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Two Unrecorded Speces of *Hemicycliophora minora* and *Pratylenchoides ivanovae* and Additional SEM Description of *Pratylenchoides utahensis* and *Rotylenchus feroxcis* from Korea

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한국 미기록 선충 *Hemicycliophora minora, Pratylenchoides ivanovae* 2종 보고 및 *Pratylenchoides utahensis*와 *Rotylenchus feroxcis*의 주사전자현미경 관찰

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ABSTRACT : *Hemicycliophora minora* Wu, 1966 and *Pratylenchoides ivanovae* Ryss, 1980 are newly collected from Korea. Five species of *Hemicycliophora* and 3 species of *Pratylenchoides* were reported in Korea and key is given. Two preciously described species, *Pratylenchoides utahensis* Baldwin, Luc & Bell and *Rotylenchus feroxcis* Eroshenko were observed under the scanning electron microscope.

KEY WORDS : *Hemicycliophora minora*, *Pratylenchoides ivanovae*, *Pratylenchoides utahensis*, *Rotylenchus feroxcis*, Scanning electron microscopy, Taxonomy

초 록 : *Hemicycliophora minora* Wu, 1966와 *Pratylenchoides ivanovae* Ryss, 1980를 국내 미기록종으로 보고한다. 현재 국내에는 *Hemicycliophora*속에서 총 5종, *Pratylenchoides*속에서 총 3종의 선충이 보고되었으며, 이들 종에 대한 검색표를 첨부하였다. 아울러 주사전자현미경을 이용하여 *Pratylenchoides utahensis* Baldwin, Luc & Bell 와 *Rotylenchus feroxcis* Eroshenko의 형태적 특징을 추가적으로 기록하였다.

검색어 : 미노라껍질선충, 분류, 이바노바뿌리썩이선충, 주사전자현미경

During the nematode survey from Korea in 2002, two unrecorded species of nematodes belonging to the genus of *Hemicycliophora* and *Pratylenchoides* were found around the roots of *Caeltis siensis* Persoon and *Liriodendron tulipifera* L., respectively.

Hemicycliophora is immediately recognized by the sheath cuticle and sloping stylet knobs. The sheath is fifth cuticle, which become loose from the body when a sixth cuticle is formed beneath it. Economic importance of *Hemicycliophora* was reported by Van Gundy (1957) from rough lemon, *Citrus limonia; Hemicycliophora* attached root tips and formed gall-like terminal growths on roots.

Pratylenchoides was originally described by Thorne

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(1935), on a single female, from bark beetle frass associated with a pine tree in Horse Creek district, Utah, USA. It is closely related to the genera *Radopholus* and *Zygotylenchus* (Sher, 1970) but differed by deirids which are absent in the two other genera. *Pratylenchoides* is generally distributed in cool and temperate regions throughout the world, in contrast to *Radopholus* of hot climate region.

Materials and Methods

Soil samples were collected from mountainous area from Korea in 2002. Nematodes were killed with 70℃ hot F:G 4-1 and processed by Seinhorst's rapid glycerin method (Seinhorst, 1962) for light microscope observations. For scanning electron microscope observation, fresh nematodes were prefixed with 4% glutalaldehyde-2% formalin and postfixed in 2% osmium tetroxide (4℃, pH 7.2). Then, they were 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).

Family Criconematidae

Genus Hemicycliophora de Man, 1921

Hemicycliophora minora Wu, 1966 미노라껍질선충 (신칭)

Hemicycliophora minora Wu, 1966 (Fig. 1, 2)

Measurements: Female (n=15) L=919.5±43.7 (850-1000)㎛; a=21.9±1.1 (19.7-23.7); b=5.5±0.2 (4.9-5.8); c=9.8±1.3 (8.3-12.3); V=83.2±1.1 (81.4-85.6); Stylet=99.6±2.8 (95.2-103.6)㎛; Oesophagus length=166.1±5.2 (156.4-173.6)㎛; Tail length=94.8±12.3 (75.6-114.8)㎛; G1=43.9±2.7 (40-48.2); R=243.5±7.6 (230-259); Rex=50.9±2.2 (46-54); Rv=52.5±3.9 (45-60); Rvan=15.1±3.2 (9-20); Ran=37.7±4.3 (32-48).

Description: Female. Body generally curved slightly ventrally. Lip region semi-circular with labial disc and three to four annules. The base of the annule gives a constriction that sharply off sets the head. Stylet slender with curved basal knobs directed toward backward. Oesophagus typical for the genus, with a small basal bulb. Excretory pore located at 46th to 54th annules from anterior end. Female reproductive system typical for the genus; vulva is well marked off by a constriction of the body behind it. Spermatheca absent. Post-vulval region slightly tapering for anterior two-thirds, then abruptly

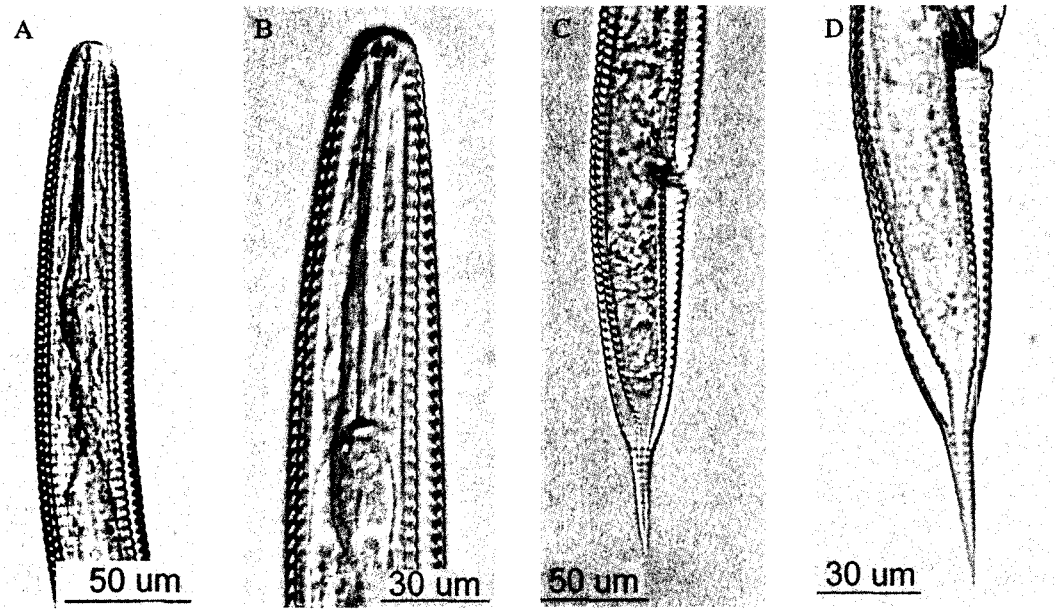

Fig. 1. *Hemicycliopora minora.* A-B. Anterior parts, C-D. Posterior parts.

tapering and ending in a sharply conical tail part. The annulation gradually disappears towards the tail terminus.

Male. not found.

Discussion: Korean specimen is well corresponded with the original description (Wu, 1966) except excretory pore located more posteriorly (46-54th annules on Korean specimens vs. 41-49th annules on the original description). Total of five species, *H. epicharoides*, *H. juglandis*, *H. koreana*, *H. minora*, *H. parajuglandis*, are reported in Korea and their key is provided.

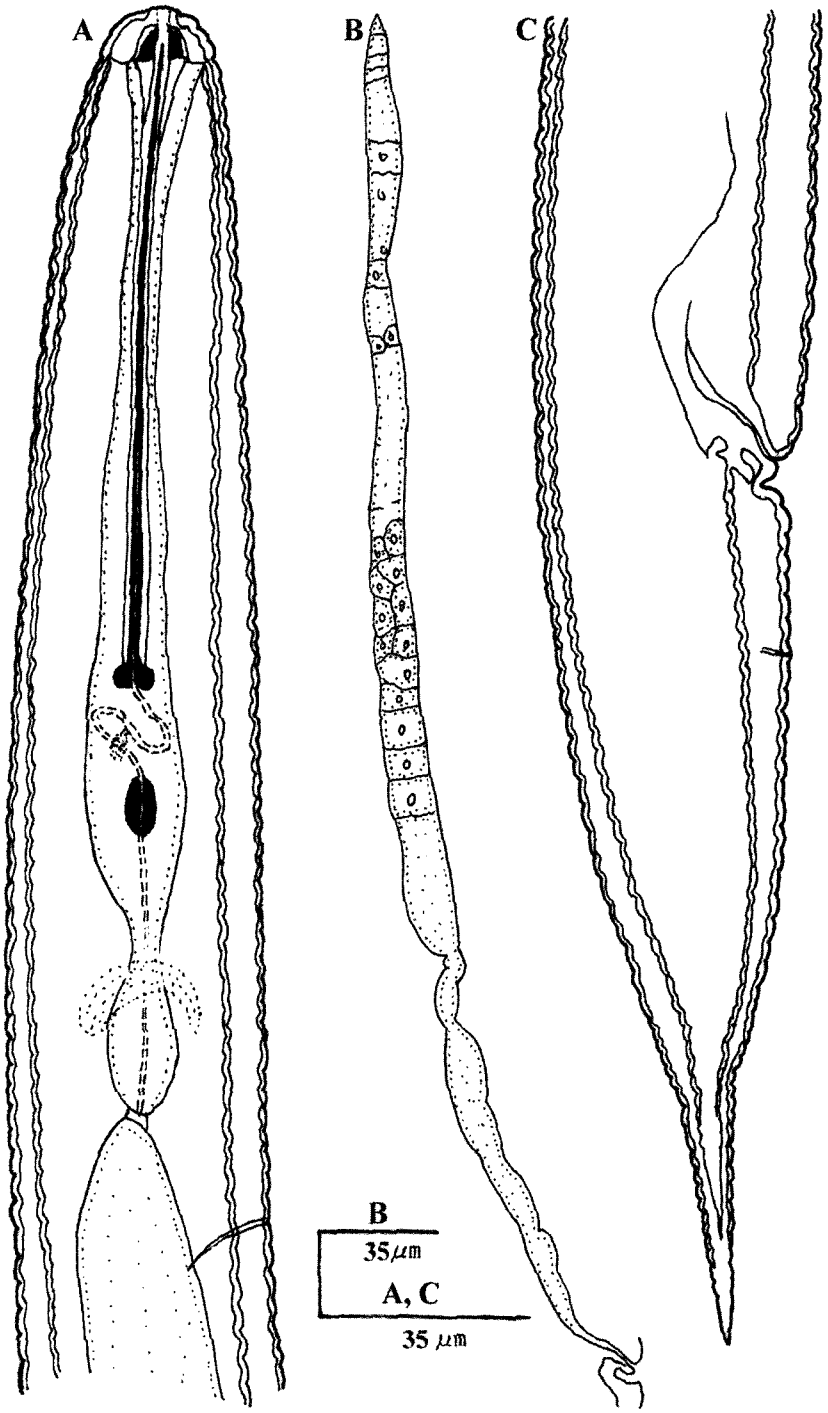

Fig. 2. *Hemicycliopora minora*. A. Anterior region, B. Female gonad, C. Posterior region.

Locality and habitats: Soil around *Caeltis siensis* Persoon at Mai Mt., Jinan district, Jeonbuk province.

Family Pratylenchidae

Genus Pratylenchoides Winslow, 1958

Pratylenchoides ivanovae Ryss, 1980 이바노바뿌리썩이선충(신칭)

Pratylenchoides ivanovae Ryss, 1980 (Fig. 3, 4)

Measurements: Female (n=10) L=815.4±78.5 (672-896) ㎛; a=33±1.3 (31.5-34.4); b=6.1±0.6 (5-7); b'=4.5±0.4 (4-5.1); c=14.9±1.1 (13.2-16.8); c'= 3.2±0.4 (2.9-4); V= 63.5±4.8 (58.7-72.3); Stylet=29.8±1.3 (28-32.2)㎛; Tail length=55±7.6 (44.8-66.5)㎛; Head to excretory pore=

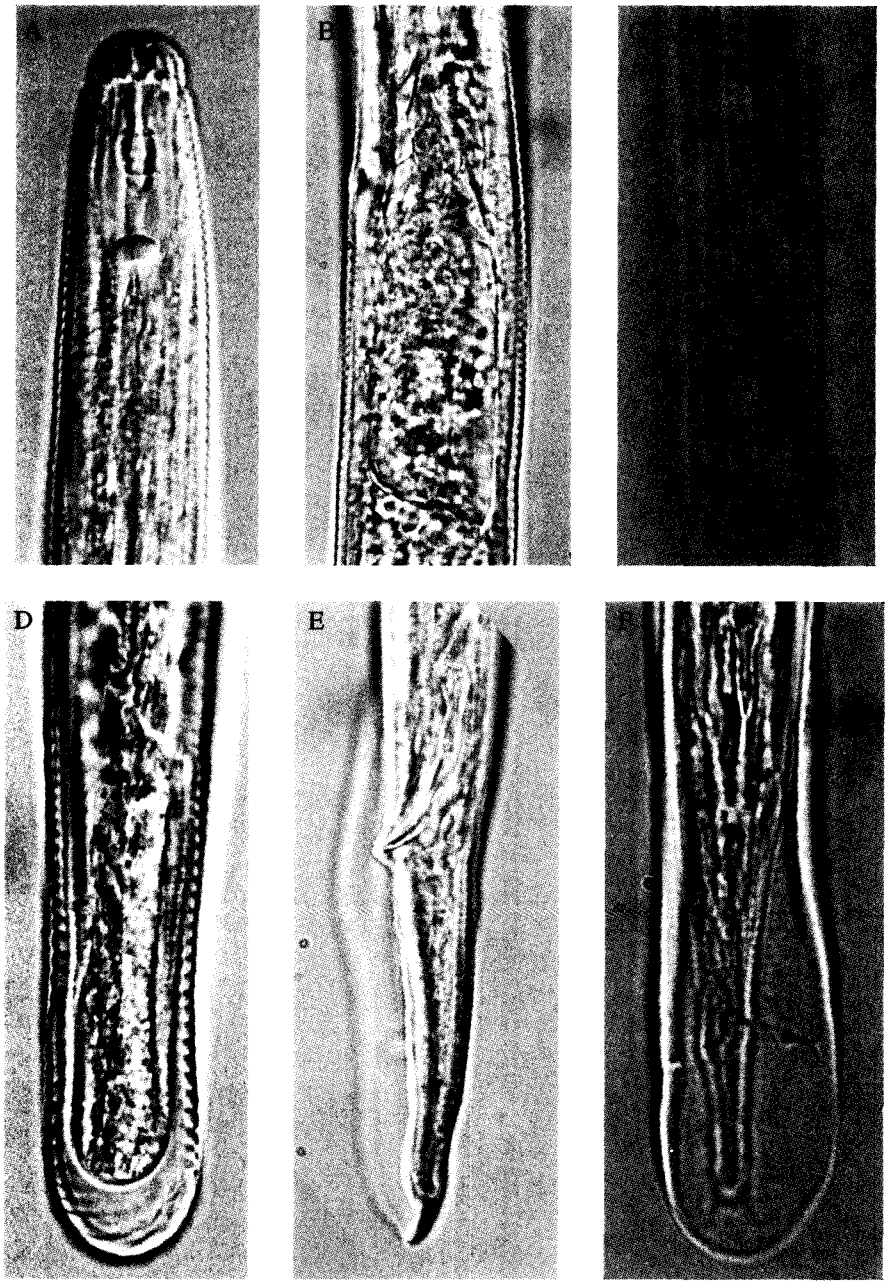

Fig. 3. *Pratylenchoides ivanovae*. A. Head region, B. Basal bulb, C. Lateral field, 6 lines, D. Female posterior region, E. Male posterior region, F. Ventral view of male posterior region (bar = 10㎛).

131.3±4.0 (123.2-137.2)㎛; D.O.G=5.9±1.7 (4.2-9.8)㎛; MB=46.8±1.2 (44.9-48.8); Oesophagus length=180±9.4 (165-196)㎛; Number of tail annule=31.7±3.6 (27-37); Anus to phasmid=28.5±7.7 (18.9-42.7)㎛; Tail end to phasmid=26.6±4 (20.3-30.8)㎛; G1=19.9±1.9 (16.7-22.5); G2=18.5±1.8 (15.8-20.7); Head to hemizonid=122.9±5.5 (114.1-129.7)㎛.

Male (n=8) L=800±62.6 (721-861)㎛; a=33.6±1.7 (31.5-35.1); b=6.7±0.7 (5.8-7.7); b'=5.2±0.3 (4.8-5.5); c=14.3±1.5 (12.4-16.4); c'=3.2±0.5 (2.5-3.9); Stylet=26.8±1.2 (25.2-28.0)㎛; Tail length=56.5±9.0 (44.8-69.3)㎛; Head to excretory pore=129±8.9 (118.3-142.8)㎛; Spicule =25±

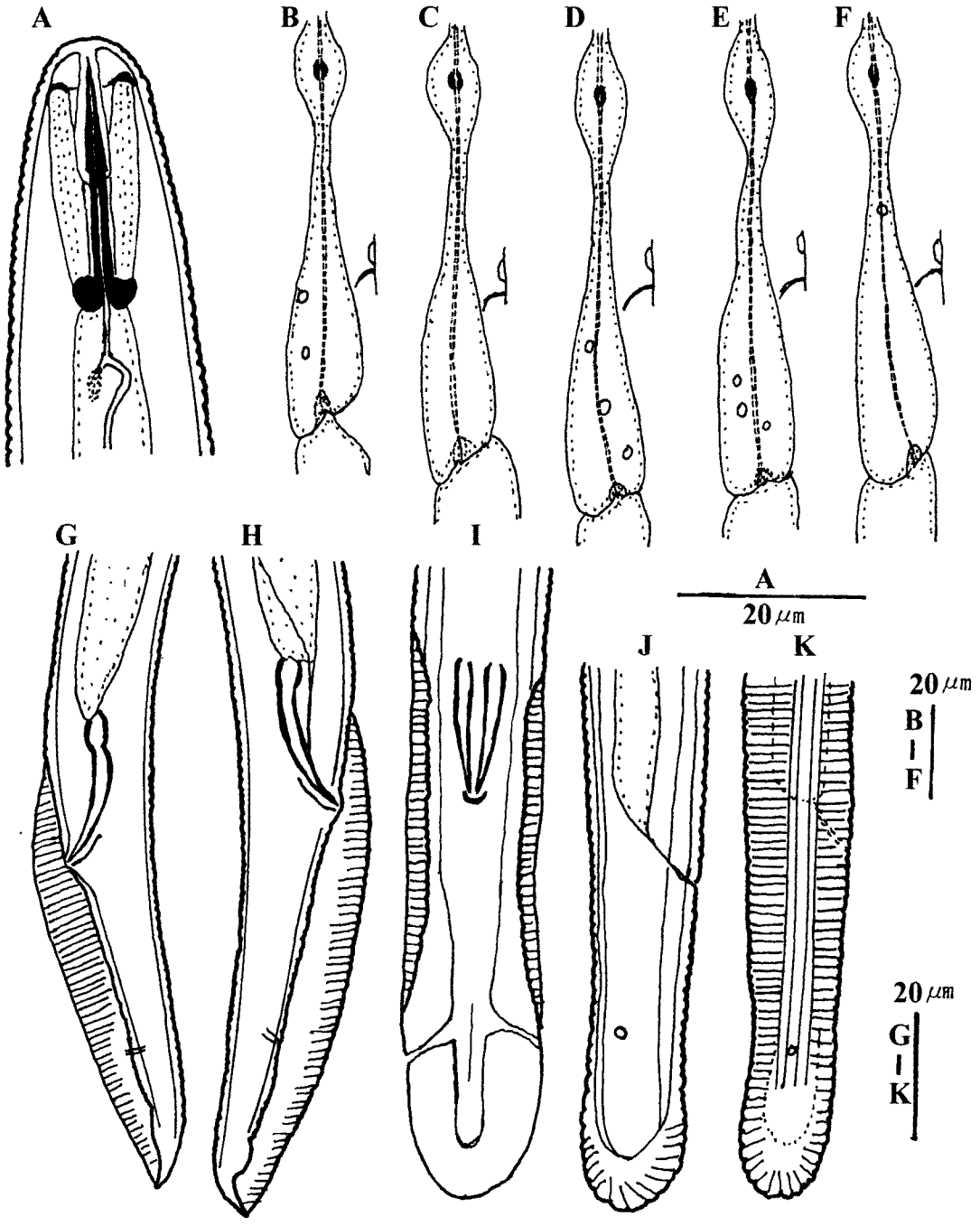

Fig. 4. *Pratylenchoides ivanovae*. A. Female head region, B-F. Various shape of oesophago-intestinal junction, G-H. Lateral view of male tail region, I. Ventral view of male tail, J-K. Female posterior region.

1.4 (23.1-26.6)㎛; D.O.G=5.0±1.3 (4.7-5.6)㎛; Anus to phasmid=32.3±4.8 (27.3-38.5)㎛; Tail end to phasmid= 24.2±4.8 (16.8-31.5)㎛.

Female: Body straight or slightly curved ventrally behind vulva. Cephalic region prominent, continuous with body contour, hemispherical to conical. Cephalic framework strongly sclerotized. Stylet massive, the knobs directed laterally, with anterior surface, slightly sloping. Oesophageal gland lobe slightly overlaps intestine dorso-laterally. Lateral field with six lines at middle of body, but anterior and posterior part of body with four lines, the outer lines areolated. Tail cylindrical to clavate, terminus rounded, and annulated. Annule are more coarse (about 1.4-2.1㎛) on terminal part of tail. Hyaline 8.4-9.8㎛ width.

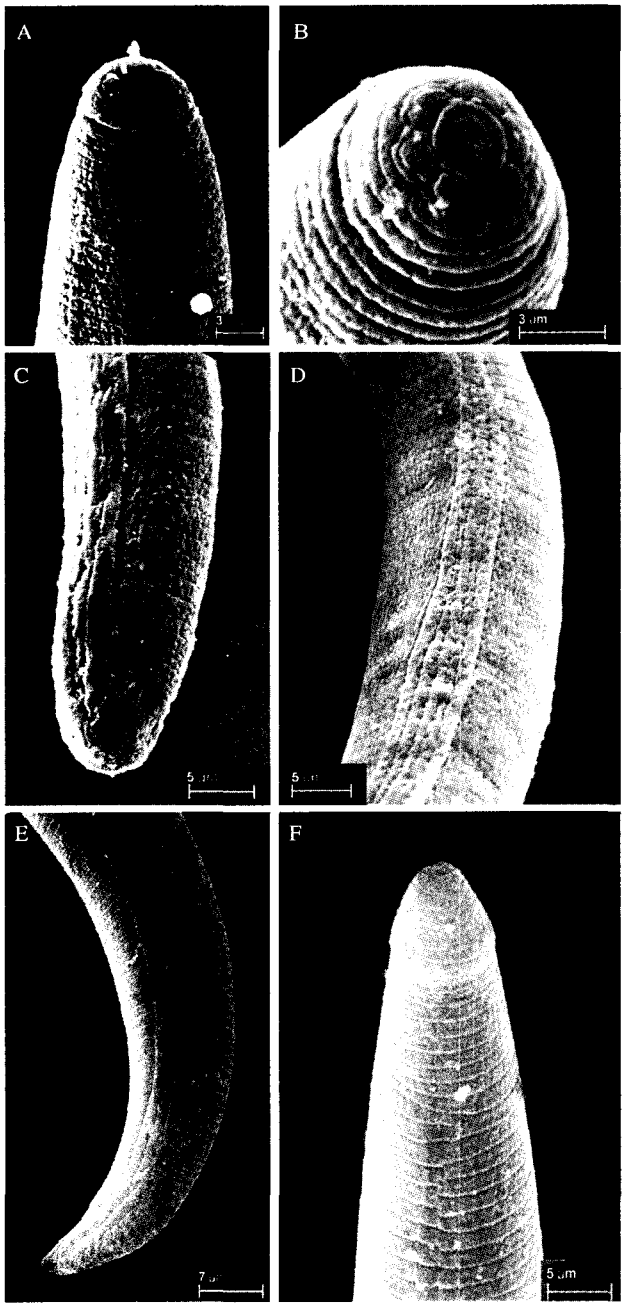

Fig. 5. Scanning electron microscopy observations of *Pratylenchoides utahensis*(A-D): A. Head part, B. En face view, C. Tail, D. Lateral field at the middle of body. *Rotylenchus feroxcis* (E, F): E. Tail region, F. Head region.

Male: Body straight or slightly curved ventrally. Lip region with 5-6 annule, continuous with body contour, hemispherical to conical, anteriorly flattened. Cephalic framework strongly sclerotized. Stylet well developed, its knobs directed laterally, with anterior surface slightly sloping. Glandular overlaps as in female. Spicule slender, slightly curved ventrally, with conical tip. Gubernaculum not protrusible. Tail slender and conical. Bursa envelop tail terminus. Phasmids conspicuous.

Discussion: Korean specimen is similar to the Russian specimens (Chukchi pennisula) in measurements and description (Eroshenko, 1981) except vulval position which is slightly posterior in Korean specimens. Total of three species, *P. clavicauda*, *P. ivanovae*, *P. utahensis*, are reported in Korea and their key is provided.

Locality and habitats: Soil around *Liriodendron tulipifera* L. at Odae Mt., Gangweon province.

Pratylenchoides utahensis Baldwin, Luc & Bell, 1983 and *Rotylenchus feroxcis* Eroshenko, 1981 were previously described in Korea (Choi *et al.*, 1995, 2000). In this paper, additional morphological characters were observed using scanning electron microscope (Fig. 5). *P. utahensis* was collected from soil around the *Aster tataricus* L. from medicinal plants field at Gyeongbuk Agricultural Technology Administration, Daegu. *R. feroxcis* Eroshenko was collected from soil around the *Liriodendron rulipifera* L. at Odae Mt. at Gangweon province.

Key to the species of *Pratylenchoides* in Korea

(based on females, when not otherwise stated)

1. - Tail round (Stylet length = 20-22 ㎛) .... *P. utahensis*
   - Tail clavate 2

2. - Stylet length = 20-22㎛ ..... *P. clavicauda*
   - Stylet length = 28-32㎛ ..... *P. ivanovae*

Key to the species of *Hemicycliophora* in Korea

1. - Tail conical but more round 2
   - Tail conical and sharp 3
2. - Stylet length 72-89, R=180-225 ..... *H. epicharoides*
   - Stylet length 95-103, R=46-54 ..... *H. minora*
   - Stylet length 102-127, R=203-254 ..... *H. Koreana*
3. - Labilal disk outward, Stylet length 89-108 ..... *H. parajuglandis*
   - Labilal disk not outward, Stylet length 104-113 ..... *H. juglandis*

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