

Description of *Radopholoides triversus* n. sp. from Japan
with a Reference to the Classification of the Family
Pratylenchidae (Nematoda: Tylenchida)

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Radopholoides triversus n. sp. was detected from the rhizosphere of *Lespedeza cyrtobotrya* in Kumamoto Prefecture, Japan. This species is distinguished from others by having three, rather than four, incisures in the lateral field and by the absence of a spine on the tail terminus. *Radopholoides* is placed in the subfamily Radopholinae of the family Pratylenchidae. Subfamilies Hoplotylinae and Acontylinae are synonymous with Radopholinae, and subfamily Hirschmanniellinae is treated as a junior synonym of Pratylenchinae. The key to subfamilies and genera of Pratylenchidae is given.

The genus *Radopholoides* DE GUIRAN, 1967 was established in the subfamily Pratylenchinae (s. l.) based on *R. litoralis* DE GUIRAN, 1967 from Madagascar, and now includes two other species from Australia and U.S.S.R. (COLBRAN, 1970; NESTEROV and KOZHOKARU, 1980). A species of this genus was also reported from Japan (GOTOH, 1972), and obviously the same nematode was obtained by the author from soil around the root of *Lespedeza cyrtobotrya* MIQ. in the Kyushu National Agricultural Experiment Station, Nishigoshi, Kumamoto, Japan. This species is distinguished from others of this genus, and is described under the name of *Radopholoides triversus* n. sp. So far, this genus has been placed in the subfamily Pratylenchinae (DE GUIRAN, 1967; GOLDEN, 1971; ANDRÁSSY, 1976; WOUTS, 1979), in Radopholinae of Pratylenchidae (SIDDIQI, 1971), or in Radopholidae (FOTEDAR and HANDOO, 1979). The systematic position of *Radopholoides* and allied genera including classification of Pratylenchidae is discussed and a revision is proposed in this paper. Nematode specimens in this study were fixed by TAF fixative, and mounted in glycerine after slow dehydration.

Radopholoides triversus n. sp.

Descriptions. Female. Paratypes: $n=25$, $L=277-559 \mu\text{m}$ (422 ± 60 : mean \pm standard deviation), $a=19.3-29.3$ (23.7 ± 2.9), $b=4.4-6.7$ (5.8 ± 0.6), $b'=2.1-3.6$ (2.9 ± 0.3), $c=10.7-14.6$ (13.2 ± 1.0), $c'=1.9-3.2$ (2.7 ± 0.3), $V=67.5-72.6$ (69.3 ± 1.6), stylet= $14.3-19.5 \mu\text{m}$ (16.9 ± 1.2), prothabdion= $7.2-9.9 \mu\text{m}$ (8.5 ± 0.7), E. P.= $13.3-21.6\%$ (17.0 ± 1.6). Holotype: $L=434 \mu\text{m}$, $a=24.8$, $b=5.9$, $b'=3.4$, $c=13.3$,

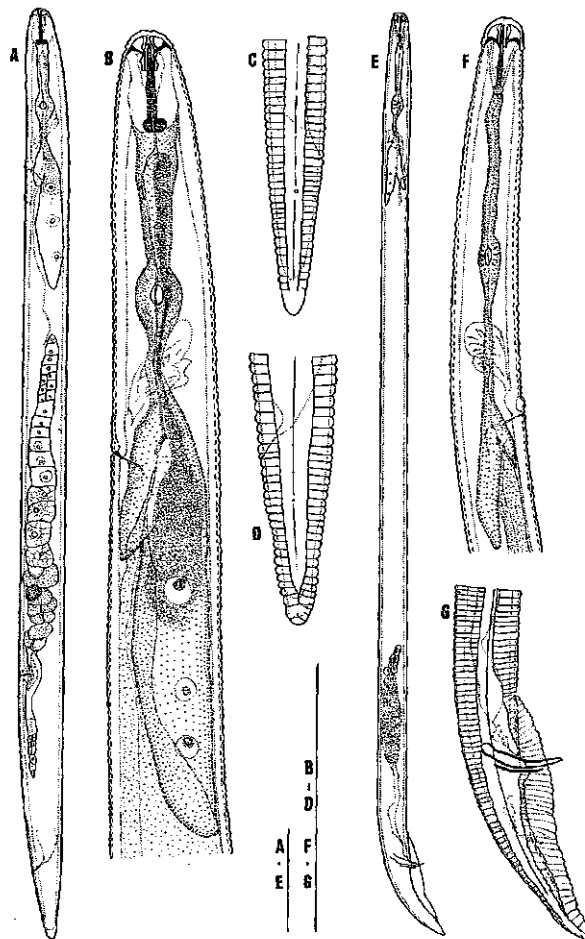


Fig. 1. *Radopholoides triversus* n. sp. Female: A, entire body. B, anterior body; C-D, tail end. Male: E, entire body; F, anterior body; G, tail end. Scales indicate 50 μ m.

$c' = 2.6$, $V = 68.8$, stylet = 17.5 μ m, prorhabdion = 8.8 μ m, E. P. = 14.3%. Body cylindrical, gradually tapering to lip region and bluntly pointed tail end. Lip region subspherical, slightly flattened at tip, continuous from the body contour, usually having three annules though in rare cases two or four. Labial framework strongly sclerotized, arch-shaped. Stylet stout; knobs round and anterior surface flattened, 1.9–2.8 μ m (2.4 ± 0.2) high, and 3.5–4.8 μ m (4.2 ± 0.4) across. Dorsal esophageal gland orifice 2.5–4.0 μ m (3.4 ± 0.4) behind stylet base. The distance from anterior end to esophageal-intestinal valve 56.2–89.1 μ m (73.1 ± 8.2) and to middle of median bulb 40.4–56.8 μ m (48.9 ± 4.9). Median bulb oval, well developed. Esophageal gland overlapping intestine dorsally. Glandular esophageal basal lobe massive, ending 113.7–206.5 μ m (144.3 ± 22.5) from lip. Excretory pore 59.7–84.3 μ m (71.5 ± 7.0) from anterior end, opposite esophageal-intestinal valve. Hemizonid prior to excretory pore, two-body

annule-long. Himizonion one-annule long, 8.7–24.6 μm (16.8 ± 4.5 , $n=21$) posterior to hemizonid. Lateral field 4.0–5.7 μm (4.8 ± 0.6 , $n=14$) wide with three incisures, inner one occasionally indistinct. Tail 23.1–41.4 μm (32.1 ± 4.0) long, with 17–26 (21 ± 2.1) annules. Tail terminus bluntly pointed, usually without annulations. Hyaline part of tail 3.5–7.5 μm (6.1 ± 1.2) in length. Phasmids 19.1–28.6 μm (23.1 ± 2.4) from tail end. Reproductive system well developed. Ovary outstretched. Spermatheca round with rod-like sperm. Post uterine vulval branch 8.9–42.9 μm (33.5 ± 6.4) in length, 1.2–3.0 times (2.0 ± 0.4) body width at vulva, occasionally with vestigial ovary.

Male. Paratypes: $n=10$, $L=358$ – 454 μm (415 ± 26), $a=24.0$ – 32.9 (29.4 ± 3.1), $b=4.8$ – 6.6 (5.9 ± 0.6), $b'=3.0$ – 4.6 (4.1 ± 0.5), $c=10.8$ – 13.9 (12.1 ± 0.9), $c'=2.6$ – 3.7 (3.3 ± 0.4), stylet= 9.5 – 13.9 μm (11.5 ± 1.6), prorhabdion= 5.7 – 8.2 μm (7.0 ± 0.7), spicules= 13.3 – 17.7 μm (15.8 ± 1.3), gubernaculum= 8.2 – 10.1 μm (9.7 ± 0.7), E. P.= 16.6 – 19.6% (18.0 ± 0.8). Distinct sexual dimorphism present. Body more slender than female. Lip region dome-like, distinctly set off, 6.9–8.2 μm (7.3 ± 0.3) wide, 3.2–4.4 μm (3.9 ± 0.5) high, with three to five, though usually four, annules. Stylet weak, basal part occasionally obscure; knobs round, 1.3–1.9 μm high, and 1.6–2.5 μm wide. Esophagus narrow, and median bulb indistinct. Basal lobe short, ending 88.4–125.1 μm (101.5 ± 12.4) from lip. Excretory pore 68.2–80.2 μm (74.6 ± 3.8) from anterior end. Hemizonid two-annule long, and located at prior to excretory pore; himizonion one-annule long, 9.5–20.9 μm (16.8 ± 3.4 , $n=8$) behind hemizonid. Lateral field 3.2–4.4 μm (3.6 ± 0.5 , $n=9$) wide with three incisures. Spicules arch-shaped; gubernaculum long with a small knob-like structure on basal part. Bursa well developed, enveloping tail. Phasmids on bursa, rod-like shaped, 15.8–27.8 μm (22.2 ± 3.2) from posterior end. Testis single, 76.4–113.7 μm (96.0 ± 11.8) long, outstretched. Sperms rod shaped. Tail end pointed.

Type specimens. Holotype: female; paratypes: 58 females, 16 males and 1 larva. All specimens are deposited in the Herbarium and Insect Museum of the National Institute of Agricultural Sciences in Yatabe, Ibaraki Prefecture.

Type host and locality. Specimens were collected from soil around root of *Lespedeza cyrtobotrya* MIQ. in the Kyushu National Agricultural Experiment Station in Nishigoshi, Kumamoto Prefecture, Japan on May 23, 1980 and June 27, 1980 by N. MINAGAWA.

Diagnosis. *Radopholoides triversus* n. sp. is distinguished from other species of this genus by having three incisured rather than the four of other species (DE GUIRAN, 1967; COLBRAN, 1970), and/or without a spine on the tail terminus (NESTEROV and KOZHOKARU, 1980). Key to the species is as follows.

- 1 (2) Tail terminus with a spine; $c=4.5$ *R. scryabini* NESTEROV and KOZHOKARU, 1980
- 2 (1) Tail terminus without spine; c -value more than 9.
- 3 (4) Lateral incisures three *R. triversus* n. sp.
- 4 (3) Lateral incisures four.
- 5 (6) Female stylet 14–17 μm ; tail terminus annulated; male known *R. litoralis* DE GUIRAN, 1967
- 6 (5) Female stylet 12–13 μm ; tail terminus smooth; male unknown *R. laevis* COLBRAN, 1970

DISCUSSION

The classification of Hoplolaimidae and its allied families based on gonad morphology has been widely accepted. Within this family, the genus *Radopholoides* was thought to belong to subfamily Pratylenchinae because of the female's single ovary (GOLDEN, 1971; WOUTS, 1979), although this character was not appropriate to classify this family. For example, in the subfamily Pratylenchinae, the morphology of the anterior body of the genus *Pratylenchus* FILIPJEV, 1936 and *Hirschmanniella* LUC and GOODEY, 1963 have a close resemblance except for the female gonads which are monodelphic in the former and didelphic in the latter. Similarly, *Radopholus* THORNE, 1949 and *Radopholoides* DE GUIRAN, 1967 can be differentiated by their female reproductive organs, but there are some common characteristics, such as dorsally extending esophageal basal lobes, distinct sexual dimorphism of the anterior body, rod-like sperm and long gubernaculum, which suggest phylogenetically close relationships between the two genera belonging to the same subfamily Radopholinae. Although ANDRÁSSY (1976) defined Hoplolaimidae as "Phasmids of males flattened, not lying on bursal flaps, . . .," he placed Radopholinae, the male of which has rod-like phasmids lying on bursal flaps, in this family. Radopholinae is considered to be a subfamily belonging not to family Hoplolaimidae but to family Pratylenchidae. The principal characteristics classifying subfamilies of Pratylenchidae are not their female gonad morphology, but the esophagus lobes as pointed out by SIDDIQI (1971) and SHER (1973). SEINHORST (1971) showed the similar notion of his study on the structure of esophagus of this group.

Although *Hoplotylus* s'JACOB, 1959 and *Acontylus* MEAGHER, 1968 are now included in subfamily Hoplotylinae KHAN, 1969 and in Acontylinae FOTEDAR and HANDOO, 1979 of family Hoplolaimidae, respectively (KHAN, 1969; SIDDIQI, 1971; FOTEDAR and HANDOO, 1979), the morphological characters of both genera are analogous to those of Radopholinae in the round lip region, dorsally overlapping esophageal gland lobes, and highly degenerate male adults (s'JACOB, 1959, 1979; MEAGHER, 1968; BERNARD and NIBLACK, 1982). These two genera also belong to subfamily Radopholinae, and here such subfamilies as Hoplotylinae, Acontylinae, and family Radopholidae are synonymous with subfamily Radopholinae ALLEN and SHER, 1967. An amended definition of this subfamily is provided below.

Subfamily Radopholinae ALLEN and SHER, 1967

=Hoplotylinae KHAN, 1969 n. syn.

=Acontylinae FOTEDAR and HANDOO, 1979 n. syn.

=Radopholidae (ALLEN and SHER, 1967) KHAN and NANJAPA, 1972

Definition (Amended). Family Pratylenchidae. *Female*. Lip region high and subspherical. Esophageal gland well developed, overlapping intestine dorsally or laterally. Median bulb massive. Stylet stout; knobs strong, rounded, anterior surface flattened or pointed. Ovary one or two. Vulva in posterior part or middle of body. *Male*. Sexual dimorphism present; male adult degenerate to various degrees. Lip region set off from body, usually rounded or dome-like. Esophagus and stylet weakly developed. Spicules arch-shaped; gubernaculum rather long, occasionally with appendix in the basal part and projecting from cloaca. Reproductive system simple, outstretched. Sperms rod-shaped or round. Bursa subterminal. Phasmids usually on bursa, rod-like.

Remarks: Differential diagnoses of subfamilies and genera of Pratylenchidae are given in the following key.

Key to subfamilies and genera of Pratylenchidae.

- 1 (2) Adult female saccate, gall forming
 Subfamily Nacobbinae CHITWOOD and CHITWOOD, 1955
 Genus *Nacobbus* THORNE and ALLEN, 1944
- 2 (1) Adult female vermiform, not gall-forming.
- 3 (8) Esophageal basal lobes extending ventrally and ventro-laterally over intestine.....Subfamily Pratylenchinae THORNE, 1949
 (=Hirschmanniellinae FOTEDAR and HANDOO, 1979 n. syn.)
- 4 (5) Ovary one; tail terminus smooth or annulated
 Genus *Pratylenchus* FILIPJEV, 1936
- 5 (4) Ovary two.
- 6 (7) Tail elongate-conoid, with a terminal mucronate or peg; bursa in male sub-terminal.....Genus *Hirschmanniella* LUC and GOODEY, 1963
- 7 (6) Tail short, cylindrical, without terminal mucro or peg; bursa in male terminalGenus *Zygotylenchus* SIDDIQI, 1963
- 8 (3) Esophageal basal lobes extending dorsally and dorso-laterally over intestine
 Subfamily Radopholinae ALLEN and SHER, 1967
- 9 (12) Female phasmids in posterior or middle portion of tail; male not highly degenerate.
- 10 (11) Ovary one; deirids absent Genus *Apratylenchoides* SHER, 1973
- 11 (10) Ovary two; deirids present Genus *Pratylenchoides* WINSLOW, 1958
- 12 (9) Female phasmids in anterior portion of tail; male highly degenerate.
- 13 (14) Female tail terminus pointed; male gubernaculum small, not projecting from cloaca.....Genus *Hoplotyylus* s'JACOB, 1959
- 14 (13) Female tail terminus bluntly pointed or annulated; male gubernaculum long and modified, projecting from cloaca.
- 15 (16) Ovary two Genus *Radopholus* THORNE, 1949
- 16 (15) Ovary one.
- 17 (18) Mature female swollen, tail short ($c=23.5-30.5$); dorsal esophageal gland orifice more than a half stylet length behind stylet base; sperms round
 Genus *Acontylus* MEAGHER, 1968
- 18 (17) Mature female not swollen, tail long ($c=9-14.6$); dorsal esophageal gland orifice near the stylet base; sperms rod-shape
 Genus *Radopholoides* DE GUIRAN, 1967

REFERENCES

ALLEN, M. W. and S. A. SHER (1967) Taxonomic problems concerning the phytoparasitic nematodes. *Annu. Rev. Phytopath.* 5: 247-264.

ANDRÁSSY, I. (1976) *Evolution as a Basis for the Systematization of Nematodes*. Pitman Publ., London, 288 pp.

BERNARD, E. C. and T. L. NIBLACK (1982) Review of *Hoplotyylus* s'JACOB (Nematoda: Pratylenchidae). *Nematologica* 28: 101-109.

COLBRAN, R. C. (1970) Studies of plant and soil nematodes. 15. Eleven new species of *Radopholus* THORNE and a new species of *Radopholoides* DE GUIRAN (Nematoda: Tylenchoidea) from Australia. *Qd. J. agric.*

- Anim. Sci.* **27**: 437-460.
- FOTEDAR, D. N. and Z. A. HANDOO (1979) A revised scheme of classification to order Tylenchida THORNE, 1949 (Nematoda). *J. Sci., Univ. Kash.* **3**: 55-82.
- GOLDEN, A. M. (1971) Classification of the genera and higher categories of the order Tylenchida (Nematoda). In *Plant Parasitic Nematodes*, Vol. 1 (B. M. ZUCKERMANN, W. G. MAI and R. A. ROHDE, eds.), Academic Press, New York, pp. 191-232.
- GOTOH, A. (1972) *Radopholoides* sp. detected from a natural grassland in Kyushu. *Abstr. 16th Annu. Meet. Jap. Soc. Appl. Ent. Zool., Shizuoka, 6-8 Apr.*, p. 118 (in Japanese).
- DE GUIRAN, G. (1967) Description de *Radopholoides litoralis* n. g., n. sp. (Nematoda: Pratylenchinae). *Nematologica* **13**: 231-234.
- s'JACOB, J. J. (1959) *Hoplotylus femina* n. g., n. sp. (Pratylenchinae: Tylenchida) associated with ornamental trees. *Nematologica* **4**: 317-321.
- s'JACOB, J. J. (1979) The description of the male of *Hoplotylus*, collected from an oak forest. *Nematologica* **25**: 147-148.
- KHAN, E. (1969) On the classification of Tylenchoidea. *All India Nematol. Symp., New Dehli, Ind. Council Agric. Res.*, p. 26 (abstract).
- MEAGHER, J. W. (1968) *Acontylus vipriensis* n. g., n. sp. (Nematoda: Hoplolaimidae) parasitic on *Eucalyptus* sp. in Australia. *Nematologica* **14**: 94-100.
- NESTEROV, P. I. and G. I. KOZHOKARU (1980) Two new species of plant nematodes *Radopholoides scrijabini* n. sp. (Nematoda: Tylenchoidea) and *Leptonchus arcticus* n. sp. (Nematoda: Actinolaimoidea) from the rhizosphere of cultivated and wild plants. In *Vozbuditeli Parazitarnykh Zabolevanii. Shatiintsia, Kishinev, U.S.S.R.*, pp. 125-128 (in Russian).
- SEINHORST, J. W. (1971) The structure of the glandular part of the esophagus of Tylenchidae. *Nematologica* **17**: 431-443.
- SHER, S. A. (1973) The esophageal glands of *Pratylenchus* FILIPJEV and *Apratylenchoides belli* n. gen., n. sp. (Nematoda: Tylenchoidea). *J. Nematol.* **5**: 218-221.
- SIDDIQI, M. R. (1963) On the classification of the Pratylenchidae (THORNE, 1949) nov. grad. (Nematoda: Tylenchida), with a description of *Zygotylenchus browni* nov. gen. et nov. sp. *Z. f. Parasitenkunde* **23**: 390-396.
- SIDDIQI, M. R. (1971) Structure of the oesophagus in the classification of the superfamily Tylenchoidea (Nematoda). *Indian J. Nematol.* **1**: 25-43.
- THORNE, G. (1949) On the classification of the Tylenchida, new order (Nematoda: Phasmodia). *Proc. Helminthol. Soc. Wash.* **16**: 37-73.
- THORNE, G. and M. W. ALLEN (1944) *Nacobbus dorsalis* nov. gen., nov. spec. (Nematoda: Tylenchidae) producing galls on the roots of aifileria, *Erodium cicutarium* (L.) L'HÉR. *Proc. Helminthol. Soc. Wash.* **11**: 27-31.
- WOUTS, W. M. (1979) Characterization of the family Meloidogyridae with a discussion on its relationship to other families of the suborder Tylenchida based on gonad morphology. In *Root Knot Nematodes (Meloidogyne species): Systematics, Biology and Control* (F. LAMBERTI and C. E. TAYLOR, eds.), Academic Press, London, pp. 21-35.