

## Seven new vagrant eriophyoid species (Acari: Eriophyoidea) from semi-arid and arid environment in East Iran

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### Abstract

During field surveys of eriophyid mites associated with autochthonous plants species in semi-arid and arid environments in East Iran (Birjand, South Khorasan, Iran, summer 2016 and 2017), seven new eriophyid mite species (Acari: Eriophyidae) were discovered. They are *Aceria astratorae* **sp. nov.** on *Astragalus pinetorum* Boiss. (Leguminosae), *Aceria astracanthae* **sp. nov.** on *Astracantha echidna* (Bunge) Podlech (Leguminosae), *Aceria furgae* **sp. nov.** on *Ephedra major* Host (Ephedraceae), *Aceria runicae* **sp. nov.** on *Rubia caramanica* Bornm. (Rubiaceae), *Aculus birsutum* **sp. nov.** on *Epilobium hirsutum* L. (Onagraceae), *Phyllocoptes birreae* **sp. nov.** on *Centaurea virgata* Lam. (Compositae), and *Neophytoptus semenovis* **sp. nov.** on *Semenovia suffruticosa* (Freyn & Bornm.) Manden (Apiaceae), which are illustrated and described herein. All seven new species appear to be vagrants on green parts of their host plants with no particular symptom.

**Key words:** Eriophyidae, autochthonous plants, semi-arid and arid environments, survey, fauna

### Introduction

The plant genera *Astragalus* and *Astracantha* belong to Leguminosae family. *Astragalus* consists of approximately 2850 species and is the largest genus of flowering plants throughout the world (Bagheri *et al.* 2014). The center diversity of this genus appears to be the arid and semi-arid mountain parts of Northern Hemisphere and South America, and it is also the largest genus in Iran (Bidarlord 2018). *Astracantha* includes about 270 species names but synonymies need to be ascertained, yet (The Plant List, 2013). *Centaurea* is one of the largest genera within the Compositae family, consists of approximately 600 species and Iran represents the main diversity center of this genus in West Asia (Rahiminezhad *et al.* 2010; Negaresh & Rahmininezhad 2014). *Epilobium* belongs to the Onagraceae family, consists of approximately 200 species in the world and a high proportion of these species are herbs; 18 species of them are known for Iran (Sheidai 2018). The plants of the genus *Semenovia* are mainly distributed in Mediterranean, Turkish and Iranian mountains; 11 species of them have been reported from Iran and 5 of them are endemic (Mottaghipisheh *et al.* 2017). *Ephedra* is a single genus in the Ephedraceae family, consisting of more than 50 species around the world, distributed mainly in arid and semi-arid areas of Asia, Europe, North Africa, North and South of America (Elhadeh *et al.* 2020). The plants of the genus *Rubia* belong to the Rubiaceae family, consisting of about 80 species mainly widespread in temperate parts of Asia, Europe and Africa (Wang *et al.* 2018).

Up to now, 15 species of the Eriophyoidea have been reported from *Centaurea* plant species, 5 species from *Rubia*, 2 species from *Astragalus*, 2 species from *Epilobium*, 1 species from *Ephedra*

and no eriophyoid mites have been reported from *Astracantha* spp. and *Semenovia* spp. around the world. *Aceria plectrumscuti* Lotfollahi, Irani-Negad, Khanjan, Moghadam, de Lillo, 2013, was reported from *Centaurea virgata* Lam. and *Phyllocoptes epilobiorum* Liro, 1940, from *Epilobium hirsutum* L. (originally host type was *E. palustre* L.) (Liro 1940; Lotfollahi *et al.* 2013a and 2013b). No eriophyid mites have been reported from *Ephedra major* Host, *Rubia caramanica* Bornm., *Semenovia suffruticosa* (Freyn & Bornm.) Manden, *Astragalus pinetorum* Boiss. and, obviously, *Astracantha echidna* (Bunge) Podlech (previously reported as *Astragalus echidna*) (Amrine and de Lillo unpublished databases).

In order to complete our knowledge about eriophyoid mite fauna in arid and semi-arid regions, a field survey on eriophyoids associated with autochthonous host plants was carried out in Birjand regions, South Khorasan, Iran.

## Materials and methods

Samples of some autochthonous plants were collected from arid and semi-arid regions in the vicinity of Birjand (South Khorasan, East Iran) during the summers 2016 and 2017. Green organs were examined and mites were recovered directly under a dissecting stereomicroscope. Mites were collected also from washed suspensions after washing the green parts of plant samples (Monfreda *et al.* 2007). Oudemans' solution and 70% ethanol were used for preserving mites (Krantz & Walter 2009). Eriophyoid specimens were cleared and mounted by Keifer's media (Keifer 1975). In order to keep spatial shape of mites, avoid mite flattening and also allow mite rotation around their longitudinal axis, some kapok fibers were added between slide and coverslip. This procedure makes measurements and drawings easier and more realistic (de Lillo *et al.* 2010). Generic key of Amrine *et al.* (2003) was used for identification at the genera levels. Lindquist (1996) was followed for the morphological terminology and setal notations. Morphological measurements and line drawing were taken by phase contrast microscope Olympus BX50 according to Amrine and Manson (1996) as modified by de Lillo *et al.* (2010). The holotypes' measurements were followed by the range values of the studied specimens (holotype plus measured paratypes) in parentheses. Measurements are given in micrometers ( $\mu\text{m}$ ), rounded off to the nearest integer, and regard the length of the morphological traits unless otherwise specified. Abbreviations used in the drawings follow Amrine *et al.* (2003). The host plants were identified by Mohammad Reza Joharchi, botanist at the Plant Science Research Institute, Ferdowsi University of Mashhad, Iran. The host plant names and their synonyms are in accordance with The Plant List on-line database (2013). Three paratypes of each new species are deposited at the Entomological and Zoological Section, Department of Soil, Plant and Food Sciences (DiSSPA), University of Bari Aldo Moro, Italy (UNIBA). The remaining paratype and the holotype specimens are deposited in the collection of the Acarology Laboratory, Department of Plant Protection, Faculty of Agriculture, Ferdowsi University of Mashhad, Iran (FUM).

## Results

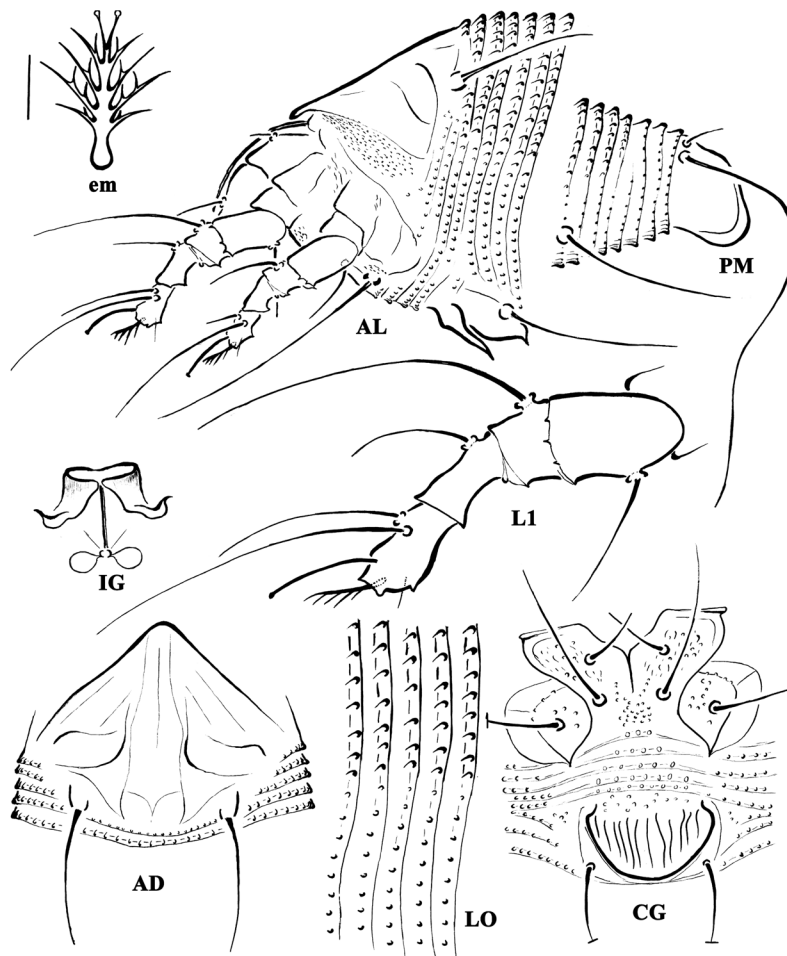
### *Aceria astratorae* sp. nov. (Fig. 1)

#### Description

FEMALE: (n=10) Body vermiform, 250 (230–260, including gnathosoma), 48 (48–55) wide, 52 (52–60) thick. **Gnathosoma** 20 (20–21) projecting obliquely downwards, pedipalp coxal setae *ep*

3 (no range), dorsal pedipalp genual setae *d* 7 (6–7), unbranched, palp tarsus setae *v* not detectable, cheliceral stylets 20 (19–20). **Prodorsal shield** subtriangular 32 (32–34), including frontal lobe, 37 (37–40) wide; with rounded frontal lobe 5 (4–5) over gnathosomal base. Median line on the anterior half of shield not reaching the frontal lobe; V shaped mark in the middle and close to the rear margin of the prodorsal shield; admedian lines complete, slightly sinuate, reaching the frontal lobe. Inner submedian lines almost angled for around ninety-degree becoming transversal on the middle part of shield length; two outer short submedian lines almost in the middle of the shield continuing on the anterior half of the shield; one pair of transverse line between inner submedian lines and lateral side of shield; any of submedian lines reaching the rear of shield. Several small granules between lateral side of prodorsal shield and coxal region in lateral view. Tubercles of scapular setae *sc* on rear shield margin, 20 (20–22) apart, scapular setae *sc* 22 (20–22), directed backward. **Leg I** 33 (32–33), femur 10 (no range), genu 5 (no range), tibia 7 (no range), tarsus 7 (7–8), solenidion  $\omega$  9 (no range), curved down, distally slightly enlarged, empodium 5 (no range), simple, 5-rayed; femoral setae *bv* 11 (10–11), genual setae *l''* 27 (25–28), tibial setae *l'* 10 (9–10), tarsal setae *ft'* 15 (14–16), setae *ft''* 26 (25–28). **Leg II** 31 (31–32), femur 10 (9–10), genu 5 (no range), tibia 5 (5–6), tarsus 6 (6–7), solenidion  $\omega$  9 (9–10), curved down, distally enlarged forming a small knob, empodium 5 (no range), simple, 5-rayed; femoral setae *bv* 11 (11–12), genual setae *l''* 12 (10–12), tarsal setae *ft'* 5 (no range), setae *ft''* 25 (25–26). **Coxae I** ornamented with some dashes and a few microtubercles, and coxae **II** ornamented with a few microtubercles; setae *Ib* 10 (10–11), tubercles *Ib* 10 (10–11) apart, setae *Ia* 24 (23–25), tubercles *Ia* 7 (7–9) apart, setae *2a* 40 (40–45), tubercles *2a* 22 (21–22) apart, prosternal apodeme 6 (6–7). **Opisthosoma** dorsally arched with 70 (68–71) dorsal semiannuli, with elliptical microtubercles close to the rear margin, and 71 (70–74) ventral semiannuli, with small and rounded microtubercles in the middle of the semiannuli; 5 (5–6) semiannuli with microtubercles between coxae and genital coverflap; last 7 (7–8) ventral semiannuli of the opisthosoma with elongated microtubercles on the ventral side. Setae *c2* 45 (44–50), on ventral semiannulus 10 (9–10); setae *d* 57 (55–60), on ventral semiannulus 23 (23–26); setae *e* 30 (26–30), on ventral semiannulus 40 (38–42); setae *f* 28 (28–32), on ventral semiannulus 65 (63–68), 7 (no range) annuli after setae *f*. Setae *h2* 72 (66–72), setae *h1* 6 (5–6). **External genitalia** 12 (12–14), 20 (20–23) wide, coverflap with 12 (no range) longitudinal striae, setae *3a* 27 (27–30), 16 (15–16) apart; with a few sparse microtubercles at the genital coverflap base. **Internal genitalia** with anterior, trapezoidal transversal apodeme, longitudinal bridge relatively long; oblique apodeme present; short spermathecal tubes directed laterad; and spermathecae oval-shaped.

**MALE** (n=1). Body vermiform, 250 (including gnathosoma), 48 wide, 50 thick. **Gnathosoma** 20 projecting obliquely downwards, chelicerae 18, palp coxal setae *ep* 3, palp genual setae *d* 6, unbranched, palp tarsus setae *v* not detectable. **Prodorsal shield** 31, including frontal lobe, 38 wide, frontal lobe 4. Shield pattern similar to that of female. Tubercles of scapular setae *sc* on rear shield margin, 20 apart, setae *sc* 19. **Leg I** 30, femur 9, genu 5, tibia 5, tarsus 6, solenidion  $\omega$  9, curved down, distally slightly enlarged, empodium 5, simple, 5-rayed; femoral setae *bv* 9, genual setae *l''* 21, tibial setae *l'* 6, tarsal setae *ft'* 15, setae *ft''* 22. **Leg II** 28, femur 9, genu 4, tibia 5, tarsus 6, solenidion  $\omega$  10, curved down, distally slightly enlarged, empodium 5, simple, 5-rayed; femoral setae *bv* 9, genual setae *l''* 10, tarsal setae *ft'* 5, setae *ft''* 21. **Coxae** similar to those of female; setae *Ib* 9, tubercles *Ib* 10 apart, setae *Ia* 14, tubercles *Ia* 9 apart, setae *2a* 30, tubercles *2a* 20 apart. Prosternal apodeme 5. **Opisthosoma** dorsally arched with 65 dorsal semiannuli; 62 ventral semiannuli; 6 semiannuli between coxae and genital region. Setae *c2* 35 on ventral semiannulus 10, setae *d* 40 on ventral semiannulus 20; setae *e* 20 on ventral semiannulus 35; setae *f* 28 on ventral semiannulus 55, 7 annuli after setae *f*. Setae *h2* 55; setae *h1* 5; setae *3a* 20, 16 apart.



**FIGURE 1.** Line drawings of *Aceria astratorae* sp. nov.: **AD.** Prodorsal shield; **AL.** Lateral view of anterior body region; **CG.** Female coxigenital region; **em.** Empodium; **IG.** Internal female genitalia; **LO.** Lateral view of annuli; **L1.** Leg I; **PM.** Lateral view of posterior opisthosoma. Scale bar: 10 µm for AD, AL, CG, IG, PM; 5 µm for LO, L1; 2.5 µm for em.

*Type host plant*

*Astragalus pinetorum* Boiss. (family Leguminosae)

*Relation to the host plant*

Vagrant on leaves and no symptom was observed on the infested plants.

*Type locality*

Mazhan village, Birjand, Iran. 32°21'0.986"N, 58°49'26.933"E, 1880 m above sea level; 19 August 2016, coll. Arash Honarmand.

*Type material*

Holotype: single female on a microscope slide (slide code: AH96-30-1); paratypes: 9 females (slide codes: AH96-30-2 to AH96-30-10) and one male (slide code: AH96-30-19) mounted on separate microscope slides.

#### Other material

Mites extracted from the same sample as the type specimens were preserved in part in 70% ethanol and in part in Oudemans' solution.

#### Etymology

The specific epithet, *astratorae*, is a combination of the genus and species names of the host plant in the genitive singular case.

#### Remarks

This is the first report of an eriophyid mite species associated to *A. pinetorum* host plant.

#### Differential diagnosis

*Aceria astratorae* **sp. nov.** differs from *Aceria* species known on *Astragalus* species plants up to now, and in particular with *A. astragali* (Liro, 1940) for the prodorsal shield pattern, which is characterized by complete median, admedian and submedian lines, on the contrary of *A. astratorae* **sp. nov.**, which is provided with incomplete and folded lines. *Aceria astratorae* **sp. nov.** appears to be close to *Aceria trichocnema* (Nalepa) which was found on *Indigofera trifoliata* L. (Leguminosae) from Java, Indonesia (Nalepa 1914), and later re-described by Mohanasundaram (1990). These two species have quite similar prodorsal shield pattern which differs for the median line, inner and outer submedian lines (complete and reaching the rear of shield in *A. trichocnema* versus incomplete in *A. astratorae* **sp. nov.**). Other differences regard the number of empodium rays (5 in *A. astratorae* **sp. nov.** versus 6 in *A. trichocnema*), scapular setae *sc* length (20–22 in *A. astratorae* **sp. nov.** versus 50 in *A. trichocnema*). Minor differences consist in the length of opisthosoma setae: *c*2 (44–45 in *A. astratorae* **sp. nov.** versus 52 in *A. trichocnema*), *d* (55–60 in *A. astratorae* **sp. nov.** versus 50 in *A. trichocnema*), *e* (26–30 in *A. astratorae* **sp. nov.** versus 33 in *A. trichocnema*), *f* (28–32 in *A. astratorae* **sp. nov.** versus 22 in *A. trichocnema*).

#### *Aceria astracanthae* **sp. nov.** (Fig. 2)

#### Description

FEMALE: (n=10) Body vermiform, 200 (180–210, including gnathosoma), 36 (36–40) wide, 35 (35–40) thick. **Gnathosoma** 20 (19–20) projecting obliquely downwards, pedipalp coxal setae *ep* 3 (no range), dorsal pedipalp genual setae *d* 5 (no range), unbranched, palp tarsus setae *v* 1 (1–2), cheliceral stylets 18 (17–19). **Prodorsal shield** subtriangular 28 (29–30), including frontal lobe, 27 (26–29) wide; with rounded frontal lobe 4 (3–4) over gnathosomal base. Median line complete, slightly sinuate, broken on about posterior 3/4 of the shield; V shaped mark at the end on posterior rear margin of the shield; admedian lines complete and slightly sinuate; inner submedian lines complete, forming parentheses-like marks at the middle and shorter than median and admedian lines; short outer submedian lines present on about anterior 3/4 of the shield delimiting three pairs of closed cells with the admedian lines; some microtubercles on lateral sides of shield and base of coxae. Tubercles of scapular setae *sc* on rear shield margin, 14 (14–16) apart, scapular setae *sc* 14 (13–15), directed backward. **Leg I** 26 (24–26), femur 7 (7–9), genu 4 (no range), tibia 4 (4–5), tarsus 6 (5–6), solenidion  $\omega$  7 (6–7), curved down, distally rounded, empodium 4 (4–5), simple, 4-rayed; femoral setae *bv* 7 (7–8), genual setae *l''* 19 (17–19), tibial setae *l'* 5 (5–6), tarsal setae *ft'* 11 (11–12), setae *ft''* 18 (17–19). **Leg II** 23 (23–24), femur 8 (7–8), genu 4 (no range), tibia 4 (4–5), tarsus 5 (5–6), solenidion  $\omega$  7 (7–8), curved down, distally rounded, empodium 4 (4–5), simple, 4-rayed; femoral setae *bv* 8 (7–8), genual setae *l''* 9 (9–10), tarsal setae *ft'* 5 (4–5), setae *ft''* 17 (16–18). **Coxae**

ornamented with a few microtubercles around the setal tubercles; several granules near prosternal apodeme; setae *lb* 6 (6–7), tubercles *lb* 8 (7–9) apart, setae *la* 20 (17–20), tubercles *la* 4 (4–5) apart, setae *2a* 33 (30–35), tubercles *2a* 16 (16–17) apart, prosternal apodeme 6 (5–6). **Opisthosoma** dorsally arched with 63 (57–64) dorsal semiannuli, with elliptically based microtubercles on the middle of semiannuli, and 60 (52–61) ventral semiannuli, with elliptically based, small microtubercles on rear part; 4 (4–5) semiannuli with microtubercles between coxae and genital coverflap; last 6 (5–6) ventral and dorsal semiannuli of the opisthosoma with elongated microtubercles. Setae *c2* 25 (21–26), on ventral semiannulus 7 (7–9); setae *d* 40 (32–40), on ventral semiannulus 20 (17–20); setae *e* 17 (15–18), on ventral semiannulus 35 (32–36); setae *f* 17 (16–18), on ventral semiannulus 55 (50–55), 5 (5–6) annuli after setae *f*. Setae *h2* 58 (53–60), setae *h1* 4 (3–4). **External genitalia** 10 (10–11), 17 (17–20) wide, coverflap with 8 (7–8) longitudinal striae, setae *3a* 13 (10–14), 14 (14–15) apart; with two rows of microtubercles at the genital coverflap base. **Internal genitalia** with anterior, trapezoidal transversal apodeme, longitudinal bridge relatively long; oblique apodeme present; spermathecal tubes short; spermathecae oval-shaped.

**MALE** (n=1). Body vermiform, 190 (including gnathosoma), 35 wide, 35 thick. **Gnathosoma** 18 projecting obliquely downwards, chelicerae 17, palp coxal setae *ep* 3, palp genual setae *d* 4, unbranched, palp tarsus setae *v* 1. **Prodorsal shield** 28, including frontal lobe, 23 wide, frontal lobe 3. Shield pattern similar to that of female. Tubercles of scapular setae *sc* on rear shield margin, 15 apart, setae *sc* 11. **Leg I** 24, femur 8, genu 4, tibia 5, tarsus 5, solenidion *ω* 7, curved down, distally rounded, empodium 4, simple, 4-rayed; femoral setae *bv* 6, genual setae *l''* 12, tibial setae *l'* 4, tarsal setae *ft'* 10, setae *ft''* 15. **Leg II** 21, femur 7, genu 4, tibia 4, tarsus 5, solenidion *ω* 6, curved down, distally rounded, empodium 4, simple, 4-rayed; femoral setae *bv* 6, genual setae *l''* 9, tarsal setae *ft'* 4, setae *ft''* 16. **Coxae** similar to those of female; setae *lb* 6, tubercles *lb* 8 apart, setae *la* 18, tubercles *la* 5 apart, setae *2a* 28, tubercles *2a* 16 apart. Prosternal apodeme 5. **Opisthosoma** dorsally arched with 50 dorsal semiannuli; 51 ventral semiannuli; 4 semiannuli between coxae and genital region. Setae *c2* 20 on ventral semiannulus 7, setae *d* 25 on ventral semiannulus 17; setae *e* 15 on ventral semiannulus 28; setae *f* 13 on ventral semiannulus 46, 5 annuli after setae *f*. Setae *h2* 40; setae *h1* 3; setae *3a* 7, 11 apart.

#### *Type host plant*

*Astracantha echidna* (Bunge) Podlech (family Leguminosae).

#### *Relation to the host plant*

Vagrant on stems and leaves. No symptom was observed on the infested plants.

#### *Type locality*

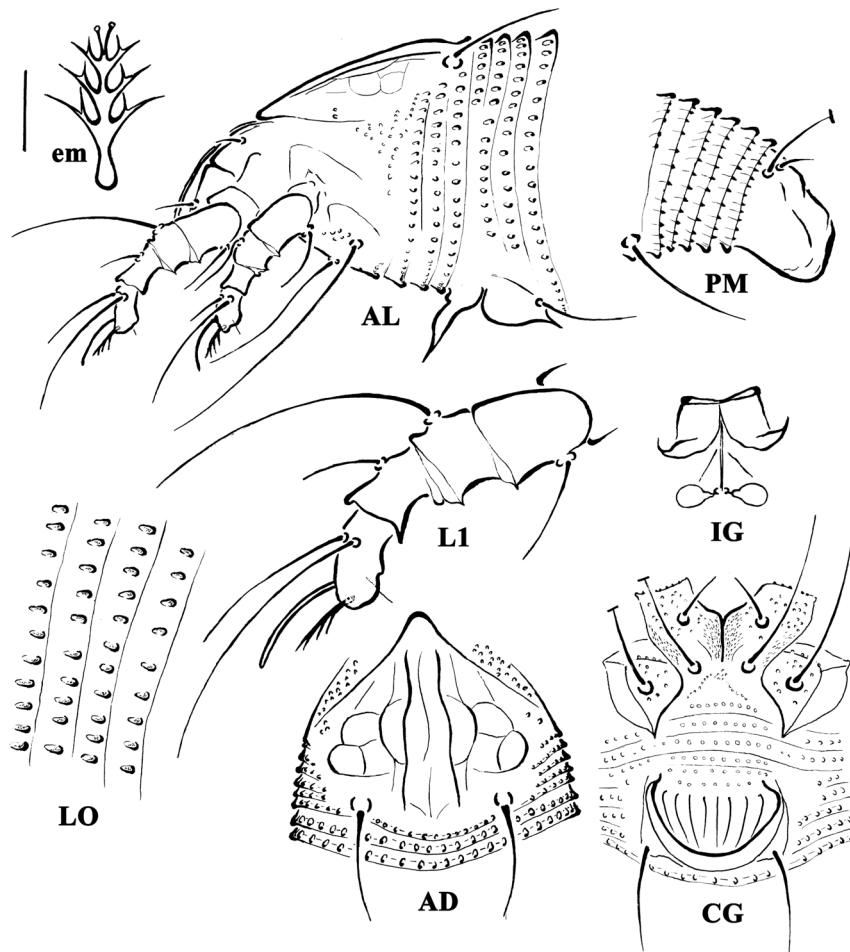
Behdan village, Birjand, Iran. 32°44'55.183"N, 59°22'34.05"E, 1852 m above sea level; 10 August 2016, coll. Arash Honarmand.

#### *Type material*

Holotype: single female on a microscope slide (slide code: AH95-14-1); paratypes: 9 females (slide codes: AH95-14-2 to AH95-14-10), one male (slide code: AH95-14-14) and one nymph (slide code: AH95-14-17; was not measured) mounted on separate microscope slides.

#### *Other material*

Mites extracted from the same sample as the type specimens were preserved in part in 70% ethanol and in part in Oudemans' solution.



**FIGURE 2.** Line drawings of *Aceria astracanthae* sp. nov.: AD. Prodorsal shield; AL. Lateral view of anterior body region; CG. Female coxigenital region; em. Empodium; IG. Internal female genitalia; LO. Lateral view of annuli; L1. Leg I; PM. Lateral view of posterior opisthosoma. Scale bar: 10  $\mu$ m for AD, AL, CG, IG, PM; 5  $\mu$ m for LO, L1; 2.5  $\mu$ m for em.

*Etymology*

The specific epithet comes from the genus name, *Astracantha*, of the type host plant in the genitive singular case.

*Remarks*

This is first report of an eriophyid mite species associated to *A. echidna* host plant.

*Differential diagnosis*

*Aceria astracanthae* sp. nov. appears to be close to *Aceria dictyna* Meyer (Smith) which was found on *Acacia nilotica* (L.) Delile subsp. *kraussiana* (Benth.) Brenan (Leguminosae) from South Africa (Meyer 1990). The prodorsal shield pattern is relatively similar in both species but the median line is on the posterior third of the shield in *A. dictyna*, whereas is complete in *A. astracanthae* sp. nov. The admedian lines are sinuous in both species but two transversal lines joint them only in *A. dictyna*. Furthermore, submedian lines provided three close cells in *A. astracanthae* sp. nov.,

whereas just one open cell is displayed on *A. dictyna*. A V-shaped mark is close to rear margin of the prodorsal shield in both species which have a similar frontal shape. Also coxae ornamentation are similar and opisthosoma annular number is close together (57–64 in *A. astracanthae* **sp. nov.** and 48–62 in *A. dictyna*). The new species can be differentiated by the number of the empodium rays (4 in *A. astracanthae* **sp. nov.** versus 7 in *A. dictyna*), scapular setae *sc* length (13–15 in *A. astracanthae* **sp. nov.** versus 22–25 in *A. dictyna*), *c2* setae length (21–26 in *A. astracanthae* **sp. nov.** versus 13–19 in *A. dictyna*), *f* setae length (16–18 in *A. astracanthae* **sp. nov.** versus 22–28 in *A. dictyna*), *3a* setae length (10–14 in *A. astracanthae* **sp. nov.** versus 41–60 in *A. dictyna*).

### *Aceria furgae* **sp. nov.** (Fig. 3)

#### Description

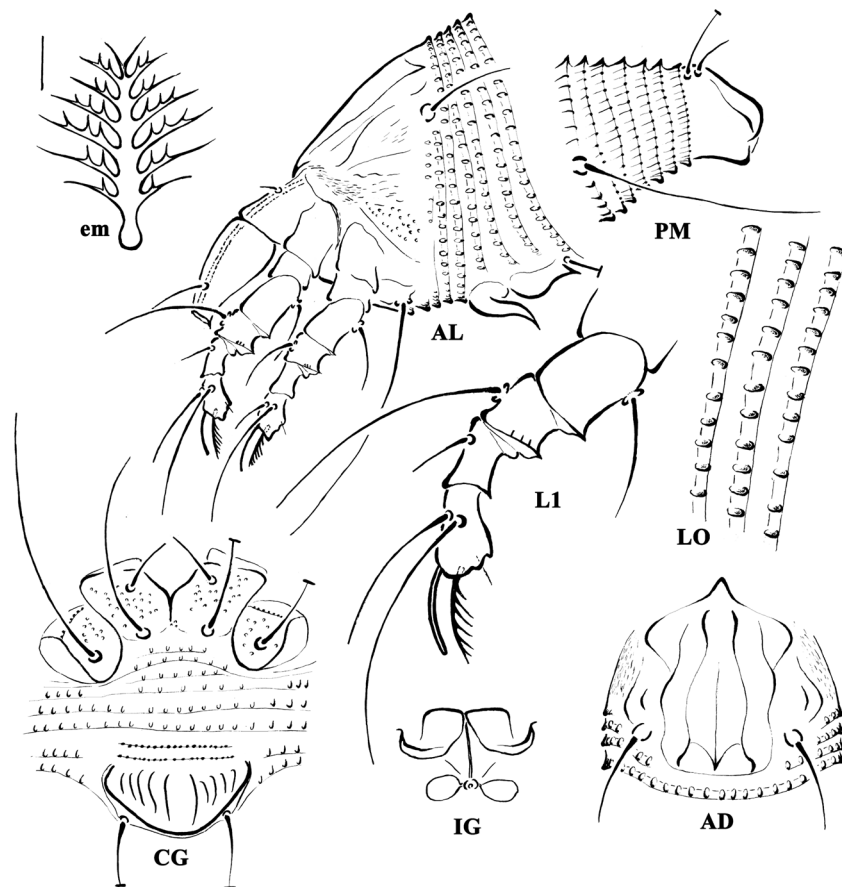
FEMALE: (n=10) Body vermiform, 210 (200–225, including gnathosoma), 45 (45–55) wide, 52 (52–59) thick. **Gnathosoma** 31 (30–31) projecting obliquely downwards, pedipalp coxal setae *ep* 3 (2–3), dorsal pedipalp genual setae *d* 10 (10–11), unbranched, palp tarsus setae *v* 1 (1–2), cheliceral stylets 30 (27–30). **Prodorsal shield** 37 (35–37), semicircular, including frontal lobe, 37 (35–37) wide; with acuminate frontal lobe 4 (4–5) over gnathosomal base. Median line on posterior two third of the shield; a 'V' shaped mark at posterior end of the shield connected to the median line; admedian lines complete, sinuate with pronounced arches (like wide commas) along its length; inner submedian lines complete, sinuate; outer submedian lines arched (like parentheses) on the anterior 1/3 of the shield. Two pair of short and long arched lines located between scapular tubercles and lateral sides of the shield. Some dashes on the lateral sides of the shield; a few small microtubercles between the lateral sides of shield and base of coxae. Tubercles of scapular setae *sc* on rear shield margin, 24 (23–24) apart, scapular setae *sc* 16 (16–17), directed backward. **Leg I** 31 (30–31), femur 10 (10–11), genu 5 (no range), tibia 6 (5–6), tarsus 8 (6–8), solenidion  $\omega$  8 (7–8), curved down, distally rounded, empodium 8 (7–8), simple, 7-rayed; femoral setae *bv* 12 (10–12), genual setae *l''* 25 (25–26), tibial setae *l'* 6 (6–7), tarsal setae *ft'* 16 (15–16), setae *ft''* 25 (24–25). **Leg II** 28 (28–29), femur 10 (9–10), genu 5 (no range), tibia 5 (5–6), tarsus 7 (7–8), solenidion  $\omega$  9 (no range), curved down, distally rounded, empodium 7 (7–8), simple, 7-rayed; femoral setae *bv* 12 (10–12), genual setae *l''* 13 (11–13), tarsal setae *ft'* 7 (6–7), setae *ft''* 25 (25–27). **Coxae** ornamented with some microtubercles; setae *lb* 10 (9–11), tubercles *lb* 13 (11–13) apart, setae *la* 35 (35–37), tubercles *la* 9 (8–9) apart, setae *2a* 50 (48–51), tubercles *2a* 28 (25–28) apart, prosternal apodeme 5 (5–6). **Opisthosoma** dorsally arched with 60 (59–61) dorsal semiannuli, with elliptical microtubercles, and 61 (59–70) ventral semiannuli, with elliptical microtubercles on rear part; 6 (6–7) semiannuli with microtubercles between coxae and genital coverflap; last 6 (6–7) ventral and dorsal semiannuli of the opisthosoma with elongated microtubercles. Setae *c2* 39 (37–40), on ventral semiannulus 11 (9–11); setae *d* 80 (70–85), on ventral semiannulus 19 (18–22); setae *e* 65 (65–70), on ventral semiannulus 34 (33–36); setae *f* 45 (45–50), on ventral semiannulus 55 (52–55), 6 (6–7) annuli after setae *f*. Setae *h2* 110 (95–120), setae *h1* 8 (7–8). **External genitalia** 12 (10–12), 26 (24–26) wide, coverflap with 10 (8–10) longitudinal striae, setae *3a* 58 (58–62), 17 (15–17) apart; with two transversal rows of granulated lines at the genital coverflap base. **Internal genitalia** with anterior, trapezoidal transversal apodeme, longitudinal bridge and oblique apodeme present; short spermathecal tubes, directed laterad; spermathecae oval-shaped.

**MALE.** Not found

#### Type host plant

*Ephedra major* Host (family Ephedraceae)





**FIGURE 3.** Line drawings of *Aceria furgae* sp. nov.: **AD**. Prodorsal shield; **AL**. Lateral view of anterior body region; **CG**. Female coxigenital region; **em**. Empodium; **IG**. Internal female genitalia; **LO**. Lateral view of annuli; **L1**. Leg I; **PM**. Lateral view of posterior opisthosoma. Scale bar: 10  $\mu$ m for **AD**, **AL**, **CG**, **IG**, **PM**; 5  $\mu$ m for **LO**, **L1**; 2.5  $\mu$ m for **em**.

*Relation to the host plant*

Vagrant on green organs and no symptom was observed on the infested plants.

*Type locality*

Shokatabad, South Khorasan, Birjand, Iran. 32°51'39.946"N, 59°18'11.718"E, 1514 m above sea level; 19 August 2016, coll. Arash Honarmand.

*Type material*

Holotype: single female on a microscope slide (slide code: AH95-25-1); paratypes: 9 females (slide codes: AH95-25-2 to AH95-25-10) mounted on separate microscope slides, and 2 nymphs (slide code: AH95-25-14; were not measured) mounted on one slide.

*Other material*

Mites extracted from the same sample as the type specimens were preserved in part in 70% ethanol and in part in Oudemans' solution.

### Etymology

The specific designation is derived from the name of magnificent and historical Furg Citadel in South Khorasan, Iran, Latinized in the genitive singular case.

### Remarks

This is first report of an eriophyid mite species associated to *E. major* host plant.

### Differential diagnosis

*Aceria furgae* **sp. nov.** is not close to *Aceria ephedrae* Fockeu (whose genus position requires to be confirmed according to Amrine and Stasny 1994), which is the only species of eriophyid mites reported on Ephedraceae plants up to now, whereas it appears to be close to *A. ingensi* Ueckermann, which was found on *Ficus ingens* (Miq.) Miq (Moraceae) from South Africa (Fockeu 1892; Ueckermann 1991). They have similar prodorsal shield pattern and frontal lobe, coxae and coverflap ornamentation (8–10 striae on the coverflap in *A. furgae* **sp. nov.** and 9–11 in *A. ingensi*) and coxigenital semiannuli number (6–7 in *A. furgae* **sp. nov.** and 7 in *A. ingensi*). *Aceria furgae* **sp. nov.** can be differentiated from *A. ingensi* by the number of the empodium rays (8 in *A. furgae* **sp. nov.** and 5 in *A. ingensi*), scapular setae *sc* length (16–17 in *A. furgae* **sp. nov.** and 19–20 in *A. ingensi*), setae *d* length (70–85 in *A. furgae* **sp. nov.** and 35–39 in *A. ingensi*), setae *f* length (45–50 in *A. furgae* **sp. nov.** and 16 in *A. ingensi*) and setae *c2* length (37–40 in *A. furgae* **sp. nov.** and 13 in *A. ingensi*).

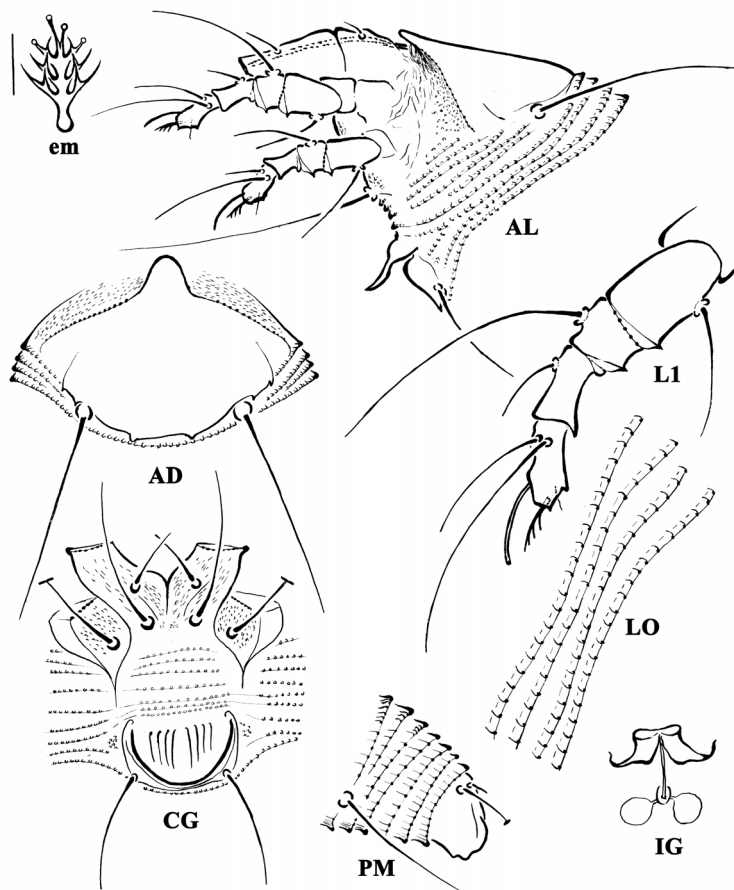
### *Aceria runicae* **sp. nov.** (Fig. 4)

#### Description

FEMALE: (n=10) Body vermiform, 200 (200–210, including gnathosoma), 50 (45–50) wide, 45 (40–45) thick. **Gnathosoma** 28 (28–30) projecting obliquely downwards, pedipalp coxal setae *ep* 3 (3–4), dorsal pedipalp genual setae *d* 6 (6–7), unbranched, palp tarsus setae *v* not detectable, cheliceral stylets 28 (27–28). **Prodorsal shield** subtriangular 30 (29–30), including frontal lobe, 40 (35–40) wide; with rounded frontal lobe 5 (4–5) over gnathosomal base. Prodorsal shield smooth apart one pair of weak and short lines on rear margin of the shield between scapular tubercles and lateral side of the shield; several small dashes on lateral sides of the shield. Tubercles of scapular setae *sc* on rear shield margin, 22 (20–22) apart, scapular setae *sc* 35 (35–36), directed backward. **Leg I** 29 (28–30), femur 9 (8–9), genu 4 (4–5), tibia 6 (5–6), tarsus 7 (6–7), solenidion  $\omega$  7 (no range), curved down, distally rounded, empodium 4 (4–5), simple, 4-rayed; femoral setae *bv* 11 (11–12), genual setae *l''* 24 (23–24), tibial setae *l'* 6 (5–6), tarsal setae *ft'* 12 (12–13), setae *ft''* 21 (20–21). **Leg II** 27 (27–28), femur 9 (no range), genu 4 (4–5), tibia 4 (4–5), tarsus 6 (6–7), solenidion  $\omega$  8 (7–8), curved down, distally rounded, empodium 4 (4–5), simple, 4-rayed; femoral setae *bv* 15 (14–15), genual setae *l'''* 13 (12–13), tarsal setae *ft'* 6 (5–6), setae *ft''* 20 (19–21). **Coxae** ornamented with several small dashes; setae *lb* 10 (10–12), tubercles *lb* 8 (8–9) apart, setae *la* 26 (25–27), tubercles *la* 5 (5–6) apart, setae *2a* 43 (40–44), tubercles *2a* 17 (16–18) apart, prosternal apodeme 6 (5–6). **Opisthosoma** dorsally arched with 62 (59–63) dorsal semiannuli, with elliptically based microtubercles close to the semiannular margin, and 63 (59–63) ventral semiannuli, with small circularly based microtubercles on rear semiannular margin; 7 (6–7) semiannuli with microtubercles between coxae and genital coverflap; last 6 (5–6) ventral and dorsal semiannuli of the opisthosoma with elongated microtubercles. Setae *c2* 25 (23–25), on ventral semiannulus 11 (9–11); setae *d* 54 (50–56), on ventral semiannulus 24 (21–24); setae *e* 14 (12–14), on ventral semiannulus 39 (35–39); setae *f* 25 (23–25), on ventral semiannulus 58 (55–58), 6 (5–6) annuli after setae *f*. Setae *h2* 62 (58–64), setae *h1* 3 (3–4). **External genitalia** 10 (10–11), 18 (18–20) wide, coverflap with 8 (no range)

longitudinal striae, setae *3a* 20 (20–21), 13 (13–14) apart. **Internal genitalia** with anterior, trapezoidal transversal apodeme, longitudinal bridge relatively long; oblique apodeme not visible; short spermathecal tubes, spermathecae oval to rounded shaped.

**MALE** (n=1). Body vermiform, 180 (including gnathosoma), 45 wide, 46 thick. **Gnathosoma** 23 projecting obliquely downwards, chelicerae 20, palp coxal setae *ep* 3, palp genual setae *d* 6, unbranched, palp tarsus setae *v* not detectable. **Prodorsal shield** 25, including frontal lobe, 25 wide, frontal lobe 4. Shield pattern similar to that of female. Tubercles of scapular setae *sc* on rear shield margin, 18 apart, setae *sc* 24. **Leg I** 26, femur 9, genu 4, tibia 6, tarsus 5, solenidion  $\omega$  6, curved down, distally rounded, empodium 4, simple, 4-rayed; femoral setae *bv* 6, genual setae *l''* 21, tibial setae *l'3*, tarsal setae *ft'* 11, setae *ft''* 17. **Leg II** 25, femur 8, genu 4, tibia 5, tarsus 6, solenidion  $\omega$  7, curved down, distally rounded, empodium 4, simple, 4-rayed; femoral setae *bv* 11, genual setae *l''* 11, tarsal setae *ft'* 5, setae *ft''* 17. **Coxae** similar to those of female; setae *1b* 9, tubercles *1b* 8 apart, setae *1a* 20, tubercles *1a* 4 apart, setae *2a* 30, tubercles *2a* 14 apart. Prosternal apodeme 5. **Opisthosoma** dorsally arched with 47 dorsal semiannuli; 58 ventral semiannuli; 5 semiannuli between coxae and genital region. Setae *c2* 21 on ventral semiannulus 10, setae *d* 40 on ventral semiannulus 21; setae *e* 11 on ventral semiannulus 34; setae *f* 18 on ventral semiannulus 53, 5 annuli after setae *f*. Setae *h2* 60; setae *h1* 3; setae *3a* 15, 10 apart.



**FIGURE 4.** Line drawings of *Aceria runicae* sp. nov.: AD. Prodorsal shield; AL. Lateral view of anterior body region; CG. Female coxigenital region; em. Empodium; IG. Internal female genitalia; LO. Lateral view of annuli; L1. Leg I; PM. Lateral view of posterior opisthosoma. Scale bar: 10  $\mu$ m for AD, AL, CG, IG, PM; 5  $\mu$ m for LO, L1; 2.5  $\mu$ m for em.

*Type host plant*

*Rubia caramanica* Bornm. (family Rubiaceae)

*Relation to the host plant*

Vagrant on stems and leaves. No symptom was observed on the infested plants.

*Type locality*

Akbarabad village, Birjand, South Khorasan, Iran. 32°42'56.398"N, 59°21'25.456"E, 2193 m above sea level; 6 August 2017, coll. Arash Honarmand.

*Type material*

Holotype: single female on a microscope slide (slide code: AH96-13-1); paratypes: 9 females (slide codes: AH96-13-2 to AH96-13-10) and one male (slide code: AH96-13-15) mounted on separate microscope slides.

*Other material*

Mites extracted from the same sample as the type specimens were preserved in part in 70% ethanol and in part in Oudemans' solution.

*Etymology*

The specific designation is derived from combining the genus and species names of the host plant in the singular genitive case.

*Remarks*

This is the first report of eriophyid mites species associated to *R. caramanica* host plant.

*Differential diagnosis*

*Aceria runicae* **sp. nov.** appears to be morphologically close to *A. morindae* Nalepa which was found on *Morinda jackiana* Korth. (family Rubiaceae) from Java, Indonesia (Nalepa 1914) and far from *A. rubiae* (Canestrini) collected on *Rubia peregrina* L. (Canestrini 1897) and few other *Rubia* species, but causing globular galls at the tips of the shoots and last whorls of leaves and flowers. According to comparative Nalepa's description, they have some similarities like empodium rays number (4), subtriangular and smooth prodorsal shield, rounded frontal lobe, coverflap with striae. *Aceria runicae* **sp. nov.** differs from *A. morindae* by the following features: scapular setae *sc* length (one and half time longer than the prodorsal shield length in *A. morindae* whereas these setae are just a bit longer than the prodorsal shield in *Aceria runicae* **sp. nov.**), *3a* setae length which is as long as *e* setae length in *A. morindae* whereas it is longer in *Aceria runicae* **sp. nov.** (*3a* setae 20–21 and setae *e* 12–14), the number of the opisthosoma annuli which are more in *Aceria runicae* **sp. nov.** (59–63) than in *A. morindae* (54).

***Aculus birsutum* sp. nov. (Fig. 5)**

*Description*

FEMALE (n=10). Body vermiform, 190 (180–200, including gnathosoma), 46 (46–58) wide, 48 (48–59) thick. **Gnathosoma** 27 (27–29) projecting downwards, pedipalp coxal setae *ep* not detectable, dorsal pedipalp genual setae *d* 7 (6–7), unbranched, palp tarsus setae *v* 2 (no range), cheliceral stylets 25 (24–26). **Prodorsal shield** 30 (30–32), including frontal lobe, 37 (37–40) wide;

rounded and rigid frontal lobe, 6 (5–6) over gnathosomal base. Shield pattern composed of median line on the posterior 5/6, connected to admedian lines at posterior 1/3 and 2/3 by transverse lines. Admedian lines complete; median and admedian lines together forming 4 cells. Four submedian lines on the anterior 1/3 and inner submedian lines longer than others. One transversal line connected the posterior of submedian lines and crossed the median and admedian line at anterior 1/3. A few granules on posterior of shield between tubercles; some granules and short dashes on lateral sides of prodorsal shield. Tubercles of scapular setae *sc* on rear shield margin, 22 (22–23) apart, scapular setae *sc* 52 (50–55), divergently and directed back. **Leg I** 32 (30–32), femur 9 (9–10), genu 5 (4–5), tibia 8 (8–9), tarsus 7 (6–7), solenidion  $\omega$  7 (6–7), curved down, distally knobbed, empodium 5 (no range), simple, 4-rayed; femoral setae *bv* 10 (10–11), genual setae *l''* 25 (23–25), tibial setae *l' 6* (5–6), tarsal setae *ft' 14* (14–15), setae *ft'' 21* (20–21). **Leg II** 30 (29–30), femur 9 (9–10), genu 5 (4–5), tibia 6 (5–6), tarsus 5 (5–6), solenidion  $\omega$  7 (6–7), curved down, distally knobbed, empodium 5 (no range), simple 4-rayed; femoral setae *bv* 8 (8–9), genual setae *l'' 9* (8–9), tarsal setae *ft' 4* (4–5), setae *ft'' 20* (19–21). **Coxae** ornamented with a few short dashes; setae *lb* 6 (6–7), tubercles *lb* 9 (9–10) apart, setae *la* 22 (22–24), tubercles *la* 4 (4–5) apart, setae *2a* 44 (41–44), tubercles *2a* 18 (18–20) apart, prosternal apodeme 7 (7–8). **Opisthosoma** dorsally arched; 55 (52–56) dorsal semiannuli, with circularly based microtubercles close to the semiannular margin, and 66 (62–66) ventral semiannuli, with small and circularly based microtubercles on rear margin; 6 (5–6) semiannuli with microtubercles between coxae and genital coverflap; last 5 (no range) ventral and dorsal semiannuli with elongated microtubercles. Setae *c2* 20 (18–20, on ventral semiannulus 11 (10–11); setae *d* 40 (39–43), on ventral semiannulus 25 (23–25); setae *e* 17 (16–18), on ventral semiannulus 42 (40–43); setae *f* 30 (28–31), on ventral semiannulus 59 (57–61), 5 (no range) annuli after setae *f*. Setae *h2* 90 (85–100), setae *h1* 2 (2–3). **External genitalia** 13 (13–15), 20 (20–22) wide, coverflap with 8 (no range) longitudinal striae, setae *3a* 35 (33–36), 11 (11–13) apart, with two transversal arched lines at the genital coverflap base. **Internal genitalia** with anterior, trapezoidal transversal apodeme, longitudinal bridge not long; oblique apodeme present; short spermathecal tubes and spermathecae piriform.

**MALE.** Not found.

*Type host plant*

*Epilobium hirsutum* L. (family Onagraceae), codlins and cream

*Relation to the host plant*

Vagrant on leaves, stems. No apparent symptom was observed.

*Type locality*

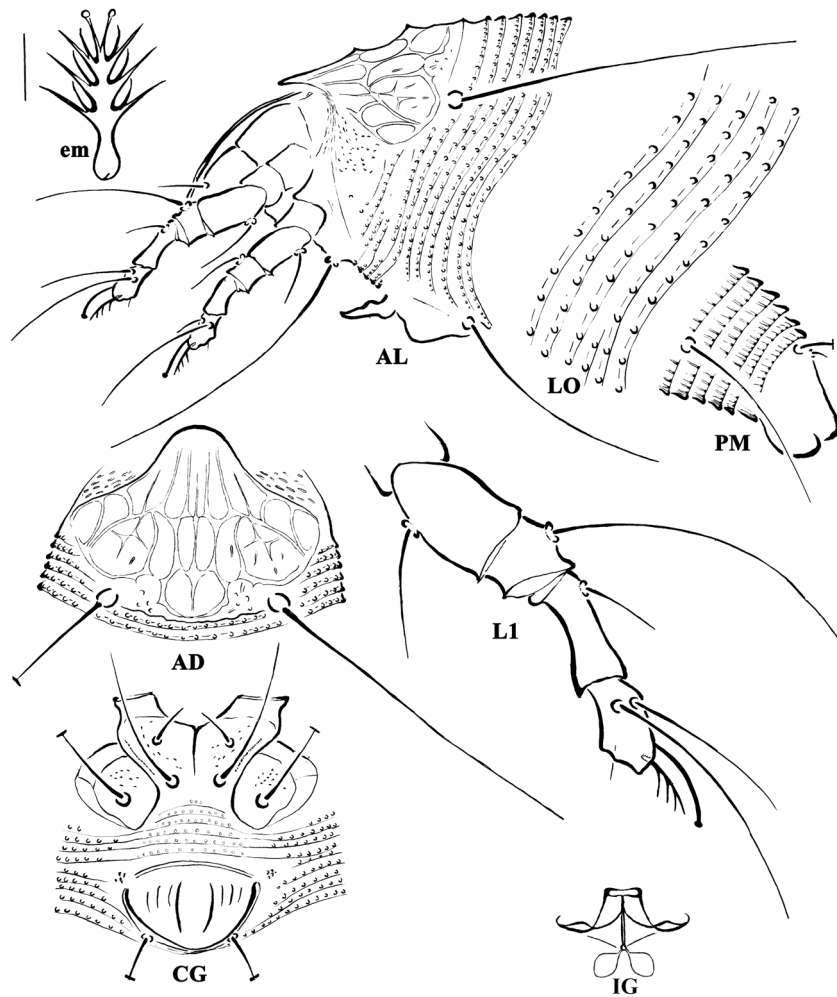
Now Qand village, Birjand, Iran. 33°15'45.324" N, 59°41'57.246" E, 2,113 m above sea level; 24 June 2017, coll. Arash Honarmand.

*Type material*

Holotype: single female on a microscope slide (slide code: AH96-1-1); paratypes: 9 females (slide codes: AH96-1-2 to AH96-1-10) and 2 nymphs (slide code: AH96-1-16 and AH96-1-17; were not measured) on separate microscope slides.

*Other material*

Mites preserved in 70% ethanol and in Oudemans' solution extracted from the same sample as the type specimens.



**FIGURE 5.** Line drawings of *Aculus birsutum* sp. nov.: **AD.** Prodorsal shield; **AL.** Lateral view of anterior body region; **CG.** Female coxigenital region; **em.** Empodium; **IG.** Internal female genitalia; **LO.** Lateral view of annuli; **L1.** Leg I; **PM.** Lateral view of posterior opisthosoma. Scale bar: 10  $\mu$ m for **AD, AL, CG, IG, PM**; 5  $\mu$ m for **LO, L1**; 2.5  $\mu$ m for **em**.

#### *Etymology*

The specific designation is derived from combining the name of the type location Birjand and the host plant species name, *hirsutum*, in the nominative case.

#### *Remarks*

This is the first report of an eriophyid mite species belonging to the genus *Aculus* in association to plants of the family Onagraceae and the second report of eriophyid mites associated to *E. hirsutum*. This plant species is of particular relevance as weed in the USA (<https://plants.usda.gov/core/profile?symbol=EPHI>).

#### *Differential diagnosis*

*Aculus niphoclae* Keifer, which was found originally on *Salix niphoclada* Rydb. (Salicaceae) from Canada (Keifer 1966), appears to be morphologically close to *Aculus birsutum* sp. nov., with

similarities concerning the number of empodium rays (4-rayed), dorsal semiannuli (52–56 in *A. birsutum* **sp. nov.** and 57 in *A. niphocladae*) and ventral semiannuli (62–66 in *A. birsutum* **sp. nov.** and 67 in *A. niphocladae*) as well as the length of ventral setae *d* (39–43 in *A. birsutum* **sp. nov.** and 44 in *A. niphocladae*) and palp genual setae *d* (6–7 in *A. birsutum* **sp. nov.** and 6–7 in *A. niphocladae*). Lines and cells compose the pattern of the prodorsal shield in both species, but median, admedian and submedian lines reach the anterior margin of the prodorsal shield in *A. niphocladae* on the contrary of that observed in *A. birsutum* **sp. nov.** The new species can be differentiated also by the length of the scapular setae *sc* (50–55 in *A. birsutum* **sp. nov.** versus 60 in *A. niphocladae*), setae *e* (16–18 in *A. birsutum* **sp. nov.** versus 26 in *A. niphocladae*), setae *3a* (33–36 in *A. birsutum* **sp. nov.** versus 41 in *A. niphocladae*), the number of semiannuli in the coxigenital region (5–6 in *A. birsutum* **sp. nov.** versus 8 in *A. niphocladae*), of striae on the coverflap (8 in *A. birsutum* **sp. nov.** versus 12 in *A. niphocladae*), and the ornamentation of the coxae which are provided with a few short and weak dashes in *A. birsutum* **sp. nov.** and many strong dashes in *A. niphocladae*.

### *Phyllocoptes birreae* **sp. nov.** (Fig. 6)

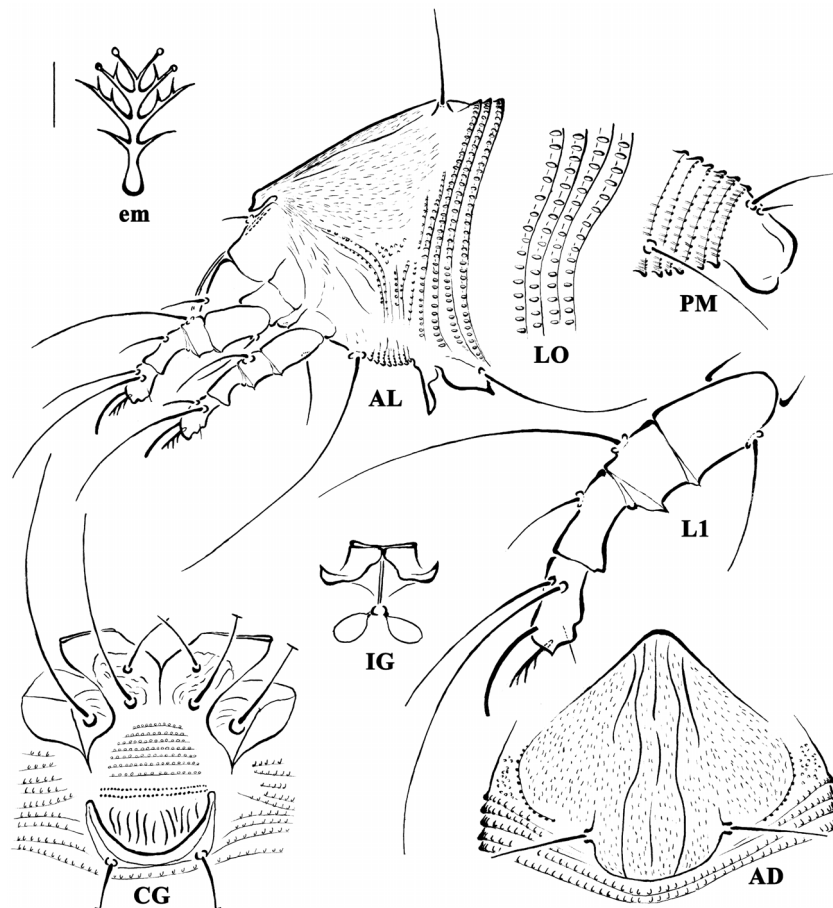
#### Description

FEMALE (n=10). Body fusiform, 190 (180–210, including gnathosoma), 56 (56–59) wide, 43 (41–43) thick. **Gnathosoma** 22 (21–23) projecting downwards, pedipalp coxal setae *ep* 4 (no range), dorsal pedipalp genual setae *d* 7 (6–7), unbranched, palp tarsus setae *v* not detectable, cheliceral stylets 18 (18–19). **Prodorsal shield** 39 (38–40), including frontal lobe, 41 (40–42) wide, subtriangular; with subtriangular frontal lobe 5 (no range) over gnathosomal base and rounded tip in dorsal view. Median line complete and interrupted at 1/3 and 2/3 of the shield and not reaching rear margin of the shield. Admedian lines complete and sinuose. One pair of submedian lines present on the anterior half of the shield and slightly sinuose. Prodorsal shield pattern ornamented with several and weak dashes. Tubercles of scapular setae *sc* 3 (2–3) ahead of rear shield margin 19 (17–19) apart, scapular setae *sc* 15 (14–15), directed upward divergently. **Leg I** 31 (31–32), femur 9 (9–10), genu 5 (4–5), tibia 7 (no range), tarsus 7 (6–7), solenidion  $\omega$  8 (7–8) distally rounded, empodium 4 (4–5), 4-rayed; femoral setae *bv* 11 (11–12), genual setae *l''* 25 (25–26), tibial setae *l'* 7 (6–7), tarsal setae *ft'* 16 (15–16), setae *ft''* 26 (26–27). **Leg II** 28 (28–29), femur 9 (no range), genu 5 (4–5), tibia 6 (5–6), tarsus 7 (6–7), solenidion  $\omega$  8 (8–9) distally rounded, empodium 4 (4–5), 4-rayed; femoral setae *bv* 11 (11–13), genual setae *l''* 13 (13–14), tarsal setae *ft'* 5 (4–5), setae *ft''* 25 (24–25). **Coxae** ornamented with few lines; setae *lb* 10 (9–10), tubercles *lb* 9 (8–9) apart, setae *la* 32 (31–34), tubercles *la* 7 (6–7) apart, setae *2a* 45 (44–47), tubercles *2a* 20 (20–21) apart, prosternal apodeme 6 (6–7). **Opisthosoma** dorsally arched with 65 (62–67) dorsal semiannuli, with elliptical microtubercles, and 72 (69–75) ventral semiannuli, with small elliptical microtubercles close to rear margin; 7 (no range) coxigenital semiannuli with microtubercles between coxae and genital coverflap; last 5 (no range) ventral and 3 (3–5) dorsal semiannuli with linear microtubercles. Setae *c2* 36 (35–38), on ventral semiannulus 12 (11–13); setae *d* 56 (53–60), on ventral semiannulus 26 (24–28); setae *e* 25 (25–26), on ventral semiannulus 46 (44–50); setae *f* 23 (23–24), on ventral semiannulus 65 (63–70), 5 (no range) annuli after setae *f*. setae *h2* 76 (69–76), setae *h1* 5 (4–5). **External genitalia** 10 (9–10), 18 (18–20) wide, coverflap with 13 (12–13) longitudinal striae, setae *3a* 28 (27–30), 11 (11–13) apart; with two transversal rows of granulated lines above the coverflap. **Internal genitalia** with anterior, trapezoidal transversal apodeme, longitudinal bridge relatively long; oblique apodeme present; short spermathecal tubes, spermathecae oval-shaped.

**MALE** (n=1). Body fusiform, 180 (including gnathosoma), 50 wide, 40 thick. **Gnathosoma** 18 projecting downwards, chelicerae 16, palp coxal setae *ep* not detectable, palp genual setae *d* 5, unbranched, palp tarsus setae *v* not detectable. **Prodorsal shield** 36, including frontal lobe, 35 wide, frontal lobe 4. Shield pattern similar to that of the female. Tubercles of scapular setae *sc* 2 ahead rear shield margin 14 apart, setae *sc* 12. **Leg I** 26, femur 7, genu 4, tibia 6, tarsus 6, solenidion  $\omega$  7 rounded, empodium 4 simple, 4-rayed; femoral setae *bv* 10, genual setae *l''* 20, tibial setae *l'* 6, tarsal setae *ft'* 12, setae *ft''* 21. **Leg II** 25, femur 8, genu 4, tibia 5, tarsus 6, solenidion  $\omega$  7 rounded, empodium 4 simple, 4-rayed; femoral setae *bv* 7, genual setae *l''* 10, tarsal setae *ft'* 4, setae *ft''* 20. **Coxae** similar to that of the female; setae *lb* 7, tubercles *lb* 6 apart, setae *la* 26, tubercles *la* 4 apart, setae *2a* 38, tubercles *2a* 16 apart, prosternal apodeme 6. **Opisthosoma** dorsally arched with 54 semiannuli; 65 ventral semiannuli; 7 semiannuli between coxae and genital region. Setae *c* 2 30 on ventral semiannulus 11, setae *d* 51 on ventral semiannulus 23; setae *e* 21 on ventral semiannulus 40; setae *f* 18 on ventral semiannulus 60, 5 annuli after setae *f*. Setae *h* 2 70; setae *h* 1 3; setae *3a* 18, 10 apart.

*Type host plant*

*Centaurea virgata* Lam. (family Compositae), squarrose knapweed.



**FIGURE 6.** Line drawings of *Phyllocoptes birreae* sp. nov.: **AD**. Prodorsal shield; **AL**. Lateral view of anterior body region; **CG**. Female coxigenital region; **em**. Empodium; **IG**. Internal female genitalia; **LO**. Lateral view of annuli; **L1**. Leg I; **PM**. Lateral view of posterior opisthosoma. Scale bar: 10  $\mu$ m for **AD**, **AL**, **CG**, **IG**, **PM**; 5  $\mu$ m for **LO**, **L1**; 2.5  $\mu$ m for **em**.



#### *Relation to the host plant*

Vagrant on the leaves and flowers. No damage was observed on the infested plants.

#### *Type locality*

Roshnavand, Birjand, Iran. 33°11'59.687"N, 59°11'37.136"E, 1695 m above sea level; 27 July 2016, coll. Arash Honarmand.

#### *Type material*

Holotype: single female on a microscope slide (slide code: AH95-3-1); paratypes: 9 females (slide codes: AH95-3-2 to AH95-3-10) and 1 male (slide code: AH95-3-14) on separate microscope slides.

#### *Other material*

Mites preserved extracted from the same sample as the type specimens in 70% ethanol and Oudemans' solution.

#### *Etymology*

The specific designation is derived from combining the name of the type location Birjand and the host plant genus name, *Centaurea*, in the genitive case.

#### *Remarks*

*Aceria plectrumscuti* Lotfollahi et al. 2013 (renamed from *A. virgatae* due to homonymy with a species described by Meyer (Smith) & Ueckermann 1996), was previously described on *C. virgata*. The group of *Centaurea* species has a relevant importance as weed in the USA ([http:// plants.usda.gov/core/profile?symbol=CEVI](http://plants.usda.gov/core/profile?symbol=CEVI)) and the survey of their pests has particular interest.

#### *Differential diagnosis*

*Phyllocoptes birreae* **sp. nov.** was compared with all *Phyllocoptes* species associated with Compositae host plants without pointing out any similarity with them. It appears to be morphologically close to *Phyllocoptes gracilis* Nalepa, that was reported from *Rubus idaeus* L. as type host (Rosaceae) (Nalepa 1890) and later from many alternative *Rubus* species by Keifer (1939), Liro & Roivainen (1951), Baker *et al.* (1996) and many other reports. The new species can be differentiated for the number of the empodium rays (4-rayed in *P. birreae* **sp. nov.** versus 5-rayed in *P. gracilis*), coxal ornamentation (few lines in *P. birreae* **sp. nov.** versus some tubercles in *P. gracilis*), prodorsal shield ornamentation (fine granules on the whole shield in *P. birreae* **sp. nov.** versus larger granules on the lateral sides of the shield in *P. gracilis*), length of setae *2a* (44–47 in *P. birreae* **sp. nov.** versus 33 in *P. gracilis*), setae *c2* (35–38 in *P. birreae* **sp. nov.** versus 9 in *P. gracilis*), setae *d* (53–60 in *P. birreae* **sp. nov.** versus 34 in *P. gracilis*), setae *e* (25–26 in *P. birreae* **sp. nov.** versus 11 in *P. gracilis*) and setae *3a* (27–30 in *P. birreae* **sp. nov.** versus 14 in *P. gracilis*)

#### *Neophytoptus semenovis* **sp. nov.** (Fig. 7)

#### *Description*

FEMALE: (n=10) Body vermiform, 185 (165–190, including gnathosoma), 45 (45–50) wide, 52 (50–57) thick. **Gnathosoma** 25 (24–26) projecting obliquely downwards, pedipalp coxal setae *ep* 3 (no range), dorsal pedipalp genual setae *d* 7 (6–8), unbranched, palp tarsus setae *v* not detectable, cheliceral stylets 21 (21–22). **Prodorsal shield** subtriangular 42 (42–46) including frontal lobe, 34

(34–37) wide; with rounded and broad frontal lobe 8 (8–9) over gnathosomal base. prodorsal shield pattern ornamented by several short and weak lines. Tubercles of scapular setae *sc* 5 (5–6) ahead of rear shield margin, 20 (19–21) apart, scapular setae *sc* 7 (6–7), convergent backward. **Leg I** 30 (29–31), femur 10 (9–10), genu 4 (4–5), tibia 6 (6–7), tarsus 4 (4–5), solenidion  $\omega$  7 (no range), curved down, distally knobbed, empodium 4 (no range), simple, 4-rayed; femoral setae *bv* absent, genual setae *l''* 22 (21–23), tibial setae *l'* 4 (4–5), tarsal setae *ft'* 17 (16–18), setae *ft''* 20 (19–20). **Leg II** 28 (27–28), femur 9 (9–10), genu 4 (4–5), tibia 5 (no range), tarsus 5 (4–5), solenidion  $\omega$  8 (7–8), curved down, distally knobbed, empodium 4 (no range), simple, 4-rayed; femoral setae *bv* absent, genual setae *l''* 6 (6–7), tarsal setae *ft'* 5 (4–5), setae *ft''* 18 (18–20). **Coxae** ornamented with few short and long lines; setae *lb* 10 (9–11), tubercles *lb* 10 (10–12) apart, setae *la* 30 (30–34), tubercles *la* 4 (4–5) apart, setae *2a* 52 (49–52), tubercles *2a* 19 (19–20) apart, prosternal apodeme 5 (4–5). **Opisthosoma** dorsally arched with 61 (59–66) dorsal semiannuli, with small and circularly based microtubercles on rear margin, and 77 (73–80) ventral semiannuli, with fine and circularly based microtubercles on rear part; 7 (6–7) semiannuli with fine microtubercles between coxae and genital coverflap; last 5 (5–6) ventral and dorsal semiannuli of the opisthosoma with elongated microtubercles. Setae *c2* 15 (13–15), on ventral semiannulus 11 (11–12); setae *d* 56 (50–58), on ventral semiannulus 27 (26–28); setae *e* 14 (13–15), on ventral semiannulus 52 (49–54); setae *f* 24 (20–25), on ventral semiannulus 72 (68–75), 5 (5–6) annuli after setae *f*. Setae *h2* 64 (60–65), setae *h1* 2 (2–3). **External genitalia** 12 (12–13), 18 (18–20) wide, coverflap with 8 (8–9) longitudinal striae, setae *3a* 10 (10–11), 11 (11–12) apart. **Internal genitalia** with anterior, trapezoidal transversal apodeme, longitudinal bridge relatively long; oblique apodeme not visible; short spermathecal tubes, spermathecae rounded-shaped.

**MALE** (n=1). Body vermiform, 170 (including gnathosoma), 45 wide, 48 thick. **Gnathosoma** 23 projecting obliquely downwards, chelicerae 21, palp coxal setae *ep* 3, palp genual setae *d* 7, unbranched, palp tarsus setae *v* not detectable. **Prodorsal shield** 40, including frontal lobe, 36 wide, frontal lobe 7. Shield pattern similar to that of female. Tubercles of scapular setae *sc* 4 ahead rear shield margin 18 apart, scapular setae *sc* 6, convergent backward. **Leg I** 27, femur 9, genu 4, tibia 6, tarsus 5, solenidion  $\omega$  7, curved down, distally knobbed, empodium 4, simple, 4-rayed; femoral setae *bv* absent, genual setae *l''* 21, tibial setae *l'* 5, tarsal setae *ft'* 14, setae *ft''* 16. **Leg II** 25, femur 9, genu 4, tibia 5, tarsus 5, solenidion  $\omega$  9, curved down, distally knobbed, empodium 4, simple, 4-rayed; femoral setae *bv* absent, genual setae *l''* 6, tarsal setae *ft'* 4, setae *ft''* 16. **Coxae** similar to those of female; setae *lb* 9, tubercles *lb* 10 apart, setae *la* 20, tubercles *la* 4 apart, setae *2a* 30, tubercles *2a* 15 apart. Prosternal apodeme 4. **Opisthosoma** dorsally arched with 64 dorsal semiannuli; 65 ventral semiannuli; 6 semiannuli between coxae and genital region. Setae *c2* 12 on ventral semiannulus 10, setae *d* 22 on ventral semiannulus 24; setae *e* 12 on ventral semiannulus 41; setae *f* 21 on ventral semiannulus 59, 6 annuli after setae *f*. Setae *h2* 65; setae *h1* 2; setae *3a* 10, 12 apart.

#### *Type host plant*

*Semenovia suffruticosa* (Freyn & Bornm.) Manden (family Apiaceae)

#### *Relation to the host plant*

Vagrant on stems and leaves and fruits. No symptom was observed on the infested plants.

#### *Type locality*

Zoolesk village, Birjand, Iran. 32°42'26.24"N, 59°51'25.016"E, 2090 m above sea level; 20 August 2017, coll. Arash Honarmand.

#### *Type material*

Holotype: single female on a microscope slide (slide code: AH96-27-1); paratypes: 9 females (slide codes: AH96-27-2 to AH96-27-10) and one male (slide code: AH96-27-17) mounted on separate microscope slides.

*Other material*

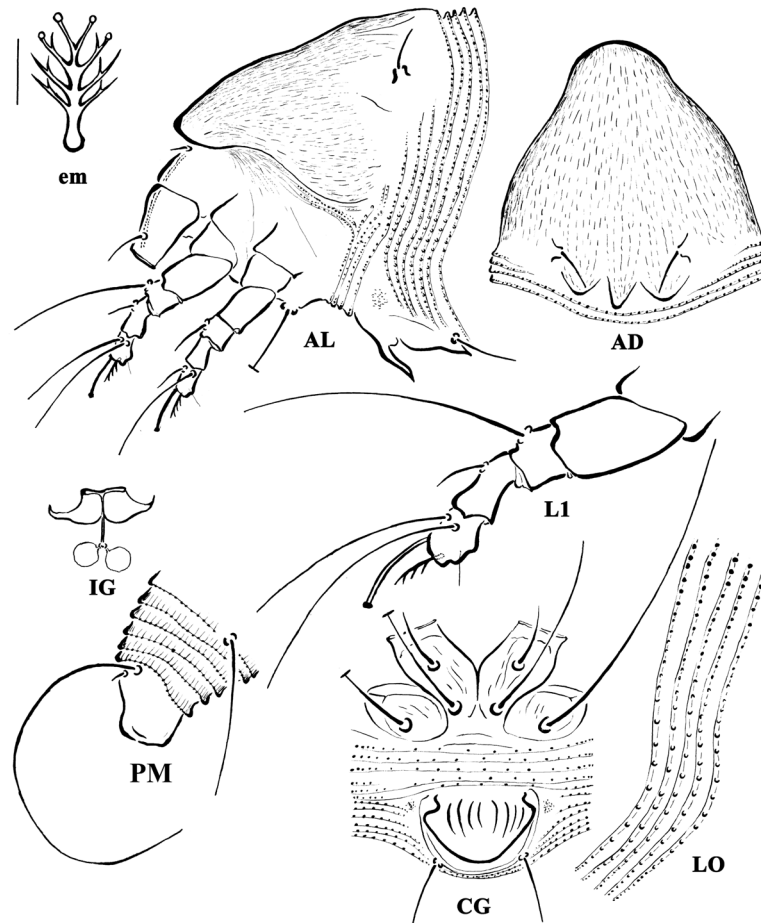
Mites extracted from the same sample as the type specimens were preserved in part in 70% ethanol and in part in Oudemans' solution.

*Etymology*

The specific epithet, *semenovis*, comes from the genus name of the host plant in the plural genitive case.

*Remarks*

This is the first report of an eriophyid mite in association with a plant of the genus *Semenovia*, and also the second report of species belonging to *Neophytoptus* genus.



**FIGURE 7.** Line drawings of *Neophytoptus semenovis* sp. nov.: AD. Prodorsal shield; AL. Lateral view of anterior body region; CG. Female coxigenital region; em. Empodium; IG. Internal female genitalia; LO. Lateral view of annuli; L1. Leg I; PM. Lateral view of posterior opisthosoma. Scale bar: 10  $\mu$ m for AD, AL, CG, IG, PM; 5  $\mu$ m for LO, L1; 2.5  $\mu$ m for em

*Differential diagnosis*

*Neophytoptus ocimae* Mohanasundaram, found on *Ocimum* sp. (Lamiaceae) from Tamil Nadu, India (Mohanasundaram 1981), was compared with *N. semenovis* **sp. nov.** showing some similarities including prodorsal shield ornamentation (median, admedian and submedian lines absent and ornamented several lines), empodium rays number (4), scapular setae *sc* length (7), tibial setae *l'* (about 4), number of dorsal semiannuli (59–66 in *N. semenovis* **sp. nov.** and 60 in *N. ocimae*) and ventral semiannuli (73–80 in *N. semenovis* **sp. nov.** and 82 in *N. ocimae*), and setae *3a* length (10–11 in *N. semenovis* **sp. nov.** and 12 in *N. ocimae*). The new species can be easily differentiated by leg ornamentation: both legs in *N. ocimae* are ornamented by longitudinal rib-like scoring on the contrary of the smooth legs in *N. semenovis* **sp. nov.** Other differences regard the length of setae *e* (13–15 in *N. semenovis* **sp. nov.** versus 20 in *N. ocimae*), setae *c2* (13–15 in *N. semenovis* **sp. nov.** versus 20 in *N. ocimae*) and setae *d* (50–58 in *N. semenovis* **sp. nov.** versus 25 in *N. ocimae*). Furthermore, 6–7 semiannuli are in the coxigenital region in new species on the contrary of 11 in *N. ocimae*, and the genital coverflap in *N. semenovis* **sp. nov.** is provided only with longitudinal striae, whereas *N. ocimae* shows also basal scorings. Based on these qualitative differences and a few others, the diagnosis of the genus can be revised as follows.

Body worm like, circular in cross section. Gnathosoma small, with short chelicerae; dorsal pedipalp genual setae prominent and unbranched; shield subtriangular, with anterior blunt and rounded frontal lobe overhanging gnathosomal base. Tubercles of the scapular setae *sc* a little ahead of rear shield margin, scapular setae *sc* pointing upward. Legs with all usual set of setae except for the femoral setae *bv*, absent in both legs; empodium simple. Opisthosoma arched with microtuberculated annuli, ventral semiannuli more numerous than dorsal semiannuli; set of setae on the opisthosoma according to Eriophyidae complete arrangement. Coxae broadly joined; all three setal tubercles present. External female genitalia away from coxal base; ornamented genital coverflap.

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