

REDESCRIPTION OF FOUR SPECIES OF THE GENUS *TYROPHAGUS* (ACARI: ACARIDAE) FROM WESTERN IRAN

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ABSTRACT: We redescribe four species of the genus *Tyrophagus* Oudemans (Acari: Acaridae): *T. longior* (Gervais), *T. similis* Volgin, *T. vanheurni* Oudemans and *T. neiswanderi* Johnston and Bruce, collected from the forest soil and tree litter in Hamedan province, Western Iran. We note minor differences between our specimens and other published descriptions of these species.

KEY WORDS: Mites, Sarcoptiformes, *Tyrophagus*, redescription, Iran.

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INTRODUCTION

The family Acaridae (Acari: Sarcoptiformes) is an ecologically diverse and cosmopolitan group that includes more than 90 genera and about 400 described species (OConnor 2009; Fan and Zhang 2007). The cosmopolitan genus *Tyrophagus* (with 35 valid species) was erected by Oudemans, 1924 with *Acarus putrescentiae* Schrank, 1781 as its type species (Fan and Zhang 2007). Most species of this genus are fungivorous. They are also commonly associated with stored products and have a substantial economic impact (Hughes 1976; Fan and Zhang 2007). Eight species of *Tyrophagus* have been recorded in Iran (Khanjani *et al.* 2000; Kamali *et al.* 2001; Hadad Iraninezhad *et al.* 2007; Lotfollahi *et al.* 2010). Namely, *T. brevicrinatus* Robertson, 1959; *T. longior* (Gervais, 1844); *T. neiswanderi* Johnston and Bruce, 1965; *T. vanheurni* Oudemans, 1924 [= *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 paper, four species of *Tyrophagus* collected in the forested areas of Hamedan province, Western Iran are redescribed and illustrated. We also compare our specimens with those reported from New Zealand and other regions (Fan and Zhang, 2007). This manuscript also gives a key to females of the genus *Tyrophagus* from Iran.

MATERIAL AND METHODS

Specimens were collected from soil and forest litter. The mites were mounted in Hoyer's medium on microscope slides. Slides were dried in an oven (50 °C), sealed with an industrial painting material, and examined under an Olympus BX51 Dif-

ferential Interference Contrast (DIC) microscope. Drawings were made with a camera lucida and all measurements are presented in micrometers (µm). The terminology and abbreviations follow that of Griffiths *et al.* (1990) for idiosomal chaetotaxy; Grandjean (1939) for leg chaetotaxy; and Klimov and OConnor (2003) for organotaxy.

SYSTEMATICS

Acaridae Latreille, 1802

Tyrophagus Oudemans, 1924: 250

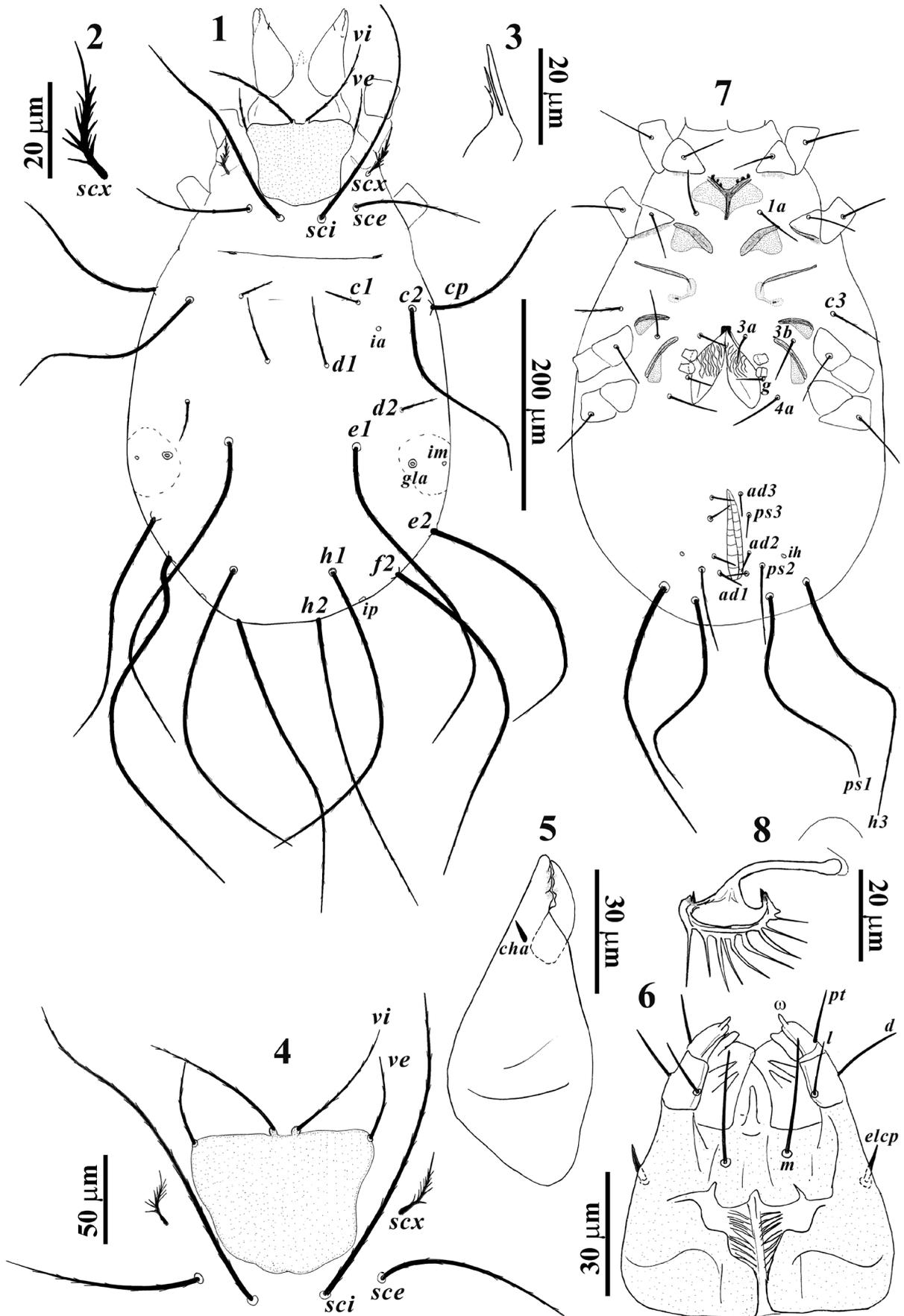
Type species: *Acarus putrescentiae* Schrank, 1781

Tyrophagus longior (Gervais, 1844): 262

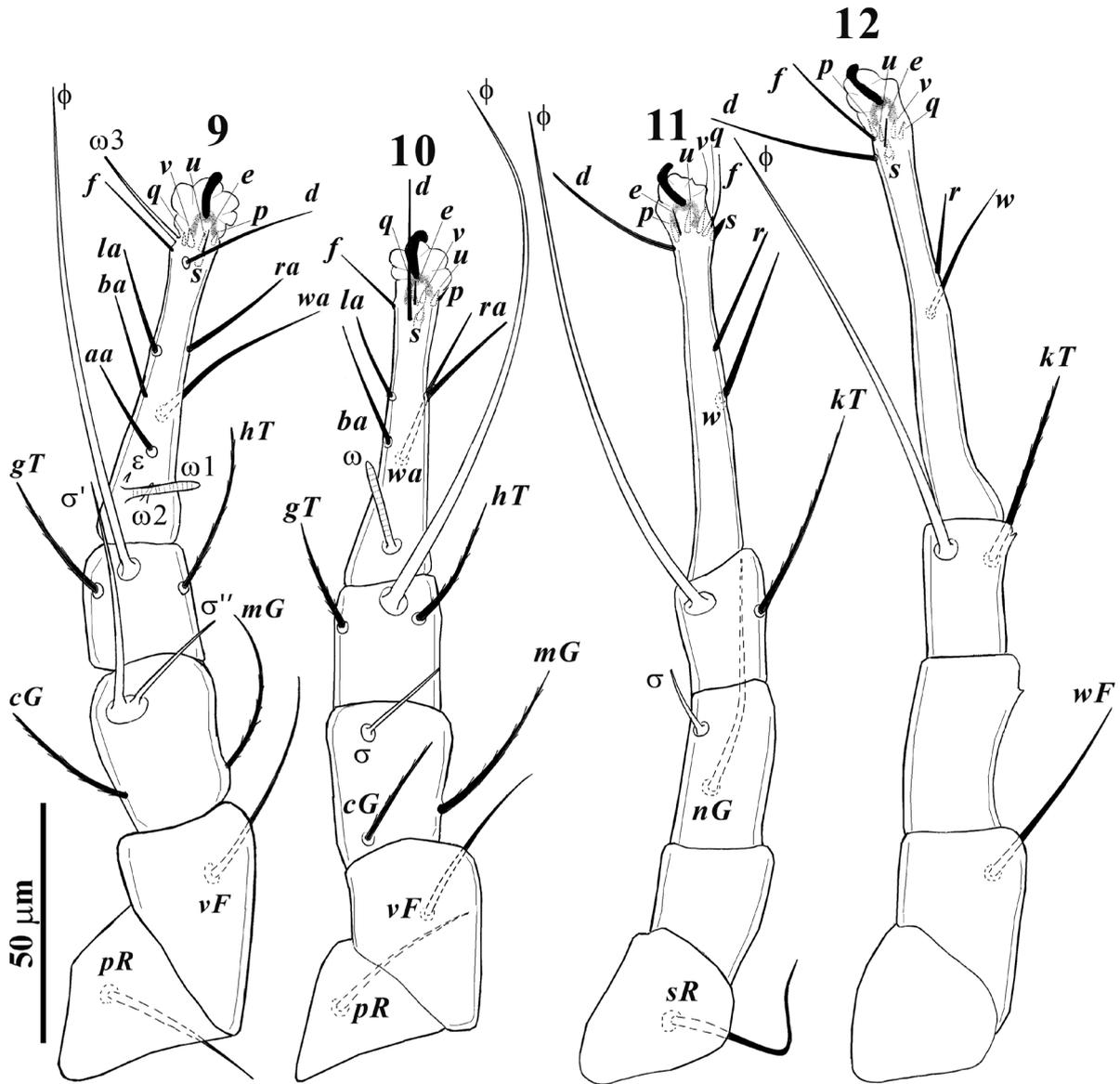
Diagnosis. Eyespots absent; *scx* slender, tapering from base to tip; ratio: *d1/c1* 1.46–1.50; *d1/d2* 1.34–1.35; *d2/c1* 1.10; coxal plates I triangular; coxal plates II triangular with posterior margin slightly sinuous; spermathecal duct broad, widening gradually from midway to base of spermathecal sac; solenidion *ω1* and *ω* of legs I–II slender and cylindrical and tapered distally; tarsus IV with setae *w* and *r* filiform.

Female (Figs. 1–12, 60, 65, 70, 75, 80, 85, 90, 95; n=7). Idiosoma oval. Length of body, including gnathosoma, 519–563, excluding gnathosoma 437–480; width 250–288.

Dorsum (Figs. 1–4, 60, 65). Prodorsal shield punctate, with two pairs of setae (*vi* and *ve*) almost pentagonal, with lateral margins slightly concave; 82–88 long, 97–102 wide between setae *ve*–*ve*. Eyespots absent (Figs. 1, 4, 60); basal lobe of Grandjean's organ with one large tooth and three small teeth, 15–20, 12–13, 5 and 2 long, respectively (Fig. 3). Supracoxal seta *scx* slender, tapering from



Figs. 1–8. *T. longior* (Gervais, 1844) (female): 1. dorsal view; 2. supracoxal seta (*scx*); 3. Grandjean's organ; 4. prodorsal shield; 5. chelicera; 6. gnathosoma; 7. ventral view; 8. spermatheca.



Figs. 9–12. *T. longior* (Gervais, 1844) (female): 9. leg I; 10. leg II; 11. leg III; 12. leg IV.

base to tip and with six–seven tines on each side (Figs. 1–2, 4, 65). All dorsal setae finely serrated. All opisthosomal setae whip-like except for *c1*, *d1* and *d2*. Dorsal opisthosoma with three pairs of cupules (*ia*, *im* and *ip*) and one pair of opisthosomal gland (*gla*) at level of seta *e1*; seta *c1* is the shortest, whereas seta *h1–2* are the longest dorsal setae; length of dorsal setae: *vi* 82–87; *ve* 40–55; *sci* 182–195; *sce* 112–128; *scx* 30–42; *c1* 32–38; *c2* 187–202; *cp* 125–138; *d1* 47–57; *d2* 35–42; *e1* 282–300; *e2* 207–212; *f2* 317–352; *h1* 295–350; *h2* 322–355. Distances: *vi–vi* 11–12; *vi–ve* 37–40; *ve–ve* 95–100; *sce–sce* 87–95; *sci–sce* 25; *sci–sci* 35–38; *sce–ve* 75–80; *c1–c1* 100–105; *c1–c2* 37–53; *c2–c2* 175–207; *c2–cp* 30–35; *cp–cp* 230–263; *c1–d1* 42–63; *d1–d1* 50–63; *d1–d2* 72–85; *d2–d2* 165–195; *d2–gla*

45–50; *gla–gla* 182–225; *gla–e1* 42–53; *e1–e1* 100–113; *e1–e2* 75–100; *e2–e2* 187–253; *e2–f2* 180–213; *f2–f2* 100–135; *e1–h1* 102–115; *h1–h1* 65–88; *h1–h2* 40–50; *h2–h2* 67–85. Ratio: *d1/c1* 1.46–1.50; *d1/d2* 1.34–1.35; *d2/c1* 1.09–1.10.

Gnathosoma (Figs. 5–6). Punctate; palp tarsus with a simple seta (*pt*) and one solenidium (ω) 13 and 5–7 long, respectively; palp tibia with two simple setae (*d* 22–30 and *l* 18–23 long); infracapitulum with one simple seta (*m*) 32–37 long, distance: *m–m* 19–23; palp coxa with one *elcp* setae 10–15 (Fig. 6); helicerae 85–100 long, cheliceral seta *cha* spine-like 6–7 long, movable and fixed digits with 4 teeth (Fig. 5).

Venter (Figs. 7–8, 70, 75, 95). Coxal plates I divided with apodemes I anteriorly on each side

with three nodules; coxal plates II triangular and with a well-developed apodeme and distally not reaching apex of apodeme II (Figs. 7, 70, 75); with a pair of thin, sclerotized sejugal apodemes, 57–63 long, between coxae II and III; coxal plates III–IV each with apodemes (Fig. 7); genital region (posterior to sejugal apodemes to coxae IV) with a pair of setae (*g*) and genital folds (Fig. 7). Anal region with three pairs of adanal setae (*adl*–3) and three pairs of pseudanal setae (*psl*–3), seta *psl* the longest anal setae (Fig. 7); there is a pair of cupule (*ih*) at level of seta *ad2* base. Copulatory opening (5–6 in diameter), spermathecal duct broad (26–30 long) and widening gradually from midway to base of spermathecal sac (Figs. 8, 95); length of ventral setae: *la* 37–50, *c3* 30–35, *3a* 20–25, *3b* 37–45, *4a* 50–53, *g* 13–18, *ad3* 13–18, *ad2* 15–20, *adl* 17–20, *ps3* 22–25, *ps2* 77–90, *psl* 200–228, *h3* 262–300.

Legs (Figs. 9–12, 80, 85, 90). Solenidia ω 1 and ω of legs I–II slender and cylindrical (Figs. 9–10, 80, 85). Measurements of leg segments and setae as follows: *leg I*: Tr 35–38, *pR* 35–38, Fe 50–58, *vF* 52–55, Ge 32–38, *cG* 32–40, *mG* 45–50, σ 1 52–63, σ 2 25–32, Ti 30–38, *gT* 25–38, *hT* 32–43, ϕ 115–118, Ta (L.) 75, Ta (W.) 18–20, ω 1 20, ω 2 7–8, ω 3 25–28, ϵ 4–5, *aa* 15–23, *ba* 17–20, *wa* 37–50, *ra* 30, *la* 20–23, *d* 30–35, *e* 7–10, *f* 18–23, *p* 4–5, *q* 4–5, *s* 5–6, *u* 5, *v* 5, condylophore 12–15, claw 12–15; *leg II*: Tr 32–38, *pR* 37–43, Fe 50–55, *vF* 42–63, Ge 37–48, *cG* 27–35, *mG* 30–43, σ 25–30, Ti 32–35, *gT* 30–37, *hT* 32–43, ϕ 115–120, Ta (L.) 65–73, Ta (W.) 15–18, ω 17–23, *ba* 20–25, *wa* 42–58, *ra* 27–33, *la* 25–30, *d* 30–38, *e* 7–8, *f* 15–18, *p* 4, *q* 4, *s* 5–7, *u* 5, *v* 5, condylophore 12–15, claw 11–13; *leg III*: Tr 37–39, *sR* 47–53, Fe 35–45, Ge 35, *nG* 50–63, σ 14–19, Ti 27–35, *kT* 55–60, ϕ 112–133, Ta (L.) 82, Ta (W.) 12–13, *w* 37–40, *r* 27–30, *d* 30–38, *e* 7–8, *f* 22–32, *p* 3–4, *q* 3–4, *s* 5–7, *u* 4–5, *v* 4–5, condylophore 10–13, claw 10–13; *leg IV*: Tr 37–48, Fe 42–50, *wF* 42–55, Ge 42–45, Ti 35–43, *kT* 40–60, ϕ 102–113, Ta (L.) 87–95, Ta (W.) 12–13, *w* 32–43, *r* 15–18, *d* 37–40, *e* 7–8, *f* 22–30, *p* 2–4, *q* 2–4, *s* 5, *u* 5, *v* 5, condylophore 12–13, claw 11–13; Fe, Ge and Ti IV with minute preapical process (Fig. 12). Tarsus IV with setae *w* and *r* spiniform (Figs. 12, 90).

Remarks. Our redescription shows minor differences between the Iranian specimens and previously published specimens of *T. longior* (by Fan and Zhang 2007). (1) Ratios: *sci/sce* 1.525–1.625; *d1/d2* 1.34–1.35 vs. *sci/sce* 2.1 (1.9–2.1); *d1/d2* 1.5

(1.5–1.9). (2) Dorsal setae of Iranian specimens are shorter than those of New Zealand specimens: *vi* 82–87; *ve* 40–55; *sci* 182–195; *c1* 32–38; *c2* 187–202; *cp* 125–138; *d1* 47–57; *e1* 282–300; *e2* 207–212; *f2* 317–352; *h1* 295–350; *h2* 322–355; *h3* 262–300 vs. *vi* 100–107, *ve* 60–62, *sci* 238–248, *c1* 45–50, *c2* 263–280, *cp* 188–196, *d1* 67–88, *e1* 413–421, *f2* 427–433, *h1* 408–425, *h2* 433–446, *h3* 369–385. (3) Ventral setae of Iranian specimens are shorter than those of New Zealand specimens: *la* 37–50, *3a* 20–25, *4a* 50–53, *ad3* 13–18, *ad2* 15–20, *adl* 17–20, *ps3* 22–25, *ps2* 77–90, *psl* 200–228 vs. *la* 58–60, *3a* 31–33, *4a* 77–87, *ad2* 32–35, *adl* 31–38, *ps2* 129–139, *Ps1* 258–289. (4) Measurements of legs I–IV of Iranian specimens are smaller than those of the New Zealand specimens: Leg I: *vF* 52–55, σ 1 52–63, σ 2 25–32, *mG* 45–50, ϕ 115–118, *gT* 25–38, *hT* 32–43, tarsus 75, *aa* 15–23, *ba* 17–20, *ra* 30, *la* 20–23; Leg II: *cG* 27–35, *mG* 30–43, ϕ 115–120, *hT* 32–43, tarsus 65–73, *ba* 20–25, *wa* 42–58, *ra* 27–33; Leg III: *nG* 50–63, σ 14–19, ϕ 112–133, *kT* 55–60, *w* 37–40; Leg IV: *wF* 42–55, ϕ 102–113, tarsus *w* 32–43 vs. Leg I: *vF* 65–66; σ 1 72–75, σ 2 40–41, *mG* 59–60; ϕ 139–144, *gT* 43–45, tarsus 109–113, *aa* 35–36, *ba* 36–38, *ra* 40–41, *la* 29–31; Leg II: *cG* 41–43, *mG* 53–60; ϕ 153–158, *hT* 45–52; tarsus 105–110, *ba* 36–38, *wa* 56–64, *ra* 38–44; Leg III: *nG* 75–85, σ 28–45, ϕ 155–166, *kT* 77–83; *w* 45–46; Leg IV: *wF* 63–66; ϕ 127–143, tarsus 138–139, *w* 56–59.

Material examined. Our specimens were collected from the soil and litter under a white willow tree, *Salix alba* L. (Salicaceae), in Kamar Basteh Forest Park, Tuyserkan region, Hamedan province, Iran (34°35'58" N, 48°13'39" E; 34°35'59" N, 48°26'38.8" E). They were collected by F. Masoudian on June 1, 2015 and September 4, 2015. After the analysis, all specimens were deposited in the Collection of the Acarology Laboratory, University of Bu-Ali Sina, Hamedan, Iran.

***Tyrophagus similis* Volgin, 1949: 387**

Diagnosis. Eyespots absent; supracoxal seta (*scx*) long, slender and with pectinations (40–50 μ m); ratio: *d1/c1* 0.75–1.03; *d1/d2* 1.08–1.12; *d2/c1* 0.70–0.92; coxal plates II broadly triangular and with a well-developed apodeme near base of trochanter seta; tarsi I–II with cylindrical solenidia (ω 1 and ω , respectively); spermathecal duct (35–45 long) very wide and long on its entire length with a long neck near spermathecal sac; tarsus IV with setae *w* and *r* spiniform.

Female (Figs. 13–23, 61, 66, 71, 76, 81, 86, 91, 96; n=8). Idiosoma oval. Length of body, including gnathosoma, 613–730, excluding gnathosoma 525–630; width 312–338.

Dorsum (Figs. 13–15, 61, 66). Prodorsal shield punctate, with two pairs of setae (*vi* and *ve*) almost pentagonal in shape with lateral margins a slightly concave; 85–95 long, 100–118 wide between setae *ve*–*ve*. Eyespots absent (Figs. 13, 15, 61); basal lobe of Grandjean's organ with one large tooth and two small teeth, 17–20, 4–5 and 4 long, respectively (Fig. 14). Supracoxal seta *scx* pectinated and slender with four branches on each side (Figs. 13, 15, 66). All dorsal setae finely serrated. All opisthosomal setae whip-like except *c1*, *d1* and *d2*. Dorsal opisthosoma with three pairs of cupules (*ia*, *im* and *ip*) and one pair of opisthosomal gland (*gla*) at level of seta *e1*; seta *c1*, *d1* and *d2* are the shortest, whereas seta *h2* is the longest dorsal setae; length of dorsal setae: *vi* 88–105; *ve* 45–60; *sci* 195–218; *sce* 112–143; *scx* 37–50; *c1* 17–27; *c2* 190–208; *cp* 140–163; *d1* 13–28; *d2* 12–25; *e1* 240–263; *e2* 195–250; *f2* 295–363; *h1* 320–350; *h2* 375–395. Distances: *vi*–*vi* 10–13; *vi*–*ve* 37–50; *ve*–*ve* 100–113; *sce*–*sce* 90–110; *sci*–*sce* 25–30; *sci*–*sci* 37–50; *sce*–*ve* 80–83; *c1*–*c1* 125–150; *c1*–*c2* 42–58; *c2*–*c2* 225–278; *c2*–*cp* 30–50; *cp*–*cp* 275–338; *c1*–*d1* 50–63; *d1*–*d1* 75–93; *d1*–*d2* 87–113; *d1*–*e1* 82–103; *d2*–*d2* 227–233; *d2*–*gla* 62–75; *gla*–*gla* 262–313; *gla*–*e1* 62–83; *e1*–*e1* 150–160; *e1*–*e2* 125–150; *e2*–*e2* 282–350; *e2*–*f2* 45–50; *f2*–*f2* 225–270; *e1*–*h1* 150–175; *h1*–*h1* 110–130; *h1*–*h2* 50–68; *h2*–*h2* 85–113. Ratio: *d1/c1* 0.75–1.03; *d1/d2* 1.08–1.12; *d2/c1* 0.70–0.92.

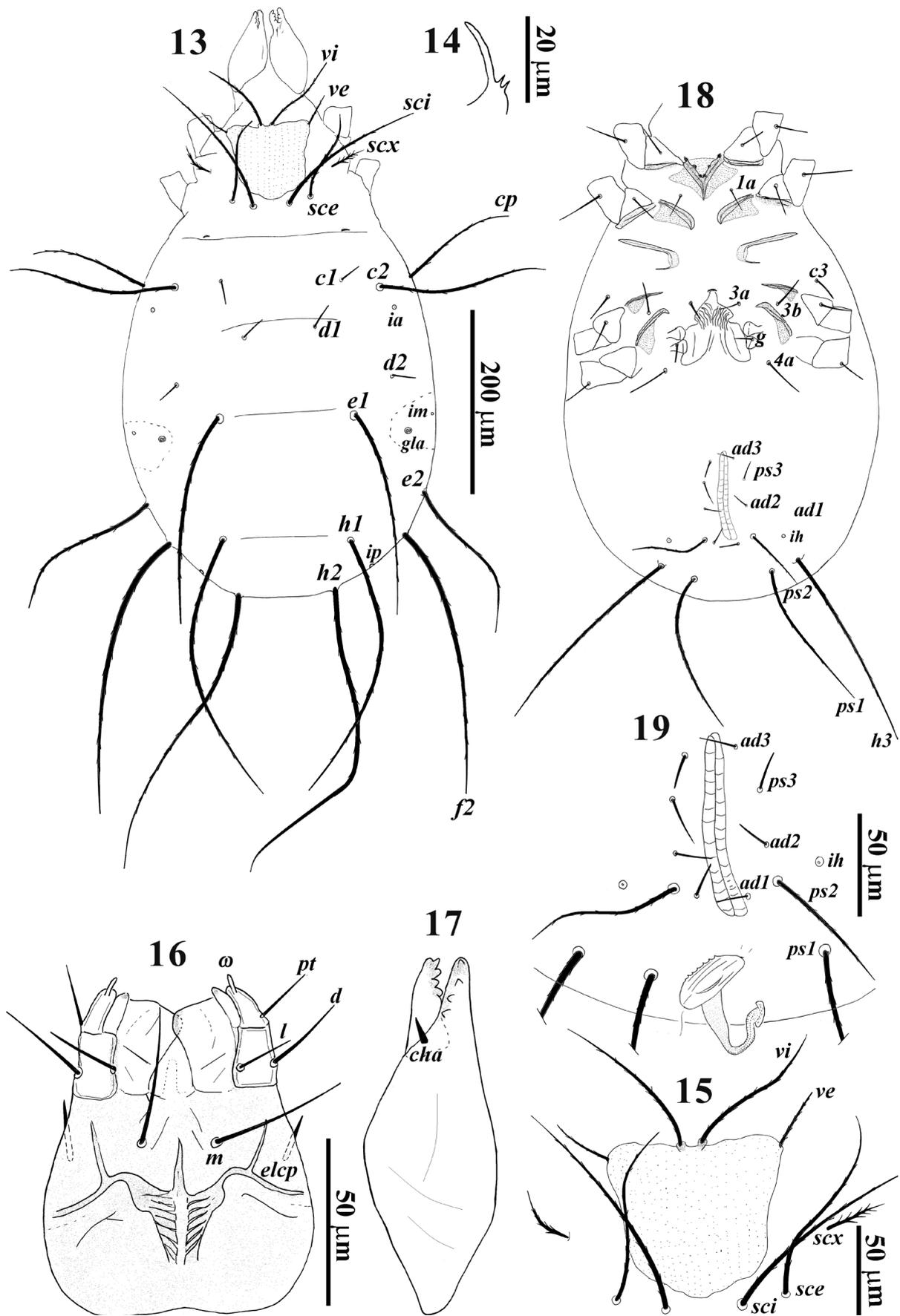
Gnathosoma (Figs. 16–17). Punctate; palp tarsus with a simple seta (*pt*) and one solenidion (ω) 18–23 and 6–7 long, respectively; palp tibia with two simple setae (*d* 25–28 and *l* 18–21 long); Infracapitulum with one simple seta (*m*) 30–38 long, palp coxa with one *elcp* setae 13–15 (Fig. 16); Chelicerae 95–110 long, cheliceral seta *cha* spine-like 8–10 long, movable and fixed digits with 4 teeth (Fig. 17). Distance: *m*–*m* 19–23.

Venter (Figs. 18–19, 71, 76, 96). Coxal plates I divided with apodemes I anteriorly on each side with three nodules (Fig. 71); coxal plates II broadly triangular and with an well-developed apodeme near base of trochanter seta (Fig. 76); between coxae II and III with a pair of thin sclerotized sejugal apodemes, 63–65 long; coxal plates III–IV each with apodemes (Fig. 18); genital region (posterior to sejugal apodemes to coxae IV) with a pair

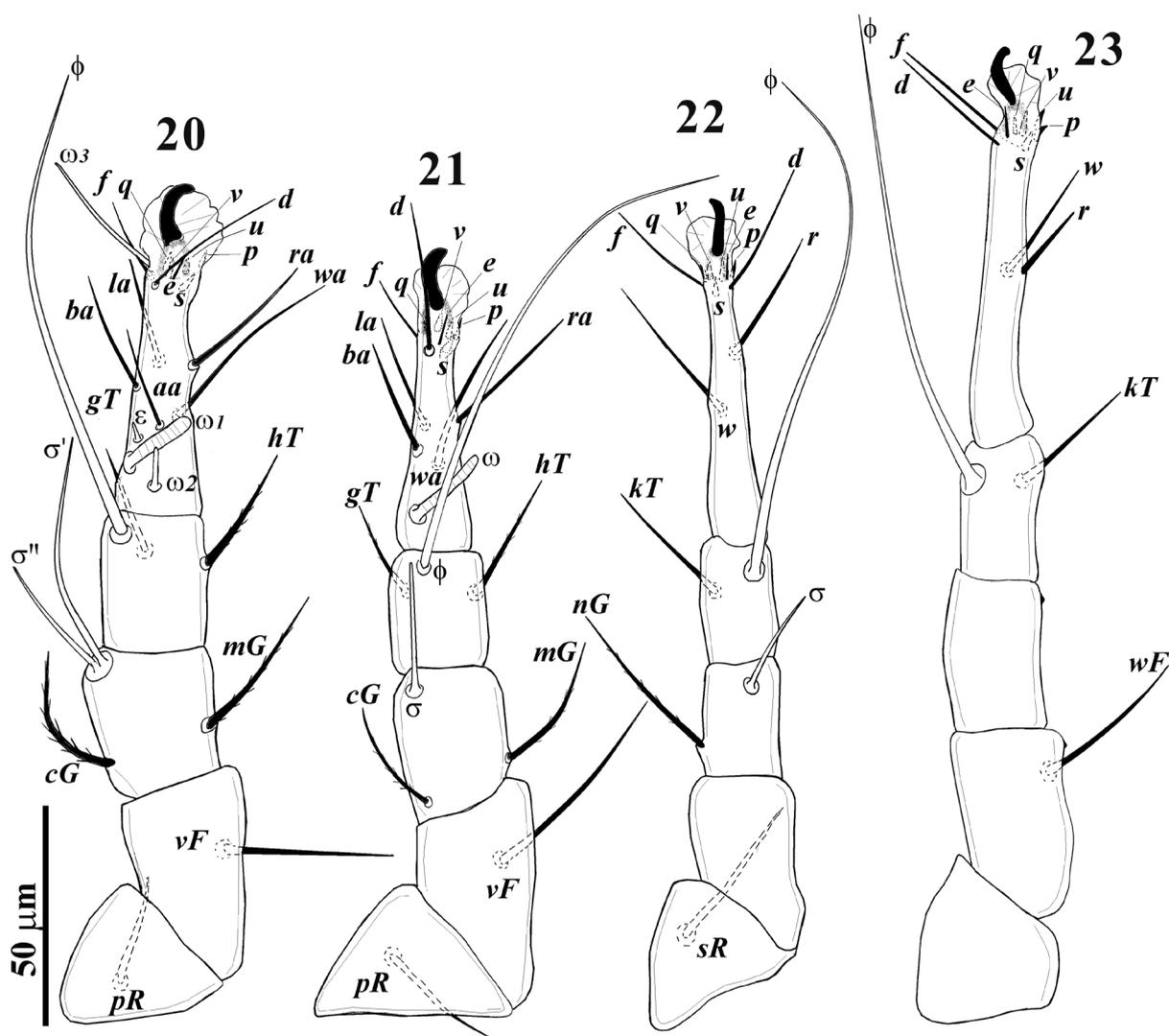
of setae (*g*) and genital folds (Fig. 18). Anal region with three pairs of adanal setae (*ad1*–*3*) and three pairs of pseudanal setae (*ps1*–*3*), seta *ps1* the longest anal setae (Fig. 18); a pair of cupule (*ih*) at level base of seta *ps2*. Copulatory opening (10–11 in diameter) located posterior to anal opening, Spermathecal duct (35–45 long) very wide along its entire length and join base of spermathecal sac and with a long neck (Figs. 19, 96); Length of ventral setae: *1a* 32–33, *c3* 25–43, *3a* 15–23, *3b* 35–43, *4a* 37–50, *g* 15–23, *ad3* 12–18, *ad2* 15–18, *ad1* 15–19, *ps3* 20–25, *ps2* 75–92, *ps1* 175–238, *h3* 225–303.

Legs (Figs. 20–23, 81, 86, 91). Leg I–II with cylindrical solenidion ($\omega 1$ and ω , respectively) (Figs. 21–22, 81, 86). Measurements of leg segments and setae as follows: *leg I*: Tr 35–50, *pR* 17–27, Fe 50–65, *vF* 43–50, Ge 37–48, *cG* 32–35, *mG* 37–48, $\sigma 1$ 60–70, $\sigma 2$ 25–35, Ti 37–38, *gT* 25–33, *hT* 37–40, ϕ 125–150, Ta (L.) 57–80, Ta (W.) 20–25, $\omega 1$ 20, $\omega 2$ 9–10, $\omega 3$ 30–38, ϵ 4–5, *aa* 20–25, *ba* 18–25, *wa* 42–55, *ra* 32–45, *la* 22–30, *d* 35–43, *e* 8–10, *f* 18–25, *p* 4–5, *q* 4–5, *s* 7–8, *u* 5–6, *v* 5–6, condylophore 16–18, claw 15–16; *leg II*: Tr 37–45, *pR* 25–30, Fe 50–63, *vF* 50–55, Ge 37–43, *cG* 27–38, *mG* 37–50, σ 27–30, Ti 30–32, *gT* 20–27, *hT* 32–43, ϕ 132–150, Ta (L.) 62–75, Ta (W.) 17–20, ω 20–25, *ba* 20–28, *wa* 42–50, *ra* 32–48, *la* 25–30, *d* 32–38, *e* 8–10, *f* 17–20, *p* 4–5, *q* 4–5, *s* 7–8, *u* 6–7, *v* 6–7, condylophore 12–15, claw 12–15; *leg III*: Tr 42–50, *sR* 38–50, Fe 32–45, Ge 37–45, *nG* 45–63, σ 20–23, Ti 25–38, *kT* 37–45, ϕ 120–152, Ta (L.) 62–85, Ta (W.) 12–15, *w* 35–45, *r* 25–38, *d* 25–30, *e* 8–10, *f* 18–23, *p* 5, *q* 5, *s* 7–8, *u* 5–6, *v* 5–6, condylophore 13–15, claw 13–14; *leg IV*: Tr 38–45, Fe 45–55, *wF* 38–50, Ge 43–50, Ti 40–44, *kT* 38–45, ϕ 115–121, Ta (L.) 85–100, Ta (W.) 15–18, *w* 30–38, *r* 20–25, *d* 30–35, *e* 8–10, *f* 28–35, *p* 4, *q* 4, *s* 7–8, *u* 6, *v* 6, condylophore 13–14, claw 13; Fe, Ge and Ti IV with minute preapical process (Fig. 23). Tarsus IV with setae *w* and *r* spiniform (Figs. 23, 91).

Remarks. Our redescription shows minor differences between the Iranian specimens and those from New Zealand (Fan and Zhang 2007): (1) The distance between dorsal seta *c1*–*d1* in Iranian specimens is shorter than that of the New Zealand specimens (50–63 vs. 71–72); (2) The ratio *c1*–*d1*/*d1*–*e1* is 0.61 vs. 0.77–0.9; (3) Movable and fixed digits of chelicera have four teeth in Iranian specimens, as opposed to three teeth in New Zealand specimens.



Figs. 13–19. *T. similis* Volgin, 1949 (female): 13. dorsal view; 14. Grandjean's organ; 15. prodorsal shield; 16. gnathosoma; 17. chelicera; 18. ventral view; 19. anal region.



Figs. 20–23. *T. similis* Volgin, 1949 (female): 20. leg I; 21. leg II; 22. leg III; 23. leg IV.

Material examined. The specimens were collected from the forest soil and litter under a Persian walnut, *Juglans regia* L., (Juglandaceae), in Kamar Basteh Forest Park, Tuyserkan region, Hamedan province, Iran (34°35'55" N, 48°26'38" E; 34°35'40" N, 48°26'38.7" E). The specimens were collected by F. Masoudian on June 1, 2015 and September 4, 2015. All specimens have been deposited in the Collection of the Acarology Laboratory, University of Bu-Ali Sina, Hamedan, Iran.

***Tyrophagus vanheurni* Oudemans, 1924: 326**

Diagnosis. Eyespots absent; supracoxal seta *scx* pectinated and slender with 4–5 branches on each side; ratio: $d1/c1$ 1.62–2.19; $d1/d2$ 1.42–2.04; $d2/c1$ 1.07–1.13; coxal plates II broadly triangular, not reaching to beyond apex of apodeme II and with posterior margin sinuous shaped; spermathecal duct (45–50 long) cylindrical tube like and

slightly widening toward base of spermathecal sac; aedeagus obviously with lateral arms supporting aedeagus turning inwards; tarsus I–II with cylindrical solenidion ($\omega 1$ and ω , respectively); tarsus IV with setae *w* and *r* filiform.

Female (Figs. 24–35, 62, 67, 72, 77, 82, 87, 92, 97; n=5). Idiosoma oval. Length of body including gnathosoma 633–700, excluding gnathosoma 540–600; width 325–413.

Dorsum (Figs. 24–26, 62, 67). Prodorsal shield punctate, with two pairs of setae (*vi* and *ve*) almost pentagonal in shape with lateral margins a slightly concave; 88–100 long, 100–112 wide between setae *ve*–*ve*. Eyespots absent (Figs. 24, 62); basal lobe of Grandjean's organ with one large tooth and three small teeth, 18–20 and 7–8 long, 3 and 2–3 respectively (Fig. 25). Supracoxal seta *scx* pectinated and slender with 4–5 branches on each side (Figs. 26, 67). All dorsal setae finely serrated. All

opisthosomal setae whip like except *c1*, *d1* and *d2*. Opisthosoma with three pairs of cupules (*ia*, *im* and *ip*) and one pair of opisthosomal gland (*gla*) at level of seta *e1*; Seta *c1* and *d2* are the shortest whereas seta *h1-2* is the longest dorsal setae; Length of dorsal setae: *vi* 100–112; *ve* 57–62; *sci* 217–237; *sce* 125–137; *scx* 30–40; *c1* 37–42; *c2* 222–237; *cp* 145–187; *d1* 60–92; *d2* 42–45; *e1* 295–320; *e2* 175–235; *f2* 337–347; *h1* 337–347; *h2* 337–362. Distances: *vi-vi* 13–17; *vi-ve* 42–45; *ve-ve* 102–112; *sce-sce* 110–120; *sci-sce* 27–30; *sci-sci* 42–50; *sce-ve* 80–85; *c1-c1* 137–152; *c1-c2* 50–75; *c2-c2* 235–300; *c2-cp* 37–50; *cp-cp* 312–375; *c1-d1* 70–92; *d1-d1* 52–75; *d1-d2* 95–130; *d1-e1* 95–117; *d2-d2* 237–300; *d2-gla* 57–77; *gla-gla* 255–342; *gla-e1* 57–85; *e1-e1* 125–177; *e1-e2* 75–125; *e1-f2* 150–167; *e2-e2* 262–342; *f2-f2* 237–275; *e1-h1* 125–157; *h1-h1* 107–137; *h1-h2* 52–57; *h2-h2* 70–100. Ratio: *d1/c1* 1.62–2.19; *d1/d2* 1.42–2.04; *d2/c1* 1.07–1.13.

Gnathosoma (Figs. 27–28). Punctate; palp tarsus with a simple seta (*pt*) and one solenidion (*ω*) 12–15 and 6–7 long, respectively; palp tibia with two simple setae (*d* 27–28 and *l* 17–20 long); Infracapitulum with one simple seta (*m*) 37–42 long, palp coxa with one *elcp* setae 9–10 (Fig. 28); Chelicerae 100–105 long, cheliceral seta *cha* spine-like 7–8 long, movable and fixed digits with 3 teeth (Fig. 27). Distance: *m-m* 19–20.

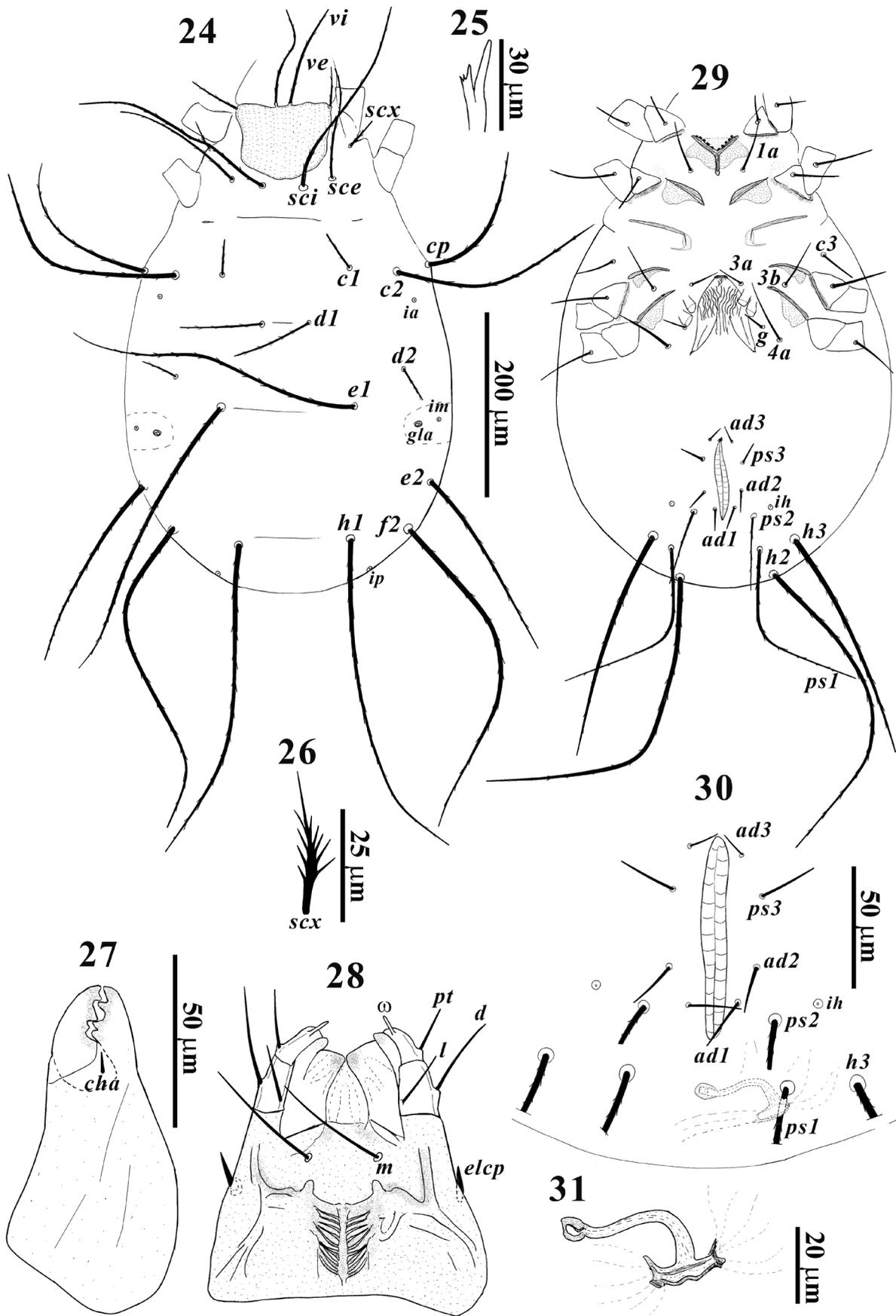
Venter (Figs. 29–31, 72, 77, 97). Coxal plates I divided with apodemes I anteriorly on each side with five nodules (Figs. 29, 72); coxal plates II broadly triangular, not reaching to beyond apex of apodeme II and with posterior margin sinuous shaped (Figs. 29, 77); between coxae II and III with a pair of thin sclerotized sejugal apodemes, 70–75 long; coxal plates III–IV each with apodemes (Fig. 29); genital region (posterior to sejugal apodemes to coxae IV) with a pair of setae (*g*) and genital folds (Fig. 29). Anal region with three pairs of adanal setae (*adl-3*) and three pairs of pseudanal setae (*psl-3*), seta *psl* the longest anal setae (Fig. 29); a pair of cupule (*ih*) at level base of seta *adl*. Copulatory opening (6–8 in diameter) located posterior to anal opening, Spermathecal duct (45–50 long) cylindrical tube like and slightly widening toward base of spermathecal sac (20–22 long) (Figs. 31, 97); Length of ventral setae: *1a* 50–57, *c3* 40–42, *3a* 25–30, *3b* 42–57, *4a* 57–67, *g* 20–25, *ad3* 15–18, *ad2* 22–30, *ad1* 22–27, *ps3* 22–27, *ps2* 75–102, *ps1* 157–215, *h3* 262–277.

Legs (Figs. 32–35, 82, 87, 92). Leg I–II with cylindrical solenidion (*ω1* and *ω*, respectively)

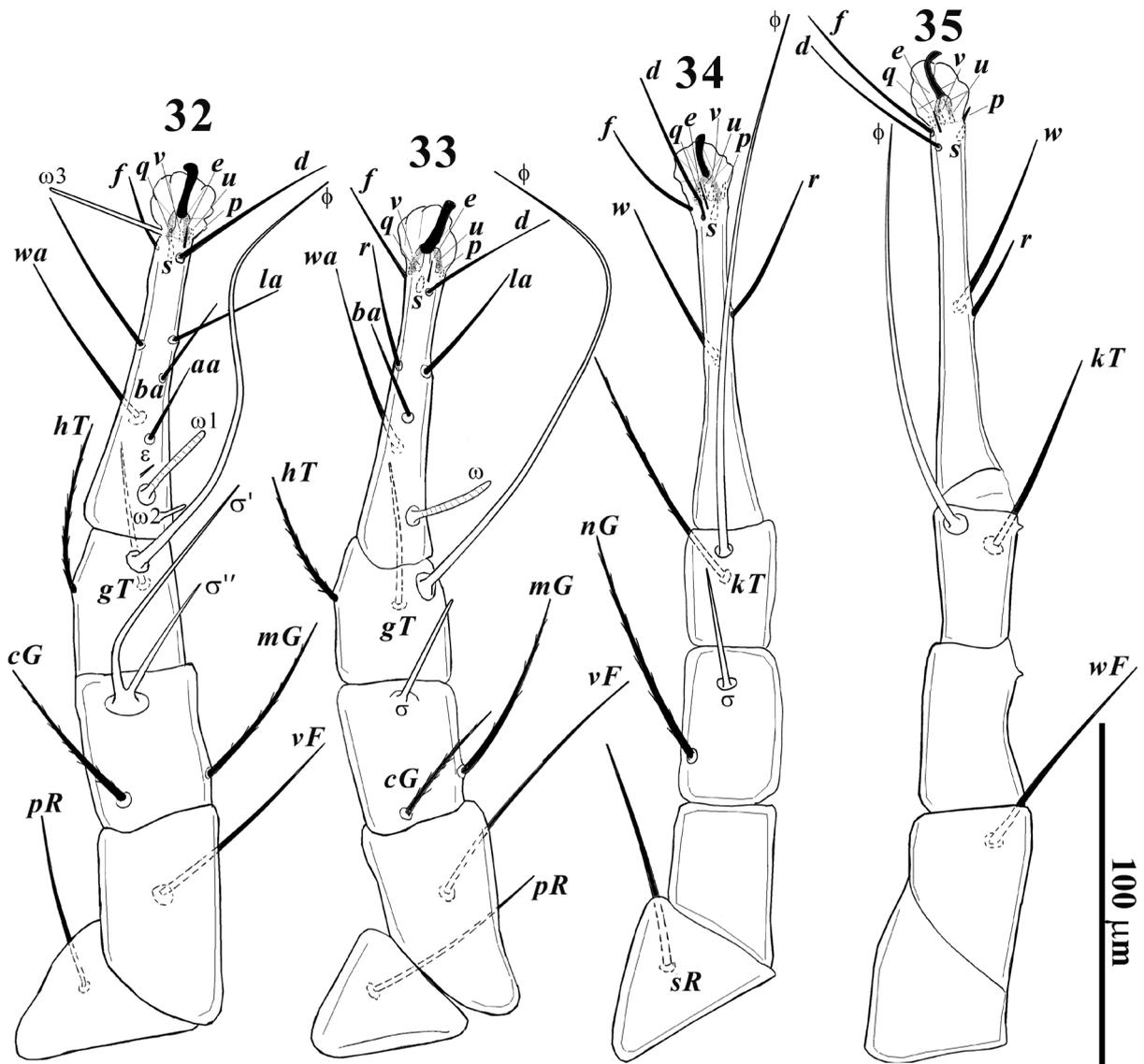
(Figs. 32–33, 82, 87). Measurements of leg segments and setae as follows: *Leg I*: Tr 37–52, *pR* 37–42, Fe 50–60, *vF* 50–62, Ge 37–45, *cG* 42–45, *mG* 42–55, *σ1* 65–70, *σ2* 30–32, Ti 35–42, *gT* 32–40, *hT* 42–45, *φ* 115–140, Ta (L.) 87–89, Ta (W.) 20–27, *ω1* 22–25, *ω2* 10–11, *ω3* 27–32, *ε* 6–7, *aa* 25–27, *ba* 18–22, *wa* 38–50, *ra* 29–35, *la* 28–31, *d* 32–38, *e* 8–10, *f* 18–20, *p* 4–5, *q* 4–5, *s* 7–8, *u* 5–6, *v* 5–6, condylophore 17–18, claw 15; *Leg II*: Tr 37–50, *pR* 42–52, Fe 50–60, *vF* 57–75, Ge 37–45, *cG* 32–42, *mG* 47–50, *σ* 30–32, Ti 32–42, *gT* 37–40, *hT* 42–50, *φ* 120–145, Ta (L.) 80–82, Ta (W.) 17–22, *ω* 25–30, *ba* 25–30, *wa* 47–57, *ra* 35–40, *la* 25–30, *d* 40–47, *e* 8–12, *f* 22–25, *p* 4–5, *q* 4–5, *s* 7–8, *u* 6–7, *v* 6–7, condylophore 15–18, claw 12–15; *Leg III*: Tr 37–45, *sR* 50–60, Fe 37–50, Ge 37–42, *nG* 50–62, *σ* 27–30, Ti 30–42, *kT* 57–62, *φ* 135–142, Ta (L.) 87–90, Ta (W.) 15–17, *w* 40–42, *r* 30, *d* 32–37, *e* 7–10, *f* 27–32, *p* 4–5, *4-q* 5, *s* 6–8, *u* 5–7, *v* 5–7, condylophore 12–16, claw 12–15; *Leg IV*: Tr 45–50, Fe 45–52, *wF* 50–65, Ge 37–47, Ti 35–42, *kT* 50–62, *φ* 125–137, Ta (L.) 100–107, Ta (W.) 12–15, *w* 40–42, *r* 20–22, *d* 35–45, *e* 8–9, *f* 35–37, *p* 3–4, *q* 3–4, *s* 7–8, *u* 5–7, *v* 5–7, condylophore 12–17, claw 12–13; Ge and Ti IV with minute preapical process (Fig. 32). Tarsus IV with seta *r* filiform (Fig. 92).

Male (Figs. 36–47, 63, 68, 73, 78, 83, 88, 93, 99–100; n=3). Idiosoma oval, length of body including gnathosoma 552–565, excluding gnathosoma 467–475; width 300–320.

Dorsum (Figs. 36–38, 63, 68). Prodorsal shield punctate, with two pairs of seta (*vi* and *ve*) nearly pentagonal in shape with lateral margins slightly concave; 85–88 long, 90–95 wide between setae *ve-ve*. Eyespots absent (Figs. 36, 63); Basal lobe of Grandjean's organ with one large tooth and one small teeth, 17–18 and 6–7 long, respectively (Fig. 38). Supracoxal seta *scx* pectinated with four branches on each side (Figs. 37, 68). All dorsal setae finely serrated. All opisthosomal setae whip like except *c1*, *d1* and *d2*. Opisthosoma with three pairs of cupules (*ia*, *im* and *ip*) and one pair of opisthosomal glands (*gla*) at level of seta *e1*; Setae *c1* and *d2* the shortest and setae *f2* and *h2* the longest dorsal setae; Length of dorsal setae: *vi* 95–100; *ve* 44–50; *sci* 195–201; *sce* 120–124; *scx* 34–37; *c1* 35–37; *c2* 214–218; *cp* 94–97; *d1* 51–55; *d2* 39–42; *e1* 321–326; *e2* 180–187; *f2* 356–365; *h1* 320–325; *h2* 360–364. Distances: *vi-vi* 10–12; *vi-ve* 33–35; *ve-ve* 90–93; *sce-sce* 95–100; *sci-sce* 20–24; *sci-sci* 30–35; *c1-c1* 120–125; *c1-c2* 51–54; *c2-c2* 220–225; *c2-cp* 25–30; *cp-cp* 277–280; *c1-d1*



Figs. 24–31. *T. vanheurni* Oudemans, 1924 (female): 24. dorsal view; 25. Grandjean's organ; 26. supracoxal seta (scx); 27. chelicera; 28. gnathosoma; 29. ventral view; 30. anal region; 31. spermatheca.



Figs. 32–35. *T. vanheurni* Oudemans, 1924 (female): 32. leg I; 33. leg II; 34. leg III; 35. leg IV.

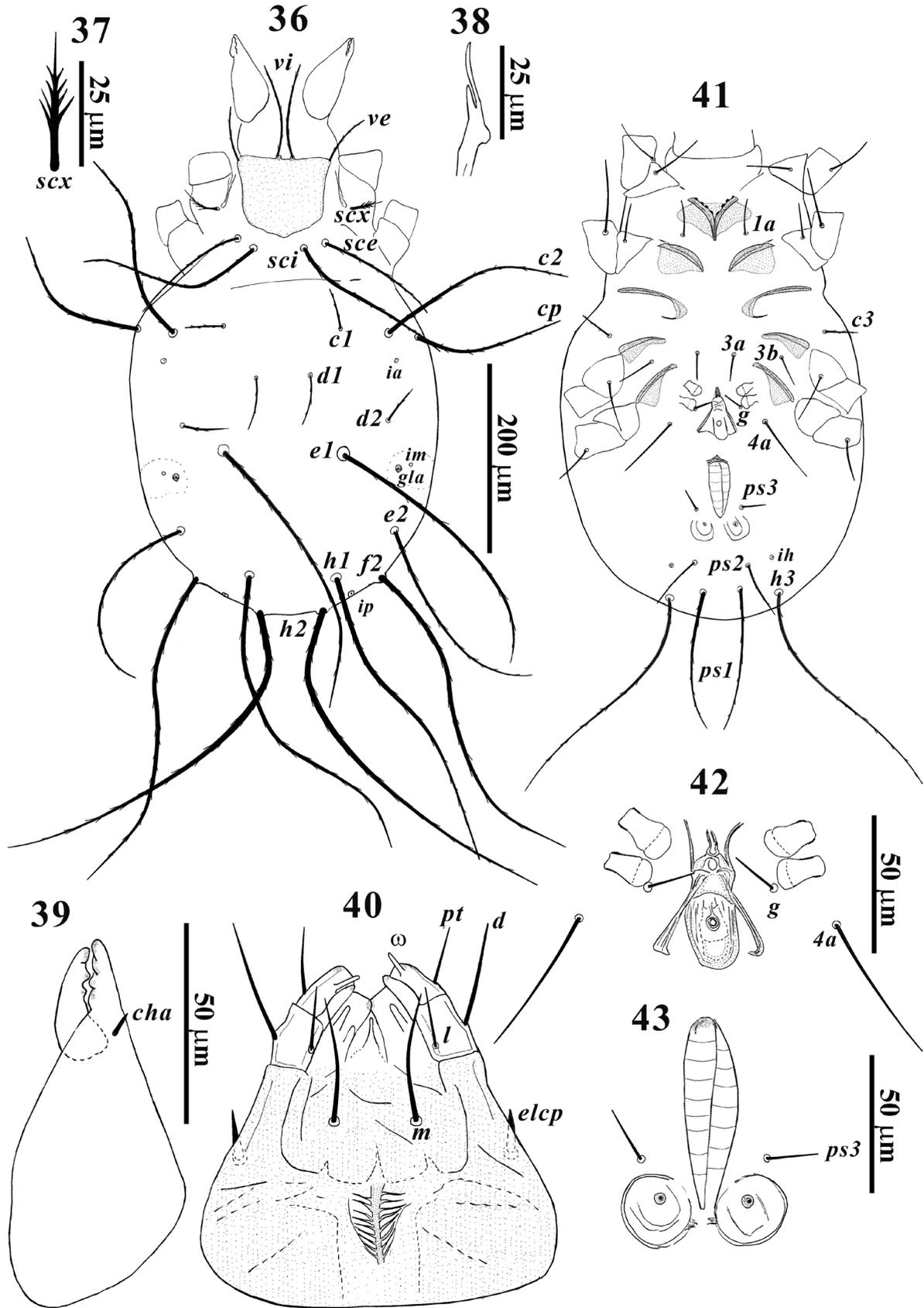
58–62; *d1–d1* 48–50; *d1–e1* 85–88; *d1–d2* 90–92; *d2–d2* 215–217; *d2–gla* 48–50; *gla–gla* 220–225; *e1–gla* 55–60; *e1–e1* 115–120; *e1–e2* 84–87; *e2–e2* 220–225; *f2–f2* 180–185; *e1–h1* 120–125; *h1–h1* 85–87; *h1–h2* 48–52; *h2–h2* 55–60.

Gnathosoma (Figs. 39–40). Punctate; palp tarsus with a simple seta (*pt*) and one solenidion (ω) 13–14 and 6–7 long, respectively; palp tibia with two simple setae (*d* 18–20 and *l* 15–16 long); infracapitulum with one simple seta (*m*) 32–35 long, distance: *m–m* 19–21; Palp coxa with one *elcp* setae 7–8 (Fig. 40); chelicerae 91–95 long, cheliceral seta *cha* spine like 7–8 long, movable and fixed digits with 3 teeth (Fig. 39).

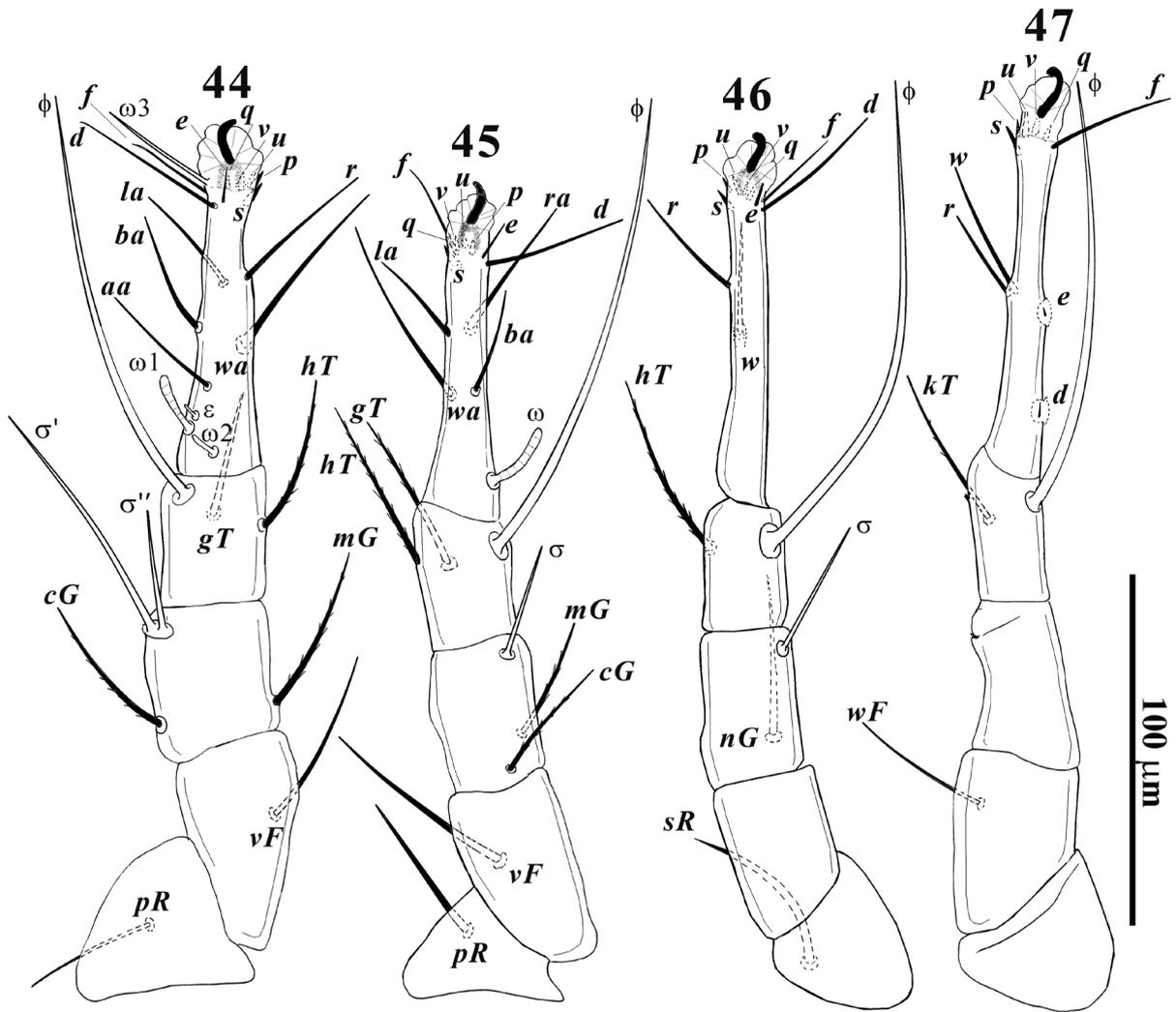
Venter (Figs. 41–43, 73, 78). Coxal plates I divided with apodemes I anteriorly on each side with four nodules (Figs. 41, 73); coxal plates II broadly triangular, not reaching to beyond apex of

apodeme II and with posterior margin sinuous shaped (Figs. 41, 78); between coxae II and III with a pair of thin sclerotized sejugal apodemes, 60–65 long; Coxal plates III–IV each with apodemes (Fig. 41); genital region (between coxae IV) with a pair of setae (*g*); aedeagus 43–45 long and obviously with lateral arms supporting aedeagus turning inwards (Figs. 42, 99–100). Anal region with three pairs of pseudanal setae (*ps1–3*), seta *ps1* and *ps3* the longest and the shortest anal setae respectively, a pair of anal suckers 28–30 and a pair of anal discs 4–5 in diameter (Figs. 43, 100); Length of ventral setae: *1a* 33–35, *c3* 40, *3a* 17–19, *3b* 35–37, *4a* 60, *g* 20–24, *ps3* 18–19, *ps2* 53–55, *ps1* 190–200, *h3* 280–288.

Legs (Figs. 44–47, 83, 88, 93). Solenidion $\omega1$ and ω of legs I–II cylindrical solenidion ($\omega1$ and ω , respectively) (Figs. 44–45, 83, 88). Measure-



Figs. 36–43. *T. vanheurni* Oudemans, 1924 (male): 36. dorsal view; 37. supracoxal seta (*scx*); 38. Grandjean's organ; 39. chelicera; 40. gnathosoma; 41. ventral view; 42. aedeagus; 43. anal region.

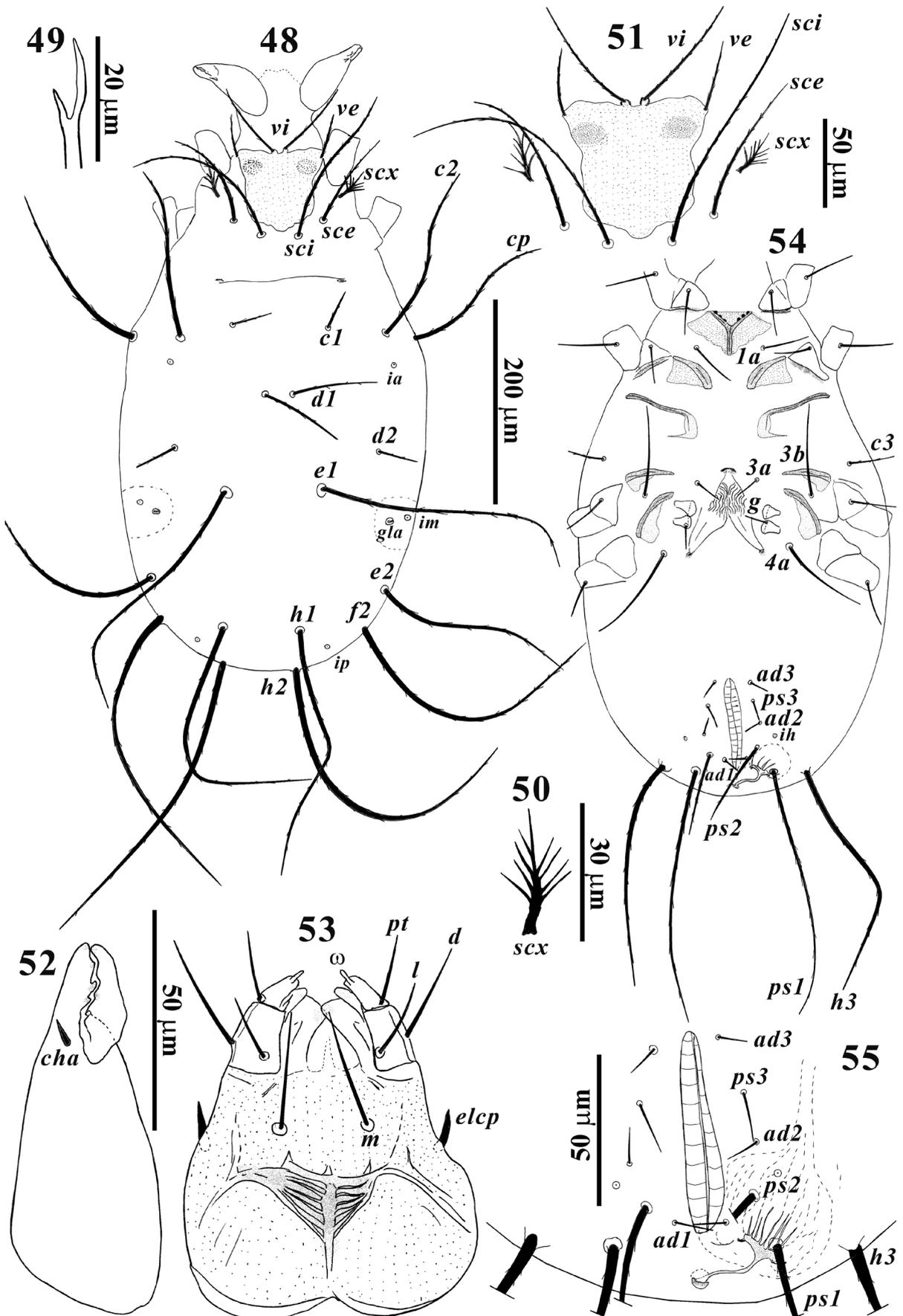


Figs. 44–47. *T. vanheurni* Oudemans, 1924 (male): 44. leg I; 45. leg II; 46. leg III; 47. leg IV.

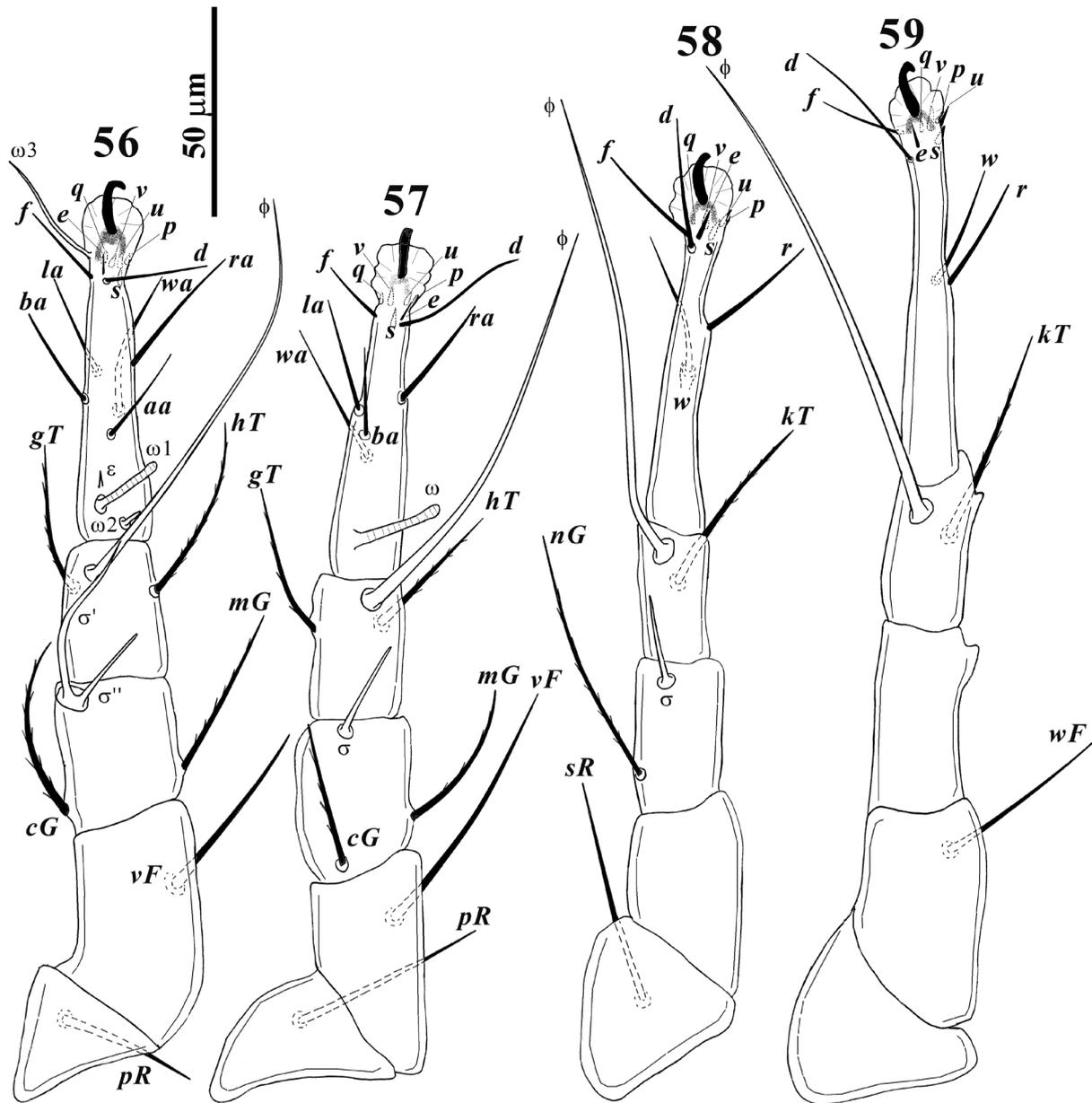
ments of leg segments and setae as follows: *leg I*: Tr 40–42, *pR* 35–37, Fe 57, *vF* 45–50, Ge 42–45, *cG* 35–37, *mG* 45–49, $\sigma 1$ 60–62, $\sigma 2$ 28–30, Ti 35–38, *gT* 32–33, *hT* 40–41, ϕ 115–117, Ta (L.) 78–80, Ta (W.) 22–25; $\omega 1$ 20, $\omega 2$ 7–8, $\omega 3$ 29–30, ϵ 5, *aa* 25–27, *ba* 20–23, *wa* 48–51, *ra* 38–41, *la* 30, *d* 37–38, *e* 11–13, *f* 18–20, *p* 3, *q* 3, *s* 6–7, *u* 5, *v* 5, condylophore 17–18, claw 15; *leg II*: Tr 40–42, *pR* 40–43, Fe 38–52, *vF* 50–55, Ge 35–38, *cG* 29–32, *mG* 42–45, σ 27, Ti 34–37, *gT* 29–30, *hT* 35–37, ϕ 110–115, Ta (L.) 70–75, Ta (W.) 20, ω 20, *ba* 28–31, *wa* 34–35, *ra* 40, *la* 24–26, *d* 34–38, *e* 10, *f* 20–23, *p* 3–4, *q* 3–4, *s* 7–8, *u* 5, *v* 5, condylophore 17–18, claw 14–15; *leg III*: Tr 38–41, *sR* 48–52, Fe 39–44, Ge 37–39, *nG* 52, σ 30, Ti 35–38, *kT* 54–58, ϕ 120–125, Ta (L.) 90–100, Ta (W.) 15, *w* 44–46, *r* 34–37, *d* 42–45, *e* 10, *f* 28–31, *p* 4, *q* 4, *s* 6–7, *u* 5, *v* 5, condylophore 14–16, claw 12–13; *leg IV*: Tr 42–45, Fe 50, *wF* 40–41, Ge 36–38, Ti 35–37, *kT* 40–45, ϕ 108–115, Ta (L.) 85, Ta (W.)

14–15, *w* 40–42, *r* 11–12, *d* 2–3, *e* 2–3, *f* 35–37, *s* 7–8, *p* 4–5, *q* 4–5, *u* 5–6, *v* 5–6, condylophore 12–13, claw 12–13. Tarsus IV with two suckers (seta *d* on proximal and seta *e* on distal sucker), distance between base of seta *d* and proximal segment of tarsus 19–20, *e*–*d* 24–25, *e*–*f* 38–40 (Figs. 47, 93). Tarsus IV with seta *r* filiform (Fig. 92).

Remarks. Our specimens have minor differences when compared to those from New Zealand (Fan and Zhang 2007). (1) Female pseudanal seta *ps2* (75–102 long) is shorter than that of the New Zealand specimens (126–167 long). (2) Genual solenidia I–III of female specimens are longer than those of New Zealand specimens ($\sigma 1$ 65–70, $\sigma 2$ 30–32 vs. $\sigma 1$ 38–48, $\sigma 2$ 18–24; $\sigma 30$ –32 vs. $\sigma 16$ –22; $\sigma 27$ –30 vs. $\sigma 13$ –16, respectively). (3) Dorsal setae of Iranian male specimens are shorter or longer than those of New Zealand specimens: *cp* 94–97; *d1* 51–55 vs. *cp* 135–152; *d1* 68–110 and *d2* 39–42; *e1* 321–326; *f2* 356–365; *h1* 320–325;



Figs. 48–55. *T. neiswanderi* Johnston and Bruce, 1965 (female): 48. dorsal view; 49. Grandjean's organ; 50. supracoxal seta (scx); 51. prodorsal shield; 52. chelicera; 53. gnathosoma; 54. ventral view; 55. anal region.



Figs. 56–59. *T. neiswanderi* Johnston and Bruce, 1965 (female): 56. leg I; 57. leg II; 58. leg III; 59. leg IV.

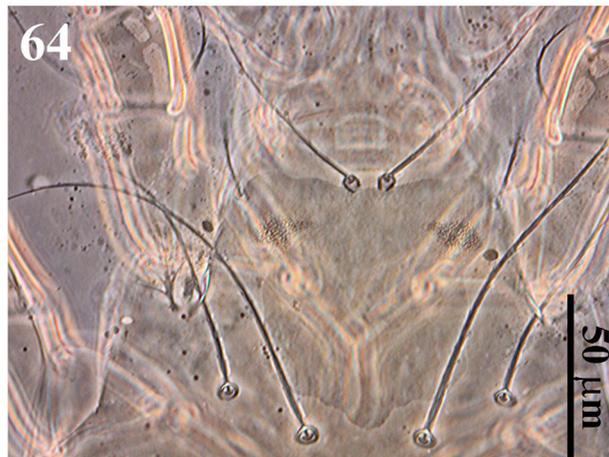
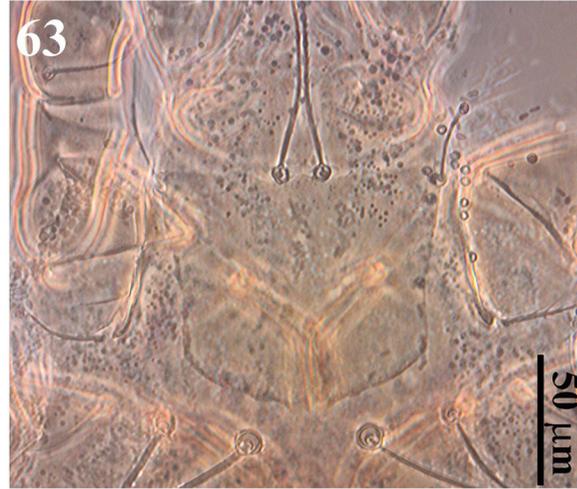
h2 360–364 vs. *d2* 23–28; *e1* 222–278; *f2* 226–299; *h1* 247–288; *h2* 331–331, respectively. (4) Legs setae of Iranian male specimens are longer: *leg I* ($\sigma 1$ 60–62, $\sigma 2$ 28–30 vs. $\sigma 1$ 28–40, $\sigma 2$ 13–18; *leg II*: σ 27 vs. σ 13–17; *leg III*: σ 30, *w* 44–46, *r* 34–37 vs. σ 12–20, *w* 23–28, *r* 20–25; *leg IV*: *w* 40–42 vs. *w* 22–32).

Material examined. The specimens were collected from soil and litter under a narrow-leaved ash tree, *Fraxinus angustifolia* Vahl (Oleaceae), in Giyan, Nahavand region, Hamedan province, Iran (34°08'44"N, 48°13'23"E), by F. Masoudian on August 19, 2015. All specimens have been deposited in the Collection of the Acarology Laboratory, University of Bu-Ali Sina, Hamedan, Iran.

***Tyrophagus neiswanderi*
Johnston and Bruce, 1965: 3**

Diagnosis. Eyespots present; supracoxal seta *scx* pectinated and slender with 4 branches on each side; ratio: *d1/c1* 2.23–2.28; *d1/d2* 2.28; *d2/c1* 0.97–1.00; coxal plates II broadly triangular, not reaching to beyond apex of apodeme II and with posterior margin sinuous shaped; spermathecal duct (28–35 long) thin tube; tarsus I–II with slender and cylindrical shape solenidion ($\omega 1$ and ω , respectively); tarsus IV with setae *w* and *r* filiform.

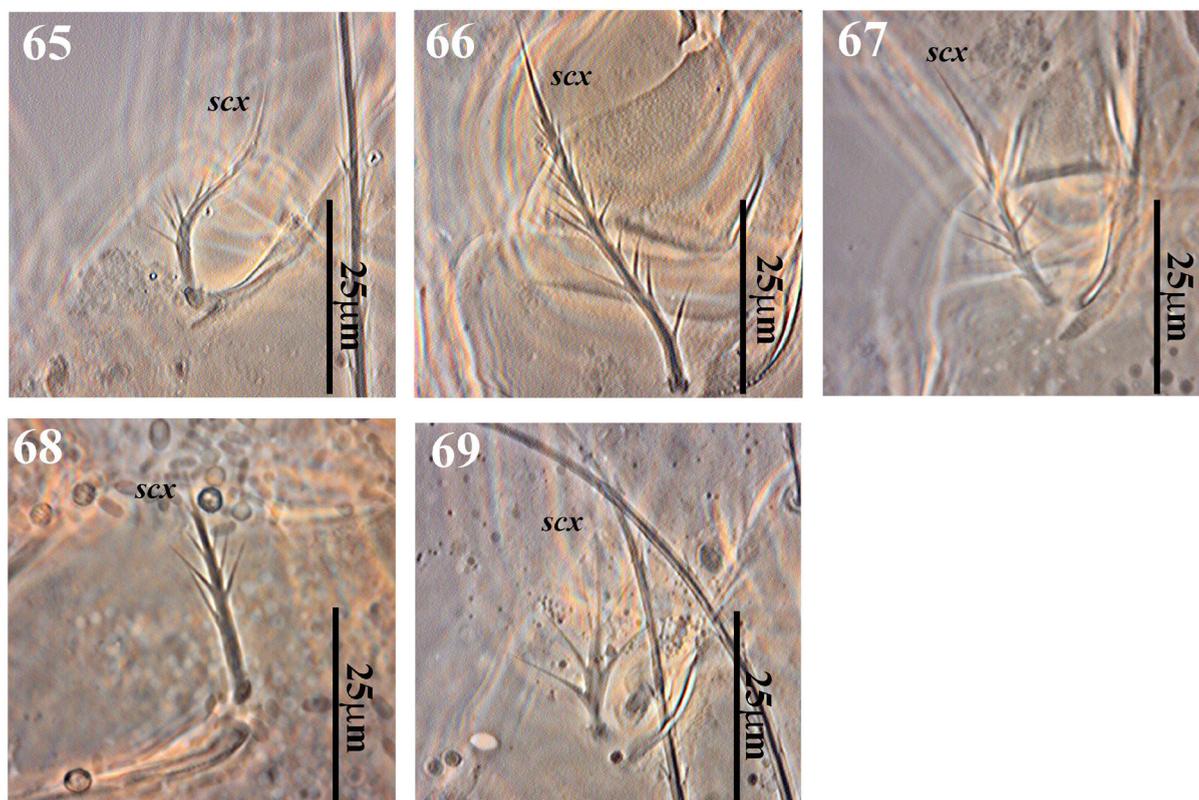
Female (Figs. 48–59, 64, 69, 84, 89, 94, 98; *n*=4). Idiosoma oval. Length of body including gnathosoma 500–575, excluding gnathosoma 425–500; width 240–280.



Figs. 60–64. Prodorsal shields: 60. *T. longior* (Gervais, 1844) (female); 61. *T. similis* Volgin, 1949 (female); 62. *T. vanheurni* Oudemans, 1924 (female); 63. *T. vanheurni* Oudemans, 1924 (male); 64. *T. neiswanderi* Johnston and Bruce, 1965 (female).

Dorsum (Figs. 48–51, 64, 69). Prodorsal shield punctate, with two pairs of setae (*vi* and *ve*) almost pentagonal in shape with lateral margins a slightly concave; 75–78 long, 83–88 wide between setae *ve-ve*. Eyespots present and 15–18 in diameter (Figs. 48, 51, 64); basal lobe of Grandjean’s organ

with one large tooth and one small teeth, 13–15 and 5–6 long respectively (Fig. 49). Supracoxal seta *scx* pectinated and slender with 4 branches on each side (Figs. 48, 50–51, 69). All dorsal setae finely serrated. All opisthosomal setae whip like except *c1*, *d1* and *d2*. Opisthosoma with three pairs



Figs. 65–69. Supracoxal setae (*scx*): 65. *T. longior* (Gervais, 1844) (female); 66. *T. similis* Volgin, 1949 (female); 67. *T. vanheurni* Oudemans, 1924 (female); 68. *T. vanheurni* Oudemans, 1924 (male); 69. *T. neiswanderi* Johnston and Bruce, 1965 (female).

of cupules (*ia*, *im* and *ip*) and one pair of opisthosomal gland (*gla*) at level of seta *e1*; seta *c1* and *d2* are the shortest whereas seta *h2* the longest dorsal setae; length of dorsal setae: *vi* 74–76; *ve* 40–43; *sci* 145–165; *sce* 88–100; *scx* 28–33; *c1* 35–38; *c2* 165–175; *cp* 145–150; *d1* 80–85; *d2* 35–37; *e1* 280–300; *e2* 185–210; *f2* 288–300; *h1* 275–288; *h2* 301–306. Distances: *vi-vi* 12–13; *vi-ve* 33–35; *ve-ve* 80–83; *sce-sce* 75–80; *sci-sce* 25–28; *sci-sci* 35–38; *sce-ve* 58–65; *c1-c1* 86–95; *c1-c2* 40–50; *c2-c2* 168–190; *c2-cp* 25–37; *cp-cp* 230–270; *c1-d1* 50–65; *d1-d1* 27–30; *d1-d2* 80–100; *d1-e1* 80–100; *d2-d2* 180–200; *d2-gla* 50–63; *gla-gla* 180–220; *gla-e1* 50–62; *e1-e1* 78–95; *e1-e2* 85–100; *e1-f2* 100–125; *e2-e2* 180–220; *f2-f2* 180–200; *e1-h1* 100–125; *h1-h1* 60–78; *h1-h2* 35–38; *h2-h2* 53–70. Ratio: *d1/c1* 2.23–2.28; *d1/d2* 2.28; *d2/c1* 0.97–1.00.

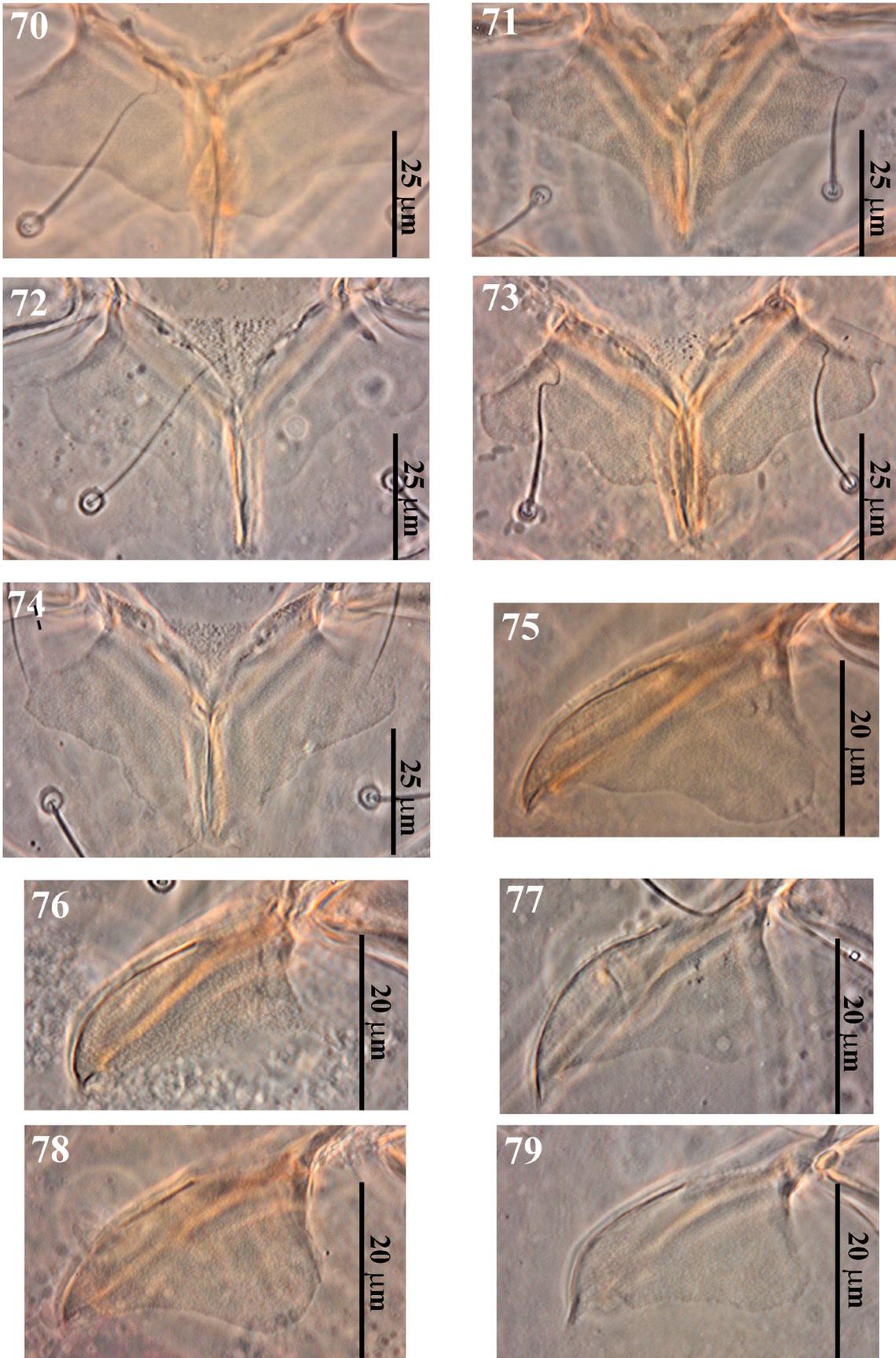
Gnathosoma (Figs. 52–53). Punctate; palp tarsus with a simple seta (*pt*) and one solenidion (ω) 12–13 and 5 long, respectively; palp tibia with two simple setae (*d* 21–27 and *l* 17–19 long); infracapitulum with one simple seta (*m*) 30–35 long, distance: *m-m* 20; palp coxa with one *elcp* setae 12–13 (Fig. 53); chelicerae 80–85 long, cheliceral

seta *cha* spine-like 7–8 long, movable and fixed digits with 3 teeth (Fig. 52).

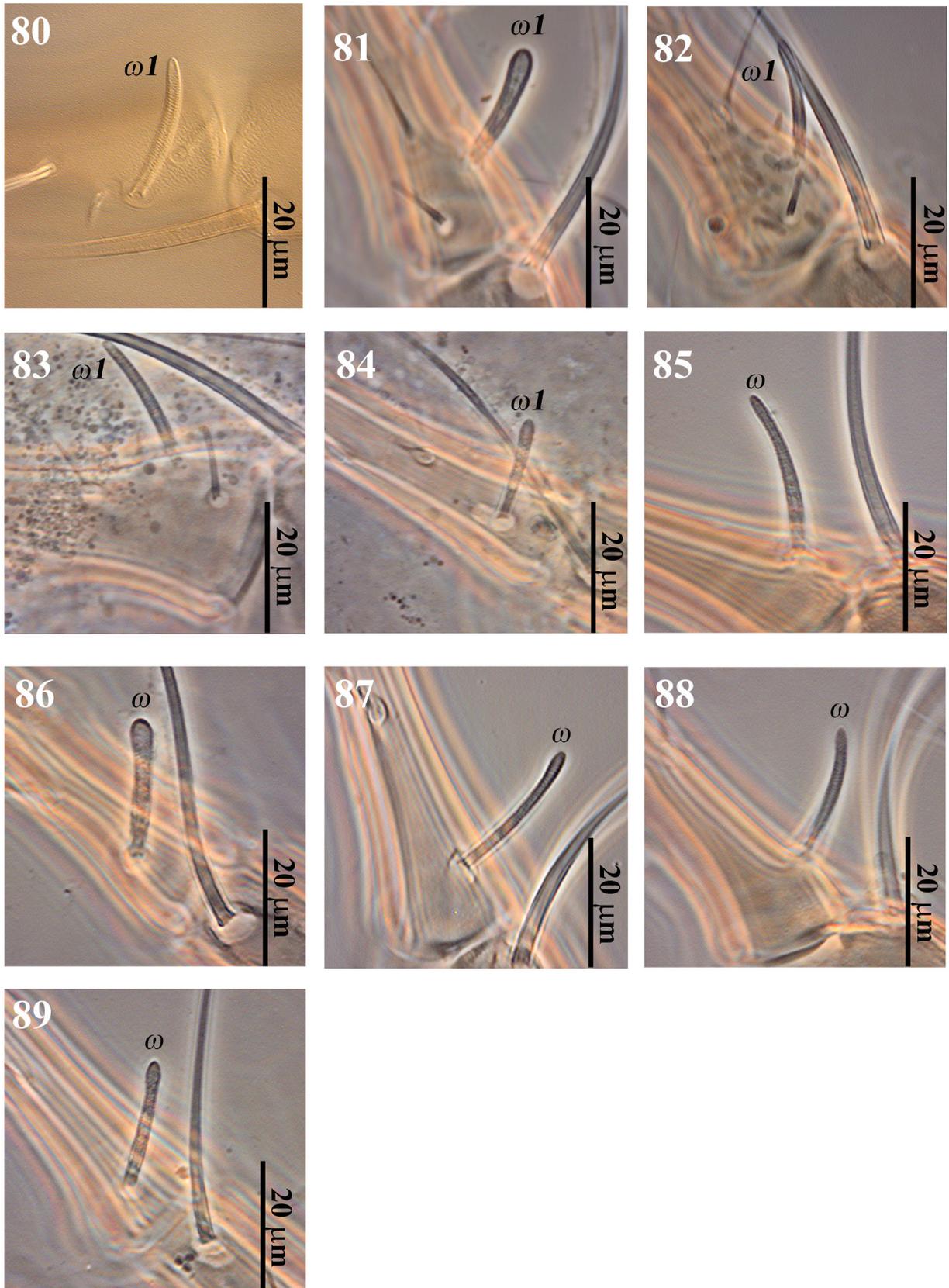
Venter (Figs. 54–55, 74, 79, 98). Coxal plates I divided with apodemes I anteriorly on each side with three nodules (Fig. 54, 74); coxal plates II broadly triangular, not reaching to beyond apex of apodeme II and with posterior margin sinuous shaped (Fig. 54, 79); between coxae II and III with a pair of thin sclerotized sejugal apodemes, 57–62 long; coxal plates III–IV each with apodemes (Fig. 54); genital region (posterior to sejugal apodemes to coxae IV) with a pair of setae (*g*) and genital folds (Fig. 54). Anal region with three pairs of adanal setae (*ad1*–3) and three pairs of pseudanal setae (*ps1*–3), seta *ps1* the longest anal setae (Fig. 54); a pair of cupule (*ih*) at level base of seta *ad1*. Copulatory opening (5–6 in diameter) located posterior to anal opening, spermathecal duct (28–35 long) thin tube, spermathecal sac (15–18 long) (Figs. 55, 98); Length of ventral setae: *1a* 45–48, *c3* 32–35, *3a* 18–25, *3b* 83–88, *4a* 75–78, *g* 15–18, *ad3* 10–13, *ad2* 12–15, *ad1* 15–18, *ps3* 18–21, *ps2* 80–92, *ps1* 188–200, *h3* 210–238.

Legs (Figs. 56–59, 84, 89, 94). Leg I–II with slender and cylindrical shape solenidion ($\omega1$ and

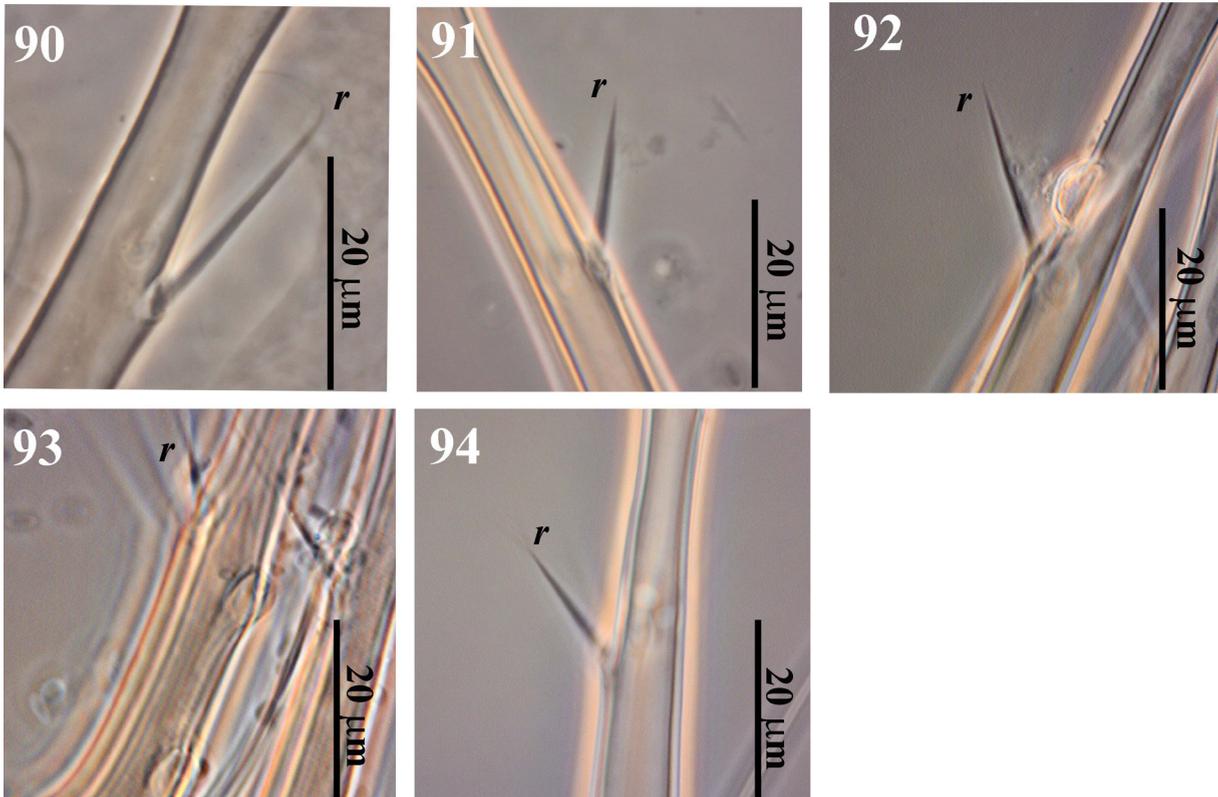
Redescription of four species of *Tyrophagus*



Figs. 70–79. Coxae I–II, respectively: 70, 75. *T. longior* (Gervais, 1844) (female); 71, 76. *T. similis* Volgin, 1949 (female); 72, 77. *T. vanheurni* Oudemans, 1924 (female); 73, 78. *T. vanheurni* Oudemans, 1924 (male); 74, 79. *T. neiswanderi* Johnston and Bruce, 1965 (female).



Figs. 80–89. Solenidion $\omega 1$ on tarsus I and Solenidion ω on tarsus II (female), respectively: 80, 85. *T. longior* (Gervais, 1844) (female); 81, 86. *T. similis* Volgin, 1949 (female); 82, 87. *T. vanheurni* Oudemans, 1924 (female); 83, 88. *T. vanheurni* Oudemans, 1924 (male); 84, 89. *T. neiswanderi* Johnston and Bruce, 1965 (female).



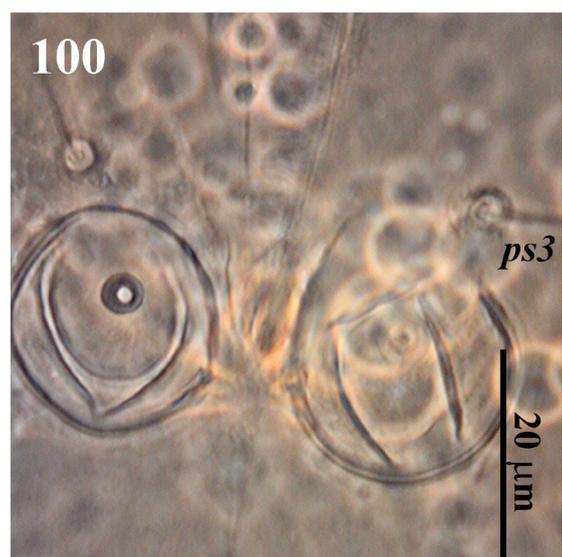
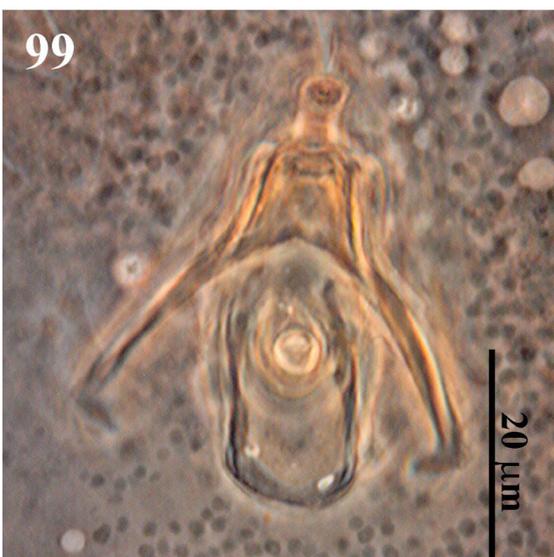
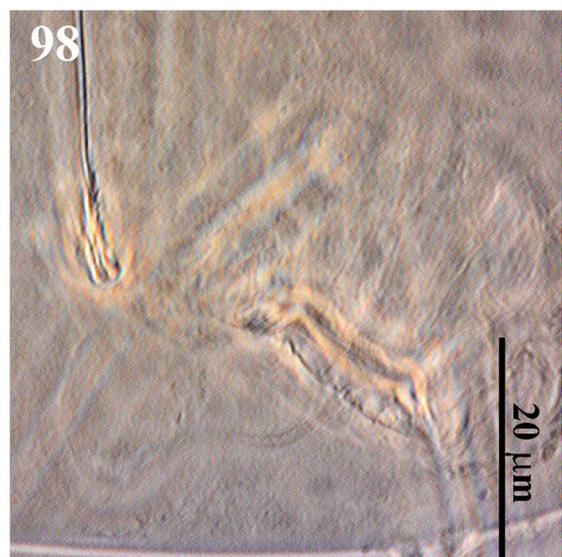
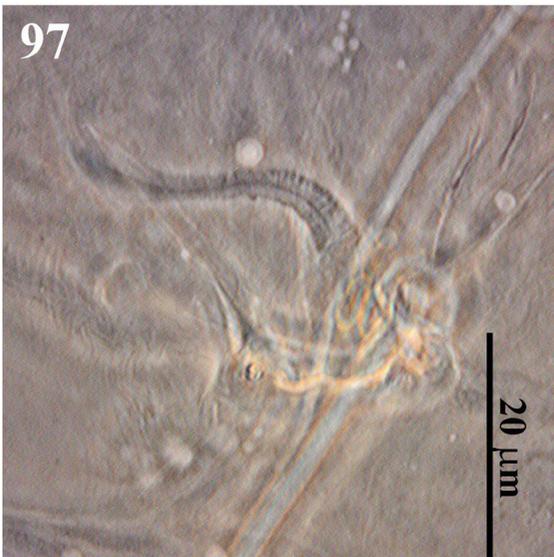
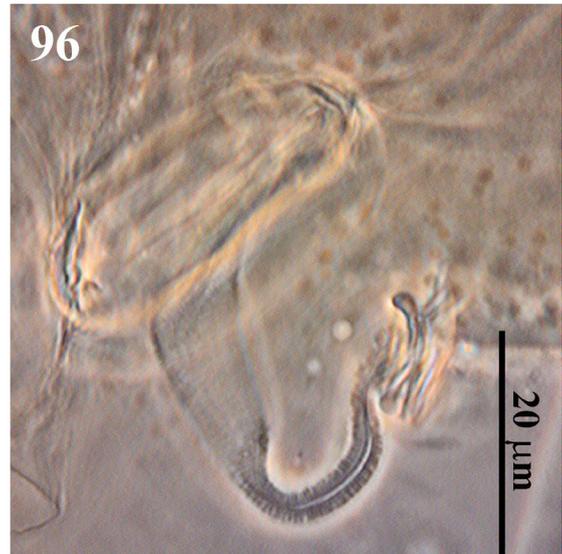
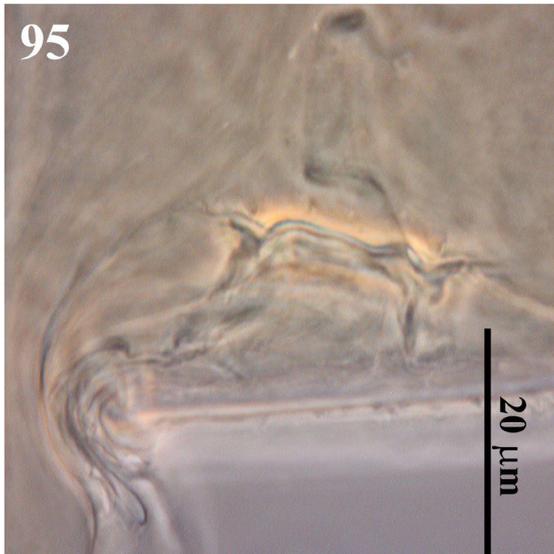
Figs. 90–94. Seta *r* on tarsus IV: 90. *T. longior* (Gervais, 1844) (female); 91. *T. similis* Volgin, 1949 (female); 92. *T. vanheurni* Oudemans, 1924 (female); 93. *T. vanheurni* Oudemans, 1924 (male); 94. *T. neiswanderi* Johnston and Bruce, 1965 (female).

ω , respectively) (Figs. 56–57, 84, 89). Measurements of leg segments and setae as follows: *leg I*: Tr 35–38, *pR* 30–35, Fe 50–52, *vF* 45–50, Ge 30–35, *cG* 35–38, *mG* 39–45, $\sigma 1$ 45–47, $\sigma 2$ 23–28, Ti 27–32, *gT* 30–34, *hT* 38–40, ϕ 85–93, Ta (L.) 60–65, Ta (W.) 17–19, $\omega 1$ 17–18, $\omega 2$ 7–8, $\omega 3$ 25–26, ε 4–5, *aa* 23–25, *ba* 18–20, *wa* 42–44, *ra* 30–35, *la* 23–25, *d* 28–35, *e* 9–10, *f* 15–16, *p* 4, *q* 4, *s* 5–6, *u* 4–5, *v* 4–5, condylophore 13–15, claw 13–14; *leg II*: Tr 32–35, *pR* 32–35, Fe 45–50, *vF* 50–55, Ge 33–35, *cG* 28–30, *mG* 40–43, σ 20–23, Ti 25–28, *gT* 30–32, *hT* 30–33, ϕ 103–110, Ta (L.) 58–62, Ta (W.) 15, ω 22–24, *ba* 18–20, *wa* 35–40, *ra* 28–30, *la* 23–25, *d* 37–42, *e* 7–8, *f* 13–15, *p* 3–4, *q* 3–4, *s* 5–6, *u* 5, *v* 5, condylophore 12–14, claw 13; *leg III*: Tr 35–38, *sR* 38–45, Fe 40–45, Ge 30–35, *nG* 50–53, σ 20–23, Ti 28–30, *kT* 50–53, ϕ 120–125, Ta (L.) 68–75, Ta (W.) 13–15, *w* 30–33, *r* 23–25, *d* 33–37, *e* 7–8, *f* 17–20, *p* 4, *q* 4, *s* 5, *u* 5, *v* 5, condylophore 13–15, claw 13–15; *leg IV*: Tr 38–41, Fe 44–46, *wF* 40–45, Ge 40–42, Ti 36–42, *kT* 43–50, ϕ 103–110, Ta (L.) 80–83, Ta (W.) 13–15, *w* 31–34, *r* 18–20, *d* 32–38, *e* 6–8, *f* 17–20, *p* 3–4, *q* 3–4, *s* 5, *u* 5–6, *v* 5–6, condylophore 13–15, claw 12–13; Ge and Ti IV with minute

preapical process (Fig. 59). Tarsus IV with seta *r* filiform (Fig. 94).

Remarks. There are minor differences between our specimens and specimens from New Zealand (Fan and Zhang 2007). (1) Dorsal and ventral setae of Iranian specimens are shorter than those of New Zealand specimens (*vi* 74–76; *ve* 40–43; *sci* 145–165; *c1* 35–38; *c2* 165–175; *cp* 145–150; *e1* 280–300; *e2* 185–210; *f2* 288–300; *h1* 275–288; *h2* 301–306; *h3* 210–238; *4a* 75–78; *ps1* 188–200; *ps2* 80–92 vs. *vi* 87–110; *ve* 51–63; *sci* 221–228; *c1* 45–58; *c2* 240–251; *cp* 183–192; *e1* 349–405; *e2* 262–284; *h1* 404–449; *h2* 392–423; *h3* 300–318; *4a* 99–107; *ps1* 232–238; *ps2* 118–170). (2) The ratio *sci/sce* is 1.65 vs. 2.1–2.3. (3) Leg setae II–IV of Iranian specimens are shorter (*leg II*: ϕ 103–110 vs. ϕ 137–176; *leg III*: ϕ 120–125, *w* 30–33, *r* 23–25 vs. ϕ 138–182, *w* 50–56, *r* 34–38; *leg IV*: ϕ 103–110 vs. ϕ 126–141).

Material examined. Our specimens were collected from the soil and litter under wild cherry plum trees, *Prunus cerasifera* Ehrh. (Rosaceae), near Giyan, Nahavand region, Hamedan province, Iran (34°08'44"N, 48°13'24"E). They were collected by F. Masoudian on August 19, 2015. All



Figs. 95–100. Spermatheca, aedeagus and anal region: 95. *T. longior* (Gervais, 1844) (female); 96. *T. similis* Volgin, 1949 (female); 97. *T. vanheurni* Oudemans, 1924 (female); 98. *T. neiswanderi* Johnston and Bruce, 1965 (female); 99–100. *T. vanheurni* Oudemans, 1924 (male).

specimens have been 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, except for the treatment of *T. putrescentiae*, which is followed by Fain and Fauvel 1993, Samšinák 1962; characters of *T. brevicrinatus* and *T. zachvatkini* were derived from Samšinák 1962)

1. Dorsal seta *dl* and *cl* subequal.....2
— Dorsal seta *dl* 1.5–3.2 times longer than seta *cl*.....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. Eyespots present.....4
— Eyespots absent5
4. Ratio *dl/cl*: > 2; Base of spermathecal sac flat *T. putrescentiae* (Schrank, 1781)
— Ratio *dl/cl*: 1.5–1.8; Base of spermathecal sac funnel-shaped.....
.....*T. neiswanderi* Johnston and Bruce, 1965
5. Dorsal seta *dl* 2.4–3.2 times longer than seta *cl*.....6
— Dorsal seta *dl* at most twice as long as seta *cl*.....7
6. Tarsus IV with *w* and *r* setae spiniform, spermathecal duct wide, tarsus I with short, stout and apically clavate solenidion *ω1*
.....*T. perniciosus* Zakhvatkin, 1941
— Tarsus IV with *w* and *r* setae filiform, spermathecal duct slender, tarsus I with slender solenidion *ω1*.....*T. vanheurni* Oudemans, 1924 [= *T. palmarum* Oudemans; sensu Robertson, 1959 (Fan and Zhang, 2007)]
7. Solenidion I *ω1* cylindrical, tapered distally ...
.....*T. longior* (Gervais, 1844)
— Solenidion I *ω1*, not tapered distally
.....*T. zachvatkini* Volgin, 1948

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