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An unrecorded species of *Hemicycliophora litoralis* (Criconematoidea: Hemicyliophorinae) from South Korea

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Hemicycliophora litoralis is newly collected from Korea. Korean population is well matched and within a range of original description and additional record from Solomon island in de Man's of L, b, c, V, R, Rex, Ran, Roes, RV (ant), annule, excretory pore, stylet length, and tail length. Differences are observed in RV and RVan. RV and RVan of original description was 55 (48-69) and 14 (10-19) but Korean population is 68 (61-76) and 22 (19-24), respectively. *H. litoralis* described from Solomon island has RVan of 19.6 (17-23) and is similar to Korean population. *H. litoralis* from Solomon island has slight higher Rst value of 39 (35-59) compared to Korean population of 33.5 (29-38). The measurements of MB (%), s, G1, G2 values are newly given.

Keywords: Criconematoidea, *Hemicycliophora litoralis*, Hemicyliophorinae, South Korea

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Introduction

During the nematode survey in Korea in 2015, an unrecorded species of nematodes belonging to the genus of *Hemicycliophora* was found from wet sandy soil at edge of river, Miryang, Gyeongsangnam-do, Korea. *Hemicycliophora* is immediately recognized by the sheath cuticle and sloping stylet knobs. There are more than 132 species around the world (Chitambar and Subbotin, 2014). Five species were recorded in the Republic of Korea (Choi and Geraert, 1975; 1995; Choi, 2001; Kim *et al*., 2005). Identification of *Hemicycliophora* species is usually based on measurement of female, head shape, lateral field markings, tail shape, stylet knob cavity, and spicule shape, as well as by using polytomous key (Chitambar and Subbotin, 2014). Economic importance of *Hemicycliophora* was reported by Van Gundy (1959) from rough lemon, *Citrus limonia* where *Hemicycliophora* attacks root tips and form gall-like terminal growths on roots.

Materials and Methods

Soil samples were collected from wet sandy soil at edge of river, Miryang, Gyeongsangnam-do, Korea. Nematodes were extracted from soil by modified Baermann's funnel method (Viglierchio and Schmitt, 1983). Extracted nematodes were fixed with hot F:G 4-1, transferred to glycerin according to the Seinhorst's rapid method, and permanently mounted using paraffin ring method on glass slides (Seinhorst, 1959). Nematodes were measured and photographed with an Olympus BX53 microscope and an Olympus DP73 digital camera. Raw photographs were edited using Adobe Photoshop software. Morphometrics included de Man's. Polytomous key is differences states of morphological character and morphometric value for identification of 132 species of *Hemicycliophora* (Chitambar and Subbotin, 2014).

Systematic Accounts

Infraorder Tylenchomorpha De Ley and Blaxter, 2002 참선충하목
Superfamily Criconematoidea Taylor, 1936 환선충상과
Family Criconematidae Taylor, 1936 환선충과
Subfamily Hemicycliophorinae Skarbilovich, 1959 껍질선충아과

Genus *Hemicycliophora* de Man, 1921 껍질선충속

***Hemicycliophora litoralis* Reay, 1985**
갈대껍질선충 (신칭) (Figs. 1, 2)

Measurements.

Korea population. Female (n = 8): L = 992.0 (870.7-1163.0) μm; a = 30.9 (26.8-34.8); b = 5.4 (5.1-5.8); MB (%) = 68.5 (66.9-69.5); c = 8.5 (7.5-9.0); c′ = 6.3 (5.2-7.0); V = 81.7% (75.3-85.3); s (stylet length per body diameter at base of stylet) = 3.0 (2.6-3.7); G1 = 56.7 (55.2-58.1); G2 = 80.6 (80.3-80.9); tail = 117.2 (97.6-129.1) μm; body diameter = 32.3 (25.1-37.6) μm; pharynx = 184.7 (166.2-200.6) μm; stylet = 96.6 (87.9-108.1) μm; annule = 3.1 (2.5-3.4) μm; excretory pore = 168.7 (135.8-184.7) μm; Rst = 33.5 (29.0-38.0); Roes = 68.2 (60.0-80.0); Rex = 60.1 (47.0-74.0); RV (ant) = 266.5 (253.0-283.0); RV = 68.0 (61.0-76.0); Ran = 46.0 (42.0-54.0); R = 334.5 (317.0-359.0); RVan = 22 (19.0-24.0).

Reay (1985). Female (n = 52): L = 1,114 (850-1,380) μm; b = 5.5 (4.7-6.6); c = 9.1 (7.6-10.9); V = 84.5 (82-86); stylet = 109 (94-118) μm; tail = 121 (95-150) μm; R = 326 (299-380); Rex = 66 (60-73); RV = 55 (48-69); RVan = 14 (10-19); Ran = 41 (34-50).



Fig. 1. *Hemicycliophora litoralis* Reay, 1985. A. overall view; B. Anterior part and C. Posterior part of female. Scale bars: A = 100 μm; B, C = 20 μm.

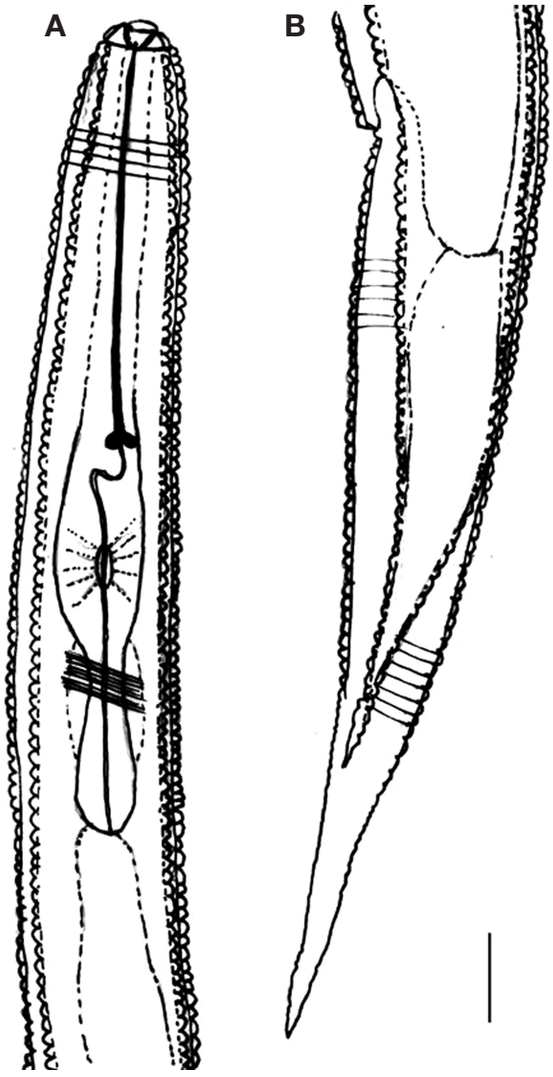

Fig. 2. *Hemicycliophora litoralis* Reay, 1985. A. Anterior part and B. Posterior part of female. Scale bar: A, B = 20 μm.

Ye and Geraert (1997). Female (n = 11): L = 956 (867-1,080) μm; a = 3.1 (27.6-37.3); b = 5.4 (4.7-5.7); c = 7.1 (6.4-7.8); c′ = 6.6 (5.8-8.1); V = 82.65 (79.2-85.9); stylet = 95 (87-106) μm; annule = 2.8-3.2 μm; excretory pore = 166 (140-188) μm; tail = 136 (112-169) μm; R = 353 (329-376); Rst = 39 (35-50); Roes = 73 (64-79); Rex = 68 (63-73.0); RV (ant) = 280 (249-299); RVan = 19.6 (17-23); Ran = 54.6 (38-65).

Polytomous Key code. A3, B4, C1, D1, E3, F12, G2, H1, I3, J1, K4, L3, M2, N2, O23, P12, Q3, R1, S3, T2, U34, V1, W1, X2, Y1.

Description. Body slightly curved ventrally when fixed with hot FG41 fixative. Cuticle sheath double as a characteristics of *Hemicycliophora*. Outer and inner surface annulated. Labial region not offset. Stylet slightly curved ventrally and their base backward directed. Excretory located at the level of hemizonid. Vulval lip changed to flap, anterior lip longer than posterior lip. Post-vulval body with slight constriction, then uniformly tapering. Tail tapering to the end and having sharp tip. Cuticle of tail tip is not annulated.

Distribution. Korea (new record), Oceania: Australia (Port Wakefield, South Australia) (Reay, 1985), Solomon Islands (Ye and Geraert, 1997).

Material examined. Sandy soil at edge of river, Miryang, Gyeongsangnam-do, Korea.

Remarks. *Hemicycliophora litoralis* has long tapering tail with sharp tip which share similar characters with *H. eugeniae*, *H. attapadii* and *H. dahomensis*. But *H. litoralis* is differ from other three species by elevated lip and long anterior valval lip. *H. litoralis* is differ in R and Rst with *H. eugeniae*; stylet length and Rvan with *H. attapadii*; Rst and RV with *H. dahomensis*. Korean population is well matched and within a range of original description (Reay, 1985) and additional record from Solomon island (Ye and Geraert, 1997) in de Man's indics of L, b, c, V, R, Rex, Ran, Roes, RV (ant), annule, excretory pore, stylet length, and tail length. Differences are observed in RV and RVan. RV and RVan of original description was 55 (48-69) and 14 (10-19) but those of Korean population is 68 (61-76) and 22 (19-24), respectively. RVan (19.6) of *H. litoralis* described from Solomon island (Ye and Geraert, 1997) is similar to Korean population but has slight higher Rst (39). The measurements of MB (%), s, G1, G2 values are newly given in this study.

Key to the species of Hemicycliophora in Korea

1. Tail cylindrical, tapering uniformly, then abruply digitate at end ····· 2
− Tail conical, then tapering more or less abruptly at posterior end ····· 3
− tail tapering gradually to the end, head not offset, stylet = 106.1 μm; R = 335 ····· *H. litoralis*
2. Stylet = 72-89 μm, R = 180-225, RV = 30-42 ····· ····· *H. epicharoides*
− Stylet = 102-127 μm, R = 203-254, RV = 32-52 ····· ····· *H. koreana*
3. Labilal disk outward protruding, Stylet = 89-108 μm, R = 200-240 ····· *H. parajuglandis*
− Head offset; Labilal disk not outward, Stylet = 104-113 μm, R = 234-241 ····· *H. juglandis*
− Head offset; Stylet length 95-103 μm, R = 46-54 ····· ····· *H. minora*

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