

Review of the family Veigaiidae (Acari: Mesostigmata) in Iran with a key to the species

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Abstract: Four species of veigaiid mites were collected from Guilan province in Northern Iran. This paper provides a checklist for veigaiid mites species recorded from Iran, with a key for identification of the species.

Keywords: Gamasida; veigaiid mites; key; new record; Iran.

1 Introduction

Mites of the family Veigaiidae Oudemans, 1939 (Mesostigmata: Veigaiioidea) comprises free-living predator species. These mites live in the upper soil surface, in the litter of forests, moss, decaying organic matter, often found in nests of ants, birds, and rodents (Karg, 1965; Evans and Till, 1979; Hurlbutt, 1984; Solomon, 1985; Karg and Freier, 1995; Lindquist et al., 2009; Ács and Kontschán, 2015). They mainly prey on eggs or larvae of small insects, smaller mite species, nematodes, and collembolans (Karg, 1961; Hurlbutt, 1965; Lindquist et al., 2009; Ács and Kontschán, 2015). The family is generally having three accepted genera, namely *Cyrthydroaelaps* Berlese, 1905, *Gamasolaelaps* Berlese, 1904 and *Veigaia* Oudemans, 1905 (Lundquist et al., 2009). Taxonomic information about the family is available from different regions of the world, including: America (Farrier, 1957), Africa (Hurlbutt, 1979), Europe (Willmann, 1936; Evans, 1955; Bregetova, 1961; Karg, 1993; Salmane and Kontschán, 2005a; Mašán et al., 2008; Ács and Kontschán, 2015), Australia and New Zealand (Womersley, 1956), Caucasus (Petrova and Makarova, 1989), China (Ma, 1996). Compared with the other mite families of Iran, data on the family Veigaiidae is incomplete and scattered. Seven species have been reported in the literature (Kazemi and Rajaei, 2013; Nemati et al., 2018; Hajizadeh et al., 2020; Ghasemi and Hajizadeh, 2021). A checklist and

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an identification key to the seven species of Veigaiidae of Iran is provided, based on published records and collected material.

2 Materials and Methods

Veigaiid mites were collected from soil and plant litter samples in Guilan province, Northern Iran. Each soil or litter sample contained about 2 kg that was taken to a depth of 15 cm. Mites were extracted from samples using Berlese funnels. Specimens were sorted and preserved in 70% ethanol, cleared in Nesbitt's fluid and mounted permanently on microscope slides using Hoyer's medium. The veigaiid mites were identified by the relevant taxonomic keys and papers (Evans, 1955; Farrier, 1957; Bregetova, 1961; Athias-Henriot, 1961; Gilyarov, 1977; Karg, 1993; Tseng, 1994; Mašán et al., 2008). We also made a search of the literature on the family Veigaiidae of Iran published to date, using electronic and printed data sources. For precise inspection of morphological characters of prepared specimens, a compound Olympus microscope (Olympus Optical Co., Ltd, Tokyo, Japan) equipped with differential interference contrast and phase contrast optical system, Canon camera (EOS Kiss X5; Japan) was used. The voucher specimens of each species were preserved as slide-mounted specimens in the Acarology Laboratory, Department of Plant Protection, Faculty of Agricultural Sciences at University of Guilan, Rasht, Iran.

3 Results and Discussion

3.1. Checklist of the Iranian veigaiid mites' species:

- . Superfamily Veigaiioidea
- . Family Veigaiidae Oudemans, 1939
- . Genus *Gamasolaelaps* Berlese, 1904
- . *Gamasolaelaps excisus* Koch, 1879 (Fig. 1)
- . *Sejus excisus* Koch, 1879: 37.

Material examined: 1 ♀, Guilan Province, Rasht, Bijar Boneh Village (37°18'10"N, 49°39'10"E, -6 m), collected from soil, 25.04.2019.

Habitat and distribution in Iran: Guilan Province, soil (Ghasemi and Hajizadeh, 2021).

World Distribution: Siberia, Ireland, Africa, USSR, Caucasus (Bregetova, 1961, 1977; Hurlbutt, 1983).

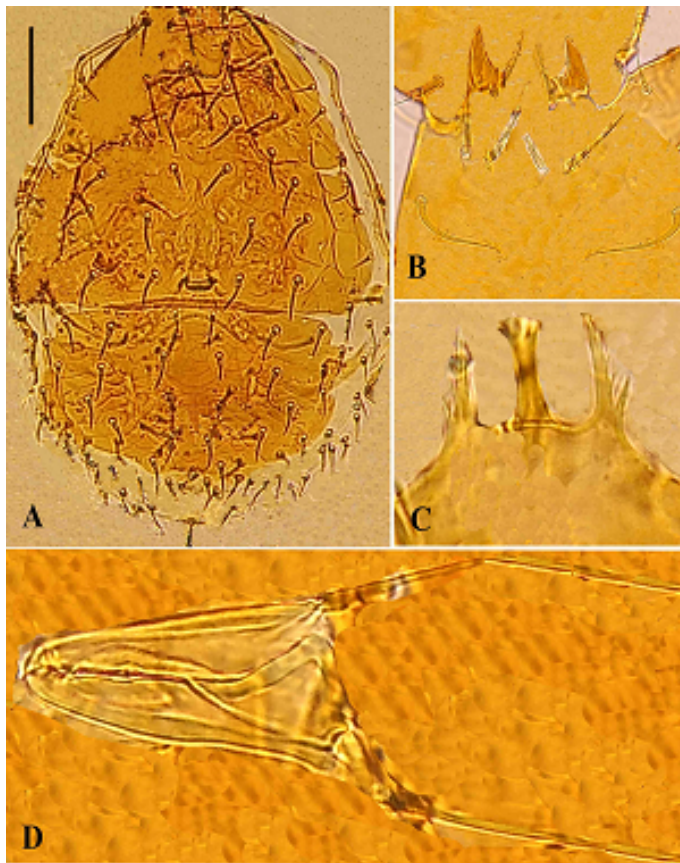


Figure 1: *Gamasolaelaps excisus* (Koch, 1879), female: A-Idiosoma, dorsal view B-Basis capitulum; C-Epistome; D-Chelicerae. Scale bar: 70 μm for A; B, C and D not scaled.

- . *Gamasolaelaps whartoni* Farrier, 1957 (Fig. 2)
- . *Gorirossia whartoni* Farrier, 1957: 91
- . *Gamasolaelaps pygmaeus* Bregetova, 1961; *Gorirossia cooki* Woodring, 1964; *Gamasolaelaps ctenisetiger* Ishikawa, 1978.

Material examined: 15 (♀ ♀) and 1 Deutonymph, Guilan Province, Lahijan (37°12'0"N, 50°0'0"E, 94m), collected from soil of tea [*Camellia sinensis* (L.)] garden, 16. 9. 2022.

Habitat and distribution in Iran: Mazandaran Province, Nowshahr (Ecological Garden), soil and litter (Saber et al. 2016).

World Distribution: Japan, USA, USSR, Taiwan, Africa (Farrier, 1957; Bregetova, 1961; Ishikawa, 1978; Tseng, 1994).

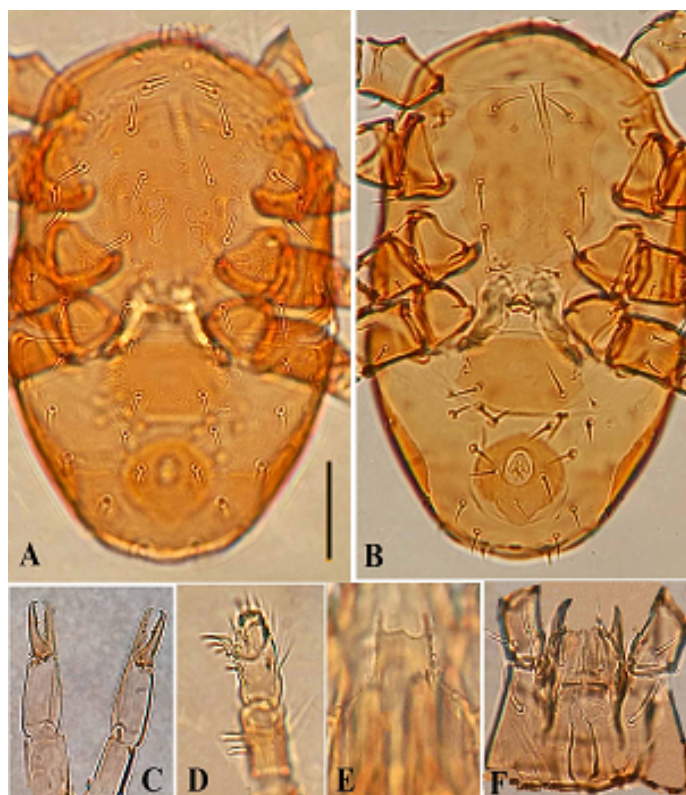


Figure 2: *Gamasolaelaps whartoni* (Farrier, 1957), female: A–Idiosoma, dorsal view; B–Idiosoma, ventral view; C–Chelicerae; D–Palp; E–Epistome; F–Basis capitulum. Scale bar: 60 μm for A and B; C, D, E and F not scaled.

- . Genus *Veigaia* Oudemans, 1905
- . *Veigaia decurtata* Athias-Henriot, 1961
- . *Veigaia decurtata* Athias-Henriot, 1961: 413.

Habitat and distribution in Iran: Fars Province, Koohmare-Sorkhi Region, oak forests, soil and leaf litter (Kazemi and Yazdanpanah, 2013; Yazdanpanah and Kazemi, 2014; Sadat Shojaei and Kazemi, 2021); Yazd Province, soil (Kafi et al., 2014); Isfahan Province, Goldasht, foliage of trees, weeds and soil of orchards (Jalaeian, et al., 2004).

World Distribution: Spain, Algeria, USSR, Georgia (Athias-Henriot, 1961; Bregetova, 1961, 1977).

- . *Veigaia exigua* Berlese, 1916 (Fig. 3)
- . *Cyrtolaelaps exiguus* Berlese, 1916: 300
- . *Veigaia exiguus* Evans, 1955; *Veigaia decurtata*, Athias-Henriot, 1961.

Material examined: 1 (♀), Mahvizan-Someh Sara, 37°18'23.01"N, 49°11'28.01"E, 26 m, collected from soil of tea [*Camellia sinensis* (L.)] garden, October 2018; 1 (♀), Divshal-Langarud, 37°10'34.27"N, 50°06'21.94"E, 199 m, collected from soil of tea garden, January 2019.

Habitat and distribution in Iran: Kerman Province, Sirjan and Mahan, soil and leaf litter (Masnavipour et al., 2011; Masnavipour et al., 2014; Mojaz and Kazemi, 2020); East Azarbaijan Province, Arasbaran forests, soil, leaf-litter and plant debris (Ordoukhanian et al, 2017); Fars Province, Sepidan, foliage, soil, leaf-litter, weeds and soil of apple trees (Maneshi et al., 2012; Sadat-Shojaei and Kazemi, 2021).

World Distribution: Slovakia, Bulgaria, Irish, England, Africa, Algeria, USA, USSR, Italy (Farrier, 1957; Athias-Henriot, 1961; Bregetova, 1961, 1977; Till, 1988; Mašan et al., 2008; Hurlbutt, 1983).

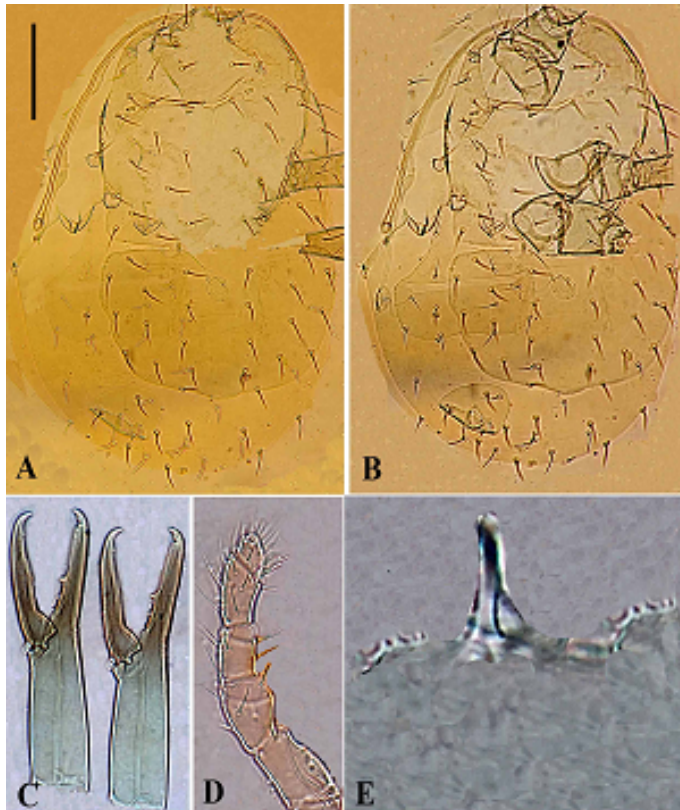


Figure 3: *Veigaia exigua* (Berlese, 1916), female: A–Idiosoma, dorsal view B–Idiosoma, ventral view; C–Chelicerae; D–Palp; E–Epistome. Scale bar: 60 μm for A and B; C, D and E not scaled.

- . *Veigaia nemorensis* (Koch, 1839).
- . *Gamasus nemorensis* Koch, 1839: 18.

Gamasus nemorensis Kramer, 1876; *Gamasus nemorensis* Canestrini, 1882; *Cryptolaelaps nemorensis* Berlese, 1892; *Cryptolaelaps nemorensis* Oudemans, 1902; *Cryptolaelaps kochi* Tragardh, 1901; *Veigaia nemorensis* Willmann, 1936; *Veigaia kochi* Willmann, 1936; *Veigaia nemorensis* Schweizer, 1949; *Veigaia selnickii* Mihelčič, 1958; *Veigaia nemorensis* Bregetova, 1961; 1977.

Habitat and distribution in Iran: Hamedan Province, Sarab Gamasiab of Nahavand vicinity; Ganjnameh Region, soil and litter of Chicory, *Cichorium intybus* L., soil of fruit trees and weeds (Rostami et al., 2010; Masoudian and Khanjani, 2013); Fars Province, Koohmare-Sorkhi Region, oak forests, soil and leaf litter (Kazemi and Yazdanpanah, 2013; Yazdanpanah and Kazemi, 2014; Abolghasemi and Kazemi, 2016); Lorestan Province, Makhmalkooh District, soil under willow tree (Hasanvand et al., 2014b); Zanjan Province, soil (Bigdeli et al., 2014); Chaharmahal va Bakhtiari Province, ants nest and *Fomes* sp., soil of ant nests, *Tapinoma* sp. (Hym. Formicidae), soil of corn and rape seed farms (Moradian et al., 2011; Khalili-Moghadam and Nemati, 2014a; Khalili-Moghadam and Saboori, 2015; Khalili-Moghadam, 2022); East Azarbaijan Province, Arasbaran forests, soil and plant debris, leaf-litter (Mohammad-Dustar-Sharaf et al., 2016; Ordoukhanian et al., 2017). Fars Province, leaf-litter (Sadat Shojaei and Kazemi, 2021); Kermanshah Province, Rijab, soil of fruit orchards (Babakfard et al. 2008).

World Distribution: Slovakia, Bulgaria, Irish, UK, Africa, Algeria, USA, USSR (Evans, 1955; Farrier, 1957; Athias-Henriot, 1960; Bregetova, 1961; 1977; Hurlbutt, 1983; Till, 1988; Mašán et al., 2008).

- . *Veigaia planicola* Berlese, 1892 (Fig. 4)
- . *Crytolaelaps nemorensis* var. *planicoa* Berlese, 1892: 61
- . *Veigaia planicola* Evans, 1955; *Veigaia serrata* Willmann, 1936.

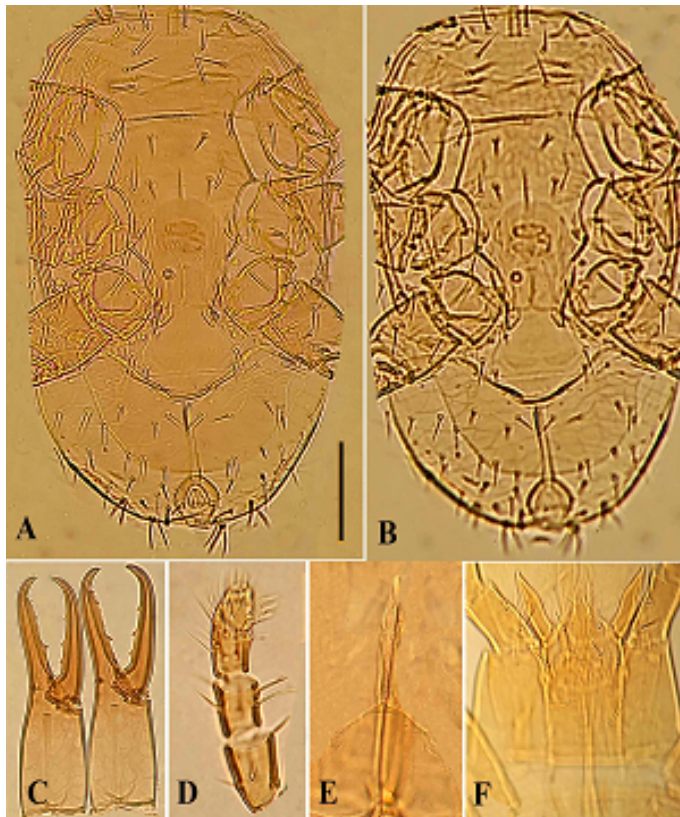


Figure 4: *Veigaia planicola* (Berlese, 1892), female: A–Idiosoma, dorsal view; B–Idiosoma, ventral view; C–Chelicerae; D–Palp; E–Epistome; F–Basis capitulum. Scale bar: 100 μ m for A and B; C, D, E and F not scaled.

Material examined: 1 (♀), Siahkal, 37°08'53.63"N, 49°52'49.18"E, 53 m, collected from soil of tea garden, October 2018; 1 (♀), Amlash, 37°5'20.21"N, 50°8'53.77"E, 76 m, collected from soil of tea garden, December 2019; 1 (♀), Otaghvar-Langarud, 37°5'4.19"N, 50°5'12.60"E, 90 m, collected from soil, December 2019; 1 (♀) Rahimabad-Rudсар, 37°0'27.61"N, 50°16'56.13"E, 392 m, collected from soil of tea garden, November 2019; 1 (♀), Amlash, 37°3'40.69"N, 50°6'54.18"E, 134 m, collected from soil of tea garden, December 2019; 1 (♀), Lahijan (37°12'00"N, 50°00'E, 94m), collected from soil of tea garden, 10.10.2018; 1 (♀), Rasht County, Saravan Forest Park, 37°05'48.1"N, 49°38'46.4"E, collected from soil 18.6.2007; 1 (♀), Sowme'eh Sara County, Baham Bar village (37°27'46"N, 49°14'41"E) collected from soil, 5.7.2007; 1 (♀), Fuman County, Masouleh village, 37°09'18"N, 48°59'23"E, collected from soil of walnut tree, 20.9.2007; 1 (♀), Talesh County, Gisum village, 37°39'49"N, 49°01'18"E, soil of pine tree, 15.5.2008; 1 (♀), Talesh County, Chubar village, 38°10'49"N, 48°53'36"E, soil of pine tree, 5.8.2008; 3 (♀ ♀) Rasht County, Lakan village, 37°12'18"N, 49°35'17"E, soil of tea garden, 7.9.2008; 1 (♀), Khomam, city, 37°23'21"N, 49°39'30"E, soil of elm garden, 19.8.2008; 3 (♀ ♀), Langarud, Parashkuh village, 37°08'55"N, 50°09'40"E, 90 m, collected from soil of citrus and tea gardens, 6.10.2011; 2 (♀ ♀), Rudсар County, Qasemabad village, 37°00'02"N, 50°29'25"E, collected from soil of citrus garden, 9.7.2011; 2 (♀ ♀), Rasht, 37°16'51"N, 49°34'59"E, collected from

soil of mulberry garden, 14.8.2008; 1 (♀), Fuman County, Masuleh, 37°21'21"N, 48°58'42"E, collected from soil of mulberry garden, 30.8.2007.

Habitat and distribution in Iran: Lorestan Province, Bishe District, soil under cedar tree (Hasanvand et al., 2014b); East Azarbaijan Province, Tabriz, soil and foliage of poplar and elm trees (Rahbar Shahlan, et al., 2014); Arasbaran Forests, soil, leaf-litter and plant debris (Mohammad-Dustar-Sharaf et al., 2016; Ordoukhanian et al., 2017); Chaharmahal va Bakhtiari Province, Lordegan, Khanmirza Region, Salehat Village, Cheshmeh khani Villages, soil from different parts of oak forests (Bagheri Kordeshami et al., 2015); Saman), soil (Shariati et al., 2017); associated with ants (Khalili-Moghadam, 2022); Lordegan, soil of oak forest (Bagheri-Kordeshami et al., 2015); Fars Province, Koochmare-Sorkhi Region, oak forests, soil and debris (Abolghasemi and Kazemi, 2016); Estahban, soil, leaves, fruits, and trunk of fig trees (Daneshnia and Akrami, 2013); leaf-litter (Sadat Shojaei and Kazemi, 2021); Mazandaran Province, Nowshahr, Botanical garden of Nowshahr, soil and litter (Sabeti et al., 2016); North Khorasan Province, in the nests of *Tapinoma* sp. (Formicidae) (Rezaei et al., 2016). Isfahan Province, Najaf Abad). Foliage of trees, weeds and soil of orchard (Jalaeian, et al., 2004a); Kashan, Soil (Sekonji et al., 2011); Tehran Province, Tehran, Shahid Beheshti University Campus, Soil (Kamali et al., 2004); Kermanshah Province, Rijab, fruit orchards (Babakfard et al., 2008); West Azerbaijan Province, Salmas, soil and plant debris of apple orchards (Alizadeh and Shirdel, 2012). Kerman province (Mojaz and Kazemi, 2020).

World Distribution: Italia, England, Belgium, Slovakia, Bulgaria, Taiwan, Irish, UK, Africa, USA, USSR (Farrier, 1957; Hurlbutt, 1965; Bregetova, 1961, 1977; Hurlbutt, 1983; Till, 1988; Tseng, 1994; Mašán et al., 2008).

- . *Veigaia uncata* Farrier, 1957
- . *Veigaia uncata* Farrier, 1957: 82

Habitat and distribution in Iran: Mazandaran Province, Nowshahr, Botanical garden of Nowshahr, soil and litter (Sabeti et al., 2014; Sabeti et al., 2016).

World Distribution: USA, USSR, Africa, Madagascar, India (Farrier, 1957; Bregetova, 1961; Bregetova 1977; Hurlbutt, 1983).

Key to genera and species of *Veigaiidae* from Iran (females):

1. Genital shield absent, ventral shield reduced to a small plate.....*Gamasolaelaps*(Berlese)...2.
- Genital and ventral shields present; ventral shield broad.....*Veigaia Oudemans*...3.
2. SMovable digit of chelicerae with 2 teeth; genitoventral shield with five long setae (Fig. 1).....*Gamasolaelaps excisus* (Koch, 1879).
- Movable digit of chelicerae with more than 5 teeth; genitoventral shield with 2 pairs of short and one pair of long setae (Fig. 2).....*Gamasolaelaps whartoni* Farrier, 1975.
3. Dorsum with separate podonotal and opisthonotal shields.....4.

- Dorsum with a single laterally incised schizodorsal shield.....5.
4. Fixed digit of chelicerae with 22-24 teeth; genital and ventral shields completely separated by a transverse suture; ventral shield with five pairs of setae (Jv2, Jv3, Zv2, Zv3, Lv3) (Fig. 4).....*Veigaia planicola* (Berlese, 1892).
- Fixed digit of chelicerae with 2 teeth; genital and ventral shields not completely separated by a transverse suture; ventral shield with four pairs of setae (Jv2, Jv3, Zv2, Zv3).....*Veigaia nemorensis* (Koch, 1839).
5. Femur IV with strong hook-like protuberance; dorsal shield setae heterogeneous 4 pairs (j1, j4, z5, r3) long, the rest are short and moderately long; posterior margin of peritremal plate sharply pointed; ventral surface of femur IV with round puncta from base to apex.....*Veigaia uncata* Farrier, 19574.
- Femur IV without protuberance, dorsal shield setae not heterogeneous;.....6.
6. Lateral projections of epistome widened and with well-differentiated anterior margin widely rounded and densely serrate (Fig. 3).....*Veigaia exigua* (Berlese, 1916).
- Lateral projections of epistome evenly wide, with a serrated, apex.....*Veigaia decurtata* Athias-Henriot, 1961.

4 Conclusion

The mites of the family Veigaiidae of Iran are poorly known. Most of the recorded species were collected marginally during investigation for other mesostigmatid mites. Therefore, it is expected that more species will be collected and reported from Iran. The purpose of this article is introduction and providing an identification key for the recorded species of the family Veigaiidae in Iran. It is expected that this review will be useful for future Iranian acarologists. Further investigations on taxonomy, ecology, habitat preferences, and biological interactions of veigaiid mites with other species in Iran would be of considerable value.

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Conflict of interests

The authors declare that there are no conflict of interest

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