Persian Journal of Acarology, 2015, Vol. 4, No. 1, pp. 43–55.

Article

Redescription of *Neophyllobius astragalusi* and *Favognathus orbiculatus* with *F. acaciae* (Acari: Raphignathoidea) as a new record from Iran

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Abstract

Adult females of *Favognathus orbiculatus* (Livshitz) and females, male and protonymph of *Neophyllobius astragalusi* Khanjani & Ueckermann are redescribed. Also, *F. acaciae* Doğan & Ayyildiz is reported for the first time from Iran.

Key words: Trombidiformes, Prostigmata, Cryptognathidae, Camerobiidae, new record, predatory mites, Iran.

Introduction

Mites of the Raphignathoidea are important predatory mites in suborder Prostigmata. These mites have high potential as biological control agents in agricultural ecosystems (Fan & Zhang 2005). Members of the superfamily are found on foliage, branches, trunks (tree bark and holes), moss and lichen, litter, soil, animal nests (birds, possum, and honeybee), stored products, and house dust (Fan & Zhang 2005).

The Cryptognathidae was erected by Oudemans (1902) with *Cryptognathus* Kramer as type genus. Members of this family are recognized by the presence of a protective hood anterior of the propodosoma and extremely extendable gnathosomal base (Doğan 2008). *Favognathus* proposed by Luxton (1973) with *Cryptognathus cucurbita* Berlese as type species. This genus comprises 41 species worldwide (Doğan 2008; Khanjani & Ueckermann 2008; Hassanzadeh *et al.* 2014; Jafari *et al*. 2014; Khanjani *et al*. 2014; Shirinbeik Mohajer *et al*. 2014).

The Camerobiidae, commonly known as "stilt-legged mites", are widely distributed and found in various habitats such as the aerial parts of plants, soil, straw, moss and leaf litter. Species of the Camerobiidae are known to feed on crawlers of the scale insects and tarsonemid mites (Fan & Zhang 2005; Khanjani *et al*. 2014). This family contains seven genera of which *Neophyllobius* Berlese with more than 120 species is the largest genus. *Neophyllobius* was erected by Berlese (1886) with *Neophyllobius elegans* Berlese.

Up to now, 13 species of *Favognathus* (Hassanzadeh *et al*. 2014; Jafari *et al*. 2014; Khanjani *et al*. 2014; Shirinbeik Mohajer *et al*. 2014; Yousefi *et al*. 2014) and 17 species of *Neophyllobius* have been reported from Iran (Ahaniazad & Bagheri 2013; Beyzavi *et al*. 2013; Khanjani *et al*. 2014). In this paper, two species, *Favognathus orbiculatus* and *Neophyllobius astragalusi*, are redescribed and *F. acaciae* is reported for the first time in

Iran.

Material & methods

Samples were collected from field and orchards of different regions of Shahindezh and Mamaghan (Northwestern Iran). Mites were extracted from samples using a Berlese-Tullgren funnel. Collected specimens were cleared in Nesbitt's fluid and mounted in Hoyer's Medium (Walter & Krantz 2009), and examined with an Olympus Bx41 phase-contrast microscope. The length of the idiosoma was measured from the suture between the gnathosoma and idiosoma to the posterior margin of the idiosoma; the width of the idiosoma was measured at the broadest part of the idiosoma and setae were measured from their insertion to their tip; distances between setae were measured between setal bases. Leg measurements are calculated from the coxae to the tip of the claws. Dorsal setae and leg setal designations follow that of Kethley (1990). All measurements are given in micrometers (μm). All specimens are deposited in the Acarological Collection, Department of Plant Protection, Faculty of Agriculture, University of Maragheh, Maragheh, Iran.

Results

Family Cryptognathidae Kramer
Genus *Cryptognathus* Kramer
Type species: *Cryptognathus lagena* Kramer

Favognathus orbiculatus (Livshitz, 1974) (Figs. 1–8)

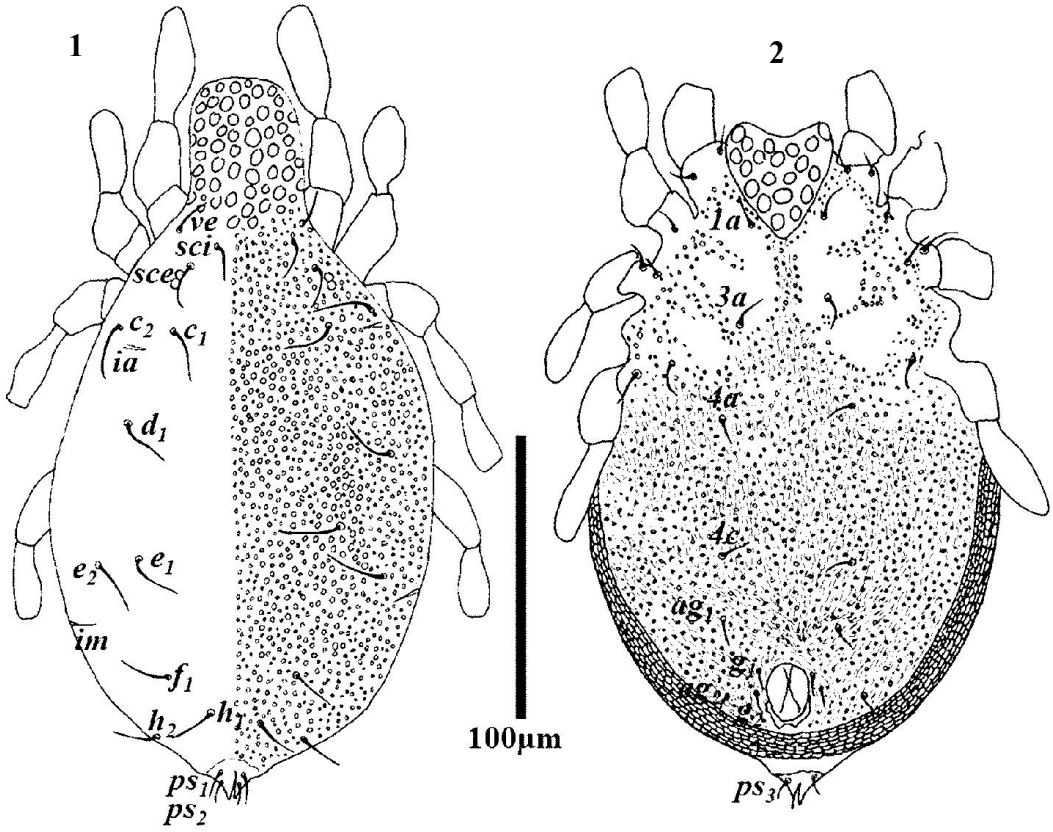
Krisper & Schneider 1998: 201; Koç & Ayyildiz 1999: 626; Doğan & Ayyildiz 2004: 123; Doğan 2008: 1678; Khaustov & Sergeyenko 2014: 366.

Redescription

Female (n = 5) - Length of body (including hood) 298 (295–305); width 182 (150–157); leg I 254 (250–254), leg II 208 (217), leg III 205 (210–214), leg IV 225 (221–227).

Dorsum (Fig. 1) - Anterior margin of hood smooth, with 7–8 round dimples in each longitudinal row; dorsal plate with 11 pairs of simple setae, one pair of eyes and one pair of postocular bodies laterally between setae *sce* and c_2; two pairs of slit-like cupules (*ia*, *im*) present; dorsum ornamented with evenly spaced pores, without reticulation, striation, or clusters of closely set punctations. Anus opening dorsoventraly, with three pairs of setae (ps_1–ps_3). Setal measurements as follows: *ve* 22 (21–24), *sci* 22 (20–21), *sce* 24 (20–21), c_1 30 (27–30), c_2 22 (22–24), d_1 34 (27–29), e_1 31 (25–28), e_2 28 (25–29), f_1 28 (25–30), h_1 22 (21–22), h_2 22 (21–22), distances between setae: *ve–ve* 44 (42–43), *sci–sci* 32 (25–38), *ve–sci* 9 (9–10), *sce–sce* 48 (52–54), *sci–sce* 8 (8–11), c_1–c_1 66 (65), c_2–c_2 98 (103–106), d_1–d_1 108 (107–114), d_1–e_1 37 (45–50), e_1–e_1 82 (83–87), e_1–e_2 23 (19–23), f_1–f_1 55 (55–56), e_1–f_1 52 (55–61), f_1–h_1 26 (27–32), e_2–e_2 115 (116–117), h_1–h_1 20 (19), h_2–h_2 62 (56–61), h_1–h_2 23 (21–25).

Venter (Fig. 2) - Prosternal apron wedge shaped with 18–20 dimples; ventral pattern similar to dorsum but with faint striations between pores; venter with 4 pairs of ventral setae (*1a*, *3a*, *4a* and *4c*); genital opening with 2 pairs of genital (g_1–g_2) and 2 pairs of aggenital (ag_1–ag_2) setae; intercoxal area smooth, without striation. Length of ventral setae: *1a* 14 (12–13), *3a* 15 (14–15), *4a* 11 (11–12), *4c* 11 (12–13).



Figures 1–2. *Favognathus orbiculatus* (Female) - 1. Dorsal view of idiosoma; 2. Ventral view of idiosoma.

Gnathosoma (Figs. 3–4) - Hypostome narrow (Fig. 3), with one pair of long setae *m* 20 (21–23) and two pairs of adoral setae (or_1–or_2); palp (Fig. 4) 91 (90–95) long, palptarsus with four eupathidia, four simple setae and one solenidion; palptibia with three simple setae; palpgenu with two and palpfemur with three simple setae.

Legs (Figs. 5–8) - Setal formulae of leg segments (solenidia in parentheses and not included) as follows: coxae 2-1-2-1, trochanters 1-1-2-1, femora 4-3-2-2, genua 5(+κ)-4(+κ)-2-3, tibiae 5(+φ, φρ)-5(+φρ)-4(+φρ)-3; tarsi 15(+ω1, ω2)-12(+ω1, ω2)-9(+ω1)-9(+ω1).

Male - Unknown

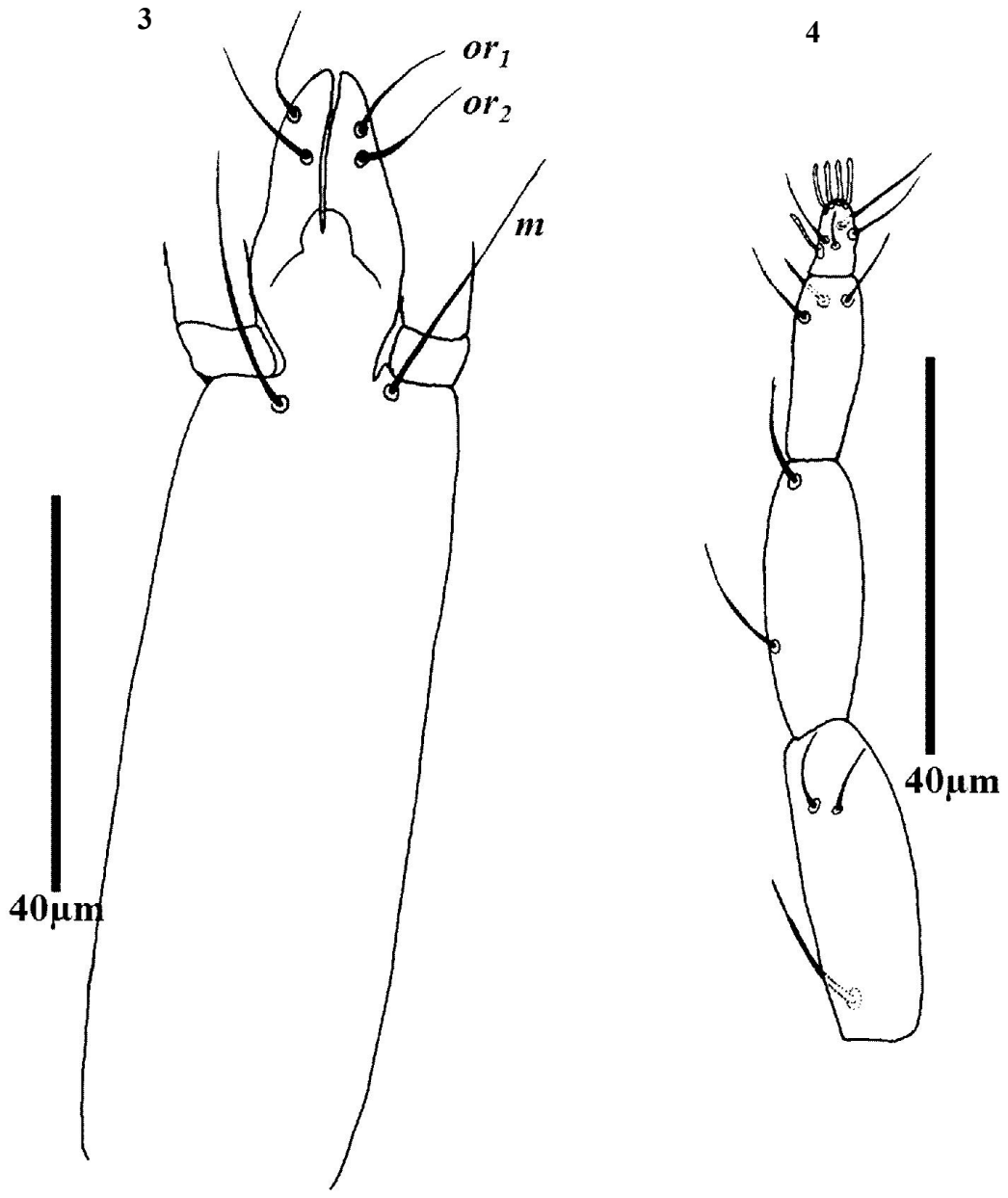
Material examined

Five females of *Favognathus* were collected from soil and rotten leaves under tamarisk (*Tamarix gallica*, Tamariaceae), 16, September, 2013, Shahindezh, West Azerbaijan province, Iran, by Asal Yousefi.

Remarks

This species was originally collected from Crimea and Russia and was described in Russian by Kuznetzov & Livshitz (1974) with lack of details and discrepancies between the description and the figures, Luxton (1978) synonymized this species with *F. cucurbita* (Berlese) according similarity of dorsal and ventral shields, both species with partial reticulations. Koç & Ayyildiz (1999) refused this synonymy and their identification was based on the original description, where no mention was made of reticulations and the leg

chaetotaxy, and for this reason, their provided diagnosis was with miscount of legs setal formula (personal communication). The Iranian specimens show all characters of the original description but with more details. Herein, we provide the only description of this species containing complete description with correct legs setal number which is missed in previous ones.



Figures 3–4. *Favognathus orbiculatus* (Female) - 3. Gnathosoma; 4. Palp.

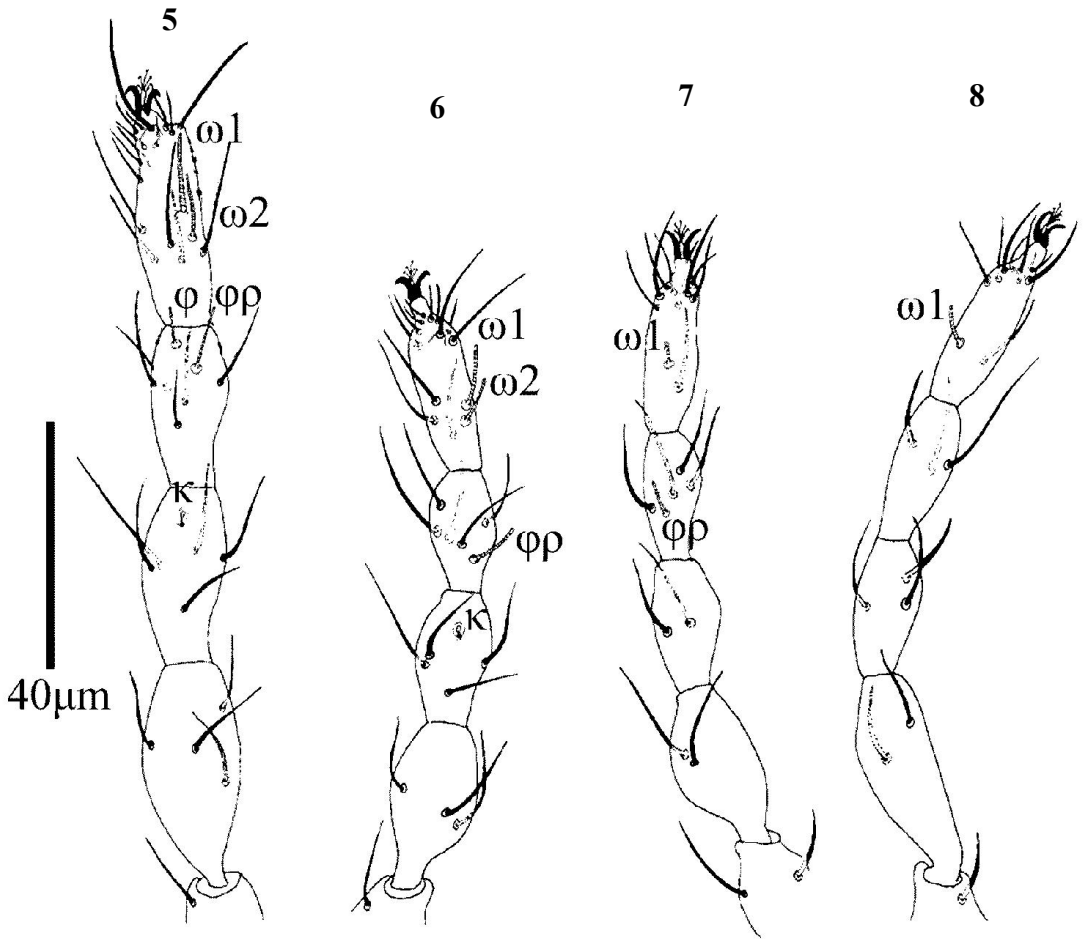
Favognathus acaciae Doğan & Ayyildiz, 2004

Doğan & Ayyildiz, 2004: 127.

This species was described from Turkey (Doğan & Ayyildiz 2004). This is a new record of this species from Iran.

Material examined

Three females from the soil and humus under apple trees, 17 June 2013, Shahindezh city, West Azerbaijan Province, Iran by Asal Yousefi.



Figures 5–8. *Favognathus orbiculatus* (Female) - 5. Leg I; 6. Leg II; 7. Leg III; 8. Leg IV.

Family Camerobiidae
Genus *Neophyllobius* Berlese
Type species: *Neophyllobius elegans* Berlese, 1886

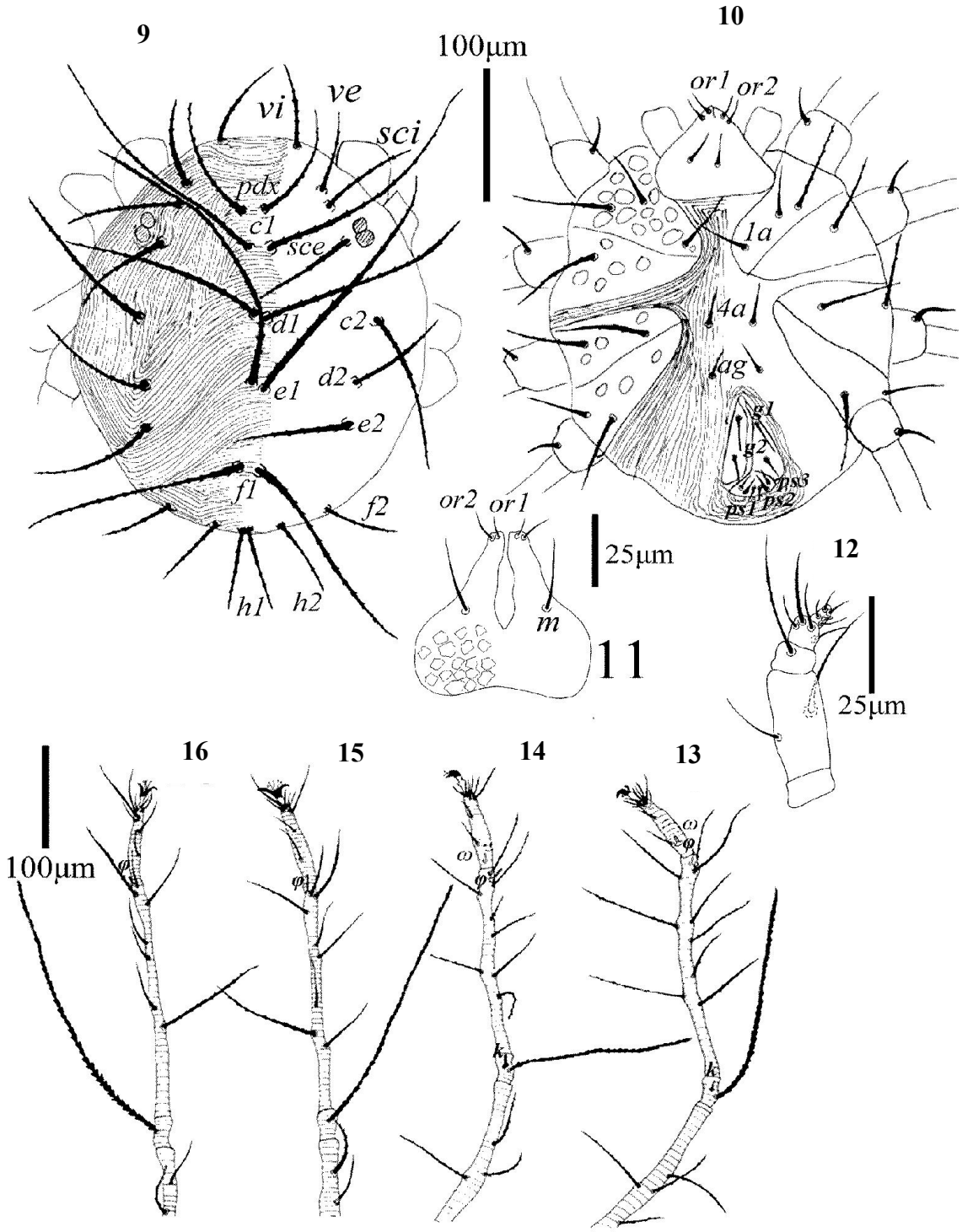
Neophyllobius astragalusi Khanjani & Ueckermann, 2002 (Figs. 9–29)

Redescription

Female (n = 8) - Length of idiosoma 329–351, length of gnathosoma 65–97, width of idiosoma 285 (253–298).

Dorsum (Fig. 9) - Almost ovoid; striation on integument; with 15 pair of setae, set on tubercles, all setae long and serrate; two pairs of eyes present; setal measurements as follows: *vi* 78 (75–98), *ve* 70 (63–90), *sci* 72 (70–93), *sce* 76 (75–92), *pdx* 98 (100–112), c_1 205 (200–237), c_2 155 (150–185), d_1 194 (193–235), d_2 75 (75–100), e_1 198 (190–225),

e_2 100 (94–112), f_1 180 (164–192), f_2 80 (58–80), h_1 70 (63–75), h_2 60 (50–60).



Figures 9–16. *Neophyllobius astragalusi* (Female) - 9. Dorsal view of idiosoma; 10. Ventral view of idiosoma; 11. Gnathosoma; 12. Palp; 13. Leg I; 14. Leg II; 15. Leg III; 16. Leg IV.

Distances between setae: *vi–vi* 60 (58–67), *ve–ve* 100 (105–107), *vi–ve* 45 (45), *pdx–pdx* 15 (14–17), *vi–pdx* 50 (50–55), *ve–pdx* 50 (47–52), c_1*–pdx* 42 (23–30), *sci–pdx* 48

(47–50), *sce–pdx* 75 (70–75), *sci–sci* 112 (112–115), *sce–sce* 138 (112), *sci–sce* 40 (43–58), c_1–c_1 18 (17–20), c_2–c_2 175 (175–178), *sce*–c_2 60 (65–68), d_1–d_1 10 (7–12), e_1–e_1 5 (5), f_1–f_1 5 (5–7), d_1–e_1 50 (55–65), e_1–f_1 52 (45–67), f_1–h_1 47 (38–48), d_2–d_2 150 (150–160), e_2–e_2 137 (138–150), f_2–f_2 125 (120–125), c_2–d_2 47 (42–50), d_2–e_2 37 (37–39), e_2–f_2 38 (38), h_1–h_1 3 (3–5), h_2–h_2 45 (45–47), h_1–h_2 28 (25–30).

Venter (Fig. 10) - Endopodal shields divided and with pronounced reticulation; aggenital area with one pair of aggenital setae (ag_1); genital and anal shields fused and with two pairs of genital setae (g_1) and three pairs of pseudanal setae (ps_1–ps_3); length of ventral setae as follows: *1a* 30 (30–32), *4a* 40 (40–42), ag_1 15 (13–19), g_1 20 (18–20), g_2 13 (12–15), ps_1 8 (9–10), ps_2 5 (6–8), ps_3 5 (5–8).

Gnathosoma (Fig. 11) - Subcapitulum reticulate, with one pair of subcapitular setae (*m*) and two pairs of adoral setae (or_1, or_2). Palpal chaetotaxy: tarsus with two terminal eupathidia, one solenidion and two tactile setae; tibia with one blade-like seta and three tactile setae; genua with one long smooth or slightly serrated seta, femur with two serrated setae, trochanter without seta (Fig. 12).

Legs (Figs. 13–16) - Length of legs I–IV (from base of coxa to tip of tarsal claw): 590 (560–590), 500 (475–510), 540 (525–580) and 600 (575–600). Chaetotaxy of leg segments as follows (solenidia in parentheses and not included): coxae 3-1-2-2; trochanters 1-1-1-1; femora 4-3-2-2; genua 1(+*k*)-1(+*k*)-1-1; tibiae 9(+φ)-8(+φ)-8(+φ)-7(+φ); tarsi 10(+ω)-9(+ω)-8-8. Length of genual setae as follows: I 238–281, II 275–345, III 355–358, IV 313–368.

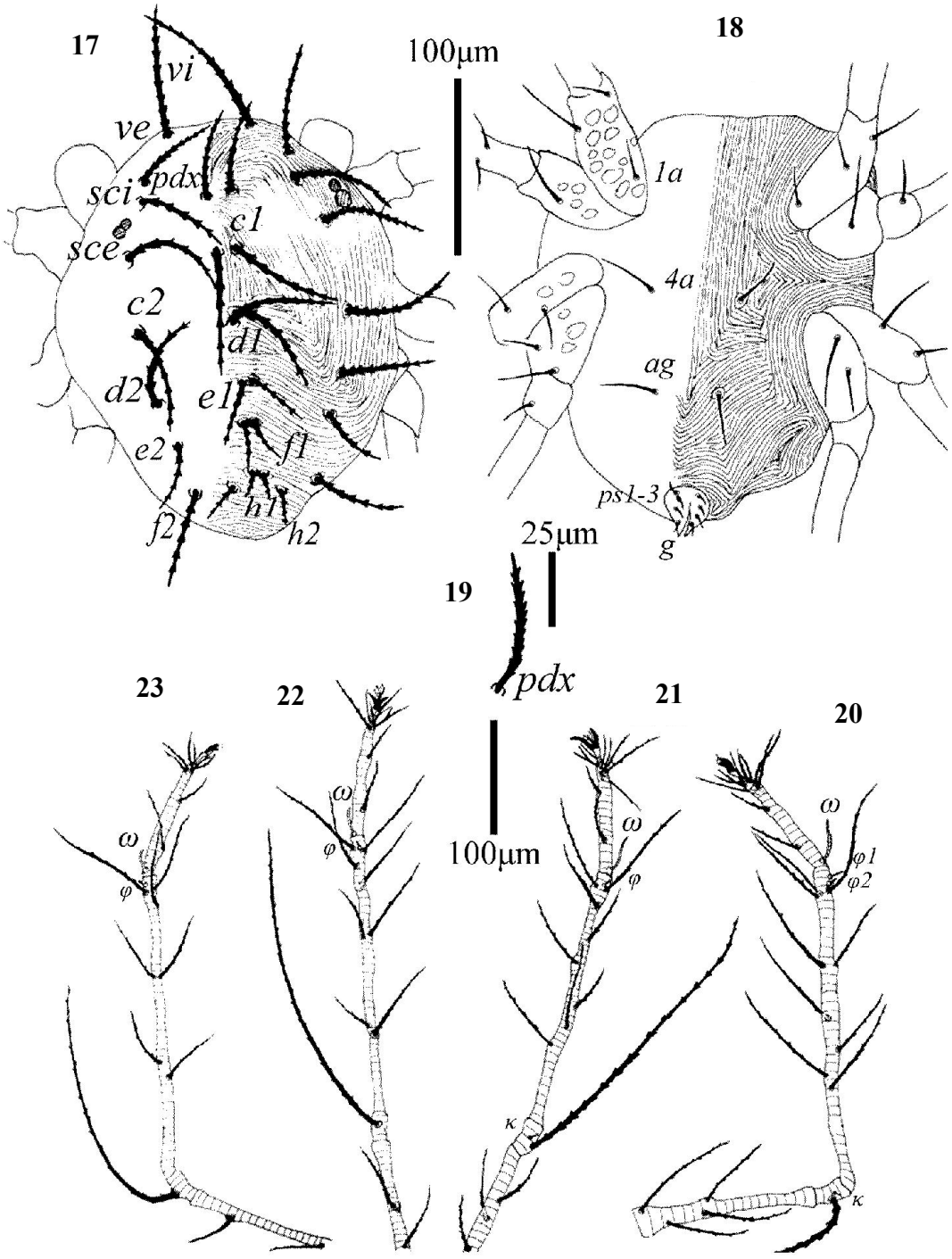
Male (n = 1) - Length of idiosoma 245, length of gnathosoma 60, width of idiosoma 200.

Dorsum (Fig. 17) - Hysterosoma somewhat tapered; striation on integument; with 15 pairs (including *pdx* setae) of long and serrated setae, two pairs of eyes present; setal measurements as follows: *vi* 57, *ve* 58, *sci* 57, *sce* 60, *pdx* 50 (Fig. 19), c_1 65 ,c_2 74, d_1 50, d_2 50, e_1 35, e_2 45, f_1 25, f_2 50, h_1 15, h_2 20, distances between setae: *vi–vi* 50, *ve–ve* 87, *vi–ve* 32, *vi–pdx* 44, *ve–pdx* 37, c_1–*pdx* 35, *sci–pdx* 35, *sce–pdx* 55, *sci–sci* 87, *sce–sce* 113, *sci–sce* 30, c_1–c_1 12, c_2–c_2 125, *sce*–c_2 51, d_1–d_1 5, e_1–e_1 5, f_1–f_1 5, d_1–e_1 36, e_1–f_1 19, f_1–h_1 26, d_2–d_2 107, e_2–e_2 97, f_2–f_2 70, c_2–d_2 37, d_2–e_2 27, e_2–f_2 40, h_1–h_1 5, h_2–h_2 21, h_1–h_2 13.

Venter (Fig. 18) - Coxae I-II and III-IV fused; ventral setae *4a* present; aggenital area with one pair of aggenital setae (ag_1); genital and anal shields fused and with one pair of genital seta (g_1) and three pairs of pseudanal setae (ps_1–ps_3); length of ventral setae as follows: *1a* 23, *4a* 32, *ag* 17, g_1 7, ps_1 7, ps_2 7, ps_3 7.

Gnathosoma - Gnathosoma often covered by prodorsum; chelicerae fused to form a stylophore; subcapitulum reticulate, with one pair of subcapitular setae (*m*) and two pairs of adoral setae (or_1, or_2). palpal chaetotaxy: tarsus with two terminal eupathidia, one solenidion and two tactile setae; tibia with one blade-like seta and three tactile setae; genua with one long smooth or slightly serrated seta, femur with two serrated setae, trochanter without seta.

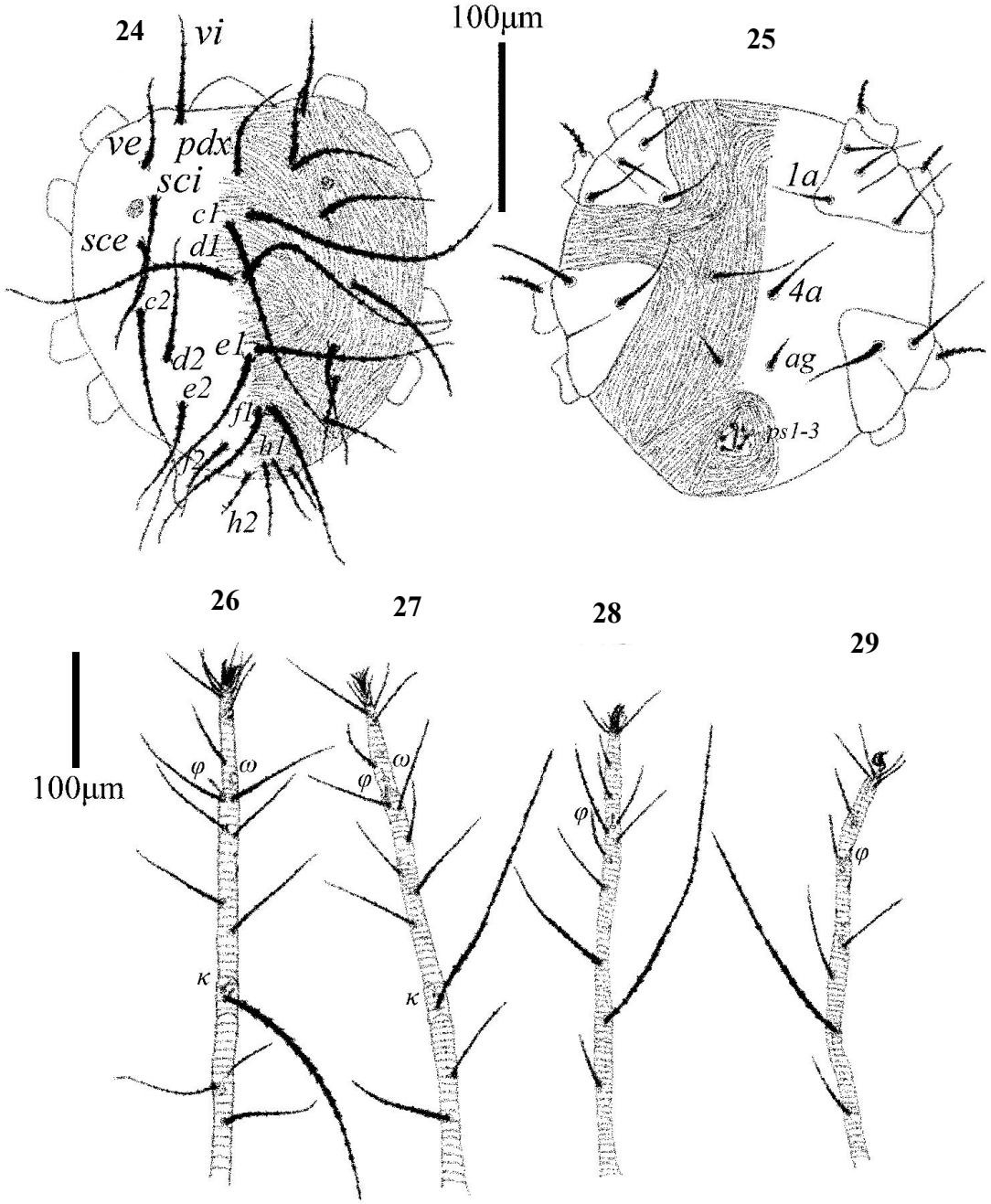
Legs (Figs. 20–23). Length of legs I-IV, (from base of coxa to tip of tarsal claw): 612, 500, 530 and 609. Chaetotaxy of leg segments as follows (number of solenidia on tarsi same as female but enlarged): coxae 3-1-2-2; trochanters 1-1-1-1; femora 4-3-2-2; genua 1(+κ)-1(+κ)-1-1; tibiae 9(+2φ)-8(+φ)-8(+φ)-7(+φ); tarsi 10(+ω)-9(+ω)-8(+ω)-8(+ω). Length of genual setae as follows: I 203, II 278, III 310, IV 240.



Figures 17–23. *Neophyllobius astragalusi* (Male) - 17. Dorsal view of idiosoma; 18. Ventral view of idiosoma; 19. Setae *pdx*; 20. Leg I; 21. Leg II; 22. Leg III; 23. Leg IV.

Protonymph (n = 1) - Length of idiosoma 220, length of gnathosoma 60, width of idiosoma 210.

Dorsum (Fig. 24) - As in female but with less sclerotization, with 15 pairs of setae, eyes present; setal measurements as follows: *vi* 68, *ve* 67, *sci* 62, *sce* 75, *pdx* 90, c_1 150, c_2 100, d_1 160, e_1 140, e_2 70, f_1 107, f_2 58, h_1 43, h_2 33.



Figures 24–29. *Neophyllobius astragalusi* (Protonymph). 24. Dorsal view; 25. Ventral view; 26. Leg I; 27. Leg II; 28. Leg III; 29. Leg IV.

Distances between setae: *vi–vi* 50, *ve–ve* 87, *vi–ve* 32, *vi–pdx* 35, *ve–pdx* 40, c_1–*pdx* 32, *sci–pdx* 45, *sce–pdx* 65, *sci–sci* 92, *sce–sce* 118, *sci–sce* 37, c_1–c_1 15, c_2–c_2 138, *sce*–c_2 47, d_1–d_1 7, e_1–e_1 6, f_1–f_1 4, d_1–e_1 53, e_1–f_1 34, f_1–h_1 35, d_2–d_2 107, e_2–e_2 98, f_2–f_2 77, c_2–d_2 38, d_2–e_2 25, e_2–f_2 40, h_1–h_1 4, h_2–h_2 25, h_1–h_2 14.

Venter (Fig. 25) - Aggenital area with one pair of aggenital setae (ag_1); genital shields and setae absent, anal shields present and with three pairs of pseudanal setae (ps_1–ps_3); length of ventral setae as follows: *1a* 22, *4a* 32, ag_1 10 ps_1 5, ps_2 5, ps_3 5.

Gnathosoma - Stylophore stout, subcapitulum with one pair of subcapitular setae (*m*) and two pairs of adoral setae (or_1, or_2). palpaltarsus with two eupathidia, one solenidion

and two simple setae.

Legs (Figs. 26–29) - Length of legs I-IV: 410, 375, 395 and 380. Chaetotaxy of leg segments as follows: coxae 3-1-2-0; trochanters 1-1-1-0; femora 3-2-1-1; genua 1(+κ)-1(+κ)-1-1; tibiae 6(+φ)-6(+φ)-6(+φ)-3(+φ); tarsi 8(+ω)-8(+ω)-7-5. Length of genual setae as follows: I 205, II 231, III 262, IV 238.

Discussion

Khanjani & Ueckermann (2002) described this species base on one female collected from Hamedan, Iran and we decided to redescribed it with more females, one male and one protonymph. Our specimens resembles original description but differ from it in having one more seta (this was also confirmed by original authors, personal communication) on tarsus IV and also seta h_1 is longer than h_2.

Material examined

Specimens of *N. astragalusi* were collected from the soil of apple orchards, Mamaghan, Iran, 23 July 2013, by Nazanin Seilsepur.

Acknowledgement

We greatly appreciate the support for this project provided by the Research Divisions of University of Maragheh, Maragheh, Iran. The authors wish to thank Mr. Saeed Paktinat-Saeej and Mrs. Mansoureh Ahaniazad (Ph. D. students) for their kind help in preparation of the manuscript.

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Received: 25 November 2014
Accepted: 28 December 2014
Published: 15 January 2015

بازتوصیف گونه‌های *Neophyllobius astragalusi* و *Favognathus orbiculatus* با گزارش جدید گونهٔ *F. acaciae* (Acari: Raphignathoidea) از ایران

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چکیده

کنه‌های کامل (Livshitz) *Favognathus orbiculatus* و کنه‌های کامل نر، ماده و پورهٔ سن یکم گونهٔ Khanjani & Ueckermann *Neophyllobius astragalusi* بازتوصیف شده و همچنین گونهٔ *F. acaciae* Doğan & Ayyildiz برای نخستین بار از ایران گزارش می‌شود.

واژگان کلیدی: Trombidiformes، پیش‌استیگمایان، Cryptognathidae، Camerobiidae، گزارش جدید، کنه‌های شکارگر، ایران.

تاریخ دریافت: ۱۳۹۳/۹/٤

تاریخ پذیرش: ۱۳۹۳/۱۰/۷

تاریخ چاپ: ۱۳۹۳/۱۰/۲۵