

Two new species of Eriophyidae (Acari: Trombidiformes: Eriophyoidea) on *Tilia begoniifolia* Steven (Tiliaceae) in Golestan province of Iran

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Abstract

Two new species belonging to the Eriophyidae were found on *Tilia begoniifolia* Steven in Golestan province of Iran, and are described and illustrated herein. *Eriophyes begoniifoliae* **sp. nov.** was associated to round galls protruded on both surfaces of the leaves. *Aculus namdari* **sp. nov.** was vagrant on the leaf undersurface and no damage was observed on the infested plants.

Keywords: *Aculus*, *Eriophyes*, alpha-taxonomy, lime tree, survey

Introduction

Six *Tilia* species have been recorded in Iran (Zare *et al.* 2012) among 30–40 species known in the world (Veličković 2010). The lime tree, *Tilia begoniifolia* Steven (Tiliaceae), locally named Namdar, is a woody plant distributed in the Hyrcanian forests of the northern slopes of Elburz Mountains in Iran (Zare *et al.* 2012).

About 40 name species of eriophyoid mites have been recorded from the family Tiliaceae in the World up to now (Amrine & Stasny 1994; Boczek & Szymkowiak 1997; Amrine & de Lillo unpublished database) and about 30 species are associated with *Tilia* species. Two thirds of them induce leaf galls or erineae and the remaining species are vagrants on leaves. To date, only *Eriophyes tiliae* (Pagenstecher, 1857) has been reported in Iran (Gol *et al.* 2015).

During a survey of eriophyoid mites in the Golestan province, mites were collected also from *T. begoniifolia* and two of them were identified as new species; they are described and illustrated herein.

Materials and methods

Leaf samples from *T. begoniifolia* were transported to the laboratory. *Aculus namdari* **sp. nov.** was collected from plant materials by direct inspection under a dissecting stereomicroscope. *Eriophyes begoniifoliae* **sp. nov.** was recovered from the vein angle galls using a fine needle. Samples of both specimens were preserved in vials containing Oudemans' fluid (Krantz & Walter 2009). *Eriophyes begoniifoliae* **sp. nov.** was cleared in lactic acid at room temperature and mounted on slides into Hoyer's medium according to Baker *et al.* (1996). No fiber was posed in the mounting medium

between the slide and coverslip. *Aculus namdari* **sp. nov.** was cleared and mounted in Keifer's media (Amrine & Manson 1996), adding kapok fibers into the mounting medium between the slide and coverslip according to de Lillo *et al.* (2010). Specimens of both species were examined under a phase contrast microscope (Olympus BX50, Tokyo, Japan) provided with a camera lucida.

Morphological terminology and setal notation follows Lindquist (1996). The generic classification and the abbreviations in figures follow Amrine *et al.* (2003). Measurements were taken according to Amrine and Manson (1996) as modified by de Lillo *et al.* (2010). Line drawings were handmade according to de Lillo *et al.* (2010). All measurements are given in micrometres (μm) and they refer to the holotype whereas range values in parentheses refer to the holotype and paratypes. Measurements and means (for few traits which are indicated by asterisks in the narrative description of the holotype) are rounded off to the nearest integer, referring to the length of the morphological traits unless otherwise specified.

Type materials are deposited in the collection of the Acarology Laboratory, Department of Plant Protection, Faculty of Agriculture, Ferdowsi University of Mashhad (FUM), Iran. Two paratypes of both 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), formerly indicated as UBI by Zhang (2018).

Results

Eriophyes begoniifoliae Sadeghi-Namaghi, Gol & de Lillo **sp. nov.**

(Fig. 1)

Description. FEMALE: (n = 10). Body fusiform, milky-white, 214 (157–214, including gnathosoma), 54 (49–56) wide, 52* (49–54) thick. **Gnathosoma** 25 (24–28) projecting obliquely down, palp coxal setae *ep* 2* (no range), dorsal palp genual setae *d* 4 (4–5), unbranched, cheliceral stylets 22 (22–26). **Prodorsal shield** 31 (27–31 including frontal lobe), 37 (35–38) wide; triangular frontal lobe, 5 (4–5), over gnathosomal base. Shield pattern composed of a complete pair of admedian lines forming a bottle-shaped figure, including two short V-shaped lines in the middle side, near rear shield margin; three submedian lines, first and second ones complete and converging posteriorly and anteriorly, third one short and outermost; median line absent. Tubercles of scapular setae *sc* on rear shield margin, 12 (11–12) apart, scapular setae *sc* 27 (27–29), projecting forward. **Leg I** 31 (29–32), femur 10 (9–11), genu 5 (4–5), tibia 7 (6–7), tarsus 8 (7–8), solenidion ω 8 (7–8) distally tapered, empodium simple, 4 (4–5), 4-rayed; femoral setae *bv* 9 (9–10), genual setae *l''* 20 (18–22), tibial setae *l'* 4 (3–4), tarsal setae *ft'* 10 (8–11), setae *ft''* 21 (19–22). **Leg II** 27 (27–28), femur 9 (9–10), genu 4 (no range), tibia 5 (no range), tarsus 7 (7–8), solenidion ω 8 (7–8) distally tapered, empodium simple, 4 (4–5), 4-rayed; femoral setae *bv* 9 (9–10), genual setae *l''* 12 (9–12), tarsal setae *ft'* 5 (4–5), setae *ft''* 22 (19–22). **Coxae** with sparse, short lines; setae *lb* 8 (7–9), tubercles *lb* 9 (8–9) apart, setae *la* 22 (20–27), tubercles *la* 7 (6–7) apart, setae *2a* 41 (38–42), tubercles *2a* 20 (20–21) apart. Prosternal apodeme 7 (6–7). **Opisthosoma** arched, dorsally with 56 (55–61) semiannuli, 57 (55–63) ventral semiannuli, 18 (17–19) smooth semiannuli between coxae and genital coverflap. Annuli with oval microtubercles close to posterior margins; last 17 (16–18) dorsal semiannuli smooth; last 5 (4–5) ventral semiannuli with elongated and linear microtubercles. Setae *c* 20 (17–22), on ventral semiannulus 9 (8–10); setae *d* 25 (24–28), on ventral semiannulus 20 (18–22); setae *e* 37 (37–40), on ventral semiannulus 34 (31–37); setae *f* 13 (12–14), on ventral semiannulus 52 (50–57), 5 (4–5) annuli after setae *f*. Setae *h* 1 2 (2–3), setae *h* 2 75 (69–77). **Genital coverflap** 11 (10–11), 19 (19–20) wide, with 8 (8–9) longitudinal striae, setae *3a* 15 (11–15), 13 (11–13) apart.

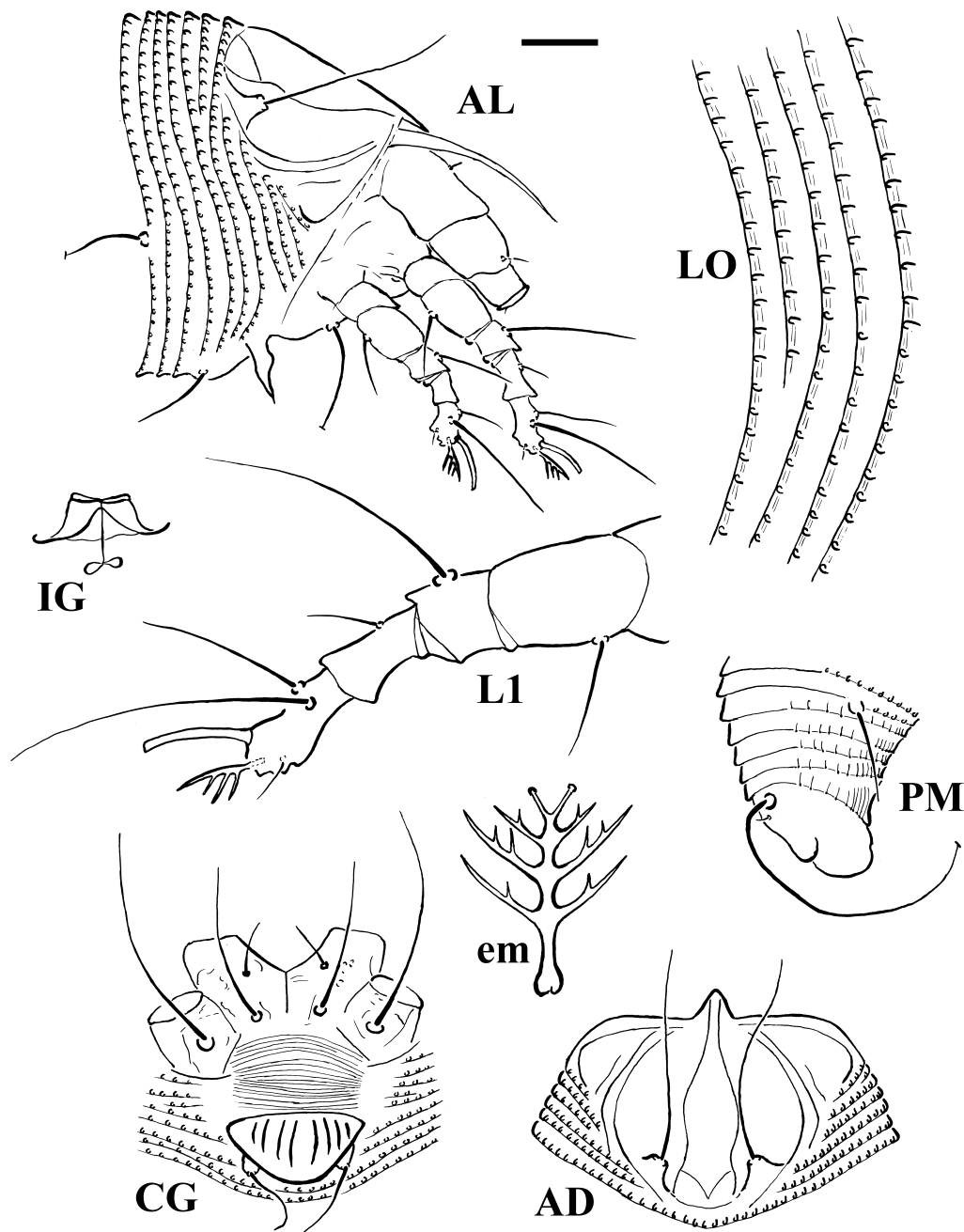


FIGURE 1. Line drawings of a female of *Eriophyes begoniifoliae* sp. nov.: **AD.** Prodorsal shield; **AL.** Lateral view of anterior body region; **CG.** Female coxigenital region; **em.** Empodium; **IG.** Internal genitalia; **LO.** Lateral view of annuli; **L1.** Leg I; **PM.** Lateral view of posterior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

MALE (n = 1). Body fusiform, 135 (including gnathosoma), 42 wide. **Gnathosoma** 21 projecting obliquely downwards, chelicerae 18, palp coxal setae *ep* 2, palp genual setae *d* 4, unbranched. **Prodorsal shield** 26, including frontal lobe, 32 wide, frontal lobe 4. Shield pattern similar to that of females. Tubercles of scapular setae *sc* on rear shield margin 11 apart, setae *sc* 17, projecting forward. **Leg I** 23, femur 8, genu 3, tibia 5, tarsus 6, solenidion ω 6 distally tapered,

empodium simple, 4, 4-rayed; femoral setae *bv* 6, genual setae *l''* 16, tibial setae *l' 3*, tarsal setae *ft' 6*, setae *ft'' 15*. **Leg II** 22, femur 7, genu 3, tibia 4, tarsus 6, solenidion ω 8 distally tapered, empodium simple, 4, 4-rayed; femoral setae *bv* 6, genual setae *l'' 5*, tarsal setae *ft' 4*, setae *ft'' 15*. **Coxae** with sparse, short lines; setae *lb* 5, tubercles *lb* 7 apart, setae *la* 15, tubercles *la* 5 apart, setae *2a* 27, tubercles *2a* 17 apart. Prosternal apodeme 5. **Opisthosoma** arched, with 53 dorsal semiannuli, 56 ventral semiannuli, 8 smooth semiannuli between coxae and genital region. Microtubercles similar to that of females; last 13 dorsal semiannuli smooth; last 5 ventral semiannuli with elongated and linear microtubercles. Setae *c2* 15, on ventral semiannulus 10; setae *d* 19, on ventral semiannulus 19; setae *e* 30, on ventral semiannulus 32; setae *f* 12, on ventral semiannulus 51, 5 annuli after setae *f*. Setae *h2* 43, Setae *h1* 2; setae *3a* 4, 11 apart.

Host plant. *Tilia begoniifolia* Steven (Tiliaceae), lime tree.

Relation to the host plant. Mites induce round galls on both surfaces of the leaves (Fig. 2)



FIGURE 2. Round galls on leaf of *Tilia begoniifolia* inhabited by *Eriophyes begoniifoliae* sp. nov.

Type locality. Ziarat Village, 36°44'56.2"N, 54°29'1.36"E, 800 m above sea level, 5 August 2017 and 25 July 2018; coll. A. Gol.

Material. Holotype: single female on a microscope slide (TIBE1708-1); paratypes: 10 females and 1 male mounted singly on separate microscope slides (TIBE1708-2 to TIBE1708-12).

Other material. Mites extracted from the same sample as the type specimens are preserved in Oudemans' solution.

Etymology. The specific epithet comes from the species name *begoniifolia* of the type host plant, in the genitive case.

Remarks and differential diagnosis. The new species here described was compared with the *Eriophyes* species associated with the family Tiliaceae and a few similarities were observed with *E. exilis* (Nalepa, 1892) (Nalepa 1892a, b) collected from *Tilia platyphyllos* Scop. in the Botanical Garden of the University of Warsaw, Poland (Soika & Kozak 2013). *Eriophyes exilis* was originally named (as *nomen nudum*) from mites found on leaf galls associated with *T. grandifolia* Ehrh., currently synonym of *T. platyphyllos* subsp. *cordifolia* (Besser) Schneid. (Nalepa 1891a). *Eriophyes begoniifoliae* **sp. nov.** is similar to *E. exilis* in having 4-rayed empodia and complete admedian lines, but differs in the main characters listed in Table 1.

TABLE 1. Main morphological differences between *Eriophyes begoniifoliae* Sadeghi-Namaghi, Gol & de Lillo **sp. nov.** and *Eriophyes exilis* (Nalepa, 1892).

Characters	<i>E. exilis</i> (Nalepa, 1892)	<i>E. begoniifoliae</i> Sadeghi-Namaghi, Gol & de Lillo sp. nov.
prodorsal shield pattern	median line incomplete submedian lines irregular in protogynes; submedian lines complete in deutogynes granules on lateral and posterior sides	median line absent first and second submedian lines complete no granules on lateral and posterior sides
Semiannuli between coxae and genital coverflap	10 (10–12) semiannuli with microtubercles in protogynes; 10–14 smooth semiannuli in deutogynes	18 (17–19) semiannuli with microtubercles
Coxal ornamentation	distinct dense dashes in protogynes; short lines in deutogynes	few short lines
Last dorsal semiannuli	with minute and barely visible microtubercles in protogynes; last 11 are smooth in deutogynes	last 17 (16–18) are smooth

Aculus namdari* Sadeghi-Namaghi, Gol & de Lillo **sp. nov.*

(Fig. 3)

Description. FEMALE: (n = 10). Body fusiform, light yellow, 210 (200–273, including gnathosoma), 65 (65–90) wide, 84* (83–88) thick. **Gnathosoma** 22 (22–27) projecting obliquely downwards, palp coxal setae *ep* 3 (3–4), dorsal palp genual setae *d* 8 (7–9), unbranched, cheliceral stylets 18 (17–25). **Prodorsal shield** 47 (46–54), including frontal lobe, 73* (70–80) wide; subtriangular frontal lobe with a thick and broad base, 8 (7–9), over gnathosomal base. Shield pattern of faint continuous and granulated lines: median line extending on posterior 2/3 of prodorsal shield; complete pair of admedian lines; complete first pair of submedian lines; an outer pair of submedian lines joint transversally the first pair of submedian, admedian and median lines on the anterior 1/3 of shield; a transverse line joints the admedian with the median line on the posterior 2/3 of shield; numerous sparse granules on shield. Tubercles of scapular setae *sc* on rear shield margin, 38 (34–50) apart, scapular setae *sc* 11 (11–17), directed divergently backward. **Leg I** 35 (32–37), femur 10 (10–12), genu 5 (5–6), tibia 11 (9–11), tarsus 7 (6–7), solenidion ω 5 (5–6) distally knobbed, empodium simple, 4 (4–5), 4-rayed; femoral setae *bv* 11 (10–12), genual setae *l''* 19 (19–25), tibial setae *l' 5* (4–5), tarsal setae *ft' 20* (17–20), setae *ft'' 23* (19–24). **Leg II** 33 (29–34), femur 10 (9–11), genu 5 (4–

5), tibia 9 (7–10), tarsus 7 (6–8), solenidion ω 7 (6–8) distally knobbed, empodium simple, 4 (4–5), 4-rayed; femoral setae *bv* 10 (9–11), genual setae *l''* 7 (6–8), tarsal setae *ft'* 4 (4–5), setae *ft''* 20 (17–23). **Coxae** with short lines; setae *lb* 9 (8–10), tubercles *lb* 12 (12–13) apart, setae *la* 25 (21–26), tubercles *la* 9 (8–10) apart, setae *2a* 42 (40–51), tubercles *2a* 26 (24–30) apart. Prosternal apodeme 8 (6–8). **Opisthosoma** arched, with 45 (42–46) dorsal semiannuli, with elongated and linear microtubercles, 76 (68–80) ventral semiannuli, with rounded and small microtubercles on their rear margin; 9 (9–10) semiannuli between coxae and genital coverflap; last 9 (8–10) ventral semiannuli with elongated and linear microtubercles. Setae *c2* 38 (31–40), on ventral semiannulus 16 (14–18); setae *d* 46 (46–68), on ventral semiannulus 31 (26–33); setae *e* 27 (22–30), on ventral semiannulus 52 (44–57); setae *f* 35 (32–42), on ventral semiannulus 72 (61–76), 4 (4–5) annuli after setae *f*. Setae *h1* 4 (3–4), setae *h2* 105 (72–118). **Genital coverflap** 15 (14–15), 23 (22–25) wide, with 12 (12–14) longitudinal striae, setae *3a* 40 (35–55), 15 (14–17) apart.

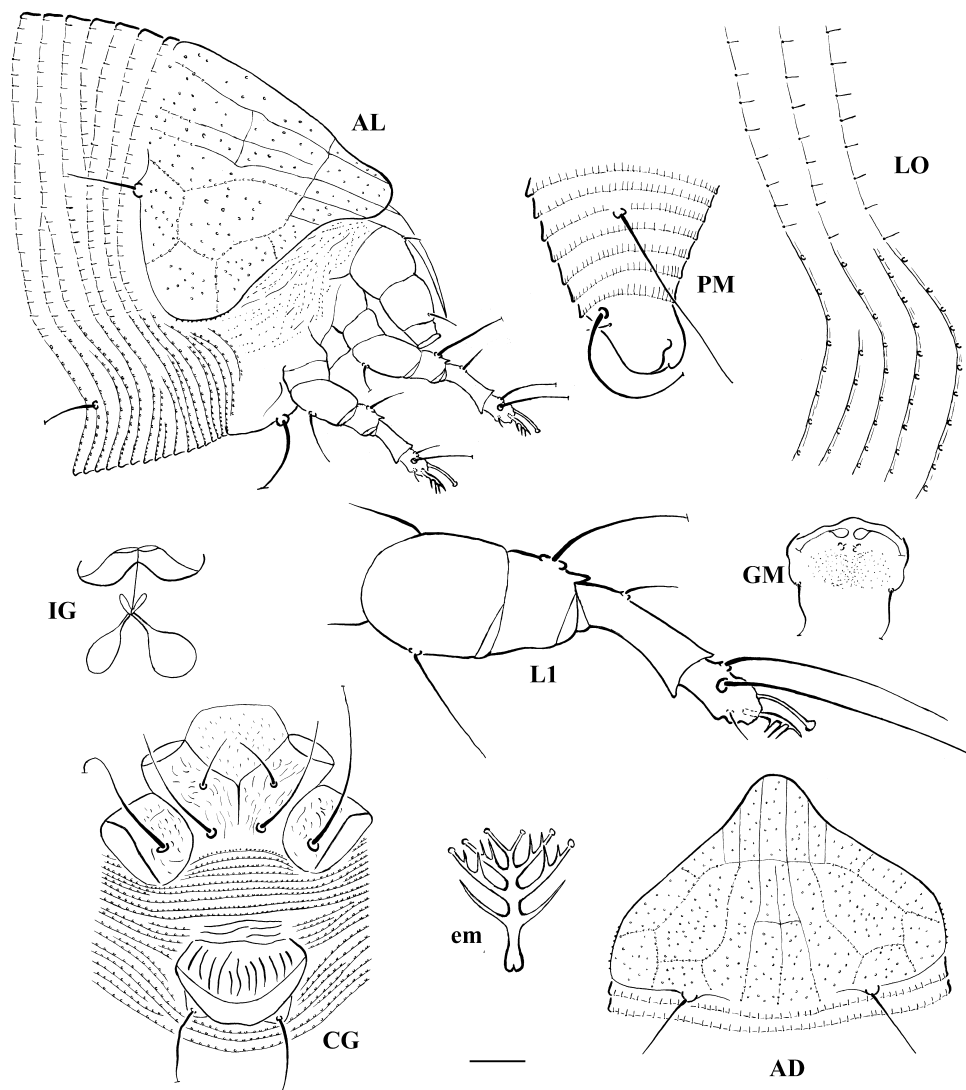


FIGURE 3. Line drawings of *Aculus namdari* sp. nov.: **AD**. Prodorsal shield; **AL**. Latero-dorsal view of anterior body region; **CG**. Female coxigenital region; **em**. Empodium; **GM**. Male genital region; **IG**. Internal female genitalia; **LO**. Lateral view of annuli; **L1**. Leg I; **PM**. Lateral view of posterior opisthosoma. Scale bar: 10 μ m for **AD**, **AL**, **CG**, **GM**, **IG**, **PM**; 5 μ m for **LO**, **L1**; 2.5 μ m for **em**.

MALE (n = 1). Body fusiform, 200 (including gnathosoma), 59 wide. **Gnathosoma** 21 projecting obliquely downwards, chelicerae 17, palp coxal setae *ep* 2, palp genual setae *d* 7, unbranched. **Prodorsal shield** 46, including frontal lobe, 63 wide, frontal lobe 6. Shield pattern similar to that of females. Tubercles of scapular setae *sc* on rear shield margin 39 apart, setae *sc* 13, directed posteriorly. **Leg I** 35, femur 12, genu 5, tibia 9, tarsus 7, solenidion ω 5 distally knobbed, empodium simple, 4, 4-rayed; femoral setae *bv* 10, genual setae *l''* 20, tibial setae *l'* 4, tarsal setae *ft'* 18, setae *ft''* 21. **Leg II** 30, femur 10, genu 4, tibia 8, tarsus 7, solenidion ω 5 distally knobbed, empodium simple, 4, 4-rayed; femoral setae *bv* 10, genual setae *l''* 6, tarsal setae *ft'* 5, setae *ft''* 20. **Coxae** with few short lines; setae *1b* 8, tubercles *1b* 8 apart, setae *1a* 25, tubercles *1a* 7 apart, setae *2a* 35, tubercles *2a* 24 apart. Prosternal apodeme 8. **Opisthosoma** arched, 42 dorsal semiannuli with elongated and linear microtubercles, 66 ventral semiannuli, 10 semiannuli between coxae and genital region. Microtubercles similar to those of females; last 9 ventral semiannuli with elongated and linear microtubercles. Setae *c2* 35, on ventral semiannulus 14; setae *d* 62, on ventral semiannulus 27; setae *e* 28, on ventral semiannulus 44; setae *f* 37, on ventral semiannulus 62, 4 annuli after setae *f*. Setae *h2* 81, Setae *h1* 3; setae *3a* 44, 17 apart.

Host plant. *Tilia begoniifolia* Steven (Tiliaceae), lime tree.

Relation to the host plant. Vagrant on the underside of the leaves. No symptoms were observed.

Type locality. Tuskestan Village, 36°46'19.44"N, 54°35'39.8"E, 754 m above sea level, 5 August 2017 and 25 July 2018; coll. A. Gol.

Material. Holotype: single female on a microscope slide (TIBE1807-1); paratypes: 15 females and 3 males mounted singly on separate microscope slides (TIBE1807-2 to (TIBE1807-19).

Other material. Mites extracted from the same sample as the type specimens are preserved in Oudemans' solution.

Etymology. The specific epithet comes from the Persian vernacular name, Namdar, given to *T. begoniifolia*.

Remarks and differential diagnosis. The new species is close to *Aculus ballei* (Nalepa, 1891b) described from leaves of *T. platyphyllos* (Nalepa 1891b, 1897). The new species differs from *A. ballei* in the main characters listed in Table 2.

TABLE 2. Main morphological differences between *Aculus namdari* Sadeghi-Namaghi, Gol & de Lillo **sp. nov.** and *Aculus ballei* (Nalepa, 1891b).

Characters	<i>A. ballei</i> (Nalepa, 1891b)	<i>A. namdari</i> Sadeghi-Namaghi, Gol & de Lillo sp. nov.
Prodorsal shield	admedian lines complete	median, admedian and submedian lines continuous and granulated
	no granules	numerous sparse granules
	two distinct spines on the frontal lobe projecting forward	no spine
Dorsal semiannuli	smooth	with elongated and linear microtubercles
Semiannuli between coxae and genital coverflap	smooth	with small and rounded microtubercles

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