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Article

Tyrophagus hamedaniensis sp. nov. (Acari: Acaridae) from Western Iran

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ABSTRACT
A new species belonging to the family Acaridae, *Tyrophagus hamedaniensis* **sp. nov.**, is described and illustrated from specimens collected from soil and litter beneath forest trees, Hamedan province, Iran. Also, a key to Iranian species of the genus *Tyrophagus* is provided.

KEY WORDS: Description; fungivorous; Hamedan; mite; Sarcoptiformes.

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INTRODUCTION

The members of the family Acaridae (Acari: Sarcoptiformes) are ecologically diverse, a large cosmopolitan group including more than 90 genera and about 400 described species (Fan and Zhang 2007; Oconnor 2009). The genus *Tyrophagus* was erected by Oudemans (1924a) with type species *Acarus putrescentiae* Schrank, 1781. Members of the genus *Tyrophagus* are considered as fungivorous or graminivorous and can also feed voraciously on nematodes, yeast or algae (Sinha and Mills 1968; OConnor 1982: Walter *et al.* 1986; Walter and Krantz 2009). Up to now about 35 species of the genus *Tyrophagus* Oudemans are recorded worldwide (Fan and Zhang 2007), of which eight species are present in Iran (Khanjani *et al.* 2000; Kamali *et al.* 2001; Hadad Irani-Nejad *et al.* 2007; Lotfollahi *et al.* 2010; Asali Fayaz *et al.* 2016; Masoudian *et al*. 2017, 2018), namely: *T. brevicrinatus* Robertson, 1959; *T. longior* (Gervais, 1844); *T. neiswanderi* Johnston and Bruce, 1965; *T. vanheurni* Oudemans, 1924b [syn.: *T. palmarum* Oudemans; sensu Robertson, 1959 (Fan and Zhang 2007)]; *T. perniciosus* Zakhvatkin, 1941; *T. putrescentiae* (Schrank, 1781); *T. similis* Volgin, 1949; *T. zachvatkini* Volgin, 1948. In this study, a new species, *T. hamedaniensis* **sp. nov.**, is described from soil and litter beneath forest trees, Hamedan province. Also, a key to the Iranian species of the genus *Tyrophagus* is presented.

MATERIAL AND METHODS

The mites were collected from soil and litter under forest trees (blackthorn trees, *Prunus spinose* L. (Rosaceae), Hamedan province, Iran. The specimens were mounted directly in Hoyer's medium on microscope slides. The slides were dried in an oven (50 °C) for a week, sealed with industrial painting

material and examined with an Olympus BX51 Differential Interference Contrast (DIC) microscope. Drawings were made with a camera Lucida. All measurements are presented in micrometers (μm) and the measurements of the holotype are followed by ranges of the paratypes in parentheses. The terminology and abbreviations of idiosomal chaetotaxy used follow that of Griffiths *et al.* (1990), Grandjean (1939) for leg chaetotaxy, and organotaxy complies with Klimov and OConnor (2003).

Acaridae Latreille, 1802
Tyrophagus Oudemans, 1924a: 250.

Type species: *Acarus putrescentiae* Schrank, 1781

Tyrophagus hamedaniensis sp. nov.

http://zoobank.org/urn:lsid:zoobank.org:act:9BAF81E3-8166-4E44-91BD-5DA51AC34343

Diagnosis

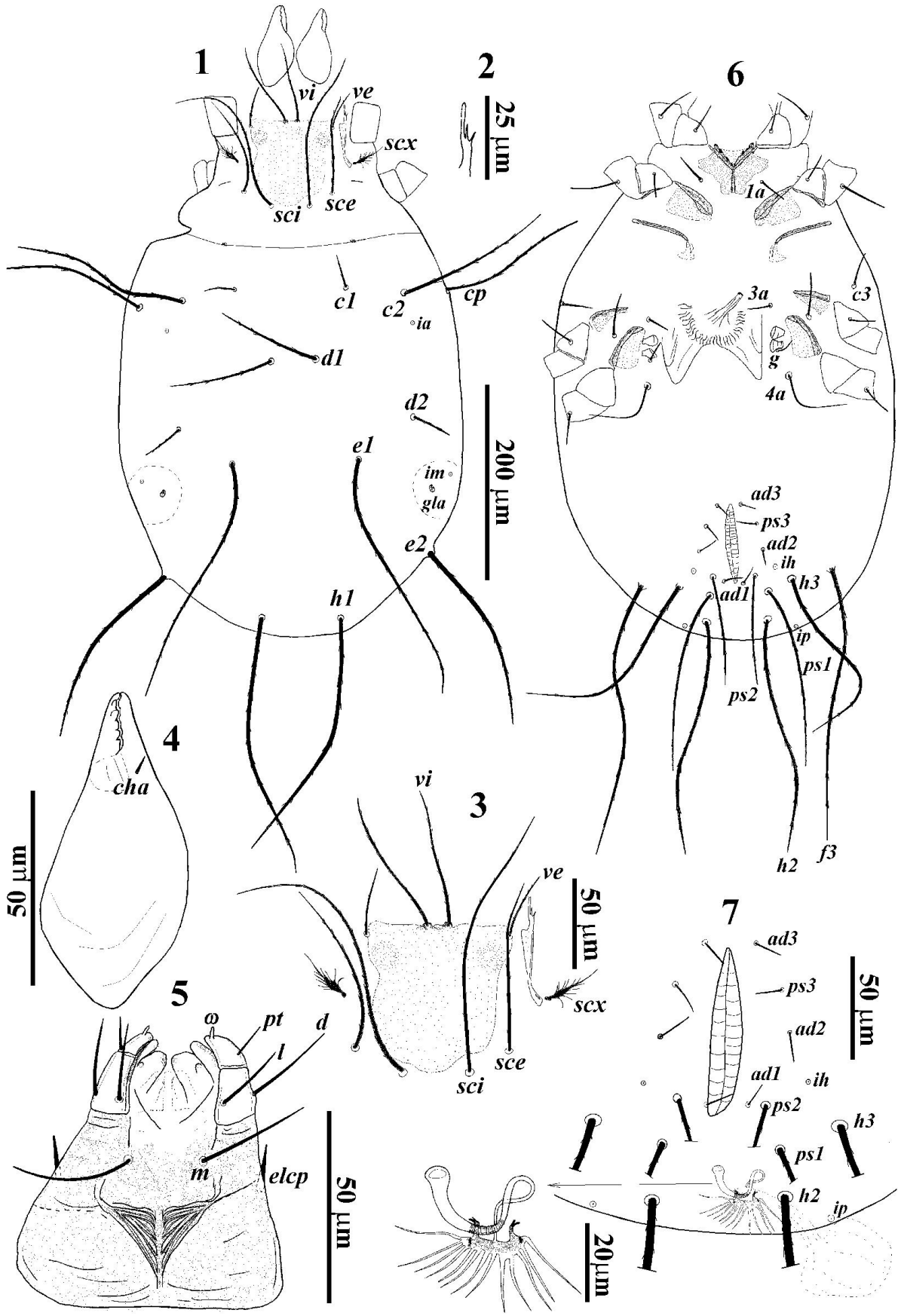
Prodorsal shield with un-sharp eye spots, dorsal seta *d1* considerably longer than seta *c1*, *d1*/*c1* 3.0–3.50 times; tarsus I with short, stout and clavate apically solenidion *ω1*; *w* and *r* of tarsus IV setiform; spermathecal duct long 48 (45–48) and with an annulated (taenidium like) lining in distal half from base of spermathecal sac, base of spermathecal sac flat and normal 12 (12–13 μm) in width; Ratio: *d1*/*c1* 3.0–3.50; *d1*/*d2* 2.72–2.76; *d2*/*c1* 1.1–127.

Description

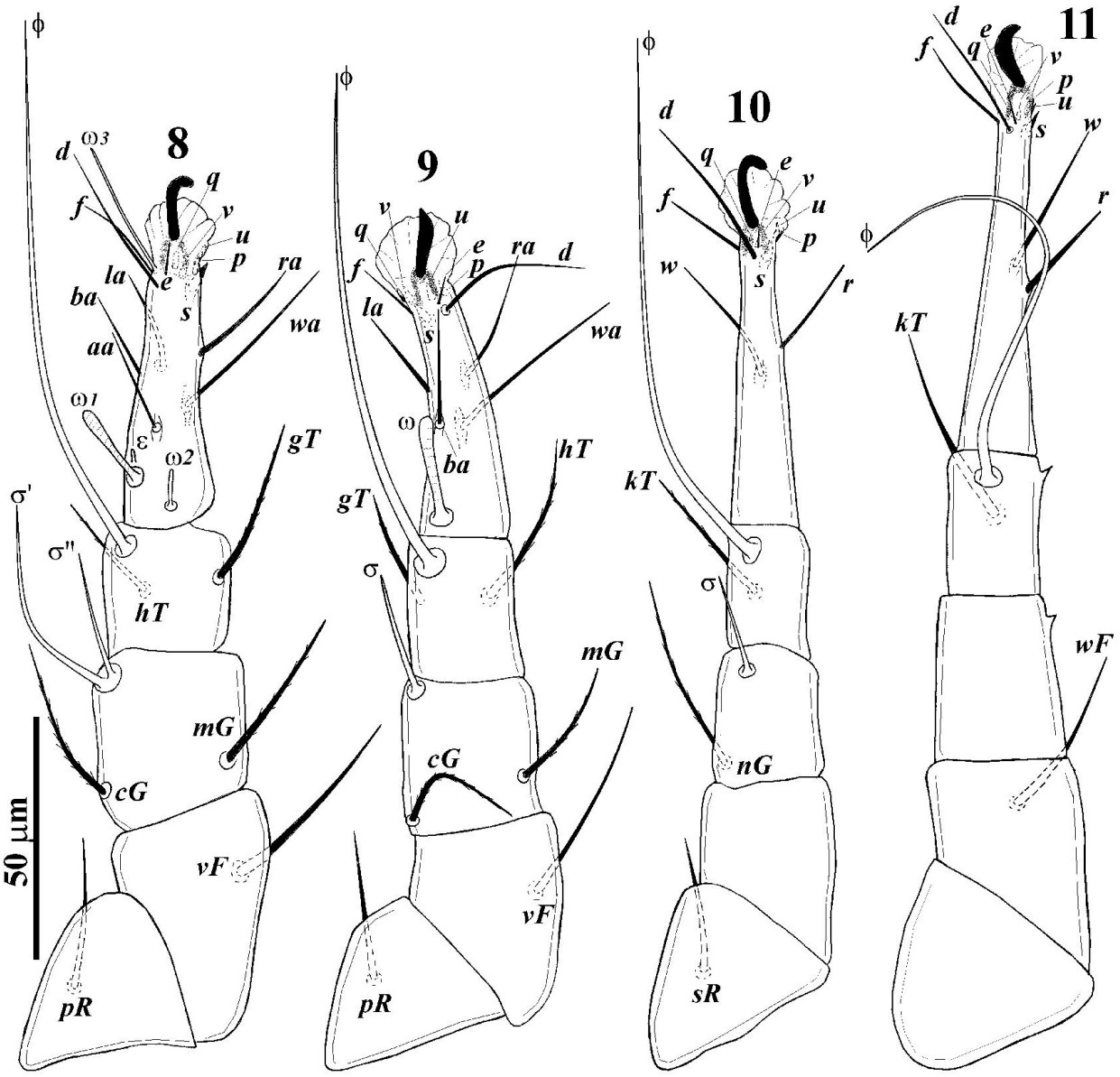
Female (Figs. 1–19; n = 4) – Idiosoma oval. Length of body including gnathosoma 618 (538–593), excluding gnathosoma 550 (470–525); width 333 (255–290).

Dorsum (Figs. 1–3, 12, 14) – Prodorsal shield punctate, with two pairs of setae (*vi* and *ve*), 83 (75–79) long, 80 (75) wide between setae *ve-ve*, almost pentagonal in shape with lateral margins slightly concave (Figs. 3, 12). Eye spots present (Figs. 1, 3, 12); Basal lobe of Grandjean's organ with one large tooth and two small teeth, 13 (12–15), 7 (6) and 3 long, respectively (Fig. 2). Supracoxal seta *scx* pectinated with 4–6 branches on each side and broadly expanding at the base but gradually tapers to a fine point distally (Figs. 1, 3, 14). All dorsal setae finely serrated. All opisthosomal setae whip-like except *c1*, *d1* and *d2*. Opisthosoma with three pairs of lyrifissures (*ia*, *im* and *ip*) and one pair of opisthosomal gland (*gla*) at level of seta *e1*; setae *c1* and *d2* are the shortest whereas setae *f2* and *h1-2* are the longest dorsal setae. Length of dorsal setae: *vi* 78 (73–77), *ve* 38 (38–40), *sci* 155 (150–153), *sce* 90 (75–85), *scx* 30 (30–33), *c1* 30, *c2* 155 (165–168), *cp* 145 (150–160), *d1* 98 (90–105), *d2* 38 (33–38), *e1* 255 (260–280), *e2* 188 (200–214), *f2* 270 (285–290), *h1* 273 (288), *h2* 265 (285). Distances: *vi-vi* 10 (10–13), *vi-ve* 35 (30–33), *ve-ve* 80 (75), *sce-sce* 88 (83–87), *sci-sce* 25, *sci-sci* 38 (30–33), *sce-ve* 60 (60–80), *c1-c1* 113 (90), *c1-c2* 58 (49–55), *c2-c2* 225 (190–200), *c2-cp* 38 (35–38), *cp-cp* 300 (245–265), *c1-d1* 75 (63–65), *d1-d1* 45 (35–40), *d1-d2* 115 (90–100), *d2-d2* 238 (190–210), *d2-gla* 68 (55–65), *gla-gla* 263 (220–245), *gla-e1* 78 (58–68), *e1-e1* 125 (95–113), *e1-e2* 125 (100–113), *e2-e2* 263 (205–260), *f2-f2* 188 (165–200), *e1-h1* 147 (125–135), *h1-h1* 78 (68–75), *h1-h2* 38 (33–35), *h2-h2* 60 (63–68). Ratio: *d1*/*c1* 3.37 (3.0–3.50), *d1*/*d2* 2.58 (2.72–2.76), *d2*/*c1* 1.27 (1.1–1.27).

Gnathosoma (Figs. 4–5) – Punctate; palpi two-segmented, palp tarsus with a simple seta (*pt*) and one solenidion (*ω*) 13 and 6 (6–7) long, respectively; palp tibia with two simple setae [*d* 25 (25–27) and *l* 20 (17) long]; infracapitulum with one simple seta (*m*) 28 (30–33) long, rutellum distinct and developed (Fig. 5); chelicerae 78 (75) long, cheliceral seta *cha* spine-like 5 (6) long, movable and fixed digits with 4–5 teeth (Fig. 4). Palp coxa with one *elcp* setae 10 (12–13) (Fig. 16). Distance: *m-m* 23 (25).



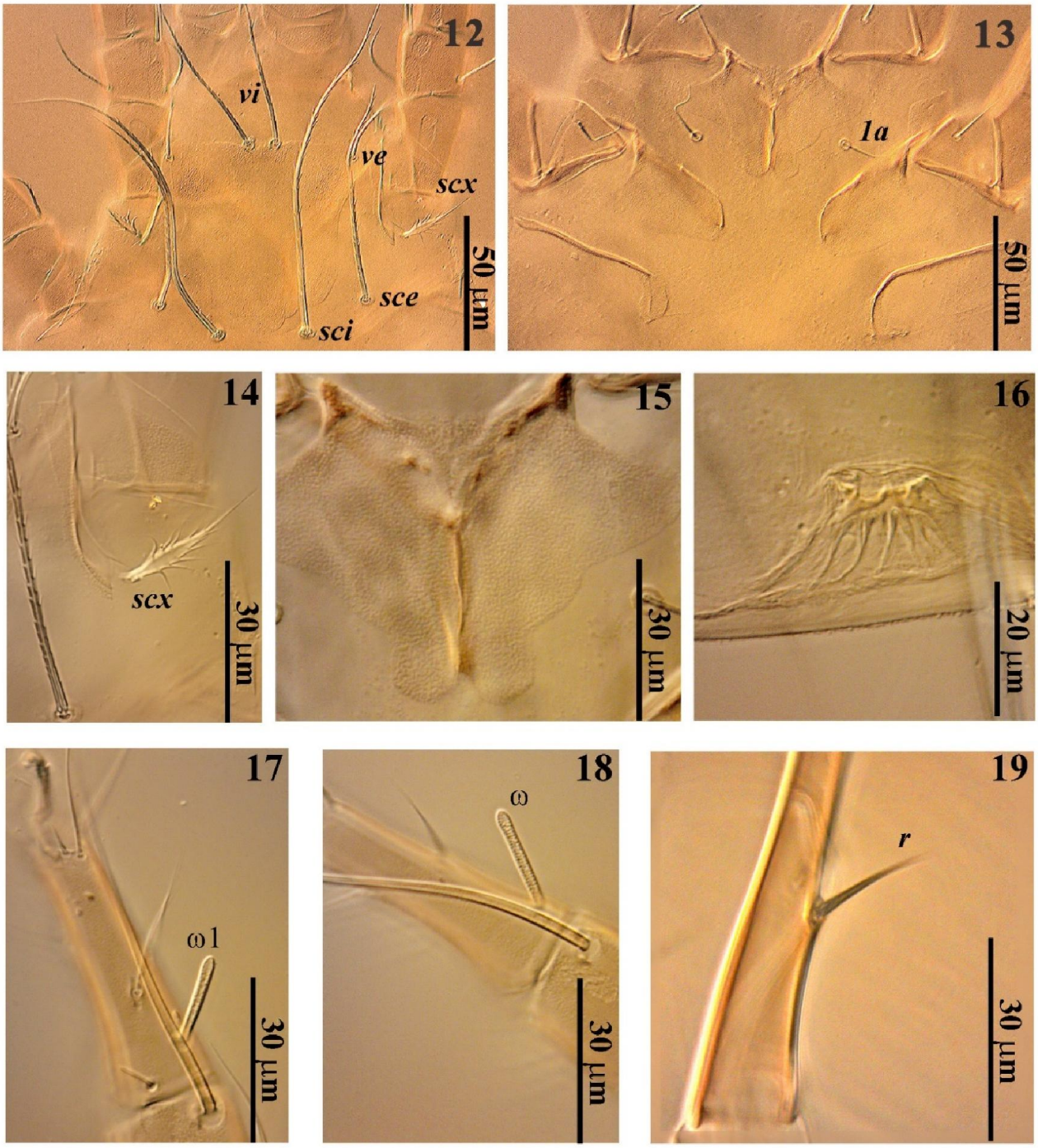
Figures 1-7. *Tyrophagus hamedaniensis* **sp. nov.** (female) – 1. Dorsal view of idiosoma; 2. Grandjean's organ; 3. Prodorsal shield; 4. Chelicera; 5. Gnathosoma; 6. Ventral view of idiosoma; 7. Anal region.



Figures 8-11. *Tyrophagus hamedaniensis* **sp. nov.** (female) – 8. Leg I; 9. Leg II; 10. Leg III; 11. Leg IV.

Venter (Figs. 6–7, 13, 15–14) – Coxal plates I well developed and divided with apodemes anteriorly on each side with four nodules, coxal plates I extending postero-medially beyond apex of prosternal apodeme forming two lobes (Figs. 6, 13, 15); coxal plates II broadly triangular and developed beyond apex of well-developed apodeme; between coxae II and III is a pair of thin sclerotized sejugal apodemes, 60 long; coxal plates III-IV each with apodemes (Fig. 6); genital region (posterior to sejugal apodemes to coxae IV) with two pairs of genital papillae 17 (18) long and 13 wide, a pair of setae (*g*) and genital folds (Fig. 6). Anal region with three pairs of adanal setae (*ad1-3*) and three pairs of pseudoanal setae (*ps1-3*), seta *ps1* the longest anal setae (Fig. 6); a pair of lyrifissures (*ih)* between the base of setae *ad2* and *ps2*. Copulatory opening 6 (5–6) in diameter, spermathecal duct narrowing gradually from copulatory, spermathecal duct 48 (45–48) long, the thin part of the duct 18 (17–19) in length and 1 in width, the thick part of duct 2 (2–2.5) in width, the distal half part of spermathecal duct from base of spermathecal sac with an annulated (taenidium like) lining, 10 (8–10) in length, base of spermathecal sac flat 12 (12–13) in width, sclerites of oviducts Y shape and 8 (8–9) in apart (Fig. 7, 16); Length of ventral setae: *1a* 28 (30–35), *c3* 30 (30–33), *3a* 15

(17–20), *3b* 45 (43–45), *4a* 65 (55–60), *g* 15 (15–18), *ad3* 13 (12–13), *ad2* 18 (16), *ad1* 13 (13–14), *ps3* 15, *ps2* 110 (95–100), *ps1* 170 (175), *h3* 195 (175–205).



Figures 12-19. *Tyrophagus hamedaniensis* **sp. nov.** (female) – 12. Prodorsal shield; 13. Ventral view of propodosoma region; 14. Supracoxal seta *scx*; 15. Coxal plates and apodemes I; 16. Spermatheca; 17. Solenidion *ω1* on tarsus I; 18. Solenidion *ω* on tarsus II; 19. Seta *r* on tarsus IV.

Legs (Figs. 8–11, 17–19) – Setal formulae of leg segments I-IV as follows (solenidia and special setae in parentheses): coxae 1-0-2-1; trochanters 1-1-1-0; femora 1-1-0-1, genua 2(2σ)-2(1σ)-1(1σ)-0; tibiae 2(1φ)-2(1φ)-1(1φ)-1(1φ); tarsi 13(3*ω*, 1*ε*)-12(1*ω*)-10-10. Leg I-II with solenidion cylindrical and apex obviously widened (*ω1* and *ω*, respectively) (Figs. 8–9, 17–18). Measurements of leg

segments and setae as follows: **Leg I:** Tr 38 (33–38), *pR* 33 (25–30), Fe 43 (43–50), *vF* 48 (38–45), Ge 30 (33–35), *cG* 28 (28–30), *mG* 43 (37–42), *σ*1 45 (37–43), *σ*2 25 (20–25), Ti 25 (25–27), *gT* 25, *hT* 30 (25–30), *ϕ* 110 (110–113), Ta (L.) 53 (50–53), Ta (W.) 20 (20–23), *ω1* 17 (18), *ω2* 8, *ω3* 25 (25–30), *ε* 4, *aa* 20 (18), *ba* 24 (18–20), *wa* 43 (33–38), *ra* 25 (23–25), *la* 23 (20–23), *d* 30 (35), *e* 8, *f* 18, *p* 4 (4–5), *q* 4 (4–5), *s* 8, *u* 5, *v* 5, empodium 17 (13–15), claw 15 (13–14); **Leg II:** Tr 38 (30–33), *pR* 27 (25–33), Fe 45 (43–50), *vF* 55 (43–50), Ge 33 (33–35), *cG* 28, *mG* 38, *σ* 18 (18–23), Ti 25 (28), *gT* 25, *hT* 33 (30–33), *ϕ* 110 (100–115), Ta (L) 48 (50), Ta (W) 18 (18–20), *ω* 20, *ba* 15 (15–18), *wa* 39 (35–38), *ra* 29 (28–33), *la* 20 (18), *d* 30 (28–33), *e* 7 (8), *f* 13 (15), *p* 5, *q* 5, *s* 6 (6–7), *u* 7 (6), *v* 7 (6), empodium 13 (13–15), claw 13; **Leg III:** Tr 30 (38), *sR* 33 (33–38), Fe 35 (33–38), Ge 25 (30), *nG* 38 (43–45), *σ* 20 (18), Ti 25, *kT* 38 (38–43), *ϕ* 115 (120–125), Ta (L) 55 (60), Ta (W) 13 (15), *w* 30 (27–33), *r* 25 (22–25), *d* 28 (25–28), *e* 7 (8), *f* 18 (15–19), *p* 4, *q* 4, *s* 6 (5–7), *u* 5 (6), *v* 5 (6), empodium 15 (13–15), claw 13 (10–13); **Leg IV:** Tr 38 (40), Fe 40 (42–45), *wF* 38 (40–43), Ge 33 (38), Ti 30 (35), *kT* 35 (35–38), *ϕ* 110 (100–120), Ta (L) 55 (63–68), Ta (W) 15 (13–15), *w* 35 (28–35), *r* 20 (18–20), *d* 28 (25), *e* 8 (7–8), *f* 18 (16–18), *p* 4 (4–5), *q* 4 (4–5), *s* 7 (6–7), *u* 5, *v* 5, empodium 13 (12–13), claw 13 (12–13), Ge and Ti IV with minute preapical process (Fig. 11), setae *w* and *r* of tarsus IV setiform (Fig. 18).

Remarks

The new species is similar to *T. putrescentiae* (Schrank, 1781) (re-described from New Zealand by Fan and Zhang, 2007) in having dorsal seta *d1* considerably longer than seta *c1*, 2.1–3.5 times, prodorsal shield with eye spots, tarsus I with short, stout and clavate apically solenidion *ω1*, setae *w* and *r* of tarsus IV setifom but it differs in: 1. Ratio setae *d1*/*c1* 3.0-3.5 vs. 2.1-2.8; 2. Coxal plate II broad and convex and well developed beyond apex of apodeme in the former but normal and sinuous shaped and not extending beyond apex of apodeme in the latter; 3. Spermathecal duct without neck at its distal half in Iranian species opposed to present in New Zealand specimens; 4. Dorsal setae of new species are shorter than other species: *vi* 73–78, *ve* 38–40, *sci* 150–155, *sce* 75–90, *c1* 30, *c2* 155–168, *e1* 255–280, *e2* 188–214, *f2* 270–290, *h1* 273–288, *h2* 265–285, *h3* 175–205 vs. *vi* 98–117, *ve* 60–62, *sci* 185–210, *sce* 116–137, *c1* 50–51, *c2* 247–261, *e1* 319–333, *e2* 276–286, *f2* 337–391, *h1* 384–392, *h2* 370–373, *h3* 314–319.

The individuals of *T. hamedaniensis* **sp. nov.** are closely similar to *T. womersleyi* Fan and Zhang, 2007 (from New Zealand) in having dorsal setae *c1* and *d2* short and subequal in length, prodorsal shield with eye spots; tarsus I with short, stout and clavate apically solenidion *ω1*, base of spermathecal sac flat but it differs in: 1. The setae *f2* and *h1-2* is the longest dorsal setae in Iranian species vs. seta *h2* in Australian species; 2. The distal half of spermathecal duct without neck in Iranian species but it present in Australian species; 3. The distal half part of the spermathecal duct from the base of the spermathecal sac with an annulated (taenidium like) lining in the first species whereas smooth in the second species; 4. Ratio pseudoanal setae: *ps1*/*ps2*: 1.5–1.8 vs. 2.7 and *ps2*/*ps3* 6.3–7.3 vs. 5; 5. Ratio adanal setae *ad2/ad1* 1.14–1.38 vs. 0.83; 6. Tarsus II with short, stout and clavate apically solenidion *ω*, 20 long vs. stout, almost cylindrical, 16 long; 7. Seta *r* of tarsus IV setiform in the former opposed to spiniform in the latter; 8. Hysterosomal setae are shorter: *e1* 255–280, *e2* 188–214, *f2* 270–290, *h1* 273–288, *h2* 265–285 and *h3* 175–205 vs. *e1* 303, *e2* 231, *f2* 318, *h1* 310, *h2* 338 and *h3* 309.

Etymology

This species is named after the region of origin, Hamedan province, Iran.

Material examined

The specimens were collected from soil and litter beneath forest trees (blackthorn trees, *Prunus spinose* L. (Rosaceae), Nahavand region (34° 08′ 48″ N, 48° 13′ 26″ E), 01.05.2015, Hamedan

province, Iran, by F. Masoudian. All specimens (holotype and three paratypes) are deposited in the Collection of the Acarology Laboratory, University of Bu-Ali Sina, Hamedan, Iran.

Key to Iranian *Tyrophagus* species (Based on Fan and Zhang 2007)

1. Dorsal seta *d1* subequal to seta *c1* in length 2
– Dorsal seta *d1* 1.5–3 times longer than seta *c1* in length 3
2. Supracoxal seta (*scx*) short (less than 20 µm) and almost smooth ..... *T. brevicrinatus* Robertson, 1959
– Supracoxal seta (*scx*) long, slender and with pectinations (40–50 µm) ..... *T. similis* Volgin, 1949
3. Eye spots present 4
– Eye spots absent 6
4. Ratio setae *d1*/*c1*: > 2; base of spermathecal sac flat 5
– Ratio setae *d1*/*c1*: 1.5-1.8; base of spermathecal sac funnel-shaped ..... *T. neiswanderi* Johnston and Bruce, 1965
5. Spermathecal duct with a neck at its distal half, coxal plate II normal ..... *T. putrescentiae* (Schrank, 1781)
– Spermathecal duct without a neck at its distal half, coxal plate II broad and convex ..... *T. hamedaniensis* **sp. nov.**
6. Dorsal seta *d1* considerably longer than seta *c1*, 2.4–3.2 times 7
– Dorsal seta *d1* at most twice as long as seta *c1* 8
7. Tarsus IV with *w* and *r* setae spiniform, spermathecal duct wide, tarsus I with short, stout and clavate apically solenidion *ω1* ..... *T. perniciosus* Zakhvatkin, 1941
– Tarsus IV with *w* and *r* setae setiform, spermathecal duct slender, tarsus I with slender solenidion *ω1* ..... *T. vanheurni* Oudemans, 1924
8. Solenidion I *ω1* cylindrical, tapered distally ..... *T. longior* (Gervais, 1844)
– Solenidion I *ω1* not tapered distally ..... *T. zachvatkini* Volgin, 1948

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گونهٔ جدید *Tyrophagus hamedaniensis* sp. nov. (Acari: Acaridae) از غرب ایران

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* نویسندهٔ مسئول

چکیده

گونهٔ جدیدی متعلق به خانوادهٔ Acaridae، *Tyrophagus hamedaniensis* **sp. nov.** از روی نمونه‌های جمع‌آوری شده از خاک و خاکبرگ درختان جنگلی از استان همدان، ایران جمع‌آوری و توصیف شده است. همچنین کلیدی برای گونه‌های *Tyrophagus* ایران تهیه شده است.

واژگان کلیدی: توصیف؛ قارچخوار؛ همدان؛ کنه؛ Sarcoptiformes.

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