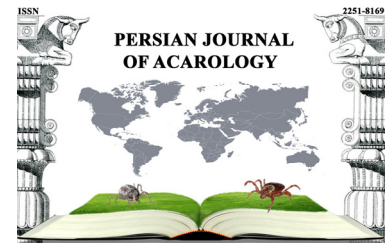




Persian J. Acarol., 2020, Vol. 9, No. 2, pp. 161–171.
<http://dx.doi.org/10.22073/pja.v9i2.59382>
Journal homepage: <http://www.biotaxa.org/pja>



Article

Eriophyoid (Trombidiformes: Eriophyoidea) mite fauna of Miandoab region in Iran with redescription of *Aceria kiefferi* (Nalepa)

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ABSTRACT

During the study of the eriophyoid mite fauna of Miandoab region (West Azerbaijan province, Iran), specimens of two eriophyoid families, four subfamilies, four tribes, 11 genera and 19 species were collected and identified. Among them, three species including *Aceria kiefferi* (Nalepa), *Phyllocoptes bilobospinosus* Chetverikov and *Diptacus gigantorhynchus* (Nalepa) were recorded for the first time in Iran. The most abundant species was *Acalitus phloeocoptes* (Nalepa) and six other species including *Aceria* cf. *tosichella* Keifer, *A. anthocoptes* (Nalepa), *Calepitrimerus baileyi* Keifer, *Aculus fockeui* (Nalepa & Trouessart), *Abacarus* cf. *hystrix* (Nalepa) and *Rhynophytoptus nemalobos* Lotfollahi & de Lillo were abundant species in the surveyed region. The old species, *A. kiefferi* is redescribed and illustrated herein, according to the current standard, due to the poor details of the previous old descriptions.

KEY WORDS: Abundant species; *Aceria kiefferi*; Diptilomiopidae; Eriophyidae; redescription; survey; West Azerbaijan.

PAPER INFO.: Received: 23 January 2020, Accepted: 17 February 2020, Published: 15 April 2020

INTRODUCTION

Mites of the superfamily Eriophyoidea have high economic importance and host specialization (Walter *et al.* 2009; de Lillo *et al.* 2018). These mites may be plant pests, vectors of plant pathogens, weed biological control agents, and food sources for predators. In some cases, the induced deformations provide sites to overwintering, egg laying, and provide preys for growing also dense populations of natural enemies (Skoracka and Kuczyński 2003, 2006; Graham 2004; Mitsuhiro and Hiroshi 2004).

Miandoab is one of the southern regions of West Azerbaijan province in northwestern Iran. It is the fourth fertile plain in the country and is the second largest agricultural producer in the province. Its climate is variable, with relatively warm summers and short cold winters. It is noteworthy that no extended and detailed faunistic studies have been performed on the eriophyoid mites of this region up to now, apart for the symptomatic diagnosis which was made evident for *Acalitus*

How to cite: Mehri-Heyran, H., Lotfollahi, P., de Lillo, E. & Azimi, S. (2020) Eriophyoid (Trombidiformes: Eriophyoidea) mite fauna of Miandoab region in Iran with redescription of *Aceria kiefferi* (Nalepa). *Persian Journal of Acarology*, 9(2): 161–171.

phloeocoptes (Nalepa).

Given the economic importance of eriophyoids, this study aims to survey the species of this taxon on abundant plants of Miandoab region. By identifying eriophyoid species, we can take a major step towards improving knowledge on potential candidates of biological control of weeds and identifying potential pest species on agricultural crops of Miandoab region.

MATERIAL AND METHODS

In order to study the eriophyoid mites of Miandoab region (West Azerbaijan province, Iran), samplings were done on most abundant plant species, only during July 2018. The sampling details have been shown in Table 1. Eriophyoid mites were recovered from the 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 modifications: specimens were placed in modified Hoyer's medium without previous clarification. Slide mounted specimens were kept at about 90 °C for some minutes in an oven in order to favor mite clarification. Then, the slides were dried for about four weeks at about 47 °C. The terminology and the setal notation used in the morphological description of the mites follow mainly Lindquist (1996), whereas the terminology of the internal female genitalia follows Chetverikov (2014) and Chetverikov *et al.* (2014). All morphological measurements were taken by means of a phase contrast microscope Olympus BX 53, at 1,000 magnifications (oil immersion) according to Amrine and Manson (1996) as modified by de Lillo *et al.* (2010), and are given in micrometers. Some measurements were taken as follows: dorsal semiannuli were counted from the first semiannulus behind the rear margin of the prodorsal shield; ventral semiannuli were counted from the 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 trait unless otherwise specified and are given in micrometers. In the supplementary description, range values of the studied population are given. Line drawings were hand-drawn by the first author through a *camera lucida* according to de Lillo *et al.* (2010) and the abbreviations labelling schematic drawings in figure 1 follow mainly Amrine *et al.* (2003). The genera classification follows Amrine *et al.* (2003) and comparisons were also made with new genera described since that publication.

Table 1. List of sampling localities, their geographic location and altitude.

Abbreviation	Sampling Locality	Longitude	Latitude	Altitude (m)
YTV	Yaghinali Tappe Village	46° 03' 57.2"	36° 59' 49.9"	1289
DAV	Dolat Abad Village	46° 02' 30.5"	36° 58' 53.4"	1288
OSV	Ozmanake Sofla Village	46° 03' 14.0"	36° 57' 18.0"	1288
OTKV	Ooch Tappe Kord Village	46° 00' 46.1"	37° 01' 08.8"	1286
OTGV	Ooch Tappe Ghalee Village	45° 59' 94.0"	37° 01' 37.9"	1287
GV	Garyaghdi Village	46° 12' 42.5"	36° 55' 59.9"	1308
BIT	Bakeri Industrial Town	46° 12' 52.6"	36° 56' 71.2"	1376
ZKV	Zeynal Kandi Village	46° 00' 47.2"	36° 55' 59.9"	1286
ND	Noroozloo Dam	46° 14' 36.6"	36° 52' 41.5"	1307
NDR	Noroozloo Dam Road	46° 14' 38.4"	36° 52' 44.0"	1311
EAV	Ebrahim Abad Village	46° 12' 59.4"	36° 53' 06.7"	1300
MSV	Molla Shahabeddin Village	46° 09' 27.2"	36° 59' 07.5"	1301
TAV	Taghi Abad Village	46° 07' 35.9"	36° 56' 42.0"	1295
HEAV	Heidar Abad Village	46° 09' 19.9"	36° 55' 58.0"	1295
HOAV	Hosein Abad Village	46° 11' 52.4"	36° 53' 26.2"	1301

Host plant names and their synonymies are in accordance with "The Plant List on-line database" (2013).

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

RESULTS

Family Eriophyidae Subfamily Cecidophyinae Tribe Colomerini

***Colomerus vitis* (Pagenstecher, 1857)** – collected from *Vitis vinifera* L. (Vitaceae) in one locality (Table 2).

Subfamily Eriophyinae Tribe Aceriini

***Acalitus phloeocoptes* (Nalepa, 1890)** – collected from *Prunus domestica* L. in six surveyed localities (Table 2). This species was the most abundant species during this study and it was found in high dense population in most of sampling localities. This is one of the key pests of Miandoab region in recent years, which causes lots of damages to the plum orchards, especially Shablon cultivar (personal observations; Fig. 1).

***Aceria cf. tosichella* Keifer, 1969** – collected from *Lolium temulentum* L., *Sorghum halepense* (L.) Pers. and *Setaria italica* (L.) P. Beauv. (Poaceae), and occasionally from other 75 plant species in all sampled localities (Table 2). It should be commented that this mite species, as well as many others here listed, can be subjected to wind dispersal and can be landed on non-elective host plant species. Subsequently this species was one of the abundant ones that was found in all developmental stages in the surveyed region and is marked by one asterisk (*) in Table 2. It is one of the most important eriophyoid mites associated with Poaceae with a high potential in causing yield reduction by direct feeding on wheat and barley, and by transmitting viruses to the host plants (de Lillo *et al.* 2018).

***Aceria cynodonis* Wilson, 1959** – only females collected from *Vitis vinifera* L. (Vitaceae) and *Populus alba* L. (Salicaceae) in two localities (Table 2). Its collection can be considered occasional and depends on its dispersal due to the large spread of its elective host plant species in the sampled localities.

***Aceria medicaginis* (Keifer, 1941)** – collected from *Medicago sativa* L. (Leguminosae) in one locality (Table 2).

***Aceria anthocoptes* (Nalepa, 1892)** – collected from *Achillea millefolium* L., *Arctium lappa* L., *Cirsium altissimum* (L.) Hill, *C. arvense* (L.) Scop., *C. palustre* (L.) Coss. ex Scop. (Compositae) and due to the windy weather of sampling area, it's all developmental stages occasionally collected from *Malus pumila* Mill. (Rosaceae) in five localities (Table 2). This species was one of the abundant species in the surveyed region and is marked by one asterisk (*) in Table 2.

***Aceria plectrumscuti* Lotfollahi, Haddad, Khanjani, Moghaddam & de Lillo, 2013** – collected from *Centaurea virgata* Lam. (Compositae) in one locality (Table 2).

Aceria dioicae (Keifer) – collected from *Tamarix* sp. (Tamaricaceae) in two localities (Table 2).



Figure 1. Stem galls caused by *Acalitus phloeocoptes* (Nalepa).

Aceria kiefferi (Nalepa, 1891) (Fig. 2)

Female (measured specimens $n = 10$)

Body vermiform, 203–236 (excluding gnathosoma), 42–46 thick, 41–48 wide. **Gnathosoma** projecting obliquely downwards, chelicerae 15–22, palp 16–20, palp coxal setae *ep* 2–3, dorsal palp genual setae *d* 5–6, unbranched. **Prodorsal shield** 26–32 including frontal lobe, 33–39 wide, sub-circular; with a thin distally acute frontal lobe, 3–4, over gnathosomal base. Shield pattern distinct, consisting of complete median and admedian lines, inner submedian lines extending on $\frac{3}{4}$ of prodorsal shield length, one pair of complete outer submedian lines, some short lines among the inner and outer submedian lines, and the posterior prodorsal shield margin. Tubercles of scapular setae *sc* on rear shield margin, 20–24 apart, setae *sc* 50–61, directed posterior divergently. **Legs** with all usual segments and setae. Leg I 27–33, trochanter 6–8, femur 10–12, genu 7–9, tibia 5–7, tarsus 6–8, tarsal solenidion ω 8–10 distally a little enlarged and tapered, empodium simple, 7–8, 4-rayed; femoral setae *bv* 6–8, genual setae *l'* 18–28, paraxial tibial setae *l''* 8–10, located in basal

forth of tibia, paraxial fastigial tarsal setae *ft'* 15–17, antaxial fastigial tarsal setae *ft''* 24–29, paraxial unguinal tarsal setae *u'* 4–5. Leg II 24–30, trochanter 6–8, femur 9–12, genu 5–8, tibia 5–7, tarsus 6–8, tarsal solenidion ω 8–10 distally a little enlarged and tapered, empodium simple, 7, 4-rayed; femoral setae *bv* 7–9, genual setae *l''* 10–13, paraxial fastigial tarsal setae *ft'* 7–10, antaxial fastigial tarsal setae *ft''* 25–30, paraxial unguinal tarsal setae *u'* 3–4. **Coxisternal region:** Prosternal apodeme 7–8, anterior setae on coxisternum I *lb* 6–9, 11–12 apart; proximal setae on coxisternum I *la* 17–22, 10–12 apart; proximal setae on coxisternum II *2a* 38–46, 23–28 apart; 6–7 microtuberculate semiannuli between coxae and genital coverflap plus 2–3 transversal rows of lined granules at the base of the coverflap. Coxae with lined granules, dashes and short lines. **External genitalia** 14–17, 21–25 wide, coverflap with 14 (no variation) longitudinal ridges; setae *3a* 15–17, 17–20 apart. **Internal genitalia:** spermathecae ovoid, oriented posterolaterad; spermathecal tubes relatively short; transverse genital apodeme trapezoidal, distally folded. **Opisthosoma** dorsally arched, with 54–63 dorsal semiannuli, 64–72 ventral semiannuli. **Microtubercles** oval on posterior margin of dorsal semiannuli and posterior part of ventral semiannuli; spiny on the rear margin of the last 4–5 dorsal semiannuli and elongated and linear on last 5 (no variation) ventral semiannuli. Setae *c2* 20–26 on ventral semiannulus 10–12, setae *d* 55–69 on ventral semiannulus 22–25; setae *e* 13–17 on ventral semiannulus 37–42; setae *f* 18–25 on ventral semiannulus 59–67; 5 (no variation) annuli posterior to setae *f*. Setae *h2* 64–73 apically very thin, *h1* 5–8.

Male (measured specimen n = 1)

Similar in shape and prodorsal shield arrangement to female. Body smaller than female, 187, 40 wide; palp genual setae *d* 6; prodorsal shield 29, 37 thick; setae *sc* 28, 13 apart. Opisthosoma with 61 dorsal semiannuli and 73 ventral semiannuli; 7 semiannuli between coxae and genitalia, with microtubercles similar to that of female. Setae: *lb* 10, *la* 14, *2a* 37, *c2* 19, *d* 42, *e* 14, *f* 20, *h1* 6, *h2* 51). Male genitalia 15 wide, setae *3a* 18, 15 apart.

Type host plant

Achillea millefolium L. (Compositae), Common Yarrow, Milfoil.

Type locality

Bitche, France.

Relation to the host plant

Vagrant; causing leaf curling and flower deformation.

Material examined

17 females and 1 male mounted singly on separate microscope slides (AM-IWA-OK18M-1–18), from *A. millefolium* in Ozmanake Sofla village, Miandoab region, West Azerbaijan province, Iran, 36° 58' 18" N, 46° 03' 14" E, 1,288 m above sea level, coll. H. Mehri-Heyran, late July 2018.

Other material

Mites preserved in a vial (AM-IWA-OK18M) of Oudemans' fluid (Walter and Krantz 2009) as extracted from the same sample as the type specimens.

Remarks

The original description of *A. kiefferi* by Nalepa (1891) and other descriptions published by Farkas (1965) and Petanović (1988) provide few morphological information, which makes difficult the comparisons between those descriptions and Iranian specimens. There are similarities in setae *sc* length (50 according to Petanović (1988) and 52–61 in Iranian specimens) and setae *d* length (70 according to Farkas (1965) and 55–69 in Iranian specimens). The prodorsal shield ornamentation of

Iranian specimens is similar to Farkas (1965) drawings, but it shows some differences from the original drawing of Nalepa (1891) on the line arrangement on the shield lateral side and the drawing of Petanović (1988) on the length of median line and line arrangement of the shield lateral sides. The Iranian specimens differ from previous descriptions in the ornamentation of dorsal and ventral semiannuli: Nalepa (1891) and Farkas (1965) reported 60 dorsal semiannuli partly smooth and partly with fine microtubercles, and 60 microtuberculated ventral semiannuli; Petanović (1988) reported 70 smooth dorsal semiannuli and 70 microtuberculated ventral semiannuli; the Iranian specimens have 54–63 dorsal and 64–72 ventral semiannuli which are all provided with microtubercles. Another difference regards the ornamentation of female genital coverflap (10 striae according to Petanović (1988) *versus* 14 striae in the Iranian specimens). The only obvious difference is in the number of empodium rays (5 according to Nalepa (1891), Farkas (1965) and Petanović (1988) *versus* 4 in the Iranian specimens). It could be hypothesized that differences could be due to the consequence of intraspecific variability, geographic differences, host plant genotype differences and/or not so good quality of microscopes prepared in the past. No holotype or paratypes are available in the Nalepa's collection at the Natural History Museum of Wien (Austria).

Subfamily Phyllocoptinae Tribe Phyllocoptini

***Phyllocoptes abaenus* Keifer, 1940** – collected from *Prunus domestica* L., *Prunus armeniaca* L. and *Prunus persica* (L.) Batsch (Rosaceae), and due to the windy weather of sampling area, it's all developmental stages occasionally collected from *Galium aparine* L. (Rubiaceae), *Populus alba* L., *Populus tremula* L. (Salicaceae), *Sonchus* sp. (Compositae), *Morus alba* L., *Plantago major* L., *Plantago lanceolata* L. (Plantaginaceae) and *Salvia sclarea* L. (Lamiaceae) in five localities (Table 2).

***Phyllocoptes bilobospinosus* Chetverikov, 2019** – collected from *Tamarix* sp. (Tamaricaceae) in two localities (Table 2). This species is new for the fauna of Iran.

***Calepitrimerus baileyi* Keifer, 1938** – collected from *Malus pumila* Mill., *Prunus armeniaca* L., *Prunus persica* (L.) Batsch, *Rosa × damascena* Herrm., *Prunus cerasifera* Ehrh., *Prunus dulcis* (Mill.) D.A. Webb, *Prunus avium* (L.) L., *Pyrus anatolica* Browicz (Rosaceae), and due to the windy weather of sampling area, it's all developmental stages occasionally collected from 43 plant species in 10 localities (Table 2). This species was one of the abundant species in the surveyed region that marked by one asterisk (*) in Table 2.

Tribe Anthocoptini

***Aculodes cf. dubius* (Nalepa, 1891)** – due to the windy weather of sampling area, females and males occasionally collected from *Populus alba* L. (Salicaceae), *Daucus carota* L. (Apiaceae) and *Melilotus officinalis* (L.) Pall. (Leguminosae) in three localities (Table 2).

***Aculus fockeui* (Nalepa & Trouessart, 1891)** – collected from *Prunus persica* (L.) Batsch, *Malus pumila* Mill., *Rosa × damascena* Herrm., *Prunus dulcis* (Mill.) D.A. Webb, *Prunus cerasifera* Ehrh., *Cydonia oblonga* Mill., *Prunus domestica* L., *Prunus avium* (L.) L. (Rosaceae), and due to the windy weather of sampling area, it's all developmental stages occasionally collected from 33 plant species in 8 localities (Table 2). This species was one of the abundant species in the surveyed region that marked by one asterisk (*) in Table 2.

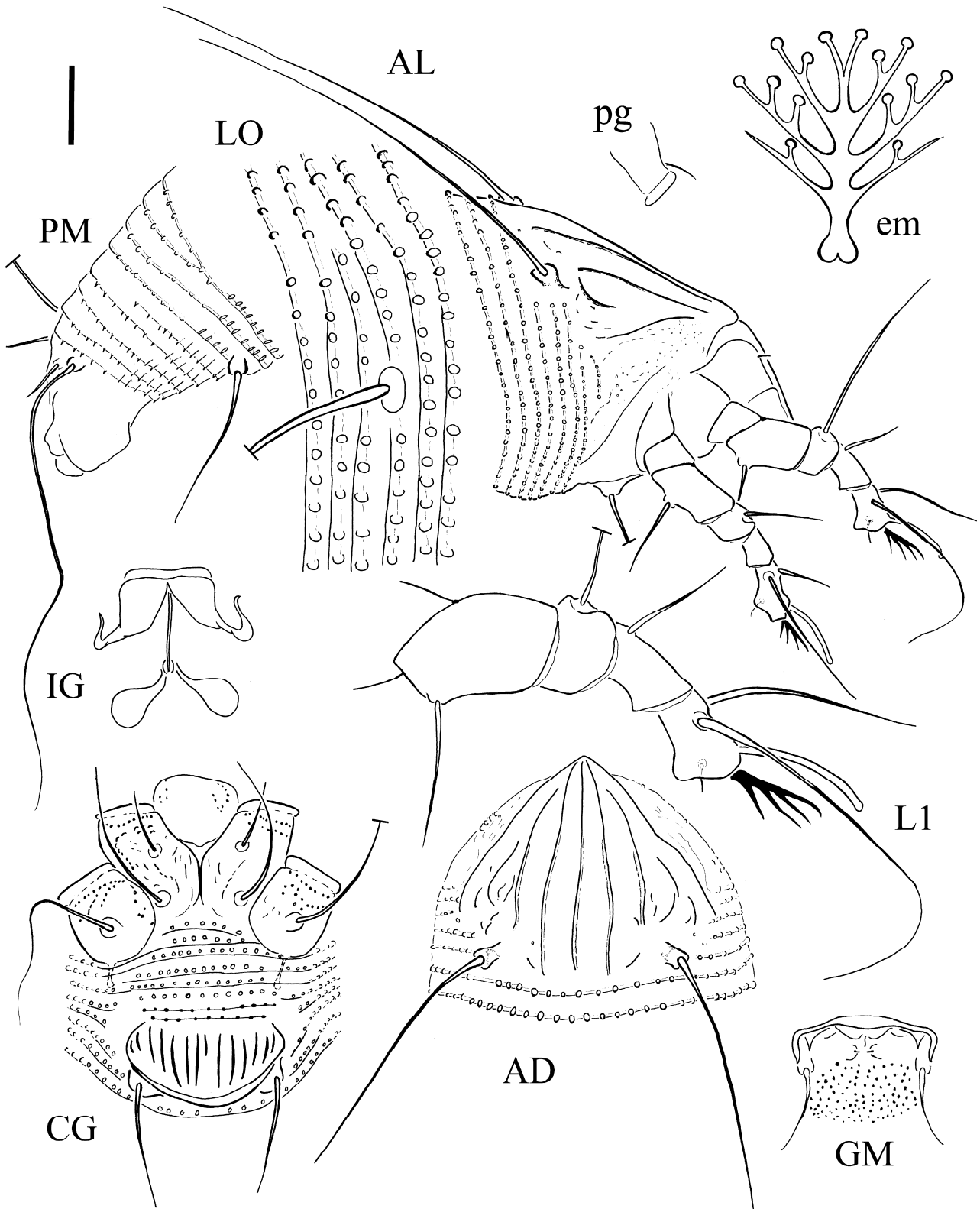


Figure 2. Schematic drawings of *Aceria kiefferi* (Nalepa, 1891): **AD.** Prodorsal shield; **AL.** Lateral view of anterior body region; **CG.** Female coxigenital region; **em.** Empodium; **GM.** Male genital region; **IG.** Internal female genitalia; **LO.** Lateral view of annuli; **L1.** Leg I; **pg.** palp genua; **PM.** Lateral view of posterior opisthosoma. Scale bar: 10 μ m for **AD, AL, CG, GM, IG, pg, PM**; 5 μ m for **LO, L1**; 2.5 μ m for **em**.

Table 2. List of surveyed species, their distribution and number of collected specimens distinct for localities during the current survey; most abundant species marked by two asterisk (**) and the other six abundant species marked by one asterisk (*).

Species	Sampling localities (refer to table 1 for the abbreviations)											Total				
	YTV	DAV	OSV	OTKV	OTGV	GV	BITI	ZKV	ND	NDR	EAV		MSV	TAV	HEAV	HOAV
<i>Colomerus vitis</i>			3													3
<i>Acalitus phloeocoptes</i> **			Many mites of all stages present (+) in each gall; uncountable											> 1000		
<i>Aceria cf. tosichella</i> *	39	51	86	42	48	136	29	120	91	42	8				6	698
<i>Aceria cynodonis</i>			2	1												3
<i>Aceria medicaginis</i>			2													2
<i>Aceria anthocoptes</i> *	30		12	17			20			23						102
<i>Aceria plectrumscuti</i>									14							14
<i>Aceria dioicae</i>			2							15						17
<i>Aceria kiefferi</i>			18													18
<i>Phyllocoptes abaenus</i>	14	5	7	20		3										49
<i>Phyllocoptes bilobospinosus</i>			12							7						19
<i>Caleptrimerus baileyi</i> *	28	48	42	101	29	37	1	1	4	3						294
<i>Aculodes cf. dubius</i>					1					1				1		3
<i>Aculus fockeui</i> *	14	8	47	92	39	22	1			42						265
<i>Aculus mogeri</i>			10													10
<i>Aculus asparagi</i>										5						5
<i>Abacarus cf. hystrix</i> *	1	1	56	19	34											111
<i>Aculops rhodensis</i>			10													10
<i>Echinacrus ruthenicus</i>				2												2
<i>Rhynophytoptus nemalobos</i> *	5	2	7	122	37	1										174
<i>Diptacus gigantorynchus</i>		11		20	19											50

Family Diptilomiopidae Subfamily Rhyncaphytoptinae

***Rhynophytoptus nemalobos* Lotfollahi & de Lillo, 2014** – collected from *Prunus domestica* L., *Prunus cerasifera* Ehrh., *Rosa × damascena* Herrm., *Prunus dulcis* (Mill.) D.A. Webb, *Prunus armeniaca* L., *Prunus avium* (L.) L. and *Prunus persica* (L.) Batsch (Rosaceae), and due to the windy weather of sampling area, it's females and males occasionally collected from 22 plant species in six localities (Table 2). This species was one of the abundant species in the surveyed region especially in Ooch Tappe Kord Village that marked by one asterisk (*) in Table 2.

***Diptacus gigantorynchus* (Nalepa, 1892)** – collected from *Prunus persica* var. *nucipersica* (L.) C.K. Schneid., *Prunus domestica* L., *Prunus cerasifera* Ehrh. and *Pyrus anatolica* Browicz (Rosaceae), and due to the windy weather of sampling area, it's females and nymphs occasionally

collected from 10 plant species in three localities (Table 2). This species is new for the mite fauna of Iran.

ACKNOWLEDGEMENTS

The authors are grateful to Prof. Radmila Petanović (Department of Entomology and Agricultural Zoology, Faculty of Agriculture, University of Belgrade, Serbia) for her suggestions and critical review of an earlier draft of this manuscript. This research was supported by Iran National Science Foundation (Iran) and partially by Azarbaijan Shahid Madani University (Iran) and MIUR (Progetto “Pietro Della Valle”) which are greatly appreciated.

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فون کنه‌های اریوفیوئید (Trombidiformes: Eriophyoidea) شهرستان میان‌دوآب همراه با بازتوصیف *Aceria kiefferi* (Nalepa)

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چکیده

طی مطالعه فون کنه‌های اریوفیوئید شهرستان میان‌دوآب (استان آذربایجان غربی، ایران)، نمونه‌هایی از دو خانواده اریوفیوئید، چهار زیرخانواده، چهار قبیله، ۱۱ جنس و ۱۹ گونه جمع‌آوری و شناسایی شدند. در بین آن‌ها، سه گونه شامل *Phyllocoptes* *Aceria kiefferi* (Nalepa) *bilobospinosus* Chetverikov و *Diptacus gigantorhynchus* (Nalepa) برای نخستین بار از ایران گزارش می‌شوند. فراوان‌ترین گونه در این مطالعه *Acalitus phloeocoptes* (Nalepa) و شش گونه شامل *Aceria* cf. *tosichella* Keifer *A. anthocoptes* (Nalepa) *Calepitrimerus baileyi* Keifer *Abacarus* cf. *hystrix* (Nalepa) *Aculus fockeui* (Nalepa & Trouessart) *Rhynophytoptus nemalobos* Lotfollahi & de Lillo گونه‌های فراوان دیگر در ناحیه مورد بررسی بودند. در این‌جا گونه قدیمی *A. kiefferi* به دلیل این‌که در توصیف‌های پیشین آن جزئیات کمی آمده بود، بر اساس استانداردهای امروزی بازتوصیف و ترسیم شد.

واژگان کلیدی: گونه فراوان؛ *Aceria kiefferi*؛ Diptilomiopidae؛ Eriophyoidea؛ بازتوصیف؛ بررسی؛ آذربایجان غربی.

اطلاعات مقاله: تاریخ دریافت: ۱۳۹۸/۱۱/۳، تاریخ پذیرش: ۱۳۹۸/۱۱/۲۸، تاریخ چاپ: ۱۳۹۹/۱/۲۷