Persian J. Acarol., 2024, Vol. 13, No. 2, pp. 233–241.
https://doi.org/10.22073/pja.v13i2.84055
Journal homepage: http://www.biotaxa.org/pja

http://zoobank.org/urn:lsid:zoobank.org:pub:569730E6-C7A4-4C32-9089-C27100C4E3B8

Article

Eustigmaeus pseudosetiferus sp. nov. (Acari: Trombidiformes: Stigmaeidae) from Iran

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ABSTRACT
A new species of *Eustigmaeus* Berlese, 1910 (Acari: Stigmaeidae), *E. pseudosetiferus*, is described and illustrated from *Astragalus* sp. (Fabaceae), in Urmia, West Azerbaijan province, Iran. A key to the species of *Eustigmaeus* known from Iran is provided and *E. isfahaniensis* is considered as a junior synonym of *E. ottavii*.

KEYWORDS: Description, new species, predatory mite, Prostigmata, Northwest Iran.

PAPER INFO.: Received: 31 October 2023, Accepted by: A. Saboori, 2 February 2024, Published: 15 April 2024

INTRODUCTION

Stigmaeidae (Acari: Raphignathoidea) with more than 640 species and 33 genera is the most diverse and largest family in Raphignathoidea (Fan *et al*. 2016, 2019; Beron 2020; Khaustov 2023; Khaustov *et al*. 2023; Mohammad-Doustaresharaf *et al.* 2023). Members of this family consist of a large group of mites that are mainly predators of small arthropods. However, some species feed on pollen, moss, and a few are considered ectoparasites of sandflies (Walter *et al*. 2009). The genus *Eustigmaeus* contains the largest number of species (over 120 species) after genus *Stigmaeus* Koch, and are found in ground litter, soil, lichen and ant's nests (Summers and Price 1961; Gerson 1972; Doğan *et al*. 2003; Khaustov *et al*. 2023). So far, 21 species of this genus were recorded from Iran. The aim of this study is to describe a new species, *E. pseudosetiferus* **sp. nov.**, and provide a key to all species recorded from Iran. We also consider *E. isfahaniensis* **syn. nov.** as a junior synonym of *E. ottavii*.

MATERIAL AND METHODS

Samples of soil, moss, ground litter, lichens and plants were collected by junior author, during 2021–2022, from West Azerbaijan province of Iran. Mites were extracted using a Berlese-Tullgren funnel, stored in 70% ethanol, cleared in Nesbitt's fluid and mounted in Hoyer's medium. An Olympus BX41 microscope, equipped with a drawing tube was used for the illustrations. Pencil line drawings were traced over using Adobe Illustrator (version 15.0.0). Measurements were taken as follows: length of

How to cite: Bagheri, M. & Mohammad-Doustaresharaf, M. (2024) *Eustigmaeus pseudosetiferus* sp. nov. (Acari: Trombidiformes: Stigmaeidae) from Iran. *Persian Journal of Acarology*, 13(2): 233–241.

idiosoma from the cheliceral tips to the posterior margin of idiosoma, width of idiosoma at the broadest part and setae from the alveoli to the tips. For the legs, measurements were made from base of trochanter to the tarsal tips. The terminology and abbreviations used in the description follow those of Grandjean (1939, 1944, 1946) and Kethley (1990). All measurements are given in micrometers (μm) for

RESULTS

Raphignathoidea Kramer, 1877
Stigmaeidae Oudemans, 1931
Eustigmaeus Berlese, 1910

Type species: *Stigmaeus kermesinus* Koch, 1841 by original designation.

***Eustigmaeus pseudosetiferus* sp. nov. (Figs. 1–3)**

http://zoobank.org/urn:lsid:zoobank.org:act:3307059D-A249-48D2-9328-0E0D5DB52D0C

Diagnosis

Female – Dorsal shields ornamented with irregular dimples forming polygonal reticulum containing 7–15 internal and 14–25 peripheral tiny vacuoles, dorsal setae multi-pectinate, consist of slender shaft around which are whorls of spinules, the length of the largest spinules is more than three times the diameter of the shaft and setae without hyaline; setae c_2 and f_1 dissimilar to other dorsal setae, bearing small spinules. Endopodal plates smooth, without reticulation and fused, aggenital shield smooth and with three pairs of setae, femora I–IV: 6-5-3-2, tarsi I–IV: 13+1 *ω*, 9+1 *ω*, 7+1 *ω*, 7. Eyes present.

Description

***Female* (n = 4)** – Length of idiosoma (including chelicerae) 360 (370–380), width 225 (225–230).

Dorsal idiosoma (Fig. 1A) – Oval, dorsal shields ornamented with irregular dimples forming polygonal reticulum containing 7–15 internal and 14–25 peripheral tiny vacuoles, dorsal setae multi-pectinate, consist of slender shaft around which are whorls of spinules, the length of the largest spinules is more than three times the diameter of the shaft and setae without hyaline (Fig. 2C). Prodorsal shield triangular, with protuberance in front and bearing four pairs of setae (*vi*, *ve*, *sci* and *sce*) and one pair of eyes between setae *ve* and *sci*, humeral shield ornamented with dimples and vacuoles, bearing c_2, and situated ventrally; suranal shield postero-ventrally, ornamented as dorsal shields and bearing two pairs of setae (h_1 and h_2). Lengths and distances of dorsal setae as follows: *vi* 35 (33–36), *ve* 40 (37–40), *sci* 30 (30–31), *sce* 35 (33–36), c_1 35 (32–35), c_2 47 (46–48), d_1 35 (32–35), d_2 31 (32–33), e_1 42 (41–44), e_2 35 (34–36), f_1 55 (53–56), h_1 45 (44–46), h_2 43 (43–44); *vi*–*vi* 35 (29–35), *ve*–*ve* 66 (63–71), *vi*–*ve* 35 (38–40), *sci*–*sci* 135 (130–136), *ve*–*sci* 35 (35–38), *sce*–*sce* 170 (168–171), *sci*–*sce* 36 (37–40), c_1–c_1 48 (45–48), d_2–d_2 175 (170–174), c_1–d_1 45 (47–50), c_1–d_2 70 (68–72), d_1–d_1 50 (48–51), e_2–e_2 65 (63–66), d_2–e_2 53 (52–55), d_1–e_1 55 (53–55), d_1–e_2 55 (53–56), e_1–e_1 62 (61–65), e_2–e_1 50 (46–49), f_1–f_1 60 (56–58), e_1–f_1 40 (37–39), e_2–f_1 79 (80–83), h_1–h_1 26 (25–27), h_2–h_2 80 (77–80), h_1–h_2 25 (25–27).

Ventral idiosoma (Fig. 1B) – Endopodal plates of legs I–IV fused and smooth. Aggenital area, smooth (not completely fused in midline in the holotype), with three pairs of aggenital setae ($ag_{1–3}$); pseudanal shield with three pairs of setae ($ps_{1–3}$). Lengths of ventral setae: 1*a* 15 (15–17), 1*b* 25 (23–24), 1*c* 15 (13–14), 2*b* 14 (14–15), 2*c* 13 (14–15), 3*a* 16 (15–16), 3*b* 15 (13–15), 3*c* 12 (10–11), 4*a* 12 (11–12), 4*b* 12 (12–13), 4*c* 10 (10–11), ag_1 12 (11–12), ag_2 15 (14–15), ag_3 17 (15–17), ps_1 15 (15–16), ps_2 17 (16–18), ps_3 17 (17–18).

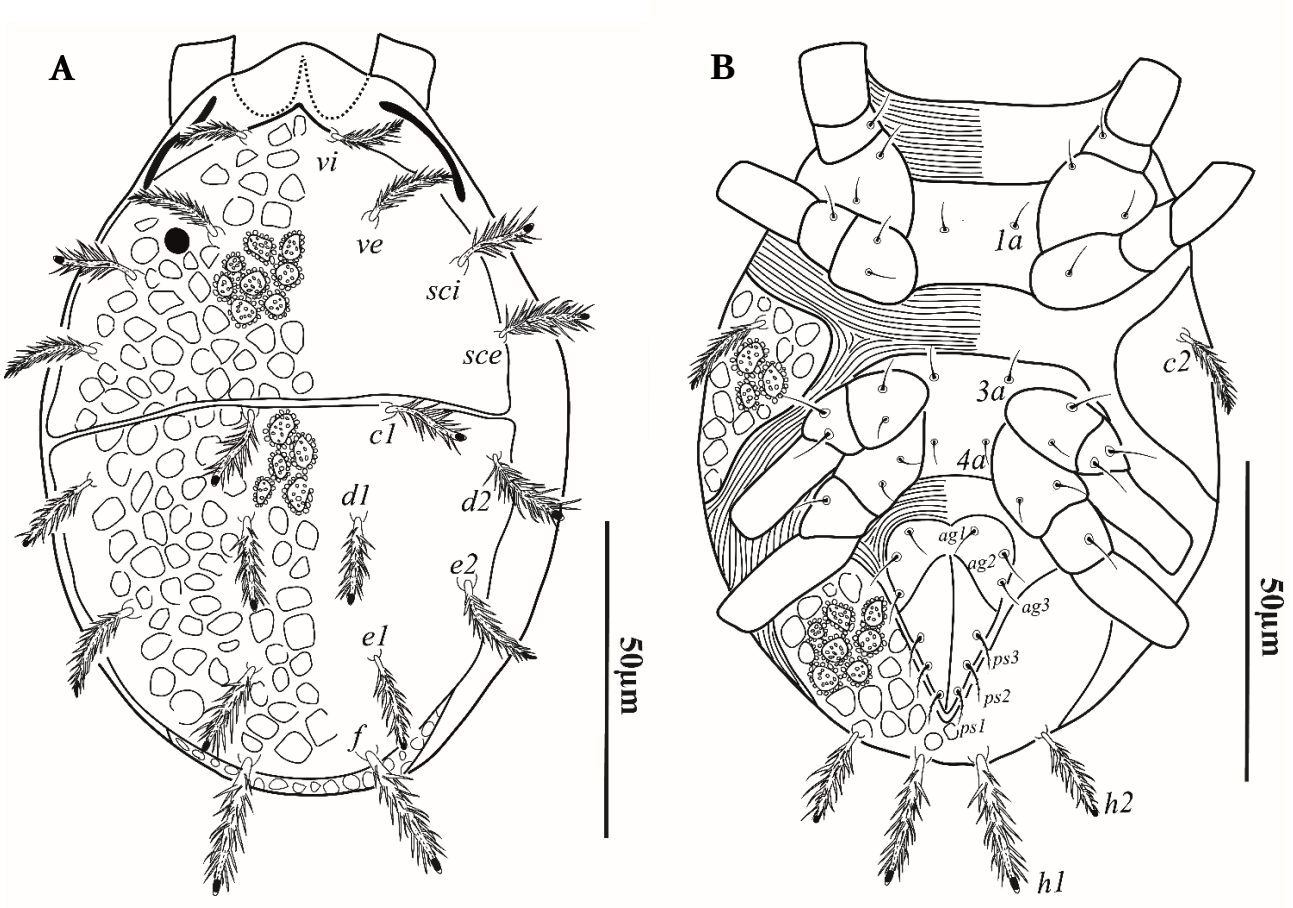

Figure 1. *Eustigmaeus pseudosetiferus* **sp. nov.** (holotype female) – **A.** Dorsum of idiosoma; **B.** Venter of idiosoma.

Gnathosoma (Fig. 2) – Subcapitulum smooth (Fig. 2B) with two pairs of subcapitular setae (*m* and *n*) and two pairs of adoral setae ($or_{1–2}$). Palp tibial claw large, about as long as palptarsus (Fig. 2A). Setae *l'* on palpaltibia spine-like, dorsal setae on palpfemur strongly pectinated. Number of setae on palpal segments: Tr 0, Fe 3 (*d, l', v"*), Ge 2 (*d, l"*), Ti 3 (*d, l', l"*), Ta 8(1*ω*) (fused eupathidia *ul', ul", sul,* eupathidia *acm* and *va, ba, bp, lp,* and one solenidion *ω*). Palpalsupracoxal setae (*ep*) short, with distinctly pointed tip. All subcapitular setae smooth and pointed. Lengths of subcapitular setae: *m* 15 (14–15), *n* 15 (15–16), *or1* 15 (14–15), or_2 16 (15–16). Length of cheliceral stylets 28 (23–30); length of palps 108 (90–110).

Legs (Fig. 3) – All legs with one pair of well-developed claws. Empodial raylets with distinctly widened tips. Lengths of legs: I 165 (160–166), II 144 (141–146), III 145 (140–146), IV 160 (161–1162). Leg I (Fig. 3A). Leg setation: Tr 1 (*v'*), Fe 6 (*d, l', l", v', v", bv"*), Ge 3(1) (*d, l', l", κ*), Ti 5(2) (*d, l', l", v', v", φ, φρ*), Ta 13(1) (*p' ξ, p" ξ, tc' ξ, tc" ξ, ft" ξ, ft' ξ, u', u", a', a", pl', pl", vs, ω*). Solenidion *ω* 20 (20–21) digitiform; solenidion *φ* 10 (10–11) digitiform, *φp* 18 (17–18) attenuate. Leg II (Fig. 3B). Leg setation: Tr 1 (*v'*), Fe 5 (*d, l', l", v', bv"*), Ge 3(1) (*d, l', l", κ*), Ti 5(1) (*d, l', l", v', v", φ*), Ta 9(1) (*p' ξ, tc' ξ, tc", u', u", a', a", pl', vs, ω*). Seta *tc"* of tarsus smooth, eupathid-like, other setae barbed. Solenidion *ω* 15 (15–16) digitiform; solenidion *φ* 16 (16–17) digitiform, with rounded tip. Leg III (Fig. 3C). Leg setation: Tr 2 (*v', l'*), Fe 3 (*d, l', ev'*), Ge 1 (*d*), Ti 5(1) (*d, l', l", v', v", φ*), Ta 7(1) (*tc', tc", u', u", a', a",vs, ω*). Solenidion *ω* 6 (5–6) digitiform; solenidion *φ* 19 (17–19) digitiform, with pointed tip. Leg IV (Fig. 3D). Leg setation: Tr 1 (*v'*), Fe 2 (*d, ev'*), Ge 1(*d*), Ti 5(1) (*d, l', l", v', v", φp*), Ta 7 (*tc', tc", u', u", a', a", vs*). Solenidion *φp* 11 (10–12) attenuate, with pointed tip. Seta *d* of tibia distinctly longer than all other leg setae.

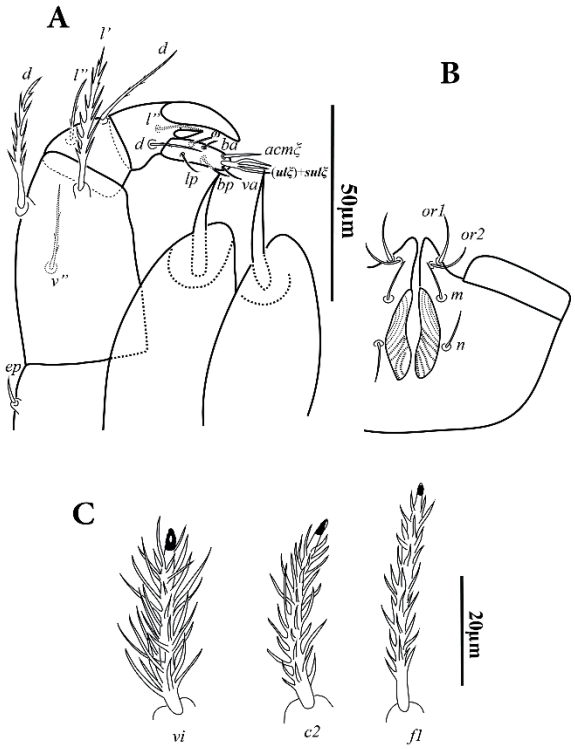

Figure 2. *Eustigmaeus pseudosetiferus* **sp. nov.** (holotype female) – **A.** Dorsal view of palp and chelicerae; **B.** subcapitulum; **C.** Setae *vi*, c_2 and f_1.

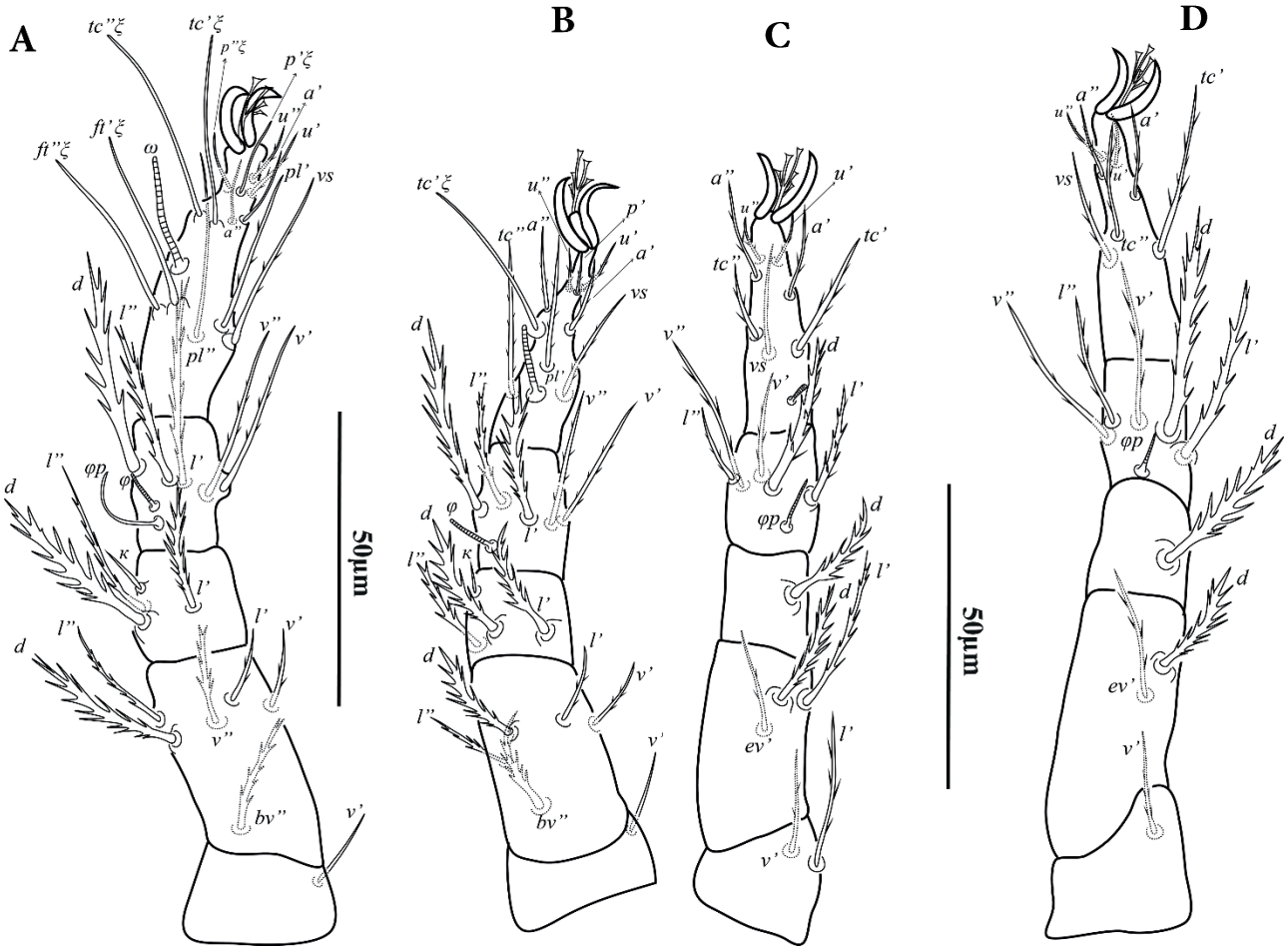

Figure 3. *Eustigmaeus pseudosetiferus* **sp. nov.** (holotype female) – **A.** Left leg I in dorsal view; **B.** Left leg II in dorsal view; **C.** Left leg III in dorsal view; **D.** Left leg IV in dorsal view.

Material examined

Female holotype and three paratype females, Urmia County, West Azerbaijan Province, Iran, 44° 53′ 37.0″ N, 37° 10′ 41.0″ E, 1890 m a.s.l, 09.08.2018, coll. M. Mohammad-Doustaresharaf, on *Astragalus* sp. (Fabaceae).

Type deposition

The holotype female and three paratypes are deposited in the Acarological Collection of the Acarology Laboratory, Plant Protection Department, Agricultural Faculty, University of Maragheh, Iran (UMI); one paratype (female) will be deposited in the collection of the Jalal Afshar Zoological Museum (JAZM), Department of Plant Protection, Faculty of Agriculture, University of Tehran, Karaj, Iran.

Etymology

The specific name, *pseudosetiferus*, composed of '*setiferus'* meaning "bearing bristles" and, *pseudo*, meaning "false", indicating the similarity of the new species to *E. setiferus*, which was described from Iran.

Differential diagnosis

Eustigmaeus pseudosetiferus **sp. nov.** resembles *E. capitatus* Stathakis, Kapaxidi & Papadoulis, *E. collegiensis* (Wood), *E. craticulus* (Summers & Price), *E. dogani*, *E. dumosus* (Wood), *E. myrteus* (Chaudhri), *E. plumifer*, *E. setiferus* and *E. sculptus* in having similar reticulation on dorsal shields and bush-like or multi-pectinated dorsal setae. It can be distinguished from each of the above related species by the following features: having irregular dimples containing 7–15 internal vacuoles (uniform dimples with 20–35 vacuoles in *E. capitatus*, 15–35 vacuoles in *E. myrteus* and 1–30 vacuoles in *E. dogani*); smooth endopodal plates (Fig. 5B) [reticulate plates in *E. capitatus*, *E. dogani*, *E. plumifer*, *E. myrteus*, *E. sculptus, E. collegiensis* and *E. setiferus* (Fig. 5A)]; dorsal setae consist of thin slender shaft (stronger in *E. setiferus*) around which are whorls of spinules, the length of the largest spinules is more than three times the diameter of the shaft (is not twice the diameter of the shaft in *E. collegiensis*) (Fig. 4B), aggenital plate smooth (reticulate in *E. collegiensis* and *E. sculptus*); spinules of dorsal setae are strong and spread along the entire length of shaft (spinules tufted on distal half of shaft in *E. craticulus* and delicate in *E. dumosus*); dorsal reticulum containing internal and peripheral vacuoles (vacuoles presented along the reticulation margins in *E. dumosus*).

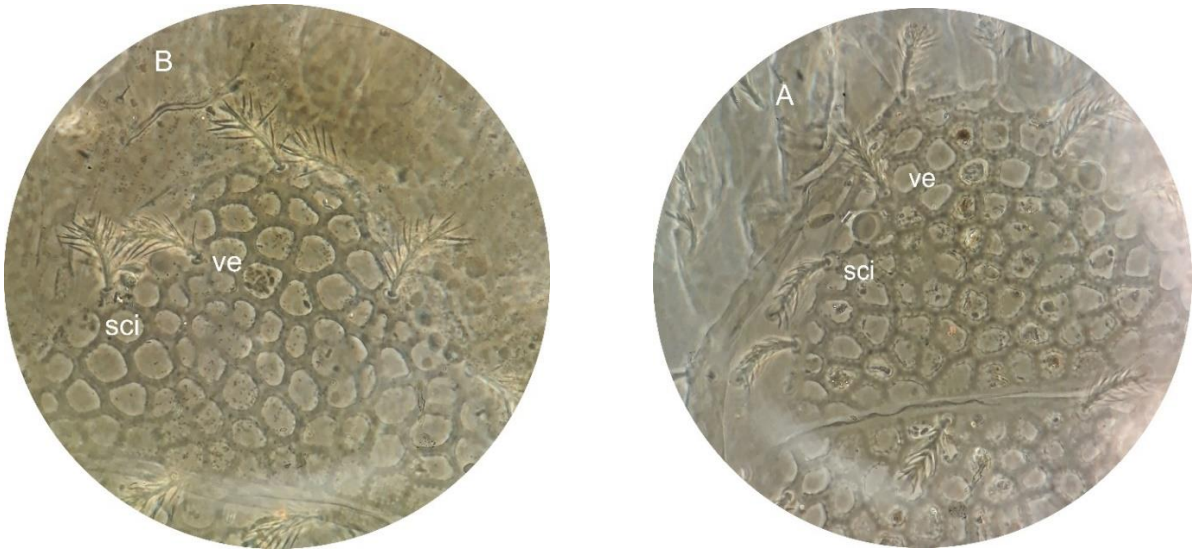

Figure 4. Prodorsal shield – **A.** *Eustigmaues setiferus*; **B.** *Eustigmaeus pseudosetiferus* **sp. nov.** (out of scale, 1000× magnification).

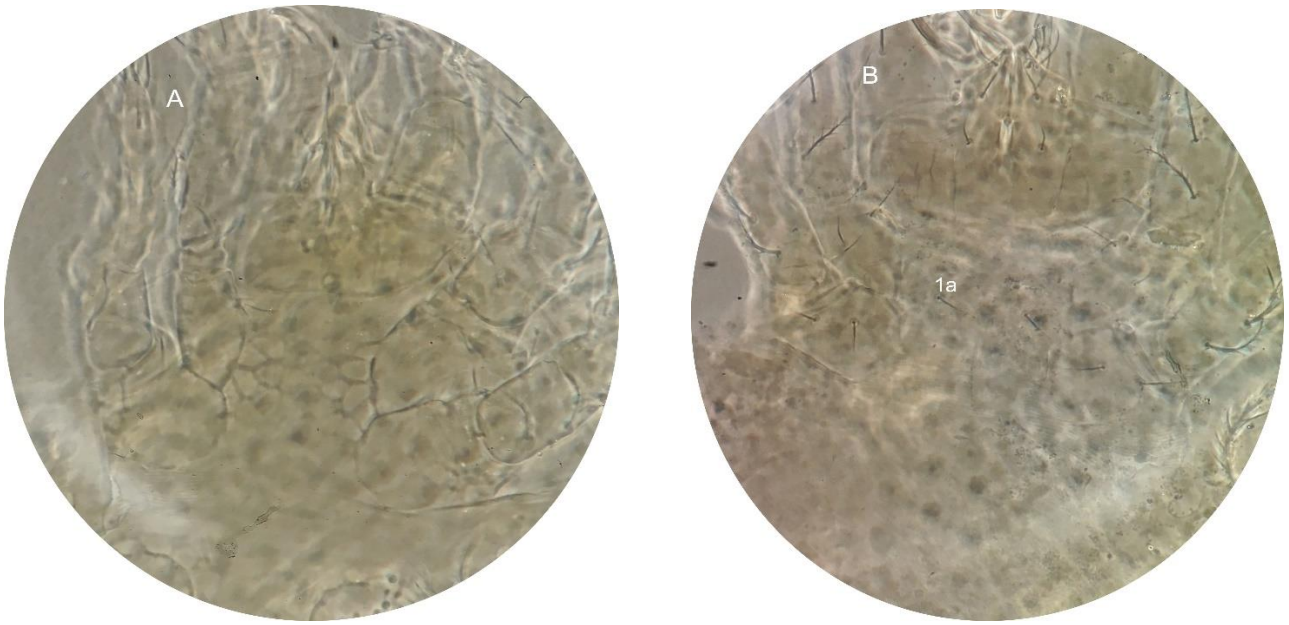

Figure 5. Endopodal shield I – **A.** *Eustigmaues setiferus*; **B.** *Eustigmaeus pseudosetiferus* **sp. nov.** (out of scale, 1000× magnification).

Key to the species of the genus *Eustigmaeus* of Iran (females)

1. Ocelli absent 2
– Ocelli present 4
2. Two pairs of aggenital setae ..***E. azerbaijanensis*** Haddad Irani-Nejad, Lotfollahi & Akbari, 2011
– Three pairs of aggenital setae 3
3. Femur II with five setae; seta *κ* on genu II present; Trochanter III with one seta ..... ***E. johnstoni*** Zhang & Gerson, 1995
– Femur II with four setae; seta *κ* on genu II absent; Trochanter III with two setae ..... ***E. ueckermanni*** Bagheri & Beyzavi, 2013
4. Callosities present 5
– Callosities absent 6
5. Humeral setae c_2 short, approximately 1/2 as long as preoculars *ve*; dorsal shields with evenly spaced dimples ..... ***E. rhodomelus*** (Koch, 1841)
– Humeral setae c_2 very short, approximately 1/3 to 1/4 as long as preoculars *ve*; dorsal shields with dimples, clearly evident only marginally ..... ***E. ottavii*** (Berlese, 1910), ***E. isfahaniensis*** Khanjani, Najaf-Abadi & Khanjani, 2014 **syn. nov.***
6. Setae *4a* absent 7
– Setae *4a* present 8
7. Dorsal setae clavate; ps_1 rod like; ps_2 and ps_3 subequal and shorter than ps_1 ..... ***E. jiangxiensis*** Hu, Chen & Huang, 1996
– Dorsal setae rod-like; ps_1 spine like; ps_1 and ps_3 subequal and longer than ps_2 ..... ***E. gulingensis*** Hu & Chen, 1996
8. Endopodal plates I–II and III–IV separated medially 9
– Endopodal plates I–II and III–IV fused medially 10
9. One pair of aggenital setae; Tarsus II with 8 (+1*ω*); endopodal shields smooth ..... ***E. ornatus*** Ueckermann & Smith-Meyer, 1987
– Two pairs of aggenital setae; Tarsus II with 9 (+1*ω*); endopodal shields reticulate ..... ***E. nahidae*** Gheblealivand & Bagheri, 2012
10. Tarsus II with 8 (+1*ω*) 11

– Tarsus II with 9 (+1ω) 13
11. One pair of aggenital setae; seta κ on genu II absent ..... ***E. segnis*** (C.L. Koch, 1836)
– Three pairs of aggenital setae; seta κ on genu II present 12
12. Femur II with four setae ..... ***E. caspianensis*** Bagheri & Paktinat Saeej, 2014
– Femur II with five setae .... ***E. setiferus*** Bagheri, Saber, Ueckermann, Ghorbani & Bonab, 2011
13. Femur II with five setae 4
– Femur II with four setae 17
14. Dorsal setae with hyaline ..... ***E. dogani*** Khanjani, Fayaz, Mirmoayedi & Ghaedi, 2011
– Dorsal setae without hyaline 15
15. Endopodal plates smooth (Fig. 5B) .....***E. pseudosetiferus* sp. nov.**
– Endopodal plates reticulate 16
16. Aggenital shield smooth; dorsal setae bushy, consisted of numerous slender spinules, length of spinules being reduced from base to tip, giving setae conical shape ***E. plumifer*** (Halbert, 1923)
– Aggenital shield with reticulation; dorsal setae bushy, length of spinules not being reduced from base to tip; dorsal setae curved ..... ***E. sculptus*** Doğan, Ayyıldız & Fan, 2003
17. Dorsal idiosomal setae bushy 18
– Dorsal setae otherwise 20
18. Endopodal shields smooth .....***E. nasrinae*** Khanjani & Ueckermann, 2002
– Endopodal shields reticulate 19
19. Ratio of dorso-central setae to their distances: *vi*/*vi*–*vi* 0.78–0.93, *ve*/*ve*–*ve* 0.37–0.43, d_1/d_1–d_1 0.54–0.61, e_1/e_1–e_1 0.56–0.59, f_1/f_1–f_1 0.61–0.62, h_1/h_1–h_1 0.94 .... ***E. seemani*** Khanjani, Firozfar, Mirmoayedi & Asali Fayaz, 2013
– Ratio of dorso-central setae to their distances: *vi*/*vi*– *vi* 0.45, *ve*/*ve*–*ve* 0.17; d_1/d_1–d_1 0.25, e_1/e_1–e_1 0.14, f_1/f_1–f_1 0.40, h_1/h_1–h_1 0.54 ..... ***E. anauniensis*** (Canestrini, 1889)
20. Dorsal idiosomal setae spatulate ..... ***E. spathatus*** Ueckermann & Meyer, 1987
– Dorsal idiosomal setae lanceolate ..... ***E. pinnatus*** (Kuznetsov, 1977)

* *Eustigmaeus isfahaniensis* Khanjani, Najaf-Abadi & Khanjani, 2014 diagnosing by: Dorsal shields with irregular reticulation which is distinct laterally, fade away medially; ocelli present; humeral callosities present; dorsal setae slender, slightly serrated, with hyaline sheath; endopodal shields separated along midline and faintly reticulated; setae *4a* present; with two pairs of *ag* setae; genu II with four setae; femur II with five setae and tarsus II with 9 (+1ω). All mentioned characteristics correspond to the *E. ottavii* (Berlese, 1910), and there are actually no important differences between two species and therefore, we consider *E. isfahaniensis* **syn. nov.** as a junior synonym of *E. ottavii*.

ACKNOWLEDGEMENT

This paper is published as part of a research project supported by the University of Maragheh (project number 561230) which is greatly appreciated.

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گونهٔ جدید *Eustigmaeus pseudosetiferus* (Acari: Trombidiformes: Stigmaeidae) از ایران

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چکیده

گونهٔ جدیدی از جنس *Eustigmaeus* Berlese, 1910 (Acari: Stigmaeidae) به نام *E. pseudosetiferus* از روی گیاه *Astragalus* sp. (Fabaceae) در شهر ارومیه استان آذربایجان غربی توصیف و کلید گونه‌های ایران ارایه شده است و گونه *E. isfahaniensis* به عنوان مترادف گونهٔ *E. ottava* در نظر گرفته شد.

واژگان کلیدی: توصیف، گونهٔ جدید، کنهٔ شکارگر، راستهٔ پیش‌سفتیان، شمال‌غرب ایران.

اطلاعات مقاله: تاریخ دریافت: ۱۴۰۲/۸/۹، تاریخ پذیرش توسط ع. صبوری: ۱۴۰۲/۱۱/۱۳، تاریخ چاپ: ۱۴۰۳/۱/۲۷