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Article

Redescription of *Aceria varia* and *Tegoprionus dentatus* (Trombidiformes: Eriophyoidea: Eriophyidae) from Iran

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ABSTRACT
This paper describes two eriophyid species, poorly detailed in the past, which have been found for the first time in Iran. *Aceria varia* (Nalepa) (Eriophyinae: Acerini) was collected on *Populus alba* L. (Salicaceae) and *Tegoprionus dentatus* (Nalepa) (Phyllocoptinae: Anthocoptini) on *Galium aparine* L. (Rubiaceae) in Miandoab region of West Azerbaijan province (Iran). More information about the type host plants, other hosts and habitus of five *Aceria* species associated with *P. alba* and a gross comparison of some traits among *Tegoprionus* species known worldwide are provided.

KEY WORDS: Miandoab; Rubiaceae; Salicaceae; Taxonomy; West Azerbaijan.

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INTRODUCTION

About 144 eriophyoid species have been reported on plants of the family Salicaceae including 23 *Aceria* species (Amrine and de Lillo unpublished database). Two species of this latter genus were recorded from Iran: *Aceria parapopuli* (Keifer) from *Populus alba* L., *P. fremontii* S. Wats. and *P. nigra* L. in some parts of Iran, especially in Khorasan Razavi province; *Aceria zanjani* Flechtmann, Tarasi & Saboori from *Populus nigra* L. in Zanjan province (Sepasgozarian 1973; Flechtmann *et al.* 2003; Kamali and Amrine 2005; Shibani Fahandi *et al.* 2011).

Also about 120 eriophyoid species have been associated to plants of the family Rubiaceae (Amrine and de Lillo unpublished database) which three of them were found in Iran including *Leipothrix retidorsi* Lotfollahi, Haddad Irani-Nejad & de Lillo and *Aculops rubitinctus* Lotfollahi, Haddad & de Lillo from *Rubia tinctorum* L. in Azarshahr region of East Azerbaijan province, and *Tetra aparinea* Kamali, Doryanizadeh & Akrami from *Galium aparine* L. in Bajgah region of Fars province (Lotfollahi *et al*. 2014; Kamali *et al*. 2018). In a survey of the Miandoab region, old described species were collected and appear to be the new records to Iranian fauna. Considering the need of respecting the current descriptive standards, *Aceria varia* (Nalepa) and *Tegoprionus dentatus*

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(Nalepa) were illustrated and redescribed based on Iranian specimens. In addition, more information has been provided about the worldwide species known in *Aceria*, recorded on *P. alba*, and in *Tegoprionus*.

MATERIAL AND METHODS

In order to study the eriophyoid mites of Miandoab region, plant sampling was done in West Azerbaijan province of Iran. Eriophyoid mites were recovered in the laboratory from the sampled plant material by means of a modified washing method developed by Monfreda *et al.* (2007). The mites were slide mounted according to Baker *et al*. (1996) with some changes: specimens were directly placed in modified Hoyer's medium, without previous clarification. Next, specimens were clarified at 90 °C for some minutes. Then, slides were dried for about four weeks at 47 °C. The terminology and the setal notation in the morphological description of the mites follow mainly Lindquist (1996) with the exception of the internal female genital apparatus whose terminology follows Chetverikov (2014) and Chetverikov *et al*. (2014). All morphological measurements were taken by means of a phase-contrast microscope Olympus BX53, × 1,000 magnification (in immersion oil), according to Amrine and Manson (1996) as modified by de Lillo *et al.* (2010). Slight clarifications should be added as it follows: dorsal semiannuli were counted from the first semiannulus behind the rear margin of the prodorsal shield; ventral semiannuli were counted from first complete annulus after coxae II; coxigenital semiannuli were counted medially from the coxal region to the anterior margin of the external genitalia and were not included in the ventral semiannuli count. Measurements and means are rounded off to the nearest integer when required. Measurements refer to the length of the morphological characters unless otherwise specified and are given in micrometers. In the description of the female, male and immature stages, the range values are given. Line drawings were hand-drawn through a *camera lucida* according to de Lillo *et al*. (2010) and the schematic drawings were labeled following Amrine *et al.* (2003). Host plant names and their synonymies are in accordance with *"The Plant List on-line database"* (2013).

Slides are deposited at the Acarology Laboratory, Department of Plant Protection, Faculty of Agriculture, Azarbaijan Shahid Madani University, Tabriz (Iran).

Family Eriophyidae
Subfamily Eriophyinae
Tribe Acerini

Aceria varia (Nalepa, 1892) (Fig. 1)

Female (measured specimens n = 10)

Body vermiform, 177–205 (excluding gnathosoma), 35–38 thick, 33–37 wide. **Gnathosoma** projecting obliquely downwards, chelicerae 17–22, palp 19–25, palp coxal setae *ep* 2, dorsal palp genual setae *d* 5–6, unbranched. **Prodorsal shield** 25–28 including frontal lobe, 29–34 wide, sub-circular; with a flexible distally pointed or rounded frontal lobe, 5–7, over gnathosomal base. Shield pattern distinct, consisting of short median line at the basal third of shield, complete admedian lines, short first submedian lines on anterior half of the shield, quite complete second submedian lines bent laterally on its anterior half and numerous short lines on the outer side of the shield. Tubercles of scapular setae *sc* on rear shield margin, 15–18 apart, setae *sc* 31–35, directed divergent posteriorly. **Legs** with all usual segments and setae. Leg I 27–30, trochanter 5–8, femur 9–11, genu 5–7, tibia 5–7, tarsus 6–8, tarsal solenidion *ω* 6–7 distally enlarged and tapered, empodium simple, 5–7, 5-rayed; femoral setae *bv* 7–10, genual setae *l″* 18–21, paraxial tibial setae *l′* 5–7, located in basal third of tibia,

paraxial fastigial tarsal setae *ft'* 10–14, antaxial fastigial tarsal setae *ft"* 18–22, paraxial unguinal tarsal setae *u'* 2–3. Leg II 25–28, trochanter 5–7, femur 10–12, genu 5–6, tibia 4–7, tarsus 5–7, tarsal solenidion *ω* 7–9 distally tapered, empodium simple, 5–7, 5-rayed; femoral setae *bv* 6–9, genual setae *l"* 6–10, paraxial fastigial tarsal setae *ft'* 5–6, antaxial fastigial tarsal setae *ft"* 21–24, paraxial unguinal tarsal setae *u'* 2–3. **Coxisternal region.** Prosternal apodeme 6–9, anterior setae on coxisternum I *1b* 5–7, 8–11 apart; proximal setae on coxisternum I *1a* 13–17, 8–10 apart; proximal setae on coxisternum II *2a* 31–37, 18–20 apart; 8–9 microtuberculated semiannuli between coxae and genital coverflap plus 2–3 transversal rows of lined granules at the base of the coverflap. Coxae with distinct granules. **External genitalia** 10–11, 18–21 wide, coverflap with 14–15 longitudinal ridges; setae *3a* 15–19, 13–15 apart. **Internal genitalia:** spermathecae relatively big, ovoid, oriented postero-laterad; spermathecal tubes relatively short; transverse genital apodeme trapezoidal, distally folded. **Opisthosoma** dorsally arched, with 73–86 dorsal semiannuli, 64–80 ventral semiannuli. **Microtubercles:** circular, spiny on rear margin of last 4 dorsal semiannuli, elongated and linear on last 5 ventral semiannuli. Setae *c2* 21–24 on ventral semiannulus 12–14, setae *d* 46–60 on ventral semiannulus 24–27; setae *e* 15–17 on ventral semiannulus 39–45; setae *f* 20–24 on ventral semiannulus 59–71; 5 annuli posterior to setae *f*. Setae *h2* 89–108 apically very fine, *h1* 9–10.

Male (measured specimen n = 1)

Similar in shape and prodorsal shield arrangement to female. Body smaller than female, 143, 32 wide; palp genual setae *d* 5; prodorsal shield 26, 29 wide; setae *sc* 26, 29 apart. Opisthosoma with 79 dorsal semiannuli and 69 ventral semiannuli; 11 semiannuli between coxae and genitalia, with microtubercles similar to those of female. Setae: *1b* 5, *1a* 9, *2a* 30, *c2* 24, *d* 45, *e* 15, *f* 15, *h1* 8, *h2* 76. Male genitalia 10 wide, setae *3a* 15, 14 apart.

Nymph (measured specimens n= 3)

Body vermiform, 128–141 (excluding gnathosoma), 32 wide, 29–31 thick; palp genual setae *d* 4. Prodorsal shield 21–23 including frontal lobe, 28 wide. Tubercles of *sc* setae on rear shield margin, 18 apart, setae *sc* 22–24, directed posterior. Opisthosoma with 72–76 dorsal and 60–62 ventral semiannuli, circular microtubercles set on rear part of semiannuli. Setae: *1b* 3–5, *1a* 7–9, *2a* 16–20, *c2* 10–13, *d* 24–30, *e* 11–12, *f* 13–16, *h2* 99–114, *h1* 5–8. Setae *3a* 7–10, 7 apart on semiannulus 11 after coxae.

Type host plant

Populus tremula L. (Salicaceae), European Aspen.

Type locality

Lorraine, France.

Relation to the host plant

Causing spots on leaves which were silver-red at first and later brown; causing erinea on the undersurface of the leaves, with or without slight bulges on the opposite side of the lamina (Boczek 1969).

Material examined

2 females and 2 males, mounted singly on separate microscope slides (PA-IWA-OK17M-1-4), from *P. alba* in Ozmanake Sofla village (36° 95' 50.5" N, 46° 05' 39.3" E, 1353.3 m above sea level) on 1 July 2017; 25 females, 7 males and 7 nymphs mounted singly on separate microscope slides (PA-IWA-UD17M-1-39) from *P. alba* in Uch Tappeh Kord village (37° 01' 91.1" N, 46° 01' 28.0" E, 1250.5 m above sea level) on 2 July 2017; Miandoab region, West Azerbaijan province, Iran, coll. H. Mehri-Heyran.

Other material

Mites preserved in Oudemans' fluid (Walter and Krantz 2009) (vials coded PA-IWA-OK17M; PA-IWA-UD17M) as extracted from the same samples like the examined specimens.

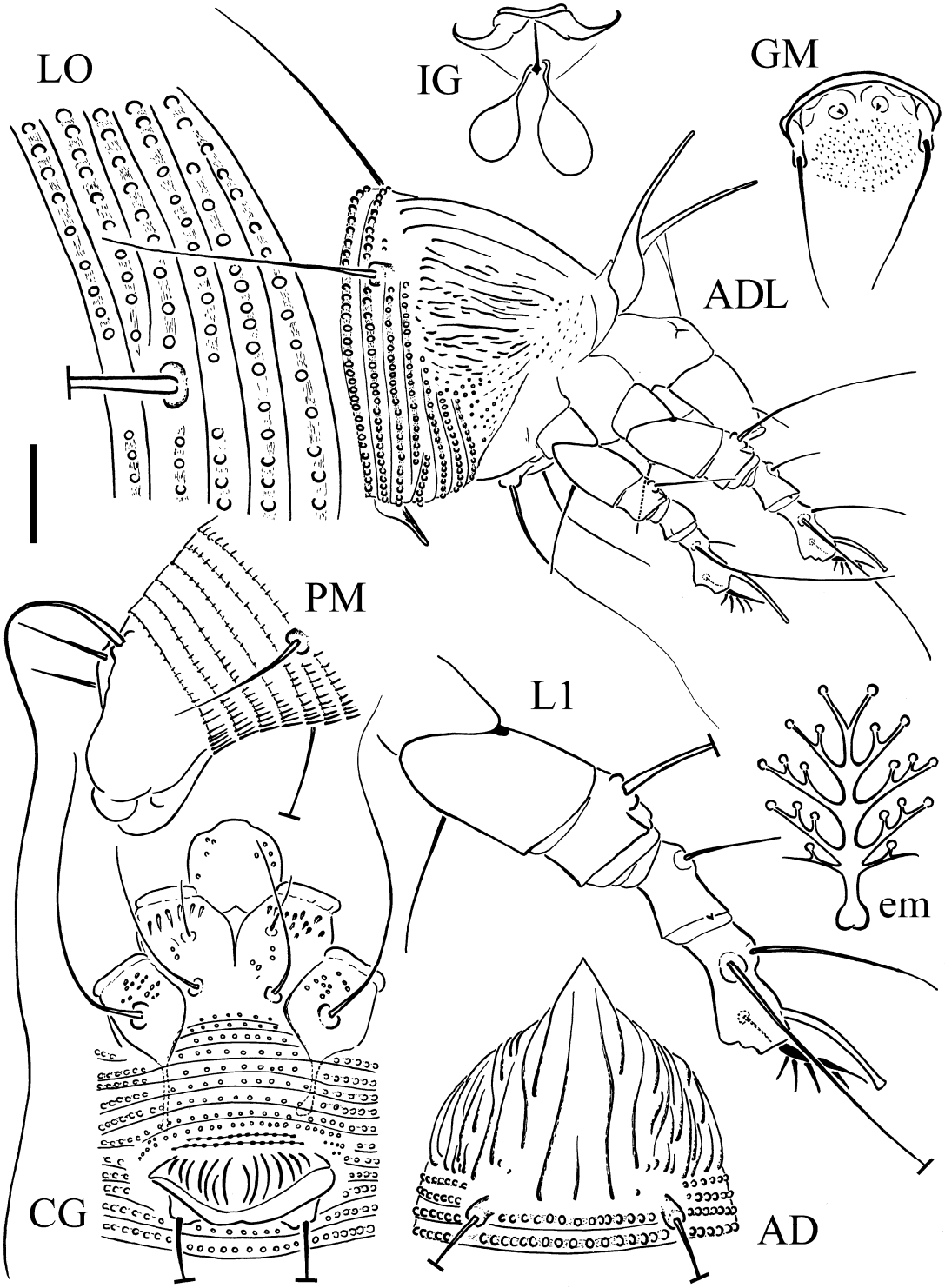

Figure 1. Schematic drawings of *Aceria varia* (Nalepa) – **AD.** Prodorsal shield; **ADL**. Latero-dorsal view of anterior body region of a female; **CG.** Female coxigenital region; **em.** Empodium; **GM.** Male genital region; **IG.** Internal female genitalia; **LO**. Lateral view of annuli; **L1**. Leg I; **PM.** Lateral view of posterior opisthosoma. Scale bar: 10 µm for **AD**, **AL**, **CG**, **GM**, **IG**, **PM**; 5 µm for **LO**, **L1**; 2.5 µm for **em.**

Remarks

Until now five *Aceria* species have been recorded on *P. alba* (Table 1). Apart *A. parapopuli*, the descriptions of the other species appear to be not consistent with the current descriptive standard (de Lillo *et al.* 2010). The prodorsal shield ornamentation of Iranian specimens is closer to *A. varia* according to the drawing by Nalepa (1892) and Boczek (1969). The main differences between the Iranian specimens and Nalepa's (1892) description regards the shape of the frontal lobe (evident in the Iranian specimens and neglected in the given descriptions, but the previous authors might have not seen the lobe due to the less sharpening of the available instruments) and the length of setae *e* (as long as setae *d* in the original description but in the Iranian specimens setae *d* is longer (46–60) than setae *e* (15–17)). Iranian specimens have been found vagrants on the *P. alba* leaves, while *A. varia* causes erinea on the undersurface of the leaves and bulges on the opposite side of the lamina on *P. tremula* according to Boczek (1969), whereas it is related to felty silver surface on the underside of the leaves of *P. alba* in Poland (Szulc 1966). Therefore, in absence of further data and with the will to be quite conservative, the Iranian specimens were redescribed as *A. varia* according to the observed similarities with the previously described species.

Table 1. *Aceria* mite species collected on *Populus alba* L. worldwide and their type host, alternative hosts and habitus (according to Amrine and de Lillo, unpublished database).

Species	Type host plant	Alternative hosts	Plant-mite relationships
***A. dispar* (Nalepa)**	*P. tremula*	*P. alba*, *P. nigra* var. *italica* Münchh., *P. nigra* L., *Populus* sp., *P. tomentosa* Carrière	Rolling both sides of young leaves upwards towards midrib; often involving many leaves which are small, distorted and remain bunched together
***A. parapopuli* (Keifer)**	*Populus* sp.	*P. alba* and many *Populus* spp.	Causing irregular woody proliferation around buds, eventually hindering growth; the galls may be one inch or more in diameter during in several years
***A. populi* (Nalepa)**	*P. nigra*	*P. alba* (many reports) and many *Populus* spp.	Causing irregular, warty, cauliflower-like growth, usually more than 10 mm in diameter; soft and downy at first, grey, yellow or reddish, later woody without internal chamber
***A. populicanescentis* Roivainen**	*P. canescens* Smith	*P. alba* [recorded only by Farkas (1966)]	Vagrant
***A. varia* (Nalepa)**	*P. tremula*	*P. alba*, *Populus* sp.	Causing erinea on the undersurface of the leaves

Subfamily Phyllocoptinae
Tribe Anthocoptini

Tegoprionus dentatus (Nalepa, 1891) (Fig. 2)

Female (measured specimens n = 6)

Body fusiform, 212–223 (excluding gnathosoma), 57–59 thick, 45–48 wide. **Gnathosoma** projecting obliquely downwards, chelicerae 18–20, palp 21–27, palp coxal setae *ep* 3–4, dorsal palp genual setae *d* 6–8, unbranched. **Prodorsal shield** 42–53 including frontal lobe, 47–49 wide, subtriangular; with a broad-based frontal lobe, 9–12, over gnathosomal base; frontal lobe ending with one pointed protuberance. Shield pattern distinct, with a pair of complete admedian lines joined by a transverse line at about their middle length, a pair of arched submedian lines joined to admedians; numerous disperse granules on each lateral side of prodorsal shield. Tubercles of scapular setae *sc* on rear shield margin, 30–31 apart, setae *sc* 17–21, directed posteriorly. **Legs** with all usual segments

and setae. Leg I 34–38, trochanter 7–9, femur 12–14, genu 6–78, tibia 9–11, tarsus 9–10, tarsal solenidion *ω* 7–8 distally enlarged and tapered, empodium simple, 6–7, 4-rayed; femoral setae *bv* 10–16, genual setae *l″* 19–22, paraxial tibial setae *l′* 5–7, located in basal third of tibia, paraxial fastigial tarsal setae *ft*' 19–22, antaxial fastigial tarsal setae *ft″* 22–25, paraxial unguinal tarsal setae *u′* 5–5. Leg II 33–36, trochanter 7–8, femur 12–14, genu 6–8, tibia 8–9, tarsus 7–9, tarsal solenidion *ω* 7–8 distally tapered, empodium simple, 5–6, 4-rayed; femoral setae *bv* 11–13, genual setae *l″* 7–11, paraxial fastigial tarsal setae *ft′* 5–8, antaxial fastigial tarsal setae *ft*" 21–25, paraxial unguinal tarsal setae *u′* 4–6. **Coxisternal region.** Prosternal apodeme 8–9, anterior setae on coxisternum I *1b* 9–10, 12–13 apart; proximal setae on coxisternum I *1a* 21–27, 10–11 apart; proximal setae on coxisternum II *2a* 44–52, 27 apart; 6 microtuberculated semiannuli between coxae and genital coverflap plus 1–2 transversal rows of lined granules at the base of the coverflap. Coxae I with coarse dots, coxae II smooth. **External genitalia** 15–18, 21–22 wide, coverflap with 12 longitudinal striae; setae *3a* 15–18, 13–15 apart. **Internal genitalia:** spermathecae ovoid, oriented laterad; spermathecal tubes relatively short; transverse genital apodeme trapezoidal, distally folded. **Opisthosoma** with 19–22 dorsal semiannuli, first 2 dorsal semiannuli dorsally arched, remained dorsal semiannuli irregularly bearing a wide central lobe projecting dorsally, a pair of distinct lateral ridges extended for the whole opisthosomal length; 66–74 ventral semiannuli, three simple annuli before the anal lobes. **Microtubercles:** dorsal semiannuli smooth except of lateral ridges that are ornamented with elliptical microtubercles, the last 3 dorsal semiannuli with spiny microtubercles; ventral semiannuli with circular microtubercles equipped with very short spines, last 5 ventral semiannuli with elongated and linear microtubercles. Setae *c2* 11–13 on ventral semiannulus 12–13, setae *d* 49–59 on ventral semiannulus 25–28; setae *e* 13–17 on ventral semiannulus 41–46; setae *f* 21–26 on ventral semiannulus 61–69; 5 annuli posterior to setae *f*. Setae *h2* 52–58 apically very fine, *h1* 4.

Male (measured specimen n = 1)

Similar in shape and prodorsal shield arrangement to female. Body smaller than that of female, 145, 40 thick; palp genual setae *d* 6; prodorsal shield 40; setae *sc* 15, 23 apart. Opisthosoma with 20 dorsal semiannuli and 56 ventral semiannuli, 8 semiannuli between coxae and genitalia, with microtubercles similar to those of female. Setae: *1b* 8, *1a* 19, *2a* 32, *c2* 13, *d* 35, *e* 12, *f* 20, *h1* 5, *h2* 55. Male genitalia 15 wide, setae *3a* 16, 12 apart.

Type host plant

Galium verum L. (Rubiaceae), Yellow Bedstraw, Anise, Our-Lady's Bedstraw.

Type locality

Not stated by the author, Austria is presumed.

Relation to the host plant

Vagrant; leaf deformations have been reported, too.

Material examined

13 females and 1 male mounted singly on separate microscope slides (GA-IWA-OA17M-1-14) from *G. aparine* in Ozmanake Sofla village (37° 01' 91.1" N, 46° 01' 28.0" E, 1250.5 m above sea level) on 2 July 2017, Miandoab region, West Azerbaijan province, Iran, coll. H. Mehri-Heyran.

Other material

Mites preserved in Oudemans' fluid (Walter and Krantz 2009) (vial coded GA-IWA-OA17M) as extracted from the same sample like the examined specimens.

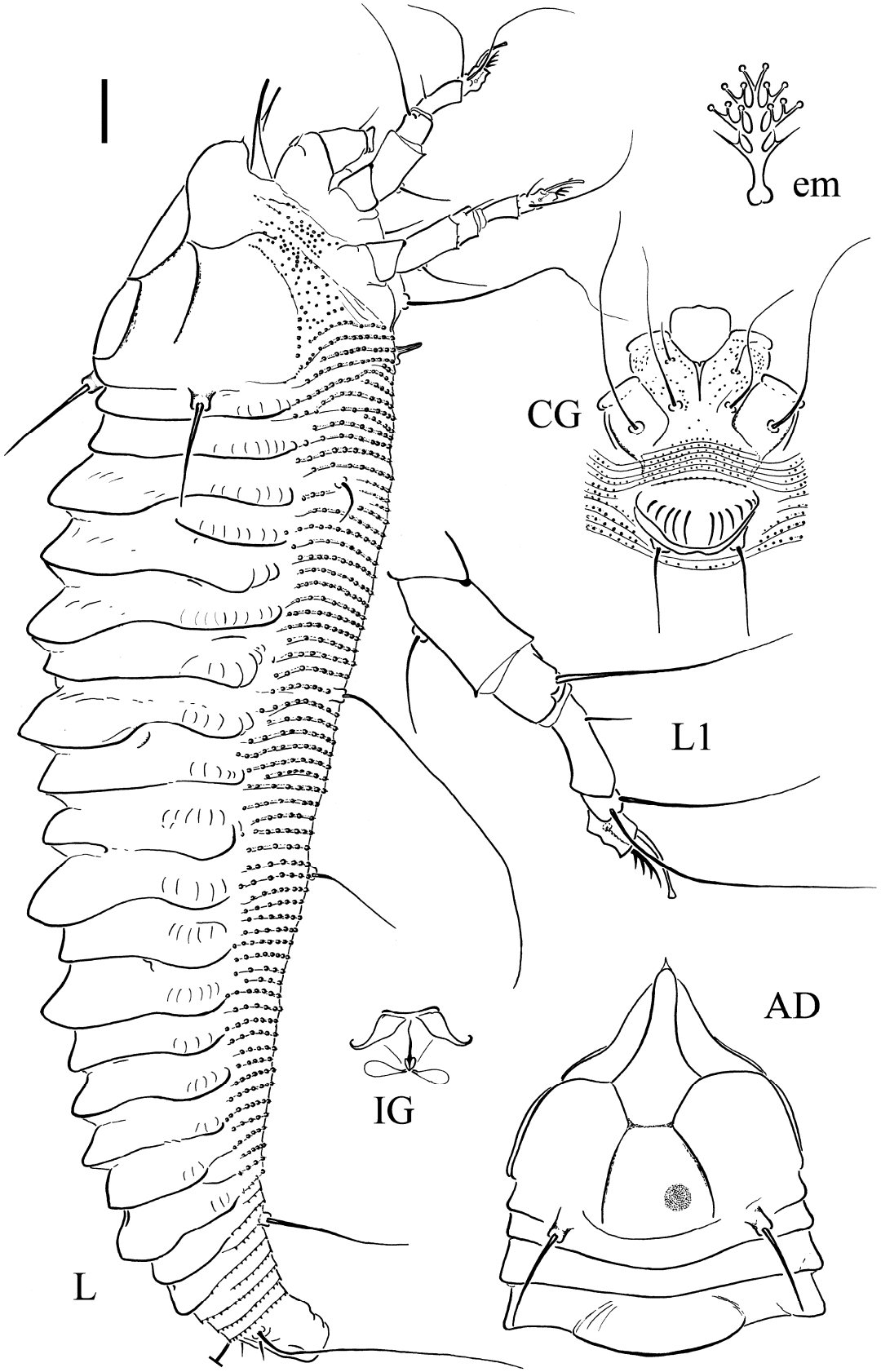

Figure 2. Schematic drawings of *Tegoprionus dentatus* (Nalepa) – **AD.** Prodorsal shield; **CG.** Female coxigenital region; **em.** Empodium; **IG.** Internal female genitalia; **L.** Lateral view (the specimen was little rounded on its longitudinal axis); **L1**. Leg I. Scale bar: 10 µm for **AD**, **CG**, **GM**, **IG**, **L**; 5 µm for **L1**; 2.5 µm for **em.**

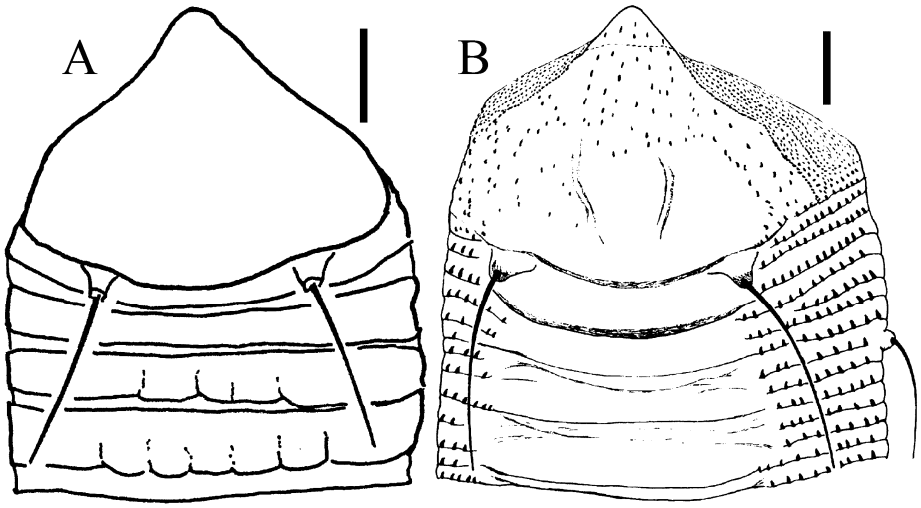

Figure 3. Schematic drawings of the prodorsal shield – A. *Tegoprionus mesogibbosus* Flechtmann & Amrine (redrawn from Flechtmann and Amrine 2014); B. *Tegoprionus alobus* Duarte, Chetverikov & Navia (from Duarte *et al*. 2016). Scale bar: 10 µm.

Table 2. Gross comparison of some traits among *Tegoprionus* species found worldwide.

Morphological details	***T. dentatus* (Nalepa)**	***T. mesogibbosus* Flechtmann & Amrine**	***T. alobus* Duarte, Chetverikov & Navia**
Number of dorsal semiannuli	19–22	18 (17–18)	19 (17–23)
Number of ventral semiannuli	66–74	56 (49–56)	59 (59–66)
Number of dorsal semiannuli with a wide central lobe	Dorsal semiannuli 3–19 irregularly bearing 8–9 wide central lobe	Contiguous dorsal semiannuli 8–11 or 9–12 with 4 wide central lobe	None
Lateral ridges	Continuous on all dorsal semiannuli	Not expressed	Not expressed
Number of semiannuli between coxae and female coverflap	6	5 (4–5)	4 (3–5)
Rows of lined granules at the base of the coverflap	2	–	2–3
Number of empodium rays	4	6	4
Setae *sc* length	17–21	19 (19–20)	27 (22–27)
Setae *c2* length	11–13	11 (10–12)	20 (14–22)
Setae *d* length	49–59	22 (22–27)	51 (41–51)
Setae *e* length	13–17	9 (9–11)	12 (7–12)
Setae *f* length	21–26	18 (18–20)	20 (17–20)
Setae *h1* length	4	2 (2–3)	2 (2–3)
Genitalia length	15–18	7 (7–12)	15 (14–16)
Genitalia width	21–22	17 (17–19)	20 (17–20)
Number of longitudinal striae on genitalia coverflap	12	8 (8–10)	10 (10–13)
Setae *3a* length	15–18	32 (32–36)	20 (16–20)

Remarks

The genus *Tegoprionus* Keifer is provided with dorsal semiannuli irregularly bearing wide

central lobes. Each dorsal semiannulus covers 3–4 ventral semiannuli. Until now three *Tegoprionus* species are known worldwide: *Tegoprionus dentatus* (Nalepa); *Tegoprionus mesogibbosus* Flechtmann & Amrine, vagrant on the leaf undersurface of *Inga sessilis* (Vell.) Mart. (Leguminosae) not causing visible symptoms, collected in the Botanical garden of Curitiba, Paraná, Brazil; *Tegoprionus alobus* Duarte, Chetverikov & Navia, vagrant on the leaf undersurface of *Lippia alba* (Mill.) N.E. Brown (Verbenaceae) presumably associated with chlorotic spots, collected in Brasília, Federal District, Brazil (Table 2).

The prodorsal shield of *T. mesogibbosus* is smooth (Fig. 3A; Flechtmann and Amrine 2014), while the prodorsal shield of *T. alobus* is provided only with faint admedian lines on the posterior half of the shield, and with rows of granules or small dashes on the anterior third of the shield and its lateral sides (Fig. 3B; Duarte *et al*. 2016). On the contrary, the prodorsal shield of *T. dentatus* has distinct lines (Fig. 2).

No opisthosomal lateral ridges were described on the dorsal opisthosoma of *T. mesogibbosus* and *T. alobus* and in the original description of *T. dentatus*. Vice versa, the Iranian specimens of *T. dentatus* have a pair of distinct lateral ridges extended for the whole opisthosomal length. This difference could depend on the fact that the Iranian specimens were not flattened in the mounting medium.

In addition to the differences mentioned above, a gross comparison of some traits among *Tegoprionus* species found worldwide is available in the Table 2.

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بازتوصیف *Aceria varia* و *Tegoprionus dentatus* (Trombidiformes: Eriophyoidea: Eriophyidae) از ایران

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چکیده

این مقاله دو گونه اریوفید را توصیف می‌کند که در گذشته جزئیات کمی در مورد آن‌ها آمده است و برای نخستین بار از ایران گزارش می‌شوند. گونهٔ *Aceria varia* (Nalepa) (Eriophyinae: Acerini) از روی *Populus alba* L. (Salicaceae) و گونهٔ *Tegoprionus dentatus* (Nalepa) (Phyllocoptinae: Anthocoptini) از روی *Galium aparine* L. (Rubiaceae) در ناحیهٔ میاندوآب استان آذربایجان غربی (ایران) جمع‌آوری شد. افزون بر این، اطلاعات بیشتری در ارتباط با گیاه میزبان تیپ گونه، دیگر میزبان‌ها و ارتباط با گیاه میزبان در مورد پنج گونهٔ *Aceria* مرتبط با *P. alba* و یک مقایسه چند صفتی بین تمامی گونه‌های شناخته شده از جنس *Tegoprionus* در جهان آورده شده است.

واژگان کلیدی: میاندوآب؛ Rubiaceae؛ Salicaceae؛ آرایه‌شناسی؛ آذربایجان غربی.

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