

Two new species of the genus *Radopholus* Thorne, 1949 (Nematoda : Pratylenchidae) from Pakistan

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Summary – Specimens of two new species of the genus *Radopholus* viz., *R. allius* n. sp. and *R. brassicae* n. sp., were collected from soil around the roots of *Allium cepa* L. and *Brassica oleracea* var. *capitata* L., respectively, from Muzaffarabad, Azadkashmir and Saifulmuluk (Pakistan). These two new species are distinguished from other species of the genus *Radopholus* by a combination of characters : more posteriorly located vulva (V greater than 75), shorter tail (less than 30 mm), greater c and smaller c' values. *R. allius* n. sp. and *R. brassicae* n. sp. differ from each other in habitus, number of tail annules, "a" value, and shape of spermatheca. Both seem to be parthenogenetic. These two new species are described and illustrated.

Résumé – Deux nouvelles espèces du genre *Radopholus* Thorne, 1949 (Nematoda : Pratylenchidae) provenant du Pakistan – Des spécimens appartenant à deux nouvelles espèces de *Radopholus* – *R. allius* n. sp. et *R. brassicae* n. sp. – ont été respectivement collectés dans la rhizosphère d'*Allium cepa* L. et de *Brassica oleracea* var. *capitata* L., à Muzaffarabad, Azadkashmir et Saifulmuluk (Pakistan). Ces deux nouvelles espèces se distinguent des autres espèces du genre *Radopholus* par la combinaison de caractères suivante : vulve située plus postérieurement (V supérieur à 75), queue plus courte (inférieure à 30 mm), plus grandes valeurs de c et c'. *R. allius* n. sp. et *R. brassicae* n. sp. diffèrent l'un de l'autre par l'habitus, le nombre d'anneaux caudaux, la valeur du coefficient a et la forme de la spermatheque. L'une et l'autre espèces sont apparemment parthénogénétiques. Ces deux nouvelles espèces sont décrites et illustrées.

Key-words : morphology, nematode, *Radopholus*, taxonomy.

De Guiran (1967) proposed the genus *Radopholoides* close to *Radopholus* Thorne, 1949 but having a monoprodelphic female. Colbran (1971) described a new species of the genus *Radopholoides*, i.e., *R. laevis*. Siddiqi (1986) confirmed the validity of the genus *Radopholoides* with the species *R. litoralis* and *R. laevis*, and transferred *Radopholoides triversus* Minagawa, 1984 to the genus *Hoplotylus* s' Jacob, 1960. Luc (1987) synonymized the genus *Radopholoides* with *Radopholus* and combined these characters : « two female genital branches equally developed or more rarely, posterior branch more or less reduced, degenerated and nonfunctional » as the species involved in *Radopholus/Radopholoides* do not show a clear cut on that point, the regression of the female posterior genital branch forming a continuous series.

In a nematode survey of northern areas of Pakistan, besides other nematode specimens, two undescribed nematode species belonging to the subfamily Pratylenchinae were collected in abundance. These two species were found having the characters : dorsally overlapping oesophageal glands, posteriorly located vulva and posterior branch of ovary reduced to post-uterine sac, tail short, subcylindrical, with broadly rounded terminus and absence of males. Following Luc (1987) these two new species are attributed to the genus *Radopholus*, at present, leaving the door open for a future revision if new and abundant material is found. In this article these

two new species have been compared with *Radopholus litoralis* (de Guiran, 1967) Luc, 1987 and *R. laevis* (Colbran, 1971) Luc, 1987, thus forming a group of four species in the genus *Radopholus* in which the female genital posterior branch is reduced to a uterine sac.

Specimens were killed by gentle heat, fixed in TAF and mounted in thin glass slides. They were placed in a tiny drop of glycerine and covered with a 19 mm cover slip supported by paraffin wax. Measurements were taken by an ocular micrometer; illustrations were made with the aid of a drawing tube.

Radopholus allius n. sp.

(Fig. 1)

MEASUREMENTS

See Table 1.

DESCRIPTION

Female : Body slender, strongly curved, C-shaped when relaxed. Cuticular annulation distinct, 0.8-1.2 mm wide at mid body. Lateral fields prominent marked with four incisures, occupying about half of the body diameter. Cephalic region low, continuous, anteriorly flattened. Framework heavily sclerotized. Head 3.0-3.5 mm high and 7.0-8.0 mm wide at base with three annules. Stylet well developed; conus 7.5-8.5 mm long, 54-56 % of stylet total length; knobs rounded, slightly indented anteriorly, 2.0-2.3 mm high and 4.0-4.5 mm wide.

Table 1. Morphometric data of females of *Radopholus allius* n. sp., and *R. brassicae* n. sp. (all measurements are in mm).

	<i>R. allius</i>		<i>R. brassicae</i>	
	Holotype	Paratypes	Holotype	Paratypes
n		10		10
L	465.0	450.0 ± 22.3 (420.0-480.5)	445.2	442.1 ± 38.4 (367.0-472.0)
a	29.1	29.0 ± 0.91 (27.5-30.0)	22.1	23.5 ± 2.1 (21.0-26.5)
b	6.5	6.5 ± 0.11 (6.4-6.7)	5.8	5.9 ± 0.29 (5.5-6.3)
b'	4.5	4.5 ± 0.05 (4.5-4.6)	4.0	4.3 ± 0.36 (4.0-4.8)
c	19.4	19.0 ± 1.18 (17.0-20.0)	22.1	22.4 ± 4.9 (16.0-29.0)
c'	2.3	2.5 ± 0.17 (2.3-2.7)	2.8	2.1 ± 0.4 (1.5-2.5)
V	76.8	76.5 ± 0.45 (76.0-77.0)	82.3	81.5 ± 1.0 (80.0-82.5)
Stylet	14.4	14.5 ± 0.58 (14.0-15.5)	16.8	15.7 ± 1.0 (14.4-16.8)
DGO	1.0	0.8 ± 0.16 (0.6-1.0)	1.5	1.4 ± 0.2 (1.0-1.8)
Excretory pore	61.6	65.0 ± 3.10 (60.0-68.0)	76.8	74.5 ± 3.0 (71.0-78.0)
Tail	24.2	25.0 ± 0.98 (24.0-26.4)	20.2	24.3 ± 3.3 (20.0-28.0)
Tail annules	25	25.5 ± 0.52 (25.0-26.0)	15	16.6 ± 2.4 (14.0-20.0)

Table 2. Comparative morphometric data of species of *Radopholus* with post-uterine sac (all measurements in µm).

	<i>R. laevis</i>	<i>R. litoralis</i>	<i>R. allius</i> n. sp.	<i>R. brassicae</i> n. sp.
n	6	22	10	12
L	443.0 (407.0-448.0)	400.0 (310.0-460.0)	450.0 (420.0-48.0)	442.1 (376.0-472.0)
a	33 (32-36)	26 (22-31)	29 (27-30)	23.5 (21-26)
b	4.9 (4.4-5.2)	-	6.5 (6.4-6.7)	5.9 (5.5-6.3)
b'	3.1 (2.9-3.7)	3.1 (2.6-3.7)	4.5 (4.5-4.6)	4.3 (4.0-4.8)
c	13 (12-14)	10 (10-12)	19.0 (17.0-20.0)	22.4 (16-29)
c'	3.8 (3.3-4.1)	4.0 (3.3-4.4)	2.5 (2.3-2.7)	2.1 (1.5-2.5)
V	71 (68-72)	68 (66-71)	76.5 (76-77)	81.5 (80-82)
Stylet	12 (12-13)	15.5 (14-17)	14.5 (14.0-15.5)	15.7 (14.4-16.8)
Tail	34 (31-36)	40 (33-44)	25.0 (24.0-26.4)	24.3 (20.0-28.0)

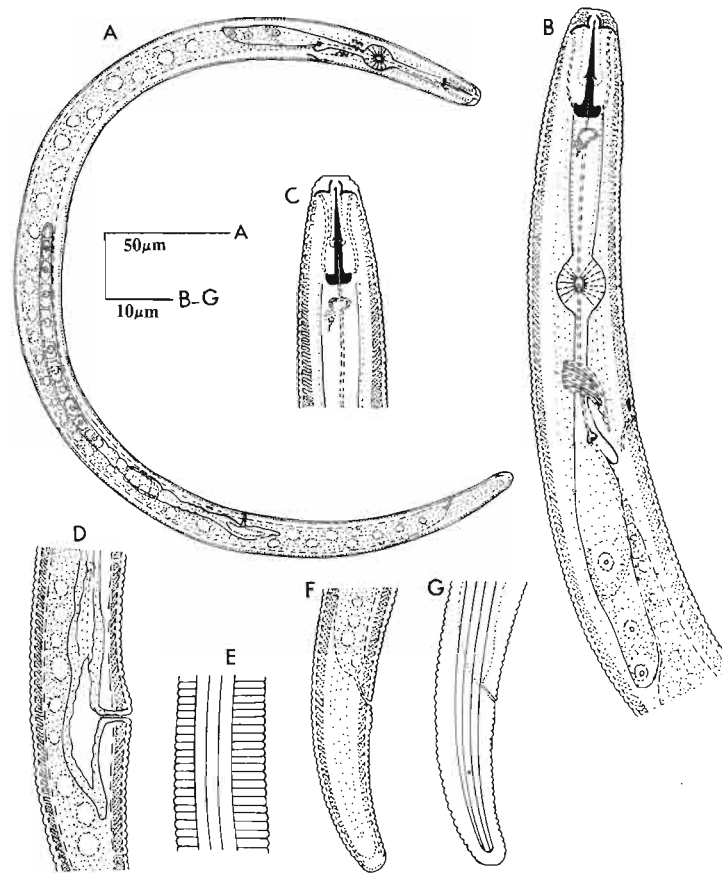


Fig. 1. *Radopholus allius* n. sp. A: Whole body; B: Oesophageal region; C: Anterior region; D: Vulvar region (ventral view); E: Cuticle (lateral field); F, G: Tails.

Median bulb round to oval, 7.0-8.0 × 9.0-10.0 mm; distance from anterior end of body to center of median bulb 40-43 mm; valve distinct, surrounded by muscle fibers; isthmus short, 15.0-18.0 mm long. Nerve ring a little anterior to the middle of the isthmus. Oesophageal glands elongated, extending mostly on dorsal side of intestine; oesophago-intestinal valve 64-68 mm from anterior end, the three gland nuclei in a row, well separated from each other; distance from anterior end of body to end of oesophageal glands 99-103 mm. Excretory pore at the level of oesophago-intestinal junction. Hemizonid two or three annules width long, two or three annules anterior to excretory pore. Vulva posterior, a transverse slit, vagina less than half of the body width long; ovary monoprodelfic, outstretched; quadricolumella present; spermatheca long, saccate, without sperm. Oocytes in single row. Post uterine sac about one anal body width long. Intestine with indistinct lumen and scattered vacuoles and granules, not extending over rectum. Tail cylindrical, terminus rounded, smooth.

Male: Not known.

TYPE HABITAT AND LOCALITY

Soil around the roots of onion (*Allium cepa* L.) from Muzaffarabad, Azadkashmir, Pakistan.

TYPE SPECIMENS

Holotype (female) slide No. NNRC 91/32 and paratype slide Nos. NNRC 91/33-34 (seven females) deposited at the National Nematode Collection of NNRC University of Karachi, Karachi, Pakistan. Slide No. NNRC 91/35 (two females) deposited at the USDA Nematode Collection, Beltsville, Maryland, USA.

DIAGNOSIS AND RELATIONSHIPS

Radopholus allius n. sp. differs from all the species of the genus by a combination of characters: presence of post uterine sac; more posteriorly located vulva; smaller tail, broadly rounded, smooth terminus.

R. allius n. sp. comes close to *R. litoralis* de Guiran, 1967 and *R. laevis* Colbran, 1971 (see Table 2). It differs from *R. litoralis* in having greater b and c values, more posteriorly located vulva, smaller tail length, smooth broadly rounded tail terminus and spermatheca without sperm (in *R. litoralis* $b' = 2.6-3.7$; $c = 10-12$; $V = 66-71$; tail length = 33-34 mm; striated, conoid tail terminus, spermatheca filled with sperm). It can be differentiated from *R. laevis* by having longer stylet, smaller a and c' values, longer b, b' and c values, more posteriorly located vulva, smaller tail length and broadly rounded tail terminus (in *R. laevis* stylet = 12-13 mm; $a = 32-36$; $c' = 3.3-4.1$; $b = 4.4-5.2$; $b' = 2.9-3.7$; $c = 12-14$; $V = 68-72$; tail length = 31-36 mm; tail conoid, slightly tapering).

***Radopholus brassicae* n. sp.**

(Fig. 2)

MEASUREMENTS

See Table 1.

DESCRIPTION

Female: Body slender, ventrally curved when relaxed. Cuticular annulation prominent, 0.8-1.8 mm wide at midbody. Lateral field marked with four incisures, forming three bands, occupying about 1/3 of the body width. Cephalic framework heavily sclerotized. Cephalic region low, continuous with body contour, anteriorly flattened. Head 2.4-3.4 mm high and 8.0-8.8 mm wide at base, with two annules. Stylet strong; conus 7.5-8.5 mm long, 46-48% of its total length; knobs rounded, slightly indented anteriorly, 2.0-2.5 mm high and 4.5-5.5 mm wide. Orifice of dorsal oesophageal gland 1.0-1.8 mm behind stylet base. Median bulb rounded, 10.0-11.0 × 11.5-12.5 mm with strong valvular apparatus surrounded by muscle fibers. Distance from anterior end of body to center of median bulb 43-48 mm. Isthmus 19.0-21.0 mm long, encircled by nerve ring. Oesophageal

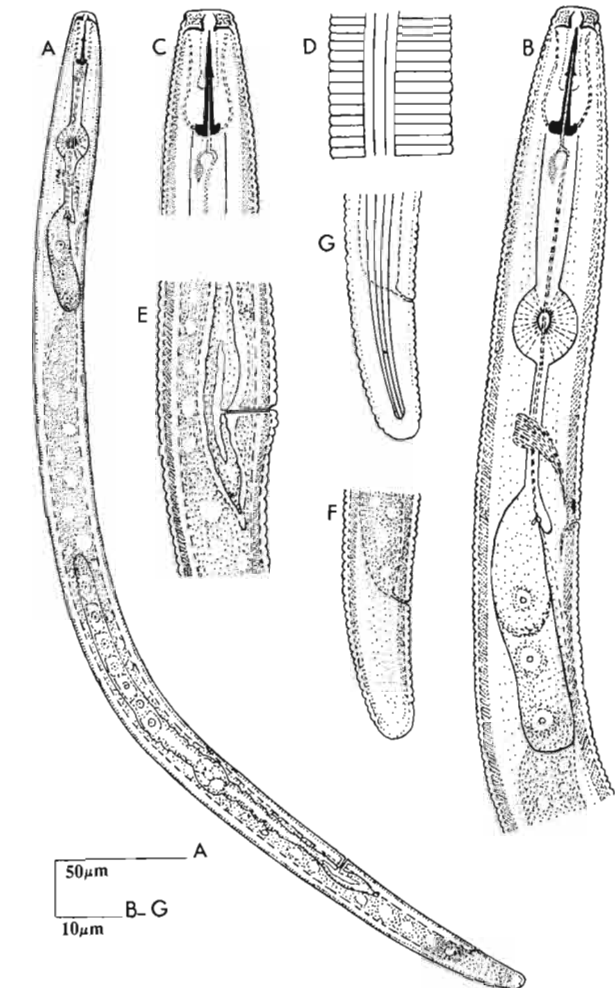


Fig. 2. *Radopholus brassicae* n. sp. A: Whole body; B: Oesophageal region; C: Anterior region; D: Cuticle (lateral field); E: Vulvar region (Ventral view); F, G: Tails.

glands dorsal to intestine; distance from anterior end of body to end of oesophageal gland 110-115 mm, gland nuclei lying in a row well separated from each other, oesophago-intestinal junction 75.0-78.0 mm from anterior end. Excretory pore just opposite the oesophago-intestinal junction. Hemizonid two or three annule widths long, just anterior to excretory pore. Vulva posterior, a transverse slit; vagina straight, less than half body width. Ovary monodelphic, outstretched; spermatheca 11-12 × 13-14 mm long, without sperm; oocytes arranged in a single row. Post uterine sac one body width long. Tail cylindrical-conoid-rounded, terminus smooth.

Male: Not known.

TYPE HABITAT AND LOCALITY

Soil around the root of cabbage (*Brassica oleracea* var. *capitata* L.) from Saifulmuluk, Pakistan.

TYPE SPECIMENS

Holotype (female) slide No. NNRC 91/36 and paratype slide Nos. NNRC 91/37, 38 (nine females) deposited in the National Nematode Collection of NNRC, University of Karachi, Karachi, Pakistan. Slide No. NNRC 91/39 (two females) deposited in USDA Nematode Collection, Beltsville, Maryland, USA.

DIAGNOSIS AND RELATIONSHIPS

Radopholus brassicae n. sp. is characterized by the following combination of characters : more posteriorly located vulva (V greater than 75%), shorter tail (less than 30 mm) greater c and smaller c' values.

It comes close to *R. laevis*, *R. litoralis* and *R. allius*. *R. brassicae* n. sp. can be distinguished from *R. laevis* and *R. litoralis* by having greater b, b' and c values, smaller c' value; more posteriorly located vulva and smaller tail (for *R. laevis* and *R. litoralis* see Table 2). It can be separated from *R. allius* n. sp. by having straight to slightly ventrally curved body, smaller a value, more posteriorly located vulva, rounded spermatheca, and lesser number of tail annules (in *R. allius* n. sp. : body

C-shaped; a = 27-30; V = 76-77; spermatheca elongate, sac like; tail annules = 22-24) (see Table 2).

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