

Research Article

Faunal study of oribatid mites (Acari, Oribatida) associated with citrus orchards in Bushehr Province, southwestern Iran, with new records

Mohammad Ali Akrami¹  & Hamid Barzegar Tavana¹ ¹. Department of Plant Protection, School of Agriculture, Shiraz University, Shiraz, Iran

Abstract. In a survey of oribatid mites (Oribatida) associated with citrus orchards in Bushehr Province (southwestern Iran), soil and litter samples were collected from seven localities in Dashtestan, Tangestan, Dashti and Jam counties between October 2021 and July 2022. A total of 27 species belonging to 22 genera and 16 families were collected and identified. Among them, the genus *Annectacarus* Grandjean, 1950 (Lohmanniidae), the species *Peloptulus* (*P.*) *reticulatus* Mihalčič, 1957 (Phenopelopidae), and *Neoppia* cf. *minuta* Bhattacharya & Banerjee, 1981 (Oppiidae) are recorded for the first time from Iran. Galumnidae, Oppiidae, and Lohmanniidae (each with three genera), as well as the families Scheloribatidae, Epilohmanniidae, and Euphthiracaridae (each with two species), showed the highest total identified species in the citrus orchards of the province. All recorded species are new records for Bushehr Province. Prior to the present study, no information was available on the oribatid mite fauna associated with citrus orchards in southwestern Iran.

Keywords: Mite, Sarcoptiformes, fauna, Rutaceae, distribution, Persian Gulf

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Corresponding author: Mohammad Ali Akrami

E-mail: akrami@shirazu.ac.ir

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Introduction

Oribatida (oribatid mites, moss mites, beetle mites, or armored mites), with a body size ranging from 200–1,400 µm, is a suborder of mites (subclass Acari) belonging to the superorder Acariformes and the order Sarcoptiformes. The Oribatida comprises more than 11,600 described species and subspecies worldwide, mainly distributed in the Palaearctic region (approximately 4,000 species) (Subías, 2004; updated 2024). However, the total number of species has been estimated to range from 50,000 to 100,000 (Schatz & Behan-Pelletier, 2008). Southern Iran (including parts of Sistan & Baluchestan, Kerman, Fars, Hormozgan and Bushehr Provinces) is one of the least investigated regions of the country with respect to taxonomic studies of its oribatid mite fauna. During a taxonomic investigation of oribatid mites in southwestern Iran, several specimens were collected. A total of 27 species are reported here, including one genus (*Annectacarus* Grandjean, 1950, Lohmanniidae) and two species (*Peloptulus* (*P.*) *reticulatus* Mihalčič, 1957, Phenopelopidae; *Neoppia* cf. *minuta* Bhattacharya & Banerjee, 1981, Oppiidae) recorded for the first time in the Acari fauna of Iran. All other genera and species are recorded for the first time from Bushehr Province. Specimens were collected over a 10-month period, from October 2021 to July 2022, from soil and litters beneath citrus trees.

Bushehr Province is located in southwestern Iran, between 27°17' and 30°17' N latitude and 50°08' and 52°58' E longitude. The province covers an area of 27,653 km², has more than 700 km of maritime border along the Persian Gulf. It is bordered by Khuzestan and Kohgiluyeh & Boyerahmad Provinces to the north, Hormozgan Province to the south, Fars Province to the east, and the Persian Gulf to the west and south. Elevation ranges from sea level to Birmi Peak (1,960 m a.s.l.). The climate is generally hot and dry particularly in the interior regions, whereas coastal regions experience hot and humid conditions. The average annual precipitation is about 220 mm. The province consists of 10 counties and sampling was conducted in Dashtestan, Tangestan, Dashti and Jam

counties. Prior to this research, information on the oribatid mite fauna of Bushehr Province was very limited. A brief survey by Alikhani *et al.* (2013) reported only one species, *Damaeolus asperatus* (Berlese, 1904) (Damaeolidae), from soil under meadow vegetation in the southern part of the province (Assaluyeh Port). In another study, three species—*Ramusella (R.) clavipectinata* (Michael, 1885) (= *Oppia assimilis* Mihelčič, 1956), *Oppia (O.) nitens* Koch, 1835 and *Discoppia (Cyliandroppia) cylindrica rostrata* Subías & Rodríguez, 1986 (Oppiidae)—were collected from soil beneath date palm trees (*Phoenix dactylifera*) in Borazjan county (unpublished data). The present study aims to investigate the oribatid mite fauna associated with citrus orchards in selected areas of Bushehr Province.

Materials and methods

Soil and litter samples were collected from 79 sampling points in citrus orchards between October 2021 and July 2022 at seven locations (Table 1, Fig. 1) in Bushehr Province, by H. Barzegar Tavana, using a standard soil sampling technique. The oribatid mites were studied by collecting five samples (each sample consisted 2–4 trowels) in each orchard, taken from the surface to a soil depth of 15 cm. Mites were extracted using a modified Berlese funnel, cleared in Lactophenol, and mounted in Hoyer's medium on glass microscope slides for identification. The slides were placed in an oven at 45°C for one month, after which the specimens were examined under a light microscope (Zeiss Standard 20). The taxonomic classification follows Subías (2024). Data on local and general distributions were compiled from relevant records (Akrami, 2015; Akrami & Saboori, 2021; Arbab & Akrami, 2023; Subías, 2024; Akrami & Eskandari-Nasab, 2025). All specimens are deposited in the Acarological Collection of the Department of Plant Protection, School of Agriculture, Shiraz University, Shiraz, Iran. Samples collected from *Citrus* spp. (family Rutaceae) were categorized according to host plant species as follows: orange trees: *Citrus sinensis* (CS); lemon: *Citrus limon* (CL); lime: *Citrus limetta* & *C. aurantifolia* (CA); grapefruit: *Citrus paradisi* (CP); and tangerine: *Citrus reticulata* (CR).

Results

During this study, 27 species belonging to 22 genera and 16 families of oribatid mites were collected and identified, of which one genus and two species are recorded for the first time from Iran. As most of the species reported here are well recognized, their descriptions are not provided. The abbreviations used refer to the scientific names of the host plants in the sampling habitats (see Materials and methods section for sampling data and abbreviations). The species listed below are arranged according to their taxonomic classification at the family level.

Taxonomic hierarchy

Phylum Arthropoda von Siebold, 1848

Order Sarcoptiformes Reuter, 1909

Suborder Oribatida van der Hammen, 1968

Family Euphthiracaridae Jacot, 1930

Genus *Acrotritia* Jacot, 1923

Acrotritia penicillata (Pérez-Íñigo, 1969)

Syn. *Acrotritia pirovaci* Niedbała, 2006

Material examined. Five specimens. Iran, Bushehr Province, Dashtestan county, Derang: CL, Faryab: CL; Tangestan county, Khaeiz: CR.

Zoogeographical distribution. Southern Palaearctic.

Distribution in Iran. East Azerbaijan, Fars, Guilan, Kerman, Kermanshah, Sistan & Baluchestan and Yazd Provinces.

Distribution in Iran. Sistan & Baluchestan and Yazd Provinces.

Family Phthiracaridae Perty, 1841

Genus *Hoplophorella* Berlese, 1923

Subgenus *Hoplophorella* (*Hoplophorella*) Berlese, 1923

Hoplophorella (*Hoplophorella*) *vitrina* (Berlese, 1913)

Material examined. Three specimens. Iran, Bushehr Province, Dashtestan county, Derang: CL.

Zoogeographical distribution. Pantropical and Subtropical.

Distribution in Iran. Hormozgan and Sistan & Baluchestan Provinces.

Family Lohmanniidae Berlese, 1916

Genus *Annectacarus* Grandjean, 1950

Annectacarus sp.

Material examined. Two specimens. Iran, Bushehr Province, Jam county, Jam(a): CR (**New generic record for Iran**).

Remarks. The genus *Annectacarus* was proposed by Grandjean (1950) with *Annectacarus mucronatus* Grandjean, 1950 as type species from Venezuela. The main generic traits are: genital plates without transverse suture; anal and adanal plate fused; preanal plate narrow; two pairs of anal setae; four pairs of adanal setae; notogastral neotrichy present, setae setiform (Grandjean, 1950). Presently, the genus comprises 19 species, which are described from following localities, distributed in the Ethiopian, Neotropical and Oriental regions and Polynesia: *A. parallelus* from Somalia (Berlese, 1916), *A. africanus* from East Africa (Balogh, 1961), *A. insculptus* and *A. sejugatus* from Ghana (Wallwork, 1962), *A. unilateralis* from Tongatanu Island (Hammer, 1973), *A. longisetosus* from West Bengal, North India (Bhattacharya *et al.*, 1974), *A. trivandricus* from South India (Haq, 1978), *A. mahabaeus* from the Philippines (Corpuz Raros, 1979), *A. perezinigo* from Cuba (Călugăr & Vasiliu, 1983), *A. granditrichosus* from Truk and Saipan, Indonesia (Sengbusch, 1984), *A. hainanensis* from China (Hu & Wang, 1990), *A. wallworki* from Kerala, South India (Adolph & Haq, 1991), *A. aokii* from South India (Jaikumar *et al.*, 1994), *A. krachan* from Thailand (Mahunka, 1995), *A. eksteeni* from South Africa (Coetzee, 2001), *A. hammerae* from Kerala (Shiji, *et al.*, 2007), *A. vinalesensis* from Cuba (Ermilov & Tolstikov, 2015) and *A. tanzanicus* from Tanzania (Ermilov & Khaustov, 2019).

The specimen collected during the present study can be distinguished by the following characters: Body size: 500 × 297 µm. Body surface with dense microfoveolae; macropolygonal pattern absent. Rostrum with deep indentation and median small tooth. Prodorsal setae long, thickened, ciliate; rostral setae curved downward. Bothridial setae pectinate, with 25 well-developed branches. Transverse bands reduced, represented by round and oval parts on prodorsum, notogaster and epimeres. Notogaster with 16 pairs of primary and five pairs of neotrichal setae; centro-dorsal setae c_1 , d_1 , e_1 , f_1 short, setiform, smooth; neotrichal setae b_{1-3} short, setiform, ciliate; other setae long, thickened, ciliated unilaterally with flagellate tips. Epimeral setal formula: 6–4–3–4. Anogenital setal formula: 10–0–2–4; three pairs of genital setae smooth, other seven pairs ciliated.

Genus *Lohmannia* Michael, 1898

Subgenus *Lohmannia* (*Lohmannia*) Michael, 1898

Lohmannia (*Lohmannia*) *turcmenica* Bulanova-Zachvatkina, 1960

Material examined. One specimen. Iran, Bushehr Province, Jam county, Jam(a): CR.

Zoogeographical distribution. Tropical: Oriental (Southeastern China); Neotropical (Argentina); and Subtropical (Southern Palearctic).

Distribution in Iran. East Azerbaijan, Fars, Guilan, Hamadan, Hormozgan, Khuzestan, Kurdistan, Markazi, Mazandaran, Razavi Khorasan, Sistan & Baluchestan, West Azerbaijan and Zanzan Provinces.

Genus *Papillacarus* Kunst, 1959

Papillacarus sp.

Material examined. One specimen. Iran, Bushehr Province, Tangestan county, Khaeiz: CR.

Remarks. More specimens are needed for accurate identification.

Family Epilohmanniidae Oudemans, 1923

Genus *Epilohmannia* Berlese, 1916

Subgenus *Epilohmannia* (*Epilohmannia*) Berlese, 1916

Epilohmannia (*Epilohmannia*) *cylindrica cylindrica* (Berlese, 1904)

Material examined. 14 specimens. Iran, Bushehr Province, Dashtestan county, Derang: CL, CS, Borazjan(a): CL; Tangestan county, Khaeiz: CL, CP, CR; Dashti county, Dasht-e Palang: CL; Jam county, Riz: CL, CS.

Zoogeographical distribution. Cosmopolitan (Palearctic, Nearctic, Ethiopian: Chad and Yemen, Oriental, Australian: Hawaii and Neotropical).

Distribution in Iran. Alborz, East Azerbaijan, Esfahan, Fars, Golestan, Guilan, Hormozgan, Kerman, Kermanshah, Khuzestan, Kurdistan, Markazi, Mazandaran, Razavi Khorasan, Sistan & Baluchestan, Tehran, West Azerbaijan, Yazd and Zanzan Provinces.

Epilohmannia (*Epilohmannia*) *minuta aegyptica* Bayoumi & Mahunka, 1976

Syn. *Epilohmannia pallida aegyptica* Bayoumi & Mahunka, 1976

Material examined. 10 specimens. Iran, Bushehr Province, Dashtestan county, Derang: CL, Borazjan(a): CL, Faryab: CL; Tangestan county, Khaeiz: CL; Jam county, Riz: CL.

Zoogeographical distribution. Southern Palearctic (eastern Mediterranean and Iran) and Vietnam.

Distribution in Iran. Fars, Guilan, Hamedan, Hormozgan and Sistan & Baluchestan Provinces.

Family Nanhermanniidae Sellnick, 1928

Genus *Bicyrthermannia* Hammer, 1979

Bicyrthermannia duodentata Hammer, 1979

Material examined. One specimen. Iran, Bushehr Province, Tangestan county, Khaeiz: CL.

Zoogeographical distribution. Oriental (Indonesia & India: Kerala) and Iran.

Distribution in Iran. Sistan & Baluchestan Province.

Family Nothridae Berlese, 1896

Genus *Nothrus* Koch, 1835

Nothrus anauniensis Canestrini & Fanzago, 1877

Material examined. Five specimens. Iran, Bushehr Province, Tangestan county, Khaeiz: CL; Dashtestan county, Faryab: CL.

Zoogeographical distribution. Cosmopolitan (except Antarctic).

Distribution in Iran. East Azerbaijan, Fars, Guilan, Hamadan, Hormozgan, Kerman, Kermanshah, Khuzestan, Kurdistan, Lorestan, Markazi, Mazandaran, Sistan & Baluchestan, Tehran, West Azerbaijan, Yazd and Zanzan Provinces.

Family Oppiidae Sellnick, 1937

Genus *Discoppia* Balogh, 1983

Subgenus *Discoppia* (*Cylindroppia*) Subías & Rodríguez, 1986

Discoppia (*Cylindroppia*) *cylindrica rostroincisa* Subías & Rodríguez, 1986

Material examined. One specimen. Iran, Bushehr Province, Dashtestan county, Borazjan(b): CA.

Zoogeographical distribution. Central-Western Europe, Dominican Republic, Tanzania and Iran.

Distribution in Iran. Bushehr, Hormozgan, Khuzestan and Sistan & Baluchestan Provinces.

Genus *Neoppia* Bhattacharya & Banerjee, 1981 (= *Antilloppia* Mahunka, 1985)

Neoppia cf. *minuta* Bhattacharya & Banerjee, 1981

Material examined. Two specimens. Iran, Bushehr Province, Dashtestan county, Borazjan(b): CA.

Remarks. Prior to this study, only *N. discreta* Ruiz, Mínguez & Subías, 1988 has been reported from northwestern Iran within this genus. The specimen collected from Bushehr Province shows distinct differences from that species and is therefore recorded as **new to the Iranian fauna**. *Neoppia minuta* is distributed in the Oriental region (India: West Bengal) and Philippines. Additional specimens are required for accurate identification.

Genus *Oppia* Koch, 1835

Subgenus *Oppia* (*Lasiobelba*) Aoki, 1959

Oppia (*Lasiobelba*) *kuehnelti* Csiszár, 1961

Syn. *Cilioppia pori* Vasiliu & Ivan, 1995

Syn. *Oppia yodai* Aoki, 1965

Material examined. 27 specimens. Iran, Bushehr Province, Tangestan county, Khaiez: CL; Dashtestan county, Borazjan(a): CL, Borazjan(b): CL, CR, Faryab: CL; Dashti county, Dasht-e Palang: CR, CA, CL; Jam county, Riz: CL, CR, Jam: CR.

Zoogeographical distribution. Tropical: Oriental, Australian and Ethiopian; Southern Palaearctic: Eastern Mediterranean and Iran.

Distribution in Iran. Alborz, East Azerbaijan, Fars, Kerman, Khuzestan, Mazandaran and Yazd Provinces.

Family Tectocephidae Grandjean, 1954

Genus *Tectocephus* Berlese, 1896

Tectocephus velatus (Michael, 1880)

Material examined. Four specimens. Iran, Bushehr Province, Dashtestan county, Derang: CL; Tangestan county, Khaiez: CL.

Zoogeographical distribution. Cosmopolitan.

Distribution in Iran. Alborz, East & West Azerbaijan, Fars, Guilan, Hamadan, Hormozgan, Kerman, Kermanshah, Khuzestan, Kurdistan, Markazi, Mazandaran, Razavi Khorasan, Sistan & Baluchestan, Tehran, Yazd and Zanzan Provinces.

Family Microzetidae Grandjean, 1936

Genus *Berlesezetes* Mahunka, 1980

Berlesezetes sp.

Material examined. Two specimens. Iran, Bushehr Province, Dashtestan county, Borazjan(b): CA; Tangestan county, Khaiez: CA.

Remarks. More specimens are needed for accurate identification.

Family Phenopelopidae Petrunkevitch, 1955**Genus *Peloptulus* Berlese, 1908****Subgenus *Peloptulus* (*Peloptulus*) Berlese, 1908**

Peloptulus (*Peloptulus*) *reticulatus* Mihelčič, 1957

Material examined. Four specimens. Iran, Bushehr Province, Tangestan county, Khaiez: CP, CL; Dashtestan county, Borazjan(a): CL.

Zoogeographical distribution. Western Palaearctic (except the northern regions)

Distribution in Iran. Bushehr Province (**New record for Iran**).

Remarks. The genus *Peloptulus* was established by Berlese (1908), with *Pelops phaeonotus* Koch, 1844 as the type species. Akrami & Keshavarz Jamshidian (2019) reported this genus from Iran for the first time, recording *Peloptulus* (*P.*) *phaeonotus* (Koch, 1844) from soil beneath apple trees in Savojbolagh (Alborz Province). Subsequently, Rahgozar *et al.* (2018) recorded *Peloptulus* (*P.*) *denticuspidatus* Bayartogtokh & Aoki, 1999 from soil and litter under apple and walnut trees in East Azerbaijan Province. The specimen collected during the present study can be distinguished by the following characters: Body length 515 – 595 µm; rostrum narrow, rounded; lamellae broad with distinct translamella. Bothridial setae claviform with long stalk; interlamellar setae moderately short. Notogastral setae bacilliform, slightly thickened tips spinulated. Octotaxic system formed by four pairs of small areae porosae, as typical in Phenopelopidae. Notogastral cuticle with a net-like (=reticulated) pattern (Weigmann, 2008). Mihelčič (1957) found this species in a dry soil among thyme plants near Aranjuez (50 km south of Madrid).

Family Galumnidae Jacot, 1925**Genus *Cryptogalumna* Grandjean, 1957**

Cryptogalumna sp.

Material examined. One specimen. Iran, Bushehr Province, Dashti county, Dasht-e Palang: CA.

Remarks. More specimens are needed for accurate identification.

Genus *Galumna* Heyden, 1826**Subgenus *Galumna* (*Galumna*) Heyden, 1826**

Galumna (*Galumna*) *flabellifera* Hammer, 1958

Material examined. 24 specimens. Iran, Bushehr Province, Dashtestan county, Derang: CL, Borazjan(a): CL, Faryab: CL; Tangestan county, Khaiez: CL; Dashti county, Dasht-e Palang: CR, CL, CA; Jam county, Riz: CR, CL, Jam(a): CR, CS.

Zoogeographical distribution. Pantropical and Subtropical.

Distribution in Iran. Alborz, Fars, Hormozgan, Kerman, Kermanshah, Sistan & Baluchestan and Yazd Provinces.

Galumna (*Galumna*) *iranensis* Mahunka & Akrami, 2001

Material examined. Two specimens. Iran, Bushehr Province, Dashtestan county: CA.

Zoogeographical distribution. Iran.

Distribution in Iran. Alborz, East & West Azerbaijan, Fars, Hormozgan, Kerman, Kermanshah, Khuzestan, Mazandaran, Yazd and Zanzan Provinces.

Galumna (*Galumna*) *karajica* Mahunka & Akrami, 2001

Material examined. One specimen. Iran, Bushehr Province, Jam county, Riz: CL.

Zoogeographical distribution. Iran and Caucasus.

Distribution in Iran. Alborz, East & West Azerbaijan, Fars, Kerman, Markazi, Mazandaran, Razavi Khorasan, Sistan & Baluchestan, Yazd and Zanzan Provinces.

Genus *Pergalumna* Grandjean, 1936

Subgenus *Pergalumna* (*Pergalumna*) Grandjean, 1936

Pergalumna (*Pergalumna*) *sistanbaluchestanica* Akrami, 2021

Material examined. Four specimens. Iran, Bushehr Province, Jam county, Jam(b): CL; Dashtestan county, Borazjan(b): CL.

Zoogeographical distribution. Iran.

Distribution in Iran. Hormozgan and Sistan & Baluchestan Provinces.

Family Haplozetidae Grandjean, 1936

Genus *Baloghiella* Bulanova-Zachvatkina, 1972

Baloghiella *granulata* Bayartogtokh & Akrami, 2000

Material examined. One specimen. Iran, Bushehr Province, Dashtestan county, Derang: CL.

Zoogeographical distribution. Iran.

Distribution in Iran. East Azerbaijan, Fars, Hormozgan, Razavi Khorasan, Sistan & Baluchestan and Yazd Provinces.

Family Oribatulidae Thor, 1929

Genus *Oribatula* Berlese, 1896

Subgenus *Zygoribatula* Berlese, 1916

Oribatula (*Zygoribatula*) sp.

Material examined. One specimen. Iran, Bushehr Province, Dashtestan county, Borazjan(a): CL.

Remarks. More specimens are needed for accurate identification.

Family Scheloribatidae Grandjean, 1933

Genus *Scheloribates* Berlese, 1908

Subgenus *Scheloribates* (*Scheloribates*) Berlese, 1908

Scheloribates (*Scheloribates*) *fimbriatus* Thor, 1930

Material examined. 27 specimens. Iran, Bushehr Province, Dashtestan county, Derang: CL, Borazjan(a): CL, Borazjan(b): CR, Faryab: CL; Tangestan county, Khaeiz: CL, CR; Dashti county, Dasht-e Palang: CL, CA; Jam county, Riz: CL, Jam(a): CR, CS, Jam(b): CL.

Zoogeographical distribution. Pantropical and Subtropical.

Distribution in Iran. East & West Azerbaijan, Fars, Guilan, Hormozgan, Kerman, Kermanshah, Khuzestan, Mazandaran, Razavi Khorasan, Sistan & Baluchestan Yazd and Zanzan Provinces.

Scheloribates (Scheloribates) praeincisus (Berlese, 1910)

Material examined. 23 specimens. Iran, Bushehr Province, Dashtestan county, Derang: CL, Borazjan(a): CL, Borazjan(b): CL, CR, Faryab: CL; Dashti county, Dasht-e Palang: CA; Tangestan county, Khaeiz: CL, CR.

Zoogeographical distribution. Pantropical and Subtropical.

Distribution in Iran. East Azerbaijan, Fars, Guilan, Hormozgan, Kerman, Mazandaran, Sistan & Baluchestan, Yazd and Zanzan Provinces.

Family Oribatellidae Jacot, 1925

Genus *Lamellobates* Hammer 1958

Subgenus *Lamellobates* Hammer, 1958

Lamellobates (Lamellobates) molecula molecula (Berlese, 1916)

Syn. *Lamellobates hauseri* Mahunka 1977

Material examined. Five specimens. Iran, Bushehr Province, Tangestan county, Khaeiz: CL; Dashtestan county, Borazjan(a): CL; Jam county, Jam(a): CS.

Zoogeographical distribution. Pantropical and Subtropical.

Distribution in Iran. Hormozgan Province.

Family Protoribatidae J. & P. Balogh, 1984

Genus *Protoribates* Berlese, 1908

Subgenus *Protoribates* (Protoribates) Berlese, 1908

Protoribates (Protoribates) paracapucinus (Mahunka, 1988)

Material examined. 23 specimens. Iran, Bushehr Province, Dashtestan county, Derang: CL, Borazjan(a): CL, Faryab: CS; Tangestan county, Khaeiz: CL, CR; Dashti county, Dasht-e Palang: CL, CR; Jam county, Riz: CR, CL, Jam(a): CS.

Zoogeographical distribution. Tropical: Palaeotropical, Neotropical and Australian (New Hebrides [Vanuatu]); Subtropical: Eastern Palaearctic (Iran).

Distribution in Iran. Alborz, East & West Azerbaijan, Fars, Guilan, Hormozgan, Kerman, Kermanshah, Kurdistan, Lorestan, Markazi, Mazandaran, Razavi Khorasan, Sistan & Baluchestan, Tehran, Yazd and Zanzan Provinces.

Discussion

The first study of oribatid mites associated with *Citrus* spp. in Iran was conducted by Faraji & Kamali (1993) in Mazandaran Province, northern Iran. They reported only three families with undetermined species. Several years later, in faunistic surveys of oribatid mites associated with citrus orchards in this province, Asadolahzade Fathi *et al.* (2016) collected 12 species belonging to seven families. One of the most comprehensive studies on oribatid mites associated with *Citrus* orchards in Iran was conducted by Khademi & Saboori (2006), who reported a total of 17 species belonging to 16 families from Jahrom county in Fars Province. The present study represented the first taxonomic investigation of the suborder Oribatida associated with citrus orchards in Bushehr Province. Based on the results obtained, Galumnidae, Oppiidae, and Lohmanniidae (each with three genera), as well as Scheloribatidae, Epilohmanniidae, and Euphthiracaridae (each with two species), are the families with the highest total identified species in the citrus orchards of the province. Among the recorded species, more than half have a

tropical distribution; three species are cosmopolitan, two are distributed in the Palearctic region, three are known only from Iran, and one species is known from Iran and the Caucasus.

Despite sampling numerous citrus orchards in Bushehr Province, the number of oribatid mites obtained in this study is low. As mentioned, the climate in this province is hot and dry, with relatively low annual rainfall and, therefore, low soil moisture content. It seems that the diversity of mites can be affected by climate, and the responses of soil animals depend on microclimatic and climatic conditions and soil moisture content. Climatic factors explain a considerable amount of variation in the species composition of soil oribatid communities, and there is a positive association between oribatid mite communities and climatic features. Cool and wet conditions enhance both biomass and diversity of soil mesofauna, while warmer and drier conditions have negative effects on them (Gan, 2013; Haimi *et al.*, 2005). The present study focused only on oribatid mites associated with citrus orchards. Consequently, many habitats in Bushehr Province remain unexplored. Further faunistic surveys in other habitats are therefore necessary to better reveal the diversity and distribution of oribatid mites in this region.

Author's Contributions

Mohammad Ali Akrami: Conceptualization, Investigation, Draft preparation, Methodology, Final review and edit, Visualization, Supervision, Project administration, and Funding acquisition; **Hamid Barzegar Tavana:** Collection, Investigation, Draft preparation, Methodology, Funding acquisition, and Primary Identification.

Author's Information

Mohammad Ali Akrami

✉ akrami@shirazu.ac.ir

 <https://orcid.org/0000-0002-7561-9508>

Hamid Barzegar Tavana

✉ H.barzegartavana@gmail.com

 <https://orcid.org/0009-0007-5028-2965>

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Data Availability Statement

The specimens examined in this study are deposited in the Acarological Collection of the Department of Plant Protection, Shiraz University, Shiraz, Iran and are available from the curator upon request.

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Ethics Approval and Consent to Participate

Mites were used in this study. All applicable international, national, and institutional guide lines for the care and use of animals were followed. This article does not contain any studies with human participants performed by the authors.

Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

Generative AI statement

The authors declare that no Gen AI was used in the creation of this manuscript.

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Research Article

مطالعه زیگان کنه‌های ارباتیید (Acari, Oribatida) مرتبط با باغ‌های مرکبات در استان بوشهر، جنوب غربی ایران، همراه با گزارش‌های جدید

محمدعلی اکرمی^۱ و حمید برزگر توانا^۱

۱. بخش گیاه‌پزشکی، دانشکده کشاورزی، دانشگاه شیراز، شیراز، ایران

چکیده: در بررسی کنه‌های ارباتیید (Oribatida) مرتبط با باغ‌های مرکبات استان بوشهر (جنوب‌غربی ایران)، نمونه‌برداری از خاک و لاشبرگ در هفت منطقه‌ی مختلف از شهرستان‌های دشتستان، تنگستان، دشتی و جم بین مهرماه ۱۴۰۰ و تیرماه ۱۴۰۱ انجام شد. در مجموع ۲۷ گونه متعلق به ۲۲ جنس و ۱۶ خانواده جمع‌آوری و شناسایی شد که از میان آنها، جنس *Annectacus* Grandjean, 1950 از خانواده‌ی Lohmanniidae، گونه‌ی *Peloptulus* (P.) *Neoppia* cf. *minuta* Bhattacharya & Phenopelopidae از خانواده‌ی *reticulatus* Mihelčič, 1957 از خانواده‌ی Oppiidae نخستین بار برای زیگان ایران گزارش می‌شوند. خانواده‌های Banerjee, 1981 از خانواده‌ی Oppiidae و Lohmanniidae (هر کدام با سه جنس) و همچنین Scheloribatidae، Euphthiracaridae و Epilohmanniidae (هر کدام با دو گونه) بیشترین تعداد گونه‌های شناسایی شده را در باغ‌های مرکبات استان بوشهر داشتند. تمامی گونه‌های شناسایی شده برای اولین بار از استان بوشهر گزارش می‌شوند. پیش از مطالعه حاضر، هیچ اطلاعاتی در مورد زیگان کنه‌های ارباتیید باغ‌های مرکبات در جنوب‌غربی ایران در دسترس نبود.

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