

Taxonomic Studies on Spider Mites (Tetranychidae: Acarina) of Korea III. Spider Mites Parasitic on Conifers

Lee, Won-Koo,*Lee, Byung-Hoon and **Kim, Byung-Jin

(Department of Biology and *Department of Biology Education, Chönbuk National University, Chönju 560-756, Republic of Korea; **Department of Molecular Biology, Wönlkwang University, Iri 570-749, Republic of Korea)

韓國産 응애과(거미강 : 진드기목)의 分類學的 研究 III. 針葉樹에 寄生하는 응애類

이원구 · *이병훈 · **김병진

(전북대학교 생물학과 · *생물교육과 · **원광대학교 분자생물학과)

摘 要

본 연구는 한국의 침엽수에 기생하는 응애과에 대한 분류학적 검토를 위하여 실시되었다. 전국 16개 지역에서 19종의 松柏類로부터 채집된 표본을 정리한 결과 다음과 같이 7종의 응애가 동정되었다.

1. *Panonychus citri*(McGregor) 굴응애, 2. *Oligonychus clavatus*(Ehara) 소나무응애(신칭), 3. *O. hondoensis*(Ehara) 삼나무응애(신칭), 4. *O. pustulosus*(Ehara) 흑등삼응애(신칭), 5. *O. karamatus*(Ehara) 낙엽송잎응애, 6. *O. perditus* Pritchard and Baker 향나무잎응애, 7. *O. ununguis*(Jacobi) 전나무잎응애.

그중 소나무응애, 삼나무응애, 흑등삼응애는 한국 미기록종이었다.

Key words: taxonomy, spider mites, Acarina, Korea

This study was supported by grants from the basic science research fund of Ministry of Education.

INTRODUCTION

A number of plant feeding mites of the superfamily Tetranychoidae are known to cause a great deal of damage to the cultivated crops, ornamental plants, forests and various wild plants and this raised a great interest in these mites throughout the world.

In Korea, a number of papers dealing primarily with bionomics and control were published by various workers. However, there are only a few covering the taxonomic details by Han(1970), Ehara(1970), Lee *et al.*(1986), Lee *et al.*(1987), Lee and Lee(1987), and Lee(1988).

Especially of sider mites parasitic on coniferous trees, only three species, *Oligonychus karamatus* (Ehara, 1956), *O. perditus* Pritchard and Baker, 1955, *O. ununguis* (Jacobi, 1905) have been recorded from Korea by Koh(1970) and Han(1977).

This paper presents a taxonomic study of conifer spider mites collected from southern Korea.

MATERIALS AND METHODS

Specimens were collected from 16 localities in the southern part of Korean peninsula during the period from May, 1986 to June, 1988 (Fig. 1).

Mites were removed from the leaves by beating twigs and leaves with white paper sheets or whitish enameled pan underneath, and put in small vials containing AGA solution.

Mites were mounted in PVA solution. And after that, slides were placed in a warming oven at 60°C for 2 hours and kept flat until PVA solution dried up. In order to observe the aedeagus, male mites were mounted in profile.

For a morphological study, a phase contrast microscope and an interference microscope were used. Figures were made with drawing apparatus.

All specimens reported here are deposited in the Department of Biology, Chōnbuk National University.

RESULT

In this study, seven species belonging to the tribe Tetranychini, subfamily Tetranychinae, family Tetranychidae were identified as follows.

Genus *Panonychus* Yokoyama, 1929

1. *Panonychus citri* (McGregor, 1916)

Tetranychus citri McGregor, 1916 (p. 284, pl. 14, figs. 1-9).

Metatetranychus citri: Prichard and Baker 1955 (pp. 133-136, figs. 96-99); Ehara, 1955 (pp. 180-182, figs. 9-11).

Panonychus citri: Ehara, 1956b (pp. 500-501).

Material examined: 8 ♀♀, Pusan, Oct. 25, 1987, on *Taxus cuspidata* Sieb. et Zucc.; 11 ♀♀, Chinju,

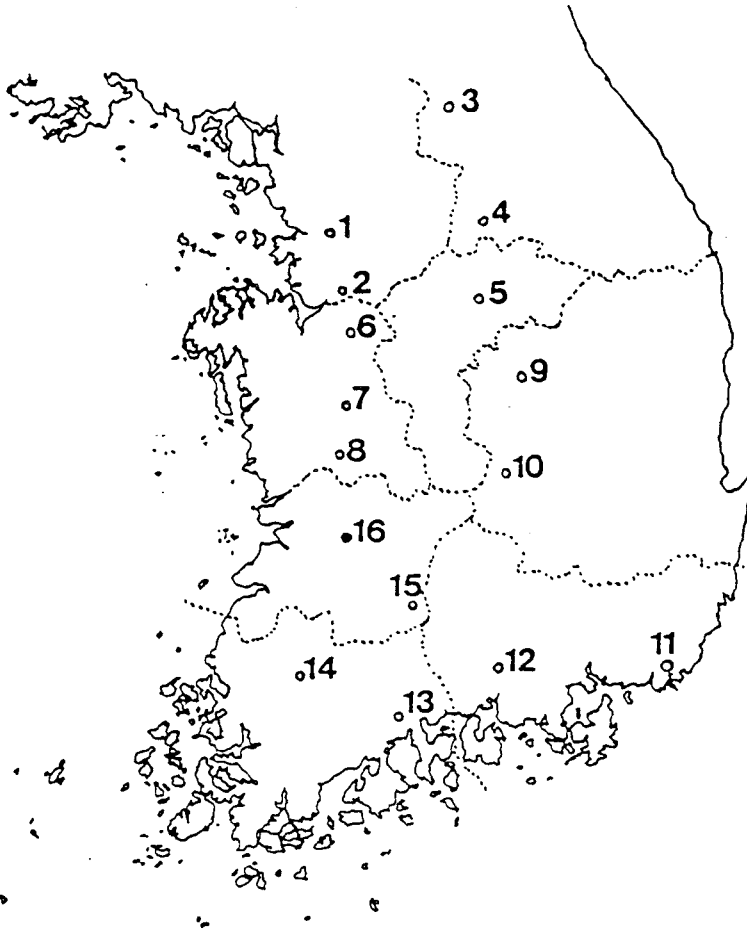


Fig. 1. Collecting localities of spider mites in Korea. 1, Suwŏn (수원); 2, P'yŏng'taek (평택); 3, Wŏnju (원주); 4, Ch'unch'ŏn (춘천); 5, Ch'ungju (충주); 6, Chŏnan (천안); 7, Kongju (공주); 8, Non-san (논산); 9, Mungyŏng (문경); 10, Kimchŏn (김천); 11, Pusan (부산); 12, Chinju (진주); 13, Sunch'ŏn (순천); 14, Kwangju (광주); 15, Inwŏl (인월); 16, Chŏnju (전주).

Oct. 24, 1987, on *T. cuspidata*; 5 ♀♀, Sunch'ŏn, Oct. 24, 1987, on *T. cuspidata*; 17 ♀♀, 2 ♂♂, Chŏnju, July 29, 1987, on *T. cuspidata*.

Remarks: This species is known to be a serious pest on citrus and also found from pear, almond, rose and other various plants. They have been reported from *Poncitrus trifoliata*, *Melia azedarach* var. *japonica*, *Cocculus trilobus* and *Cudrania tricuspidata* in Korea (Lee *et al.*, 1987). However, this is the first report of parasiting on coniferous trees. Inner sacral setae (84-120 μ m) are longer than outer sacral setae (26-46 μ m) and clunal setae (22-40 μ m). And aedeagus reveals characteristic shape of citrus red mite.

Distribution: Japan, China, Taiwan, Hongkong, Thailand, India, USSR, South Africa, South America, North America. Korea.

Genus *Oligonychus* Berlese, 1886

2. *Oligonychus clavatus* (Ehara, 1959)

(Fig. 2)

Paratetranychus clavatus Ehara, 1959 (pp. 97-100, figs. 1-13).

Oligonychus clavatus: Ehara, 1964 (p. 411); Ehara and Shinkaji, 1975 (p. 83, fig. 3-21); Ehara, 1980 (p. 283, fig. 129-B).

Material examined: 15 ♀♀, Chinju, Oct. 24, 1987, on *Pinus densiflora* Sieb. et Zucc.; 20 ♀♀, 3 ♂♂, Chōnju, May 20, 1988, on *P. densiflora*.

Description: *Female.* Reddish brown in colour. Body length (including rostrum) 424-512 (486.8)µm. Prodorsal setae(P₁)54.8µm, prodorsal setae(P₂)49.2µm, innersacral setae (IS) 44.5µm, outersacral setae (OS) 44.0µm, clunal setae (Cl) 48.5µm. Dorsal setae shorter than the distance of their bases except P₁. Spinneret with round tip and narrow base (Fig. 2-C). Peritreme simple and dilated roundly at the distal end (Fig. 2-B). Leg I 288-388 (306.7)µm, leg II 232-256 (239)µm, leg III 216-254 (237.5)µm, leg IV 226-304 (259.0)µm, tarsus I 70-94 (85.6)µm, tibia I 44-60 (51.8)µm, genu I 40-54 (48.4)µm, femur I 82-110 (93.4)µm, trochanter I 26-36 (31.4)µm. Tarsus I slender and dorsodistally provided with two adjacent sets of duplex setae; with two tactile and one sensory setae proximal to duplex setae, and with one tactile seta ventrally located at the level of the duplex setae. Tibia I with six tactile and one sensory setae. Tibia II with five tactile setae (Fig. 2D,E).

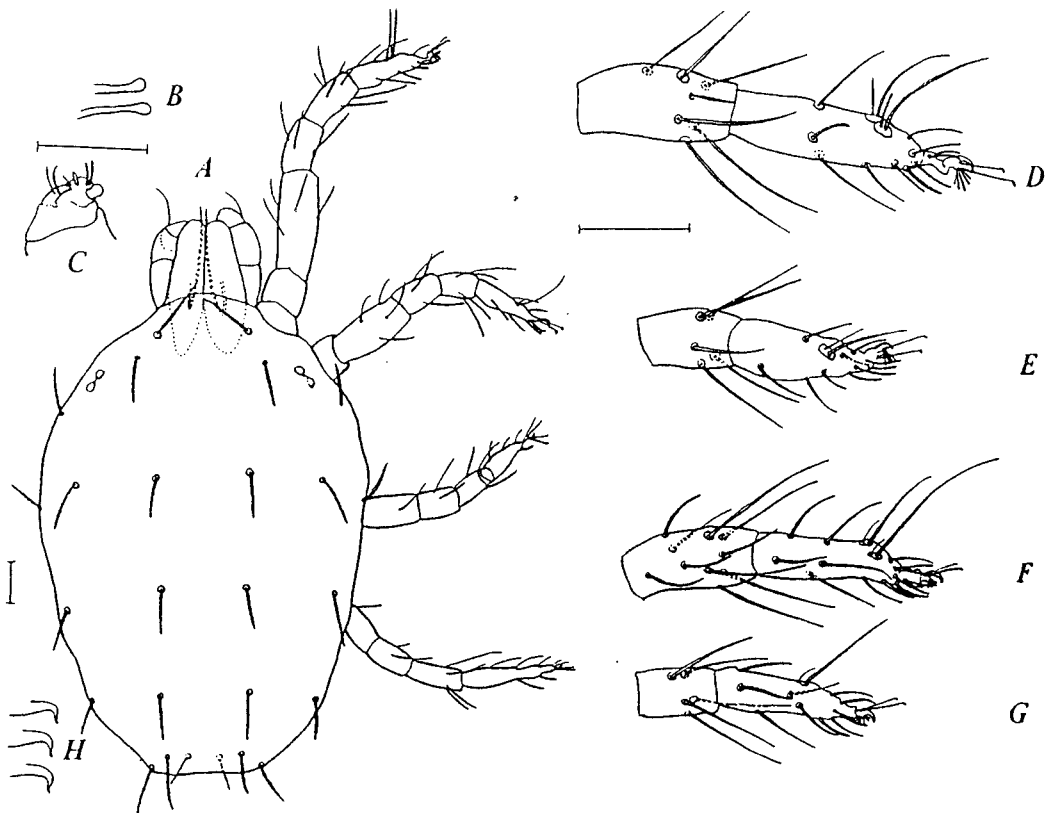


Fig. 2. *Oligonychus clavatus*. A, dorsal aspect of female; B, peritreme; C, pedipalp of female; D, tibia I and tarsus I of female; E, tibia II and tarsus II of female; F, tibia I and tarsus I of male; G, tibia II and tarsus II of male; H, aedeagus. (Scale = 50µm).

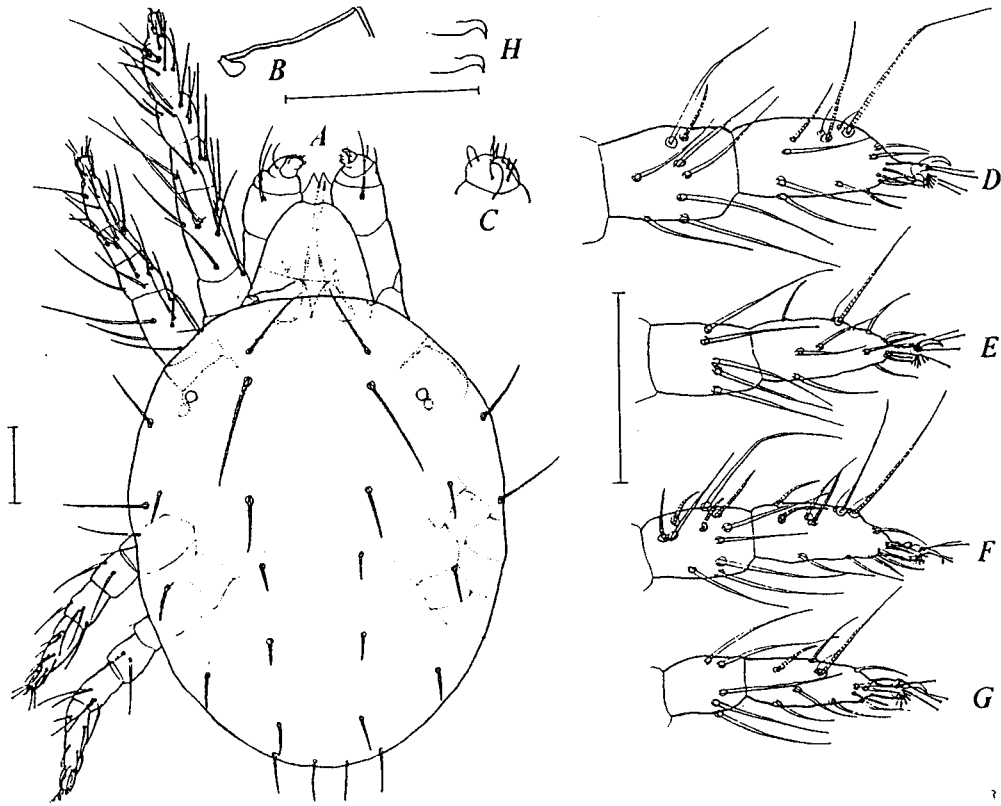


Fig. 3. *Oligonychus hondoensis*. A, dorsal aspect of female; B, peritreme; C, pedipalp of female; D, tibia I and tarsus I of female; E, tibia II and tarsus II of female; F, tibia I and tarsus I of male; G, tibia II and tarsus II of male; H, aedeagus. (Scale = 50 μ m).

Male. Body length 298 μ m, leg I 256 μ m, leg II 192 μ m, leg III 203 μ m, leg IV 220 μ m. Tibia I with seven tactile and four sensory setae and tibia II with five tactile setae (Fig. 2F,G). Aedeagus bent downward to form the distal portion which is tapering to a tip (Fig. 2H).

Remarks: This species is similar to *Oligonychus karamatus* (Ehara, 1956) at a glance, but found only on pine trees and thus lives on different host plant from the latter.

Distribution: Japan, Korea (new record).

3. *Oligonychus hondoensis* (Ehara, 1954)

(Fig. 3)

Paratetranychus hondoensis Ehara, 1954 (pp. 102-104, figs. 1-5).

Oligonychus hondoensis: Ehara, 1962 (pp. 164-165, figs. 18-21); 1966 (p. 13); Baker, 1975 (p. 916).

Material examined: 10 ♀♀, Chinju, Oct. 24, 1987, on *Cryptomeria japonica* D. Don.; 7 ♀♀, Sunchŏn, Oct. 24, 1987, on *C. japonica*; 18 ♀♀, 1 ♂, Inwŏl, Aug. 1, 1987, on *C. japonica*; 35 ♀♀, 4 ♂♂, Chŏnju, Aug. 3, 1987, on *C. japonica*.

Description: *Female*. Reddish brown in colour. Body length 256-432 (314.7) μ m. Setae on dorsal surface shorter than bases of adjacent setae and variable in length. P₁ 20-64 (40) μ m, P₂ 32-72 (51.8) μ m, IS 18-38 (28) μ m, OS 12-38 (23.5) μ m, CI 22-36 (24.3) μ m. Spinneret slender and with acute tip. Peritreme

simple and dilated at the distal end. Leg I 251.6 μ m, leg II 201.2 μ m, leg III 184.4 μ m, leg IV 210.0 μ m, tarsus I 71.0 μ m, tibia I 40.5 μ m, genu I 40.5 μ m, femur I 73.5 μ m, trochanter I 25.0 μ m. Tarsus I with three tactile and one sensory setae proximal to duplex setae. Tibia I with seven tactile and one sensory setae. Tibia II with five tactile setae.

Male. Body length 368 μ m, leg I 184 μ m, leg II 176 μ m, leg III 168 μ m, leg IV 176 μ m. Tibia I with seven tactile and four sensory setae. Tibia II with five tactile setae. Aedeagus bearing dorsally conspicuous basilar lobe; shaft posteriorly tapering and deflected to form slender and attenuate hook which is much shorter than shaft.

Remarks: Setae P₁, P₂ are longer than other dorsal setae in this species. It was highly variable in lengths of dorsal setae among specimens from different localities as mentioned by Ehara (1962). It is well known as a serious pest of Japanese cedar in Japan, but new to the fauna of Korea.

Distribution: Japan, China, Korea (new record).

4. *Oligonychus pustulosus* Ehara, 1962

(Fig. 4)

Oligonychus pustulosus Ehara, 1962 (pp. 158-160, figs. 1-11); 1964 (p. 411); Ehara and Shinkaji, 1975 (p.84, fig. 3-22).

Material examined: 43 ♀♀, 10 ♂♂, Chŏnju, May 21, 1986; May 28, 1986; Aug. 9, 1987; Aug. 3,

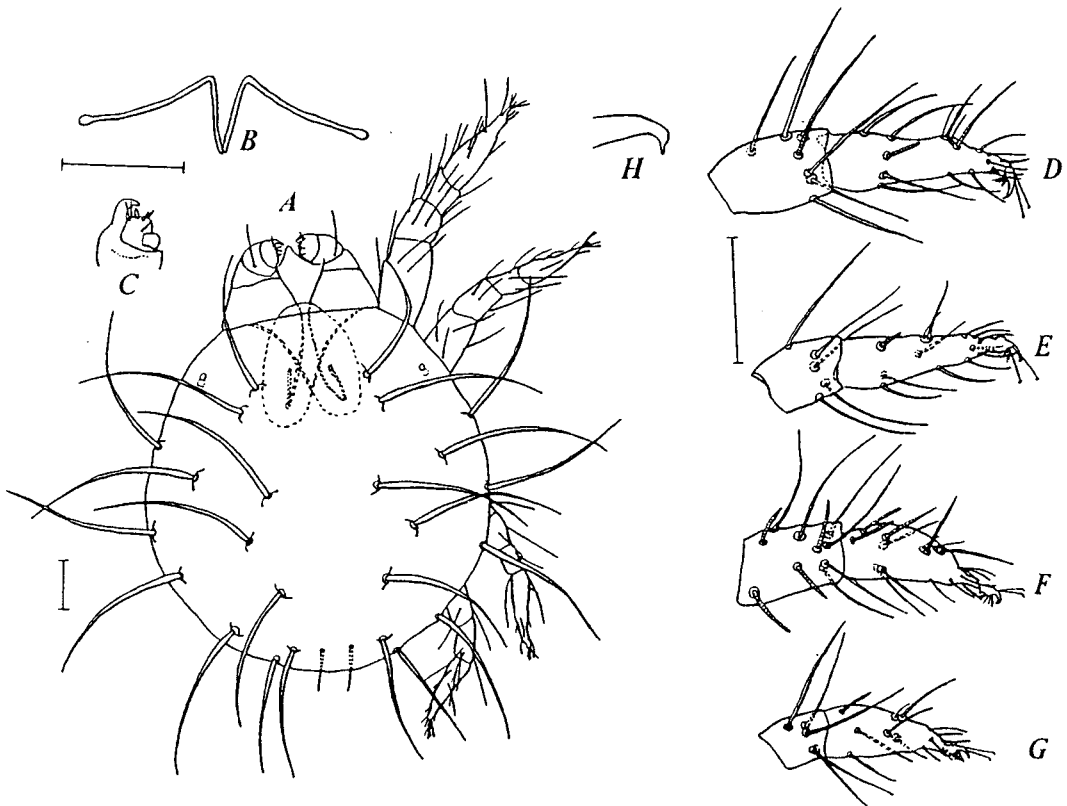


Fig. 4. *Oligonychus pustulosus*. A, dorsal aspect of female; B, peritreme; C, pedipalp of female; D, tibia I and tarsus I of female; E, tibia II and tarsus II of female; F, tibia I and tarsus I of male; G, tibia II and tarsus II of male; H, aedeagus. (Scale = 50 μ m).

1987, on *Cryptomera japonica*.

Discription: *Female*. Reddish brown in colour. Body length 416-503 (444.4) μm . Dorsal setae much longer than distance of their bases. Dorsal setae located on prominent tubercles. P_1 . 126-144 (133.3) μm , P_2 140-154 (147.0) μm , IS 112-150 (123.4) μm , OS 102-114 (107.4) μm , CI 42-46 (44) μm . Spinneret with round tip and narrow base. Peritreme simple. Leg I 272 μm , leg II 220 μm , leg III 240 μm , leg IV 242 μm , tarsus I 82.4 μm , tibia I 45.3 μm , genu I 40.9 μm , femur I 76.7 μm , trochanter I 26.0 μm . Tarsus I with four tactile and one sensory setae proximal to duplex setae. Tibia I with six tactile and one sensory setae. Tibia II with five tactile setae.

Male. Body length 328 μm , leg I 200 μm , leg II 176 μm , leg III 184 μm , leg IV 192 μm . Tibia I with six tactile and four sensory setae. Tibia II with five tactile setae. Aedeagus bent downward to form the hook which attenuates to a tip abruptly.

Remarks: This species shares same host plant (*C. japonica*) with *O. hondoensis*. It is new to Korean fauna.

Distribution: Japan, Korea (new record).

5. *Oligonychus karamatus* (Ehara, 1956)

(Fig. 5)

Paratetranychus karamatus Ehara, 1956 (p. 247, figs. 5-10).

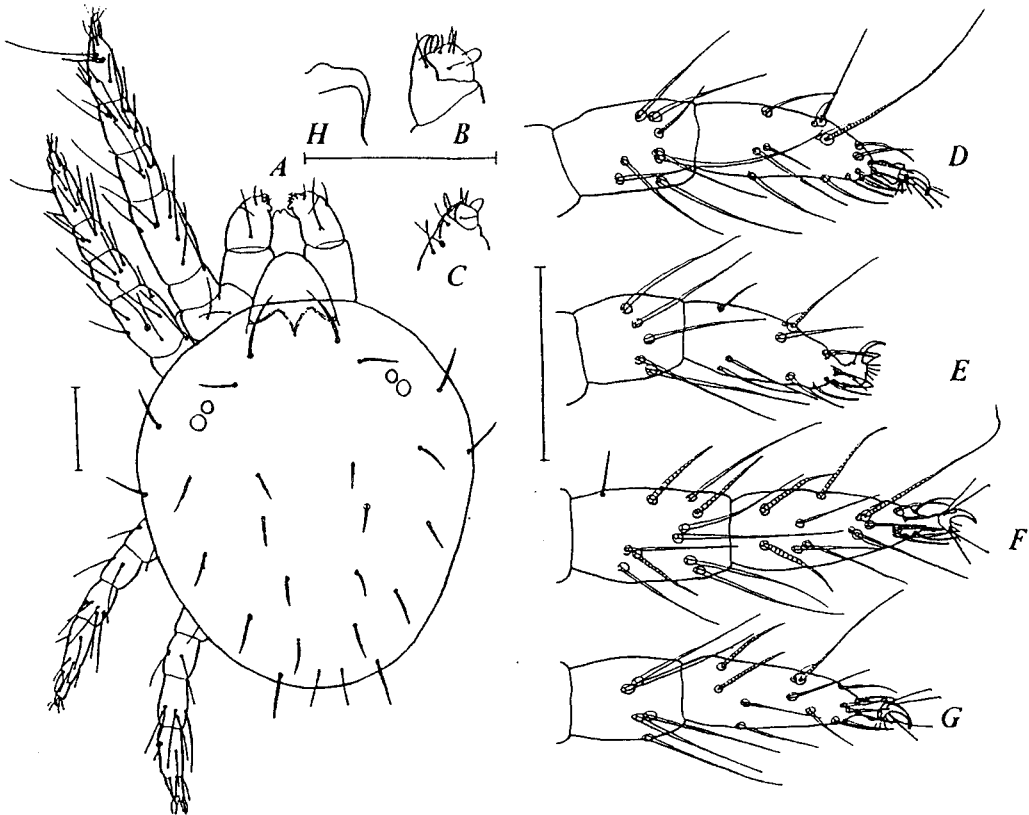


Fig. 5. *Oligonychus karamatus*. A, dorsal aspect of female; B, peritreme; C, pedipalp of female; D, tibia I and tarsus I of female; E, tibia II and tarsus II of female; F, tibia I and tarsus I of male; G, tibia II and tarsus II of male; H, aedeagus. (Scale = 50 μm).

Oligonychus karamatus: Ehara, 1962 (pp. 161-163, figs. 12-15); 1964 (p.411); Ehara, 1980 (p.283, fig. 129-B).

Material examined: 5 ♀♀, Mun-gyōng, Oct. 3, 1987, on *Laryx leptolepsis* (Sieb. et Zucc.); 19 ♀♀, 2 ♂♂, Inwōl, Aug. 1, 1987, on *L. leptolepsis*.

Measurements: *Female.* Body length 424-560 (473.6)μm. P₁ 54-68 (60.8)μm, P₂ 32-48 (41.6)μm, IS 34-44 (40.0)μm, OS 40-50 (44.0)μm, CI 18-36 (30.2)μm. Leg I 288.8μm, leg II 241.6μm, leg III 245.4μm, leg IV 274.0μm, tarsus I 85.6μm, tibia I 48.6μm, genu I 46.2μm, femur I 88.4μm, trochanter I 20.4μm.

Male. Body length 401μm, leg I 295μm, leg II 245μm, leg III 251μm, leg IV 295μm.

Remarks: This species has been reported by Koh(1970) and Han(1977) from *L. leptolepis*. Measurements and new localities in Korea are presented here.

Distribution: Japan, USSR, North America, Korea.

6. *Oligonychus perditus* Pritchard and Baker, 1955.

(Fig. 6)

Oligonychus perditus Pritchard and Baker, 1955 (pp. 316-318, figs. 270-273); Ehara, 1962 (pp. 165-168, figs. 270-273); Baker, 1975 (p.917); Ehara, 1969 (pp. 93-94, fig. 38).

Material examined: 25 ♀♀, 1 ♂♂, Suwōn, Aug. 13, 1987, on *Thuja orientalis* Linne; 10 ♀♀, P'yōng'taek, Aug. 14, 1987, on *Th. orientalis*; 7 ♀♀, Ch'unch'ōn, Oct. 2, 1987 on *Juniperus chinensis* Linné; 15 ♀♀,

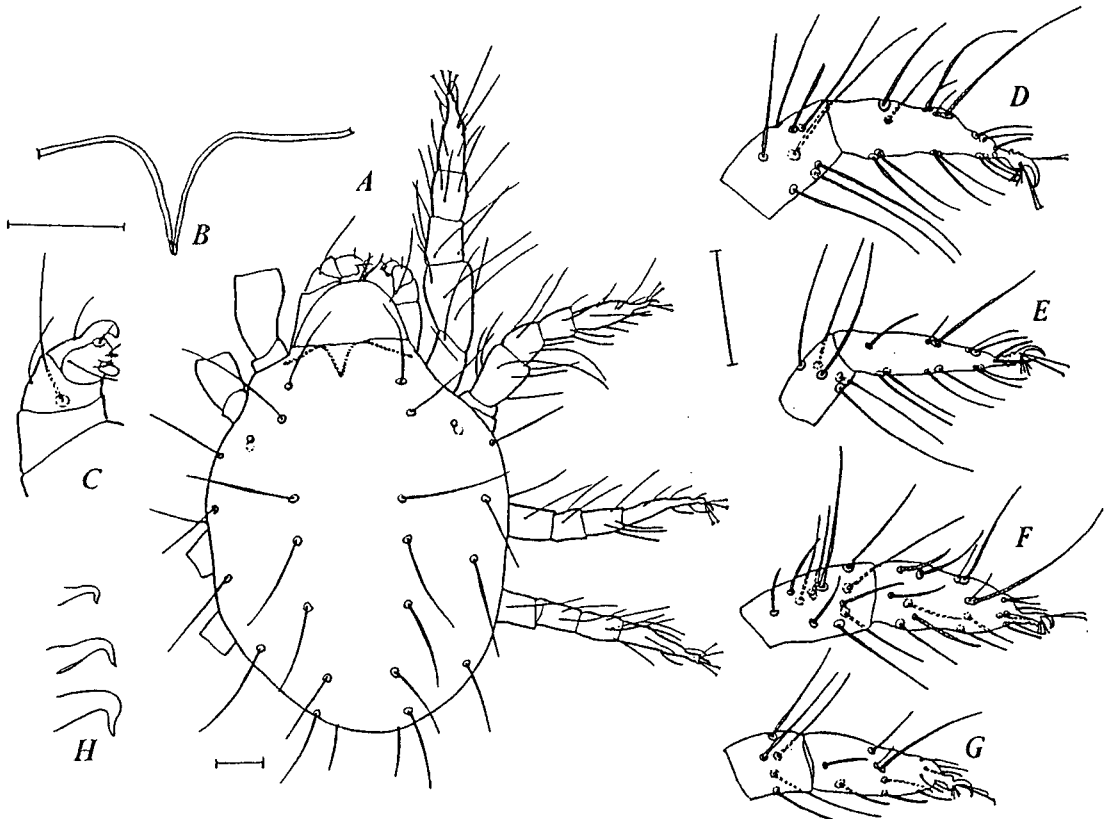


Fig. 6. *Oligonychus perditus*. A, dorsal aspect of female; B, peritreme; C, pedipalp of female; D, tibia I and tarsus I of female; E, tibia II and tarsus II of female; F, tibia I and tarsus I of male; G, tibia II and tarsus II of male; H, aedeagus. (Scale = 50μm).

2 ♂♂, Wŏnju, Oct. 3, 1987, on *J. chinensis*; 32 ♀♀, 3 ♂♂, Ch'ungju, Oct. 3, 1987, on *Th. orientalis*, *J. chinensis*, *Juniperus rigida* Sieb. et Zucc.; 12 ♀♀, Chŏnan, Aug. 14, 1987, on *J. chinensis*; 15 ♀♀, Kongju, Aug. 14, 1987, on *Taxus cuspidata*, *Chamaecyparis pisifera* (Sieb. et Zucc.); 23 ♀♀, 1 ♂♂, Non-san, Aug. 14, 1987, on *Th. orientalis*, *J. chinensis*; 18 ♀♀, Mun-gyŏng, Oct. 3, 1987, on *Th. orientalis*, *J. chinensis*; 32 ♀♀, 1 ♂♂, Pusan, Oct. 25, 1987, on *Th. orientalis*, *J. rigida*, *J. chinensis*, *Chamaecyparis obtusa* (Sieb. et Zucc.); 16 ♀♀, 1 ♂♂, Chinju, Oct. 24, 1987, on *J. chinensis*; 23 ♀♀, Sunchŏn, Oct. 24, 1987, on *T. cuspidata*, *J. chinensis*, *Th. orientalis*; 17 ♀♀, 1 ♂♂, Kwangju, Oct. 23, 1987, on *Ch. obtusa*, *J. chinensis*; 31 ♀♀, 1 ♂♂, Inwŏl, Aug. 1, 1987, on *Cryptomeria japonica*; 9 ♀♀, Chŏnju, Aug. 8, 1987, on *J. chinensis*, *J. rigida*.

Measurements: *Female.* Body length 336-440 (384) μm , P₁ 52-80 (70.6) μm , P₂ 72-116 (95.6) μm , IS 58-86 (70.8) μm , OS 56-78 (65.8) μm , CI 28-42 (33.4) μm . Leg I 243.2 μm , leg II 191.2 μm , leg III 199.2 μm , leg IV 216.5 μm , tarsus I 72.0 μm , tibia I 41.0 μm , genu I 35.6 μm , femur I 75.6 μm , trochanter I 19.0 μm .

Male. Body length 368-376 μm , leg I 237 μm , leg II 192 μm , leg III 199 μm , leg IV 214 μm .

Remarks: This species has been reported from chinese juniper by Koh (1970) and Han (1977). Measurements, new host plants and new localities in Korea are presented here.

Distribution: Japan, Taiwan, Hongkong, Korea.

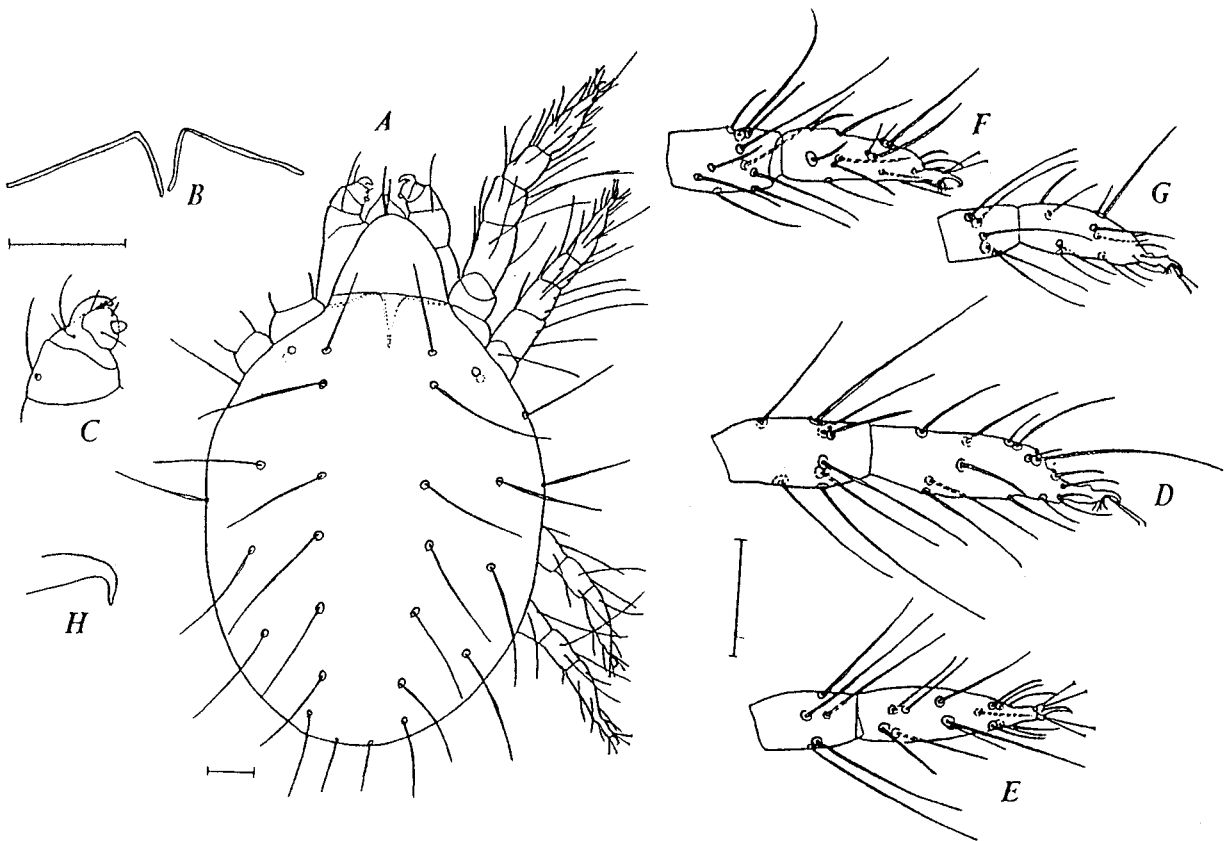


Fig. 7. *Oligonychus ununguis*. A, dorsal aspect of female; B, peritreme; C, pedipalp of female; D, tibia I and tarsus I of female; E, tibia II and tarsus II of female; F, tibia I and tarsus I of male; G, tibia II and tarsus II of male; H, aedeagus. (Scale = 50 μm).

7. *Oligonychus ununguis* (Jacobi, 1905) (Fig. 7)

Tetranychus ununguis Jacobi, 1905 (p. 239).

Oligonychus ununguis Pritchard and Baker, 1955 (pp. 319-327, figs. 274-277); Ehara, 1962 (pp. 168-171, figs. 30-36); 1969 (pp. 93-94, fig. 38); Gutierrez and Schicha, 1983 (p. 107, fig. 6).

Material examined: 42 ♀♀, 3 ♂♂, Suwŏn, Aug. 13, 1987, on *Abies holophylla* Max., *Pinus koraiensis* Sieb. et Zucc., *Picea abies* Karst., *Juniperus chinensis*, *Chamaecyparis pisifera*; 14 ♀♀, P'yongt'aek, Aug. 14, 1987, on *A. holophylla*, *J. rigida*; 12 ♀♀, Ch'unch'ŏn, Oct. 23, 1987, on *A. holophylla*; 27 ♀♀, 1 ♂♂, Ch'ungju, Oct. 3, 1987, on *A. holophylla*, *P. koraiensis*, *Pinus parviflora* Sieb. et Zucc.; 9 ♀♀, Chŏnan, Aug. 14, 1987, *Pinus thunbergii* Parl., *Pinus strobus* Linne; 13 ♀♀, Kongju, Aug. 14, 1987, on *A. holophylla*, *Picea jezoensis* Carruter; 19 ♀♀, 1 ♂♂, Nonsan, Aug. 14, 1987, on *P. strobus*, *A. holophylla*; 7 ♀♀, Kimch'ŏn, Oct. 4, 1987, on *Ch. pisifera*; 25 ♀♀, Pusan, Oct. 25, 1987, on *Ch. pisifera*, *Picea jezoensis*; 33 ♀♀, 2 ♂♂, Chinju, Oct. 24, 1987, on *Th. orientalis*, *C. obtusa*, *Ch. pisifera*, *A. holophylla*, *Abies firma* Sieb. et Zucc., *T. cuspidata*; 11 ♀♀, Sunch'ŏn, Oct. 24, 1987, on *Ch. pisifera*, *A. holophylla*; 8 ♀♀, Kwangju, Oct. 23, 1987, on *Juniperus virginiana* Linné., *P. thunbergii*; 36 ♀♀, 5 ♂♂, Chŏnju, Aug. 29, 1987, on *Th. orientalis*, *A. holophylla*, *P. abies*, *T. cuspidata*.

Measurements: *Female.* Body length 384-504 (441.6)μm, P₁ 72-100 (82.8)μm, P₂ 86-132 (111.6)μm, IS 82-120 (98.2)μm, OS 70-100 (84.0)μm, CI 36-64 (51.7)μm. Leg I 256.2μm, leg II 100.8μm, leg III 217.8μm, leg IV 232.4μm, tarsus I 78.8μm, tibia I 46.0μm, genu I 37.1μm, femur I 77.5μm, trochanter I 19.6μm.

Male. Body length 352-368 (360)μm, leg I 242μm, leg II 200μm, leg III 204μm, leg IV 200μm.

Remarks: This species has been reported from fir trees by Koh(1970) and Han(1977). Measurements, new host plants and new localities in Korea are presented here. Materials examined in this study showed variation in number of sensory setae on tibia I and tarsus I of female. One specimen collected from Chŏnju differ in number of sensory setae between left and right leg of same individual.

Distribution: Japan, Taiwan, China, Mexico, Australia, Europe, North America, Korea.

ABSTRACT

Specimens of spider mites parasiting on conifer trees were collected from Korea during the period from May, 1986 to June, 1988. As a result, seven species belonging to the tribe Tetranychini, subfamily Tetranychinae, family Tetranychidae were identified as follows:

1. *Panonychus citri* (McGregor, 1916), *2. *Oligonychus clavatus* (Ehara, 1959), *3. *O. hondoensis* (Ehara, 1954), *4. *O. pustulosus* Ehara, 1962, 5. *O. karamatus* (Ehara, 1956), 6. *O. perditus* Pritchard and Baker, 1955, 7. *O. ununguis* (Jacobi, 1905).

Of which, three species with asterisk are newly recorded from Korea.

REFERENCES

- Ins. Rpt., **25**: 911-921.
- Ehara, S., 1954. Two new spider mites parasitic on Japanese conifers. Annot. Zool. Jap., **27**: 102-106.
- Ehara, S., 1955. On two new spider mites parasitic on Japanese citrus. Annot. Zool. Jap., **28**: 178-182.
- Ehara, S., 1956a. Some spider mites from northern Japan. J. Fac. Sci. Hokkaido Univ. Ser. 6 Zool., **12**: 244-258.
- Ehara, S., 1956b. Tetranychoid mites of mulberry in Japan. J. Fac. Sci. Hokkaido Univ. Ser. 6 Zool., **12**: 499-510.
- Ehara, S., 1959. Description of a new spider mite attacking Japanese pines. Annot. Zool. Jap., **32**: 97-100.
- Ehara, S., 1962. Tetranychoid mites of conifers in Hokkaido. J. Fac. Sci. Hokkaido Univ. Ser. 6 Zool., **15**: 157-175.
- Ehara, S., 1964. The tetranychoid mites of Japan. *Acarologia*, **5** (fasc. h. s.): 409-414.
- Ehara, S., 1969. The tetranychoid mites of Taiwan (Acarina: Prostigmata). J. Fac. Educ. Tottori Univ. Nat. Sci., **20**: 79-103.
- Ehara, S., 1970. Four species of the *Carpini* complex of *Eotetranychus* in Japan (Acarina: Tetranychidae). J. Fac. Educ. Tottori Univ. Nat. Sci., **21**: 132-141.
- Ehara, S., 1980. Illustration of the mites and ticks of Japan (Edit.). Zenkoku Noson Kyoiku Kyokai, Tokyo. pp. 1-562 (in Japanese).
- Ehara, S. and N. Shinkaji, 1975. An introduction to agricultural acarology. Zenkoku Noson Kyoiku Kyokai, Tokyo. pp. 1-328 (in Japanese).
- Gutierrez, J. and E. Schicha, 1983. The spider mite family Tetranychidae (Acari) in New South Wales. *Intl. J. Acarol.*, **9**: 99-116.
- Han, K.P., 1970. Studies on the mites (III). Mites of persimmon and citrus. *Kor. J. Plant prot.*, **9**: 33-35 (in Korean).
- Han, K.P., 1977. Studies on the mites (IV). Kangwon Univ. Thesis Coll., **11**: 203-206 (in Korean).
- Jacobi, A., 1905. Eine Spinnmilbe (*Tetranychus ununguis* n. sp.) als Koniferenschadling. *Naturw. Zts. Land. Forst.*, **3**: 239-247.
- Koh, J.H., 1970. On the newly found leaf mites as pests of conifers. *Forest prot.*, **60**: 38-43 (in Korean).
- Lee, W.K., B.H. Lee and Y.J., Kim, 1986. Taxonomic study on spider mites (Tetranychidae: Acarina) of Korea. *Kor. J. Syst. Zool.*, **2**: 13-26 (in Korean).
- Lee, W.K., B.H. Lee, Y.J. Kim and D.W. Kang, 1987. Taxonomic studies on spider mites (Tetranychidae: Acarina) of Korea II. Spider mite parasitic on wild plants. *Kor. J. Syst. Zool.*, **3**: 95-116 (in Korean).
- Lee, J.S. and W.K. Lee, 1987. A taxonomic study on the false spider mites (Acarina: Tenuipalpidae) of Korea. *Chonbuk Nat. Univ. Thesis Coll.*, **29**: 333-340 (in Korean).
- Lee, J.S., 1988. A study on the taxonomy and isozymes of false spider mites (Acarina: Tenuipalpidae) from Korea. *Kor. J. Zool.*, **31**: 147-155 (in Korean).
- McGregor, E.A., 1916. The citrus mite named and described for the first time. *Ann. Ent. Soc. Amer.*, **9**: 284-290.
- Pritchard, A.E. and E.W. Baker, 1955. A revision of the spider mite family Tetranychidae. *Pac. Coast Entomol. Soc., Mem. Ser.*, **2**: 1-472.

RECEIVED: 7 APRIL 1989

ACCEPTED: 4 MAY 1989