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A checklist and a key for the phytoseiid and blattisociid mites (Acari: Phytoseioidea) associated with olive orchards in Guilan Province Iran

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Abstract

A faunistic study of superfamily Phytoseioidea (Acari: Mesostigmata) associated with olive orchards in Guilan province, Northern Iran was carried out during 2012-2013. Foliage and soil samples were taken from olive orchards. The mites were extracted by Berlese funnel and cleared in Nesbitt fluids; than were mounted in Hoyer's medium on microscopic slides. During this study 18 species belonging to 11 genera and 2 families were collected and identified. Fourteen species belonging to 8 genera are new for olive orchards mites fauna of Iran. Also an identification key for phytoseiid and blattisociid mites associated with olive orchards in Guilan province Iran is provided.

Key words: Fauna, Mesostigmata, Phytoseioidea, key, Olive, Iran.

Zusammenfassung

Vorliegende Arbeit behandelt eine faunistische Studie über Aufsammlungen der Jahre 2012-2013 von Phytoseioidea (Acari: Mesostigmata) in Olivenplantagen in der Provinz Guilan im Norden des Irans. Nach methodisch vorgegebener Präparation und Konservierung konnten 18 Arten bestätigt werden, viele daraunter als neu für die Milbenfauna des Irans. Ein Bestimmungsschlüssel ergänzt die Ausführungen.

Introduction

Olive, *Olea europaea* L. is one the most important fruit in the world, including Iran. Archaeological findings revealed that olive cultivation in Iran dates back to 2000 years ago. At present olive cultivars are cultivated mainly in the North of Iran, which is characterized by Mediterranean climatic condition. In the last ten years, olive plantation has grown in Iran and currently, 115.464 hectares of olive orchards produce about 103.000 tons of olive annually (SAMAE et al. 2003; HOSSEINI-MAZINANI et al. 2004; NOORMOHAMMADI et al. 2007; OMRANI-SABBAGHI et al. 2007; SHEIDAI et al. 2007). Guilam province has 87.533 hectares olive orchards with 489.480 tons annual production (Ministry of Jihad Agriculture of Iran 2013). Guilan Province is one of the 31 provinces of Iran. It covers an area of 14.042 km² and located in the north of Iran between the latitude 37°16′38.64″N and the longitude 49°35′20.4″E. It lies along the Caspian Sea and has a humid subtropical climate with a large margin the heaviest rainfall in Iran: reaching as high as 1,900 millimeters (75 in).

The Mesostigmata is a large, diverse and cosmopolitan assemblage of parasitiform mites. Most of them are free-living predators, and many species are parasites or symbionts of mammals, birds, reptiles, or arthropods (WALTER & PROCTOR 1999). LINDQUIST et al. (2009) divided the order into three suborders Monogynaspida, Trigynaspida and Sejida. There are about 12000 species belonging to approximately 70 families which grouped into 26 superfamilies (WALTER & PROCTOR 1999; LINDQUIST et al. 2009). The Phytoseioidea includes predatory, parasitic, fungivorous, and pollenophagous species found in both ground and aerial habitats. Its constituent families share a uniquely derived combination of sperm morphology in the males and sperm access system in the females, the complexity of which renders the option of convergence highly improbable (WALTER & LINDQUIST 1997; ALBERTI 2002a, b). Most of the 1,800-plus described species of family Phytoseiidae, about 15 % of the known diversity of the Mesostigmata, have been described in the last 50 years as a direct result of their role as biological control agents (KOSTIANINEN & HOY 1996). Typically, they inhabit vegetation and feed on small arthropods, pollen, honeydew, plant exudates or leaf cell contents, and, to a certain extent, fungi (ZEMEK & PRENEROVA 1997). Phytoseiidae also are known to be common inhabitants of leaf domatia (WALTER 1996). The family Blattisociidae is a diverse group that has adapted to a broad spectrum of terrestrial, arboreal, and subaquatic habits. As treated here, the family includes two subfamilies, the Platyseiinae and the Blattisociinae. Some platyseiine species, particularly of the genera *Platyseius* and *Cheiroseius*, inhabit various subaquatic habitats, including sod in and around marshes, mosses in springs and streams, spray zones of waterfalls, sewage filter beds, and, in a few cases, salt marshes or seashore habitats (LINDQUIST & EVANS 1965; EVANS & TILL 1979; KARG 1981, 1993).

Faunistic investigations on mites associated with olive groves in Iran is very low. Due to the predatory importance of Phytoseioid mites and their important role in natural control of injurious mites and insects of olive trees, one faunistic study was carried out for identification of phytoseiid and blattisociid mites (Acari: Phytoseioidea) associated with olive orchards in Guilan Province Iran.

Materials and methods

A fanaul study on superfamily Phytoseioidea associated with olive orchards was carried out in Guilan Province, Northern Iran during 2012-2013. Soil and plant foliage samples were collected from olive orchards of Guilan Province. Mites were extracted from soil and plant foliage by placing them on Berlese funnel or direct examination of leaves under a stereomicroscope. Specimens preserved in 75 % ethanol, cleared in Nesbitt fluids and mounted on microscopic slides using Hoyer's medium.The slides were placed in at 45 °C for two weeks. Specimens were identified by the relevant taxonomic keys and papers. The setations pattern is widely used as a taxonomic criterion in the Mesostigmata, and the system followed in the present work is that of LINDQUIST & EVANS (1965) and LINDQUIST (1994) for dorsal and ventral setations respectively. The notations used for dorsal and ventral setations of phytoseiid mites follow ROWELL et al. (1978) and CHANT & YOSHIDA-SHAUL (1991), respectively. The classification systems for phytoseiid mites follow those of CHANT & MCMURTRY (1994, 2003a, b, 2004, 2005a-c, 2006, 2007). The voucher material which comprises slide mounted specimens are deposited in the Department of Plant Protection at University of Guilan, Rasht, Iran.

Results

In the current study 18 species belonging to 11 genera from two family Phytoseiidae and Blattisocciidae were collected and identified, in association with olive orchards in Guilan province Iran. The 14 species belonging to 8 genera are new for olive orchards mite fauna in Iran. Also an identification key for phytoseiid and blattisociid mites associated with olive orchards in Guilan province Iran is provided. The list of identified species is as follow, new records for Iran olive orchards mite fauna marked with an asterisk (*).

P h y t o s e i i d a e BERLESE, 1916

Subfamily A m b l y s e i i n a e MUMA

*Amblyseius meridionalis** BERLESE, 1914

M a t e r i a l e x a m i n e d : Adult, Iran, Guilan province, collected from foliage: Roodbar, 237m, 36°49´26.86´´N, 49°25´25.42´´E, June 2013; Rostamabad, 170m, 36°53´54.00´´N, 49°29´26.00´´E, September 2012, on the olive leaves. Collected by M. Mahjoori.

D i s t r i b u t i o n : Algeria, Azerbaihan, Canada, Germany, Greece, Hungary, Iran, Italy, Morocco, Poland, Spain, Switzerland and Ukraine (MORAES et al. 2004; FARAJI et al. 2007; HAJIZADEH et al. 2009).

*Neoseiulus marginatus** (WAINSTEIN, 1961)

M a t e r i a l e x a m i n e d : Adult, Iran, Guilan province, collected from foliage: Manjil, 366m, 36°44´31.80´´N, 49°24´57.14´´E, September 2012; Ganjeh, 227m, 36°51´23.26´´N, 49°28´10.14´´E, September 2012; Taklim, 535m, 36°50´50.28´´N, 49°24´01.12´´E, September 2012; Roodbar, 237m, 36°49´26.86´´N, 49°25´25.42´´E, June 2013, on the olive leaves. Collected by M. Mahjoori.

Distribution: Algeria, Armenia, Azerbaihan, France, Georgia, Greece, Hungary, Kenya, Moldova, Russia (Krasnodar Region, Moscow, Stavropol and Yaroslavl Province), Iran, Turkmenistan, Ukraine (MORAES et al. 2004; FARAJI et al. 2007; HAJIZADEH et al. 2009).

Neoseiulus imbricatus* **(CORPUZ-RAROS & RIMANDO, 1967)**

Material examined: Adult, Iran, Guilan province, collected from foliage: Manjil, 366m, 36°44′31.80′′N, 49°24′57.14′′E, September 2012; Taklim, 535m, 36°50′50.28′′N, 49°24′01.12′′E, June 2013; Rostamabad, 170m, 36°53′54.00′′N, 49°29′26.00′′E, June 2013, collected on olive leaves. Collected by M. Mahjoori.

Distribution: Azerbaihan, China, India, Iran, Philippines, Thailand. (MORAES et al. 2004; FARAJI et al. 2007; HAJIZADEH et al. 2009).

Neoseiulus barkeri* **HUGHES, 1948**

Material examined: Adult, Iran, Guilan province, collected from foliage: Roodbar, 237m, 36°49′26.86′′N, 49°25′25.42′′E, September 2012, on the olive leaves. Collected by M. Mahjoori.

Distribution: Algeria, Australia, Brazil, Canary Islands, Cape Verde, China, Jiangxi, Finland, France, Georgia, Germany, Ghana, Greece, Guinea, Iran, Israel, Italy, Japan, Jordan, the Netherlands, Nigeria, Norway, Reunion Island, Russia, South Africa, South Korea, Spain, Sweden, Turkey, Ukraine, West Bank, Yemen (MORAES et al. 2004; FARAJI et al. 2007; HAJIZADEH et al. 2009).

Neoseiulus bicaudus* **(WAINSTEIN, 1962)**

Material examined: Adult, Iran, Guilan province, collected from foliage: Rostamabad, 170m, 36°53′54.00′′N, 49°29′26.00′′E, September 2012, on the olive leaves. Collected by M. Mahjoori.

Distribution: Armenia, Azerbaijan, Caucasus Region, France, Georgia, Greece, Hungary, Iran, Israel, Italy, Moldova, Norway, Russia, Spain, Switzerland, Tajikistan, Turkey, Ukraine and USA (MORAES et al. 2004; FARAJI et al. 2007; HAJIZADEH et al. 2009).

Euseius finlandicus **(OUDEMANS, 1915)**

Material examined: Adult, Iran, Guilan province, collected from foliage: Rostamabad, 170m, 36°53′54.00′′N, 49°29′26.00′′E, September 2012, on the olive leaves. Collected by M. Mahjoori.

Distribution: Algeria, Angola, Argentina, Armenia, Austria, Azerbaijan, Belgium, Vulgaria, Byelorussia, Canada, Scotia, Ontario, Caucasus Region, China-Giangsu, Czech-Republic, Denmark, England, Finland, France, Georgia, Germany, Greece, Hungary, India, Indonesia, Iran, Italy, Japan, Kazakhstan, Latvia, Mexico, Moldova, Montenegro, the Netherlands, Nicaragua, Norway, Poland, Russia, Scandinavia, South Korea, Spain, Sweden, Switzerland, Turkey, Ukraine and USA (MORAES et al. 2004; FARAJI et al. 2007; HAJIZADEH et al. 2009).

***Proprioseiopsis messor** (WAINSTEIN, 1960)**

M a t e r i a l e x a m i n e d : Adult, Iran, Guilan province, collected from foliage: Roodbar, 237m, 36°49′26.86′′N, 49°25′25.42′′E, June 2013; Rostamabad, 170m, 36°53′54.00′′N, 49°29′26.00′′E, September 2012; Nesfi, 455m, 36°50′44.85′′N, 49°30′o4.60′′E, June 2013, on the olive leaves. Collected by M. Mahjoori.

D i s t r i b u t i o n : Algeria, Armenia, Australia, Azerbaijan, France, Gaza Strip, Georgia, Germany, Greece, Iran, Israel, Italy, Morocco, New Zealand, South Africa, Spain, Turkmenistan and Ukraine (MORAES et al. 2004; FARAJI et al. 2007; HAJIZADEH et al. 2009).

***Transeius wainsteini** (GOMELAURI, 1968)**

M a t e r i a l e x a m i n e d : Adult, Iran, Guilan province, collected from foliage: Roodbar, 237m, 36°49′26.86′′N, 49°25′25.42′′E, September 2012; Rostamabad, 170m, 36°53′54.00′′N, 49°29′26.00′′E, September 2012; Manjil, 366m, 36°44′31.80′′N, 49°24′57.14′′E, June 2013, on the olive leaves. Collected by M. Mahjoori.

D i s t r i b u t i o n : Iran, Ukraine (MORAES et al. 2004; FARAJI et al. 2007; HAJIZADEH et al. 2009).

Subfamily P h y t o s e i i n a e BERLESE

***Phytoseius plumifer* (CANESTRINI & FANZAGO, 1876)**

M a t e r i a l e x a m i n e d : Adult, Iran, Guilan province, collected from foliage: Manjil, 366m, 36°44′31.80′′N, 49°24′57.14′′E, September 2012, on the olive leaves. Collected by M. Mahjoori.

D i s t r i b u t i o n : Algeria, Armenia, Azerbaijan, Egypt, France, Georgia, Hungary, Iran, Israel, Italy, Jordan, Kazakhstan, Lebanon, Portugal, Ukraine and USA (MORAES et al. 2004; FARAJI et al. 2007; HAJIZADEH et al. 2009).

Subfamily T y p h l o d r o m i n a e CHANT & MCMURTRY

***Neoseiulella tiliarum** (OUDEMANS, 1930)**

M a t e r i a l e x a m i n e d : Adult, Iran, Guilan province, collected from foliage: Rostamabad, 170m, 36°53′54.00′′N, 49°29′26.00′′E, September 2012; Taklim, 535m, 36°50′50.28′′N, 49°24′01.12′′E, September 2012; Ganjeh, 227m, 36°51′23.26′′N, 49°28′10.14′′E, June 2013, on the olive leaves. Collected by M. Mahjoori.

D i s t r i b u t i o n : Algeria, Austria, Azerbaijan, Canada, Denmark, England, France, Georgia, Germany, Greece, Hungary, Iran, Italy, Moldova, Montenegro, the Netherlands, Norway, Poland, Russia-Krasnodar, Spain, Switzerland, Turkey, Ukraine and USA (MORAES et al. 2004; FARAJI et al. 2007; HAJIZADEH et al. 2009).

***Typhlodromus rhenanus** (OUDEMANS, 1905)**

M a t e r i a l e x a m i n e d : Adult, Iran, Guilan province, collected from foliage: Ganjeh, 227m, 36°51′23.26′′N, 49°28′10.14′′E, September 2012; Rostamabad, 170m, 36°53′54.00′′N, 49°29′26.00′′E, September 2012; Manjil, 366m, 36°44′31.80′′N, 49°24′57.14′′E, June 2013; Nesfi, 455m, 36°50′44.85′′N, 49°30′o4.60′′E, June 2013, on the olive leaves. Collected by M. Mahjoori.

Distribution: Algeria, Azerbaijan, Belgium, Byelorussia, Canada, Cyprus, Denmark, England, Finland, France, Germany, Hungary, India, Iran, Israel, Italy, Kazakhstan, Madeira, Moldova, Montenegro, the Netherlands, Northern Ireland, Norway, Poland, Portugal, Russia, Sweden, Switzerland, Turkey, Ukraine and USA (MORAES et al. 2004; FARAJI et al. 2007; HAJIZADEH et al. 2009).

***Typhlodromus kettanehi* (DOSSE, 1967)**

Material examined: Adult, Iran, Guilan province, collected from foliage: Manjil, 366m, 36°44′31.80′′N, 49°24′57.14′′E, June 2013; Nesfi, 455m, 36°50′44.85′′N, 49°30′o4.60′′E, June 2013, on the olive leaves. Collected by M. Mahjoori.

Distribution: Iran, Armenia, Azerbaijan, Turkmenistan (MORAES et al. 2004; FARAJI et al. 2007; HAJIZADEH et al. 2009).

***Typhlodromus dalfardicus**(DANESHVAR, 1987)**

Material examined: Adult, Iran, Guilan province, collected from foliage: Roodbar, 237m, 36°49′26.86′′N, 49°25′25.42′′E, June 2013, on the olive leaves. Collected by M. Mahjoori.

Distribution: Iran (MORAES et al. 2004; FARAJI et al. 2007; HAJIZADEH et al. 2009).

***Paraseiulus soleiger* (RIBAGA, 1904)**

Material examined: Adult, Iran, Guilan province, collected from foliage: Ganjeh, 227m, 36°51′23.26′′N, 49°28′10.14′′E, September 2012; Roodbar, 237m, 36°49′26.86′′N, 49°25′25.42′′E, September 2012; Taklim, 535m, 36°50′50.28′′N, 49°24′01.12′′E, June 2013, on the olive leaves. Collected by M. Mahjoori.

Distribution: Alaska, Armenia, Austria, Azerbaijan, Byelorussia, Canada, Caucasus region, China, Czech Republic, Denmark, England, Finland, France, Georgia, Germany, Hungary, Iran, Italy, Japan, Kazakhstan, Moldova, the Netherlands, Poland, Russia, Sweden, Switzerland, Turkey, Ukraine and USA (MORAES et al. 2004; FARAJI et al. 2007; HAJIZADEH et al. 2009).

Family Blattisociidae GARMAN, 1948

***Lasioseius frankbakkeri* FARAJI & KARG, 2005**

Material examined: Adult, Iran, Guilan province, collected from soil: Roodbar, 237m, 36°49′26.86′′N, 49°25′25.42′′E, September 2012**;** Rostamabad, 170m, 36°53′54.00′′N, 49°29′26.00′′E, September 2012, on the olive leaves. Collected by M. Mahjoori.

Distribution: France, Iran (FARAJI & KARG, 2005; HAJIZADEH et al. 2010; KAZEMI & RAJAEI 2013)

***Lasioseius sugawarai* EHARA, 1964**

Material examined: Adult, Iran, Guilan province, collected from soil: Manjil, 366m, 36°44′31.80′′N, 49°24′57.14′′E, June 2013, on the olive leaves. Collected by M. Mahjoori.

Distribution: Asia, Iran, USA (EHARA, 1964; SWIFT & GOFF, 2001; HAJIZADEH et al. 2010).

***Cheiroseius longipes** (WILLMANN, 1951)**

M a t e r i a l e x a m i n e d : Adult, Iran, Guilan province, collected from foliage: Manjil, 366m, 36°44´31.80´´N, 49°24´57.14´´E, June 2013, soil under olive trees. Collected by M. Mahjoori.

D i s t r i b u t i o n : Iran and Central Europe (KALUZ & FENDA 2005; HAJIZADEH et al. 2010).

***Cheiroseius curtipes** (HALBERT, 1923)**

M a t e r i a l e x a m i n e d : Adult, Iran, Guilan province, collected from soil: Taklim, 535m, 36°50´50.28´´N, 49°24´01.12´´E, June 2013, soil under olive trees. Collected by M. Mahjoori.

D i s t r i b u t i o n : Iran, India, Philippines, Kazakhstan, Europe and Central and North America (PRAMANIK & RAYCHAUDHURI 1977; KARG 1993; CHELEBIEV 1988; KALUZ & FENDA 2005; HAJIZADEH et al. 2010).

Key to the females Phytoseiid and Blattisociid mites (Acari: Phytoseioidea) associated with olive orchards in Guilan Province Iran

Based on keys of FARAJI et al. 2007; HAJIZADEH et al. 2010

1 Peritrematic shield of adults broadly fused posteriorly to exopodal plate curving behind coxa IV, dorsal shield with more 20 pairs of setae ..... Blattisociidae 2

- Peritrematic shield of adults not broadly fused posteriorly to exopodal plate curving behind coxa IV, dorsal shield with less 20 pairs of setae ..... Phytoseiidae 5

2 Leges II-IV with mediam lobe of pulvillus slender; para-anal setae inserted level with or posterior to hind margin of anus, and longer than post-anal seta; femora I and II with 11 and 10 setae, respectively; anterior rostral and internal palp trochanter setae extremely long, whip-like ..... *Cheiroseius* (BELESE) 3

- Leges II-IV with mediam lobe of pulvillus broadly rounded; para-anal setae inserted anterior to hind margin of anus, and usually shorter than post-anal seta; femora I and II with 12 and 11 setae, respectively; anterior rostral and internal palp trochanter setae gradually tapering along entire length, not whip-like..... *Lasioseius* BERLESE 4

3 Tarsus I shorter than tibia I or equal in length..... *C. longipes* (WILLMANN)

- Tarsus I longer than tibia I ..... *C. curtipes* (HALBERT)

4 Idiosoma with only 3 pairs of marginal setae (r4, R1, R5) on soft integument..... ..... *L. frankbakkeri* FARAJI & KARG

- Idiosoma with more than 10 pairs of marginal and submarginal setae on soft integument..... *L. sugawarai* EHARA

5 Seta *z3* and *s6* absent (Amblyseiinae MUMA) 8

- Either or both setae *z3* and *s6* present 6

6 Setae *Z1*, *S2*, *S4* and *S5* absent (Phytoseiinae BERLESE, *Phytoseius* RIBAGA)..... .....*P. plumifer* (CANESTRINI & FANZAGO, 1876)

- At least one of setae *Z1*, *S2*, *S4* and *S5* present (Typhlodrominae CHANT & MCMURTRY)..... 14

7 Seta Jv1 inserted well behind anterior margin of ventrianal shield and preanal setae arranged in an almost transverse row; cheliceral digits short and stout .... *E. finlandicus* (OUDEMANS)

- Seta *Jv1* inserted near margin of ventrianal shield and preanal setae not arranged in a transverse row across the shield, cheliceral digits elongate 8

8 Macrosetae present only on leg IV or absent (*Neoseiulus* HUGHES) 9

- Macrosetae at least on genua III, as well as on leg IV 12

9 Spermatheca with atrium forked at juncture with major duct, or atrium appearing thick-walled, vacuolated ..... *N. marginatus* (WAINSTEIN)

- Spermatheca with atrium not forked at juncture with major duct, nor appearing thick-walled, vacuolated 10

10 Calyx of spermatheca cone-shaped ..... *N. barkeri* HUGHES

- Calyx of spermatheca not cone-shaped 11

11 Calyx of spermatheca a shallow dish; fixed cheliceral digit with 10 and movable digit with 3 teeth ..... *N. imbricatus* (CORPUZ-RAROS & RIMANDO)

- Calyx of spermatheca bowl-shaped; fixed cheliceral digit with 6 teeth, movable digit with one tooth ..... *N. bicaudus* (WAINSTEIN)

12 Seta *J2* absent (*Proprioseiopsis* MUMA) ..... *P. messor* (WAINSTEIN)

- Seta J2 present 13

13 Ratio of setae *s4*:*S2* < 2.7:1.0 (*Transeius* CHANT & MCMURTRY) .... *T. wainsteini* (GOMELAURI)

- Ratio seta *s4*:*S2* >3.0:1.0 (*Amblyseius* BERLESE) ..... *A. merdionalis* (BERLESE)

14 Setae *z6* present (Paraseiulini WAINSTEIN) ..... *P. soleiger* (RIBAGA)

- Setae *z6* absent (Typhlodromini CHANT & MCMURTRY) 15

15 Seta *Z1* absent (*Typhlodromus* SCHEUTEN) 16

- Seta *Z1* present, (*Neoseiulella* MUMA) ..... *N. tiliarum* (OUDEMANS)

16 Movable digit of chelicerae with one tooth ..... *T. rhenanus* (OUDEMANS)

- Movable digit of chelicerae with more than one tooth 17

17 Movable digit of chelicerae with 2 teeth ..... *T. dalfardicus* (DANESHVAR)

- Movable digit of chelicerae smooth ..... *T. kettanehi* (DOSSE)

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