

Taxonomic Study of the Genus *Cephalenchus* (Nematoda: Tylenchida) from
Japan. Descriptions of Three new Species and Records of
C. planus SIDDIQUI & KHAN with a Key to Species.

Takayuki MIZUKUBO & Nozomu MINAGAWA

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Takayuki MIZUKUBO & Nozomu MINAGAWA*

Four species of the *Cephalenchus* occurring in Japan were described and illustrated. *C. nemoralis* n. sp. from Hirakura, Mie (central Japan) resembles *C. emarginatus* and *C. megacephalus* but has moderately long body, smooth head, weak lateral incisures, spear knobs lying on the 13th to 15th body annule, posterior deirids (four to eight annule from excretory pore), longer postuterine sac being 1.5 times vaginal body diameter, and unusual appendix of gubernaculum in male. *C. daisuce* n. sp. from Mt. Aso, Kumamoto (western Japan) resembles *C. limichus* in having slender body (a=34 to 51), weakly constricted head, rounded spear knobs lying on the 13th to 15th body annule, narrow body annules in mid-body (1.4 to 1.9 μm wide), postuterine sac as long as vulval body diameter, and long tail, but is distinguished from the latter by the moderately long body and hemizonid at equal level or immediately posterior to excretory pore. *C. potamophilus* n. sp. from Mt. Aso resembles *C. lobus* and *C. sacchari* in having larger body (595 to 677 μm), basal oesophageal bulb overlapping intestine, but is distinguished from these by the central incisures of lateral fields forking slightly anterior to deirids, spear knobs lying on the 10th or 11th body annule, oblique vagina, sunken vulva, prominent lateral vulval flaps 7 μm in mean length, and c' value from 10 to 17. *C. planus* was also collected from Kusatsu-machi, Gunma (central Japan) and Mt. Aso, and herein redescribed. A key to the species was proposed. *Jpn. J. Nematol.*, 15: 26-40 (1985).

The *Cephalenchus* (GOODEY, 1962) GOLDEN, 1971¹⁰⁾ is a much homogeneous genus briefly characterized by the generally separated head; long and very thin spear; in most cases conspicuous lateral fields with six incisures; short procorpus; generally long, filiform, straight tail; presence of lateral vulval membrane; sublateral vulva; and adanal and often asymmetrical bursa. Species had been described by COBB³⁾, GERAERT⁷⁾, GOODEY¹¹⁾, SIDDIQUI¹⁶⁾, EGUNIOBI⁶⁾, NESTEROV¹⁵⁾, KNOBLOCH¹³⁾, WOOD¹⁹⁾, DHANACHAND & JAIRAJPUR⁵⁾, and SULTAN & JAIRAJPUR¹⁸⁾. Synonymy over the type species of the genus was often claimed^{2,4,9)} and generally supported^{2,8,12)}. ANDRÁSSY¹⁾, in his recent revision of the genus, summarized the research history of the genus and commented on the type species problem. In the article, he gave the generic redefinition to the *Cephalenchus* and listed 10 species including two new combinations and a new species. In the same year, *C. rotundus* SIDDIQUI & KHAN, 1984¹⁷⁾, *C. planus* SIDDIQUI & KHAN, 1984¹⁷⁾, and *C. sacchari* MAQBOOL *et al.*, 1984¹⁴⁾ were reported. Although little has been known on the Japanese *Cephalenchus* species, we found at least four species of the genus inhabiting forest and grassland. Of them, three species were additional to the genus, and a species was identified as *C. planus* SIDDIQUI & KHAN, 1984¹⁷⁾. Presently we can list 16 species of the *Cephalenchus* in the world.

The species examined were killed by gentle heat, fixed by TAF, and mounted in the glycerine after slow dehydration.

KEY TO SPECIES OF THE *Cephalenchus*

1. Basal oesophageal bulb deeply overlapping intestine..... 2
— Basal oesophageal bulb never overlapping intestine, although often slightly lobed posteriorly..... 4

*Laboratory of Nematology and Soil Zoology, Division of Microbiology, National Institute of Agro-Environmental Sciences, Kannondai 3-1-1, Yatabe, Tsukuba, Ibaraki 305, Japan.

2. MB value nearly 43%; six lateral incisures at level of deirid; vagina at right angle to body axis, not sunken into body contour; tail 15 to 22 times anal body diameter 3
 — MB value nearly 38%; four lateral incisures at level of deirid; vagina slightly directed anteriorly, sunken into body contour; tail 10 to 17 times anal body diameter *potamophilus* n. sp.
3. Deirid nearly three annule posterior to excretory pore; hemizonid at equal level of excretory pore; basal bulb short, about a half as long as isthmus length; spear knobs delicate
 *lobus* DHANACHAND & JAIRAJPURI, 1980⁵⁾
 — Deirid nearly 10 annule and hemizonid one annule posterior to excretory pore; basal bulb long, slightly shorter than isthmus; spear knobs strong *sacchari* MAQBOOL *et al.*, 1984¹⁴⁾
4. Tail 6 to 16 times anal body diameter 5
 — Tail 16 to 27 times anal body diameter 9
5. Postvulval uterine sac 39 to 97% of vulval body diameter; annules high, well expressed 6
 — Postvulval uterine sac as long as vulval body diameter or longer; annules low, somewhat weakly expressed 7
6. Basal oesophageal bulb elongate, asymmetric, dorsally humped, with slightly lobed posterior margin, about as long as isthmus *hexalineatus* (GERAERT, 1962) GOLDEN, 1971^{1, 7, 10)}
 — Basal oesophageal bulb shorter, pyriform or drop-shaped, symmetric, with rounded posterior margin, about 3/4 times as long as isthmus *platus* SIDDIQUI & KHAN, 1984¹⁷⁾
7. Head rounded, smooth with no striae; basal oesophageal bulb often lobed posteriorly; lateral fields indistinct; deirid four to eight (six) annules posterior to excretory pore *nemorialis* n. sp.
 — Head with three annules; basal oesophageal bulb with constantly rounded posterior margin; lateral fields conspicuous; deirid one to five annules posterior to excretory pore 8
8. Body longer than 650 μm ; spear 19 to 20 μm long; RVan nearly 36; vagina at right angle to body axis; deirid at equal level of excretory pore *emarginatus* (COBB, 1893) BELLO & GERAERT, 1972^{1, 23)}
 — Body 440 to 600 μm long; spear 14 to 16 μm long; RVan 25 to 32; vagina slightly directed anteriorly; deirid one to five annules posterior to excretory pore
 *megacephalus* (GOODEY, 1962) ANDRÁSSY, 1984^{1, 11)}
9. Tail long, 198 to 236 μm long 10
 — Tail shorter, 135 to 201 μm long 12
10. Spear 16 to 18 μm long; tail 22 to 27 times anal body diameter; basal oesophageal bulb slightly lobed posteriorly *leptus* (SIDDIQUI, 1963) KNOBLOCH, 1972^{13, 16)}
 — Spear 19 to 21 μm long; tail 17 to 22 times anal body diameter; basal oesophageal bulb with rounded posterior margin 11
11. Tail nearly 3.5 times vulva-anus distance, with pointed tip
 *cylindricus* SULTAN & JAIRAJPURI, 1981¹⁸⁾
 — Tail 2 to 2.8 times vulva-anus distance, with hair-like tip
 *cephalodiscus* SULTAN & JAIRAJPURI, 1981¹⁸⁾
12. Excretory pore lying anterior, at 55 to 60% of oesophageal length; deirid just anterior to excretory pore; spear short, 14 to 16 μm long; knobs lying on the eighth to ninth body annule; tail 2 times vulva-anus distance *tahus* WOOD, 1973¹⁹⁾
 — Excretory pore backward, at 59 to 83% of oesophageal length; deirid posterior to excretory pore; spear 16 to 22 μm long; knobs lying on the 10th to 15th body annule; tail 2.2 to 3.4 times vulva-anus distance 13
13. Vagina slightly anteriorly directed; excretory pore posterior, nearly at 86% of oesophageal length; procorpus as long as spear; basal bulb very small, about one third of isthmus length
 *rotundus* SIDDIQUI & KHAN, 1984¹⁷⁾
 — Vagina right angle to body axis; excretory pore anterior, at 59 to 82% of oesophageal length; procorpus shorter than spear; basal bulb longer, a half as long as to equal to isthmus length 14
14. Vagina posterior, at 67 to 68% of body length; spear knobs on the 10th to 11th body annule; annule in

- mid-body 2.1 to 2.5 μm wide; vulva sunken into body contour; postvulval uterine sac 120 to 160% of vulval body diameter; tail 2.2 to 2.4 times vulva-anus distance.....*illustris* ANDRÁSSY, 1984¹¹
- Vagina anterior, at 52 to 62% of body length; spear knobs on the 13th to 15th body annule; annule in mid-body narrower, 1.4 to 1.9 μm wide; vulva not sunken into body contour; postvulval uterine sac shorter, 90 to 140% of vulval body diameter; tail nearly 2.9 times vulva-anus distance.....15
15. Spear 17 to 19 μm long; hemizonid equal level or just posterior to excretory pore; RVan 35 to 42; total body annules excluding tail 229 to 248 in number.....*daisuce* n. sp.
- Spear 19 to 21 μm long; hemizonid one or two annule anterior to excretory pore; RVan 52 to 53; total body annules excluding tail 278 to 284 in number.....*limichus* (NESTEROV, 1973) ANDRÁSSY, 1984^{1,15)}

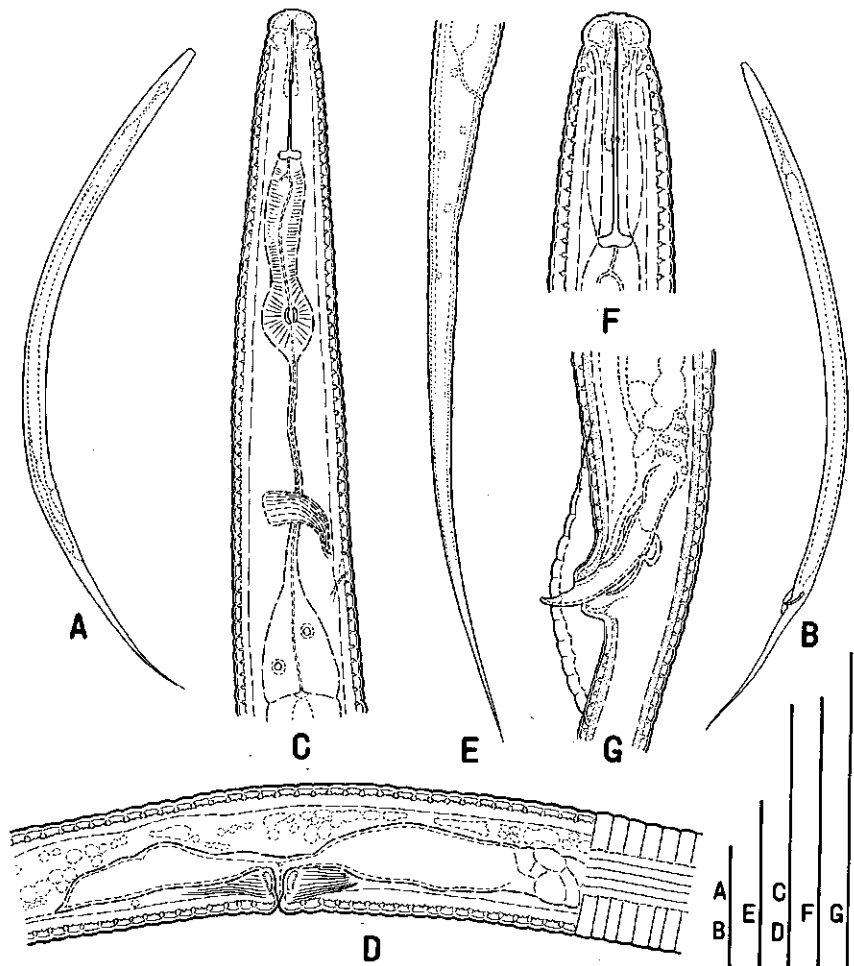


Fig. 1. *Cephalenchus nemoralis* n. sp. Female: A, general view; C, oesophageal region, inner view; D, vulval region; E, tail; F, anterior body end. Male: B, general view; G, cloacal region. Scale: A, B=100 μm ; C-E, G=30 μm ; F=20 μm .

CEPHALENCHUS NEMORALIS N. SP.

(Fig. 1 A-G)

MEASUREMENTS

Holotype (female): L=544 μm ; a=28.6; b=6.1; c=5.2; c'=9.4; V=69%; MB=47%; spear=16.6 μm ; Females (n=15): L=502-664 (566 \pm 43; mean \pm standard deviation) μm ; a=28.1-39.5 (33.1 \pm 3.4); b=5.1-6.8(5.9 \pm 0.4); c=3.9-5.2 (4.4 \pm 0.4); c'=9.4-15.8 (12.7 \pm 2.0); V=63-69% (65.9 \pm 1.8); MB=38-48% (42 \pm 3); spear=16.2-19.0 (17.5 \pm 0.8) μm .

Allotype (male): L=540 μm ; a=38.0; b=6.2; c=4.8; T=54%; MB=44%; spear=17.8 μm . Males (n=10): L=502-599 (548 \pm 31) μm ; a=30.5-40.9 (36.3 \pm 3.6); b=5.1-6.9 (6.2 \pm 0.5); c=4.1-5.3 (4.4 \pm 0.4); T=40-56% (52 \pm 5); MB=41-50% (44 \pm 2); spear=15.8-19.0 (17.7 \pm 0.9) μm .

DESCRIPTION

Female (n=15): Body slightly curved ventrally when relaxed by gentle heat. Cuticle thin, shallowly annulated, annules 1.7 to 2.4 (2.0 \pm 0.2) μm apart in mid-body. Inner cuticle discernible, often double crenate. Number of annules on the oesophageal region 53 to 60 (58 \pm 3); between oesophageal end and vulva 132 to 154 (141 \pm 6); between vulva and anus 31 to 36 (33 \pm 1); between anterior body end and vulva 190 to 207 (199 \pm 5); total body annules excluding tail 223 to 238 (232 \pm 5). Lateral fields 4.0 to 9.5 (6.2 \pm 1.6) μm wide, 30 to 44% (36 \pm 4) of body diameter; assuming six indefinite incisures.

Head smooth, low and rounded in lateral view; 2.0 to 2.8 μm high and 5.1 to 6.0 (5.5) μm wide at base; separated from body by shallow constriction. Body at posterior end of oesophagus 2.3 to 3.5 (3.0 \pm 0.3) times head base. Spear slender, 2.9 to 3.6 (3.2 \pm 0.2) times head base; anterior portion as long as shaft, 42 to 55% (48 \pm 4) of entire spear length; basal knobs thick, weakly directed posteriorly, with somewhat angulate lateral edges, 29 to 40% (34 \pm 3) of corresponding body diameter, located at the 13th to 14th (exceptionally 15th) body annule. Orifice of dorsal oesophageal gland 1.0 to 2.4 μm behind spear base. Oesophagus 85 to 115 (96 \pm 9) μm long; procorpus 13.4 to 19.8 (16.2 \pm 2.0) μm long, slightly shorter than spear, *i.e.* 74 to 110% (92 \pm 12) of spear length. Median bulb strong oval lying anteriorly, 37.8 to 43.5 (40.7 \pm 1.9) μm from anterior body end to its valve; 7.1 to 11.1 μm long and 6.3 to 8.7 μm wide, 56 to 69% (60 \pm 3) of corresponding body diameter; with well developed valve. Isthmus 24.5 to 42.7 (31.3 \pm 4.3) μm long. Basal bulb small, 15.0 to 22.1 (18.7 \pm 2.6) μm long, about a half as long as isthmus, *i.e.* 41 to 80% (59 \pm 11) of the latter; posterior margin variable, rounded or slightly lobed posteriorly. Excretory pore mostly lying at about posterior half of isthmus, 66.4 to 77.5 (71.5 \pm 3.5) μm or on the 42nd to 48th (46 \pm 2) annule from anterior body end, 61 to 87% (75 \pm 6) of oesophagus length, and 11.7 to 13.7% (12.7 \pm 0.5) of entire body length; excretory duct hardly discernible. Deirids 4 to 8 (6 \pm 1) annules posterior to excretory pore. Hemizonid 1.5 to 2.5 annule long, lying at the same level of excretory pore.

Vulva aberrant, in most cases on right subventral; vulval lips slightly protruding; vagina tubular, often separated inwardly, at right angle to body axis; vulval lateral flaps not seen. Postuterine sac well developed, 18.0 to 28.5 (24.4 \pm 2.8) μm long, 110 to 193% (154 \pm 23) of corresponding body diameter. Gonad 158 to 346 (240 \pm 45) μm long, 78 to 99% (87 \pm 9) of distance between posterior end of oesophagus and vulva. Distance between vulva and anus 55.4 to 75.1 (62.4 \pm 6.1) μm , 31 to 36 (33 \pm 1) annules, and 40 to 61% (49 \pm 7) of tail length. Phasmids hardly visible. Rectum 51 to 100% (73 \pm 16) of anal body diameter. Tail short, filiform, 104 to 157 (130 \pm 13) μm long and 1.6 to 2.5 (2.1 \pm 0.3) times vulva-anus distance; terminus sharply pointed or finely rounded.

Male (n=10): Male similar to female in the general characteristics. Body arcuate. Annules in mid-body 1.7 to 2.2 (1.9 \pm 0.2) μm wide. Lateral fields 4.0 to 6.3 (4.9 \pm 0.9) μm wide, 30 to 40% (33 \pm 4) of corresponding body diameter. Head 5.0 to 5.5 (5.3 \pm 0.2) μm wide at base.

Body at posterior end of oesophagus 2.3 to 3.1 (2.8 ± 0.2) times head base. Spear 2.9 to 3.6 (3.4 ± 0.2) times head base; anterior portion 50 to 63% (55 ± 4) of entire spear. Oesophagus 81 to 102 (89 ± 6) μm and 52 to 58 annule long; median bulb lying anteriorly, 36.4 to 41.9 (39.0 ± 1.9) μm from anterior body end; 7.9 to 11.1 (9.5) μm long. Isthmus 28 to 36 (32 ± 2) μm long. Basal oesophageal bulb 13.4 to 16.6 (15.1 ± 1.2) μm long. Excretory pore 64.1 to 73.6 (70.5 ± 3.4) μm and 44 to 47 annules from anterior body end, 72 to 87% (79 ± 5) of oesophageal length, and 12 to 14% (13 ± 1) of body length. Testis 208 to 326 (286 ± 37) μm long. Bursal alae well developed and weakly crenate on margins; both arched normally, though somewhat asymmetric in length, left ala 21 to 45 (32 ± 7) μm long, right ala 28 to 32 (30 ± 2) μm long; about 30% of tail length. Spicule curved, with offset manubrium and little swollen medially, 16.6 to 20.6 (18.6 ± 1.1) μm long. Gubernaculum 5.1 to 7.9 (6.7 ± 0.7) μm long, accompanied by unusual cuticularization loosely hinged to its dorso-proximal extremity; the latter about 4 μm long, probably flexible structure, often strongly bent ventrally or partially overlapping gubernaculum. Tail 101 to 139 (125 ± 11) μm long.

DIAGNOSIS AND RELATIONSHIPS

C. nemoralis n. sp. comes close to *C. emarginatus* (COBB, 1893) BELLO & GERAERT, 1972^{2,3)} and *C. megacephalus* (GOODEY, 1962) ANDRÁSSY, 1984^{1,10)} not only in the general dimensions expressed by a, b, c, c', and V values, but also in some other morphometrics, i.e. excretory pore in oesophagus (%), valve of median bulb in oesophagus (%), and basal bulb length by isthmus. In some absolute measurements, the new species comes between the latter two species, i.e. L (μm) = 502 to 664: 670 to 680: 440 to 600, spear (μm) = 16 to 19: 19 to 20: 14 to 16, oesophagus length (μm) = 85 to 115: 106 to 108: 83 to 97, tail length (μm) = 104 to 157: 150 to 152: 94 to 130, annules between vulva and anus = 31 to 36: 36: 25 to 32, total annules excluding tail = 223 to 238: 246 to 248: 190 to 208. Nevertheless, the new species apparently differs from the latter two in (a) smooth head without anterior expansion in profile, (b) deirid more posterior to excretory pore (4 to 8 (6) annule posterior: same level: 2 to 5 posterior), (c) procarpus slightly shorter than spear (74 to 110% (92) of spear: equal length: 110 to 120%), (d) inconspicuous lateral fields, (e) constantly produced vulval lips, (f) absence of lateral vulval flaps, (g) rectum shorter than anal body diameter (51 to 100% (73): more than 100%: about 100%), (h) commonly arched both bursal alae crenate on margins, (i) often offset base of spicule, and (j) unusual appendix of gubernaculum.

TYPE HABITAT AND LOCALITY

Soil around the tree (unidentified) in the Mie University Forest, Hirakura, Misugi-mura, Mie (central Japan).

TYPE MATERIALS

All the type materials were collected by authors in October 9, 1983. Holotype (female) and allotype (male) are deposited in the National Institute of Agro-Environmental Sciences (NIAES), Yatabe, Tsukuba, Ibaraki, Japan. Paratypes are deposited also in the following Institutes: U. S. Department of Agriculture Nematode Collection, Beltsville, Maryland, USA (3 females, 3 males); Department of Nematology, Rothamsted Experimental Station, Harpenden, Herts., England (3 females, 3 males); and NIAES.

CEPHALENCHUS DAISUCE N. SP.

(Fig. 2 A-F)

MEASUREMENTS

Holotype (female): L=589 μm ; a=35.5; b=6.1; c=3.2; c'=18.0; V=58%; MB=41%; spear=16.6 μm . Females (n=20): L=512-644 (569 ± 33) μm ; a=31.5-46.6 (38.5 ± 4.0); b=5.1-6.8 (6.0 ± 0.4); c=2.9-3.8 (3.2 ± 0.2); c'=13.1-22.1 (18.5 ± 2.3); V=54-62% (58.9 ± 2); MB=38-50% (42 ± 3); spear=16.6-19.0 (17.9 ± 0.7) μm .

DESCRIPTION

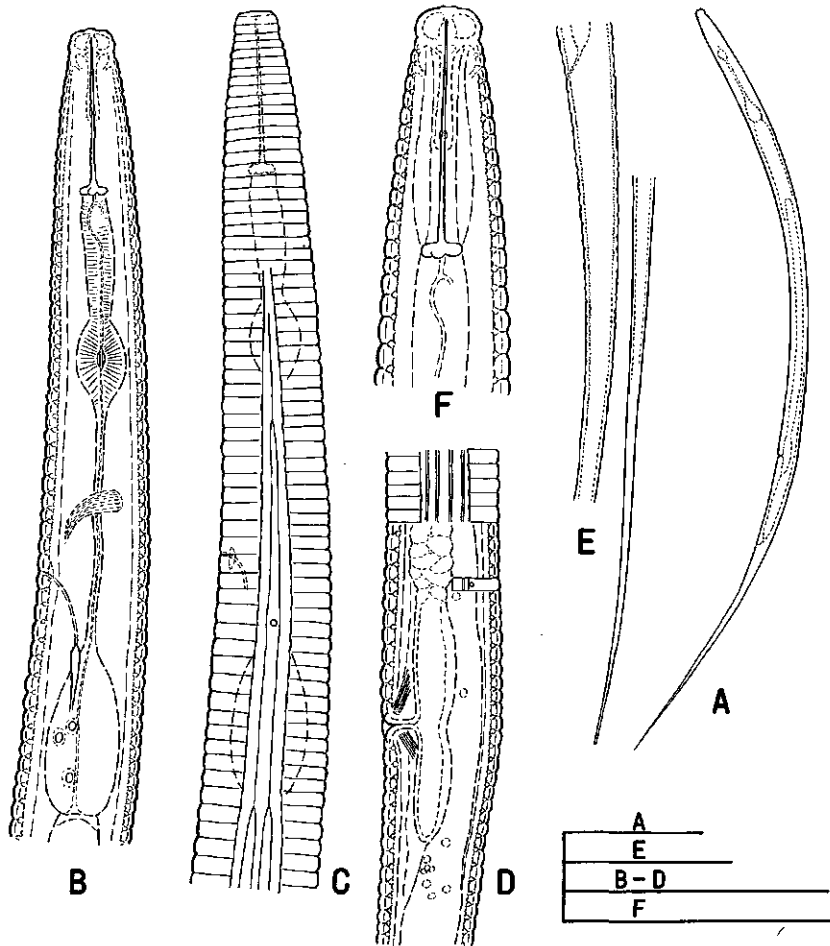


Fig. 2. *Cephalenchus daisuca* n. sp. Female: A, general view; B, oesophageal region, inner view; C, *do.*, surface view; D, vulval region; E, tail; F, anterior body end. Scales: A=100 μm ; B-E=30 μm ; F=20 μm

Female (n=20): Body slightly curved ventrally when relaxed by gentle heat. Cuticle moderately thick with distinct striae 1.4 to 1.9 (1.6 ± 0.1) μm apart in mid-body. Inner cuticle double crenate. Number of annules on the oesophageal region 54 to 61 (58 ± 2) but exceptionally 70; between oesophageal end and vulva 138 to 148 (142 ± 3); between vulva and anus 35 to 42 (38 ± 2); between anterior body end and vulva 193 to 207 (200 ± 4); total body annules excluding tail 229 to 248 (238 ± 5). Lateral fields 4.0 to 6.3 (5.1 ± 0.8) μm wide, 32 to 47% (37 ± 5) of body diameter; bearing six conspicuous incisures with outer ones crenate; incisures originating from two between four and 13 annules behind spear knobs, immediately coming three shortly posteriorly, increasing to four between 15 and 20 annules behind spear knobs, branching further to reach six between 13 and 17 (15 ± 1) annules posterior to excretory pore or between 11 annules before and three annules anterior (exceptionally one annule posterior) to posterior margin of basal oesophageal bulb, then decreasing to four between 10 and 15 (12 ± 2) annules posterior to vulva.

Head low and rounded in lateral view with two or three annules, 2.4 to 3.2 μm high and 4.7 to 5.5 μm wide at base, separated from body by shallow constriction. Body at posterior end of oesophagus 2.3 to 3.2 (2.8 ± 0.3) times head base. Spear slender, 3.0 to 3.9 (3.4 ± 0.3) times head base; anterior portion as long as shaft, 43 to 51% (49 ± 2) of entire spear; basal knobs rounded, broad, 2.8 to 3.7 μm across, 28 to 39% (34 ± 3) of corresponding body diameter, located at the 13th to 15th body annule. Orifice of dorsal oesophageal gland close to spear base. Oesophagus 84 to 114 (95 ± 7) μm long; procorpus shorter than spear, 11.9 to 17.4 (15.2 ± 1.4) μm long, 68 to 96% (85 ± 9) of spear; median bulb oval lying anteriorly, 37.2 to 42.7 (39.9 ± 1.4) μm from head; 8.7 to 11.9 μm long and 4.7 to 7.5 μm wide, 41 to 64% (55 ± 5) of corresponding body width, with distinct valve. Isthmus 24.0 to 42.7 (29.2 ± 4.2) μm long. Basal bulb pyriform never lobed posteriorly, 14.2 to 23.7 (20.6 ± 2.3) μm long, and exceeding half times isthmus length, *i.e.*, 54 to 97% (70 ± 10) of the latter. Excretory pore at level of posterior half of isthmus, 59.3 to 72.8 (64.5 ± 3.5) μm and 39 to 45 (42 ± 2) annules from anterior body end, 65.2 to 82.2% (69.0 ± 6.2) of oesophagus length, 10.6 to 14.1% (11.4 ± 0.9) of body length; excretory duct cuticularized at its posterior half. Deirids 3 to 5 annules posterior to excretory pore. Hemizonid one or one and a half annules long, lying just behind or equal level of excretory pore.

Vulva in most cases on right subventral; vulval lips not protruding; vagina tubular at right angle to body axis, vulval lateral flaps moderately developed, 3.2 to 6.3 (4.1 ± 0.9) μm long. Postuterine sac well developed, 12.7 to 17.4 (14.7 ± 1.3) μm long, 89 to 137% (103 ± 12) of corresponding body diameter. Gonad 141 to 204 (174 ± 21) μm long, 57 to 94% (73 ± 10) of distance between posterior end of oesophagus and vulva. Distance between vulva and anus 56 to 71 (61 ± 3) μm , 35 to 42 (38 ± 2) annules, and 30 to 44% (35 ± 4) of tail length. Rectum shorter than anal body diameter, 52 to 95% (68 ± 15) of the latter. Tail markedly long and filiform, 135 to 201 (176 ± 19) μm long and 2.3 to 3.4 (2.9 ± 0.3) times vulva-anus distance; terminus needle-like or finely rounded.

Male: Unknown.

DIAGNOSIS AND RELATIONSHIPS

C. daisuce n. sp. comes close to *C. limichus* (NESTEROV, 1973) ANDRÁSSY, 1984^{1,151} in having slender body, moderately long tail, anterior vulva, larger value of tail length in vulva-anus distance, rather backward position of spear knobs lying on the 13th to 15th body annule, postuterine sac being about as long as corresponding body diameter, shallowly constricted head, and rather narrow annules in mid-body. This new species, however, can be distinguished from the latter by the shorter body (512 to 664 μm *vs.* 610 to 740 μm), conspicuous lateral incisures of cuticle (inconspicuous in *limichus*), hemizonid equal level or just posterior to excretory pore (one or two annules anterior in *limichus*), body annules fewer in number (in oesophageal region 54 to 61, rarely 70 *vs.* 65 to 69, in post vulval region or RVan=35 to 42 *vs.* 52 to 53, on the entire body excluding tail 229 to 248 *vs.* 278 to 284), and moderately developed vulval lateral flaps (small in *limichus*).

It also resembles *C. leptus* (SIDDIQI, 1963) KNOBLOCH, 1972^{13,161} and *C. cylindricus* SULTAN & JAIRAPURI, 1981¹⁸¹ in the anteriorly situated vulva (V=54 to 57% in *leptus* and 57 to 60% in *cylindricus*) and hemizonid posterior to excretory pore. However, from both species it differs in the shorter body (650 to 750 μm in *leptus*, 620 to 750 μm in *cylindricus*), relatively stout body (a=41 to 53 in *leptus* and *cylindricus*), anterior spear knobs position in body annule (11th to 13th in *leptus*, 10th in *cylindricus*), and narrower annules in mid-body (2.0 to 2.3 μm in *leptus*, 2.0 to 2.5 μm in *cylindricus*).

TYPE HABITAT AND LOCALITY

Soil around the root of *Cirsium suffultum* (MAXIM.) MATSUM., Kusasenri, Mt. Aso, Kumamoto (western Japan).

TYPE MATERIALS

All the type materials were collected by the junior author in October 19, 1979. Holotype

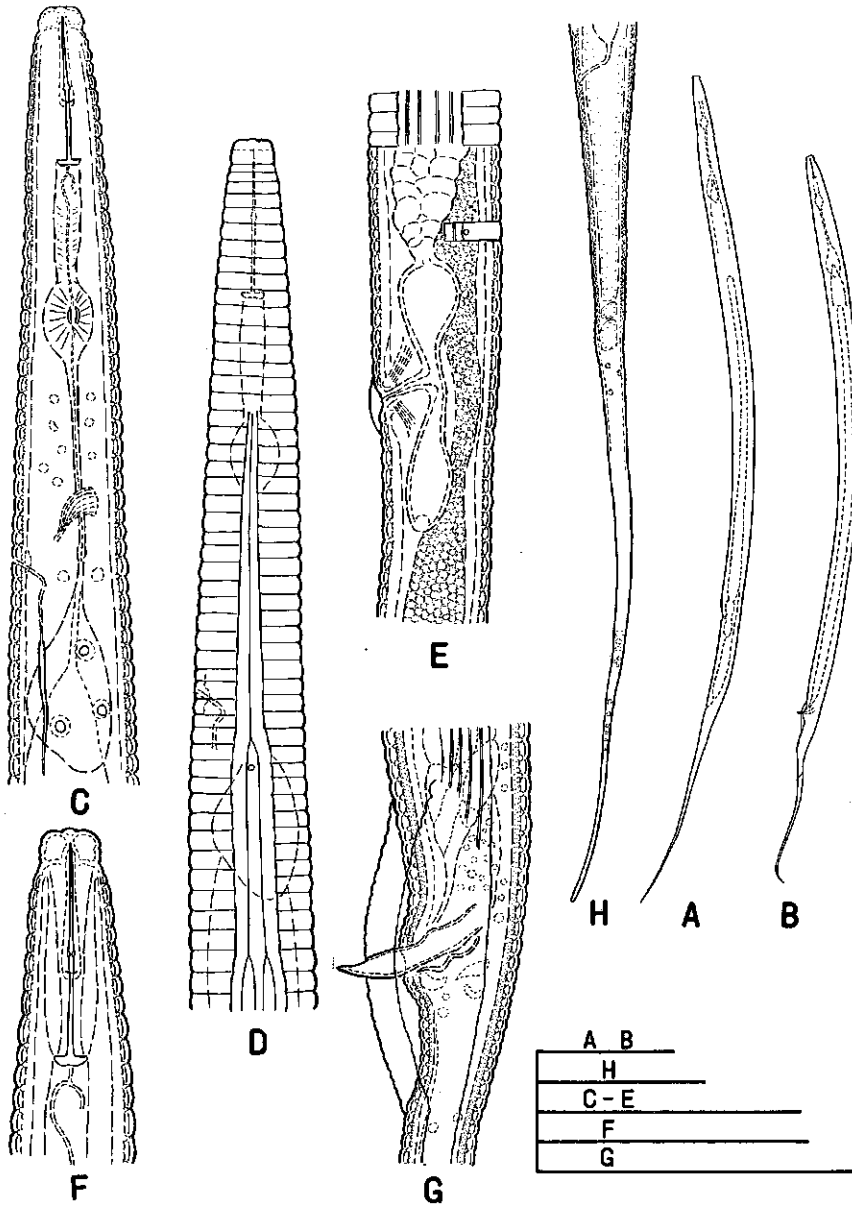


Fig. 3. *Cephalenchus potamophilus* n. sp. Female: A, general view; C, oesophageal region, inner view; D, do., surface view; E, vulval region; F, anterior body end; H, tail. Male: B, general view; G, cloacal region. Scale: A, B=100 μ m; C-E, G, H=30 μ m; F=20 μ m.

slide is deposited in the NIAES. Paratypes are deposited in the USDA Nematode Collection (5 females); Rothamsted Experimental Station (5 females); and NIAES.

CEPHALENCHUS POTAMOPHILUS N. SP.

(Fig. 3 A-G)

MEASUREMENTS

Holotype (female): L=655 μm ; a=36.0; b=6.9; c=4.6; c'=11.2; V=67%; MB=38%; spear=19.0 μm . Females (n=15): L=595-677 (630 \pm 27) μm ; a=31.3-40.8 (36.1 \pm 2.5); b=5.5-7.0 (6.5 \pm 0.4); c=3.7-5.2 (4.1 \pm 0.4); c'=10.4-17.3 (13.2 \pm 1.7); V=60-67% (64 \pm 2); MB=36-41% (38 \pm 1); spear=16.6-19.0 (17.9 \pm 0.7) μm .

Allotype: L=620 μm ; a=34.1; b=6.5; c=3.7; T=47%; MB=38%; spear=17.4 μm . Males (n=12): L=546-645 (610 \pm 25) μm ; a=31.4-53.1 (40.1 \pm 6.8); b=5.9-7.2 (6.6 \pm 0.4); c=3.7-4.2 (3.9 \pm 0.2); T=44-59% (53 \pm 5); MB=37-42% (39 \pm 1); spear=16.6-18.2 (17.6 \pm 0.6) μm .

DESCRIPTION

Female (n=15): Body almost straight when killed by gentle heat. Cuticle thick, coarsely annulated, 1.7 to 2.3 (2.0 \pm 0.2) μm apart in mid-body. Inner cuticle double crenate. Number of annules on oesophageal region 45 to 56 (48 \pm 3); between oesophageal end and vulva 142 to 159 (149 \pm 5), exceptionally 171; between anterior body end and vulva 190 to 208 (198 \pm 6), exceptionally 219; between vulva and anus 35 to 43 (38 \pm 2); total body annules excluding tail 227 to 261 (237 \pm 10). Lateral fields 4.7 to 8.7 (6.8 \pm 1.3) μm wide, 28 to 47% (39 \pm 6) of body diameter; bearing six conspicuous incisures, outer ones shallowly crenate; incisures originating from three at level between three and nine annules behind spear knobs, becoming four at equal level to six annules behind excretory pore, branching further to increase to six at between 13 and 20 annules behind excretory pore or between six annules before and eight annules behind posterior margin of basal bulb, then decreasing to four at between 11 and 16 annules posterior to vulva.

Head offset by constriction, bearing two or three annules, anteriorly slightly expanded in profile, 2.4 to 3.5 μm high and 5.0 to 6.0 μm wide at base. Body at the posterior end of oesophagus 2.6 to 3.2 (2.9 \pm 0.2) times head base. Spear 2.8 to 3.7 (3.2 \pm 0.2) times head base; anterior portion as long as shaft, 45 to 55% (50 \pm 2) of entire spear; basal knobs moderately thick, with angulate lateral edges, not directed posteriorly, occupying 29 to 36% (33 \pm 2) of corresponding body diameter, located at the 10th or 11th (exceptionally 12th) body annule. Orifice of dorsal oesophageal gland close to spear knobs. Oesophagus 85.4 to 113.9 (96.9 \pm 6.6) μm long; procorpus 10.3 to 17.4 (12.5 \pm 1.6) μm long, shorter than spear, *i.e.* 61 to 96% (70 \pm 9) of spear length. Median bulb lying much anteriorly, 32.4 to 41.1 (36.9 \pm 2.0) μm from head to its valve; 8.7 to 11.1 (10.1) μm long and 5.9 to 7.9 (6.6) μm wide, 48 to 62% (52 \pm 4) of corresponding body diameter, with distinct valve. Isthmus 22.9 to 43.5 (29.5 \pm 4.9) μm long. Basal bulb largely overlapping intestine, not separated into dorsal and ventral lobes, junction not seen; 21.4 to 29.3 (23.8 \pm 2.0) μm long, exceeding 1/2 times isthmus, *i.e.* 68 to 104% (81 \pm 11) of the latter. Excretory pore 66.4 to 75.5 (70.2 \pm 2.3) μm or on the 34th to 39th (37 \pm 1) annule from anterior body end, 60 to 83% (73 \pm 6) of oesophageal length, and 10.3 to 12.2% (11.2 \pm 0.5) of body length; excretory duct much elongate, often exceeding the posterior margin of basal bulb, posterior half cuticularized. Deirids 2 to 8 (4 \pm 1) annules posterior to excretory pore. Hemizonid 1.5 to 2.0 annule long, lying just equal level of excretory pore.

Vulva in most cases on right subventral; vulva sunken into body contour; vagina tubular, slightly directed anteriorly; vulval lateral membrane enlarged, 5.5 to 9.5 (7.2 \pm 1.1) μm long. Postuterine sac 16.0 to 20.0 (18.3 \pm 1.3) μm long, 96 to 116% (109 \pm 7.2) of corresponding body diameter. Gonad 178 to 273 (239 \pm 26) μm long, 68 to 92% (79 \pm 6) of distance between posterior end of oesophagus and vulva. Distance between vulva and anus 62.5 to 80.7 (70.6 \pm

5.5) μm and 39 to 52% (46 ± 4) of tail length. Phasmids conspicuous, lying at the fourth to 10th annule anterior to vulva. Rectum 41 to 118% (84 ± 18) of anal body diameter. Tail elongate, filiform, 132 to 178 (155 ± 13) μm long and 1.9 to 2.6 (2.2 ± 0.2) times vulva-anus distance; terminus variable, rounded, pointed, narrowly rounded, and finely pointed.

Male (n=12): Male resembles female in general characteristics. Body almost straight. Annules in mid-body 1.6 to 2.1 (1.9 ± 0.2) μm wide. Lateral fields 4.0 to 7.0 (5.4 ± 1.0) μm wide, 30 to 42% (35 ± 4) of corresponding body diameter. Head 4.7 to 5.9 (5.3) μm at base. Body at posterior end of oesophagus 2.3 to 3.4 (2.9 ± 0.3) times head base. Spear 3.1 to 3.7 (3.3 ± 0.2) times head base, spear knobs lying on the ninth to 11th body annule. Oesophagus 87 to 101 (93 ± 4) μm and 43 to 51 (48 ± 3) annule long; median bulb lying anteriorly, 34.8 to 37.4 (36.4 ± 0.8) μm from head; 9.5 to 11.9 (10.0 ± 0.9) μm long; basal bulb 19.8 to 24.5 (22.5 ± 1.5) μm long. Excretory pore 61 to 76 (69 ± 4) μm and 34 to 39 (37 ± 2) annules from anterior body end, 65.9 to 83.5% (74.0 ± 5.4) of oesophageal length, and 10.4 to 12.1% (11.3 ± 0.4) of body length. Testis 269 to 373 (321 ± 32) μm long. Bursal alae narrowly crenate on margins; both normally arched, though slightly asymmetrical in length, left ala 26.1 to 33.2 (30.2 ± 2.8) μm long, right ala 29.3 to 39.5 (34.8 ± 3.5) μm long; right ala 17.9 to 27.4% (22.4 ± 3.1) of tail length. Spicule variable in shape, manubrium mostly not swollen, 15.0 to 16.6 (15.7 ± 0.5) μm long. Gubernaculum almost straight or crescent-shaped, rarely weakly sinuate, never hooked posteriorly, 6.5 (exceptionally 5.5) μm long. Tail 133 to 169 (157 ± 10) μm long.

DIAGNOSIS AND RELATIONSHIPS

By having markedly lobed basal bulb overlapping intestine, *C. potamophilus* n. sp. comes close to *C. lobus* DHANACHAND & JAIRAJPURI, 1980⁹ and *C. sacchari* MAQBOOL *et al.*, 1984¹⁰. From the both species, however, this new species is readily distinguished in the smaller 'a' value (31 to 41 (36) in *potamophilus*: 40 to 46 (42) in *lobus*: 36 to 52 (45) in *sacchari*), smaller 'c' value (10 to 17 (13.2): 17 to 22 (19): 15 to 21 (18.2)), anterior spear knobs in body annule (10th to 11th: (14th): (12th to 13th)), fewer annules in the oesophageal region (45 to 56 (48): (56): (58)), fewer Rex (34 to 39 (37): (42): (43 or more)), larger value of excretory pore in body length (10 to 12%: (9%): (9% longer excretory duct, smaller MB value (36 to 41% (38): (43%): (42%)), longer lateral vulval membrane (5.5 to 9.5 (7.0) μm : 3 μm : 5.6 to 7.2 (5.9) μm), few lateral incisions at the deiridis level (4: 6: 6), and vulva slightly oblique and sunken into body contour (right angle to body axis and not sunken into body contour in the latter two). Further from *C. lobus*, *C. potamophilus* differs in having smaller b value (5.5 to 7.0 (6.5) *vs.* 7.0 to 7.7 (7.4)), smaller c value (3.7 to 5.2 (4.1) *vs.* 3.0 to 4.0 (3.5)), longer spear (16.6 to 19.0 μm *vs.* 15 to 17 μm), longer basal bulb (68 to 104% of basal bulb *vs.* half as long as isthmus), broader lateral fields (1/3 to 1/2 of body diameter *vs.* 1/4 to 1/3). From *C. sacchari*, *C. potamophilus* differs in the tail length in vulva-anus distance (1.9 to 2.6 (2.2) *vs.* 2.6), distance of deirid from excretory pore (2 to 8 (4) annule posterior *vs.* (10)), hemizonid at equal level of excretory pore (one annule posterior).

TYPE HABITAT AND LOCALITY

The type species was collected from the rhizosphere of a kind of the semi-aquatic Bulrush, *Scirpus Wichurii* BÖCKLER, forma *concolor* (MAXIM.) T. KOYAMA in Mt. Aso, Kumamoto (western Japan). Since the root of Bulrush was under fresh water stream at the very sides of a river, the name *potamophilus* was designated for the new species.

TYPE MATERIALS

All the materials were collected by the junior author in September 2, 1980.

Holotype and allotype are deposited in the NIAES. Paratypes are deposited in the USDA Nematode Collection (3 females, 3 males); Rothamsted Experimental Station (3 females, 3 males); and NIAES.

CEPHALENCHUS PLANUS SIDDIQUI & KHAN, 1984

(Fig. 4 A-H)

SIDDIQUI & KHAN, 1984: pp. 86-88, Fig. 2 A-G (*Cephalenchus planus*); rhizosphere of banana; Idukki, Kerala, India. Females (n=8): L=0.41-0.52 mm; a=27.8-43.3; b=4.9-6.36; c=3.2-5.2; V=59.6-70%; spear=15-17 μ m. Males (n=2): L=0.48-0.52 mm; a=26.6-40.0; b=5.5-6.0; c=3.7-4.25; T=41.3-48.9%; spear=15-16 μ m.

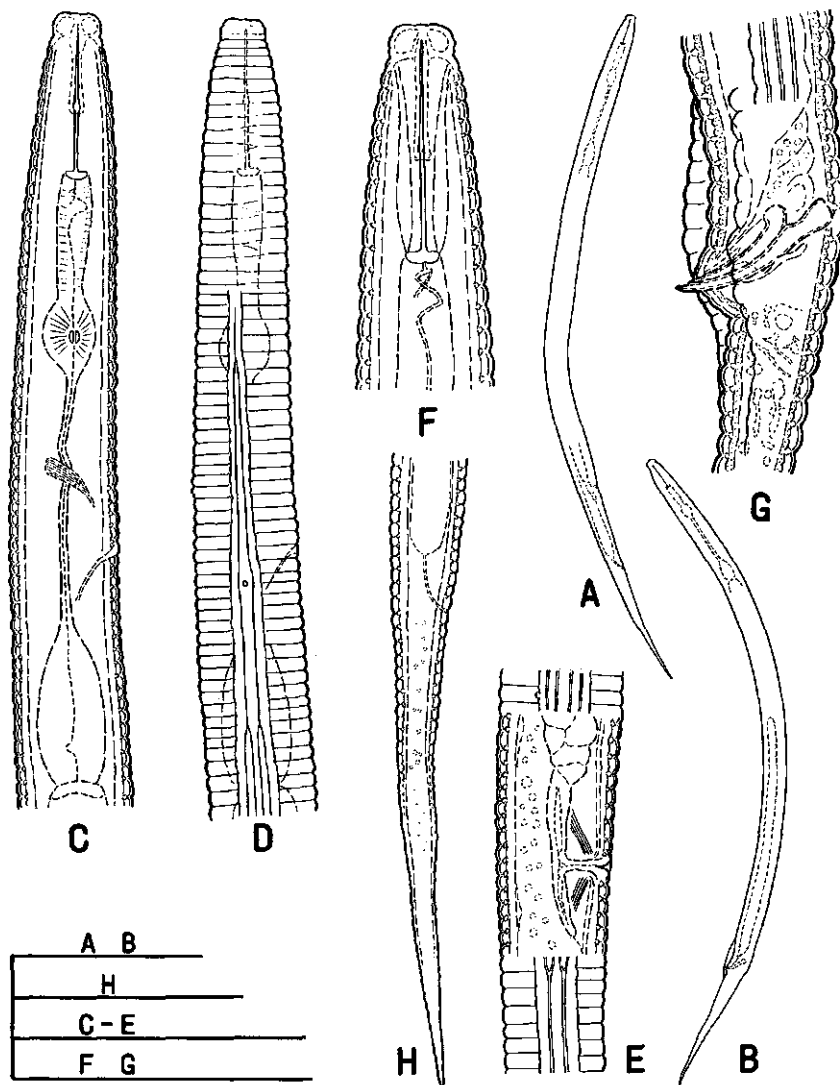


Fig. 4. *Cephalenchus planus* SIDDIQUI & KHAN, 1984 from Mt. Aso, Kumamoto. Female: A, general view; C, oesophageal region, inner view; D, *do.*, surface view; E, vulval region; F, anterior body end; H, tail. Male: B, general view; G, cloacal region. Scale: A, B=100 μ m; C-E, H=30 μ m; F, G=20 μ m.

Recent specimens from Kusatsu, Gunma, Japan. Females (n=20): L=401-494 (456±28) μm ; a=24.1-34.5 (28.7±2.6); b=4.6-5.8 (5.1±0.4); c=4.5-6.1 (5.3±0.4); c'=6.3-12.4 (9.0±1.3); V=66-70% (68±1); MB=38-45% (42±2); spear=13.8-15.8 (14.8±0.6) μm .

Recent specimens from Mt. Aso, Kumamoto, Japan. Females (n=11): L=379-430 (406±17) μm ; a=26.7-32.8 (30.3±2.5); b=4.3-5.0 (4.7±0.2); c=4.8-5.9 (5.3±0.4); c'=7.8-11.6 (9.4±1.3); V=67-70% (69±1); MB=41-44% (42.1±0.9); spear=15.0-15.8 (15.6±0.3) μm . Male (n=1): L=392 μm ; a=31.9; b=4.7; c=5.2; T=38%; MB=43%; spear=15.0 μm .

DESCRIPTION BASED ON THE ASO POPULATION

Female (n=11): Body slightly arcuate when killed by gentle heat, widest at mid-body, 12.3 to 14.6 (13.4±0.8) μm wide. Cuticle thick, annules coarse and high, 1.5 to 1.7 μm wide at mid-body. Inner cuticle mostly simply annulated. Number of annules on oesophageal region 53 to 63 (58±3); between oesophageal end and vulva 103 to 119 (111±5); between anterior body end and vulva 161 to 176 (170±4); between vulva and anus 27 to 31 (29±1); total body annules excluding tail 190 to 206 (199±4). Lateral fields 4.4 to 6.3 (5.2±0.7) μm wide, 34.9 to 44.4% (38.4±3.1) of body diameter; bearing six conspicuous incisures with outer ones weakly crenate; incisures originating from two at level between eight and 10 annules behind spear knobs, increasing to three at one or two annules further backward, coming to four at between 11 and 26 annules behind spear knobs or between four and 16 annules before excretory pore, branching further to six at between 12 and 15 (13±1) annules behind excretory pore or between six annules before and three annules behind (3±3 before) posterior margin of basal bulb, then decreasing to four between 7 and 17 (11±3) annules behind vulva.

Head with two or three annules, offset by distinct constriction, 2.0 to 2.4 μm high and 4.7 to 5.1 μm wide at base. Body at the posterior end of oesophagus 2.4 to 3.0 (2.7±0.2) times head base. Spear 3.0 to 3.4 times head base; anterior portion as long as shaft, 46 to 50% (mostly 50) of entire spear; basal knobs rounded, never directed posteriorly, occupying 29 to 33% (31±1) of corresponding body diameter, located at the 11th or 12th (rarely 13th) body annule. Orifice of dorsal oesophageal gland close to spear base. Oesophagus 82.3 to 91.8 (86.7±3.0) μm long; procorpus 13.4 to 16.6 (15.4±1.1) μm long, as long as spear, *i.e.* 85 to 108% (99±7) of spear length. Median bulb lying anteriorly, 34.8 to 37.6 (36.5±1.0) μm from head; 8.7 to 11.1 (9.8) μm long and 5.5 to 6.7 (6.1) μm wide, 46 to 61% (54±4) of corresponding body diameter, with distinct valve. Isthmus 22.1 to 28.2 (26.1±1.9) μm long. Basal bulb 16.6 to 20.6 (18.8±1.4) μm long, exceeding half times isthmus, *i.e.* 62 to 90% (72±10) of the latter; posterior margin rounded, never lobed posteriorly. Excretory pore mostly lying at posterior half of isthmus, 60.1 to 64.9 (62.9±1.4) μm or on the 40th to 46th annule from anterior body end, 68.5 to 76.9% (72.6±2.7) of oesophageal length, and 14.7 to 16.5% (15.5±0.6) of body length; duct not cuticularized. Deirids two to four annules behind excretory pore. Hemizonid seldom discernible in Kusatsu population, 1.0 to 2.5 annule long, lying just anterior to excretory pore.

Vulva aberrant, in most cases on right subventral; vulval lips not protruded; vagina tubular at right angle to body axis; vulval lateral membrane small, 2.4 to 4.0 (3.2±0.6) μm long. Postuterine sac short and never expanded, 5.5 to 12.3 (7.9±1.8) μm long, 43 to 97% (63.9±1.4) of corresponding body diameter. Gonad 120 to 154 (136±11) μm long, 56.3 to 82.9% (70.6±7.6) of distance between posterior end of oesophagus and vulva. Distance between vulva and anus 47.5 to 53.0 (50.6±1.8) μm and 57.2 to 76.5% (66.2±6.7) of tail length. Phasmids seven to 12 annules anterior to vulva. Rectum 46 to 100% (69±17) of anal body diameter. Tail much short and stout for the genus, 67.2 to 87.0 (76.7±7.8) μm long and 1.3 to 1.8 (1.5) times vulva-anus distance; terminus acutely pointed or rounded.

Male (n=1): Male resembles female in general characteristics. Body slightly arcuate, 12.3 μm wide at mid-body. Annules in mid-body 1.7 μm wide. Annules on the oesophageal region 57, between posterior end of oesophagus and anus 142, total body annules excluding tail 199.

Lateral fields are not measured because of its subventral orientation. Head 2.4 μm high, 5.1 μm wide at base. Body at posterior end of oesophagus 2.3 times head base. Spear 2.9 times head base; anterior portion 47% of entire spear. Oesophagus 83.8 μm long; median bulb lying anteriorly 35.6 from anterior body end, 8.7 μm long, 5.9 μm wide. Excretory pore 62.5 μm and 42 annules from anterior body end, 74.5% of oesophageal length, and 15.9% of body length. Testis 149.5 μm long. Bursa narrow, strongly and very coarsely crenate on margin; both alae normally arched, though asymmetric in length, left ala 23.7 μm long, right ala 19.8 μm long; about 30% of tail length. Spicule slender, offset proximally, 12.7 μm long. Gubernaculum 6.3 μm long. Tail 75.1 μm long.

DIAGNOSIS AND RELATIONSHIPS

The two populations from Japan were well consistent with the original description of the species by SIDDIQUI & KHAN¹⁷⁾, although there are some deviations due to infraspecific variations.

Differences in the c -, c' -, V -value, and tail length in vulva-anus distance (2.0 in original description *vs.* 1.3 to 1.9 in Japanese populations) are of apparent correlation to those of tail length. Larger number of Rex (37 in original drawing: 39 to 44 in Kusatsu population: 40 to 46 in Aso population), more posterior excretory pore in both oesophagus length (70 to 85% in Kusatsu; 69 to 77% in Aso) and in body length (14 to 16% in Kusatsu; 15 to 17% in Aso) of Japanese populations in comparison with original description (73% and 13.6% respectively calculated from drawing) are also related with their larger absolute distance from head to excretory pore. Anterior spear knobs position in body annules in Kusatsu population (on the ninth to 11th) is mainly due to the length of spear. In short, the major differences between the populations exist only in the following characters: (1) body length, (2) spear length, (3) excretory pore distance from anterior body end, (4) number of annules on the oesophageal region, and (5) tail length. Most of them are within the ranges of fluctuation of dimensions actually occur in the other congeneric species, and of no absolute importance in distinguishing the species.

Accordingly, *C. planus* is briefly characterized by the smallest body, mostly shorter than 500 μm long; posterior vulva ($V=60$ to 70%); shorter spear, 14 to 17 μm long; shorter tail, about 100 μm long or shorter; hemizonid just anterior to excretory pore; procoprus mostly longer than spear; shortest postuterine sac, about half as long as and never exceeding corresponding body diameter; rounded or acutely pointed tail terminus.

However, in the above and other almost all character-states that were not mentioned here, *C. planus* surprisingly agree with *C. hexalineatus* (GERAERT, 1962) GOLDEN, 1971. Above all, by the common small body (375 to 570 μm long) and short postvulval uterine sac (shorter than corresponding body diameter), both species stand alone among the congeneric species. Obvious differences in female are observed in nothing but the basal oesophageal bulb: the symmetric, drop-shaped, with rounded posterior margin in *C. planus* against the asymmetric, humped dorsally and slightly lobed posterior margin in *C. hexalineatus*¹⁾. And, in male, bursal alae and gubernaculum of *C. planus* appear to be somewhat different from those of *hexalineatus* illustrated and described by GERAERT^{7,8)}. Our single male of *C. planus* has normally arched bursal alae as shown in the original illustration¹⁷⁾, and their margins are rather strongly crenate in comparison with *C. hexalineatus*. Also gubernaculum of *C. planus* is examined normally and different from that of *C. hexalineatus* which "proximally more or less curved to form a hook"⁷⁾. We consider, for the present, that *C. planus* can stand as valid species upon these character-states, although there remains still some possibility that this species is synonymous with *C. hexalineatus*.

SPECIMENS EXAMINED

Twenty females, Kusatsu-machi, Gunma (central Japan.), October 28, 1981, leg. N. MINAGAWA, soil around the root of Japanese Larch, *Larix leptolepis* (SIEB. et ZUCC.) GORDON.

Eleven females, 1 male, Mt. Aso, Kumamoto (western Japan), September 9, 1979, leg. N. MINAGAWA, soil around the root of tree (unidentified).

Specimens are deposited in the NIAES.

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和文摘要

日本産*Cephalenchus*属線虫の分類
3新種の記載及び*C. planus*の記録並びに種の検索表

永久保隆之・皆川 望

日本産*Cephalenchus*属の分類学的検討を行ない、3新種と1既知種*C. planus* SIDDQUI & KHANを確定させた。*C. nemoralis* (新種)は、 a, b, c, c' 及び V 値が、*C. emarginatus* 及び *C. megacephalus* に一致したが、頭部が滑らかで前側方へ張り出さない、deiridが排泄孔の4-8体環後方へ位置する、雄の導帯に特異な附属構造がある等の特徴により後2者から区別した。本種は三重県美杉村の本木根圏から採集された。*C. daisuze* (新種)は*C. limichus*に近似したが、半月体が排泄孔と同位かその直後 (*limichus*では1-2体環前方)に位置するため後者から区別した。本種は熊本県阿蘇山草千里のツクシアザミ根圏から採集された。*C. potamophilus* (新種)は*C. lobus*と*C. sacchari*に共通した腸と重複する後部食道球を持っていたが、中央側線がdeiridの直前で分岐し、膺が前傾し、陰門が陥没する点で後2者と異なった。本種は熊本県阿蘇山の川辺のアブラガヤ根圏から採集された。*C. planus*は*C. hexalineatus*にごく近似していたが、左右相称の短かい後部食道球を持つため独立種と考えた。熊本県阿蘇山 (木本) 及び群馬県草津町 (カラマツ) における本種の記録はインドにおける原記載以来の最初の記録である。