.5 – 3.0
Stylet length	16.5	17.0 ± 1.0 (16.0 – 17.5)	16.0
St. knob width	2.5	3.0 ± 0.5 (2.5 – 3.5)	3.0
St. cone L	10.0	9.0 ± 0.5 (8.0 – 10.0)	9.0
DOGO	6.0	6.0 ± 0.5 (5.5 – 7.0)	6.0
Ant. Ph. PE	18	18 ± 3 (14 – 21)	14
Pst. Ph. PE	14	17 ± 3 (13 – 20)	11
Nerve ring AE	62	64 ± 2 (61 – 67)	47 – 62
Hemizonid AE	69	74 ± 2 (68 – 76)	74
Exc. pore AE	72	74 ± 2 (71 – 77)	63 – 75

D = Diameter (μm); L = Length (μm); W = Width (μm); H = Height (μm); St. = Stylet; DOGO = Dorsal Oesophageal Gland Orifice; Ant. = Anterior; Pst. = Posterior; Ph. = Phasmid; AE = Anterior end; Exc. = Excretory; PE = Posterior end.

Material, type locality and habitat

Holotype female and four paratype females mounted on slide No. 3298, deposited in the collection of the University of Gent, Instituut voor Dierkunde, Ledeganckstraat 35, 9000 Gent, Belgium; one slide with one female and two juveniles in the U.S.D.A., Nematology collection, Beltsville, MD, U.S.A. This species was collected from the rhizosphere of *Psidium guajava* in a fruit orchard in Kassala, Eastern Sudan, 1.6.1987.

Discussion

Helicotylenchus babikeri sp. n. is characterized by unique features within the genus as it possesses a head which is constricted behind the basal framework whereas all species recorded with constriction, show the constriction more anterior and stylet is the smallest (16-17.5 μm long) in the genus, compared with the previous records of *H. morasii* Darekar *et* Khan, 1980 and *H. indicus* (Siddiqi, 1963) with stylets 18-20.5 and 18-24 μm long, respectively (Darekar and Khan, 1980; Fortuner *et al.*, 1981; Siddiqi, 1963; Sher, 1966; Nandakumar and Khera, 1970).

The new species was named to commemorate the first author's father.

HELICOTYLENCHUS ABUHARAZI sp. n. (Fig. 2: A-J; Table II)

Female: short, thin [21 μm ± 1 (19-23) wide] usually with closed spiral bodies when relaxed. Cuticle transver-

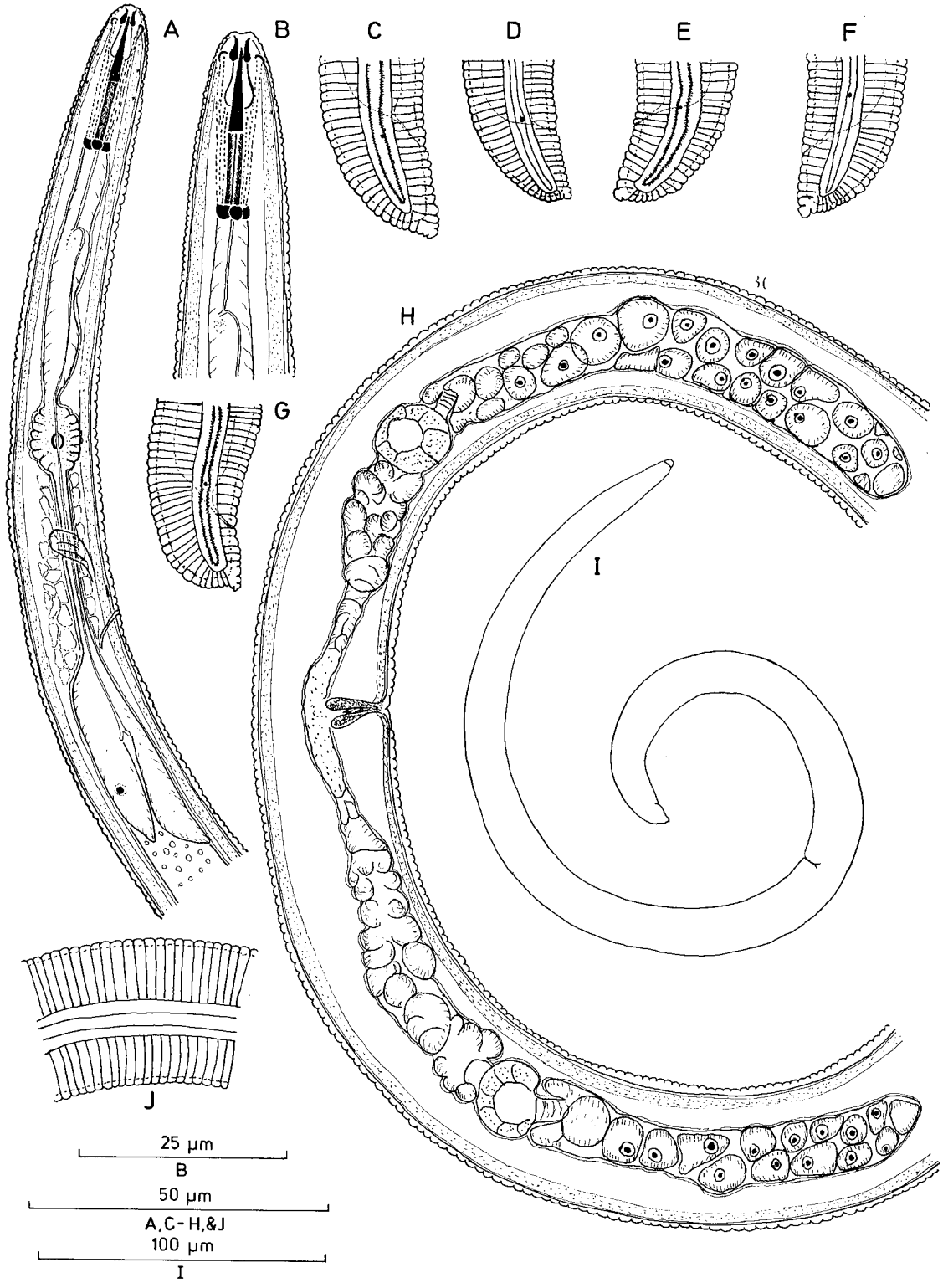

Fig. 2 - Females of *Helicotylenchus abuharazi* sp. n.: A, oesophageal region; B, anterior body end; C-G, tails showing variation in phasmid position; E and G, inner incisures with zigzag appearance; H, reproductive system; I, entire body; J, lateral field.

sally striated with annuli 1.5 µm wide. Lip region hemispherical not set off from rest of body contour, 6 µm ± 0.5 (5.5-6.5) wide and 3.5 µm ± 0.3 (3-4) high with 3-4, indistinct annuli and heavily sclerotized framework. Cephalids conspicuous in some females; anterior cephalid at about 12 annuli from anterior body end and the posterior one situated six annuli behind it. Stylet 23 µm ± 1 (21-24) long, with rounded to anteriorly flat basal knobs 4 µm ± 0.5 (3.5-5) wide. Dorsal oesophageal gland opens at 11 µm ± 2 (9- 14) behind basal knobs. Oesophagus 147 µm ± 13 (119-163) with long procorpus and isthmus and oval metacorpus. Nerve ring encircles isthmus at 87 µm ± 6 (76-99) from anterior body end. Hemizonid very distinct in most females, about 1-2 annuli wide and situated 0-2 annuli anterior to excretory pore which is at 99 µm ± 6 (85-106) from anterior body end. Lateral field four incisures occupying about 25% of corresponding body diameter. Inner two incisures not fused distally but may show a zig-zag appearance (Fig. 2: E and G). Phasmids distinct, pore-like, usually situated at 1-8 annuli anterior to anus level (exceptionally at 2 annuli posterior to anus in one female), mostly near the inner ventral incisure. Female reproductive system didelphic, amphidelphic. Oocytes may be arranged in a short single row just anterior to spermatheca, but usually in two rows untill the cap cell. Spermatheca axial without sperms. Uterus with large globular cells. Vagina 9 µm ± 1 (8-11) long and vulva a transverse slit. Tail 13 µm ± 2 (11-16) long, with 7 ± 1 (6-9) annuli, dorsally convex-conoid with a short ventral annulated projection.

Male: not found.

Material, type locality and habitat

Holotype female mounted on slide No. 3299, deposited in the collection of the University of Gent, Instituut voor Dierkunde, Ledeganckstraat 35, 9000 Gent, Belgium. It was collected from the rhizosphere of an ornamental shrub *Quisqualis* sp. in the nursery of Abu Haraz College of Agriculture, Central Sudan on 7.6.1987. Eleven paratype females, collected from the rhizosphere of ornamental plants in the nursery of Abu Haraz College of Agriculture, Central Sudan: *Quisqualis* sp., *Acalypha indica*, *Ixora* sp., and *Ficus elastica* on 7.6.1987 deposited as follows: four sent to U.S.D.A., Nematology collection, Beltsville, MD., U.S.A.; two sent to Nematology collection, Agricultural University Wageningen, the Netherlands; three females in the collection of the first author; two in the collection of the University of Gent, as the holotype, on slide No. 3300.

TABLE II - *Measurements of* H. abuharazi *sp. n.*

	Holotype (female)	Paratype (female)
n		11
mm	0.511	0.587 ± 0.037 (0.520 – 0.639)
	26	28 ± 2 (25 – 33)
b	4.6	5.2 ± 0.4 (4.6 – 5.6)
b'	3.4	4.0 ± 0.4 (3.4 – 4.8)
	39	46 ± 5 (38 – 52)
	1.1	1.0 ± 0.1 (0.9 – 1.1)
	63	62 ± 1 (61 – 64)
G_1	28	30 ± 5 (21 – 38)
G_2	25	26 ± 3 (20 – 32)
m	48	48 ± 2 (46 – 52)
o	48	50 ± 8 (38 – 64)
Head D	6.0	6.0 ± 0.5 (5.5 – 6.5)
Head H	3.5	3.5 ± 0.3 (3.0 – 4.0)
Stylet L	21	23 ± 1 (21 – 24)
Stylet knob W	4.0	4.0 ± 0.5 (3.5 – 5.0)
Stylet cone L	10	11 ± 1 (10 – 12)
DOGO	10	11 ± 2 (9 – 14)
Ant. Ph. PE.	15	19 ± 2 (16 – 22)
Pst. Ph. PE.	16	17 ± 2 (13 – 19)
Nerve ring AE.	88	87 ± 6 (76 – 99)
Hemizonid AE.	93	94 ± 7 (85 – 103) (n = 6)
Exc. pore AE.	97	99 ± 6 (85 – 106)

Discussion

Helicotylenchus abuharazi sp. n. is similar in body length, stylet length, position of dorsal oesophageal gland opening and habitus to: *H. densibullatus* Siddiqi, 1972; *H. conicephalus* Siddiqi, 1972; *H. digitatus* Siddiqi *et* Husain, 1964 (both found in Abu Haraz in association with our new species); *H. magnicephalus* Phukan *et* Sanwal, 1981; *H. elegans* Roman, 1965, redescribed by Van den Berg *et* Heyns, 1975; *H. indicus* Siddiqi, 1963; and *H. arachisi* Mulk *et* Jairajpuri, 1975.

All these species are usually characterized by a single row arrangement of oocytes in comparison with the double row of the new species.

H. abuharazi differs from *H. densibullatus* in the shape of stylet basal knobs which are not amalgamated as in *H. densibullatus*, and hence its specific name and in the heavily sclerotized labial framework with the lip region confluent with the body contour, whereas the sclerotization of *H. densibullatus* is inconspicuous and the head is slightly offset.

H. abuharazi was found with *H. conicephalus* and *H. digitatus* in samples from the rhizosphere of ornamental plants in the nursery of Abu Haraz College of Agriculture. *H. abuharazi* can be differentiated from the other two species by the longer ovaries [G_1 = 30 ± 5 (21-38), G_2 = 26 ± 3 (20- 32) compared to G_1 = 19 ± 2 (16-21), G_2 = 17 ± 2 (16-21) for *H. conicephalus* and G_1 = 19 ± 1 (17-21),

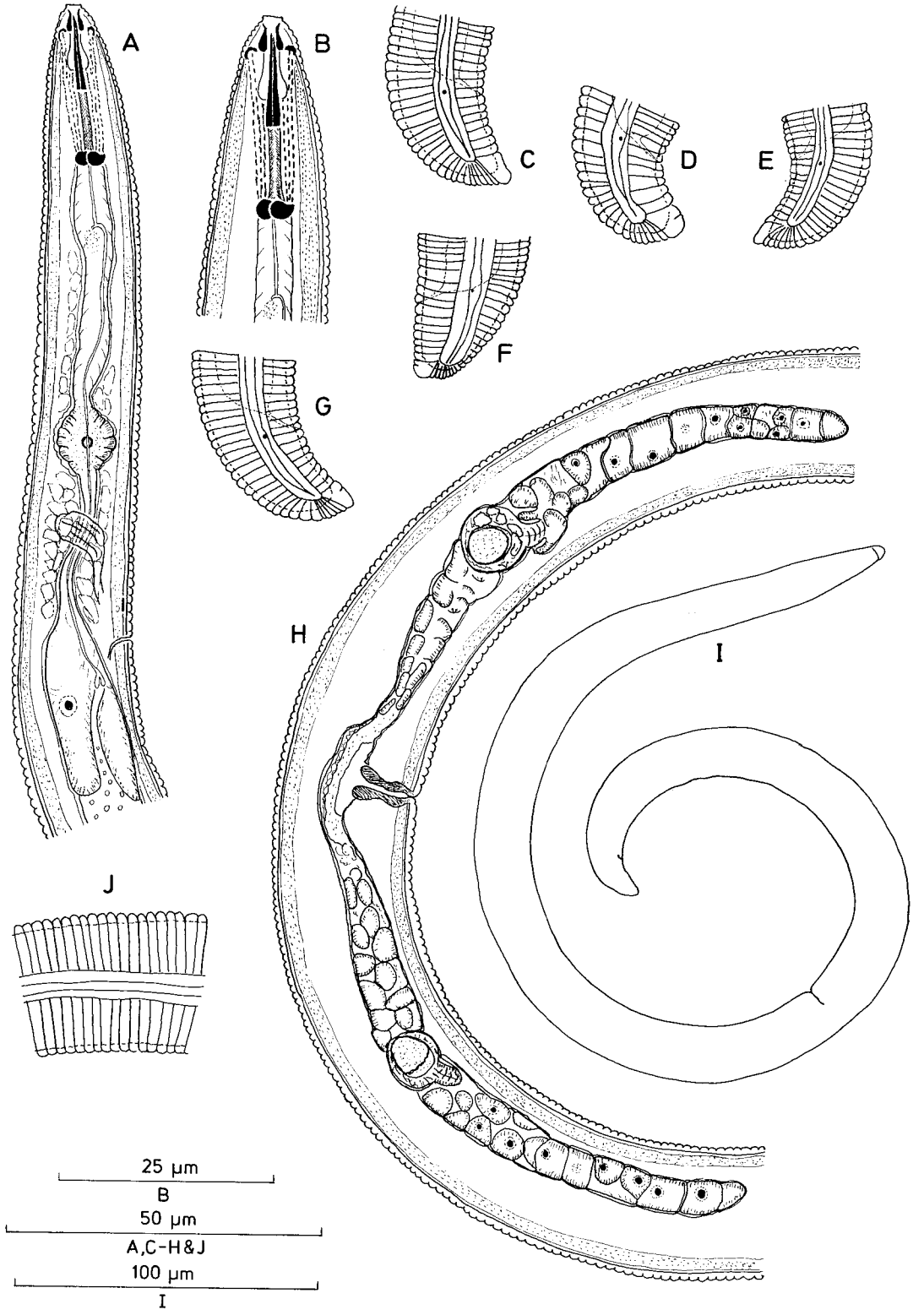

Fig. 3 - Females of *H. conicephalus*: A, oesophageal region; B, anterior body end; C-G, tails showing variation in phasmid position and inner incisures fusion pattern; H, reproductive system; I, entire body; J, lateral field.

G_2 = 18 ± 1 (17-21) for *H. digitatus*] (Fig.2: H; Fig. 3: H; Fig. 4: D); the tail tips ventral projections, short in *H. abuharazi*, conical without annulation for *H. conicephalus* and long digitate for *H. digitatus*; the position of phasmid, 1-8 annuli anterior to anus for *H. abuharazi* compared to 0-3 for *H. conicephalus* and 2 posterior to 5 anterior to anus for *H. digitatus*; the inner two incisures which do not fuse distally, and several specimens show a zigzag appearance, while those of the other two species may fuse distally with a non- zigzag appearance (Fig. 2: C-G; Fig. 3: C-G; Fig. 4: C, F, H-J) and finally the typical *H. conicephalus* has a labial disc and terminal annuli of the tail are finer than the rest. From *H. magnicephalus* this new species can be differentiated by the shape of the head and the tail length (head truncate, c = 27-34 for *H. magnicephalus* against hemispherical head with c = 38-52 for *H. abuharazi*). From *H. elegans, H. abuharazi* differs in the more anterior position of phasmid compared to anus (up to 8 annuli compared to only 2 for *H. elegans*) and tail length (c = 38-52 against c = 26-37, respectively) and *H. abuharazi* can be differentiated from both *H. indicus* and *H. arachisi* by the shape of the tail as both of them possess rounded tails without any ventral projections compared to the conical tail with very clear short ventral projection for the new species.

HELICOTYLENCHUS CONICEPHALUS Siddiqi, 1972 (Fig. 3: A-J; Table III)

Female: short, thin [19 µm ± 3 (15-23) wide] with a loose spiral body shape when relaxed. Lip region with small labial disc, with 4-5 annuli, 6 µm ± 0.5 (5.5-6.5) wide and 3-4 µm high with well developed labial framework. Cephalids indistinct. Stylet robust, 21 µm ± 1 (20-23) long with rounded, anteriorly indented 4.0 µm ± 0.5 (3.5-4.5) wide basal knobs. Dorsal oesophageal gland orifice at 9 µm ± 1 (8-11) posterior to basal knobs. Oesophagus long, 129 µm ± 12 (118-148) with large rounded median bulb, long isthmus and oesophageal glands overlapping intestine ventrally and dorsally. Nerve ring surrounds isthmus at 80 µm ± 6 (70-93) from anterior body end. Hemizonid about 2 annuli wide and situated at 0-3 annuli anterior to excretory pore which is at 92 µm ± 10 (83-109) from anterior body end. Lateral field occupies one fourth of corresponding body diameter and the inner two incisures may fuse distally. Phasmids pore-like situated at anus level, from 2 annuli posterior to 6 anterior to it and in the middle of the inner two incisures or closer to the ventral one. Female reproductive system didelphic amphidelphic. Oocytes usually arranged in one row, however a small area with two rows was seen in some specimens. Spermatheca axial and empty. Vagina 10 µm ± 1 (8-11) long and vulva a transverse slit. Tail rounded to conical, 16 µm ± 2 (14-19) long, with 8 to 10 annuli; terminal annuli finer than the rest and provided with a ventral non-annulated projection.

Male: not found.

Material, locality and habitat

Four of the five populations of *H. conicephalus* were found in Central Sudan: at Abu Haraz, females from the rhizosphere of ornamentals; *Rosa* sp. and *Ficus elastica*, June 1987; at Hantoub in the Gway Orchard, females from the rhizosphere of *Musa* sp., June 1987; in the Korina Orchard, females from the rhizosphere of *Psidium guajava*, *Mangifera indica* and *Citrus limon*, June 1987; in the Bashir Orchard, females collected from the rhizosphere of *P. guajava*, June 1987; and in Eastern Sudan at Kassala, females collected from the rhizosphere of *Musa* sp., June 1987.

Discussion

Type population of *H. conicephalus* was described by Siddiqi (1972) from soil around the roots of *Aeolanthus myrianthus* at Mzuzu, in Northern Region, Malawi and from *Citrus paradisi* and *Vitis vinifera* at Abu Naama, Northern Fung Area, Central Sudan.

All members of the five populations studied agree in most aspects with original description except for some slight differences in the lip region: we can detect 4-5 annuli which Siddiqi (1972) did not observe, on the other hand, he detected cephalids which we did not find.

This is the second report for *H. conicephalus* from Sudan and it seems to be the most widely distributed *Helicotylenchus* species in the country as it was found in five out of the seven localities in which *Helicotylenchus* species were present.

HELICOTYLENCHUS DIGITATUS Siddiqi *et* Husain, 1964 (Fig. 4: A-J)

Measurements

Females: (n = 9), L = 0.608 mm ± 0.034 (0.560-0.650), a = 32 ± 2 (30-34), b = 5.4 ± 0.4 (4.7-5.8), b' = 4.4 ± 0.3 (3.8- 4.7), c = 34 ± 3 (29-37), c' = 1.6 ± 0.1 (1.5-1.8), V = 63 ± 2 (60-65); St. = 21 ± 1 (20-23), m = 48 ± 3 (43-52), o = 43 ± 5 (36-52).

Female short, thin nematodes [19 µm ± 2 (17-21) wide] usually with spiral or open C-shape when relaxed. Cuticle transversally striated with 1-1.5 µm wide annuli. Lip region conical not demarcated from the body, 6 µm ± 0.5 (5.5-6.5) wide and 3-3.5 µm high with indistinct annuli and well developed labial framework. Stylet 21 µm ± 1 (20-23) long with 3.5-4 µm wide and anteriorly concave basal knobs. Duct of dorsal oesophageal gland opens at 9 µm ± 1 (8-11) behind basal knobs. Oesophagus 138 µm ± 10 (120-151) long with oval metacorpus; oesophageal glands overlapping intestine ventrally and dorsally. Nerve ring encircling isthmus at 86 µm ± 4 (78-89) from anterior body end. Hemizonid just anterior to excretory pore which is at 98 µm ± 7 (83-106) from anterior body end. Lateral field of four incisures occupying about 25% of cor-

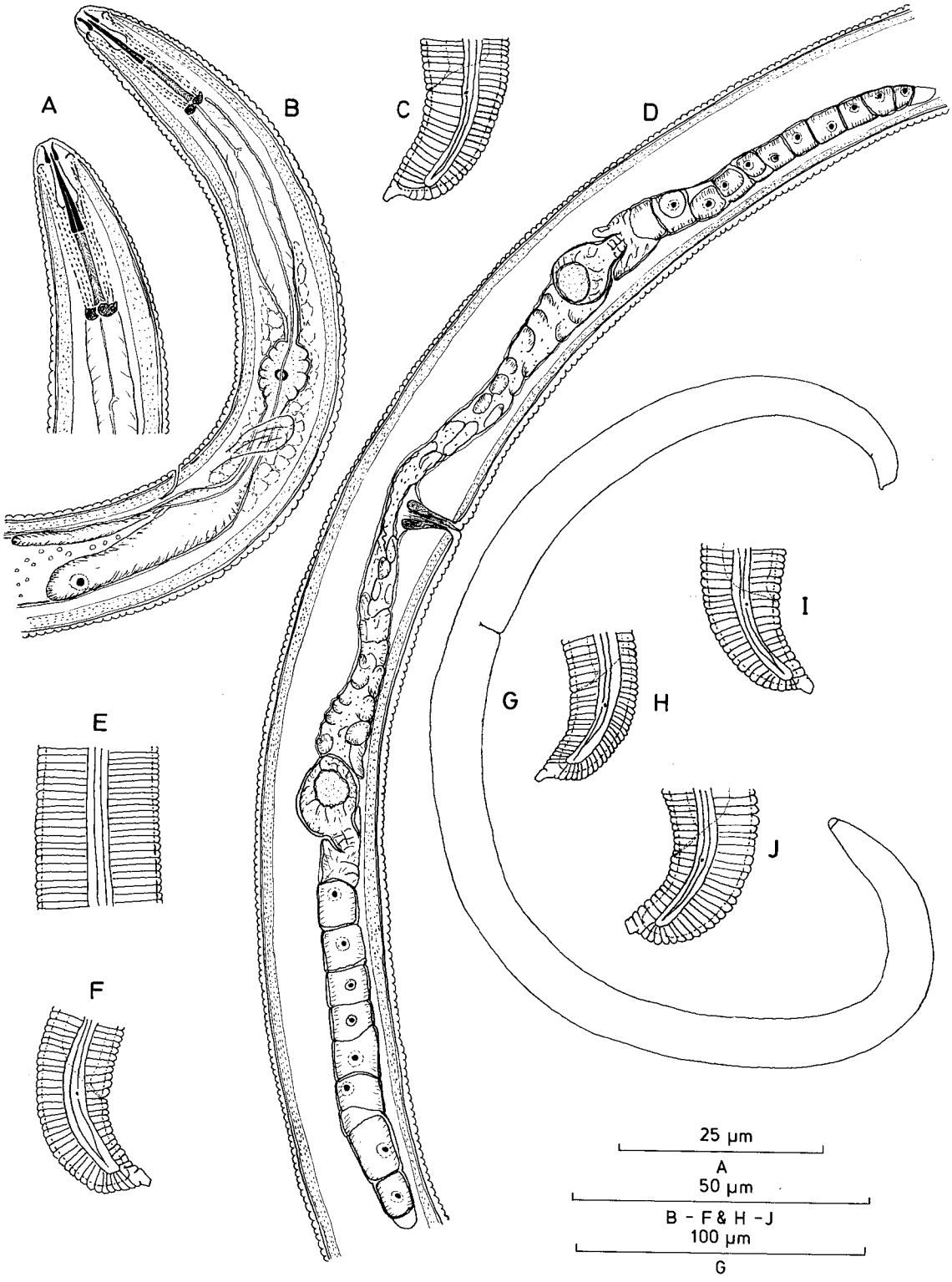

Fig. 4 - Females of *H. digitatus*: A, anterior body end; B, oesophageal region; C, F, H-J, tails showing variation of phasmid position; E, lateral field; D, reproductive system; G, entire body.

responding body diameter; the two internal ones fuse distally. Phasmids pore-like situated at the anus, from two annuli posterior to five annuli anterior to it and always situated at or close to ventral inner incisure. Female reproductive system didelphic, amphidelphic. Oocytes arranged in a single row. Spermatheca axial and empty. Vagina 10 µm ± 1 (9- 11) deep and vulva a transverse slit. Tail 18 µm ± 1 (17-21) long with 11 ± 1 (10-13) ventral annuli dorsally convex and terminated by long digitate non-annulated projection.

Male: not found.

Material, locality and habitat

Nine females from the rhizosphere of *Citrus limon*, *Rosa* sp. and *Ixora* sp. were found in the nursery of Abu Haraz College of Agriculture, Central Sudan during June 1987.

Discussion

Specimens of *H. digitatus* were first described by Siddiqi and Husain (1964) from soil around *Citrus sinensis* in Mysore, India. Later it was found and described by many other authors from different localities. Our population slightly differs from the types for the position of phasmid five annuli anterior to anus whereas in the original description, is only exceptionally two annuli anterior to anus; for the stylet knobs, anteriorly concave in our material compared to rounded in the original description; in the tail length, shorter in our population (always less than two anal body diameters compared to more than two) and for having no 'setae' on the tails of our females (which might be only bacterial growth on the tails of original specimens).

H. digitatus and *H. conicephalus* are similar, they both

TABLE III - *Measurements of* H. conicephalus *from various Sudanese localities.*

	CENTRAL SUDAN				EASTERN SUDAN
	Abu Haraz	Hantoub (Gway)	Hantoub (Korina)	Hantoub (Bashir)	Kassala
n	6	6	6	6	6
L mm	0.571 ± 0.050	0.556 ± 0.050	0.630 ± 0.102	0.618 ± 0.044	0.566 ± 0.034
	(0.500 – 0.560)	(0.455 – 0.605)	(0.530 – 0.790)	(0.580 – 0.675)	(0.515 – 0.615)
a	30 ± 4 (26 – 32)	29 ± 2 (25 – 31)	30 ± 2 (28 – 34)	31 ± 2 (29 – 34)	28 ± 3 (25 – 32)
b	5.5 ± 0.2 (5.2 – 5.8)	5.5 ± 0.5 (4.6 – 6.0)	6.0 ± 0.3 (5.6 – 6.4)	6.3 ± 0.6 (5.5 – 7.1)	5.6 ± 0.3 (5.3 – 6.2)
b'	4.4 ± 0.3 (4.2 – 4.8)	4.6 ± 0.5 (3.8 – 5.0)	5.0 ± 0.5 (4.2 – 5.5)	5.4 ± 0.6 (4.9 – 6.5)	4.8 ± 0.3 (4.5 – 5.3)
c	35 ± 2 (32 – 38)	37 ± 5 (30 – 42)	38 ± 6 (33 – 48)	40 ± 3 (37 – 44)	35 ± 2 (32 – 38)
c'	1.4 ± 0.2 (1.3 – 1.7)	1.3 ± 0.1 (1.1 – 1.4)	1.4 ± 0.1 (1.3 – 1.6)	1.4 ± 0.2 (1.1 – 1.6)	1.3
V	62 ± 1 (62 – 63)	63 ± 1 (62 – 64)	63 ± 1 (61 – 65)	63 ± 1 (62 – 65)	62 ± 1 (60 – 64)
m	49 ± 1 (48 – 40)	48 ± 1 (45 – 52)	48 ± 2 (45 – 50)	48 ± 3 (43 – 50)	50 ± 2 (48 – 52)
o	45 ± 5 (39 – 52)	44 ± 5 (38 – 48)	49 ± 11 (34 – 63)	46 ± 3 (41 – 48)	37 ± 5 (32 – 46)
Head D	6.0 ± 0.5 (5.5 – 6.5)	6.5 ± 0.5 (6.5 – 7.0)	6.0 ± 1.0 (5.5 – 7.0)	6.5 ± 0.5 (6.0 – 7.0)	6.0 ± 0.5 (5.5 – 6.5)
Head W	3.0 – 4.0	3.5	3.5 – 4.0	3.5 – 4.0	3.5 – 4.0
Stylet L	21 ± 1 (20 – 23)	21 ± 1 (20 – 22)	21 ± 1 (20 – 23)	21 ± 1 (20 – 22)	22 ± 1 (21 – 23)
St. knobs W	4.0 ± 0.5 (3.5 – 4.5)	4.0 ± 0.5 (3.5 – 4.5)	4.0 ± 0.5 (3.5 – 5.0)	4.0 ± 0.4 (3.5 – 4.0)	4.0 ± 0.5 (3.5 – 5.0)
St. cone L	10 ± 1 (10 – 11)	10 ± 1 (9.5 – 11)	10 ± 1 (9 – 11)	10 ± 1 (9 – 11)	11 ± 1 (10 – 12)
DOGO	9 ± 1 (8 – 11)	9 ± 1 (8 – 10)	10 ± 2 (8 – 14)	9 ± 1 (9 – 10)	8 ± 1 (7 – 10)
Ant. Ph. PE	18 ± 1 (16 – 20)	17 ± 4 (9 – 20)	20 ± 5 (16 – 30)	19 ± 3 (15 – 21)	18 ± 1 (17 – 21)
Pst. Ph. PE	17 ± 2 (14 – 19)	16 ± 4 (9 – 18)	17 ± 4 (14 – 22)	16 ± 2 (14 – 20)	17 ± 1 (15 – 18)
Nerve ring AE	80 ± 6 (70 – 93)	77 ± 4 (72 – 82)	81 ± 7 (75 – 95)	75 ± 8 (62 – 86)	75 ± 7 (68 – 83)
Hemizonid AE	92 ± 10 (81 – 109)	91 ± 6 (86 – 100)	82 – 97 (n = 2)	86 ± 5 (80 – 91)	85 ± 7 (77 – 94)
Exc. pore AE	92 ± 10 (83 – 109)	91 ± 7 (83 – 102)	96 ± 10 (84 – 112)	88 ± 7 (80 – 99)	89 ± 7 (79 – 96)
Tail ann.	9 ± 1 (8 – 10)	8 ± 1 (6 – 9)	8 ± 2 (6 – 10)	8 ± 1 (7 – 9)	7 ± 1 (6 – 8)
Phasmid ann.	0/3	– 2/3	– 1/6	– 1/4	0/3

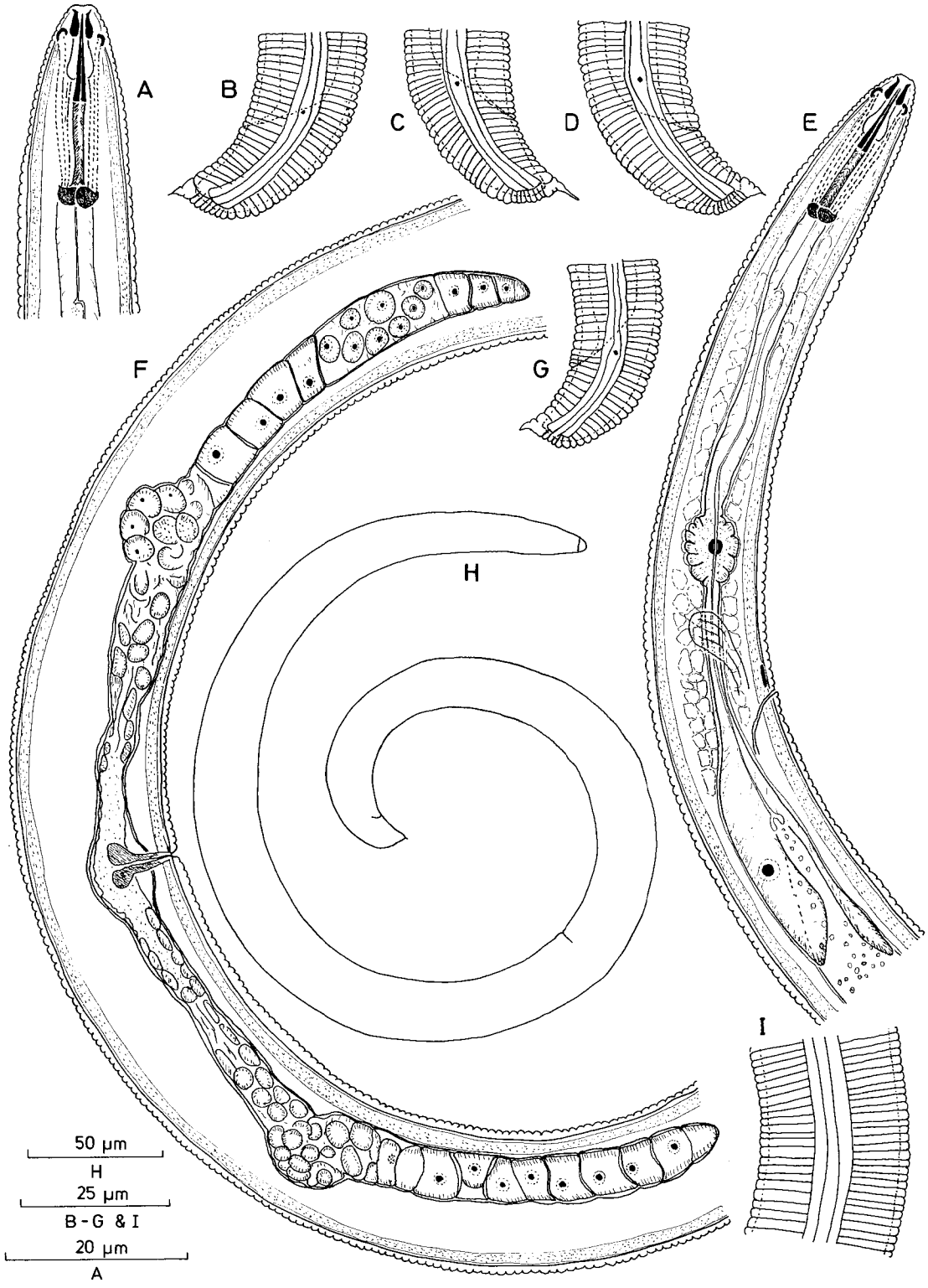

Fig. 5 - Females of *H. egyptiensis*: A, anterior body end; E, oesophageal region; B-D and G, tails showing variation of phasmid position; F, reproductive system; H, entire body; I, lateral field.

have a stylet of 20-23 μm; *H. conicephalus* has a more or less projecting labial disc and no tail projection; *H. digitatus* has a slightly longer tail with a digitate tail projection.

This is the first record of *H. digitatus* for Sudan.

HELICOTYLENCHUS DIHYSTERA (Cobb, 1893) Sher, 1961

Six females were collected from the rhizosphere of *Ficus benghalensis* in a house garden in the centre of Wadmedani, Central Sudan, during June 1987. These agree morphologically and morphometrically with former descriptions. This is the second record for *H. dihystera* for Sudan since the previous record by Decker *et al.* (1980).

HELICOTYLENCHUS EGYPTIENSIS Tarjan, 1964 (Fig. 5: A-I)

Measurements

Female: (n = 10), L = 0.634 mm ± 0.047 (0.565-0.715), a = 26 ± 2 (23-29), b = 5.0 ± 0.5 (3.8-5.7), b' = 4.2 ± 0.3 (3.9- 4.6), c = 38 ± 4 (34-45), c' = 1.4 ± 0.1 (1.2-1.6), V = 63 ± 1 (62-65); St. = 24 ± 1 (23-25), m = 47 ± 2 (44-50), o = 49 ± 3 (44-52).

Female short with rather thick bodies [25 μm ± 2 (22-28) wide]; bodies closed to open spiral shape when relaxed. Cuticle finely transversally striated with 1.5 μm wide annuli. Lip region, 7.5 μm ± 0.5 (7-8) in diameter and 4 μm ± 0.5 (3.5-5) high, truncated with 4-5 indistinct annuli and well developed labial framework. Stylet strong with rounded or slightly anteriorly indented basal knobs 4.5 μm ± 0.5 (3.5-5) wide. Dorsal oesophageal gland opens at 12 μm ± 1 (11-13) posterior to basal knobs. Oesophagus, 151 μm ± 9 (145-162) long with oesophageal glands overlapping intestine ventrally and dorsally. Nerve ring surrounding isthmus at 94 μm ± 4 (87-101) from anterior body end. Hemizonid, very clear, about 2 annuli wide just anterior to excretory pore which is situated at 105 μm ± 4 (98-111) from anterior body end. Lateral field of four lines occupying about 25% of corresponding body diameter; inner two incisures do not fuse distally and may stay apart till tail terminus. Phasmids distinct and situated in the middle between the two inner lines at 5-9 annuli anterior to anus. Female reproductive system didelphic, amphidelphic; spermatheca as a slightly enlarged and offset part at the end of uterus. Oocytes arranged in a single row, sometimes few oocytes in two rows (Fig. 5: F). Vagina 11 μm ± 1 (10-12) deep; vulva slit-like. Tail 17 μm ± 2 (13-20) long with 8-11 ventral annuli, sharply pointed tip varying in length and acuteness.

Male: not found.

Material, locality and habitat

It was collected from the rhizosphere of *Citrus limon*, *C. sinensis* and *Psidium guajava* from Abu Snoon fruit orchard in Hillat Hassan, Central Sudan, June 1987.

Discussion

Type specimens of *H. egyptiensis* were collected by Tarjan (1964) from soil and roots of sugar cane from Wabour el Barabra, Egypt. Our population differs from the original description in several aspects such as shorter body (0.565-0.715 mm compared to 0.69-0.85 mm for type population) and stylet length (23-25 μm against 24-28 μm), posterior vulva (62-65 compared to 59-62 for type specimens) and phasmid position (5-9 annuli anterior to anus against 0 to slightly anterior to anus for Egyptian population). In spite of these differences we consider our specimens only as a smaller form of *H. egyptiensis*.

This is the second record of this species in Sudan, Decker *et al.* (1980) reported it from three different localities.

HELICOTYLENCHUS MICROCEPHALUS Sher, 1966 (Fig. 6: A-I)

Measurements

Females: (n = 9), L = 0.628 mm ± 0.066 (0.555-0.735), a = 29 ± 2 (26-33), b = 4.8 ± 0.3 (4.2-5.1), b' = 4.1 ± 0.3 (3.7- 4.6), c = 40 ± 7 (32-52), c' = 1.3 ± 0.1 (1.1-1.5), V = 62 ± 1 (60-63); St. = 24 ± 1 (23-26), m = 49 ± 2 (46-52), o = 50 ± 4 (42-56).

Female short, thin nematodes [21 μm ± 2 (19-23) wide] with open spiral bodies when relaxed. Cuticle transversally striated with annuli 1-1.5 μm apart. Lip region hemispherical 7.5-8 μm wide and 4-5 μm high with 4-5 indistinct annuli; head slightly offset at the basal framework. Cephalids indistinct. Stylet with 4.5-5 μm wide anteriorly indented basal knobs. Dorsal oesophageal gland opens 12 μm ± 1 (11-14) posterior to basal knobs. Oesophageal glands overlapping intestine ventrally and dorsally. Nerve ring surrounding isthmus at 101 μm ± 11 (85-115) from anterior body end; hemizonid, about 2 μm wide, situated 1-2 annuli anterior to excretory pore which is at about 107 μm ± 11 (93-120) from anterior end. Lateral field of four lines occupying about 25% of corresponding body diameter. Phasmids pore-like, at 2-8 annuli anterior to anus situated in the middle between the two inner incisures, or on the ventral line or closer to it. Female reproductive system didelphic, amphidelphic with slightly dorsally offset, empty spermatheca. Vagina 10 μm ± 1 (9-11) deep and vulva a transverse slit. Tail, 16 μm ± 2 (11-18), with 9 ± 1 (7-10) ventral annuli, more or less conical in shape and provided with a small, less coarsely annulated projection.

Male: not found.

Material, locality and habitat

H. microcephalus was collected from the rhizosphere of *Psidium guajava* and two *Mangifera indica* trees from a house garden in the centre of Wadmedani, Central Sudan, June 1987.

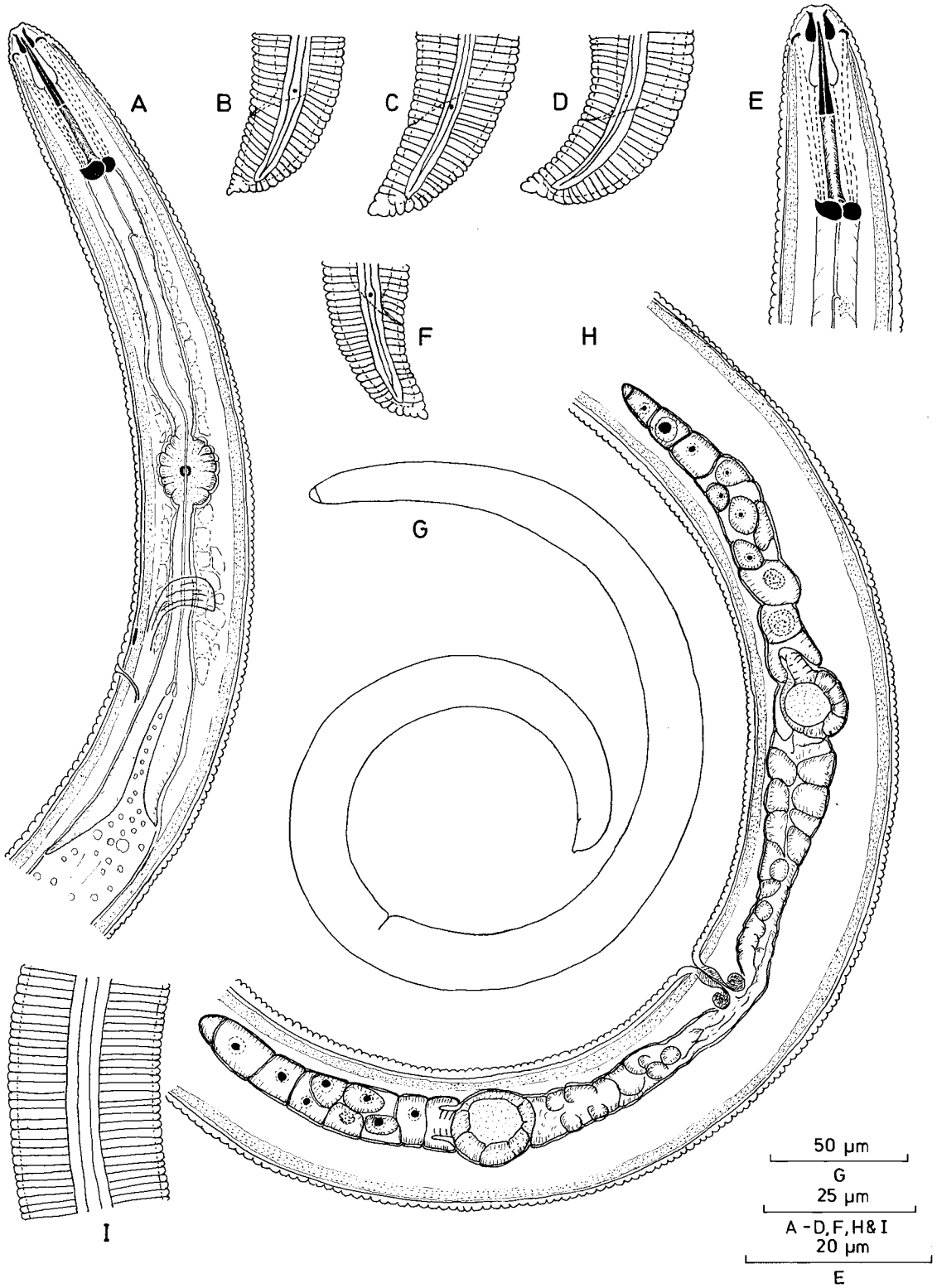

Fig. 6 - Females of *H. microcephalus*: A, oesophageal region; E, anterior body end; B-D and F, tails showing phasmid position variation, G; entire body; H, reproductive system; I, lateral field.

Discussion

The type population of *H. microcephalus* was first described by Sher (1966) from sandy loam soil around oil palm tree East Otubu village, Benin Province, Nigeria. Afterwards it was redescribed by several authors. Elmiligy (1970) described two populations from Egypt under the name *H. mangiferensis* which was synonymized later with *H. microcephalus* (Ali, 1976). Our specimens agree closely with both descriptions.

H. egyptiensis and *H. microcephalus* are similar, they have both a stylet of 23-26 µm, the 'smaller' head of *H. microcephalus* had the same height of the 'higher' head of *H. egyptiensis* (3.5-5) µm: the head is measured along the heavily sclerotized cheilorhabdia which are similar in length; the basal framework, however, in *H. microcephalus* is anterior to the end of the cheilorhabdia which in *H. egyptiensis* both are at about the same level (as usual in *Helicotylenchus*). This is the first record for *H. microcephalus* in Sudan.

HELICOTYLENCHUS MULTICINCTUS (Cobb, 1893) Golden, 1956

Three populations of this species were found in June 1987 in the rhizosphere of *Musa* sp.: one in Eastern Sudan at Kassala (15 females and 3 males) and two in Central Sudan at Hantoub in the Gway Orchard (13 females and 1 male) and in the Korina Orchard (6 females and 2 males).

Morphometrics of our populations, agree almost in every aspect with previous descriptions. *H. multicinctus* is recorded for the second time in Sudan.

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