

Study on the Tarsonemid Mites (Acari: Tarsonemidae) from Korea. I. Five Unrecorded Species of *Tarsonemus*

한국산 먼지응애류에 관한 연구.

I. *Tarsonemus*속 5미기록종

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ABSTRACT In a survey of mites associated with ornamental trees in 1992 and 1993, five *Tarsonemus* species unrecorded in Korea were identified. They are *Tarsonemus confusus* Ewing, 1939, *T. occidentalis* Ewing, 1939, *T. sasai* Ito, 1962, *T. scaurus* Ewing, 1939, and *T. waitei* Banks, 1912. Morphological characteristics and host ranges of these species are reported.

KEY WORDS Ornamental tree, Tarsonemidae, *Tarsonemus*, Taxonomy

초 록 花木類 및 觀賞樹에 寄生하는 응애류에 대한 1992년 및 1993년의 調査에서 *Tarsonemus*屬의 國內未記錄 5種이 동정되었다. *Tarsonemus confusus* Ewing, 1939, *T. occidentalis* Ewing, 1939, *T. sasai* Ito, 1962, *T. scaurus* Ewing, 1939, *T. waitei* Banks, 1912의 形態的 特徵과 寄主範圍에 대하여 報告한다.

검색어 관상수, 먼지응애과, 먼지응애속, 분류

Among many families of Acari, Tarsonemidae comprises a relatively highly derived group of mites having a greater diversity of feeding habits. Tarsonemidae includes feeders of vascular plants, fungivores, algivores, predators of other mites, and parasites of insects (Lindquist 1986). More than 300 species have been recorded in Tarsonemidae from the world. The broad mite, *Polyphagotarsonemus latus*, and the cyclamen mite, *Phytonemus pallidus* are the most important species in agriculture and have worldwide distribution with wide host ranges. Occurrence of these two species had been reported in Korea (Cho 1993, Cho *et al* 1993, Lee 1965, Lee *at al.* 1992)

Studies on the other species of Tarsonemidae are very rare in Korea Goo & Cho (1989) described *Tarsonemus floricolus* and *T. fusari* found in hospi-

tal laboratory. Lee & Yu (1988) reported associations of *Tarsonemus* spp. with apple fruits. *Tarsonemus* species associated with plants have not been studied in Korea.

During a survey on mites associated with ornamental trees, tarsonemid mites were found from most of all samples. Among them, five *Tarsonemus* species unrecorded in Korea were newly identified and their morphological characteristics and host ranges are reported herein.

MATERIALS AND METHODS

Tree samples were taken from ornamental trees planted in experimental fields of Forest Environment Research Institutes of 8 provinces in Korea, in Sept., 1992, and Aug., 1993. Twigs of trees showing dis-

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coloration and abnormal growth were cut by scissors and transported to laboratory in white plastic bags. Leaves of deciduous trees were directly examined under stereomicroscope. Mites were picked up by fine plastic needle and fixed in 80% alcohol solution. Twigs of conifers were held by hand on white paper and mites were shaken off by wood stick. Mites dropped on the paper were collected and fixed.

Permanent slides were prepared using Hoyer's mounting solution (50 g distilled water, 30 g gum arabic, 200 g chloral hydrate, 20 g glycerin), and examined under differential interference contrast microscope. Drawings were done using drawing tube

Two or more species were usually mixed in one tree sample and following descriptions are based on either males or both sexes of each species. Morphological characteristics of apodemes and 4th legs of males are important keys in identifying *Tarsonemus* species. Measurements are in μm .

RESULTS

The present materials have been determined to comprise five species as follows *Tarsonemus confusus*, *T. occidentalis*, *T. sasai*, *T. scaurus*, and *T. waiti* were collected from 23, 5, 4, 18 and 11 species of ornamental trees, respectively. Their host plants and collection sites are listed in Table 1.

Taxonomic Position of *Tarsonemus* Species

Family Tarsonemidae Canestrini & Fanzago, 1877. 먼지응애과

Subfamily Tarsoneminae Canestrini & Fanzago, 1877. 먼지응애亞科

Tribe Tarsonemini Canestrini & Fanzago, 1877. 먼지응애族

Genus *Tarsonemus* Canestrini & Fanzago, 1877. 먼지응애屬

1. *Tarsonemus confusus* Ewing, 1939. 구상나무 먼지응애 (新稱)
2. *T. occidentalis* Ewing, 1939. 동백나무 먼지응애 (新稱)
3. *T. sasai* Ito, 1962. 편백먼지응애 (新稱)
4. *T. scaurus* Ewing, 1939. 독일가문비먼지응애 (新稱)
5. *T. waiti* Banks, 1912. 화백먼지응애 (新稱)

DESCRIPTION

1. *Tarsonemus confusus* Ewing, 1939

구상나무먼지응애 (新稱) (Figs. 1-4, Table 1)

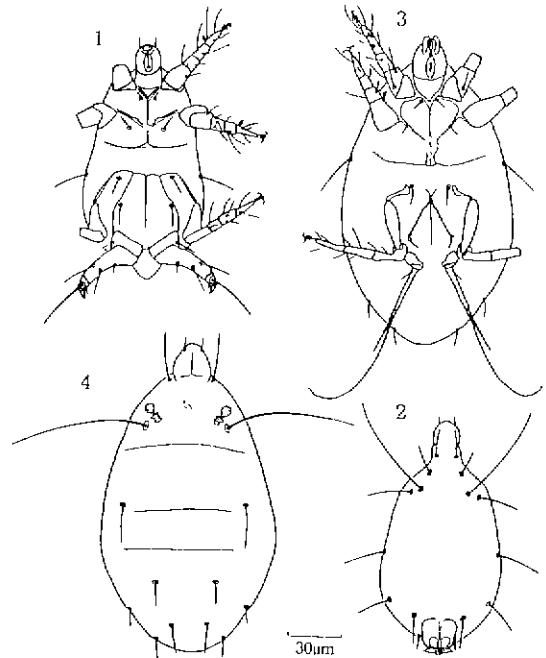
Materials examined. 7♂♂, 7♀♀, *Juniperus virginiana* L., Aug. 26, 1993, Taejŏn.

Male. Measurements: Body length 148 (143-151), body width 77 (72-83), leg I 57 (54-59), leg II 54 (52-56), leg III excluding coxa 55 (52-57), leg IV excluding coxa 39 (35-43), width at base of femur IV 16 (13-18), length of tactile seta 31 (28-35).

Morphological characteristics same as described by Ewing (1939) and Ito (1965).

Body elongate and whitish yellow in color. Basal part of the leg IV with inner margin angulated. Apodemes III and IV well developed to the anterior extremities. Apodemes III and IV connected each other and with poststernal apodeme. Coxisternal plate IV much wider at posterior part than anterior part

Female. Measurements: Body length 192 (176-211), body width 107 (92-116), leg I 58 (56-60), leg II 55 (52-57), leg III excluding coxa 61 (59-62), coxa to third segment of leg IV 30 (29-30), fourth



Figs. 1-4. *Tarsonemus confusus*. 1-2 Male, ventral and dorsal view; 3-4 Female, ventral and dorsal view.

Table 1. Host plants and collection sites of *Tarsonemus* species

Species	Host plants	Localities
<i>Tarsonemus confusus</i>	<i>Abies holophylla</i> Maxim. (갯나무)	Naju
	<i>Abies koreana</i> Wilson(구상나무)	Chunchön, Naju, Chöngju
	<i>Acer palmatum</i> Thunb.(단풍나무)	Chunchön, Naju
	<i>Cephalotaxus koreana</i> Naka(개비자나무)	Pochön
	<i>Chamaecyparis pisifera</i> Endl.(화백)	Chöngju, Chönju
	<i>Chamaecyparis obtusa</i> var <i>filifera</i> B. et H.(실편백)	Chöngju
	<i>Cryptomeria japonica</i> D. Don(삼나무)	Chöngju
	<i>Fraxinus rhynchophylla</i> Hance(물푸레나무)	Chöngju, Chönju
	<i>Fraxinus sieboldiana</i> Blume(쇠물푸레)	Chöngju
	<i>Ilex serrata</i> Thunb.(낙상홍)	Chöngju
	<i>Juniperus chinensis</i> L.(향나무)	Taejön
	<i>Juniperus virginiana</i> L.(연필향나무)	Taejön
	<i>Magnolia kabus</i> A. P. DC.(목련)	Taejön, Chöngju, Chönju
	<i>Picea abies</i> (L.) Karst(독일가문비)	Taejön, Chöngju, Chönju
	<i>Pinus koraiensis</i> Sieb. et Zucc.(잣나무)	Chunchön, Chönju
	<i>Pinus parviflora</i> Sieb. et Zucc(섬잣나무)	Taejön, Chönju, Chunchön
	<i>Pinus strobus</i> L.(스트로브잣나무)	Chönju
	<i>Pinus thunbergii</i> Parl(해송)	Chöngju
	<i>Prunus yedoensis</i> Mat.(왕벚나무)	Naju
	<i>Rhododendron schlippenbachii</i> Maxim(철쭉나무)	Naju, Chöngju
	<i>Symplocos chinensis</i> for. <i>pilosa</i> (Nak) Ohwi(노린재나무)	Taejön
<i>Taxus cuspidata</i> Sieb. et Zucc(주목)	Chunchön, Chöngju	
<i>Thuja occidentalis</i> L(서양측백)	Taejön, Chöngju	
<i>Tarsonemus occidentalis</i>	<i>Camellia japonica</i> L.(동백나무)	Seoul
	<i>Chamaecyparis obtusa</i> Sieb. et Zucc(편백)	Taejön
	<i>Juniperus chinensis</i> L.(향나무)	Taejön, Pochön
	<i>Pinus koraiensis</i> Sieb. et Zucc.(잣나무)	Osan
<i>Thuja orientalis</i> for <i>sieboldii</i> Rehder(천지백)	Taejön	
<i>Tarsonemus sasai</i>	<i>Chamaecyparis obtusa</i> Sieb. et Zucc(편백)	Taejön
	<i>Chamaecyparis obtusa</i> var <i>filifera</i> B. et H.(실편백)	Taejön
	<i>Fraxinus rhynchophylla</i> Hance(물푸레나무)	Taejön
	<i>Rhododendron schlippenbachii</i> Maxim(철쭉나무)	Chöngju
<i>Tarsonemus scaurus</i>	<i>Abies koreana</i> Wilson(구상나무)	Chöngju
	<i>Acer palmatum</i> var. <i>amoenum</i> cv. <i>sanguinum</i> Nak.(홍단풍)	Naju
	<i>Chamaecyparis obtusa</i> var. <i>filifera</i> B. et H.(실편백)	Chöngju
	<i>Chamaecyparis obtusa</i> Sieb. et Zucc.(편백)	Chöngju
	<i>Cryptomeria japonica</i> D. Don(삼나무)	Chönju
	<i>Fraxinus rhynchophylla</i> Hance(물푸레나무)	Chöngju
	<i>Juniperus chinensis</i> L.(향나무)	Chönju
	<i>Juniperus ridiga</i> Sieb. et Zucc.(노간주나무)	Chöngju
	<i>Magnolia kobus</i> A. P. DC.(목련)	Chönju
	<i>Picea abies</i> (L.) Karst.(독일가문비)	Chöngju, Chönju
	<i>Pinus banksiana</i> Lambert(방크스소나무)	Naju
	<i>Pinus densiflora</i> Sieb. et Zucc.(소나무)	Naju
	<i>Pinus koraiensis</i> Sieb. et Zucc(잣나무)	Chönju
	<i>Pinus parviflora</i> Sieb. et Zucc(섬잣나무)	Taejön
	<i>Pinus sylvestris</i> L.(구주소나무)	Chönju
	<i>Pinus thunbergii</i> Parl.(해송)	Chönju
	<i>Pinus virginiana</i> Mill(버지니아소나무)	Chöngju
<i>Taxus cuspidata</i> Sieb. et Zucc(주목)	Chönju	

Table 1. Continued

Species	Host plants	Localities
<i>Tarsonemus waitei</i>	<i>Chamaecyparis obtusa</i> Sieb. et Zucc.(편백)	Chinju, Chŏnju
	<i>Chamaecyparis pisifera</i> Sieb. et Zucc.(화백)	Chinju, Naju
	<i>C. pisifera</i> var. <i>filifera</i> B et H.(실화백)	Chinju
	<i>C. pisifera</i> var. <i>plumosa</i> for <i>aurea</i> Beiss(황금애기화백)	Chinju
	<i>Cryptomeria japonica</i> D. Don(삼나무)	Chinju
	<i>Juniperus chinensis</i> L.(향나무)	Chunchŏn
	<i>Juniperus scopulorum</i> Sarg.(스카이로켓)	Chinju
	<i>Magnolia kobus</i> A P DC.(목련)	Naju
	<i>Pittosporum tobira</i> Alt.(돈나무)	Chinju
	<i>Podocarpus macrophyllus</i> Lamb.(개금송)	Chinju
	<i>Taxus cuspidata</i> Sieb. et Zucc.(주목)	Chunchŏn

segment of leg IV 8 (8-8), subapical seta of fourth segment 26 (25-27).

Body oval shape and yellowish in color. Prosternal apodeme well developed, connected with apodemes I, and weakly connected with apodemes II and sejugal apodeme. Sejugal apodeme well developed without any interruption. Poststernal apodeme directly diverge anteriorly from the union with apodemes IV.

Distribution. Korea, Japan, North America, Europe.

2. *Tarsonemus occidentalis* Ewing, 1939

동백나무편지용애(新稱) (Figs. 5-7, Table 1)

Materials examined. 2♂♂, *Thuja orientalis* for *sieboldii* Rehder, Aug. 26, 1993, Taejŏn. 2♀♀, *Chamaecyparis obtusa* Sieb et Zucc., Aug. 26, 1993, Taejŏn.

Male. Measurements: Body length 170 (161-178), body width 87 (80-94), leg I 55 (51-60), leg II 51 (49-54), leg III excluding coxa 59 (54-65), leg IV excluding coxa 51 (48-60), width at base of femur IV 16 (16-17), length of tactile seta 25 (22-27).

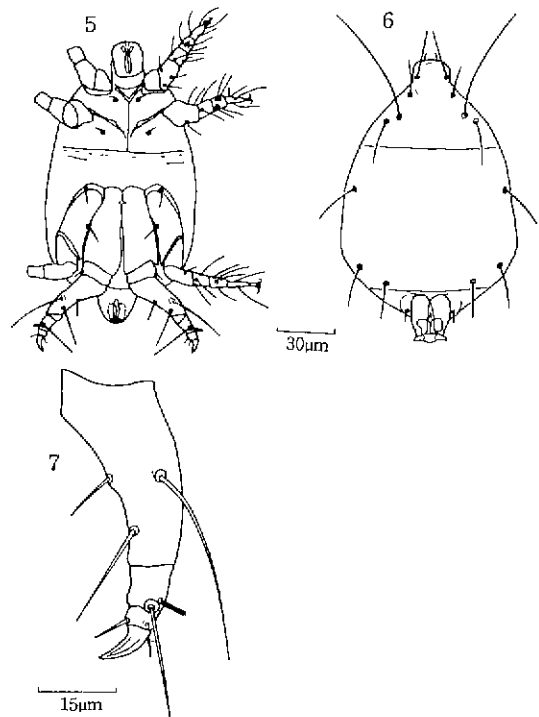
Morphological characteristics same as described by Ewing (1939) and Ito (1963).

Body longer than wide and pale yellow in color. Apodemes III and IV connected each other and with the poststernal apodeme. The anterior extrimities of the coxisternal plates III slightly narrower than at the posterior ends. Width of coxisternal plates III and IV similar. Legs IV well developed. Femur IV

angulated near the base and with long outer distal femoral seta longer than the tactile seta. Tarsal claw strongly developed.

Distribution. Korea, Japan, North America.

Remarks. This species was associated with *Ca-*



Figs. 5-7. *Tarsonemus occidentalis*, male; 5. Ventral view, 6 Dorsal view; 7. Leg IV enlarged, femur to tarsal claw

mellia japonica L. showing leaf discoloration and growth retardation symptoms. The trees were commercially grown in pots under protected structure at suburb of Seoul. Adults and larvae were found from new buds and small flower buds.

3. *Tarsonemus sasai* Ito, 1962

편백면지응애(新稱) (Figs. 8-11, Table 1)

Materials examined. 3♂♂, *Chamaecyparis obtusa* Sieb et Zucc., Aug. 26, 1993, Taejŏn. 2♂♂, *Chamaecyparis obtusa* var. *filifera* B. et H., Aug. 24, 1993, Chŏngju. 2♂♂, *Fraxinus rhynchophylla* Hance, Aug. 26, 1993, Taejŏn.

Male. Measurements: Body length 131 (114-148), body width 63 (56-73), leg I 47 (45-52), leg II 47 (45-51), leg III excluding coxa 48 (45-52), leg IV excluding coxa 39 (37-43), width at base of femur IV 11 (10-13), length of tactile seta 27 (25-30).

Morphological characteristics same as described by Ito (1962, 1964).

Body elongate and whitish yellow in color. Femur IV with inner flange-like expansion and annulated outer distal femoral seta. Tarsal claw of leg IV re-

duced to a knob-like shape.

Distribution. Korea, Japan.

Remarks. This species has relatively small body compared to the other species described in this paper. Male of this species is easily distinguished by its shape of leg IV.

4. *Tarsonemus scaurus* Ewing, 1939

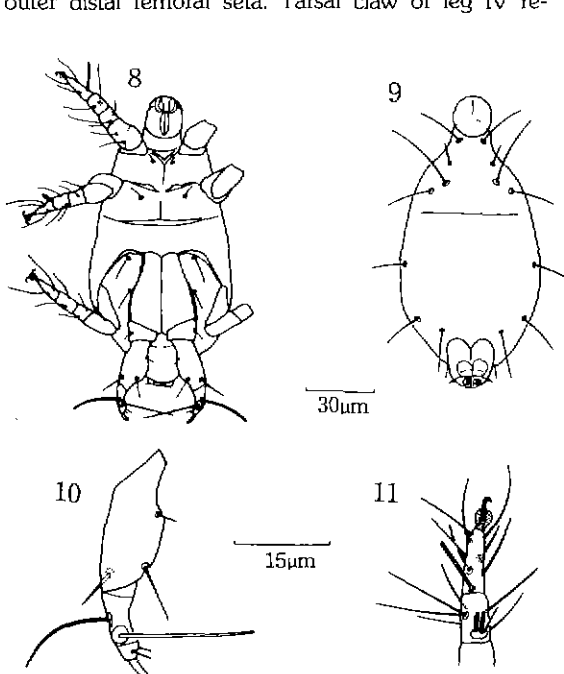
독일가문비면지응애(新稱) (Figs. 12-15, Table 1)

Materials examined. 4♂♂, 8♀♀, *Juniperus rigida* Sieb et Zucc., Aug. 24, 1993, Chŏngju. 3♂♂, *Pinus banksiana* Lambert, Aug. 25, 1993, Naju.

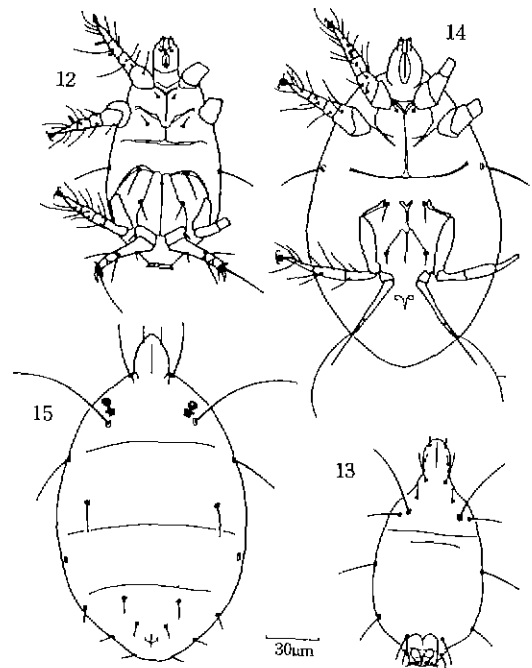
Male. Measurements: Body length 142 (119-156), body width 73 (62-84), leg I 54 (48-59), leg II 49 (45-52), leg III excluding coxa 52 (48-54), leg IV excluding coxa 42 (38-46), width at base of femur IV 12 (10-14), length of tactile seta 31 (27-35).

Morphological characteristics same as described by Ewing (1939) and Ito (1963).

Body elongate and pale yellow in color. Apodemes III and IV well developed, connected each other



Figs. 8-11. *Tarsonemus sasai*, male; 8 Ventral view; 9 Dorsal view; 10. Leg IV enlarged, femur to tarsal claw; 11. Tibia and tarsus of leg I.



Figs. 12-15. *Tarsonemus scaurus*. 12-13: Male, ventral and dorsal view; 14-15. Female, ventral and dorsal view.

and with the poststernal apodeme. Extrimities of the apodemes III extending slightly anterior to the apodemes IV. Coxisternal plates III much wider than coxisternal plates IV at the anterior extrimities. Anterior ends of coxisternal plates IV are much narrower than the posterior ends.

Female. Measurements : Body length 196 (161-213), body width 112 (105-121), leg I 62 (59-64), leg II 57 (54-59), leg III excluding coxa 61 (57-64), coxa to third segment of leg IV 29 (27-30), fourth segment of leg IV 9 (8-10), subapical seta of fourth segment 27 (25-29).

Body oval shape and whitish yellow in color. Sejugal apodeme well developed without any interruption in its length. Prosternal apodeme extending posteriorly to the junction with sejugal apodeme and weakly connected, but not connected with apodemes II. Poststernal apodeme well developed, extending anteriorly from the union with apodemes IV before it diverge at the extrimity.

Distribution. Korea, Japan, North America.

Remarks. Ewing (1939) mentioned the small size of the leg IV of male. Femur IV is relatively thin compared to the other species in *Tarsonemus*.

5. *Tarsonemus waitei* Banks, 1912

화백먼지응애(新稱) (Figs. 16-19, Table 1)

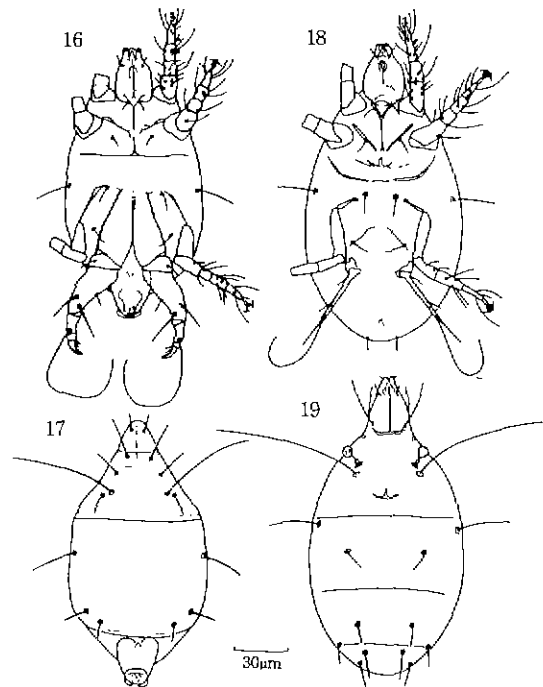
Materials examined. 6♂♂, 7♀♀, *Chamaecy-paris pisifera* var. *plumosa* for. *aurea* Beiss, Sept 18, 1992, Chinju.

Male. Measurements: Body length 165 (142-167), body width 77 (72-81), leg I 50 (45-56), leg II 48 (43-52), leg III excluding coxa 52 (51-56), leg IV excluding coxa 50 (45-54), width at base of femur IV 16 (14-17), length of tactile seta 76 (72-81).

Morphological characteristics same as described by Ewing (1939) and Lindquist (1986)

Body elongate and pale yellow in color. Apodemes III and IV well developed except at the anterior extrimities, not connected each other. Apodemes IV do not connected with poststernal apodeme. Poststernal apodeme well developed along anterior two-thirds of its extent, but vestigial posteriorly, and its two members weakly diverged from each other.

Female. Measurements: Body length 178 (162-210), body width 94 (83-116), leg I 57 (54-64),



Figs. 16-19. *Tarsonemus waitei*. 16-17: Male, ventral and dorsal view; 18-19: Female, ventral and dorsal view.

leg II 58 (54-68), leg III excluding coxa 58 (52-60), coxa to third segment of leg IV 28 (27-30), fourth segment of leg IV 10 (10-10), subapical seta of fourth segment 24 (22-25).

Body oval shape and pale yellow in color. Sejugal apodeme well developed but slightly interrupted on either side of midline, leaving short medial strip slightly separated from long lateral strips. Prosternal apodeme connected with apodemes I anteriorly, posterior ends forked and not connected with either apodemes II or sejugal apodeme.

Distribution. Korea, Japan, North America, Europe, Iran, New Zealand.

Remarks. The male of this species could be easily distinguished from other species in this paper by its long tactile seta on leg IV which is longer than the entire leg. Specific characteristics distinguishing the females of this species from other females described in this paper are on the shape of ventral plates.

Lindquist (1986) studied character state variability

expressed within populations of *T. waitei*. He redescribed this species and regarded two species of *T. setifer* Ewing, 1939, and *T. pauperoseatus* Suski, 1967 as synonyms of *T. waitei*.

DISCUSSION

The five *Tarsonemus* species described in this paper were all associated with ornamental plants. It is not certain whether they are fungivores or phytophagous. Lindquist (1986) suggested the possibility of *T. waitei* as facultative phytophagous species. *T. occidentalis* was also associated with dwarf of *Camellia japonica* as reported in this paper. *T. confusus* sometimes showed high density on decaying leaves in the survey.

The role of these *Tarsonemus* species on ornamental plants are not clear. Further studies are needed on this group of mites to understand their feeding habits and life cycles in relation to their host plants.

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