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# New mite records (Acari: Mesostigmata, Trombidiformes) from soil and vegetation of some Syrian citrus agrosystems

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## ABSTRACT

This study gives the result of collections of mite fauna inhabiting soil, litter and plant species surrounding citrus orchards at three localities in Latakia governorate. Mites collected were identified and only new recorded species are presented. During this study, 21 species belonging to 12 families (4 Mesostigmata and 8 Trombidiformes) were reported as new to the Syrian fauna. Five species were phytophagous mites (belong to Tenuipalpidae and Tetranychidae), while the others are considered as generalist predators or feed on microorganisms in their habitats. The results could be of importance for integrated pest management applied in Syrian citrus orchards.

**Keywords** survey; taxonomy; phytophagous mites; predatory mites; biological control; Syria

**Zoobank** <http://zoobank.org/19DAAD5E-3742-4DF9-8E1C-CBEBEE00706C>

## Introduction

Latakia is the main growing citrus governorate in Syria, produced about 0.90 million tons of citrus fruit in 2016 (Syrian Ministry of Agriculture and Agrarian Reform, 2016). In this governorate, recent surveys conducted in about 60 citrus orchards revealed the presence of 60 mite species belonging to 20 families. Of these, 22 mite species belonging to 11 families inhabit citrus leaves (nine Phytoseiidae, three Tetranychidae, two Cheyletidae, and one of each Acaridae, Camerobiidae, Cunaxidae, Iolinidae, Raphignathidae, Stigmaeidae, Tenuipalpidae and Tydeidae). Remaining taxa were collected from litter and (or) from vegetation adjacent to those orchards (Zriki *et al.*, 2015; Barbar, 2016, 2017; Barbar and Ueckermann, 2017; Barbar, 2018). These results showed the presence of a relatively high number of mite species, especially predators of phytophagous mites and other micro arthropods (Barbar, 2016). However, more investigations are needed to obtain a good vision about the diversity of this fauna in Latakian citrus agro ecosystems. The results of these investigations could be of a great interest to further studies about the use of predatory mites in the biological control programs.

The aim of the present study was to identify mite species inhabiting soil, litter and plant species surrounding citrus orchards at three localities in Latakia governorate, and to provide data (when available) about their trophic habits, geographic distribution and economic importance.

## Materials and methods

Surveys of mite fauna were conducted in Latakia governorate in April and May, 2016, March and April, 2017, and March, 2018. Mite collected from: (1) leaves of common plant species surrounding citrus orchards located at Burj-Islam (35°40'12" N, 35° 7'24" E) and Attabiyyat

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(35°30'24" N, 35°46'49" E); (2) ground litter of a pesticides free citrus orchard located at Al-ya'robiyah (35°30'24" N, 35°48'33" E). Mites were removed from leaves using the "dipping-checking-washing-filtering" method (Boller, 1984). For collecting mites from litter, materials were placed on a sieve (25 cm Ø x 10 cm; its screen with 5 mesh/cm) and shaken over a black plastic sheet (1.5 m<sup>2</sup>). Mites were picked off the sheet into a vial with 70 % alcohol. Mites were then mounted on slides in Hoyer's medium and dried in an oven at 40°C for four days.

Mite taxa were identified to family levels using the key of Krantz and Walter (2009). Identification to genera level was carried out mainly using the following works: **(1)** for Mesostigmata: Ameroseiidae, Ascidae and Laelapidae (Athias-Henriot, 1961; Evans and Till, 1979; Mašán, 2017) and Phytoseiidae (Chant and McMurtry, 2007); **(2)** for Trombidiformes: Anystidae (Meyer and Ueckermann, 1987), Cunaxidae (Skvarla *et al.*, 2014), Cryptognathidae (Khanjani and Ueckermann, 2008), Eupalopsellidae (Meyer and Ueckermann, 1984), Raphignathidae (Fan and Zhang, 2005), Stigmaeidae (Fan *et al.*, 2016), Tenuipalpidae (Meyer, 1979; Mesa *et al.*, 2009) and Tetranychidae (Bolland *et al.*, 1998). The specimens were deposited in the Arthropod Collection of the Department of Plant Protection, Faculty of Agriculture, Al-Baath University, Homs, Syria. Mite taxa in the text are arranged alphabetically by order, as are families within orders, genera within families and species within genera.

All mite species that have already been recorded from Syria were excluded from results.

## Results and discussion

Twenty-one mite species belonging to 12 families (4 Mesostigmata and 8 Trombidiformes) are recorded for the first time from Syria in the present study. Five species were phytophagous (three species of Tenuipalpidae and two species of Tetranychidae), while the others are considered as generalist predators or feeding on microorganisms in their habitats (Swift and Goff, 2001; Gerson *et al.*, 2003). Eleven species were found in soil and litter: 1 Ameroseiidae, 1 Ascidae, 2 Laelapidae, 2 Anystidae, 1 Cryptognathidae, 2 Raphignathidae and 2 Stigmaeidae. Remaining species were collected from vegetation surrounding citrus orchards: 1 Cunaxidae, 1 Eupalopsellidae, 1 Phytoseiidae, 2 Stigmaeidae, 3 Tenuipalpidae and 2 Tetranychidae.

### Order Mesostigmata

#### Family Ameroseiidae

##### *Epicriopsis horridus* (Kramer, 1876)

**Specimens collected** — Al-ya'robiyah: Five females from litter and soil under *Eucalyptus* sp., 7 and 9 April, 2017. This is the second ameroseiid species recorded from Syria (i.e., *Ameroseius lidiae* Bregetova; Barbar 2016). *Epicriopsis horridus* occurs mostly in leaf litter and soil detritus and known from Europe and Asia (Hajizadeh *et al.*, 2013; Mašán, 2017). The biology of mite species belonging to the genus *Epicriopsis* largely unknown (Narita and Moraes, 2016).

#### Family Ascidae

##### *Gamasellodes vulgator* Athias-Henriot, 1961

**Specimen collected** — Al-ya'robiyah: One female from litter and soil under *Eucalyptus* sp., 30 March, 2017. This is the second ascid species from Syria (i.e., *Gamasellodes americanus* (Garman); Barbar, 2016). It was previously recorded from Algeria (Athias-Henriot, 1961) and India (Bhattacharyya and Sanyal, 2002). The biology of this species is unknown. However, several *Gamasellodes* species can feed and reproduce on several nematode groups in soil (Moraes *et al.*, 2015).

## Family Laelapidae

This is the first record of this family from Syria. Two species were collected:

### ***Androlaelaps aegypticus* Hafez, El-Badry and Nasr, 1982**

**Specimen collected** — Al-ya'robiyah: One female from litter and soil under *Eucalyptus* sp., 30 March, 2017. This is the third international record of this species. It was previously recorded from Egypt (Hafez *et al.*, 1982) and Iran (Soleimani *et al.*, 2010). *Androlaelaps aegypticus* is a very active predator and can feed on immature stages of *Tyrophagus putrescentiae* (Schrank), *Rhizoglyphus echinopus* (Fumouze and Robin) (Acaridae) and *Lepidoglyphus destructor* (Schrank) (Glycyphagidae). Differences in biological characteristics (incubation period, life cycle and female fecundity) of this species were observed according to prey and temperatures (Mostafa *et al.*, 2017).

### ***Stratiolaelaps miles* (Berlese, 1892)**

**Specimens collected** — Al-ya'robiyah: Two females from litter and soil under *Eucalyptus* sp., 4 and 9 April, 2017. This species is widely distributed in the northern hemisphere and being used in the control of some glasshouse pests namely larvae of sciarid flies (Diptera: Sciaridae) and western flower thrips [*Frankliniella occidentalis* (Pergande)] (Gerson *et al.*, 2003; Walter and Campbell, 2003).

## Family Phytoseiidae

This is the largest known family from Syria with 23 reported species (Barbar, 2017; Demite *et al.*, 2018). One additional phytoseiid species is recorded in the present study:

### ***Typhlodromus (Typhlodromus) ernesti* Ragusa and Swirski, 1978**

**Specimens collected** — Borj-Islam: Nineteen females and two males on *Pinus halepensis* Mill., 25 May, 2016. It was associated with the tenuipalpid species *Cenopalpus wainsteini* (Livschitz and Mitrofanov) in this study. This species is known from several countries in Europe and also from Tunisia but nothing is known about its biology (Demite *et al.*, 2018).

## Order Trombidiformes

### Family Anystidae

This is the first record of this family from Syria. Two species were collected:

### ***Anystis wallacei* Otto, 1992**

**Specimens collected** — Al-ya'robiyah: One tritonymph and one deutonymph from litter under *Acacia cyanophylla* Lindley, 21 and 30 March, 2017, respectively. This species is described from pastures in France, Spain, Morocco and Australia and could be a natural enemy of penthaleid mite species and Collembola (Otto, 1992; Gerson *et al.*, 2003).

### ***Erythracarus pyrrholeucus* (Hermann, 1804)**

**Specimens collected** — Al-ya'robiyah: Four females from litter and soil under *A. cyanophylla*, 28 and 30 March, 2017. This species is recorded from Australia, Iran, Ukraine and the United States (Otto 1999). Small mite species and insects (i.e., Psocoptera) appear to be a possible food-source for species of *Erythracarus* including *E. pyrrholeucus* (Otto, 1999).

## Family Cunaxidae

### ***Cunaxoides lootsi* Den Heyer, 2013**

**Specimens collected** — Attabiyyat: Six females on *Sarcopoterium spinosum* (L.), 15 March, 2018. This predatory mite is the fourth cunaxid species reported from Syria (Barbar, 2016). It

was only recorded from Iran on grass (Den Heyer *et al.*, 2013).

## **Family Cryptognathidae**

This is the first record of this family from Syria. One species was collected:

### ***Favgognathus cordylus* Luxton, 1993**

**Specimens collected** — Al-ya'robiyah: One female from litter and soil under *A. cyanophylla*, 7 April, 2017. Nothing is known about the biology of this species. However, members of this family probably feed on the content of plant cells or on microorganisms in their habitats (Luxton, 1993; Swift and Goff, 2001).

## **Family Eupalopsellidae**

This is the first record of this family from Syria. One species was collected:

### ***Eupalopsis maseriensis* (Canestrini and Fanzago, 1876)**

**Specimen collected** — Borj-Islam: One female on unidentified plant species, 25 May, 2016. This species preys on the citrus chaff scale *Parloria pergandii* Comstock. It was recorded from wild plant species and litter in several countries (i.e., Italy, USSR and Turkey) (Doğan, 2008; Meyer and Ueckermann, 1984).

## **Family Raphignathidae**

Only one species of this family is known from Syria (i.e., *Raphignathus gracilis* (Rack); Barbar, 2016). Two additional species were collected in this study:

### ***Raphignathus hecmatanaensis* Khanjani and Ueckermann, 2003**

**Specimens collected** — Al-ya'robiyah: Two females from litter and soil under *A. cyanophylla*, 16 April, 2016 and 30 March, 2017. This species is known from Iran (Khanjani and Ueckermann, 2003) and Turkey (Bingül *et al.*, 2018).

### ***Raphignathus zhaoi* Hu, Jing and Liang, 1995**

**Specimens collected** — Al-ya'robiyah: Seven females from litter and soil under *A. cyanophylla*, 16 and 5 April, 2016 and 2017, respectively. This species was reported in China and Iran from cultivated and wild plant species, soil and moss (Fan and Yin, 2000; Khanjani and Ueckermann, 2003).

## **Family Stigmaeidae**

Only one species of this family is known from Syria (i.e., *Agistemus exsertus* Gonzalez-Rodriguez; Barbar, 2016). Four additional species were collected in this study:

### ***Agistemus duzgunesae* Koç, Cobanoğlu and Madanlar, 2005**

**Specimens collected** — Borj-Islam: One female on *Prunus amygdalus* L. and one female on *Olea europaea* L., 25 May, 2016. It was associated with *Bryobia rubrioculus* (Scheuten), *Tetranychus urticae* Koch and *Brevipalpus oleae* Baker in this study. It was only reported from Turkey and Greece on several cultivated plant species and natural vegetation (Koç *et al.*, 2005; Stathakis *et al.*, 2014).

### ***Stigmaeus additicus* Dönel and Doğan, 2011**

**Specimen collected** — Al-ya'robiyah: One female from litter and soil under *A. cyanophylla*, 7 April, 2017. This is the second international record of this predatory mite. It was described from Turkey from litter under *Acacia* sp. and from moss and lichen on soil (Dönel and Doğan, 2011).

## ***Stigmaeus ayyildizi* Dönel and Doğan, 2011**

**Specimens collected** — Al-ya'robiyah: Three females from litter and soil under *A. cyanophylla*, 7 April, 2017. This is the second international record of this mite species. It was described from Turkey from grassy soil (Dönel and Doğan, 2011).

## ***Zetzellia graeciana* González-Rodríguez, 1965**

**Specimens collected** — Borj-Islam: Three females on *Punica granatum* L., 25 May, 2016. It was associated with *Brevipalpus obovatus* Donnadieu and *Tenuipalpus punicae* Pritchard and Baker in this study. This species is known from several European countries and was collected from apples, citrus and other plants (Fan *et al.* 2016). It preys on *Panonychus ulmi* Koch and *T. urticae* (Inserra, 1970 [1973]).

## **Family Tenuipalpidae**

Five species of this family are known from Syria (Barbar, 2016). Three additional species were collected in this study:

## ***Brevipalpus oleae* Baker, 1949**

**Specimens collected** — Borj-Islam: Two females on *O. europaea*, 25 May, 2016. This species was associated with the phytoseiid, *Typhlodromus (Typhlodromus) athiasae* Porath and Swirski in this study. It was recorded from Morocco, Greece, Italy, Portugal and Tunisia (Castagnoli and Pegazzano, 1986; Chatti *et al.*, 2017).

## ***Cenopalpus lanceolatisetae* (Attiah, 1956)**

**Specimens collected** — Borj-Islam: Four females on *Crataegus monogyna* L., 25 May, 2016. This species was associated with the predator *T. (T.) athiasae* in this study. It was described from Egypt on several Rosaceae (i.e., *Prunus domestica* L., *Prunus armeniaca* L., *Pyrus malus* L. and *Pyrus communis* L.) and distributed in Western Palearctic (Mesa *et al.*, 2009; Khanjani *et al.*, 2012).

## ***Tenuipalpus caudatus* (Dugés, 1834)**

**Specimens collected** — Borj-Islam: Three females on *Cupressus sempervirens* L. and one female on *Pistacia lentiscus* L., 25 May, 2016. This species was associated with the predator *T. (T.) athiasae* in this study. It was described from France on *Viburnum tinus* L. and found also on other plant species in several countries (Mesa *et al.*, 2009).

## **Family Tetranychidae**

Fifteen species of this family are known from Syria (Migeon and Dorkeld, 2006-2017; Zeity, 2017). Two additional species were collected in this study:

## ***Bryobia kissophila* Eynhoven, 1955**

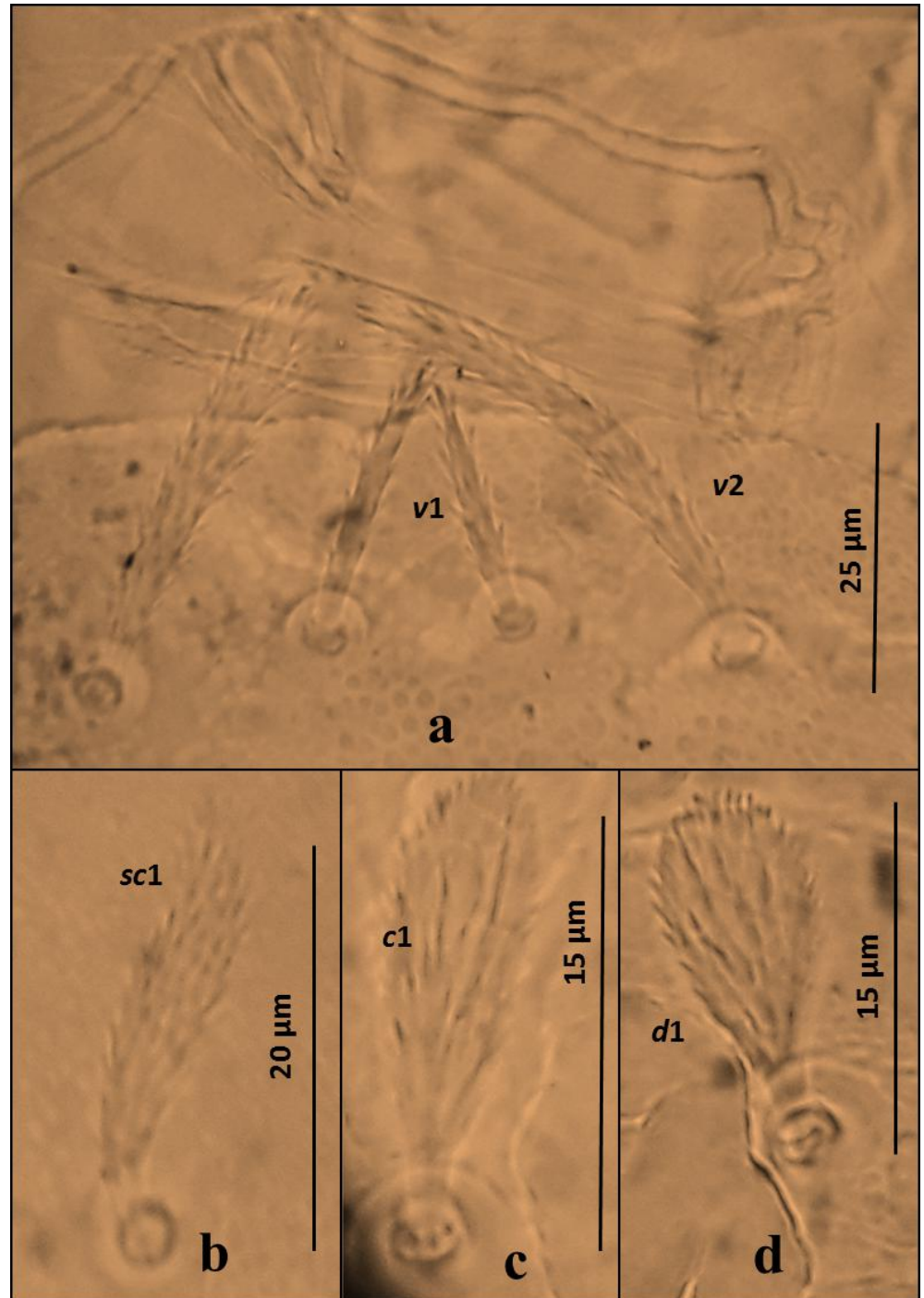
**Specimens collected** — Al-ya'robiyah: Six females and one larva on *Malva sylvestris* L., 16 April, 2016. This species was collected from three plant species particularly from *Hedera helix* L. in Europe and was also collected from other countries as South Africa, Australia and United States (Migeon and Dorkeld, 2006-2017).

## ***Pseudobryobia nikitensis* (?) (Livshitz and Mitrofanov, 1969)**

**Specimens collected** — Borj-Islam and Attabiyyat: Nine females on *S. spinosum*, 25 May, 2016 and 15 March, 2018.

This species was also previously recorded on *S. spinosum* in Ukraine (Livshits and Mitrofanov, 1969) and Italy (Vacante, 1983) and on *Silene dioica* (L.) (unknown locality, Migeon and Dorkeld, 2006-2017). The Syrian specimens are very close to those described by





**Figure 1** Variations in the shape of dorsal body setae in the Syrian specimens of *Pseudobryobia nikitensis*: a – prodorsal setae; b – *sc1* seta; c – *c1* seta; d – *d1* seta.

Livshits and Mitrofanov (1969) and similar to those reported in the redescription of Vacante (1983), except for a few small morphological differences namely: (1) in Syrian specimens, setae *v1*–*v2* elongated, slender and serrate (Figure 1a); setae *sc1*–*sc2* and *c1*–*c3* subspatulate (Figure 1b, c); remaining dorsal body setae palmate serrate and almost rounded distally (Figure 1d), but dorsohysterosomal setae are subspatulate, lanceolate and more or less acute in the

description of Livshits and Mitrofanov (1969), and setae *d*, *e*, and *f* are subspatulate in the redescription of Vacante (1983) (according to Figure presented); (2) femur II with 9 (10) setae in Syrian specimens oppose to 8 in the description of Livshits and Mitrofanov (1969); genu III with 6 (7) setae in Syrian specimens oppose to 5 setae in the description of Livshits and Mitrofanov (1969).

Furthermore, the assignment of this species to the genus *Pseudobryobia* may be uncertain. Indeed, in the diagnoses proposed by the authors who worked on this genus (e.g. Meyer, 1987; Baker and Tuttle, 1994; Smiley and Baker, 1995), in addition to the absence of prodorsal lobes, it is mentioned that members of the fourth pair of dorsocentral setae (*fl* setae) are located in normal dorsal position (not marginal). However, this condition is neither met by the specimens of *P. nikitensis* described by Livshits and Mitrofanov (1969), Vacante (1983) nor by those reported in this study.

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