

## First Record of *Aphelenchoides nonveilleri* (Nematoda: Aphelenchoididae) from South Korea

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### ABSTRACT

*Aphelenchoides nonveilleri* Andr ssy, 1959, belonging to the family Aphelenchoididae Skarbilovich, 1947, is first reported from South Korea. The genus *Aphelenchoides* Fischer, 1894 includes about 200 species worldwide, but to date only nine *Aphelenchoides* species have been reported from South Korea. Specimens of *A. nonveilleri* were collected from the roots and shoot tips of chrysanthemum (*Chrysanthemum morifolium* Ramat, 1792) from a greenhouse. This species is distinguished from other *Aphelenchoides* species by its star-shaped mucro on the female tail tip, three lateral incisures, and the length of the post-vulvar uterine sac. Here we provide details of the morphological characters and morphometrics of *A. nonveilleri* based on optical microscopy.

**Keywords:** Nematoda, Aphelenchoididae, *Aphelenchoides nonveilleri*, South Korea

### INTRODUCTION

Members of the genus *Aphelenchoides* Fischer, 1894 are known as plant pathogenic foliar nematodes. The major plant-parasitic species in this genus include *A. besseyi* Christie, 1942, which causes ‘white tip’ disease in rice, and *A. fragariae* (Ritzema Bos, 1891) Christie, 1923 and *A. ritzemabosi* (Schwartz, 1911) Steiner and Buhner, 1932, which attack a wide variety of plants. About 200 species have been described in the genus *Aphelenchoides* worldwide, but only nine species have been reported thus far from South Korea: *A. besseyi*, *A. bicaudatus* (Imamura, 1931) Filipjev and Schuurmans Stekhoven, 1941, *A. fragariae*, *A. paradalianensis* Cui, Zhuo, Wnag & Liao, 2011, *A. parasaprophilus* Sanwal, 1965, *A. parietinus* (Bastian, 1865) Steiner, 1932, *A. ritzemabosi*, *A. rotundicaudatus* Fang, Wang, Gu & Li, 2014, and *A. subtenius* (Cobb, 1926) Steiner and Buhner, 1932 (see Choi, 1996; Cui et al., 2011; Fang et al., 2014; Kim et al., 2016). In this study, we provide a detailed description and morphometrics of *A. nonveilleri* Andr ssy, 1959 collected from chrysanthemum (*Chrysanthemum morifolium*, 1792) roots and shoot tips in South Korea.

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Nematodes were isolated from roots and shoot tips of *C. morifolium* using sieving and the Baermann funnel method (Baermann, 1917), transferred into a 15 mL tube containing 2 mL water, and 4 mL of 80°C TAF (2% triethanolamine and 7% formaldehyde) solution was added for fixation. The fixed nematodes were then processed to glycerin (Seinhorst, 1959) and mounted in glycerin on HS-slides (Shirayama et al., 1993). Morphological observations were made under an optical microscope (Olympus BX-51) equipped with differential interference contrast (DIC). Morphometric characters were measured using QCapture Pro 5, from images taken with a digital camera (CoolSnap Photometrics color CCD).

### SYSTEMATIC ACCOUNTS

Order Rhabditida Chitwood, 1933  
Suborder Tylenchina Thorne, 1949  
Infraorder Tylenchomorpha De Ley and Blaxter, 2002  
Family Aphelenchoididae Skarbilovich, 1947

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**Table 1.** Morphometrics of *Aphelenchoides nonveilleri*

	Female (n=4)	Male (n=3)
L	787.4±40.2 (751.29–842.5)	697.6±23.9 (672.92–720.6)
Body width	22.8±1.1 (21.4–23.8)	19.3±1.6 (18.32–21.1)
Pharynx length	168.1±11.6 (159.54–185.3)	156.5±9.7 (150.32–167.8)
Tail length	40.7±2.5 (38.61–43.5)	42.3±6.0 (36.84–48.7)
Anal region body width	12.0±0.6 (11.47–12.9)	14.3±0.7 (13.48–15.0)
a	34.6±1.8 (31.96–35.7)	36.3±3.0 (33.11–39.0)
b	8.7±0.4 (8.27–9.1)	8.2±0.2 (8.02–8.3)
c	19.4±0.8 (18.17–20.0)	16.8±2.7 (13.81–19.0)
c'	3.4±0.1 (3.26–3.5)	3.0±0.6 (2.46–3.6)
Lip region width	7.2±0.1 (7.08–7.3)	6.7±0.2 (6.44–6.8)
Lip region height	3.2±0.2 (3.07–3.4)	2.7±0.2 (2.56–2.9)
Stylet	13.0±1.0 (11.88–14.2)	13.1±2.0 (11.84–15.3)
Corpus	58.6±3.0 (56.45–63.1)	55.9±2.5 (52.95–57.6)
Metacarpus length	16.7±1.1 (15.13–17.5)	14.2±1.7 (12.24–15.2)
Metacarpus width	12.5±1.0 (11.57–13.8)	10.9±0.7 (10.38–11.7)
Metacarpus width/body width	0.7±0.0 (0.69–0.8)	0.7±0.0 (0.7–0.72)
Isthmus	13.0±4.1 (8.96–17.7)	14.7±9.3 (4.35–22.2)
Nerve ring	81.0±3.3 (76.94–84.9)	83.2±1.9 (81.28–85.1)
Excretory pore	83.8±2.1 (81.22–86.2)	87.1±5.7 (80.82–91.9)
Nerve ring (% pharynx)	10.3±0.6 (9.75–11.1)	11.9±0.3 (11.55–12.2)
Excretory pore (% pharynx)	10.7±0.5 (10.24–11.3)	12.5±0.8 (11.56–13.2)
Vulva from anterior end	548.2±26.6 (525.96–584.5)	–
V (%)	69.6±0.3 (69.38–70.0)	–
Reproductive tract length	421.8±35.0 (371.69–448.8)	–
G (%)	53.8±6.6 (44.12–58.7)	–
Vagina	10.1±0.1 (9.99–10.1)	–
Post-vulvar sac	93.7±8.1 (84.48–103.0)	–
Post vulvar sac/body width	4.1±0.5 (3.55–4.8)	–
Uterus	57.3±13.8 (42.76–74.2)	–
Uterus/body width	2.5±0.5 (2.0–3.2)	–
Spermatheca	50.6±4.0 (46.66–55.5)	–
Rectum	17.2±3.1 (12.7–19.3)	–
Rectum/anal width	1.4±0.3 (0.98–1.7)	–
Spicule	–	18.8±1.0 (17.77–19.9)
Mucro	2.4±0.1 (2.24–2.5)	–
Cuticle thickness	0.6±0.1 (0.51–0.7)	0.6±0.1 (0.44–0.7)
Annuli width	0.9±0.3 (0.65–1.3)	1.0±0.2 (0.87–1.2)

All measurements are in  $\mu\text{m}$  and in the form mean $\pm$ SD (range).

L, body length; a, body length/greatest body diameter; b, body length/distance from anterior to base of esophageal glands; c, body length/tail length; c', tail length/tail diameter at anus or cloaca; V, % distance of vulva from anterior; G, % length of female gonad in relation to body length.

Genus *Aphelenchoides* Fischer, 1894

<sup>1</sup>\* *Aphelenchoides nonveilleri* Andr ssy, 1959

*Aphelenchus nonveilleri* Andr ssy, 1959: 265, fig. 3.

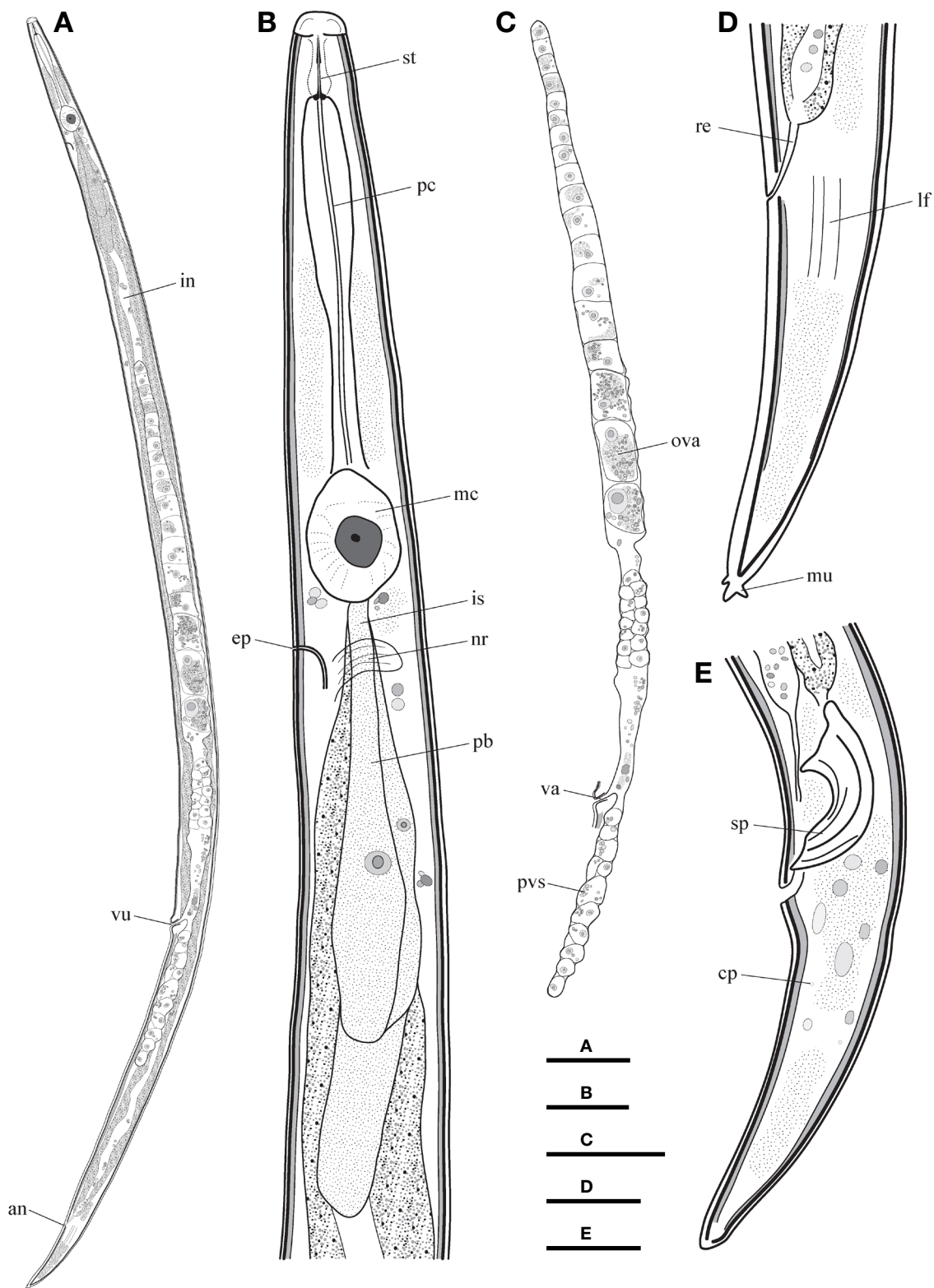
**Material examined.** 4 ♀♀, 3 ♂♂ South Korea: Chungcheongnam-do: Taean-gun, Taean-eup, Sangok-ri, 36° 46'67.9"N, 126° 19'57.2"E, 27 Apr 2016. Voucher specimens are deposited in the National Institute of Biological Resources (slide nos. ZIIYIV0000001574 and ZIIYIV0000001575) and the Animal Phylogenomics Laboratory at Ewha Womans University (slide nos. 07010102001-07010102005), South Korea.

**Measurements.** See Table 1.

**Description. Female:** Body tapering slightly anteriorly,

length 672.9–790.9  $\mu\text{m}$ , width 18.3–22.5  $\mu\text{m}$ ; ventrally curved at tail region when relaxed by gentle heat (Fig. 1A). Cuticle annulated; annuli 1.04–1.3  $\mu\text{m}$  wide and 0.62–0.7  $\mu\text{m}$  thick at mid-body. Lateral fields with 3 incisures. Head region rounded, distinctly set off from body (Fig. 1B). Lip region 6.44–7.27  $\mu\text{m}$  wide and 2.57–3.34  $\mu\text{m}$  high. Stylet weak, slender with small basal swellings, length 12.03–15.32  $\mu\text{m}$ . Oesophagus distinct but indistinct behind the median swelling. Median swelling large and rounded, occupying 72% of body width, and 12.24–16.88  $\mu\text{m}$  long. Excretory pore located at level slightly posterior to nerve ring. Vulva a transverse slit, located about 3/4 of body length from anterior end; vagina one-third of body width at vagina region. Ovary extending almost to esophageal gland lobe; oocytes in a single row (Fig. 1C). Post-vulvar uterine sac approximately three times body

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**Fig. 1.** *Aphelenchoides nonveilleri* Andr ssy, 1959. A, Entire female; B, Female neck region; C, Female reproductive system; D, Female posterior region; E, Male posterior region. an, anus; cp, caudal papillae; ep, excretory pore; in, intestine; is, isthmus; lf, lateral field; mc, metacarpus; mu, mucro; nr, nerve ring; ova, ovary; pb, posterior bulb; pc, procorpus; pvs, post-vulval sac; re, rectum; sp, spicule; st, stylet; va, vagina; vu, vulva. Scale bars: A, C=50  $\mu$ m, B, D, E=10  $\mu$ m.

width in length. Tail gradually tapering to terminus with star-shaped mucro (Fig. 1D).

**Male:** Body size slightly smaller than female. Anterior portion of body similar to female. Testis single, outstretched, reaching to oesophageal glands. Spicules thorn-like in shape, length 17.77–18.68  $\mu\text{m}$ . Gubernaculum absent. Tail with three caudal papillae: one subdorsal, one subventral and one lateral (Fig. 1E). Bursa absent.

**Habitat.** Roots and shoot tips of *Chrysanthemum morifolium*.

**Remarks.** Members of the genus *Aphelenchoides* Fischer, 1894 have variously shaped mucronate structures on the female tail tip, such as star-shaped, bifurcated, filiform, or chisel-shaped. *Aphelenchoides nonveilleri* is one of a group of species with star-shaped mucros, but this species is clearly distinguishable from the other species by the length of its post-vulvar uterine sac and its three lateral incisures.

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