

**A new species of the genus *Tarsonemus* CANESTRINI et FANZAGO, 1876
(Acari: Tarsonemidae) associated with *Scolytus amygdali* (Coleoptera:
Scolytidae) a pest of fruit trees in Iran**

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ABSTRACT. *Tarsonemus amygdali* n. sp. (Acari, Tarsonemidae) is described and illustrated based on the material of females and a male. This new species was found in galleries of the bark beetle *Scolytus amygdali* (Insecta, Coleoptera, Scolytidae), infesting plum and apricot trees in Iran. The systematic position of the new species and its biogeography are briefly discussed.

KEY WORDS: *Tarsonemus*, Scolytidae, Iran, orchards, plum, apricot, systematics, taxonomy.

INTRODUCTION

The almond bark beetle (*Scolytus amygdali* GUÉRIN-MÉNEVILLE, 1847; Insecta: Coleoptera: Scolytidae) is a pest of fruit trees in Iran (RADJABI 1991). A recent sampling (by the junior author A. AHADIYAT) of pests occurring on plum and apricot in Iran documented a number of arthropods, including mites and insects, in which mites of the family Tarsonemidae CANESTRINI et FANZAGO, 1876 appeared important. Among these, a new species of the genus *Tarsonemus* CANESTRINI & FANZAGO, 1876 was discovered. This new species ap-

parently belongs to the group *Tarsonemus pyrrhidi* SCHAARSCHMIDT, 1959, which currently is under an extensive systematic revision (MAGOWSKI, in prep.).

Here we describe this new species of *Tarsonemus*.

MATERIAL AND METHODS

Mite material was collected by direct examination of infested bark slabs. Mite individuals were mounted in Hoyer's medium on microscopic slides and subsequently studied with a phase contrast microscope (Olympus BX 50) supplied with drawing attachment and digital photographic camera. Some specimens were re-mounted. The only male specimen was in poor condition; body parts missing on this specimen are enumerated in the description.

The bark beetle individuals collected from infested bark were sent for identification to Dr M. MANDELSHTAM (Department of Molecular Genetics, Institute of Experimental Medicine, RAMS, St.-Petersburg, Russia). Individual beetles were not tallied for mite numbers.

Measurements in the description were given in micrometers (μm); terminology for the gnathosoma, idiosoma and legs followed that of LINDQUIST (1986), and was standardized according to MAGOWSKI & KHAUSTOV (2006) (with minor changes). Abbreviations are as follows: PrS (prodorsal shield), PrP (ventral propodosomal plate), MeP (ventral metapodosomal plate), tg (tegula), ap. 1-1, ap. 2-2 (distances between anterolateral ends of apodemes 1-1 and 2-2 respectively), Ta (tarsus), Tbt (tibiotarsus), Tb (tibia), Ge (genu), Fege (femorogenu), Fe (femur). Excluded from the setal counts are minute, hardly discernible setae usually flanking the pretarsi: $u'-u''$ of leg I, u'' of legs II and III and pv' of leg III of a male. In setal counts symbol "'-'" indicates the separation of leg segments, symbol "'+"', their fusion.

Tarsonemus amygdali sp. n.

(Figs 1-14)

Diagnosis

Female and male: pharyngeal glandular bodies as long as about half the length of external part of pharynx. Tarsi of leg I-III lacking one attenuate seta, femora I with 3 setae, femora II with 2 setae. Female: dorsal opisthosomal setae h longer than c_1 , d , e or f on opisthosomal dorsum, tegula wider than long, dorsal and ventral shielding with fine, sparse ornamentation, posterolateral parts of PrS and C finely striated. Male: dorsal setae (except for f) tapering though not slender, barbed, f apparently more robust. Dorsal ornament of distinct dimples, ventral mostly of apparent, dense striae on coxal fields I-IV. Solenid ϕ located near the mid length of constricted tibia IV.

Differential diagnosis: both sexes of this new species are similar to those of *Tarsonemus kennedyi* SMILEY & MOSER, 1974 in having slender pharynx with prominent glandular bodies and reduced tarsal chaetotaxy (setae Ta I *pl'*, Ta II *pv''* and Ta III *pv''* missing). The female is very similar to that of *T. kennedyi* with opisthosomal dorsal setae *h* more elongated than *e* and *f*. It differs from *T. kennedyi*, however in having elaborate striated dorsal ornament in the marginal areas of prodorsal shield and C tergite, and lacking setae Fe I *l''* and Fe II *d* from legs. The male differs from those of *T. kennedyi* and *T. pseudokennedyi* in having striated ventral and dimpled dorsal sculptures (instead of opposite), and in having an antiaxial process on femur IV broad- triangular (in contrast to narrow blade-like).

Type material

Holotype female: in gallery of *Scolytus amygdali* Guérin-Méneville, 1847, in apricot (*Prunus armeniaca*), Shahriyaar; Tehran Province, Iran, 24.04.2002, coll. A. AHADIYAT.

Paratypes (22 females and 1 male): 4 females with the collection data same as the holotype female; 2 females with the collection data same as holotype, except for date-22.04.2002; 2 females with the collection data same as holotype, except for tree-host-plum (*Prunus domestica* var. "Ghatr-e Tala"); 14 females with data as above, except for location-Vahidiyeh region of Shahriyaar; 1 male with data as above, except for location and date - Kamaal-shahr region of Karaj, 24.06.2002.

The holotype female along with 10 females (from the type location) and one male paratype of the new species are deposited in the Department of Animal Taxonomy and Ecology, A. Mickiewicz University, Poznań, Poland. Four paratype females are deposited in the Department of Plant Protection, Islamic Azad University, Tehran, Iran; another four paratype females are deposited in the Zoological Museum, Hamburg University, Hamburg, Germany, two paratype females are deposited in the Canadian National Collection, Ottawa, Canada, and remaining two paratype females are deposited in the United States National Museum, Beltsville MD, USA.

Etymology

The new species is named "*amygdali*" referring to its association with the almond bark beetle- *Scolytus amygdali*.

Description-female (Figs 1-7)

Gnathosoma: ovoid-conical in shape; pharynx width ca. 0.2x the maximum width of gnathosoma, with a pair of large glandular bodies posteriorly. Chelicerae small, short. Palpi about 3x as long as their basal width, each with small palptarsal process and two minute setae. Palptibial claw hardly discernible. Setae *dgs* about equal in length to *vgs*, setae *pp* ca. half length of *dgs*.

Idiosomal dorsum (length = 2x width): relative length of setae (*v*₁: *sc*₁: *sc*₂: *c*₂: *c*₁: *d*: *e*: *f*: *h*): 1: 0.5: 1.6: 1.2: 0.6: 0.6: 0.6: 0.7: 1.1. Rostral shieldlet nearly 3x as wide as long. Prodorsal

shield about 1.5x as wide as long. Tracheae with visible atria; no postatrial sacs present. Distance between setae v_1 slightly shorter (0.9x) than their length. Pits v_2 indiscernible. Setae sc_2 located anterior of midline of prodorsal shield, their tips not reaching the posterior edge of prodorsal shield; the distance between their bases longer (1.2x) than their length. Setae c_2 extending well beyond the bases of c_1 . Tips of setae c_1 extending to the posterior edge of tergite C. Setae d reaching beyond the posterior edge of tergite D; the distance between their bases being about 2.8x their length. Setae f spaced by a distance of ca. 1.2x their length. The distance between bases of setae h equals that of their length. Dorsal setae slender, most sharply pointed, smooth (v_1 - c_2) or weakly barbed (c_1 - h). Setae e somewhat stiffer and less pointed than others on opisthosomal dorsum. Tergites covered with uniform, fine dimpled ornament; posterolateral parts (those tending to overlap the venter) of prodorsal shield and tergite C with longitudinally striated sculpture. Posterior edges of shields PrS, C, D and EF finely serrated.

Idiosomal venter: apodemes 1 pronounced, sclerotized, fused to anteromedian apodeme; that continuous and joined to sejugal apodeme. Sejugal apodeme well defined, tripartite, with large discontinuities on each side of medial segment, and with lateral parts strongly bent anterolaterally. Setae $1a$ located on apodemes 1, separated by a distance roughly equaling their length. Setae $2a$ located on apodemes 2; the distance between their bases being about 1.7x their length. Ventral propodosomal plate concave anteriorly, its lateral edges with an angular ridge between corners of trochanters I and II. Apodemes 3 not extending beyond condyli of trochanters III, apodemes 4 not reaching posteriorly beyond bases of setae $3b$; posteromedian apodeme straight, solid, with pronounced arterial bifurcation. Setae $3a$ located at a distance of ca. 2.5x their length from the bases of setae $3b$, and separated from each other by a distance of 1.7x their length, shorter than that between $3b$. Setae $3b$ about as long as $3a$, separated by a distance of 2.5x their length. Ventral metapodosomal plate nearly straight anteriorly, somewhat angular between trochanters III and IV on each side. Trochanters IV divided by an interval slightly larger than 3x their diameters. Tegula wider than long. The distance between bases of setae ps about 1.3x their length. Venter with finely dimpled ornament.

Legs: Proportions of free segments of legs: (I: II: III: IV): 1: 1: 1.2: 1. Leg chaetotaxy (for Fe, Ge, Tb and Ta): leg I: 3-4-6(2 ϕ)+7(1 ω); leg II: 2-3-4-5(1 ω); leg III: 1+3-4-4. Leg I: claw about as large as those of tarsus II. Spine-like seta s located well proximally of the base of pretarsus, unusually weak (though not hair-like), less robust than seta u' on leg II but similar to that on leg III. Setae u' and u'' indiscernible, though paired protuberances mark their origins. Tibiotarsus ca. 2.7x as long as wide at base. Three eupathidia inserted apically on tibiotarsus I (p'' -the longest and tc'' -the shortest, p' - intermediate); tc' about as long as tc'' , inserted more proximally. Seta pl' missing from tarsal part of a segment. Solenidion ω with striated head, shorter than Ta ω II. Tibial solenidion ϕ_2 smaller, ϕ_1 nearly twice larger with striae; famulus k subequal to ϕ_2 ; located at the same level. Seta l' on genu stiff. Femur I without ventral lobe. Femoral seta l'' missing, l' and d similarly strong. Leg II: claws typically sized, hooked; empodium medium-sized. Tarsal spine-like seta pl'' shorter

than, and located distally of solenidion Ta II ω . Tarsal seta tc'' the longest on a segment; pv'' missing. Tibia with v' the longest, and l' the shortest; seta Ge l' stronger than remaining ones on the segment. Femur with seta d missing. Leg III: claws larger than those on leg II. Seta tc'' at least 2x as long as other setae of segment; pv'' missing from tarsus. Leg IV: free segments of leg apparently longer than femorogenu and tibia III. Femorogenu 2.5x longer than tibiotarsus. Tarsal seta tc'' over 2.7x as long as whole leg IV. Seta Tb v' shorter than length of femorogenu; longer than that of tibiotarsus. Genual seta v' nearly 1.5x as long as femoral v' ; located in a distance from the end of segment nearly twice the distal width of Fege.

Measurements

Measurements (female holotype first, spread of measurements among five paratypes in parentheses)- Body and tagmata: length of body: 263 (228-252), length of idiosoma: 242 (219-241), width of idiosoma: 123 (105-119), length of gnathosoma: 38 (33-40), width of gnathosoma: 28 (24-26), length of pharynx: 16 (14-16), width of pharynx: 5 (5-5); dgs : 17 (15-16), vgs : 16 (13-16). Dorsum: length of PrS: 74 (73-75), width of PrS: 121 (107-120). Lengths of setae: v_1 35 (25-35), sc_1 : 15 (13-14), sc_2 : 52 (46-50), c_2 : 37 (35-38), c_1 : 22 (18-20), d : 19 (18-19), e : 18 (16-20), f : 21 (20-21), h : 36 (30-35). Distance between setae and stigmata: v_1-v_1 : 29 (26-29), $sti-sti$: 58 (50-58), sc_1-sc_1 : 60 (44-58), sc_2-sc_2 : 62 (53-62), c_2-c_2 : 119 (104-123), c_1-c_1 : 74 (61-73), c_1-c_2 : 40 (30-37), $d-d$: 55 (46-54), $e-e$: 80 (70-80), $f-f$: 23 (23-27), $e-f$: 31 (23-33), $h-h$: 36 (31-34). Venter: lengths of setae: $1a$: 8 (7-8), $2a$: 14 (13-13), $3a$: 15 (14-14), $3b$: 15 (11-15), ps : 7 (8-14). Distance between setae: $1a-1a$: 9 (6-13), $2a-2a$: 25 (22-24), $3a-3a$: 26 (21-24), $3b-3b$: 36 (33-36), $ps-ps$: 15 (11-14). Length of PrP: 63 (58-62), width of PrP: 89 (84-95), ap. 1-1 : 20 (15-18), ap. 2-2 45 (35-42), length of tegula 17 (13-15), width of tegula 24 (19-24). Leg segments and leg setae: Tbt I: 20 (18-20), Tbt I ω 4 (4-4), Tbt I ϕ_2 : 3 (3-3), Tbt I ϕ_1 : 5 (5-5), Tbt I k : 3 (3-3), Ta II ω 5 (4-4), Ta II pl'' : 6 (6-6), Tbt IV: 14 (12-13), Ta IV tc'' : 135 (130-140), Tb IV v' : 33 (26-32), Fege IV: 35 (30-34), Ge IV v' : 16 (15-17), Fe IV v' : 11 (11-12).

Male (Figs 8-14)

Gnathosoma: similar to that of a female but shorter and less tapering. Pharynx ca. as wide as 0.2x of width of gnathosoma, longer than half of ventral length of capsule; with a pair of large glandular bodies posteriorly (sclerotization defined as in female). Setae dgs about equal in length to vgs , setae pp slightly shorter than dgs .

Idiosomal dorsum (length=1.4x width): relative length of setae (v_1 : v_2 : sc_1 : sc_2 : c_2 : c_1 : d : f): 1: 0.8: 3.1: 1.0: 2.0: 2.3: 1.6: 1.0. Prodorsal shield (PrS) about 1.7x as wide as long. Setae v_1 separated by a distance of 1.1x their length. Setae sc_2 located just behind the level of sc_1 . Setae sc_1 located in posterior two-thirds of the length of prodorsal shield, reaching beyond the level of setae c_2 , placed in a distance of 0.6x their length each to another. PrS with well developed (though diffused at margins) anchor-like prodorsomedial apodeme.

Setae c_2 reaching just beyond the bases of c_1 . Setae c_1 located by a distance of less than 0.5x their length to bases of d . Setae d reaching beyond the posterior edge of shield EF; separated by a distance of ca. 1.4x their length. Setae f located by a distance of ca. 1.4x their length each to another. Setae v_1, f stiff and blunt or weakly pointed; only c_2 more slender; all barbed. Shield CD with four flattened "v"-shaped apodemes arranged transversely; medial ones being regular, while lateral- inverted "v" s'. Cupuli im almost contiguous with bases of f . Genital capsule with hyaline flange small; setae h indiscernible. Accessory stylets weak, located in distal 2/3rd of genital capsule length. Dorsum shields covered with uniform sculpture of apparent, sparse dimples.

Idiosomal venter: anteromedian apodeme connecting anteriorly with apodemes 1, interrupted at the posteromedial ends of apodemes 2; latter not joining with anteromedian one. Sejugal apodeme pronounced. Coxal setae la separated by a distance of about 1.5x their length; setae $2a$ longer than $1a$, their bases separated by nearly 2x their length. Setae $3a$ shorter than $3b$. Setae $3a$ separated by a distance of over 4x their length, setae $3b$ separated by a distance of over 3x their length. Distance between bases of setae $3a$ ca. as that between $3b$. All ventral setae slender, smooth. Apodemes 3 and 4 joined with each other and with posteromedian apodeme by weakly defined lines anteriorly. Ventral propodosomal plate ornamented with parallel and more or less undulate striae arranged radially, solid or dashed. Coxal fields III and IV with dense parallel striae; those on fields III dashed, and most on fields IV- solid; lateral fields of ventral metapodosomal plate without ornament.

Legs: Proportions of free segments of legs (I: II: III: IV): 1: 1.3: 1.6: 1.4 (values may be distorted due to an inadequate position of the leg I in the only known male paratype). Leg chaetotaxy: leg I: 3-4-6(2 ϕ)-9(?)(1 ω); leg II: 2-3-4-5(1 ω); leg III: 1-3-4-3. Leg I: claw as those of tarsi II and III. Seta s indiscernible, may be weakly formed as in female (male specimen damaged). Tarsus about 2x as long as wide at the base. Two eupathidia (p' and p'') inserted apically on tarsus, one (tc'') subapically, and one (tc') at transverse midline of the tarsus. Solenidion ω inserted near the base of segment, with small, striated head, apparently smaller than Ta II ω . Both fastigial eupathidia ft' and ft'' shorter than ω . Tibial solenidion ϕ_2 small, ϕ_1 little larger; eupathidion k rod-like, as long as ϕ_2 , located nearly, along with solenidia. Genua seta l' not stronger than others of segment. Femoral d short, solid; l' lost (only alveolus visible); femoral l'' missing. Leg II: claws small, hooked; empodium moderate. Spine pl'' located at the base of segment, smaller than solenidion ω placed more proximally. Seta tc'' longer than other setae of segment, reaching slightly beyond the tip of empodium. Seta $Ge l'$ shorter than others of the segment but otherwise similar. Femoral setae d slender, short; l' missing. Leg III: claws and empodium similar to those on leg II. Tarsal seta p' indiscernible. Seta tc'' reaching to the empodial pad, both tc'' and tc' slender; pv' missing. Tibial and genua setae all slender, smooth; Tb v'' longer than tarsal tc'' . Leg IV: Free segments of leg IV shorter than those of leg III. Tarsal claw weakly curved, blade like, less than 3x as long as wide at the base. Tarsus separate from tibia, with three small setae (two subequal in length, one broken). Tibia about 5x longer than tarsus, 1.7x longer than its basal width, constricted at midlength. Tibial solenidion ϕ smaller than tarsal so-

lenidia of legs I and II, almost rod-like, smooth. Seta Tb v' missing from the specimen. Femorogenu IV ca. 1.7x as long as wide at the base, with a large, triangular, acute posterior lobe. Seta Ge v' strong, tapering, barbed and blunt; Fe v' and Ge l'' lacking from the specimen. Seta v' on trochanter about half as long as Ge v' .

Measurements

Measurements (one male paratype) - Body and tagmata: length of body: 124, length of idiosoma: 121, width of idiosoma: 88, length of gnathosoma: 23, width of gnathosoma: 20, length of pharynx: 12, width of pharynx: 4, dgs : 9, vgs : 10. Dorsum: length of PrS: 43, width of PrS: 71, lengths of setae: v_1 : 16, v_2 : 12, sc_1 : 50, sc_2 : 16, c_2 : 32, c_1 : 37, d : 25, f : 16, h : ?. Distance between seate: v_1-v_1 : 17, v_2-v_2 : 21, sc_1-sc_1 : 31, sc_2-sc_2 : 46, c_2-c_2 : 78, c_1-c_1 : 66, c_1-c_2 : 33, $d-d$: 34, $f-f$: 22, $h-h$: ? Venter: lengths of setae: $1a$: 7, $2a$: 12, $3a$: 10, $3b$: 13. Distance between setae: $1a-1a$: 11, $2a-2a$: 21, $3a-3a$: 44, $3b-3b$: 43. Length of PrP: 32, width of PrP: 66, ap. 1-1: 8, ap. 2-2: 30, length of genital capsule: 20, width of genital capsule: 20. Leg segments and leg setae: Ta I: 14, Ta I ω 4, Tb I ϕ_2 : 2.5, Tb I ϕ_1 : 4, Tb I k : 2, Ta II ω 5, Ta II pl'' : 3.5, claw IV length: 12, claw IV width: 5, Tb+Ta IV: 18, Tb IV v' : ?, Tb IV ϕ : 3, Fege IV: 32, Ge IV v' : 22, Ge IV l'' : ?, Fe IV v' : ?.

DISCUSSION

The new species belongs to a group which has not been formally recognized, though mentioned in MAGOWSKI & KHAUSTOV, 2006. The group, up to the date, contains *Tarsonemus* species which all share several morphological characteristics: slender pharynx with prominent glandular bodies, tapering and mostly pointed dorsal setae and reductive chaetotaxy of legs (to name those most important). The group is currently under extensive revision by the senior author (MAGOWSKI in prep.).

Both female and male of the new species show an array of uncommon morphological features. The reductive femoral chaetotaxy of legs I and II (in both sexes) and striated areas of female dorsum are not unique (these are present in e.g. new, undescribed species from USA); however the male prominent triangular flap located on the antiaxial face of the femorogenu IV is rather exceptional in *Tarsonemus*. Among the members of the group, only males of *T. kennedyi* SMILEY & MOSER, 1974 and *T. pseudokennedyi* OCHOA, 1991 has similar flap, but smaller, more acute, and nearly blade-like. Out among less approximate tarsonemids, species of the tribe Hemitarsonemini share similar character (Lindquist 1986). As this tribe comprises a genus tightly associated with bark beetles (*Heterotarsonemus* SMILEY, 1969), it would be interesting to speculate whether the new species may constitute a taxon bridging between tribes Tarsonemini and Hemitarsonemini. Other characters of both females and males seem to indicate that such speculation should not be considered groundless.

Similar to many other member species of the group, this new one is associated with a tree-inhabiting/ damaging insect - *Scolytus amygdali*. However, the essence of the relationship remains unknown. It is premature to draw any conclusions about the actual role played by the mite in the tree-bark beetle subsystem.

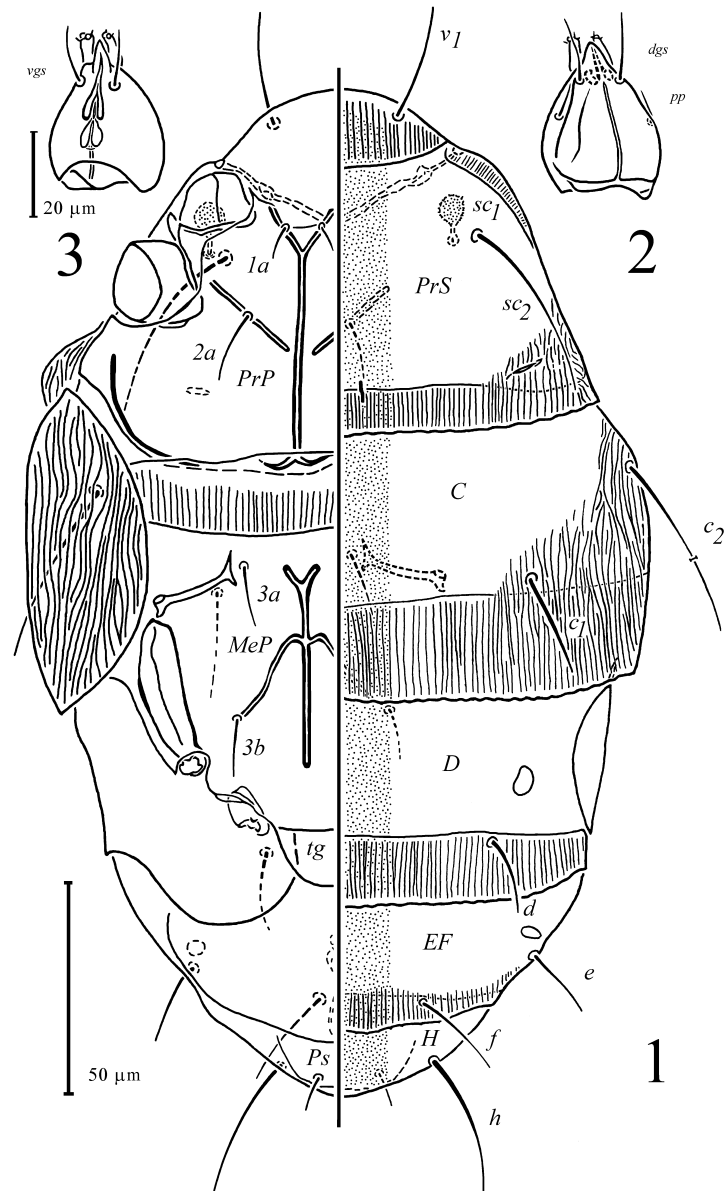
Future research on the species should focus on finding if the *T. amygdali* is host-specific, and if it covers the entire geographic range of the beetle, which is widespread in throughout southern Europe and African Mediterranean to eastern Asia. There has already been confusion regarding the biogeography of *S. amygdali*. Its presence in Iran was not listed by PFEFFER (1995) or WOOD & BRIGHT (1992), although it was documented by RADJABI (1991).

It would also be important to find out if any pathogenic fungi are involved in the mite-beetle-tree relationship, as already demonstrated by MOSER (1985) for another allied species-*Tarsonemus ips* LINDQUIST.

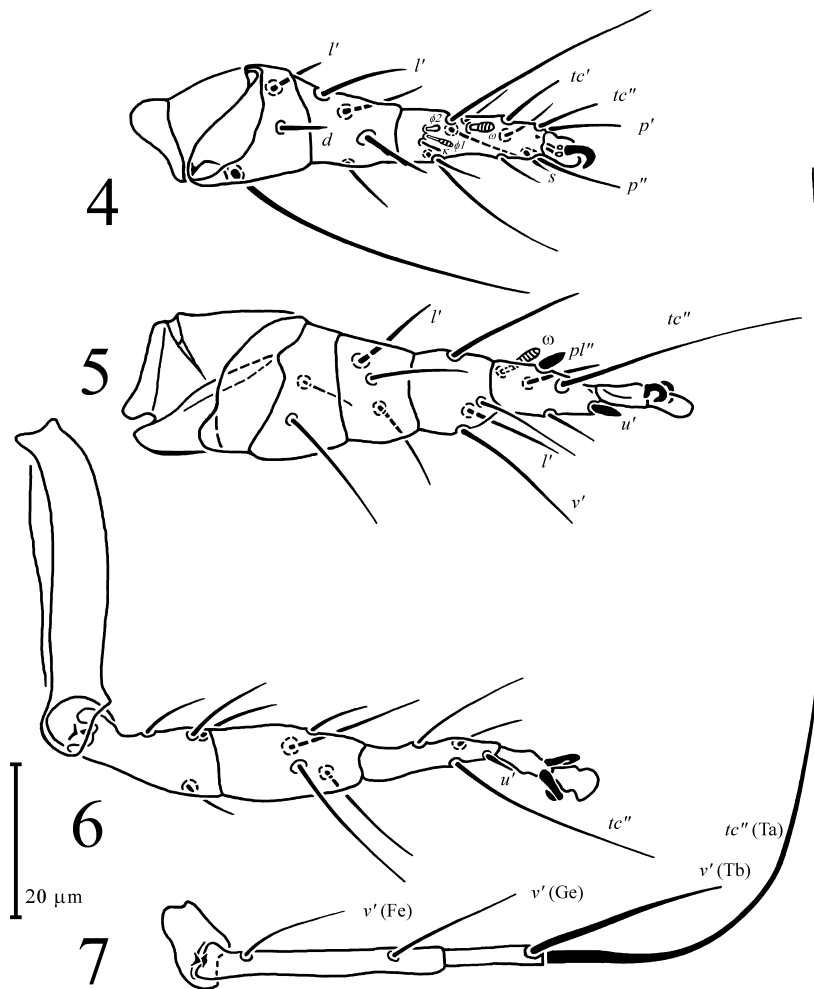
Acknowledgements

Authors are indebted to Dr E.E. LINDQUIST (Biodiversity Theme, Research Branch, Agriculture & Agri-Food Canada, Ottawa, Canada) for early identification of mite specimens, Dr M. MANDELSHTAM (Department of Molecular Genetics, Institute of Experimental Medicine, RAMS, St.-Petersburg, Russia) for determination of bark beetles material, to Dr J.C. MOSER (SRS-USDA, Pineville, Louisiana, USA) for reviewing the manuscript and valuable remarks, and to Ms M. BARTKOWIAK (Department of Animal Taxonomy & Ecology, A. Mickiewicz University, Poznań, Poland) for black inking the original pencil drawings.

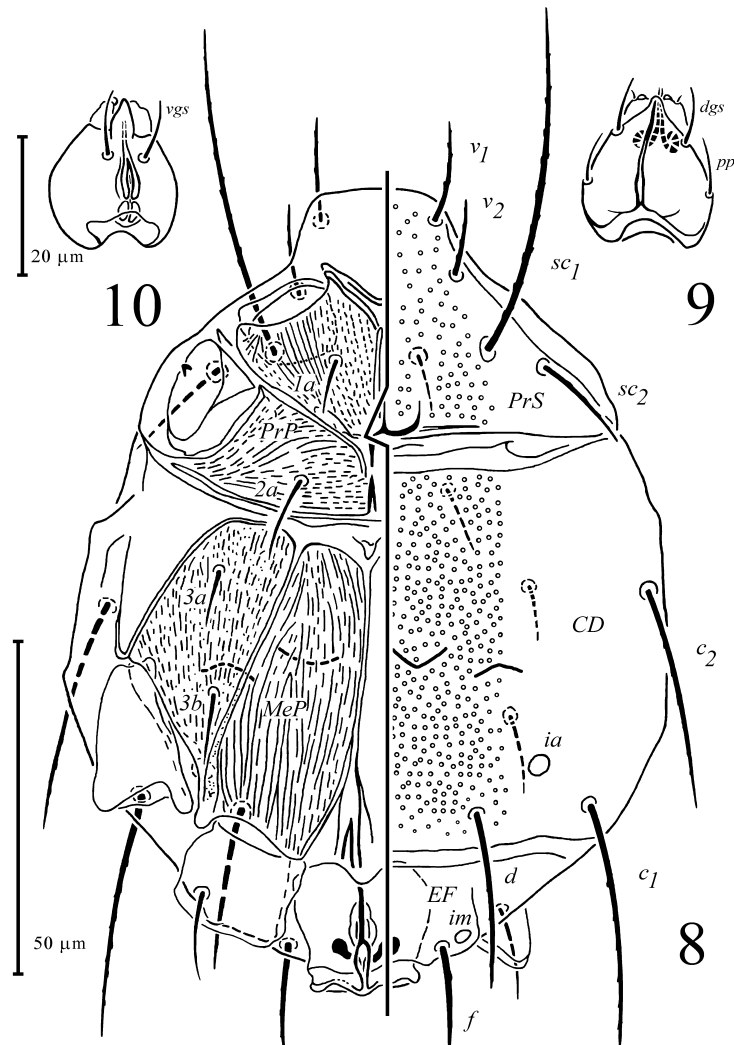
The research was technically supported by Polish Ministry of Science and Information Society Technologies (currently Ministry of Science and Higher Education) Grant no 2 P04F 05428.



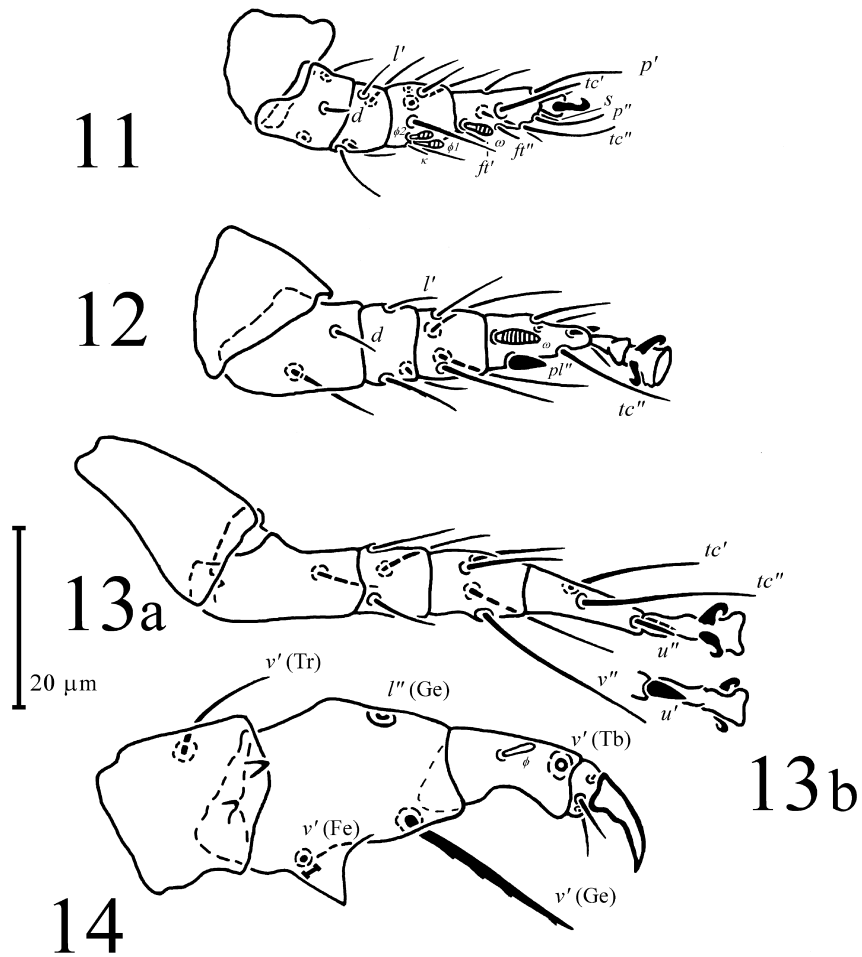
Figs 1-3. *Tarsonemus amygdali*, female: 1 - idiosoma; 2 - gnathosoma dorsum, 3 - gnathosoma venter.



Figs 4-7. *Tarsonemus amygdali*, female: 4 - leg I; 5 - leg II; 6 - leg III; 7 - leg IV.



Figs 8-10. *Tarsonemus amygdali*, male: 8 - idiosoma; 9 - gnathosoma dorsum; 10 - gnathosoma venter.



Figs 11-14. *Tarsonemus amygdali*, male: 11 - leg I; 12 - leg II; 13 - leg III (a-dorsal face of the leg, b-ventral face of a pretarsus); 14 - leg IV.

REFERENCES

- LINDQUIST E.E. 1986. The world genera of Tarsonemidae (Acari: Heterostigmata): a morphological, phylogenetic, and systematic revision, with a reclassification of family-group taxa in the Heterostigmata. *Memoirs of the Entomological Society of Canada*, 136, 1-517.
- MAGOWSKI W.Ł. KHAUSTOV A.A. 2006. Two new species of mites of the *Tarsonemus* (Acari: Tarsonemidae) associated with bark beetles (Coleoptera: Scolytidae) from Crimea, Ukraine. *Zootaxa* **1359**: 31-55.
- MOSER J.C. 1985. Use of sporothecae by phoretic *Tarsonemus* mites to transport ascospores of coniferous bluestain fungi. *Transactions of the British Mycological Society* **84**: 750-753.
- OCHOA R. SMILEY R.L. SAUNDERS J.S. 1991. The family Tarsonemidae in Costa Rica (Acari: Heterostigmata). *International Journal of Acarology* **17** (1): 41- 86.
- PFEFFER A. 1995. Zentral- und Westpaläarktische Borken- und Kernkäfer (Coleoptera: Scolytidae, Platypodidae), *Entomologica Basiliensia*, Basel, 17, 310 pp [in German].
- RADJABI GH. R. 1991. Insects attacking rosaceous fruit trees in Iran. Vol. 1: Coleoptera, Second edition, Plant Pests and Diseases Research Institute Publication, Tehran. 221 pp. [in Persian].
- SMILEY R.L. MOSER J.C. 1974. New tarsonemids associated with bark beetles (Acarina Tarsonemidae). *Annals of the Entomological Society of America* **67**: 639-665.
- WOOD S.L. BRIGHT D.E. 1992. A catalog of Scolytidae and Platypodidae (Coleoptera), Part 2: Taxonomic Index. Vols. A and B. Brigham Young University. *Great Basin Naturalist Memoir* **13**: 1553 pp.

Received: September 09, 2007

Accepted: September 20, 2007