

**RAPHIGNATHID MITES OF MARAGHEH ORCHARDS
(NORTHWEST OF IRAN) WITH A NEW RECORD
FOR IRAN FAUNA**

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ABSTRACT: Raphignathid soil mite fauna of Maragheh orchards in Northwest of Iran was studied. One genus and five species were identified and illustrated. *Raphignathus aciculatus* is recorded for first time in Iran. A key to all known species of *Raphignathus* in Iran is also provided.

KEY WORDS: Raphignathid, fauna, Maragheh, Iran, *Raphignathus acciculatus*.

Members of the family Raphignathidae are predacious. They can be found under tree bark, in lichens, in moss, in leaf litter, in pigeon nests, in soil, on a wide range of plants and in house dusts (Fan & Yin, 2000; Khanjani & Ueckermann, 2003). This family are easily recognized by the fused cheliceral bases, forming a stylophore; cervical peritremes not embedded in dorsal surface of stylophore and confluent coxae (Meyer & Ueckermann, 1989). The genus *Raphignathus* Dugés is the oldest genus in this family and has a worldwide distribution with more than 60 species of which seven are known from Iran, namely: *R. collegiatus* Atyeo, Baker & Crossley, 1961; *R. gracilis* (Rack, 1962); *R. giselae* Meyer & Ueckermann, 1989; *R. zaoi* Hu, Jing & Liang, 1995; *R. aciculatus* Fan, 2000; *R. hecmatanaensis* Khanjani & Ueckermann, 2003; *R. protaspus* Khanjani & Ueckermann, 2003; *R. aethiopicus* Meyer & Ueckermann, 1989 (Khanjani & Ueckermann, 2003; Ghorbani et al., 2010; Shirinbeik Mohajer, 2010). In this paper we review the genus *Raphignathus* from Maragheh orchards and add one new record for raphignathid fauna of Iran.

MATERIALS AND METHODS

The litter and soil samples were taken from Maragheh orchards in Northwest of Iran. Mites were extracted from the soil using a Berlese funnel and were collected in 70 ethanol, then mounted on slides in modified Hoyer's medium. The length of idiosoma was measured from the base of chelicerae to the posterior margin of opisthosomal shield, the width of idiosoma at the broadest part of the idiosoma and setae were measured from their insertion to their tip. The terminology and abbreviations are based on Kethley (1990). All measurements are given in micrometers (μm).

RESULTS

Family Raphignathidae Kramer, 1877
Type genus: *Raphignathus* Dugés, 1833

Genus *Raphignathus* Dugés, 1833

Idiosoma oval in dorsoventral view; gnathosoma projecting anterior to prodorsum; cheliceral bases fused to form a conical stylophore; peritremes arising from midbasal part of stylophore, extending along anterior margin of idiosoma; palptibial claw small; subcapitulum with two pairs of subcapitular setae and two pairs of adoral setae; dorsum with 11–12 pairs of setae in adult (*d2* and *f2* absent); propodosoma with three shields; one pair of eyes on lateral propodosomal shields present, opisthosoma with a large shield; venter with two pairs of aggenital setae, genital shield with three or four and anal shield with three pairs of setae; leg empodial axis directly producing two rows of tenet hairs and coxae II and III contiguous.

Key to Iranian species of *Raphignathus* Dugés

- 1- Interscutal membrane dorsomedially with 3 pair of setae.....***R. aethiopicus***
 - Interscutal membrane dorsomedially with 1-2 pair of setae.....2
- 2- Palpfemur with 2 setae.....3
 - Palpfemur with 3 setae.....5
- 3- Endopodal shield associated with coxae III-IV, without small shield on interscutal membrane.....4
 - Endopodal shield associated with coxae I-IV, with small shield on interscutal membrane.....***R. hecmatanaensis***
- 4- Median prodorsal shield adjacent to peritremes interiorly ; dorsal setae *e*₁ reach anterior margin of opisthosomal shield, *f*₁ on anterior margin of opisthosomal shield.....***R. gracilis***
 - Median prodorsal shield widely separated from peritremes interiorly; dorsal setae *e*₁ don't reach anterior margin of opisthosomal shield, *f*₁ far away of anterior margin of opisthosomal shield.....***R. giselae***
- 5- Interscutal membrane dorsomedially with 2 pairs of setae.....***R. aciculatus***
 - Interscutal membrane dorsomedially with 1 pair of setae.....6
- 6- Femur IV with 2 setae.....***R. zhaoi***
 - Femur IV with 4 setae.....7
- 7- Setae *e*₁ close to anterior margin of opisthosomal shield, cupules *im* on integument; 2 small shields on interscutal integument very small.....
***R. collegiatus***
 - Setae *e*₁ well behind anterior margin of opisthosomal opisthosomal shield, cupule *im* on shield; 2 shields on interscutal integument much larger.....
***R. protaspus***

***Raphignathus aciculatus* Fan, 2000**

(Figs. 1-7)

FEMAL (n=2): Dimension: length of body 452 (including gnathosoma), width 215.

Dorsum (Fig. 1). Podosoma with one median and two lateral shields; opisthosoma with a large shield, all these shields punctuated; each lateral podosomal shield with one eye, three dorsal setae and one cupules (*ia*); interscutal membrane with two pair of setae (*d1* and *e1*), one pair of cupules (*im*) and one pair of small shields near setae *d1*; four pairs of setae (*f1*, *h1*, *h2* and *h3*) and one pair of cupules (*ip*) are located on large opisthosomal shield. Measurements of setae as follows: *vi* 35; *ve* 36; *sci* 34; *sce* 35; *c1* 24; *c2* 28; *d1* 27; *e1* 25; *f1* 26; *h1* 26; *h2* 24 and *h3* 25.

Venter (Fig. 2). Setae *1a* between coxae I, *3a* and *4a* between coxae III and IV; aggenital area with two pairs of setae (*ag1* and *ag2*); genital shields punctuated and bearing three pairs of setae (*g1*, *g2* and *g3*). Measurements of setae: *1a* 37, *3a* 33, *4a* 34, *ag1* 30, *ag2* 27, *g1* 19, *g2* 20, *g3* 18, *ps1* 19, *ps2* 18 and *ps3* 18.

Gnathosoma. Palp (Fig. 3) five segmented; palp chaetotaxy (femur-tarsus) as follows: 3, 2, 3 + 1 claw, 4 + 1 solenidion + 4 eupathidia.

Legs (Figs. 4-7). Length of legs I-IV: 307- 268- 283- 336. Counts of setae: coxae 2-2-2-1, trochanters 1-1-2-1, femora 6-5-3-3, genua 5(+κ)-5(+κ)-4-4, tibiae 5(+φ)-5(+φ)- 5(+φ)- 4(+φ) tarsi 19(+ω+ωρ)- 16(+ω)- 13(+ω)- 13.

Examined materials: Tow females from soil of apricot (*Prunus armeniaca*) orchard, Eusofabad village, Maragheh, East Azerbaijan province, 18 August, 2009, H. Ghorbani.

Remarks: This species resembles *R. hecmatanaensis* but differs in that the palpfemur bears three setae. The Iranian specimens resemble the type specimens of *Raphignathus acciculatus* (Fan & Yin, 2000) in all respects. Body size of *R. aciculatus* is 367 and width 254, but 452 long and 215 wide in the Iranian specimens, our specimens were therefore smaller than the type specimen. This is the first record of this species from Iran.

***Raphignathus giselae* Meyer & Ueckermann, 1989**

(Figs. 8-14)

FEMAL (n=5) Dimension: length of body 357 (including gnathosoma), width 170.

Dorsum (Fig. 8). Podosoma with one median and two lateral plates separated by finely striated areas and small plates posteriorly; median prodorsal shield widely separated from peritremes interiorly; each lateral podosomal shield with one eye, three dorsal setae and one cupules (*ia*); interscutal membrane with two pairs of setae (*d1* and *e1*) and one pair of cupules (*im*), dorsal setae *e1* don't reach anterior margin of opisthosomal shield; opisthosomal shield with four pairs of setae (*f1*, *h1*, *h2* and *h3*) and on pair of cupules (*ip*). Measurements of setae as follows: *vi* 24; *ve* 23; *sci* 23; *sce* 25; *c1* 20; *c2* 20; *d1* 20; *e1* 21; *f1* 23; *h1* 24; *h2* 20 and *h3* 20.

Venter (Fig. 9). Endopodal shield around legs coxae of III-IV; anogenital area with two pairs of aggenital setae (*ag1* and *ag2*) and three pairs of genital setae (*g1*, *g2* and *g3*); one pair of cupules (*ih*) located laterally to genital shields. Measurements of setae: *1a* 32, *3a* 30, *4a* 28, *ag1* 21, *ag2* 19, *g1* 18, *g2* 17, *g3* 17, *ps1* 17, *ps2* 17 and *ps3* 15.

Gnathosoma. Subcapitulum with two pairs of subcapitular setae (m and n) and two pairs of adoral setae ($or1$ and $or2$); palp (Fig 10) chaetotaxy (femur-tarsus) as follows: 2, 2, 3 + 1 claw, 4 + 1 solenidion + 4 eupathidia.

Legs (Figs. 11-14). Length of legs I-IV: 255- 215- 237- 290. Counts of setae: coxae 2-2-2-1, trochanters 1-1-2-1, femora 6-5-3-3, genua 5(+κ)-5(+κ)-4-4, tibiae 5(+φ)-5(+φ)- 5(+φ)- 4(+φ); tarsi 19(+ω+ωρ)- 15(+ω)- 13(+ω)- 13.

Examined materials: Five females from soil of apricot orchard, Ghalekhalese village, Maragheh, East Azerbaijan province, 18 August, 2009, H. Ghorbani.

Remarks: General features of Iranian specimens like that given by Meyer & Ueckermann, 1989; but the body size of Iranian specimens are smaller (357 long and 170 width) than those of the type specimens (408 and width 231 (Meyer & Ueckermann, 1989)); length of dorsal setae are about 20-25 μm in the Iranian specimens, but 23-34 μm in the original description of *R. giselae*. Chaetotaxy of coxae are 3-2-3-1 in the original description, that we found one more seta on coxae IV and leg chaetotaxy in our specimens is as 3-2-3-2. This is the second record for the province. Previous records: Moghan plain (Haddad Irani-Nejad, 1996); East Azerbaijan (Bagheri, 2007).

***Raphignathus gracilis* (Rack, 1962)**

(Figs. 15-21)

FEMAL (n=5) Dimension: length of body 317 (excluding gnathosoma) width 175.

Dorsum (Fig. 15). Podosoma with one median and two lateral shields separated by finely striated areas, and small plates posteriorly; median prodorsal shield adjacent to peritremes interiorly; each lateral podosomal shield with one eye, three dorsal setae and one cupules (ia); interscutal membrane dorsomedially with two pairs of setae ($d1$ and $e1$) and one pair of cupules (im); dorsal setae $e1$ reach anterior margin of opisthosomal shield; opisthosomal shield with four pairs of setae ($f1$, $h1$, $h2$ and $h3$) and one pair of cupules (ip), setae $f1$ on anterior margin of opisthosomal shield. Dimension of setae as follows: vi 35; ve 33; sci 33; sce 32; $c1$ 23; $c2$ 28; $d1$ 24; $e1$ 24; $f1$ 25; $h1$ 28; $h2$ 25 and $h3$ 23.

Venter (Fig. 16). Endopodal shield around legs coxae of III-IV present; genital shields with three pairs of setae ($g1$ - $g3$). Measurements of setae: $1a$ 32, $3a$ 31, $4a$ 27, $ag1$ 23, $ag2$ 20, $g1$ 21, $g2$ 20, $g3$ 20 and $g4$ 15.

Gnathosoma. Palp (Fig. 17) five segmented, palp chaetotaxy (femur-tarsus) as follows: 2, 2, 3 + 1 claw, 4 + 1 solenidion + 4 eupathidia.

Legs (Figs. 18-21). Length of legs I-IV: 275- 250- 238- 290. Counts of setae: coxae 2-2-2-1, trochanters 1-1-2-1, femora 6-5-3-3, genua 5(+κ)-5(+κ)-4-4, tibiae 5(+φ)- 5(+φ)- 5(+φ)- 4(+φ), tarsi 19(+ω+ωρ)- 15(+ω)- 13(+ω)- 13.

Examined materials: Five females from soil of apple orchard, Khangah village, Maragheh, East Azerbaijan province, 27 July, 2009, H. Ghorbani.

Remarks: This species resembles *R. giselae* but differs in that median prodorsal shield adjacent to peritremes, dorsal setae $e1$ reach anterior margin of opisthosomal shield and $f1$ on anterior margin of opisthosomal shield. This is the first record of this species for the province.

***Raphignathus hecmatanaensis* Khanjani & Ueckermann, 2002**

(Figs. 22-28)

FEMAL (n=5). Dimension: length of body 387 (including gnathosoma), width 200.

Dorsum (Fig. 22). Dorsum typically covered with four shields, one median and two lateral podosomal shields and one opisthosomal shield; each lateral podosomal shield with one eye, three dorsal setae and one cupules (*ia*); interscutal membrane dorsomedially with two pairs of setae (*d1* and *e1*), one pair of small plates and one pair of cupules (*im*); opisthosomal shield with four pairs of setae and one pair of cupules (*ip*). Dimension of setae as follows: *vi* 30; *ve* 25; *sci* 26; *sce* 25; *c1* 17; *c2* 24; *d1* 21; *e1* 23; *f1* 23; *h1* 23; *h2* 22 and *h3* 20.

Venter (Fig. 23). Endopodal shields narrow and associated with coxae I-IV; aggenital area with two pairs of setae (*ag1* and *ag2*), genital shields with three pairs of setae (*g1*, *g2* and *g3*). Measurements of setae: *1a* 32, *3a* 24, *4a* 21, *ag1* 12, *ag2* 15, *g1* 14, *g2* 16, *g3* 16, *ps1* 16, *ps2* 15 and *ps3* 15.

Gnathosoma. Palp (Fig. 24) five segmented palp chaetotaxy (femur-tarsus) as follows: 2, 2, 3 + 1 claw, 4 + 1 solenidion + 4 eupathidia.

Legs (Fig. 25-28). Length of legs I-IV: 287- 236- 249- 302. Counts of setae: coxae 2-2-2-1, trochanters 1-1-2-1, femora 6-5-3-3, genua 5(+κ)-5(+κ)-4-4, tibiae 5(+φ)- 5(+φ)- 5(+φ)- 4(+φ), tarsi 19(+ω+ωρ)- 15(+ω)- 13(+ω)- 13.

Examined materials: Five females from soil of apple orchard, Narjabad village, Maragheh, East Azerbaijan province, 18 August, 2009, H. Ghorbani.

Remarks: This is the first record of this species from East Azerbaijan province. Previous record: Hamedan (Ueckermann & Khanjani, 2003).

***Raphignathus zhaoi* Hu, Jing & Liang, 1995**

(Figs. 29-35)

FEMAL (n=4) Dimension: length of body 305 (including gnathosoma), width 233.

Dorsum (Fig. 29). Podosoma with one median and two lateral shields, median shield with three pairs of setae and separated from lateral shields by finely striated areas, each lateral shields with one eye, three dorsal setae and one cupules (*ia*); interscutal membrane dorsomedially with one pair of setae (*d1*), one pair of cupules (*im*) and one pair of small shields; opisthosomal shield with finely punctuations, five pairs of setae and one pair of cupules (*ip*). Dimension of setae as follows: *vi* 35; *ve* 43; *sci* 45; *sce* 36; *c1* 35; *c2* 37; *d1* 36; *e1* 37; *f1* 44; *h1* 40; *h2* 40 and *h3* 30.

Venter (Fig. 30). Endopodal shields finely punctuated, around inner sides of coxae I-II and coxae III-IV; anogenital area with two pairs of aggenital setae (*ag1* and *ag2*) and 3 pair of genital setae (*g1*, *g2* and *g3*). Measurements of setae: *1a* 39, *3a* 25, *4a* 26, *ag1* 23, *ag2* 18, *g1* 21, *g2* 20 and *g3* 20.

Gnathosoma. Subcapitulum with two pairs of subcapitular setae (*m* and *n*) and two pairs of adoral setae (*or1* and *or2*); dorsal stylophore with striate;; palp (Fig. 31) chaetotaxy (femur-tarsus) as follows: 3, 2, 3 + 1 claw, 4 + 1 solenidion + 4 eupathidia.

Legs (Figs. 32-35). Length of legs I-IV: 282- 244- 250- 332. Counts of setae: coxae 2-2-2-1, trochantera 1-1-2-1, femora 6-5-3-2, genua 5(+κ)-5(+κ)-4-4, tibiae 5(+φ)- 5(+φ)- 5(+φ)- 4(+φ), tarsi 19(+ω+ωρ)- 15(+ω)- 13(+ω)- 13(+ω).

Examined materials: Four females from soil of apple orchard, Khangah village, Maragheh, East Azerbaijan province, 18 August, 2009, H. Ghorbani.

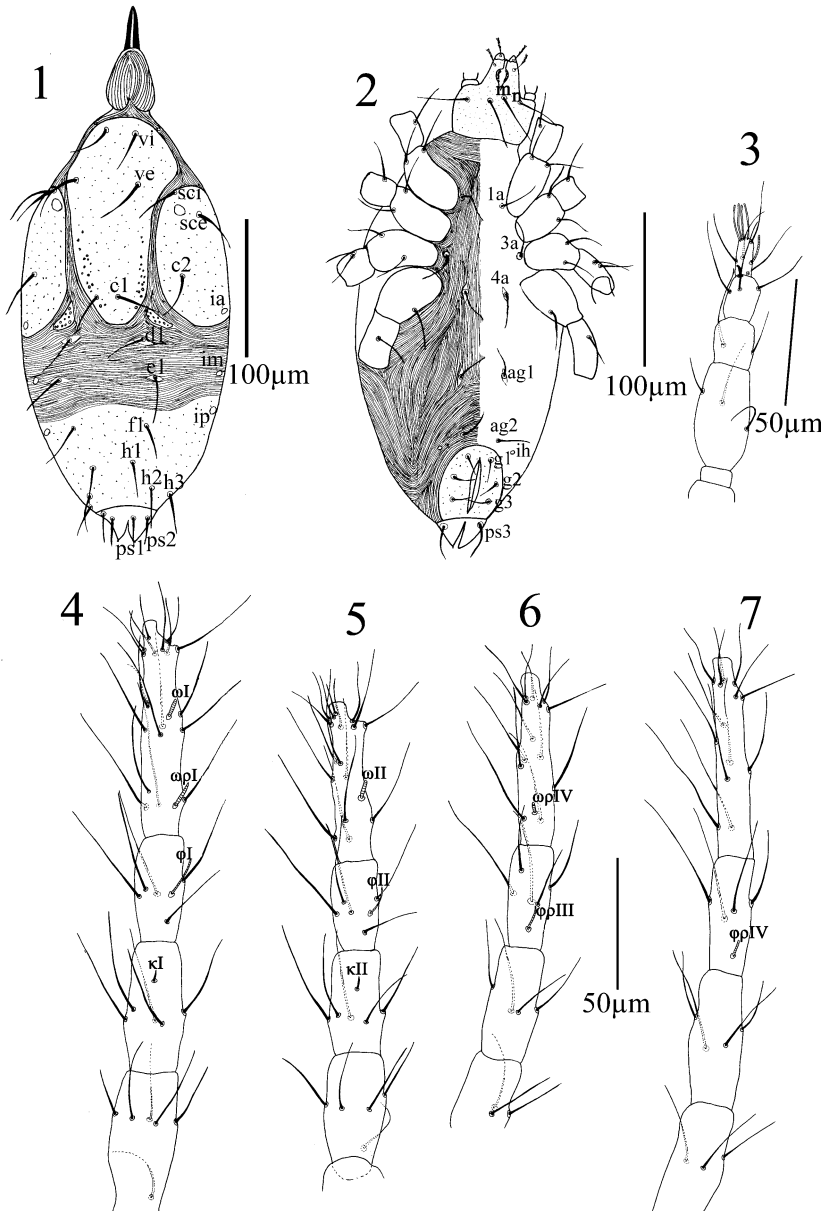
Remarks: Ensiform dorsal body setae, 3 setae on palp femur, 1 pair of setae on the interscutal membrane and 14 setae on tarsi IV are diagnostic characters of *R. zhaoi*. General features of Iranian specimens like that given by Fan & Yin, 2000.

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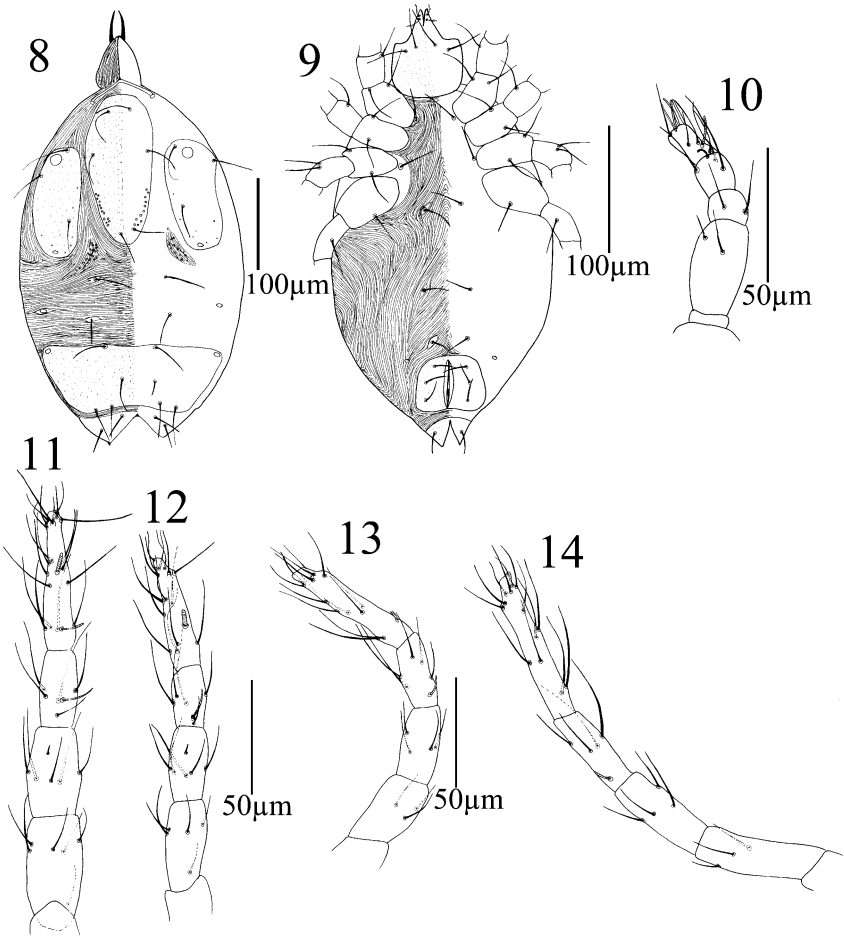
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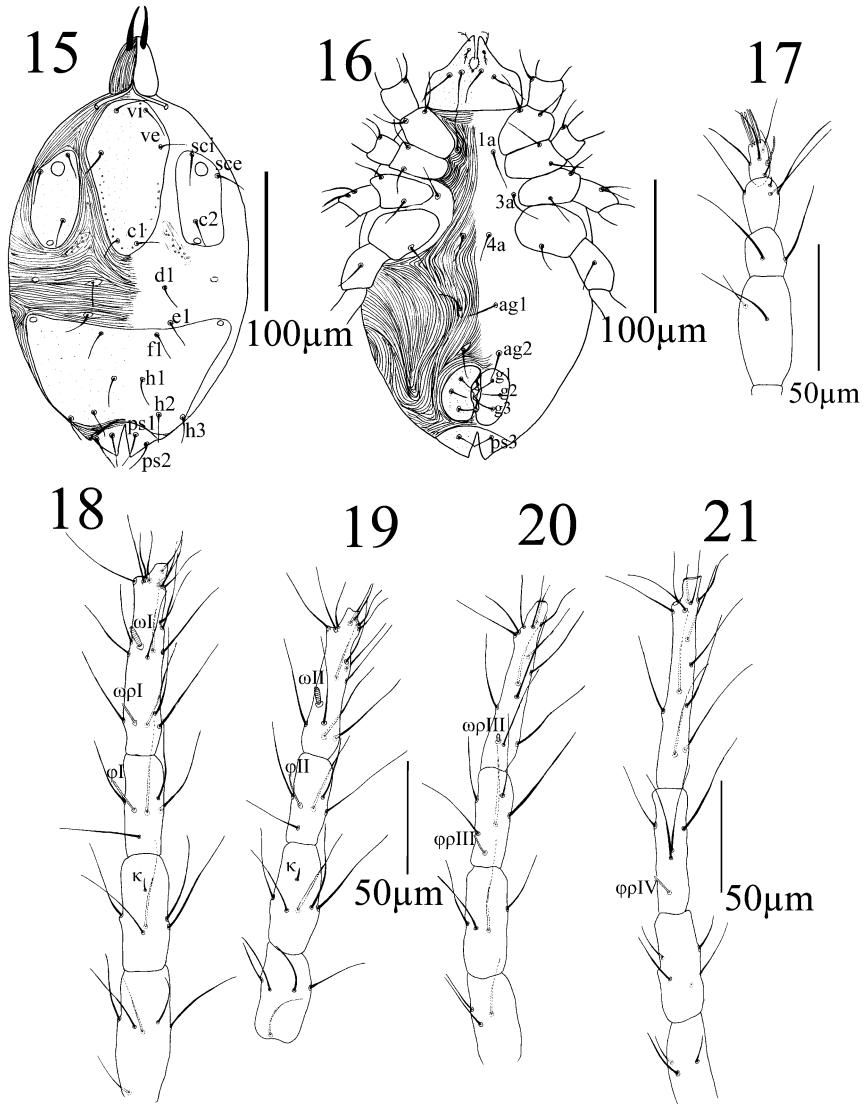
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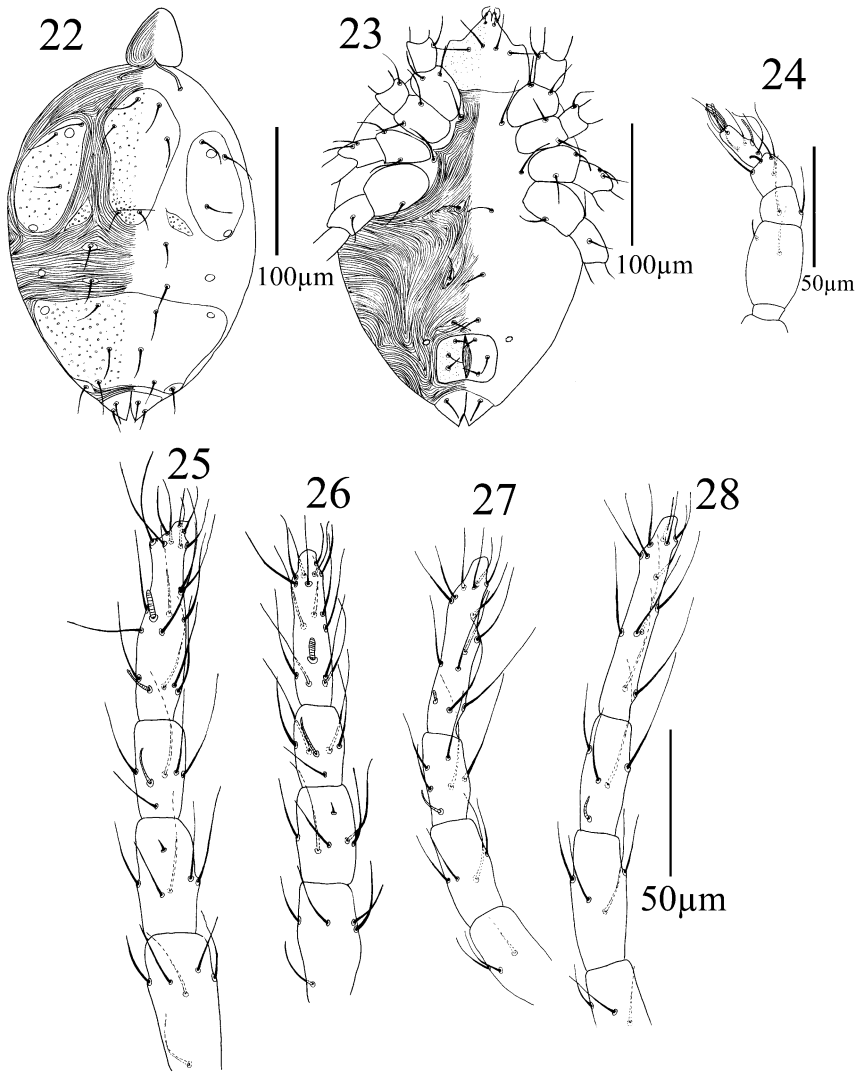
Figures 1-7. *Raphignathus aciculatus* (female): 1. dorsal view, 2. ventral view, 3. Palp, 4. leg I, 5. leg II, 6. leg III, 7. leg IV.



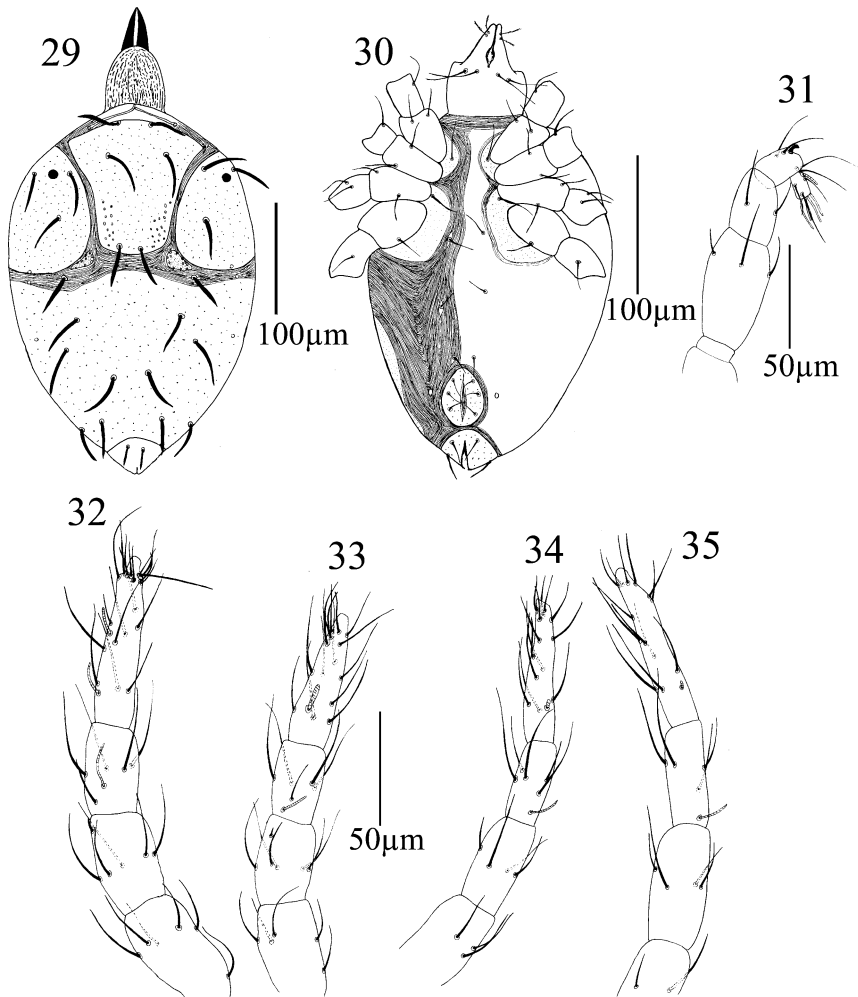
Figures 8-14. *Raphignathus giselae* (female): 8. dorsal view, 9. ventral view, 10. Palp, 11. leg I, 12. leg II, 13. leg III, 14. leg IV.



Figures 15-21. *Raphignathus gracilis* (female): 15. dorsal view, 16. ventral view, 17. Palp, 18. leg I, 19. leg II, 20. leg III, 21. leg IV.



Figures 22-28. *Raphignathus hecmatanaensis* (female): 22. dorsal view, 23. ventral view, 24. Palp, 25. leg I, 26. leg II, 27. leg III, 28. leg IV.



Figures 29-35. *Raphignathus zhaoi* (female): 29. dorsal view, 30. ventral view, 31. Palp, 32. leg I, 33. leg II, 34. leg III, 35. leg IV.