

# First Record of Two *Pseudacrobeles* Species (Nematoda: Rhabditida: Cephalobidae) in South Korea

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## ABSTRACT

*Pseudacrobeles (Pseudacrobeles) variabilis* (Steiner, 1936) Steiner, 1938 and *P. (Bunobus) pseudolatus* (Hernández, 1990) De Ley, Siddiqi and Boström, 1993 belonging to the family Cephalobidae Filipjev, 1934 are newly reported from South Korea. *Pseudacrobeles (Pseudacrobeles) variabilis* is distinguished from its congeners by having distinctly setiform cephalic probolae, three rounded or knob-shaped labial probolae and longer female tail. *Pseudacrobeles (Bunobus) pseudolatus* is distinguished from its congeners by having visibly lateral lips, a short post-uterine sac, elongated conoid tail in the female, and acute mucro on the tails of both sexes. In this study, details of the morphological characters and morphometrics of Korean populations of *P. (P.) variabilis* and *P. (B.) pseudolatus* are described and illustrated based on optical microscopy.

**Keywords:** Cephalobidae, *Pseudacrobeles*, *Bunobus*, new record, South Korea

## INTRODUCTION

The genus *Pseudacrobeles* was established by Steiner in 1938. During a taxonomic revision of the genus, De Ley et al. (1993a, 1993b) classified it into the subgenera *Pseudacrobeles* Steiner, 1938 and *Bunobus* De Ley, Siddiqi and Boström, 1993 based on morphological characters of the lip region. *Pseudacrobeles* species have triradiate lips (very rarely with hexaradiate or bilateral symmetry) and labial probolae (if absent the lips are low and amalgamated), whereas *Bunobus* species have bilaterally symmetric lips, no labial or cephalic probolae, and smaller lateral lips than subdorsal and subventral lips. Although Andrassy (2005) elevated the subgenus *Bunobus* to genus level separate from the subgenus *Pseudacrobeles*, we here treat each as a subgenus until further confirmation.

*Pseudacrobeles* species are found on every continent in the world except Antarctica. Records exist for South America (Loof, 1964; Andrassy, 1968; Zell, 1987; De Ley et al., 1993a, 1993b), Europe (Zell, 1987; Hernández, 1990; Holovachov and De Ley, 2001; Abolafia et al., 2002; Abolafia and Peña-Santiago, 2005; Holovachov and Boström, 2006; Abolafia and Peña-Santiago, 2013), Asia (De Ley et al., 1993a, 1993b; Shokoohi and Abolafia, 2012; Kim et al., 2017),

and Africa (Schuurmans-Stekhoven, 1951; Loof, 1964; De Ley et al., 1993a, 1993b). To date, only one *Pseudacrobeles* species, *P. (P.) curvatus*, has been reported in South Korea (Kim et al., 2017).

During a survey of several plots of farmland, *P. (P.) variabilis* (Steiner, 1936) Steiner, 1938 and *P. (B.) pseudolatus* (Hernández, 1990) De Ley, Siddiqi and Boström, 1993 were collected and isolated from soil samples from pear and potato farms. In this paper, we provide detailed descriptions of the morphological characters and morphometrics of *P. (P.) variabilis* and *P. (B.) pseudolatus* from South Korea.

## MATERIALS AND METHODS

### Nematode isolation

Soil samples were collected from soil below pear trees (Gongdo-eup, Anseong-si, Gyeonggi-do, South Korea [coordinates: 37°01'01.1"N, 127°10'23.4"E]) and potato farm soil (Buk-myeon, Uichang-gu, Changwon-si, Gyeongsangnam-do, South Korea [coordinates: 35°22'22.5"N, 128°36'47.3"E]). Nematode specimens were extracted by sieving and the Baermann funnel method (Baermann, 1917).

### Fixation and morphological observations

Each nematode specimen was transferred to 2 mL of water in a 15 mL tube, to which was quickly added 4 mL of 80°C TAF (2% triethanolamine and 7% formaldehyde) for fixation. The fixed nematodes were processed to dehydrated glycerin as described by Seinhorst (1959) and mounted in pure glycerin on HS slides (Shirayama et al., 1993). Nematode morphological characters were observed under an optical microscope (BX-51; Olympus, Tokyo, Japan) equipped with differential interference contrast. Morphometric characters were measured using a CoolSnap Photometrics color CCD digital camera (MP5.0-RTV-R-CLR-10; Photometrics, Tucson, AZ, USA) and the program QCapture Pro 5 (QImaging, Surrey, Canada).

## SYSTEMATIC ACCOUNTS

Order Rhabditida Chitwood, 1993  
 Suborder Tylenchina Thorne, 1949  
 Infraorder Cephalobomorpha De Ley and Blaxter, 2002  
 Family Cephalobidae Filipjev, 1934  
<sup>1\*</sup>Genus *Pseudacrobeles* Steiner, 1938  
<sup>2\*</sup>Subgenus *Pseudacrobeles* Steiner, 1938

<sup>3\*</sup>*Pseudacrobeles (Pseudacrobeles) variabilis*  
 (Steiner, 1936) Steiner, 1938 (Table 1, Fig. 1)

*Acrobeles variabilis* Steiner, 1936: 76, fig. 23.  
*Pseudacrobeles variabilis* Steiner, 1938: 37, fig. 13c–e.  
*Pseudacrobeles (Pseudacrobeles) variabilis* De Ley et al., 1993a: 223, figs. 1, 2, 3b–f, 3h–l; Abolafia et al., 2002: 148, fig. 6.

**Material examined.** 2♀♀ and 2♂♂, South Korea: Gyeonggi-do, Anseong-si, Gongdo-eup, Deokbongseowon-ro, 04 Oct, 2017, extracted by sieving and the Baermann funnel method from soil below pear trees. Two specimens (slide Nos. NIBRIV0000754015 [female] and NIBRIV0000754016 [male]) are deposited at the National Institute of Biological Resources, Republic of Korea and two specimens (slide Nos. 01010403001 [female] and 01010403004 [male]) are deposited in the Animal Phylogenomics Laboratory, Ewha Womans University, Republic of Korea.

**Measurements.** See Table 1.

**Description. Adult:** Body cylindrical; length 633.5–699.9 µm in females and 598.9–612.1 µm in males; ventrally curved after fixation, C-shaped in females, J-shaped in males. Cuticle annulated; annuli 1.3–1.8 µm wide and 1.2–1.9 µm thick at mid-body. Lateral field with three incisures,

occupying 18.7–21.2% of width of body at mid-body; incisures fading out at phasmid region. Head region continuous with neck. Lip region 7.3–7.6 µm in diameter, with triradial symmetry, six cephalic probolae distinctly setiform, three labial probolae rounded or knob-shaped, with six labial and four cephalic papillae. Stoma cephaloboid, length 1.7–1.9 times the lip region diameter. Cheilorhabdions bar-shaped. Pharyngeal corpus cylindrical, 3.4–4.0 times the isthmus length. Isthmus narrower than corpus, distinctly demarcated from metacarpus. Basal bulb spheroid, with well developed valves; 1.2–1.3 times as long as its width. Cardia conoid, surrounded by intestinal tissue. Nerve ring located at posterior corpus, at 61.0–63.2% of pharynx length. Excretory pore positioned at corpus-isthmus junction or anterior isthmus, at 67.5–71.7% of pharynx length. Position of deirids in lateral field at isthmus level, at 77.3–80.9% of total neck length.

**Female:** Reproductive system monodelphic-prodelphic. Vagina 0.3 body-diameters long. Post-uterine sac length 0.7–0.9 times the body width. Uterus 2.3–2.4 body-diameters long. Spermatheca length same as the body width. Oviduct short. Ovary directed posteriorly, with double flexure. Rectum length 1.3–1.4 times the anal body diameter. Tail elongated conoid. Mucro 8.7–9.2 µm long, with a ragged surface. Phasmids at 25.1–25.7% of tail length.

**Male:** Genital system monorchic. Testis reflexed ventrad anteriorly. Spicules curved ventrad, 23.3–24.2 µm long; manubrium rounded; calamus as wide as manubrium; without hump and velum; with one longitudinal incisure. Gubernaculum slightly curved ventrad. Two pairs of pre-cloacal and one pair of ad-cloacal subventral papillae present. Post-cloacal genital papillae in five pairs: one subventral and one lateral at mid-tail, one subdorsal near phasmid, two ventral at tail terminus region. Tail conoid, bluntly terminus, with bar-shaped mucro. Phasmid opening at 55.7–62.1% of tail length.

**Distribution.** Brazil, Kenya, South Korea, Spain, Tanzania, USA.

**Habitat.** Soil sample from a pear farm.

**Remarks.** Morphological characters and measurements of the specimens described here perfectly fit the description of *P. (P.) variabilis* in previous studies, except for the female tail mucro (long and ragged vs. with or without acute mucro) (Steiner, 1936; De Ley et al., 1993a; Abolafia et al., 2002). Intraspecific variation in some morphologies (such as body size, tail length, and mucro shape) among populations of this species has been reported from many geographic areas: North America, Africa and Europe (Steiner, 1936; De Ley et al., 1993a; Abolafia et al., 2002). Al-

Korean name: <sup>1\*</sup>평두선충속 (신칭), <sup>2\*</sup>평두선충아속 (신칭), <sup>3\*</sup>다형평두선충 (신칭)

**Table 1.** Morphometrics of *Pseudacrobeles (Pseudacrobeles) variabilis* and *Pseudacrobeles (Bunobus) pseudolatus*

Character	<i>Pseudacrobeles (Pseudacrobeles) variabilis</i>		<i>Pseudacrobeles (Bunobus) pseudolatus</i>	
	♀, n=2	♂, n=2	♀, n=2	♂, n=2
L	666.7±46.9 (633.5-699.9)	605.5±9.3 (598.9-612.1)	633.2±83.3 (574.3-692.2)	592.2±22.9 (576.0-608.4)
a	20.5±1.6 (19.3-21.6)	22.4±0.5 (22.0-22.7)	20.6±1.9 (19.3-21.9)	22.8±2.2 (21.2-24.3)
b	3.9±0.2 (3.7-4.1)	3.8±0.0 (3.8-3.8)	3.9±0.3 (3.6-4.1)	3.7±0.3 (3.4-3.9)
c	7.2±0.0 (7.2-7.2)	15.6±0.7 (15.2-16.1)	11.5±0.4 (11.2-11.8)	10.9±2.3 (9.3-12.6)
c'	5.3±0.1 (5.2-5.4)	2.0±0.0 (1.9-2.0)	3.0±0.0 (3.0-3.0)	3.0±0.5 (2.6-3.4)
V	60.9±0.3 (60.7-61.1)	-	63.2±1.3 (62.3-64.1)	-
G or T	36.8±3.3 (34.5-39.1)	58.0±1.7 (56.9-59.2)	30.1±2.3 (28.5-31.7)	42.5±2.3 (40.9-44.1)
Body diameter	32.7±4.9 (29.3-36.2)	27.1±0.2 (26.9-27.2)	31.1±6.9 (26.2-35.9)	26.2±3.5 (23.7-28.7)
Pharynx length	171.3±1.3 (170.4-172.2)	159.0±1.1 (158.3-159.8)	163.3±8.0 (157.6-169.0)	162.3±6.9 (157.4-167.2)
Tail length	92.5±7.0 (87.6-97.4)	38.7±1.1 (38.0-39.5)	54.8±5.3 (51.1-58.5)	55.8±14.1 (45.9-65.8)
Anal body diameter	17.4±1.6 (16.3-18.6)	19.8±0.3 (19.5-20.0)	18.4±1.8 (17.1-19.7)	18.5±1.4 (17.56-19.5)
Tail annuli	55.5±0.7 (55.0-56.0)	27.0±1.4 (26.0-28.0)	30.5±0.7 (30-31)	31.0±1.4 (30-32)
Lip region diameter	7.5±0.1 (7.5-7.6)	7.3±0.0 (7.3-7.3)	6.9±0.2 (6.8-7.1)	6.6±0.5 (6.2-6.9)
Stoma	13.4±1.0 (12.7-14.1)	12.4±0.0 (12.4-12.4)	13.2±1.4 (12.1-14.2)	12.3±0.3 (12.1-12.5)
Stoma diameter	4.8±0.7 (4.3-5.3)	4.7±0.1 (4.6-4.8)	5.0±0.4 (4.7-5.3)	4.4±0.4 (4.1-4.7)
Stoma/lips region diameter	1.8±0.1 (1.7-1.9)	1.7±0.0 (1.7-1.7)	1.9±0.3 (1.7-2.1)	1.9±0.1 (1.8-1.9)
Stoma/stoma diameter	2.8±0.2 (2.6-2.9)	2.6±0.1 (2.6-2.7)	2.7±0.5 (2.3-3.0)	2.8±0.2 (2.6-2.9)
Corpus	102.9±0.5 (102.5-103.2)	95.5±0.6 (95.1-95.9)	93.3±6.9 (88.4-98.2)	96.6±5.3 (92.9-100.4)
Isthmus	27.1±2.2 (25.6-28.7)	26.6±2.0 (25.2-28.0)	30.6±0.1 (30.6-30.7)	31.8±2.0 (30.4-33.2)
Basal bulb	21.4±0.7 (20.9-21.9)	19.4±0.6 (18.9-19.8)	19.7±1.0 (18.9-20.4)	17.8±2.3 (16.1-19.4)
Basal bulb diameter	17.6±0.0 (17.6-17.6)	15.5±0.2 (15.4-15.7)	15.7±2.3 (14.0-17.3)	14.5±1.4 (13.5-15.5)
Basal bulb length/diameter	1.2±0.0 (1.2-1.2)	1.2±0.1 (1.2-1.3)	1.3±0.1 (1.2-1.3)	1.2±0.0 (1.2-1.3)
Corpus:isthmus ratio	3.8±0.3 (3.6-4.0)	3.6±0.3 (3.4-3.8)	3.0±0.2 (2.9-3.2)	3.0±0.0 (3.0-3.1)
Nerve ring to ant. end	105.8±1.1 (105.1-106.6)	100.4±0.8 (99.9-101.0)	107.4±12.6 (98.5-116.3)	99.5±3.8 (96.9-102.2)
Excretory pore to ant. end	117.2±3.1 (115.0-119.4)	113.5±0.0 (113.5-113.5)	108.3±7.8 (102.9-113.8)	105.0±3.9 (102.3-107.8)
Deirid to ant. end	135.1±4.9 (131.6-138.6)	126.8±1.6 (125.7-128.0)	123.8±4.3 (120.8-126.9)	116.9±3.8 (114.2-119.5)
Nerve ring position (% pharynx)	61.8±1.1 (61.0-62.5)	63.1±0.1 (63.1-63.2)	65.7±4.5 (62.5-68.9)	61.4±4.9 (58.0-64.9)
Excretory pore position (% pharynx)	68.4±1.3 (67.5-69.3)	71.4±0.5 (71.0-71.7)	66.3±1.5 (65.2-67.4)	64.8±5.2 (61.2-68.5)
Deirid position (% pharynx)	78.9±2.3 (77.3-80.5)	79.8±1.6 (78.7-80.9)	75.8±1.1 (75.1-76.6)	72.1±5.4 (68.3-75.9)
Vulva from ant. end	406.1±30.3 (384.7-427.5)	-	399.6±44.6 (368.1-431.2)	-
Vulva to anus	167.0±12.5 (158.2-175.9)	-	173.9±33.7 (150.1-197.7)	-
Vulva to anus/tail length	1.8±0.0 (1.8-1.8)	-	3.2±0.3 (2.9-3.4)	-
Reproductive tract length	246.2±39.2 (218.5-273.9)	351.4±4.8 (348.0-354.8)	191.6±39.7 (163.5-219.7)	252.1±23.4 (235.5-268.6)
Vagina	10.5±0.5 (10.2-10.9)	-	9.9±1.8 (8.7-11.2)	-
Post-uterine sac	26.8±7.9 (21.2-32.4)	-	23.4±1.2 (22.5-24.2)	-
Uterus	77.3±9.6 (70.5-84.1)	-	52.0±16.7 (40.2-63.9)	-
Spermatheca	32.8±3.3 (30.5-35.1)	-	37.2±11.2 (29.3-45.1)	-
Oviduct	9.8±2.1 (8.4-11.3)	-	19.7±0.1 (19.6-19.7)	-
Ovary	204.4±48.1 (170.5-238.4)	-	154.6±28.3 (134.6-174.6)	-
Vagina/body diameter	0.3±0.0 (0.3-0.3)	-	0.3±0.0 (0.3-0.3)	-
Post-uterine sac/body diameter	0.8±0.1 (0.7-0.9)	-	0.8±0.1 (0.7-0.9)	-
Uterus/body diameter	2.4±0.1 (2.3-2.4)	-	1.7±0.2 (1.5-1.8)	-
Spermatheca/body diameter	1.0±0.1 (1.0-1.0)	-	1.3±0.6 (0.8-1.7)	-
Oviduct/body diameter	0.3±0.0 (0.3-0.3)	-	0.6±0.1 (0.5-0.8)	-

**Table 1.** Continued.

Character	<i>Pseudacrobeles (Pseudacrobeles) variabilis</i>		<i>Pseudacrobeles (Bunobus) pseudolatus</i>	
	♀, n=2	♂, n=2	♀, n=2	♂, n=2
Ovary/body diameter	6.2±0.5 (5.8-6.6)	-	5.0±0.2 (4.9-5.1)	-
Spicules	-	23.8±0.7 (23.3-24.2)	-	23.2±0.6 (22.8-23.6)
Spicules/anal body diameter	-	1.2±0.0 (1.2-1.2)	-	1.3±0.1 (1.2-1.3)
Gubernaculum	-	12.5±0.8 (12.0-13.1)	-	10.6±0.9 (10.0-11.2)
Gubernaculum/anal body diameter	-	0.6±0.0 (0.6-0.7)	-	0.6±0.0 (0.6-0.6)
Gubernaculum/spicules (%)	-	0.5±0.0 (0.5-0.6)	-	0.5±0.0 (0.4-0.5)
Spicule/tail length	-	0.6±0.0 (0.6-0.6)	-	0.4±0.1 (0.4-0.5)
Rectum	23.4±0.5 (23.0-23.8)	23.1±0.7 (22.6-23.7)	23.5±4.1 (20.6-26.4)	24.9±1.3 (24.0-25.8)
Rectum/anal body diameter	1.3±0.1 (1.3-1.4)	1.2±0.0 (1.2-1.2)	1.3±0.1 (1.2-1.3)	1.3±0.0 (1.3-1.4)
Anus to phasmid	23.4±1.4 (22.5-24.4)	11.4±1.2 (10.6-12.3)	19.4±2.9 (17.3-21.4)	23.5±3.2 (21.3-25.8)
Phasmid position (% tail)	25.4±0.4 (25.1-25.7)	29.4±2.3 (27.8-31.0)	35.2±2.0 (33.8-36.6)	42.8±5.1 (39.2-46.4)
Lateral field width	6.6±1.5 (5.5-7.7)	5.5±0.1 (5.4-5.5)	7.3±3.3 (5.0-9.7)	6.3±1.1 (5.5-7.1)
Lateral field width/body diameter (%)	19.9±1.8 (18.7-21.2)	20.2±0.5 (19.9-20.6)	23.0±5.5 (19.1-26.9)	24.0±0.9 (23.3-24.6)
Cuticle thickness	1.3±0.2 (1.2-1.5)	1.6±0.3 (1.4-1.9)	1.4±0.0 (1.4-1.4)	1.3±0.1 (1.2-1.3)
Annuli width	1.8±0.1 (1.7-1.8)	1.5±0.3 (1.3-1.8)	2.0±0.5 (1.7-2.4)	1.8±0.0 (1.8-1.8)
Mucro	8.9±0.3 (8.7-9.2)	2.4±0.1 (2.3-2.5)	0.7±0.0 (0.7-0.7)	2.9±0.3 (2.7-3.1)

Measurements are in µm and in the form mean±SD (range).

though a long ragged mucro has not been reported from any *P. (P.) variabilis* so far, the evidence does not justify classifying these specimens as a new species. *Pseudacrobeles (Pseudacrobeles) variabilis* is reported for the first time from South Korea.

<sup>1</sup>\*Subgenus *Bunobus* De Ley, Siddiqi and Boström, 1993

<sup>2</sup>\**Pseudacrobeles (Bunobus) pseudolatus (Hernández, 1990) De Ley, Siddiqi and Boström, 1993 (Table 1, Fig. 2)*

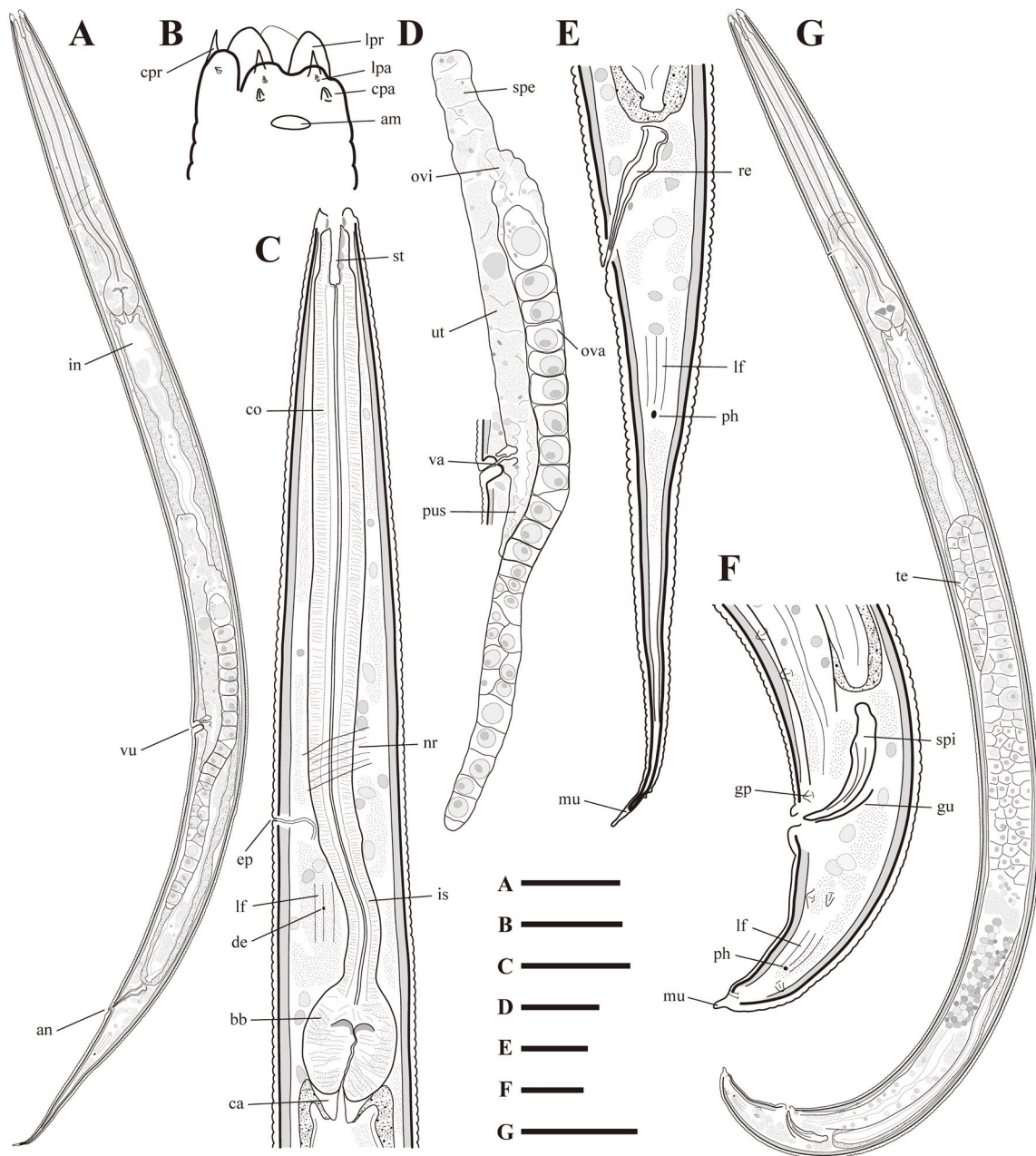
*Heterocephalobus pseudolatus* Hernández, 1990: 102, fig. 1. *Pseudacrobeles (Bunobus) pseudolatus* De Ley et al., 1993b: 290; Abolafia and Peña-Santiago, 2013: 201, figs. 1, 2.

**Material examined.** 2♀♀ and 2♂♂, South Korea: Gyeong-sangnam-do, Changwon-si, Uichang-gu, Buk-myeon, 25 Jan 2012, extracted by sieving and the Baermann funnel method from potato farm soil. The two specimens (slide Nos. NIBRIV0000754017 [female] and NIBRIV0000754018 [male]) are deposited at the National Institute of Biological Resources, Republic of Korea and two specimens (slide Nos. 01010402001 [female] and 01010402002 [male]) are deposited in the Animal Phylogenomics Laboratory, Ewha Womans University, Republic of Korea.

**Measurements.** See Table 1.

**Description. Adult:** Body cylindrical; length 574.3–692.2 µm in females and 576.0–608.4 µm in males; ventrally curved after fixation, C-shaped in females, J-shaped in males. Cuticle annulated; annuli 1.7–2.4 µm wide and 1.2–1.4 µm thick at mid-body. Lateral field with three incisures, occupying 19.1–26.9% of width of body at mid-body, fading out at phasmid region in female; outer two incisures extending beyond phasmids in males. Head region continuous with neck. Lip region 6.2–7.1 µm in diameter, with bilateral symmetry; two subventral and two subdorsal lips separated, conoid and rounded; two lateral lips sometimes slightly reduced, but visible with a light microscope. Six labial and four cephalic papillae present. Cephalic and labial probolae absent. Amphid aperture small, slit-like. Stoma cephaloboid, length 1.7–2.1 times the lip region diameter. Cheilorhabdions bar-shaped. Tiny dorsal denticle on metastom. Pharyngeal corpus cylindrical, 2.9–3.2 times isthmus length. Isthmus narrower than corpus, distinctly demarcated from metacarpus. Basal bulb spheroid, with well developed valves; 1.2–1.3 times as long as its width. Cardia conoid, surrounded by intestinal tissue. Nerve ring located at posterior corpus or corpus-isthmus junction, at 58.0–68.9% of pharynx length. Excretory pore positioned at posterior cor-

Korean name: <sup>1</sup>\*언덕선충아속 (신칭), <sup>2</sup>\*작은옆입술선충 (신칭)

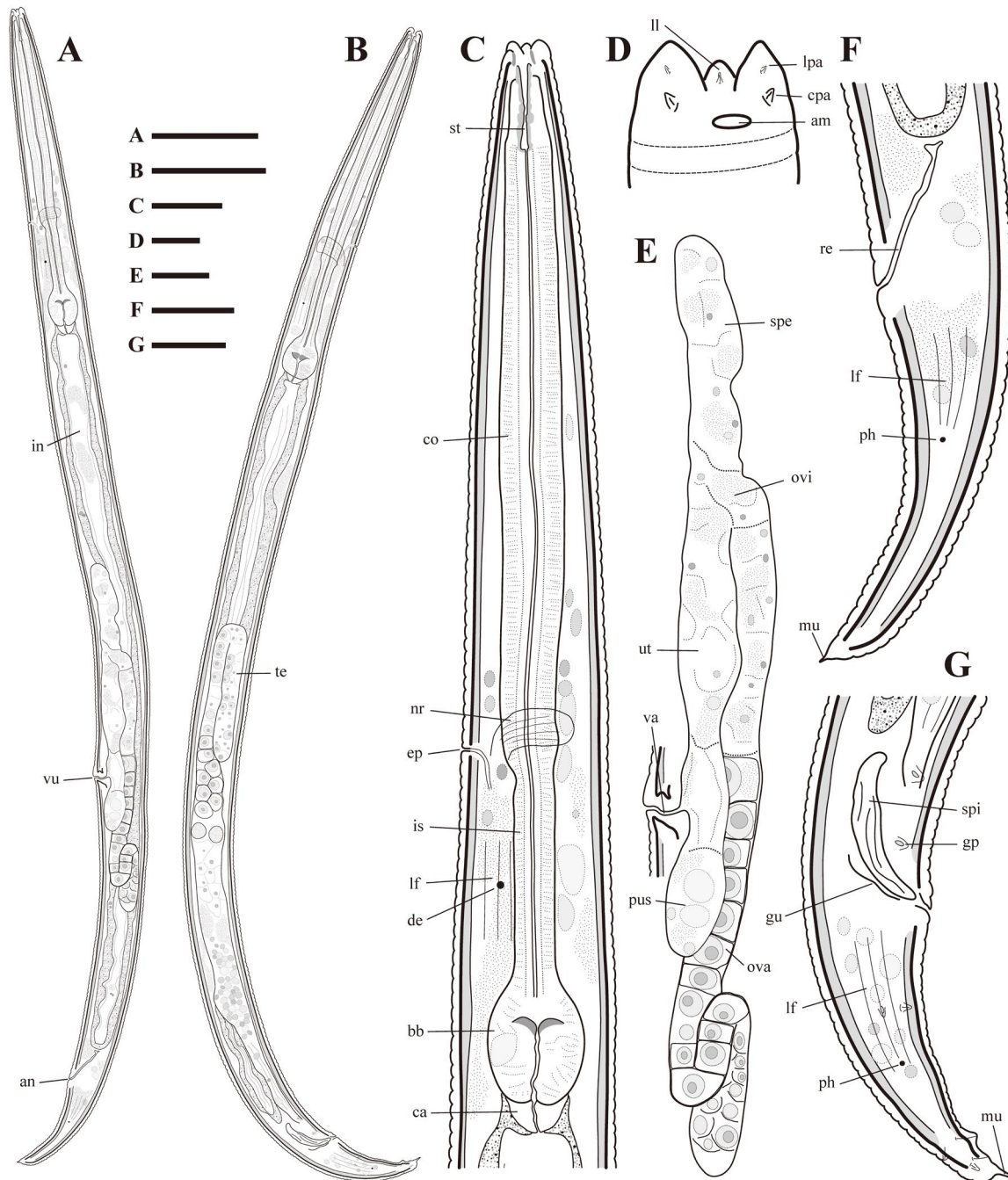


**Fig. 1.** *Pseudacrobeles (Pseudacrobeles) variabilis* (Steiner, 1936) Steiner, 1938. A, Entire female; B, Head region; C, Female neck region; D, Female reproductive system; E, Female posterior region; F, Male posterior region; G, Entire male. am, amphid; an, anus; bb, basal bulb; ca, cardia; co, corpus; cpa, cephalic papilla; cpr, cephalic probolae; de, deirid; ep, excretory pore; gp, genital papilla; gu, gubernaculum; in, intestine; is, isthmus; lf, lateral field; lpa, labial papilla; lpr, labial probolae; mu, mucro; nr, nerve ring; ova, ovary; ovi, oviduct; ph, phasmid; pus, post-uterine sac; re, rectum; spe, spermatheca; spi, spicule; st, stoma; te, testis; ut, uterus; va, vagina; vu, vulva. Scale bars: A, G=50  $\mu$ m, B=5  $\mu$ m, C, D=20  $\mu$ m, E, F=10  $\mu$ m.

pus or corpus-isthmus junction, at 61.2–68.5% of pharynx length. Position of deirids in lateral field at isthmus level, at 68.3–76.6% of total neck length.

**Female:** Reproductive system monodelphic-prodelphic. Vagina 0.3 body-diameters long. Post-uterine sac 0.7–0.9

times the body width. Uterus 1.5–1.8 body-diameters long. Spermatheca inconspicuous, 0.8–1.7 times the body width. Oviduct short. Ovary directed posteriorly, with or without double flexure, with a single row of oocytes. Rectum length 1.2–1.3 times the anal body diameter. Tail elongated conoid,



**Fig. 2.** *Pseudacrobeles (Bunobus) pseudolatus* (Hernández, 1990) De Ley, Siddiqi and Boström, 1993. A, Entire female; B, Entire male; C, Female neck region; D, Head region; E, Female reproductive system; F, Female posterior region; G, Male posterior region. am, amphid; an, anus; bb, basal bulb; ca, cardia; co, corpus; cpa, cephalic papilla; de, deirid; ep, excretory pore; gp, genital papilla; gu, gubernaculum; in, intestine; is, isthmus; lf, lateral field; ll, lateral lip; lpa, labial papilla; mu, mucro; nr, nerve ring; ova, ovary; ovi, oviduct; ph, phasmid; pus, post-uterine sac; re, rectum; spe, spermatheca; spi, spicule; st, stoma; te, testis; ut, uterus; va, vagina; vu, vulva. Scale bars: A, B=50  $\mu$ m, C, E-G=10  $\mu$ m, D=2  $\mu$ m.

with small acute mucro. Phasmids at 33.8–36.6% of tail length.

**Male:** Genital system monorchic. Testis reflexed ventrad

anteriorly. Spicules curved ventrad, 22.8–23.6  $\mu$ m long; manubrium rounded; calamus as wide as manubrium; without hump or velum; with one longitudinal incisure. Gubernac-

ulum curved ventrad. Three pairs of precloacal subventral papillae (one pair close to anus level) present. Six pairs of post-cloacal genital papillae: one subventral and one lateral located anterior to phasmid; one lateral located posterior to phasmid; two ventral and one subdorsal located at tail terminus region. Tail conoid, blunt terminus, with spike-shaped mucro. Phasmid opening at 39.2–46.4% of tail length.

**Distribution.** South Korea, Spain.

**Habitat.** Soil sample from a potato farm.

**Remarks.** The Korea population is similar to *P. (B.) pseudolatus* in having visibly lateral lips, a short post-uterine sac, an elongated conoid tail in the female, an acute mucro on the tails of both sexes, and in the positions of the nerve ring and excretory pore (both on posterior part of corpus). However, our Korean specimens differ from the previous descriptions of Hernández (1990) and Abolafia and Peña-Santiago (2013), in terms of body length (574–692 vs. 400–470 µm in female and 576–608 vs. 343–400 µm in male), body thickness (a = 19.3–21.9 vs. 15–19 in female and 21.2–24.3 vs. 17–21 in male), tail length (c = 11.2–11.8 vs. 8.4–9.9 in female and c' = 3 vs. 3.3–4.5 in female and 2.6–3.4 vs. 2.0–2.5), ratio between corpus and isthmus in males (3.0–3.1 vs. 2.2), spicule length in males (22.8–23.6 vs. 15–20 µm), phasmid position on tail in female (33.8–36.6 vs. 40–42%) and incisures in the lateral field in the male (extending over phasmids vs. fading out at phasmid region). Although some morphometric values between our specimens and previously described populations are different, the degree of difference is not meaningful and the morphologically important characters such as the shape of the head, stoma and tail, and the acute mucro on the tail of both sexes are very similar. *Pseudacrobeles (Bunobus) pseudolatus* is reported for the first time from South Korea.

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## REFERENCES

- Abolafia J, Liébanas G, Peña-Santiago R, 2002. Nematodes of the order Rhabditida from Andalucía Oriental, Spain. The subgenus *Pseudacrobeles* Steiner, 1938, with description of a new species. *Journal of Nematode Morphology and Systematics*, 4:137-154.
- Abolafia J, Peña-Santiago R, 2005. Nematodes of the order Rhabditida from Andalucía Oriental: *Pseudacrobeles elongatus* (de Man, 1880) comb. n. *Nematology*, 7:917-926. <https://doi.org/10.1163/156854105776186415>
- Abolafia J, Peña-Santiago R, 2013. Iberian species of the subgenus *Bunobus* De Ley, Siddiqi & Boström, 1993 (Nematoda, Rhabditida, Cephalobidae), with description of *Pseudacrobeles (Bunobus) rotundilabiatus* sp. n. and comments on the subgenus. *Zootaxa*, 3640:200-212.
- Andrássy I, 1968. Fauna Paraguayensis. 2. Nematoden aus den Galeriewäldern des Acaray-Flusses. *Opuscula Zoologica Budapest*, 8:167-312.
- Andrássy I, 2005. Free-living nematodes of Hungary: Nematoda errantia. Vol. I. Hungarian Natural History Museum, Budapest, pp. 1-518.
- Baermann G, 1917. Eine einfache methode zur auffindung von ankylostomum (Nematoden) larven in erdproben. *Geneeskundig Tijdschrift voor Nederlandsch-Indië*, 57:131-137.
- De Ley P, Siddiqi MR, Boström S, 1993a. A revision of the genus *Pseudacrobeles* Steiner, 1938 (Nematoda: Cephalobidae). Part 1. Subgenus *Pseudacrobeles* grad. n. *Fundamental and applied Nematology*, 16:219-238.
- De Ley P, Siddiqi MR, Boström S, 1993b. A revision of the genus *Pseudacrobeles* Steiner, 1938 (Nematoda: Cephalobidae). Part 2. Subgenus *Bunobus* subgen. n., problematical species, discussion and key. *Fundamental and applied Nematology*, 16:289-308.
- Hernández MA, 1990. *Heterocephalobus pseudolatus* n. sp. encontrada en Navarra, norte de España (Nematoda, Cephalobidae). *Boletín de la Real Sociedad Española de Historia Natural. Biología*, 85:101-106.
- Holovachov O, Boström S, 2006. Description of *Pseudacrobeles (Bunobus) arboricola* sp. n. (Rhabditida: Cephalobidae) from rotting wood in Roztochya, Ukraine. *Journal of Nematode Morphology and Systematics*, 9:49-54.
- Holovachov O, De Ley P, 2001. Description of *Pseudacrobeles (Bunobus) bostromi* sp. n. (Rhabditida: Cephalobidae) from rotting wood in Roztochya, Ukraine. *Journal of Nematode Morphology and Systematics*, 4:21-30.
- Kim J, Kim T, Park JK, 2017. Description of *Pseudacrobeles (Pseudacrobeles) curvatus* sp. n. (Cephalobidae: Rhabditida) in South Korea. *Journal of Nematology*, 49:162-167. <https://doi.org/10.21307/jofnem-2017-061>
- Loof PAA, 1964. Free-living and plant-parasitic nematodes from Venezuela. *Nematologica*, 10:201-300. <https://doi.org/10.1163/187529264X00042>
- Schuermans-Stekhoven JJ, 1951. Nématodes saprozoaires et libres du Congo Belge. *Mémoires de l'Institut Royal des Sciences Naturelles de Belgique*, 2:3-79.
- Sainhorst JW, 1959. A rapid method for the transfer of nematodes from fixative to anhydrous glycerin. *Nematologica*, 4:67-69. <https://doi.org/10.1163/187529259X00381>
- Shirayama Y, Kaku T, Higgins RP, 1993. Double-sided micro-

- scopic observation of meiofauna using an HS-slide. *Benthos Research*, 44:41-44.
- Shokoohi E, Abolafia J, 2012. Nematodes of the order Rhabditida from Tehran province, Iran. The genus *Pseudacrobeles*
- Steiner, 1938. *Annales Zoologici*, 62:331-340.
- Steiner G, 1936. *Opuscula miscellanea nematologica*, IV. Proceedings of the Helminthological Society of Washington, 3:74-80.
- Steiner G, 1938. *Opuscula miscellanea nematologica*, VII. Proceedings of the Helminthological Society of Washington, 5:35-40.
- Zell H, 1987. Nematoden eines Buchenwaldbodens 9. Die Cephaloben (Nematoda, Rhabditida). *Carolinae*, 45:121-134.

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