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Two Unrecorded Species of Spiral Nematode (Hoplolaimidae) from Korea

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나선선충과의 한국 미기록 2종 보고

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ABSTRACT : *Helicotylenchus clarkei* Sher, 1966 and *Rotylenchus usitatus* Van den Berg et Heyns, 1974 were newly found in Korea from medicinal plant collection field in Gyeongbuk Agricultural Technology Administration, Daegu, Korea. So far, 9 species of *Rotylechus* (*R. alius, R. blothrotylus, R. feroxcis, R. incultus, R. orientalis, R. pini, R. pruni, R. robustus, R. usitatus*) and 8 species of *Helicotylenchus* (*H. belli, H. cavenessi, H. clarkei, H. digonicus, H. dihystera, H. erythrinae, H. paraplatyarus, H. pseudorobustus*) are recorded in Korea.

KEY WORDS : Medicinal plant, *Helicotylenchus clarkei*, *Rotylenchus usitatus*, Korea, Taxonomy

초 록 : 경북농업기술원 약용작물 전시포에서 약용작물 기생선충을 조사하던 중 *Helicotylenchus clarkei* Sher, 1966와 *Rotylenchus usitatus* Van den Berg et Heyns, 1974 등 2종이 우리나라 미기록종으로 확인되어 보고한다. 이로서 국내에는 총 8종의 *Helicotylenchus*와 총 9종의 *Rotylenchus*가 기록되었으며 각 종에 대한 분류검색표를 첨부하였다.

검색어 : 박하나선선충, 분류, 약용작물, 원추리나선선충, 한국

Introduction

In 2002, soil samples were taken from a medicinal plants collection field at the Gyeongbuk Agricultural Technology Administration, Daegu, Korea. Two unrecorded species of nematodes belonging to Hoplolaimidae were found around the roots of *Hemerocallis fulva* L. and *Mentha canadensis* L.

Members of this subfamily are the most numerous nematode groups found around plant roots. The group is characterized by strongly developed stylets and usually feed on roots as ectoparasites. Injury is characterized by stunting and gradual decline of the plant vigor.

Among the subfamily, *Rotylenchus* and *Helicotylenchus* are readily recognized by their typical spiral or open C-shaped body posture when relaxed by gentle heat. The two genera can be identified by annules of their lip region; tiled annules as *Rotylenchus* and not tiled annules as *Helicotylenchus*. In Korea, 8 species of Rotylenchus (*R. alius, R. blothrotylus, R. feroxcis, R. incultus, R. orientalis, R. pini, R. pruni, R. robustus*), and 7 species of *Helicotylenchus* (*H. belli, H. cavenessi, H. clarkei, H. digonicus, H. dihystera, H. erythrinae, H.*

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para-platyarus, H. pseudorobustus) are recorded so far (Choi and Geraert, 1971; Choi, 1972; Choi *et al.*, 1995).

Materials and Methods

Soil samples were collected from medicinal plants collection field at the Gyeongbuk Agricultural Technology Administration. Nematodes were killed with hot F: G 4-1 and processed by Seinhorst's rapid glycerin method for light microscope observations. For scanning electron microscopy observation, fresh nematodes were prefixed with 4% glutalaldehyde-2% formalin (4°C, pH 7.2) and postfixed in 2% osmium tetroxide (4°C, pH 7.2). They were then dehydrated in an ethanol series, critical point dried in liquid CO_2, mounted on studs, sputter coated with gold palladium, and examined in a Leo 1450VP at an accelerating voltage at 10 kv (Eisenback, 1986).

Description

Rotylenchus usitatus Van den Berg et Heyns, 1974 (원추리나선선충 신칭) (Figs. 1-3)

Measurements: Female (n = 29); L = 1015.8 μm ± 81.4 (868-1144); a = 33.5 ± 3(27.5-38.4); b = 7.8 ± 0.8 (6.5-9.1); b′ = 7.4 ± 0.7 (6.3-8.8); c = 54.3 ± 6.9 (42.0-65.2); c′ = 0.8 ± 0.1 (0.6-1.0); V = 54.2% ± 1.5 (52-57.7); Stylet = 27.9 μm ± 1.0 (26.0-30.8); DGO = 4.5 μm ± 1.0 (2.8-7.0); O = 16.1% ± 3.2 (10-23.2); Oesophagus = 138 μm ± 15.5 (115.6-166.6); MB = 60.9% ± 2.9 (55.8-66.8); Body width = 30.7 μm ± 2.1 (27.2-34.0); Tail length = 19.2 μm ± 2.7 (16.0-26.0); Anterior end to excretory pore = 122 μm ± 10.3 (103.6-140.0); Distance anus to phasmid = 35.8 μm ± 5.3 (28.7-45.0).

Male (n = 21). L = 902.9 μm ± 55.0 (805-1011); a = 34.7 ± 3.3 (30.2-42.0); b = 6.6 ± 0.7 (5.9-8.0); b′ = 6.5 ± 0.6 (5.6-7.8); c = 29.7 ± 2.9 (24.9-37.2); c′ = 1.9 ± 0.2 (1.1-2.2); Stylet = 27.0 μm ± 1.1 (25.2-29.0); DGO = 4.3 μm ± 0.7 (3.5-5.6); O = 15.6% ± 2.8 (12.5-21.0); Oesophagus = 139.2 μm ± 12.5 (117.6-156.4); MB = 60.6% ± 2.9 (56.4-67.3); Body width = 26.2 μm ± 2.5 (21.0-30.6); Anterior end to excretory pore = 122.3 μm ± 7.6 (108.5-138.6); Tail length = 30.5 μm ± 2.5 (24.5-35.7); Spicule = 26.3 μm ± 1.5 (23.8-28.7); Gubernaculum = 10.1 μm ± 1.4 (7.7-12.0).

Female: body open C type. Lip region slightly flattened anteriorly continuous with body contour, with 5-6 annuli (Fig. 1. A, E, G-I). Oral aperture oval located on the hexagonal labial disc which is surrounded by small pit-like openings of the six labial sensillae arranged three on each side (Fig. 1. A-F). The oral disc is clearly separated from the first lip annule, lateral sectors slightly smaller than other sectors. Amphidial apertures at between the labial disc and lateral sectors (Fig. 1. A-F). Stylet 26-30 μm long, knobs rounded posteriorly. Dorsal oesophageal gland orifice 2.8-7 μm from base of stylet knobs. Lateral field areorated only at oesophageal region (Fig. 1. J). Excretory pore varying from opposite middle to anterior part of oesophageal lobe, 103-140 μm from anterior end of body (Fig. 3. A-C). Hemizonid 2 annuli long, situated 2 annuli anterior to excretory pore. Hemizonion not seen. Oesophageal gland overlapping the intestine shortly dorsally and dorsolaterally (Fig. 3. A-C). Vulva position at 52-57% of the body. Epiptygma distinct (Fig. 3. D, G). Spermatheca large and rounded, filled with sperms. Phasmids situated 14-24 annuli anterior to anus. Tail tapering slightly to a narrow rounded tip with 7-11 annuli; 15.3-27.2 μm long (Fig. 2. A-D).

Male: General shape similar to female. Body length shorter than female. Spicule arcuate, slightly cephalated. Bursa envelop tail tip (Fig. 2. E, F).

Discussion. Korean specimen well correspond with the original descriptions except for epiptygma distinct (indistinct, Van den Berg and Heyns, 1974).

Locality and habitat. Collected from soil around the roots of *Hemerocallis fulva* L. at medicinal plants collection field in Gyeongbuk Agricultural Technical Administration, Daegu, Korea.

Helicotylenchus clarkei Sher, 1966 (박하나선선충 신칭) (Figs. 4, 5)

Measurements: Female (n = 12); L = 546.5 μm ± 31.0

(483.7-584.8); a = 24.1±2.1 (19.6-26.5); b = 5.1±0.2 (4.8-5.6); b′ = 4.2±0.3 (3.6-5.0); c = 34.1±2.8 (29.5-38.6); c′ = 1.3±0.1(1.2-1.4); V = 61.0%±1.2 (58.9-62.9); Stylet = 26.3 μm±0.5 (25.2-27.3); Oesophagus = 129.1 μm±6.7 (115.6-134.4); DOG = 6.9 μm±1.4 (5.2-9.1); O = 26.2±5.3 (19.5-35.1); m = 49.0±13 (46.1-50.6); Body width = 22.9 μm±2.7 (18.2-28.9); MB = 53.7%±1.8 (51-56); Anterior end to excretory pore = 93.1 μm±5.0 (86.1-101); Tail length = 15.9 μm±1.6 (12.6-18.9); Oesophago-intestine junction = 105.7 μm±5.7 (98-113.4); Distance anus to phasmid = 4.5 μm±1.4 (2.4-7.7).

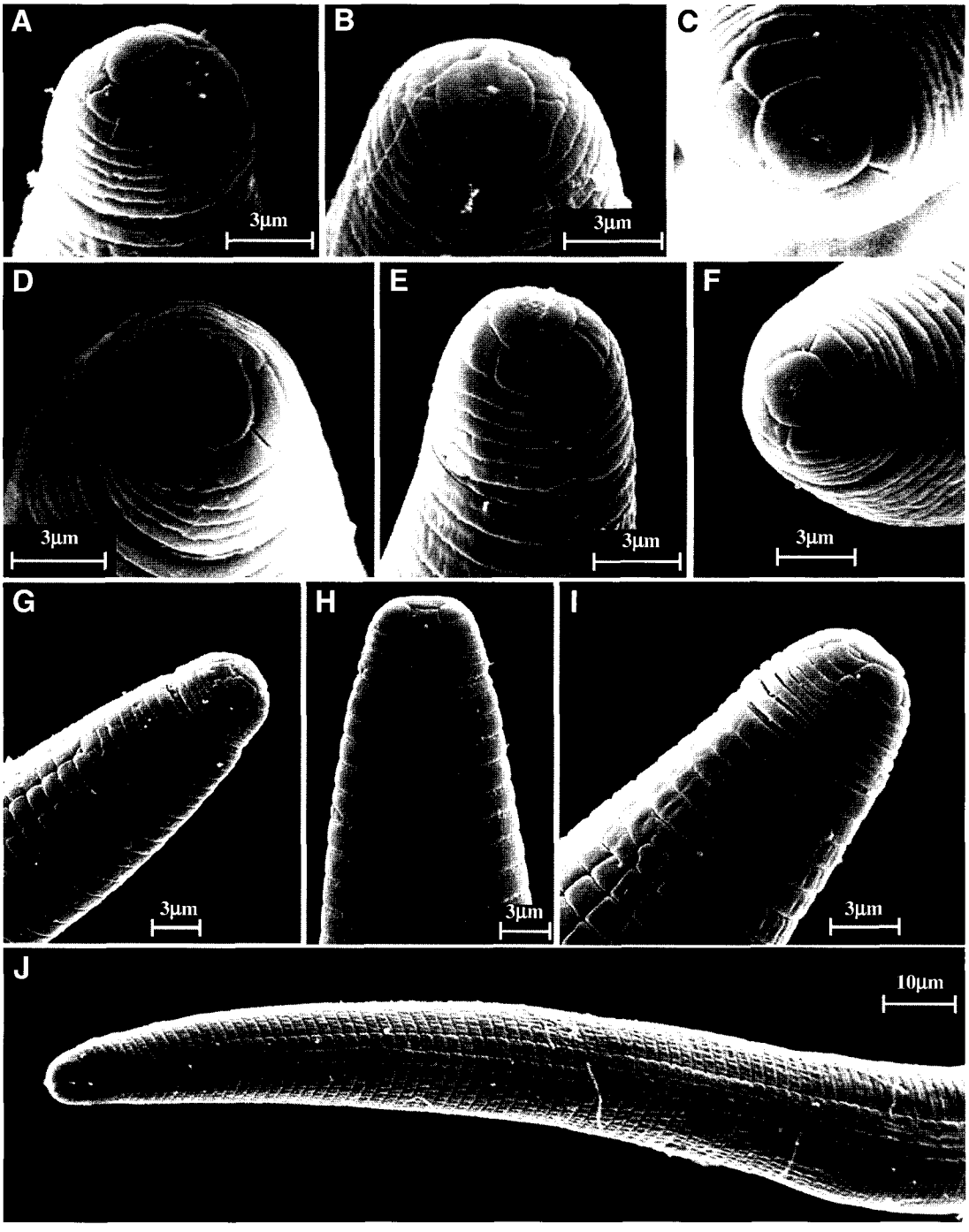

Fig. 1. *Rotylenchus usitatus*: A-F: En-face view; G-I: Head part; J: Oesophageal region, surface view.

Male (n = 13). L = 522.1 μm±28.3 (472.6-567); a = 29.8±2.3 (26.8-33); b = 5.0±0.3 (4.5-5.4); b′ = 4.0± 0.2 (3.7-4.3); c = 26.4±1.8 (23.6-29.5); c′ = 1.8±0.2 (1.5-2.0); T = 39.2%±5.1 (30.5-48.6); Stylet = 21.7 μm ±0.8 (20.3-23.1); DOG = 5.6 μm±1.1 (4.2-7); O = 25.7 ±5.4 (18.7-33.3); Oesophagus = 129.6 μm±7.5 (122.5-140); m = 50.4±2.0 (46.6-53.1); MB = 53.4%±1.2 (51.5-55.3); Body width = 17.6 μm±1.7 (15.4-20.4); Anterior end to excretory pore = 90.7 μm±3.9 (84.7-96.6); Tail length = 19.6 μm±1.8 (16.1-22.4); Oesophago-intestine junction = 104.7 μm±8.0 (95.9-119.9); Spicule = 24.5 μm±1.5 (22.4-27.3); Gubernaculum =

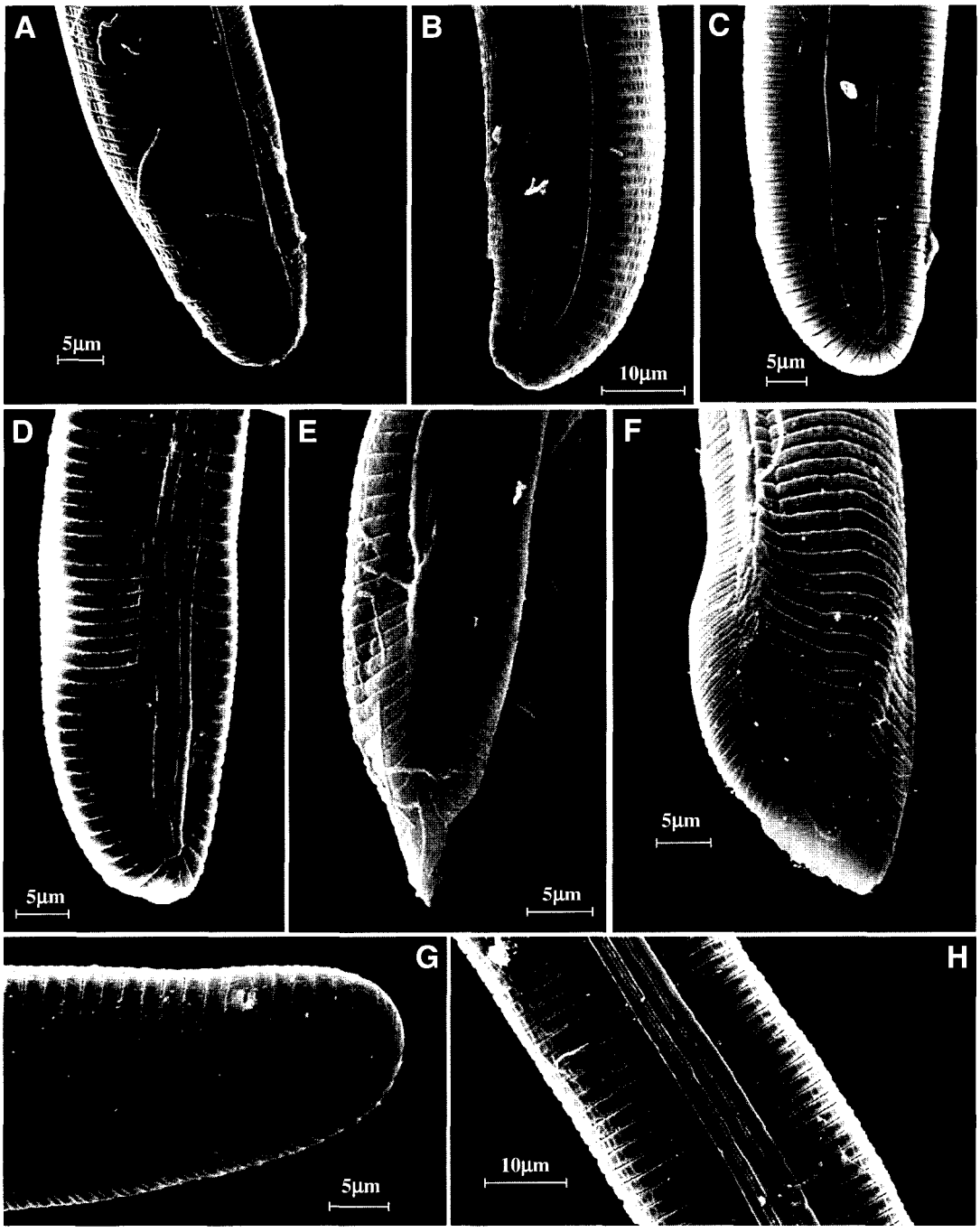

Fig. 2. *Rotylenchus usitatus*: A-D: Various shape of female tail; E: Mail tail, showing spicule tip; F: Mail tail, surface view; G: Female tail ventral view, arrow indicate anus; H: Lateral field, middle of body.

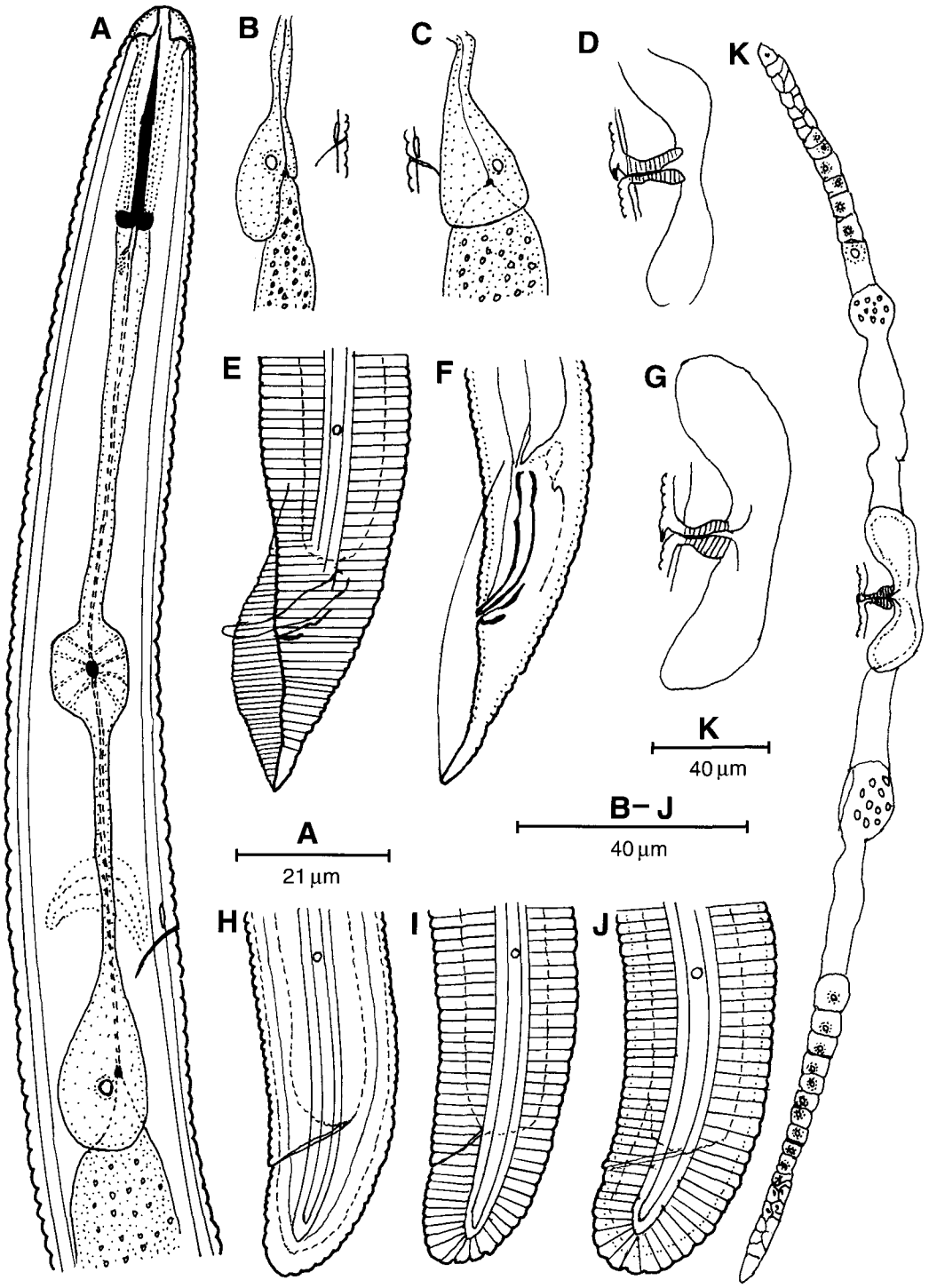

Fig. 3. *Rotylenchus usitatus*: A: Oesophageal region; B, C: Oesophageal glands overlapping intestine; D, G: Vulva; E, F: Mail tail; H-J: Various shape of female tail; K: Female gonad.

8.3 μm ± 1.3 (6.3-10.5);

Female: Body in spiral shape. Lip region truncate, without annulation, labial disc conspicuous, hexagonal (Fig. 4. B). Spear knobs with anterior surfaces flattened. Excretory pore at anterior to Oesophago-intestinal valve. Oesophago-intestinal junction 98-113 μm from

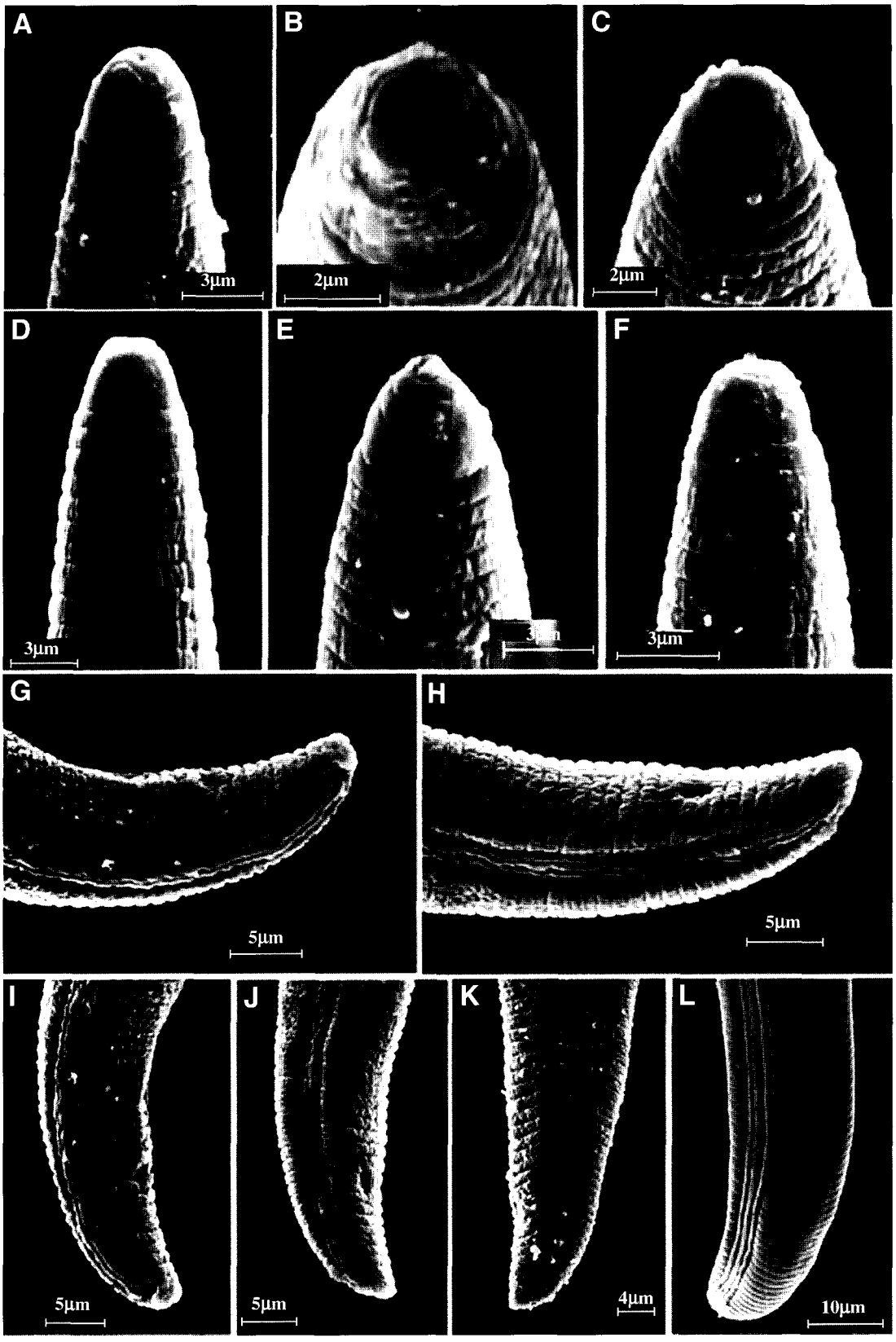

Fig. 4. *Helicotylenchus clarkei*: A: Female lip region; B, C: Female en face view; D-F: Female anterior region; G, H: Female posterior region, ventro-lateral view, arrow showing anus; I-L: Various shape of female posterior parts, lateral view.

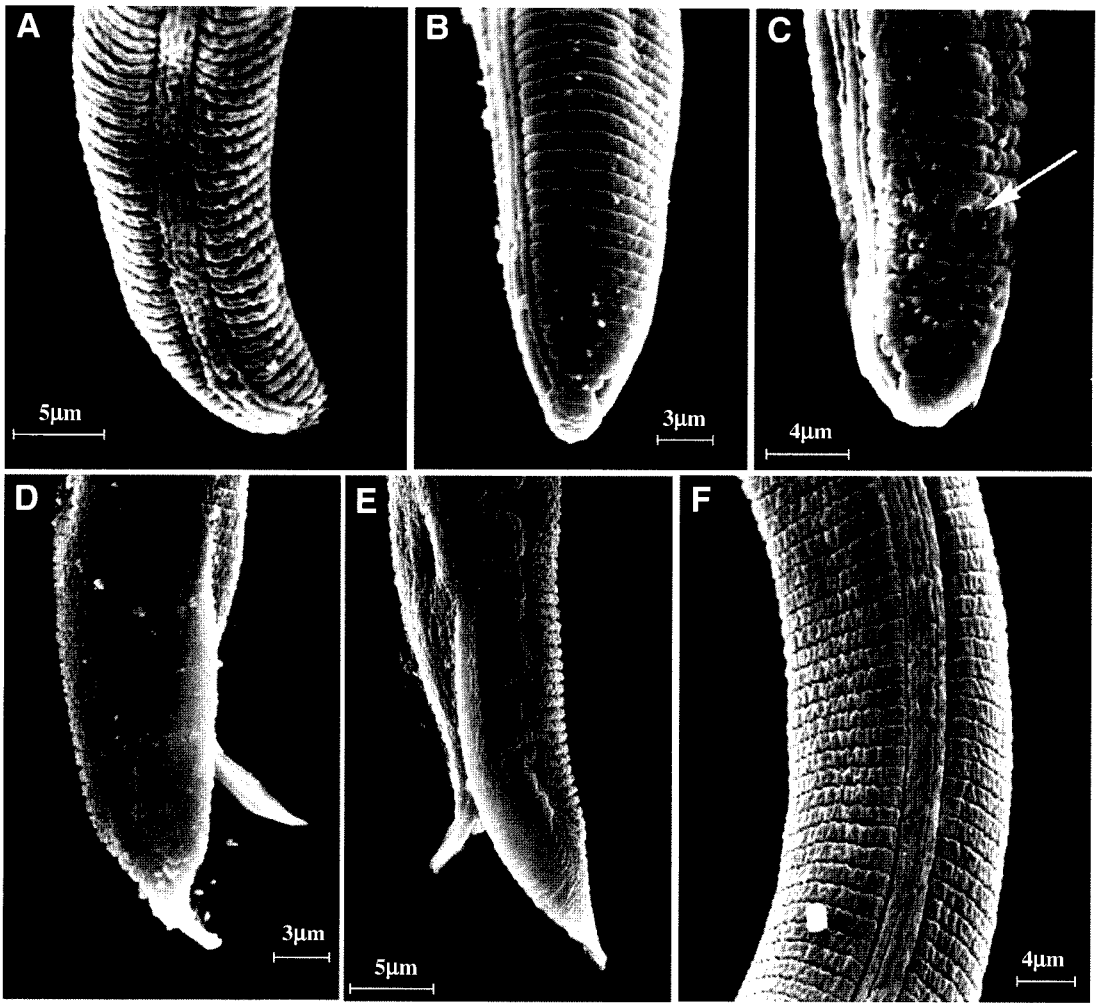

Fig. 5. *Helicotylenchus clarkei*: A: Female posterior part, lateral view; B: Female posterior part, dorsal view; C: Female posterior part, ventral view, arrow showing anus; D, E: Male posterior parts; F: Lateral field middle of body.

anterior end. Median oesophageal bulb oval; 51-56% of oesophagus length. Oesophageal gland overlap the intestine ventrolaterally. Inner lines of lateral field separate at terminus. Spermatheca set off, with sperm. Phasmids 3-6 annuli posterior to anus level. Tail tapering to a usually hemispherical, annulated terminus, lacking ventral projection. Tail with 11-12 annuli.

Male: Body curved ventrally. Lip region similar to female. Stylet less developed than female. Excretory pore anterior to level of oesophago-intestinal valve. Phasmids on tail.

Locality and habitat. Collected from soil around the roots of *Mentha canadensis* L. at medicinal plants collection field in Gyeongbuk Agricultural Technical Administration, Daegu, Korea.

Key to species of *Rotylenchus* in Korea

1. Oesophageal glands overlapping intestine 3
   Oesophageal glands not overlapping or slightly overlapping intestine 2
2. Lip region set off with 5-7 annuli, phasmid 11-20 annuli anterior to anus. Stylet 26-27 μm long. Terminal part of tail striated ..... *R. pini*
   Lip region not set off with 7-9 annuli, phasmid 3-8 annuli posterior to anus. Stylet 28-34 μm long. Terminal part of tail unstriated ..... *R. blothrotylus*
3. Stylet 40-50 μm long 4
   Stylet 23-31 μm long 5

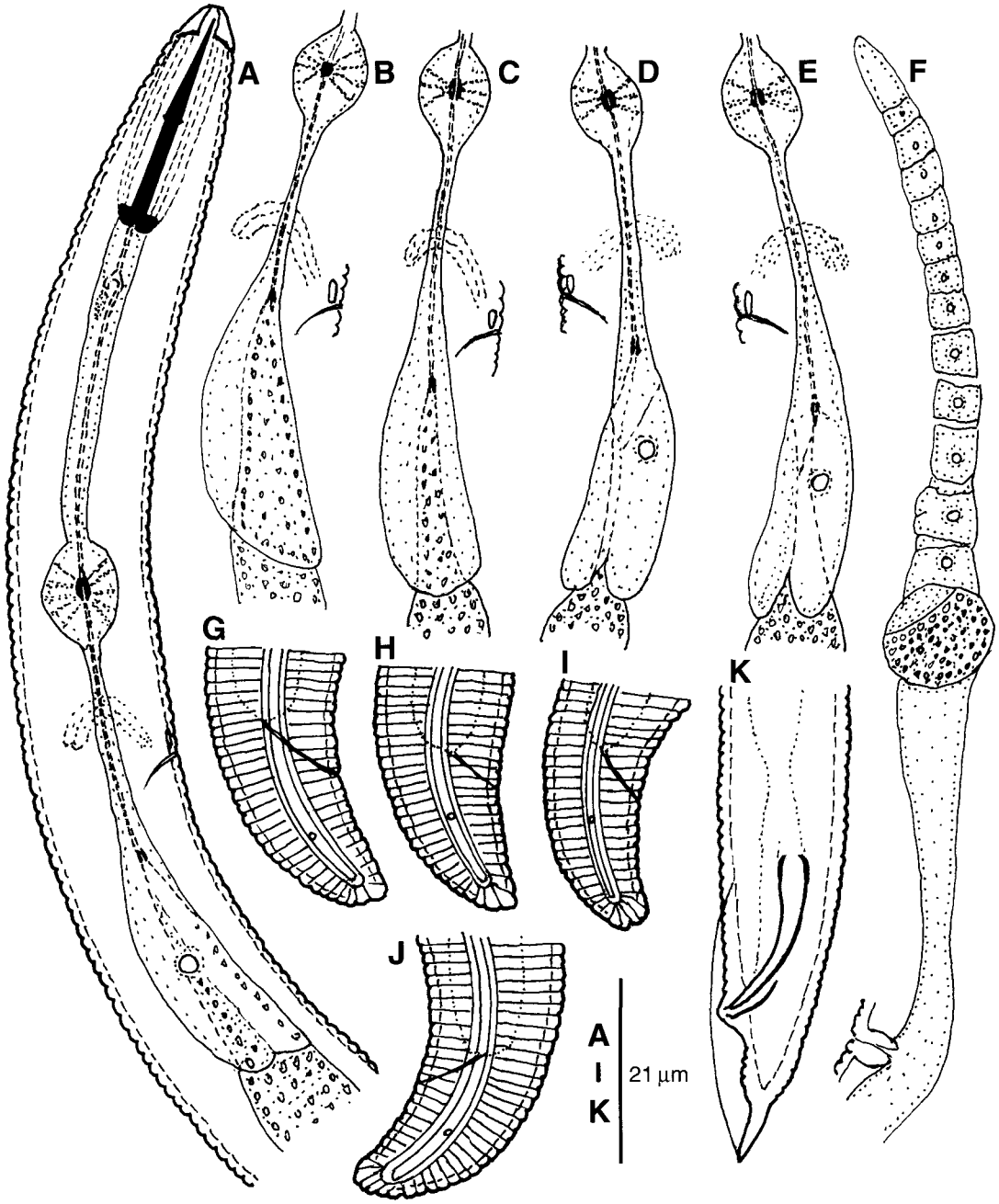

Fig. 6. *Helicotylenchus clarkei*: A: Female anterior region; B-E: Various shape of oesophageal glands overlapping intestine; F: Female gonad; G-J: Various shape of female tails; K: Mail tail.

4. Lip region with 8 annuli, stylet 40-44 μm long. Tail rounded. Lateral field areolated only at oesophageal region ..... *R. pruni*
   Lip region with 6 annuli, stylet 44-50 μm long. Tail hemispherical. Lateral field areolated in oesophageal region and irregularly areolated at mid body ..... *R. robustus*
5. Lip region with 5-6 annuli. V = 50-70% 6
   Lip region with 5-6 annuli V = about or more than 70% 8
   Lip region with 7-8 annuli. V = 50-70%. Stylet 28-31 μm long. Phasmid large 10-19 annuli posterior to anus. Posterior part of body tapering ..... *R. feroxcis*
6. Lateral field areolated at oesophageal region and

incompletely along whole length of body. Lip region conoid, Tail pointed ..... *R. alius*

Lateral field areolated only at oesophageal region 7

7. Lip region hemispherical with 4-5 annuli and longitudinal striations on basal annule. Tail hemispherical. Stylet 26-29 μm long ..... *R. incultus*

Lip region conoid-rounded with 6 annuli and without longitudinal striations on basal annule. Tail rounded. Stylet 26-31 μm long ..... *R. usitatus*

8. Lip region conoid-rounded. Stylet 23-26μm long. V = 67-73% ..... *R. orientalis*

Key to species of *Helicotylenchus* found in Korea

1. Tail hemispherical, subcylindroid or subconoid, with a rounded terminus, lacking a ventral or terminal projection 2

Tail dorsally convex-conoid to a pointed terminus, or with a slight to well developed ventral or terminal projection 6

2. Spermatheca with sperm. Male present. Lip region truncate, without annuli. Phasmids 3-6 annuli posterior to anal level. Stylet 25-27 μm long ..... *H. clarkei*

Spermatheca without sperm. Male absent 3

3. Lip region without annuli 4

Lip region with distinct annuli 5

4. Lip region truncate. Phasmids postanal. Labial disc conspicuous. Stylet 27-29 μm long ..... *H. belli*

Lip region rounded. Phasmid up to 7 annuli anterior to anal level. Tail terminus striated; inner incisures of lateral fields fused on distal third of tail ..... *H. cavenessi*

5. Lip region distinctly truncate. Tail terminus not exceedingly fine striations. Stylet 24-28 μm long. Inner incisures of lateral fields not fused on tail end ..... *H. digonicus*

Lip region rounded. Tail terminus annulated, Tail about one anal body-width or long. Stylet 24-27 μm long; annuli on tail terminus narrower than other tail annuli ..... *H. paraplatyarus*

6. Ventral or terminal projection of tail absent or slightly developed (less than 2 annuli long). Spermatheca without sperm. Lip region rounded. Inner incisures of lateral fields not fused near middle of tail ..... *H. dihystera*

Ventral or terminal projection of tail well developed (2 or more annuli long but not as long as anal body-width) 7

7. Spermatheca with sperm. Lip region with 4-5 annuli. Tail projection elongate, usually ending in a mucro or point. Stylet 24-28 μm long. Lateral field not areolated on tail ..... *H. erythrinae*

Spermatheca without sperm. Lip region rounded with distinct annuli. Phasmids more than 4 annuli anterior to anal level; O = 32-46. Tail projection distinctly annulated, usually with irregular outline. Stylet 23 μm or long ..... *H. pseudorobustus*

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