

Morphological analysis of *Tripylina stramenti* (Nematoda: Enoplida: Trischistomatidae) firstly recorded in Korea

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The genus *Tripylina* Brzeski, 1963 is a group of terrestrial nematodes that inhabit soil and semi-wet biomes, most of which have been reported from Europe, Asia, America, Africa, and New Zealand. *Tripylina stramenti* (Yeates, 1971) Tsalolikhin, 1983, belonging to the family Trischistomatidae Andr ssy, 2007, is newly discovered from Korea. The specimens were collected from the edge of the valley of Ulleung-gun, Gyeongsangbuk-do, South Korea. *Tripylina stramenti* described herein shows typical morphological characters of the genus *Tripylina*, including six and four setae in a single whorl, present dorsal tooth and subventral teeth, prodelphic reproductive system of female, absence post-uterine sac, narrow sickle-shaped spicule of male and generally S-shaped tail. The specimens differ in their body width (from the New Zealand populations), outer labial setae length, cuticles thickness (from the West African populations), and nerve ring position (from Indian populations). This species is distinguished from other *Tripylina* species by its relatively large body, two anterior and subventral teeth, and single cervical seta. In this study, morphological characteristics and morphometric information of the Korean *T. stramenti* isolate are described, illustrated, and compared with the same species from other geographic origins.

Keywords: Korea, Morphometric information, Nematoda, *Tripylina stramenti*, Trischistomatidae

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INTRODUCTION

Members of the genus *Tripylina* Brzeski, 1963 are terrestrial and are found in soil, moss, and aquatic habitats. They are widely distributed throughout all continents (Yeates, 1971; Tsalolikhin, 1983; Brzeski and Winiszewska-Ślipińska, 1993; Andr ssy, 2007; 2008; Tahseen and Nusrat, 2010; Asghari *et al.*, 2012; Cid del Prado-Vera *et al.*, 2016). About 21 species have been reported in this genus, but only one species has been recorded in Korea: *T. arenicola* (de Man, 1880) Brzeski, 1963 (see Winiszewska *et al.*, 2000). *Tripylina stramenti* (Yeates, 1971) Tsalolikhin, 1983 occurs in various terrestrial habitats, such as wet straw and moss, and is mostly reported from west Africa, New Zealand, and India (Zhao, 2009; Tahseen and Nusrat, 2010). We collected nematodes from soil samples and the isolated nematodes were identified. In this study, we provide detailed descriptions of the morphological characteristics and morphometrics of the Korean isolate of *T. stramenti*.

MATERIALS AND METHODS

Soil samples were collected from the valley edge of Ulleung-gun, Gyeongsangbuk-do, South Korea (GPS coordinates: 37 29'52.9"N, 130 53'13.0"E). We sieved the soil samples and used the Baermann funnel method to extract nematode specimens (Baermann, 1917). The nematode specimens were transferred to a 15-mL tube containing 2 mL water, to which 4 mL of 80 C TAF (2% triethanolamine and 7% formaldehyde) solution was added. The fixed nematodes were processed in dehydrated glycerin using Seinhorst's (1959) method and mounted in glycerin on HS-slides (Shirayama *et al.*, 1993). Under an optical microscope (BX-51; Olympus, Tokyo, Japan) equipped with differential interference contrast, morphological characteristics of nematode specimens were observed and measured using a CoolSnap Photometrics color CCD digital camera (MP5.0-RTV-R-CLR-10; Photometrics, Tucson, AZ, USA) and the QCapture Pro 5 program (QImaging, Surrey, Canada), respectively.

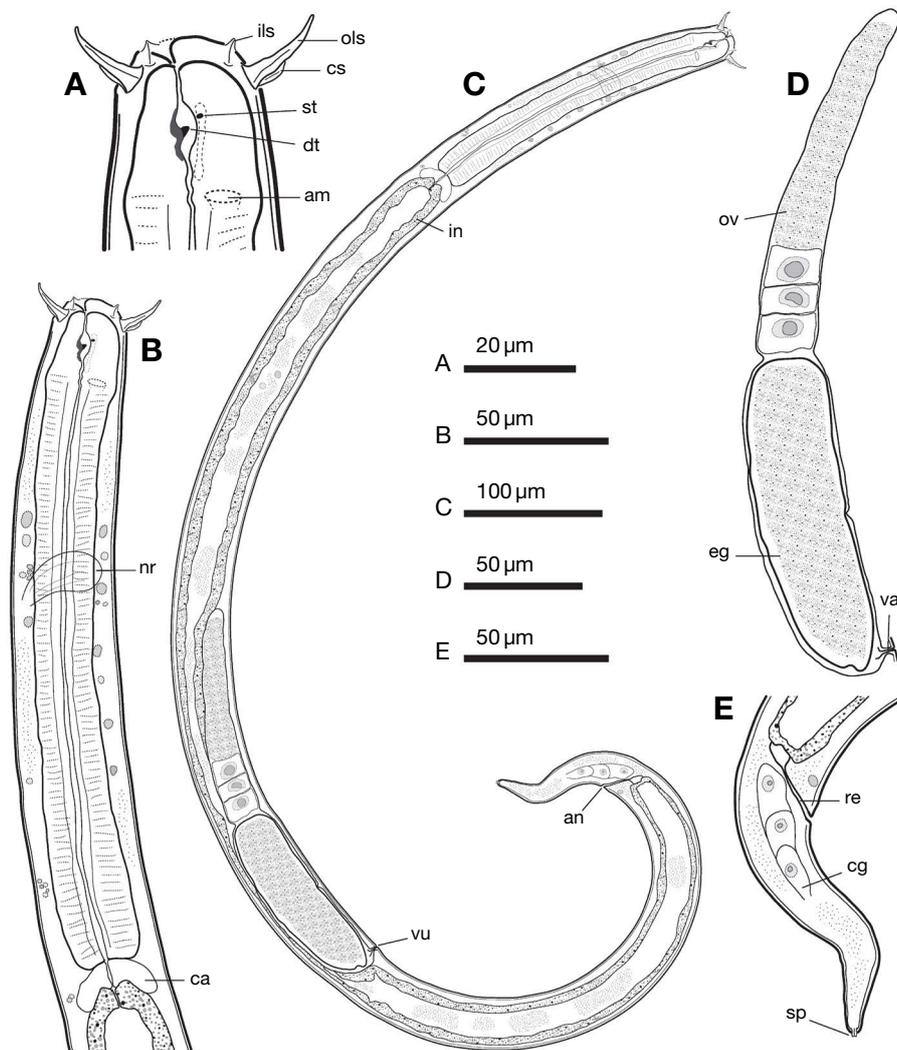


Fig. 1. *Tripylina stramenti* (Yeates, 1971) Tsalolikhin, 1983. A, Head region; B, Neck region; C, Entire body; D, Reproductive system; E, Tail region. am, amphid; an, anus; ca, caudal gland; cg, caudal gland; cs, cephalic setae; dt, dorsal tooth; eg, egg; ils, inner labial sensilla; in, intestine; nr, nerve ring; ols, outer labial setae; ov, ovary; re, rectum; sp, spinneret; st, subventral tooth; va, vagina; vu, vulva.

SYSTEMATIC ACCOUNT

Order Enoplida Filipjev, 1929
 Suborder Trefusiina Siddiqi, 1983
 Family Trischistomatidae Andr ssy, 2007
 Genus *Tripylina* Brzeski, 1963

Tripylina stramenti (Yeates, 1971) Tsalolikhin, 1983 (Table 1, Fig. 1)

지푸라기삼공붙이선충

Trischistoma stramenti: Yeates, 1971: 897; fig. 1.

Tripylina stramenti Tsalolikhin, 1983: 212; fig. 111.

Material examined. 4♀♀; Ulleung-eup, Ulleung-gun, Gyeongsangbuk-do, South Korea (18 June 2019); extrac-

ted from soil by sieving and the Baermann funnel method. Voucher specimens were deposited at the Nakdonggang National Institute of Biological Resources (slide nos. NNIBRIV74478–74481), Korea.

Measurements. See Table 1 for morphometric data.

Description. Female: Body relatively large (1,395–1,686 μm), G-shaped upon fixation, ventrally curved. Cuticle smooth, 0.7–0.9 μm thick at mid-body region. Head rounded, continuous with the neck. Six inner labial sensilla, short and conical. Six long and four short cephalic setae distinct; six longer setae 15.1–16.9 μm or 54–64% of head diameter with distal end; four shorter setae 6.1–9.1 μm or 22–34% of head diameter, slenderer than the long cephalic setae. Amphids calyciform, located at 18.4–24.8 μm , or one head width, from the anterior end. Dorsal

part of stoma wall slightly thickened; pocket-like form for teeth at mid-stoma; dorsal tooth prominent at 15.8–18.4 μm from anterior end; two small subventral denticles anterior to dorsal tooth, 1.9–7.0 μm from dorsal tooth. Pharynx cylindroid, with slight anterior swelling. Single cervical seta present, located at 87.9–106.5 μm from anterior end. Nerve ring located at 35.6–45.7% of the pharynx length. Excretory pores inconspicuous. Pharyngeal-intestinal junction with three ovoid pericardial cells. Distinct intestinal wall. Reproductive system monodelphic-prodelphic, occupying 17.9–22.1% of body length. Vulva without protuberant lips. Vagina 8.1–14.1 μm or 0.1–0.3-body diameter long. Postuterine sac absent. Laterally reflexed ovary. Rectum 0.4–1.0 times of anal body diameter in length. Tail uniformly conoid and twisted in all specimens. Caudal glands large, arranged in tandem, spinneret terminal.

Male: Not found.

Distribution. India (Tahseen and Nusrat, 2010), New Zealand (Yeates, 1971), South Korea (this study), and West Africa (Andrássy, 2008).

Habitat. Soil and freshwater.

Remarks. The morphological characters and measurements of the specimens isolated from Korea are generally consistent with the original description of *T. stramentii* type specimen, except for the body width ($a = 30.8\text{--}31.6$ vs. $26.0\text{--}30.4$; Yeates, 1971). The specimens differ from the West African population described by Andr ssy (2008) in having a longer outer labial setae (15.1–16.9 vs. 13–15 μm) and thinner cuticles (0.7–0.9 vs. 1.5–2.0 μm). Compared to the Indian populations, our specimens have nerve rings located anteriorly (35.6–45.7 vs. 46–50%; Tahseen and Nusrat, 2010). These morphological differences between the isolates are not substantial and can be regarded as intraspecific variations due to their different geographic origins. In this study, we were not able to find male specimens and conducted species identification based on morphological characteristics examined from female individuals, similar to the observations of previous studies including original description of *T. stramentii* (Yeates, 1971; Andr ssy, 2008; Zhao, 2009; Tahseen and Nusrat, 2010). No males indicates parthenogenic reproduction is common in the species and in soil nematode taxonomy.

Tripylina stramentii resembles *T. puxianensis* Xu, Zhao, Wang and Zheng, 2013, *T. ymyensis* Tahseen and Nusrat, 2010 and *T. ursulae* (Argo and Heyns, 1973) Tsalolikhin, 1983. However, it is distinguished from *T. puxianensis* by having subventral teeth anterior to and smaller than dorsal tooth (vs. posterior position and similar size). Present cervical setae of *T. stramentii* distinguish it from the absence cervical setae of *T. ymyensis* and it differs from *T. ursulae* by thinner body ($a = 26\text{--}36$ vs $22\text{--}26$).

Table 1. Morphometrics of *Tripylina stramentii* of Korean population.

Characters	<i>Tripylina stramentii</i>
	Females (n = 4)
L	1,598.0 \pm 136.0 (1,395.3–1,685.2)
a	31.2 \pm 0.4 (30.7–31.6)
b	5.7 \pm 0.1 (5.6–5.8)
c	13.9 \pm 2.8 (9.7–16.1)
c'	4.1 \pm 0.6 (3.5–5.0)
Body width	51.3 \pm 4.8 (44.2–54.8)
Pharynx length	279.2 \pm 21.9 (246.9–293.0)
Tail length	117.9 \pm 17.4 (102.6–142.8)
Anal width	28.7 \pm 0.6 (27.9–29.3)
Tail length/anal width	4.1 \pm 0.6 (3.5–5.0)
Head region width	27.3 \pm 1.8 (25.3–29.5)
Inner sensilla	1.5 \pm 0.4 (0.9–1.9)
Outer labial setae	16.2 \pm 0.8 (15.1–16.9)
Cephalic setae	7.9 \pm 1.3 (6.1–9.1)
Outer labial setae/ head region width (%)	59.5 \pm 3.5 (54.9–63.3)
Cephalic setae/ head region width (%)	29.1 \pm 4.5 (22.8–33.1)
Cervical setae from anterior end	97.1 \pm 9.0 (87.9–106.5)
Dorsal tooth from anterior end	17.2 \pm 1.1 (15.8–18.4)
Subventral teeth to dorsal tooth	3.7 \pm 2.3 (1.9–7.0)
Amphid from anterior end	21.1 \pm 2.9 (18.4–24.8)
Nerve ring	117.9 \pm 20.4 (88.0–133.8)
Nerve ring position (% pharynx)	42.0 \pm 4.4 (35.6–45.7)
Cardia long	19.5 \pm 6.0 (14.7–28.3)
Cardia wide	27.3 \pm 10.1 (12.1–32.7)
Cuticle thickness	0.8 \pm 0.1 (0.7–0.9)
Vulva from anterior end	1,044.0 \pm 92.6 (906.1–1,105.9)
V (%)	65.3 \pm 1.2 (64.2–67.1)
Reproductive tract length	321.3 \pm 34.3 (290.7–364.8)
G (%) / T (%)	20.1 \pm 1.8 (17.8–22.1)
Vagina	11.3 \pm 2.5 (8.1–14.1)
Uterus	173.3 \pm 53.5 (135.4–211.2)
Spermatheca	32.3 \pm 20.0 (18.1–46.4)
Ovary	106.8 \pm 1.1 (106–107.6)
Vagina/body width	0.2 \pm 0.1 (0.1–0.3)
Uterus/body width	3.6 \pm 0.7 (3.0–4.0)
Spermatheca/body width	0.7 \pm 0.5 (0.3–1.0)
Ovary/body width	2.2 \pm 0.3 (2.0–2.4)
Vulva-anus	444.0 \pm 41.5 (386.7–479.7)
Rectum	21.8 \pm 7.4 (13.0–29.4)
Rectum/anal width	0.8 \pm 0.3 (0.4–1.0)
Vulva-anus/tail	3.8 \pm 0.8 (2.7–4.3)
Spinneret	1.9 \pm 0.3 (1.6–2.3)

All measurements are in μm scale and in the form: mean \pm standard deviation (range).

L, Body length; a, body length/body diameter; b, body length/distance from anterior to base of esophageal glands; c, body length/tail length; c', tail length/diameter at anus region; V, % distance of vulva from anterior end/body length.

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