Phytophagous and predatory mites on olive trees in Tunisia. Catalogue, description of one new species and key for identification (Acari, Eriophyidae, Tetranychidae, Tenuipalpidae and Phytoseiidae)

Amel Chatti, Serge Kreiter, Kaouthar Lebdi-Grissa, Mohieddine Ksantini

Acarologia 57(2): 233–254 (2017)
DOI: 10.1051/acarologia/20164152

Phytophagous and predatory mites on olive trees in Tunisia. Catalogue, description of one new species and key for identification (Acari, Eriophyidae, Tetranychidae, Tenuipalpidae and Phytoseiidae)

Amel CHATTI[1], Serge KREITER[2], Kaouthar LEBDI-GRISSA[3]and Mohieddine KSANTINI[1]

(Received 01 July 2016; accepted 26 July 2016; published online 19 December 2016; edited by Marie-Stéphane TIXIER)

[1] *Institut de l'Olivier Bp.1087-3000 Sfax, Tunisie. amel_chattikolsi@yahoo.fr, ksantini_m@yahoo.fr*
[2] *Montpellier SupAgro, UMR CBGP (CIRAD/INRA/IRD/SupAgro), 755 Avenue du Campus Agropolis, CS 30016, 34988 Montferrier-sur-Lez cedex, France. serge.kreiter@supagro.fr*
[3] *Institut National Agronomique de Tunisie, 43 Avenue Charles Nicolle, 1082 Tunis, Université de 7 Novembre à Carthage, Tunisia. lebdigrissa.kaouthar@inat.agrinet.tn*

ABSTRACT — Despite the importance of olive trees in Tunisia, very little is known about mite populations. A survey of phytophagous and predatory mites species in 21 orchards distributed over several sites was conducted from 2007 to 2013. During this study, 14 species of predatory mites along with 5 species of phytophagous mites were collected and identified. Almost all species are newly identified from olive trees, five of them are new to the Tunisian fauna and one species is new to Science. This paper provides a catalogue of these species and elements on their biogeographical distribution and biology. Identification keys are also provided. The Phytoseiidae species described in this study may provide new opportunities for the integrated pest management of Eriophyidae and Tenuipalpidae mites on olive trees.

KEYWORDS — Collection; Phytoseiidae; Eriophyidae; Tenuipalpidae; olive trees

ZOOBANK — 5E47021B-D72B-4527-B771-BB43E9A32D28

INTRODUCTION

The eriophyid mites were first recorded in Tunisia in 1993. Since this date, they became serious pests and they cause serious economic damage in olive tree orchards deteriorating oil quality. Presently, chemical control with broad-spectrum miticides is used for mite control. However, these treatments have serious consequences on health, environment and also trade as residues in olives are not acceptable for international exports. Therefore the objective is to look for more efficient, bi-control agents against the mite pests on olives in Tunisia.

Phytoseiid mites are predators of phytophagous mites and small insects. Some species also feed on nematodes, fungal spores, pollens and exudates from plants, but rarely on plant tissues (McMurtry *et al.* 2013). Several members of this family are very important in the biological control of spider mites and thrips in greenhouse crop production (Van Lenteren 2012; McMurtry *et al.* 2013). Twenty species are currently mass reared commercially in the world for augmentative biological control (Wright 2004; Gerson and Weintraub 2007).

The family Phytoseiidae has a worldwide distri-

TABLE 1: Areas code and localities surveyed

Area code	Area	localities
1	Sfax	Ouled Msallem, Jbenyana, Hegeb, Taous, Ltayfa
2	Ile de Karkennah	Sidi yousef , Aouled Yaneg, Ramla, Mellita, Aataya
3	Gafsa	Oazis Gafsa, Guetar, Bou Omran, Bou Saad
4	Cap Bon	Beni Kalled, Grambalia
5	Sidi Bouzid	Regueb, Sidi Bouzid

bution, with about 2,452 species belonging to more than 90 genera (Demite *et al.* 2016).

In Tunisia, research on Phytoseiidae began more than twenty years ago, in 1994 (Kreiter *et al*. 2002a, 2004, 2006, 2010), especially in citrus orchards, and investigations were extended after 2000 to various crops (Grissa 2003). The aim of this research is to report the diversity of mites associated with olive trees in Tunisia, but also to provide identification keys to facilitate the species identification in the area of production.

MATERIALS AND METHODS

Samples were collected every month from October 2007 to October 2013. They were composed of 50 branches per locality; a hand-held GPS device was used to accurately record the collection sites (Bastide *et al.* 1989). The prospected localities are listed in Table 1.

Samples were put in polyethylene bags and then in a cooler box. They were transported to the laboratory where leaves were examined under a stereomicroscope (Leica M10). Mites were removed from the leaves with a fine brush, mounted on slides in Hoyer's medium and slides dried in an oven at 45°C for one week for subsequent identification, using a phase contrast microscope (Krantz and Walter 2009). Voucher specimens are deposited in the mite reference collection of the entomology laboratory of Institut de l'olivier (Sfax, Tunisia).

RESULTS

The mite species collected on olive trees between 2007 and 2013, belong to four families, Eriophyidae, Tenuipalpidae and Tetranychidae for phytophagous mites, and Phytoseiidae for predatory mites (Table 2).

During this study, two species of Eriophyidae belonging to two genera, two species of Tenuipalpidae belonging to one genus, one species of Tetranychidae and 14 species of Phytoseiidae belonging to seven genera were identified. All species are listed hereunder with respective taxonomical information, as well as with geographical coordinates of the collection localities and dates of collection. Identification keys for each family of mites on Tunisian olive trees are also provided.

CATALOGUE OF PHYTOPHAGOUS MITES ASSOCIATED WITH TUNISIAN OLIVE TREES

Family: Eriophyidae

Mite species of the family Eriophyidae (Acari: Thrombidiforma) are the most injurious mites of olive trees. Two species, *Oxycenus maxwelli* Keifer 1939 and *Aceria oleae* Nalepa 1900 were collected and identified from Tunisia. They are serious pests, especially in nurseries and olive production crops (Çetin *et al*. 2010). Several species of eriophyid mites can transmit viruses or phytoplasmas (Paliwal 1980) but no microorganism transmission has been proved on olive tress. The microscopic size and cryptic behavior of eriophyid mites make monitoring and management very difficult (Navia *et al.* 2010).

TABLE 2: Phytophagous mites and phytoseiid predators associated with olive trees. New species for the Tunisian mite fauna are indicated with an asterisk (*). 1,2,3,4 and 5 area code

Family and species	1	2	3	4	5
Eriophyidae					
Oxycenus maxwelli	+	+	+	+	+
Aceria oleae	+	+	+	+	+
Tenuipalpidae					
*Brevipalpus olivicola**	+	+			
*Brevipalpus oleae**					+
Tetranychidae					
Bryobia sp.*					+
Phytoseiidae					
Euseius scutalis		+		+	
Euseius finlandicus *		+			
Euseius stipulatus		+		+	+
Euseius gallicus		+			
Phytoseius finitimus		+			+
Iphiseius degenerans				+	
Neoseiulus californicus				+	
Kampimodromus aberrans	+			+	
Typhlodromus (*Anthoseius*) *athenas*	+	+	+	+	+
Typhlodromus (*Anthoseius*) *mathieui* *				+	
Typhlodromus (*Anthoseius*) *kasachstanicus*			+		
Typhlodromus (*Typhlodromus*) *phialatus*				+	
Typhlodromus (*Typhlodromus*) *exhilaratus*	+		+		+
Phytoseiulus persimilis		+			+

Oxycenus maxwelli (Keifer 1939)

Oxypleurites maxwelli Keifer, 1939: 152.
Oxycenus maxwelli Keifer, 1961: 7.

Common name — olive leaf and flower mite.

Distribution — *Oxycenus maxwelli* is recorded from Algeria, Armenia, Australia, Brazil, California, Egypt, Greece, Italy, Portugal and Spain (Vacante 2016).

Material examined — **Sfax**: Aouled Msallem (34°58′21.97"N, 10°47′20.72"E), April 2008, 56 ♀♀ and 23 ♂♂ and immatures; Hageb (34°42′16.50"N, 10°39′18.97"E), April 2008, 23 ♀♀ and 17 ♂♂; Taous (34°56′02.88"N, 10°36′52.77"E), April 2008, 45 ♀♀ and 12 ♂♂; Ltayfa (34°44′58.23"N, 10°11′39.67"E) April 2008, 26 ♀♀ and 18 ♂♂; Jbenyana (35°03′14.28"N, 10°55′46.63"E), April 2011, 52 ♀♀ 15 ♂♂ and 5 immatures. **Karkennah**: Sidi Yousef (34°39′30.27"N, 10°59′42.70"E), June 2009, 16 ♀♀; Aouled Yaneg (34°40′22.19"N, 11°08′15.07"E), June 2009, 18 ♀♀ and 9 ♂♂; Ramla (34°43′17.06"N, 11°12′34.35"E), June 2009, 21 ♀♀ and 14 immatures; Mellita (34°39′24.43"N, 11°1′59.42"E), June 2009, 26 ♀♀ and 13 ♂♂; Ataya (34°44′26.25"N, 11°18′8.47"E), May 2011, 29 ♀♀ and 2 ♂♂. **Gafsa:** Oasis Gafsa (34°24′55.53"N, 8° 44′ 42.69"E), April 2008, 62 ♀♀ and 12 ♂♂; Guetar (34°20′16.39"N, 8°54′55.85"E), April 2008, 31 ♀♀ and 23 ♂♂; Bou Omran (34°21′38.47"N, 9°8′16.61"E), April 2008, 23 ♀♀ and 5 ♂♂; Bou Saad (34°21′57.24"N, 9°9′48.46"E), April 2008, 28 ♀♀. **Cap Bon**: Grambalia (36°36′46.35"N, 10°31′30.59"E), 58 ♀♀ and 24 ♂♂, February 2010, 22 ♀♀; Beni Kalled

(36°36′44.77"N, 10°31′30.72"E), February 2010, 18 ♀♀ and 6 ♂♂. **Sidi Bouzid**: Regueb (34°50′26.08"N, 9°47′49.20"E), May 2009, 17 ♀♀ and 5 ♂♂; Sidi Bouzid (35°02′03.70"N, 9°25′24.77"E), May 2009, 45 ♀♀ and 16 ♂♂.

Notes — the only known host of *O. maxwelli* is *Olea europaea* L. This species commonly feeds on the upper surfaces of olive leaves but infests the undersurfaces when populations are high (Keifer 1939). It also feeds on developing buds and shoots causing malformations and shortening internodes between young leaves ('witch's broom' effect). The infestation is most severe in young trees under high temperature and humidity. Heavy infestations of *O. maxwelli* can cause the premature fall of olive flowers, spotting and distortion of leaves (Russo 1972).

Aceria olea (Nalepa 1900)

Eriophyes oleae Nalepa, 1900: 154.
Phytoptus oleae (Nalepa), 1905: 139-140.
Aceria oleae (Nalepa) Hatzinikolis, 1986: 49-54.

Common name — olive bud mite.

Distribution — *Aceria oleae* is recorded from Algeria, Egypt, Greece, Libya, Marocco, Span, Iran Italy, Portugal, U.S.A and South Africa (Vacante 2016).

Material examined — **Sfax**: Aouled Msallem (34°58′21.97"N, 10°47′20.72"E), April 2008, 59 ♀♀ and 8 immatures; Hageb (34°42′16.50"N, 10°39′18.97"E), April 2008, 82 ♀♀ and 23 ♂♂; Taous (34°56′02.88"N, 10°36′52.77"E), April 2008, 41 ♀♀ and 12 ♂♂; Ltayfa (34°44′58.23"N, 10°11′39.67"E), April 2008, 67 ♀♀ and 33 ♂♂; Jbenyana (35°03′14.28"N, 10°55′46.63"E), April 2011, 29 ♀♀ and 23 immatures. **Karkennah**: Sidi Yousef (34°39′30.27"N, 10°59′42.70"E), June 2009, 38 ♀♀ and 7 ♂♂; Aouled Yaneg (34°40′22.19"N, 11°08′15.07"E), June 2009, 56 ♀♀, 23 ♂♂ and 18 immatures; Ramla (34°43′17.06"N, 11°12′34.35"E), June 2009, 42 ♀♀ and 10 ♂♂; Mellita (34°39′24.43"N, 11°1′59.42"E), June 2009, 23 ♀♀ and 13 ♂♂; Ataya (34°44′26.25"N, 11°18′8.47"E), May 2011, 12 ♀♀ and 21 ♂♂. **Gafsa:** Oasis Gafsa (34°24′55.53"N, 8°44′42.69"E), April 2008, 29 ♀♀ and 5 ♂♂; Guetar (34°20′16.39"N, 8°54′55.85"E), April 2008, 64 ♀♀ and 55 ♂♂; Bou Omran (34°21′38.47"N, 9°8′16.61"E), April 2008, 23 ♀♀ and 14 ♂♂; Bou Saad (34°21′57.24"N, 9°9′48.46"E), April 2008, 13 ♀♀ and 8 ♂♂. **Cap Bon**: Grambalia (36°36′46.35"N, 10°31′30.59"E), 8 ♀♀ and 13 ♂♂, February 2010, 7 ♀♀; Beni Kalled (36°36′44.77"N, 10°31′30.72"E), February 2010, 30 ♀♀. **Sidi Bouzid**: Regueb (34°50′26.08"N, 9°47′49.20"E), May 2009, 12 ♀♀ and 26 ♂♂; Sidi Bouzid (35°02′03.70"N, 9°25′24.77"E), May 2009, 38 ♀♀ and 16 ♂♂.

Note — This species is a pest of olive trees in the Mediterranean area and is especially injurious to young trees (Elhadi and Birger 1999) and in nurseries. It causes leaf and fruit deformation, and seriously reduces the amount and quality of olives and oils. In Tunisia, the pest is very common in all olive-growing localities and it reaches very high population densities. It is often found associated with *O. maxwelli.*

Key of eriophyid species associated to *Olea europea* L. in Tunisia (after Castagnoli and Pegazzano, 1986)

1. Rostrum usually small, not abruptly bent down near bases; oral stylet short; dorsal setae various present or absent, body vermiform or fusiform, only two pairs of legs, microscopic (100 to 200 μm)..... **Eriophyidae** Nalepa **2**

2. Ridges on female coverflap occurring in one rank; female genitalia in lateral view, lying more on level with venter, genitalia not appressed to coxae and coxae not usually spread apart 3

3. Body vermiform, abdominal rings similar along full length of abdomen ..... *Aceria* Keifer ... 4
— Body usually more fusiform 5

4. Prodorsal shield with medians and admedians only visible on posterior half, submedians vague, laterally granulate ..... *Aceria oleae* (Nalepa)

5. Posterior opithosoma with a adorsal depression; scapular setae directed posteriorly..... ... ***Oxycinus*** Keifer ... 6

6. Female genitalia with 16 longitudinal ridges. . . . . *Oxycinus maxwelli* (Keifer)

Family: Tenuipalpidae

False spider mites are smaller than Tetranychidae dorsoventrally flat and slow moving. Only two species have been reported on olive trees in Tunisian orchards, belonging to the same genus (*Brevipalpus)* (Pegazzano and Castagnoli 1972). Symptoms appear generally as small white spots on the leaves and in case of heavy infestations can result in desiccation and leaf drop (Pegazzano and Castagnoli 1972).

Genus: *Brevipalpus* Donnadieu 1875

Brevipalpus Donnadieu, 1875: 116.

Brevipalpus olivicola Pegazzano and Castagnoli

Brevipalpus olivicola Pegazzano and Castagnoli, 1972: 139.
Hystripalpus olivicola Castagnoli and Pegazzano, 1979: 284.
Brevipalpus olivicola Hatzinikolis, 1981: 188.

Distribution — *Brevipalpus olivicola* is recorded from Greece, Italy and Portugal (Hatzinikolis 1987).

Material examined — **Sfax**: Taous (34°56′02.88"N, 10°36′52.77"E), April 2008, 5 ♀♀ and 3 immatures. Jbenyana, (35°03′14.28"N, 10°55′46.63"E), April 2011, 8 ♀♀ and 5 immatures and January 2012, 6 ♀♀ and 6 immatures. **Sidi Bouzid**: Regueb (34°50′26.08"N, 9°47′49.20"E), August 2009, 4 ♀♀ and 8 immatures.

Note — This species is considered as a minor pest of olive trees in Tunisia.

Brevipalpus oleae Baker

Brevipalpus oleae Baker, 1949: 361.
Hystripalpus oleae Castagnoli and Pegazzano, 1979: 282.

Distribution — *Brevipalpus oleae* is recorded from Greece, Italy, Morocco and Portugal (Castagnoli and Pegazzano 1986).

Material examined — **Gafsa:** Bou Omran (34°21′38.47"N, 9°8′16.61"E), July 2008, 9 ♀♀ and 3 immatures; Bou Saad (34°21′57.24"N, 9°9′48.46"E), July 2008, 4 ♀♀ and 4 immatures and May 2009, 2 ♀♀ and 5 immatures.

Note — this phytophagous mite is not considered as an important pest in Tunisia because of its limited area of distribution in this country. It attacks stems, leaves, inflorescences and fruits of olive trees.

Identification key of species of *Brevipalpus* genys associated to *Olea europea* in Tunisia (after Hatzinikolis, 1986)

1. Dorsal opisthosoma with six pairs setae in lateral position (h_1, h_2, f_3, e_3, d_3, c_3) 2

2. Tarsus II with a single sensory rod 3

3. Rostrum extending beyond distal end of femur I. 4
— Rostrum not extending beyond distal end of femur I 5

4. Rostrum reaching middle of genu I. Propodosoma with reticulation medio-laterally. Smooth mediodorsally; body setae broadly lanceolate. Nymphs 1,4,6, dorsolateral setae long; 2,3,5, very short . . . . . *Brevipalpus olivicola*

5. Propodosoma with reticulation but smooth mediodorsally; body setae lanceolate tapering. Nymphs with 4, 6, dorsolateral setae long; 1,2,3,5 very short . . . . . *Brevipalpus oleae*

Family Tetranychidae Donnadieu 1875
Sub-family Bryobiinae Berlese 1913
Tribe Bryobiini Reck 1952

Genus *Bryobia* Koch 1836

Bryobia Koch, 1836: 8-9; Pritchard and Baker, 1955: 14; Wainstein, 1960: 94; Tuttle and Baker, 1968: 4; Meyer, 1974: 13.

Bryobia mites puncture the plant tissues with their long, stylet-like chelicerae. They are often found on leaves, but they can also be found on branches and twigs (Ros 2009). Only one species has been reported on olive trees: *Bryobia attica* from Greece (Hatzinikolis and Emmanouel 1990).

Bryobia sp.

Note — *Bryobia* sp. is probably a new species near *Bryobia attica* Hatzinikolis & Emmanouel 1990 in having the same body shape, prodorsal lobes and spatulate dorsal setae but it can be distinguished from the latter by the leg chaetotaxy, empodium I about fourth he length of the true claws and with two pairs of tenent hairs. The peritremes are wider than that of *B. attica*. Tarsi III and IV associated setae serrate and approximate with solenidion forming duplex, the tactile member much longer and proximal.

The species is dark red in life. No damage to olive plant was observed and its economic impact seems negligible.

Material examined — Four females collected on the variety olive oil Chemlali from **Sfax**: Ltayfa (34°44′58.23"N, 10°11′39.67"E) June 2011.

Catalogue of the Tunisian Phytoseiidae species associated with olive trees

Fourteen species belonging to seven genera were identified.

Subfamily Amblyseiinae

Typhlodromus (*Amblyseius*) Chant, 1957: 292.
Amblyseiinae Muma, 1961: 273; Chant and McMurtry, 2007: 12.
Amblyseiini Schuster and Pritchard, 1963: 225.

Tribe Euseiini Chant & McMurtry

Euseiini Chant and McMurtry, 2005: 191; 2007: 107.

Subtribe Euseiina Chant & McMurtry

Euseiina Chant and McMurtry, 2005: 209; 2007: 118.

Genus *Euseius* Wainstein

Euseius scutalis (Athias-Henriot 1958)

Typhlodromus scutalis Athias-Henriot, 1958a: 183.
Amblyseius scutalis Athias-Henriot, 1960a: 297.
Amblyseius(*Typhlodromalus*) *scutalis* Muma, 1961: 288.
Amblyseius (*Amblyseius*) *scutalis* Ueckermann and Loots, 1988: 109.

Distribution — Algeria, Canary Islands, Cape Verde, Ghana, Egypt, Greece, India, Iran, Israel, Italy, Jordan, Lebanon, Morocco, Pakistan, South Africa, Spain and Turkey (Demite *et al.* 2016).

Material examined — **Karkennah**: Sidi Yousef (34°39′30.27"N, 10°59′42.70"E), April 2010, 36 ♀♀; Ataya (34°44′26.25"N, 11°18′8.47"E), June 2011, 12 ♀♀ and 2 ♂♂. **Cap Bon**: Grambalia (36°36′46.35"N, 10° 31′ 30.59"E), April 2010, 25 ♀♀ and 1 ♂; Beni Kalled (36°36′44.77"N, 10°31′30.72"E), April 2010, 42 ♀♀ and 2 ♂♂, and June 2011, 31 ♀♀ and 3 ♂♂. **Note:** This species is very common in Maghreb and South of Spain (Kreiter and *al.* 2004). It is wide spread in the Tunisian orchards. This species can be reared on pollen and was recorded as a predator of *Panonychus citri* (McGregor) in citrus orchards (McMurty 1977; Kasap and Ekerog 2004); it is also reported as a biological control agent of *Bemisia tabaci* (Nomikou et *al.* 2003). *Euseius scutalis* was observed in high numbers on olive trees in late spring.

Euseius stipulatus (Athias-Henriot 1960)

Amblyseius stipulatus Athias-Henriot ,1960a: 294.
Amblyseius (*Amblyseius*) *stipulatus* Ueckermann and Loots, 1988: 110.
Euseius stipulatus (Athias-Henriot), Ferragut *et al.*, 1985: 225; Chant and McMurtry, 2005: 216; 2007: 123.

Distribution — Algeria, Canary Islands (Spain), France, Greece, Italy, Montenegro, Morocco, Portugal, Tunisia, Turkey, and former Yugoslavia (Demite *et al.* 2016).

Material examined — **Sfax**: Taous (34°56′02.88"N, 10°36′52.77"E), May 2010, 18 ♀♀ and 2 ♂♂; **Karkennah**: Sidi Yousef (34°39′30.27"N, 10°59′42.70"E), April 2011, 14 ♀♀ and 1 ♂; **Cap**

Bon: Grambalia (36°36′46.35"N, 10°31′30.59"E), May 2010, 8 ♀♀, and June 2011, 16 ♀♀ and 2 ♂♂; Beni Kalled (36°36′44.77"N, 10°31′30.72"E), April 2010, 10 ♀♀, and June 2011, 15 ♀♀ and 2 ♂♂; **Sidi Bouzid**: Regueb (34°50′26.08"N, 9°47′49.20"E), August 2009, 12 ♀♀.

Note — *Euseius stipulatus* was classified by McMurtry and Croft (1997) as a specialized pollen feeder. This species feeds also on pest mites such as *P. citri* (Ferragut *et al.* 1988, 1992), *Tetranychus urticae* Koch (Moyano *et al.* 2009) and eriophyid mites (Ferragut *et al.* 1987).

Euseius gallicus Kreiter and Tixier 2010

Euseius gallicus Kreiter and Tixier, 2010, in Tixier *et al.*, 2010: 242.

Distribution — France, Belgium, Germany, the Netherlands and Turkey (Demite *et al.* 2016).

Material examined — **Karkennah**: Sidi Yousef (34°39′30.27"N, 10°59′42.70"E), May 2008, 2 ♀♀ and 1 ♂; Aouled Yaneg (34°40′22.19"N, 11°08′15.07"E), April 2010, 4 ♀♀; Ramla (34°43′17.06"N, 11°12′34.35"E), April 2010, 5 ♀♀ and 2 ♂♂.

Note — *Euseius gallicus* recently described is quite frequent and certainly often misidentified previously as *E. stipulatus*. It is reported to eat on whiteflies and thrips. *Euseius gallicus* also feeds on pollen and on spider mites, tarsonemid mites and eggs of various insect pests (Pijnakker 2014).

Euseius finlandicus (Oudemans 1915)

Seiulus finlandicus Oudemans, 1915: 183.
Typhlodromus pruni Oudemans, 1929: 32-33.

Distribution — Algeria; Angola, Argentina, Armenia, Austria, Azerbaijan, Belgium; Byelorussia; Canada; Caucasus region; China; Croatia; Czech Republic; Denmark, England; Finland; France; Georgia; Germany; Greece; Hungary; India; Indonesia; Iran; Israel; Italy; Japan; Kazakhstan Latvia; Mexico; Moldova; Montenegro; Nicaragua; Norway; Poland; Portugal; Romania; Russia; Slovakia; South Korea; Spain; Sweden; Switzerland; Netherlands; Turkey; Ukraine and USA (Demite *et al.* 2016).

Material examined — **Karkennah**: Sidi Yousef (34°39′30.27"N, 10°59′42.70"E), March 2011, 4 ♀♀ and 1 ♂.

Note — As most species of the genus *Euseius*, this species also develops on pollen. It was collected on a wide range of plants, generally on deciduous plants (Tixier *et al.* 2013).

Iphiseius Berlese

Iphiseius degenerans (Berlese 1887)

Seiulus degenerans Berlese, 1887: 9.
Iphiseius degenerans (Berlese) Berlese, 1921: 95.
Amblyseius (*Iphiseius*) *degenerans* (Berlese) Muma, 1961: 288.
Iphiseius (*Iphiseius*) *degenerans* (Berlese) Prichard and Baker, 1962: 299.
Iphiseius degenerans Moraes *et al.*, 2004: 92; Chant and McMurtry, 2007: 123.

Distribution — Algeria, Benin, Brazil, Burundi, Canary Islands, Cape Verde, China (Hong-Kong), Congo, Egypt, Georgia, Greece, Israel, Italy, Kenya, Lebanon, Madeira Islands, Madagascar, Malawi, Morocco, Nigeria, Portugal, Rwanda, South-Africa, Tanzania, Turkey, Yemen, Zaire and Zimbabwe (Demite *et al.* 2016).

Material examined — **Sfax**: **Cap Bon**: Beni Kalled (36°36′44.77"N, 10°31′30.72"E), April 2010, 7 ♀♀ and 2 ♂♂, and June 2011, 3 ♀♀.

Note — this species has a wide distribution in Africa and around the Mediterranean Sea on a great variety of plants (McMurtry 1977; Papaioannou *et al.* 1994; Swirski and Amitai 1997; Grissa-Lebdi 2003; Sahraoui *et al.* 2012). It is used for the biological control of the western flower thrips, *Franklinella occidentalis* (Pergande) (Vantornhout *et al.* 2005) and spider mites in greenhouses (Vantornhout *et al.* 2004).

Tribe Kampimodromini Kolodochka

Kampimodromini Kolodochka, 1998: 59; Chant and McMurtry, 2007: 3.

Subtribe Kampimodromina Chant and McMurtry

Kampimodromina Kolodochka Chant and McMurtry, 2007: 36.

Kampimodromus aberrans (Oudemans 1930)

Typhlodromus aberrans Oudemans, 1930: 48.
Typhlodromus (*Typhlodromus*) *aberrans* Beglyarov, 1957: 373.
Amblyseius aberrans Athias-Henriot, 1958b: 36.
Typhlodromus (*Amblyseius*) *aberrans* Chant, 1959: 101.
Paradromus aberrans Muma, 1961: 286.
Amblyseius (*Kampimodromus*) *aberrans* Pritchard and Baker, 1962: 294; Wainstein, 1962: 14.
Amblyseius (*Amblyseius*) *aberrans* Tseng, 1976: 108.
Kampimodromus aberrans [sic] Kolodochka, 1978 and 1998: 77.
Kampimodromus (*Kampimodromus*) *aberrans* Karg, 1983: 305.
Kampimodromus aberrans Moraes *et al.,* 2004: 93; Chant and McMurtry, 2007: 37.

Distribution — Algeria, Armenia, Austria, Azerbaijan, Bulgaria, Byelorussia, Canada, Caucasus Region, Czech Republic, England, France, Georgia, Germany, Greece, Hungary, Iran, Israel, Italy, Moldova, Montenegro, Netherlands, Norway, Poland, Portugal, Russia, Spain, Switzerland, Turkey, Ukraine, and USA (Demite *et al.* 2016).

Material examined — **Sfax**: **Karkennah**: Sidi Yousef (34°39′30.27"N, 10°59′42.70"E), May 2008, 5 ♀♀ and 1 ♂and April 2010, 3 ♀♀; **Cap Bon**: Grambalia (36°36′46.35"N, 10°31′30.59"E), April 2010, 8 ♀♀ and 2 ♂♂ on Koroneiki and Arbequina varieties; Beni Kalled (36°36′44.77" N, 10°31′30.72"E), April 2010, 3 ♀♀, and May 2011, 4 ♀♀ on Chetoui variety.

Note — *Kampimodromus aberrans* is a very common species in Europe and in North-Africa. It was recorded from uncultivated plants and crops as apple and vineyards (Duso 1992; Ragusa and Tsolakis 1996; Schausberger 1997; Kreiter *et al.* 2000, 2002a; Tixier *et al.* 2002, 2003).

Neoseiulus californicus (McGregor 1954)

Typhlodromus californicus McGregor, 1954: 89.
Amblyseius californicus Schuster and Pritchard, 1963: 271.
Cydnodromus californicus Athias-Henriot, 1977: 62.
Amblyseius (*Amblyseius*) *californicus* Ueckermann and Loots, 1988: 150; Ehara *et al.,* 1994: 126.
Amblyseius (*Neoseiulus*) *californicus* Ehara and Amano, 1998: 33.
Neoseiulus californicus Moraes *et al.*, 1986: 73; Moraes *et al.*, 2004: 109.

Distribution — Algeria, Argentina, Brazil, Chile, Colombia, Cuba, France, Guatemala, Italy, Japan, Mexico, Peru, Spain, Taiwan, Uruguay, USA, and Venezuela (Demite *et al.* 2016).

Material examined — **Cap Bon**: Beni Kalled (36°36′44.77"N, 10°31′30.72"E), April 2010, 8 ♀♀ and 2 ♂♂, and August 2011, 10 ♀♀. **Sidi Bouzid**: Regueb (34°50′26.08"N, 9°47′49.20"E) May 2010, 3 ♀♀.

Note — *Neoseiulus californicus* is used commercially around the world to control the two spotted spider mite and several other economically important mite species on several crop species (Castagnoli and Simoni 2003).

Tribe Phytoseiulini Chant & McMurtry

Phytoseiulini Chant and McMurtry, 2006: 7; 2007: 53.

Phytoseiulus Evans

Phytoseiulus Evans, 1952: 397; Chant and McMurtry, 2006: 17; 2007: 53.
Phytoseiulus (*Phytoseiulus*) Wainstein, 1962: 18.
Amblyseius (*Phytoseiulus*) Pritchard and Baker, 1962: 294.
Mesoseiulus Gonzalez and Schuster, 1962: 18.
Amblyseius (*Mesoseiulus*) Van der Merwe, 1968: 172.

Phytoseiulus persimilis Athias-Henriot 1957

Phytoseiulus persimilis Athias-Henriot, 1957: 347.
Phytoseiulus riegeli Dosse, 1958: 48.
Typhlodromus persimilis Hirschmann, 1962: 75.
Phytoseiulus (*Phytoseiulus*) *persimilis* Wainstein, 1962: 17.
Phytoseiulus persimilis Chant, 1959: 109; Moraes *et al.,* 2004: 169; Chant and McMurtry, 2007: 53.

Distribution — Algeria, Australia, Canary Islands, Chile, China, Costa Rica, Finland, France, Greece, Guatemala, Hungary, Israel, Italy, Jordan, Lebanon, Lybia, Morocco, New Caledonia, Peru, Reunion Island, South Africa, South Korea, Spain, Tunisia, Turkey, Venezuela, and USA (Demite *et al.* 2016).

Material examined — **Sfax**: **Karkennah**: Sidi Yousef (34°39′30.27"N, 10°59′42.70"E), March 2010, 3 ♀♀ and 1 ♂; May 2011, 5 ♀♀; **Sidi Bouzid**, Regueb (34°50′26.08"N, 9°47′49.20"E), May 2009, 4 ♀♀.

Note — This species has been reported on a wide range of plants, essentially on herbaceous plants. It is reared and sold by several bio-factories in the world (Tixier *et al*. 2013). It is a very efficient natural enemy of *T. urticae* especially in greenhouses (Van Lenteren and Woets 1988).

Subfamily Phytoseiinae

Phytoseiini Berlese, 1913: 3.
Phytoseiinae Vitzthum, 1941: 768; Chant and McMurtry, 1994: 231; 2007: 125.
Chantiini Pritchard and Baker, 1962: 211.
Chantiinae Chant and Yoshida-Shaul, 1986: 2025.

Phytoseius finitimus Ribaga 1904

Phytoseius finitimus Ribaga, 1904: 178.
Phytoseius (*Dubininellus*) *finitimus* Wainstein, 1959: 1365.
Phytoseius (*Pennaseius*) *finitimus* Pritchard and Baker, 1962: 223.
Pennaseius finitimus Schuster and Pritchard, 1963: 279.
Phytoseius (*Phytoseius*) *finitimus* Denmark, 1966: 16.
Phytoseius finitimus Chant, 1959: 108; Moraes *et al.*, 2004: 252; Chant and McMurtry, 2007: 129.

Material examined — **Karkennah**: Sidi Yousef (34°39′30.27"N, 10°59′42.70"E), April 2011, 8 ♀♀; Aouled Yaneg (34°40′22.19"N, 11°08′15.07"E), March 2010, 5 ♀♀; **Sidi Bouzid:** Regueb (34°50′26.08"N, 9°47′49.20"E), May 2009, 4 ♀♀ and 1 ♂.

Distribution — Algeria, Egypt, France, Greece, Iran, Israel, Italy, Montenegro, Portugal, Spain, Turkey, and USA (Demite *et al.* 2016).

Note — Some confusion between *Phytoseius finitimus and P. plumifer* existed in literature (Duso and Fontana 2002). This species is reported in Mediterranean basin and has been observed in vineyards (Minarro and Kreiter 2012). *Phytoseius finitimus* is a natural enemy of *Panonychus ulmi* (Koch) (Duso and Moretto 1994), and eriophyid mites: *Aceria ficus* (Rasmy and El-Banhawy 1974), it can also feed on pollen (Rasmy and El-Banhawy 1975).

Subfamily Typhlodrominae

Typhlodromus Scheuten, 1857, Evans, 1958: 223.
Typhlodromus (*Typhlodromus*) Chant, 1957: 531.
Gigagnathinae Wainstein, 1973: 276.
Gigagnathini Karg, 1983: 299.
Cydnodromellinae Chant and Yoshida-Shaul, 1986: 2812.
Typhlodrominae Wainstein, Chant and McMurtry, 1994: 235; 2007: 131.

Tribe Typhlodromini Wainstein

Typhlodromus Scheuten, Evans, 1953: 449.
Typhlodromus (*Typhlodromus*) Chant, 1957: 528.
Typhlodromini Wainstein, 1962: 26; Chant and McMurtry, 1994: 246; 2007: 144.

Typhlodromus Scheuten

Typhlodromus Scheuten, 1857: 111; Chant and McMurtry, 1994: 249; 2007: 147.
Kampimodromus Nesbitt, 1951: 52.
Typhlodromus (*Typhlodromus*) Chant, 1957: 528.
Typhlodromus rhenanus group Chant, 1959: 62.
Typhlodromus barkeri group Chant, 1959: 60.
Anthoseius De Leon, 1959: 258.
Amblydromella Muma, 1961: 294.
Clavidromus Muma, 1961: 296.
Typhlodromella Muma, 1961: 299.
Chanteius (*Colchodromus*) Wainstein, 1962: 19.
Typhlodromus (*Neoseiulus*), Wainstein, 1962: 21 (in part).
Mumaseius De Leon, 1965: 23.
Orientiseius Muma and Denmark, 1968: 238.
Typhlodromus (*Anthoseius*) Van der Merwe, 1968: 20.
Indodromus Ghai and Menon, 1969: 348.
Wainsteinius Arutunjan, 1969: 180; Karg, 1983: 300.
Anthoseius (*Amblydromellus*) Wainstein, 1972: 1477.

Typhlodromus (*Anthoseius*) *athenas* Swirski and Ragusa 1976

Typhlodromus (*Anthoseius*) *athenas* Swirski and Ragusa, 1976: 111.

Amblydromella athenas Moraes *et al.*, 1986: 154.
Amblydromella (*Aphanoseia*) *athenas* Denmark and Welbourn, 2002: 308.
Typhlodromus (*Anthoseius*) *athenas* Moraes *et al.*, 2004: 310; Chant and McMurtry, 2007: 152.

Distribution — Greece, Israel, Italy, Morocco, Portugal, Spain (Demite *et al.* 2016).

Material examined — **Sfax**: Aouled Msallem (34°58'21.97"N, 10°47'20.72"E), April 2008, 6 ♀♀ and 1 ♂and May 2010, 8 ♀♀ and 2 ♂♂; Hageb (34°42'16.50"N, 10°39'18.97"E), April 2008, 4 ♀♀; Taous (34°56'02.88"N, 10°36'52.77"E), May 2008, 6 ♀♀, and May 2010 adults; Ltayfa 34°44'58.23"N, 10°11'39.67"E) April 2008, 11 ♀♀ and 1 ♂; Jbenyana (35°03'14.28"N, 10°55'46.63"E), May 2009, 5 ♀♀ and 2 ♂♂; **Karkennah**: Sidi Yousef (34°39'30.27"N, 10°59'42.70"E), March 2011, 7 ♀♀; Aouled Yaneg (34°40'22.19"N, 11°08'15.07"E), April 2011, 17♀♀and 1 ♂; Ramla (34°43'17.06"N, 11°12'34.35"E), June 2011, 8 ♀♀; Mellita (34°39'24.43"N, 11°1'59.42"E), June 2011, 3 ♀♀; Ataya (34°44'26.25"N, 11°18'8.47"E), June 2011, 4 ♀♀. **Gafsa:** Oasis Gafsa (34°24'55.53"N, 8°44'42.69"E), March 2004, 6 ♀♀ and 2 ♂♂, March 2007, 9 ♀♀ and 1 ♂, and April 2008, 14 ♀♀ and 1 ♂; Guetar (34°20'16.39"N, 8°54'55.85"E), April 2008, 9 ♀♀ and 1 ♂; Bou Omran (34°21'38.47"N, 9°8'16.61"E), April 2008, 8 ♀♀ and 2 ♂♂; Bou Saad (34°21'57.24"N, 9°9'48.46"E), April 2008, 5 ♀♀. **Cap Bon**: Grambalia (36°36'46.35"N, 10°31'30.59"E), March 2009, 2 ♀♀, April 2010, 4 ♀♀, and May 2009, 8 ♀♀ and 1 ♂; Beni Kalled (36°36'44.77"N, 10°31'30.72"E), May 2009, 9 ♀♀, and April 2010, 4 ♀♀ and 1 ♂. **Sidi Bouzid**: Regueb (34°50'26.08"N, 9°47'49.20"E), March 2008, 2 ♀♀; and April 2010, 11 ♀♀ and 1 ♂; Sidi Bouzid (35°02'03.70"N, 9°25'24.77"E), April 2009, 7 ♀♀.

Note — This species has been frequently observed on olive trees and arboreal plants (Tixier *et al*. 2013). *Typhlodromus* (*Anthoseius*) *athenas* appears well adapted to high temperatures occurring in the Mediterranean region and may be a useful biological control agent (Kolokytha *et al.* 2011).

Typhlodromus (*Anthoseius*) *kazachstanicus* Wainstein 1958

Typhlodromus kazachstanicus Wainstein, 1958: 203.

Distribution — Armenia, Georgia, Iran, Kazakhstan, Kyrgyzstan, Russia, Tajikistan, and Uzbekistan (Demite *et al.* 2016).

Material examined — **Gafsa:** Oasis Gafsa (34°24'55.53"N, 8°44'42.69"E), April 2008, 5 ♀♀; Guetar (34°20'16.39"N, 8° 54' 55.85"E), April 2008, 4 ♀♀ and 1 ♂ on Chemchali variety.

Note — The biology of this species remains unknown. It seems common on various trees (Demite *et al.* 2016).

Typhlodromus (Anthoseius) mathieui Kreiter and Chatti n. sp.

Zoobank: 445F995C-A657-4114-9E7B-AF7755087D69

Material examined — **Sfax**: **Cap Bon**: Grambalia (36°36'46.35"N, 10° 31'30.59"E), April 2009, March 2010 and October 2011, 4 ♀♀ on Arbequina and Koroneiki varieties in a very high density olive orchard. The four females were collected from foliage of olive tree infested with eriophyid mites.

Diagnose — This species has five solenostomes, all dorsal setae smooth except *Z5*, peritreme extending between *j1* and *j3*, two setae inserted on the sternal shield, one on a metasternal shield and one on the membrane, four setae on the ventrianal shield with no preanal solenostome, 3 macrosetae slightly knobbed, a spermatheca pocular, 3 teeth on the fixed digit and 2 teeth on the movable digit of the chelicara. This is a unique combination of characters which clearly distinguish this species from all other species within the genus *Typhlodromus* subgenus *Anthoseius.* This new species is more close to *T.* (*A.*) *aestivalis* Athias-Henriot, 1960 but this latter species has setae with different length, setae *St4* on a small metasternal shield (not for the new species), three knobbed macrosetae but with *STiIV* and *SGeIV* more than 40 μm and the shape of the spermathecal is very different. It resembles also to *T.* (*A.*) *clairathiaseae* Wainstein & Arutunjan, 1967 but setae have different length, setae *St4* on a small metasternal shield (not for the new species), this species has only knobbed macrosetae on the basitarsus IV and the shape of the spermatheca is very different. The new species is also closed to *T.* (*A.*) *maspalomensis* Ferragut & Peña-Estévez, 2003 but setae lengths are very different, setae *St4* on a small

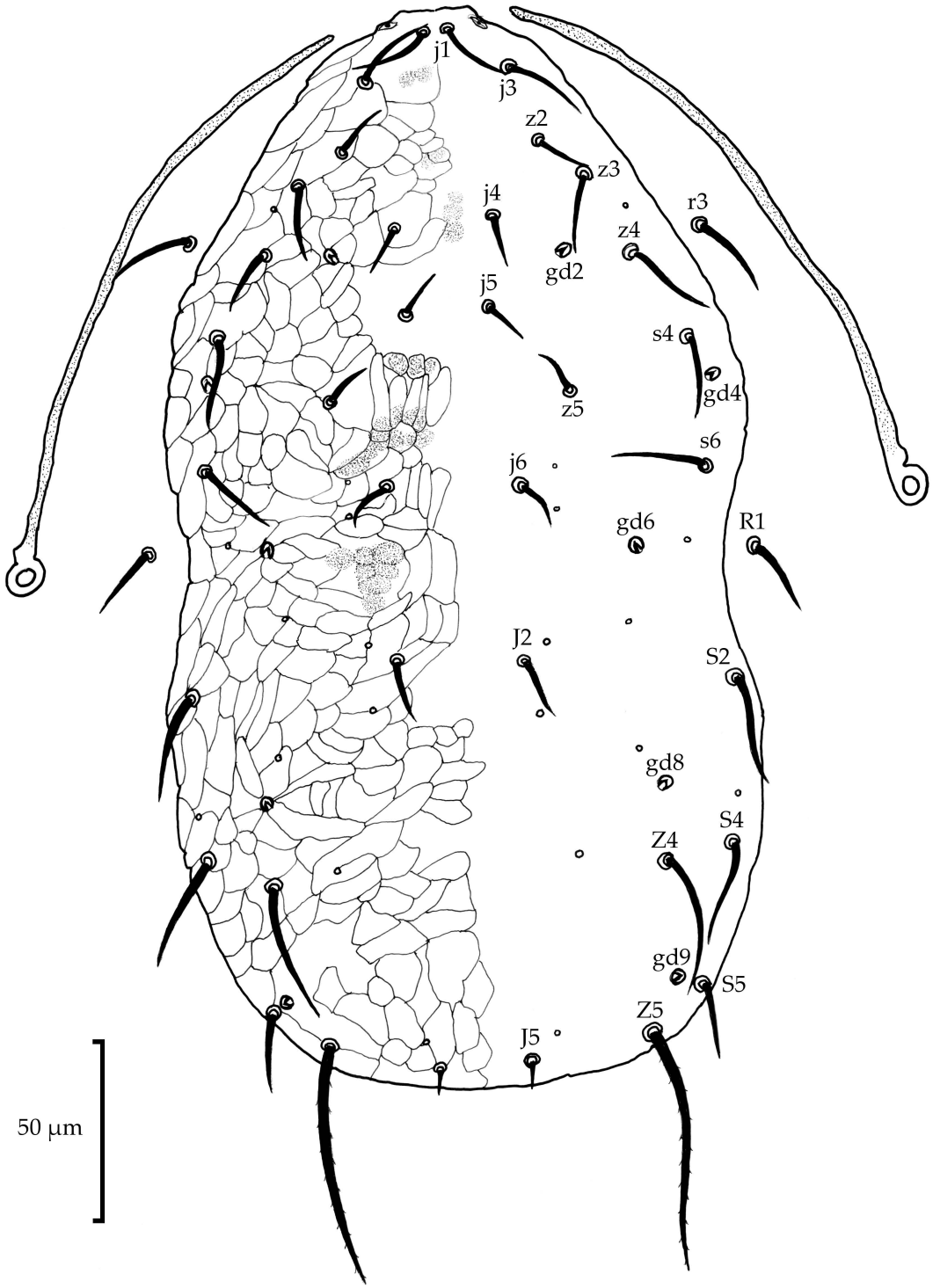

FIGURE 1: Dorsal shield and peritreme of the female of *Typhlodromus* (*Anthoseius*) *mathieui* **n. sp.**

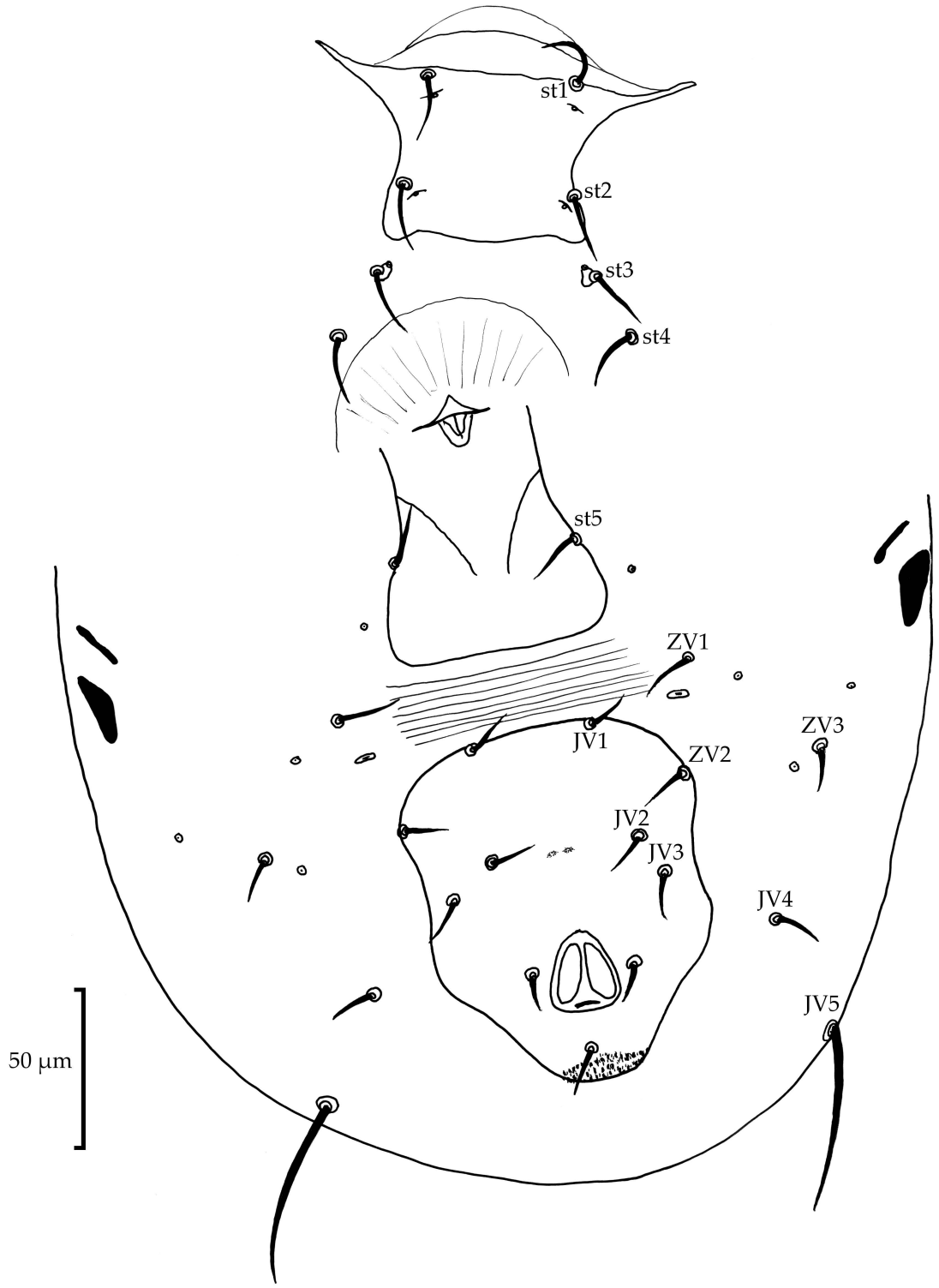

FIGURE 2: Ventral shields of the female of *Typhlodromus* (*Anthoseius*) *mathieui* **n. sp.**

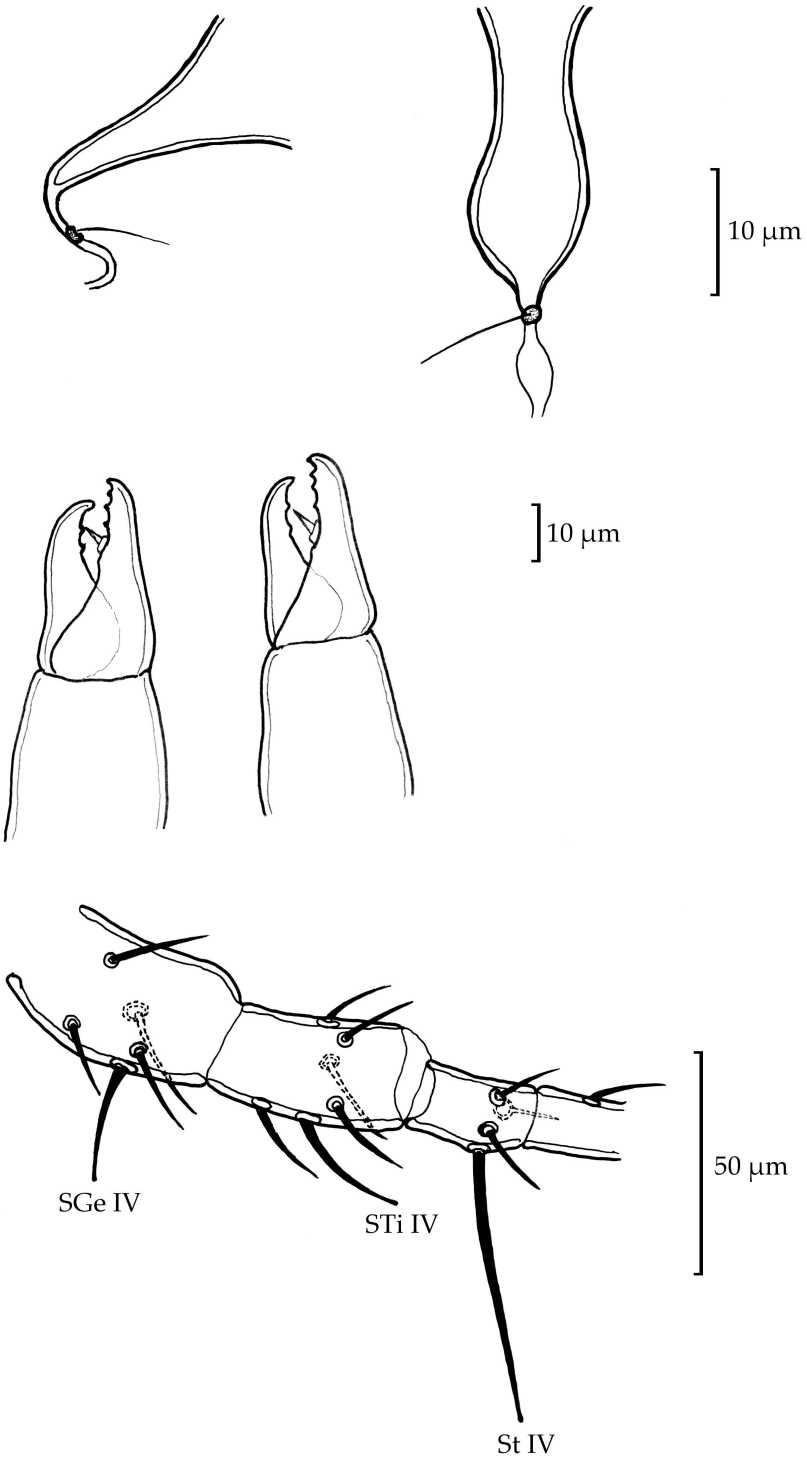

FIGURE 3: Calyx of the spermatheca (a), Chelicera (b) and Macrosetae on leg IV (c) of the female of *Typhlodromus* (*Anthoseius*) *mathieui* **n. sp.**

metasternal shield (not for the new species), ventrianal shield and spermatheca with different shape and only two pairs of macrosetae knobbed on the three pairs present in this species. Finally, it resembles also to *T.* (*A.*) *macrum* Ke & Xin, 1983 and to *T.* (*A.*) *rapidus* Wainstein & Arutunjan, 1968 but these two species have pores on the ventrianal shield, only one macroseta on leg IV and a spermatheca with a totally different shape.

Description of the adult female (n= 4) (Figs. 1-3)

Dorsum (Fig. 1) — Dorsal shield **377** (352 – 402) long and **179** (178 – 180) wide, slightly reticulated anteriorly, with five solenostomes (gd2, gd4, gd6, gd8 and gd9), 11 pairs of poroids, 18 pairs of dorsal setae and two pairs of sub-lateral setae: *j1* **27** (26 – 28), *j3* **29** (28 – 30), *j4* **15**, *j5* **16** (15 – 17), *j6* **18** (16 – 20), *J2* **24** (23 – 25), *J5* **9** (8 – 10), *z2* **19** (18 – 21), *z3* **24** (23 – 25), *z4* **23** (22 – 24), *z5* **16** (15 – 18), *Z4* **45** (43 – 47), *Z5* **60** (50 – 70), *s4* **27** (26 – 28), *s6* **29** (28 – 30), *S2* **35** (33 – 37), *S4* **34** (33 – 37), *S5* **22** (20 – 25), *r3* **26** (25 – 28), *R1* **25**. All setae smooth except *Z5* which is slightly serrated.

Peritreme (Fig. 1) — Extending between *j1* and *j3*.

Venter (Fig. 2) — All shields slightly reticulated. Sternal shield with two pairs of setae and two pairs of pores; one pair of sternal setae on a small metasternal shield and one pair on the membrane; posterior margin convex. Distances between *st1-st3* **70**, *st2-st2* **60**, *st5-st5* **53** (52 – 54). Two pairs of metapodal shields **28** long and **8** wide for the larger and **17** long and **3** wide for the slender shield. Ventri-anal shield with four pairs of pre-anal setae (*JV1*, *JV2*, *JV3* and *ZV2*), and no pre-anal solenostome but small pores very close in the center. Membrane surrounding ventri-anal shield with four pairs of setae (*ZV1*, *ZV3*, *JV4* and *JV5*), and five pairs of round to oblong poroids; ventri-anal shield **116** (113 – 120) long, **103** wide at level of anterior corners (*ZV2*), and **90** wide at level of anus. *JV5* **52** (50 – 53) long.

Chelicera (Fig. 3 a) — Fixed digit **33** long with **3** teeth; and movable digit **30** long with **2** teeth. *Pilus dentilis* visible on all chelicerae of the four females.

Spermatheca (Fig. 3 b) — Spermatheca pocular (Denmark *et al.* 1999), with an elongate cervix **22** long and **15** wide, a small neck at the basis of the cervix and an atrium at the end of this small neck. Visible ducti minor and major.

Legs (Fig. 3 c) — Legs IV with three macrosetae slightly knobbed on the basitarsus, tibia and genu. *SGeIV* **27** (26 – 28), *STiIV* **27** (26 – 28), *STIV* **59** (58 – 60). Genu II and III with 7 setae each. Chaetotactic formula of genu II: **0-2/1, 2/0-2**; genu III: **1-1/0, 2/1-2**. Length of leg I: **320** (315 – 325), II: **267** (263 – 270), III: **276** (274 – 278), IV: **383** (353 – 313).

Type material — the holotype female and two paratype females deposited in Montpellier SupAgro – INRA Acarology collection, Montpellier, France; one paratype female deposited in the mite reference collection of the entomology laboratory of Institut de l'Olivier (Sfax, Tunisia).

Etymology — The name "*mathieui*" refers to the son of Serge Kreiter, Mathieu Kreiter.

Remarks — The combination of characters of this new species clearly distinguishes it from the other species in the genus *Typhlodromus*, subgenus *Anthoseius*. However, it relates very well with a species that Athias Henriot (1960a) described based on a single male from Algeria collected from *Ranunculus* sp. As males lack in our samples, we obviously could not confirm if the species presently described resembles the latter and we therefore decided to describe it as a new species. A search for males on olive trees will continue in the hope to find males and more females to ensure the identity of the presently described species and perhaps consequently the status of the species described by Athias-Henriot based on only one male.

Typhlodromus (*Typhlodromus*) *exhilaratus* Ragusa

Typhlodromus exhilaratus Ragusa, 1977: 380.
Typhlodromus exhilaratus exhilaratus Chant and Yoshida-Shaul, 1987:1795.
Typhlodromus exhilaratus americanus Chant and Yoshida-Shau,l 1987: 1795.
Typhlodromus (*Typhlodromus*) *exhilaratus* Mores *et al.*, 2004: 371; Chant and McMurtry 2007: 157.

Distribution — France, Greece, Israel, Italy, Morocco, Tunisia, USA (Demite *et al.* 2016).

Material examined — **Sfax**: Hageb (34°42'16.50"N, 10°39'18.97"E), 30.04.2008, 16 ♀♀ and 1 ♂; Jbenyana (35°03'14.28"N, 10°55'46.63"E), April 2011, 13 ♀♀, 1 ♂and immatures; **Gafsa:** Oasis Gafsa (34°24'55.53"N, 8°44'42.69"E), March 2008, 8 ♀♀; Guetar (34°20'16.39"N, 8°54'55.85"E), April 2008, 6 ♀♀ on Chemchali; **Cap Bon**: Beni Kalled (36°36'44.77"N, 10°31'30.72"E), April 2009, 17 ♀♀ and 2 ♂♂, and March 2010, 8 ♀♀ and 2 ♂♂; **Sidi Bouzid**: Regueb (34°50'26.08"N, 9°47'49.20"E) March 2008, 13 ♀♀ and 1 ♂, and April 2010, 15 ♀♀ on Chemlali variety.

Note — This species was mainly reported from Mediterranean countries, essentially on shrubs. *Typhlodromus* (*T.*) *exhilaratus* was considered as a synonym of *T. tiliae* Oudemans by Denmark (1992). This species has shown its ability to feed *Panonychus citri*.

Typhlodromus (*Typhlodromus*) *phialatus* Athias-Henriot

Typhlodromus phialatus Athias-Henriot, 1960b: 100.
Typhlodromus (*Typhlodromus*) *phialatus* Moraes *et al.*, 2004: 366; Chant and McMurtry, 2007: 157.

Distribution — Algeria, Canary Islands, England, France, Hungary, Israel, Italy, Montenegro, Morocco, Norway, Portugal, Spain, Greece (Demite *et al.* 2016). Material examined — **Cap Bon**: Grambalia (36°36'46.35"N, 10°31'30.59"E), April 2009, 11 ♀♀ and 1 ♂, and April 2010, 5 ♀♀; Beni Kalled (36°36'44.77"N, 10°31'30.72"E), March 2010, 8 ♀♀.

Note — This species was mainly observed on shrubs and trees. It is known to feed *Panonychus citri* and to consume pollen (Ferragut *et al.* 1992). It is considered an efficient predator of *Panonychus citri* (Ferragut *et al.* 1992).

Key to the species of Phytoseiid mites on olive trees (*Olea europea* L.) in Tunisia

Forty species belonging to 17 genera are known from Tunisia. Among them, 14 species were identified on olive trees. In order to facilitate the identification of the Phytoseiidae species reported from Tunisia on olive trees, a dichotomous key comprising these 14 species of Phytoseiidae is provided below.

1. Podonotal region of the dorsal shield (anterior to setae *R1*) of the female with 5 or 6 pairs of "lateral" setae *j3, z2, z4* and *s4* always present and *z3* and/or *s6* present 2
1′. Podonotal region of the dorsal shield (anterior to setae *R1*) of the female with 4 pairs of "lateral" setae *j3, z2, z4* and *s4* present, *z3* and *s6* absent. . . . . **Amblyseiinae:** 3

2. (1) Posterior "lateral" setae *Z1, S2, S4* and *S5* absent. Setae *r3* usually inserted on the dorsal shield. . . . . **Phytoseiinae:** *Phytoseius finitimus*
2′. (1) At least one of setae *Z1, S2, S4* and *S5* present. Setae *r3* usually inserted on the interscutal soft cuticule (rarely on the shield) . . . . **Typhlodominae:** 12

3. (1′) Sternal shield with median posterior projection, some forward "migration" of preanal setae *ZV2* and/or *JV2* 4
3′. (1′) Sternal shield without posterior projection, without forward "migration" of preanal setae *ZV2* and/or *JV2* 8

4. (3) Heavily sclerotized and with separate anal and sub-rectangular ventral shield. . . . . ***Iphiseius degenerans***
4′. (3) Lightly sclerotised and ventrianal shield entire . . . . . ***Euseius*:** 5

5. Peritreme short, extending to *z4*. Spermatheca with short calyx, globular atrium. . . . . ***Euseius finlandicus***
5′. Peritreme long, extending at least to setae *z2*. Spermatheca with long calyx 6

6. (5′) Cervix of spermatheca thin, long and sinuous (43 μm). Macrosetae of the basitarsus of the leg IV long (77 μm) Peritreme short, extending to level of *z4* or between *z2* and *z4* . . . . . ***Euseius scutalis***
6′. (5′) Cervix of the spermatheca tubular and not sinuous (20-25 μm). Macrosetae of the basitarsus of the leg IV shorter (50-60 μm). Peritreme long,

extending to level of *j3* or between *j3* and *z2* 7

7. (6′) Cervix of the spermatheca not vase-shape (side walls of the calyx parallel), atrium globular. Dorsum slightly reticulated . . . . . ***Euseius stipulatus***
7′. (6′) Cervix of spermatheca vase-shaped (side walls of the calyx not parallel). Dorsum more strongly reticulated . . . . . ***Euseius gallicus***

8. (3′) Setae *S4* absent 9
8′. (3′) Setae *S4* present 10

9. (8) Setae *J2*, *S2* absent, female ventrianal shield reduced, setae *j6* very long: 2-3 times longer than distance between their bases, female ventrianal shield with 1 pair of preanal setae. The living mites are orange or red in colour . . . . ***Phytoseiulus persimilis***
9′. (8) Setae *J2*, *S2* present, female ventrianal shield elongated with three preanal setae, short distance between the bases of setae *Z1* reaching *S2*. Setae j6 not long . . . . . ***Kampidromus aberrans***

10. (8′) Ratio setae *s4*: *Z1* < 3.0:1.0; *s4*, *Z4*, and *Z5* not greatly longer than other setae Female ventrianal shield not reduced and/or markedly wider at anus level, without a marked waist. *J2* always present. Movable and fixed cheliceral digits with a larger number of teeth not confined to apical region Macrosetae are absent on Genu II and III. . . . . ***Neoseiulus*:** 11

11. Ventrianal shield with large prominent crescentic preanal pores close to the central part. Setae *Z4* longer than *S4*, *J2* longer than S5. . . . . ***Neoseiulus californicus***

12. (2′) Setae *S5* present *Typhlodromus* (*Anthoseius*). 13
12′. (2′) Setae *S5* absent *Typhlodromus* (*Typhlodromus*) 14

13. (12) Spermatheca with a globulous atrium, sometimes with a thick neck between it and cervix. Ventrianal shield elongate and not pentagonal. . . . . ***Typhlodromus* (*Anthoseius*) *kazachstanicus***
13′. (12) Basitarsus IV with a macroseta having bulbous tip. Spermatheca without a neck between atrium and cervix and a long cylindrical major duct. . . . . ***Typhlodromus* (*Anthoseius*) *athenas***
13″. Leg IV with 3 bulbous macroseta on basitarsus, tibia and genual. Spermatheca pocular with a small neck at the basis of the cervix and an atrium at the end of this small neck. . . . . ***Typhlodromus* (*Anthoseius*) *mathieui***

14. (12′) Basitarsus IV with a macroseta having bulbous tip. Calix of the spermatheca squared basally, with a short neck. . . . . ***Typhlodromus* (*Typhlodromus*) *exhilaratus***
14. (12′) Basitarsus IV with a macroseta having bulbous tip. Calix of the spermatheca rounded basally, without neck. . . . . ***Typhlodromus* (*Typhlodromus*) *phialatus***

DISCUSSION

In Tunisia, several pest mites have been detected on olive trees. The most common species collected throughout the olive producing regions are *Oxycenus maxwelli* and *Aceria oleae*. These species are economically important pests and appear very frequently and in high densities. However, heavy infestations can cause the premature fall of olive flowers, spotting and distortion of leaves and buds can lead to serious disorders in growth and even block the development of plants, and seriously reduce the amount and quality of olives and oils (increasing acidity and deterioration of physicochemical quality of the oil) These observations confirmed those of Çetin *et al*. (2010).

Brevipalpus olivicola, Brevipalpus oleae and *Bryobia* sp. are found in very small populations and seems not very important pests in Tunisia.

According to Kreiter *et al.* (2010), only five species were known for the phytoseiid fauna of olive trees in Tunisia. Results of surveys carried out in Tunisian olive groves during six years (2007 to 2013) resulted in nine additional ones. The 14 reported species from olive trees in Tunisia belong

to the subfamily Amblyseiinae (8 species), Typlodrominae (5 species) and Phytoseiinae (1 species).

Concerning predatory mites of the family Phytoseiidae, they are the main natural enemies associated with eriophyid and tenuipalpid mites in olive trees. However, this survey showed that *Typhlodromus* (*Anthoseius*) *athenas* was the dominant species among the fourteen species collected in olive trees. The following step will be to evaluate these predators, especially the dominant species, as potential bio-control agents against the eriophyid mites, with the aim to reduce the use of pesticides.

Conclusion

The cultivation of olives in Tunisia is an expanding economic activity; however, there is scarce information on mites, especially on phytophagous and phytoseiid mites present in orchards.

In this study, 19 species belonging to four families were collected. Almost all species are new to olive trees and five new species for Tunisian acarofauna. The new identified species for the fauna of Tunisia are: **Tenuipalpidae:** *Brevipalpus olivicola, Brevipalpus oleae*; **Tetranychidae**: *Bryobia* sp.; **Phytoseiidae:** Subfamily Amblyseiinae: *Euseius finlandicus;* Subfamily Typhlodrominae *Typhlodromus* (*Anthoseius*) *mathieui* new species to science.

Acknowledgements

We are grateful to Mohamed Ghorbel for his help and support in field samplings and to Martial Douin for his support in the laboratory practices in the CBGP (Center of Biology for Populations Management). We thank also Marie-Stéphane Tixier for valuable suggestions on an earlier version of this manuscript.

References

Arutunjan E.S. 1969 — A new genus of predatory mites of the family Phytoseiidae Berlese, 1916 (Parasitiformes: Phytoseiidae) — Doklady Akademii Nauk Armyanskoi SSR *Armenia* 48: 178-181.

Athias-Henriot C. 1957 — Phytoseiidae et Aceosejidae d'Algérie I. Genres *Blattisocius* Kegan. *Iphiseius* Berlese, *Amblyseius* Berlese, *Phytoseius* Ribaga, *Phytoseiulus* Evans — Bull. Soc. Hist. Nat. Afr. N. 48: 319-352 [in French].

Athias-Henriot C. 1958a — Contribution à la connaissance du genre *Typhlodromus* Scheuten. Description de deux espèces nouvelles d'Algérie et clé des espèces du groupe *finlandicus* — Rev. Pathol. Vég. Entomol. Agric. 37: 179-186 [in French].

Athias-Henriot C. 1958b — Phytoseiidae et Aceosejidae (Acarina, Gamasina) d'Algérie. II. Phytoseiidae: clé des genres, genres *Amblyseius* Berlese (suite) et *Seiulus* Berlese — Bull. Soc. Hist. Nat. Afr. N. 49: 23-43 [in French].

Athias-Henriot C. 1960a — Nouveaux *Amblyseius* d'Algérie — Acarologia 2: 288-299 [in French].

Athias-Henriot C. 1977 — Nouvelles notes sur les Amblyseiini. III. Sur le genre *Cydnodromus*: rédéfinition, composition (Parasitiformes, Phytoseiidae) — Entomophaga 22: 61-73 [in French]. doi:10.1007/BF02372991

Baker E.W. 1949 — The genus *Brevipalpus* (Acarina: Pseudoleptidae) — The American Midland Naturalist 42(2): 350-402. doi:10.2307/2422013

Bastide F., Courtial J.-P., Callon M. 1989 — The use of review articles in the analysis of a research area — Scientometrics 15(5): 535-562.

Beglyarov G.A. 1957 — Effect of DDT on the abundance of tetranychid mites and their predators — Entomologicheskoe Obozrenie, 36: 370-385.

Berlese A. 1887 — Acari, Myriopoda and Scorpiones hucusque in Italia reperta — Tipografia del Seminario, Padova 6(54): 7-9.

Berlese A. 1913 — Systema Acarorum genera in familiis suis disposita — Acaroteca Italica 1/2: 3-19.

Berlese A. 1921 — Acari, Myriopoda et Pseudoscorpiones hucusque in Italia reperta. I. Indice sinonimico dei generi e delle specie illustrate nei fascicoli 1 a 101 — Redia 14: 77-105.

Castagnoli M., Pegazzano F. 1979 — Rassegna degli acari Tenuipalpidi dell'Olivo com descrizione di Hystripalpus rotai sp. nov. — Redia 62 : 281-297.

Castagnoli M., Papaionnou-Souliotis P. 1982 — Seasonal fluctuations and biology of the eriophyids of olive in Tuskani — Redia 65: 329-339.

Castagnoli M., Pegazzano F. 1986 — Acariens- In: Entomologie Oleicole, Traité, Y. Arambourg ed. — cons. Oleicole Int., Madrid : 303-336.

Castagnoli M, Simoni S. 2003 — Neoseiulus californicus (McGregor) (Acari Phytoseiidae): Survey of biological and behavioral traits of a versatile predator — Redia 86: 153-164.

Çetin H., Arslan D., Ozcan A. 2010 — Influence of Eriophyid mites (*Aculus olearius* Castagnoli and *Aceria oleae*

(Nalepa) (Acarina: Eriophyidae) on some physical and chemical characteristics of Ayvalık variety olive fruit — Journal of the Science of Food and Agriculture. 91: 498-504.

Chant D.A. 1957 — Descriptions of some phytoseiid mites (Acarina: Phytoseiidae). Part. I. Nine new species from British Columbia. Part. II. Redescriptions of eight species described by Berlese — Can. Entomol. 89: 289-308. doi:10.4039/Ent89289-7

Chant D.A. 1959 — Phytoseiid mites. Part I. Bionomics of seven species in southeastern England. Part II. A taxonomic review of the family Phytoseiidae, with descriptions of 38 new species — Can. Entomol. 91, suppl. 12: 1-166.

Chant D.A., McMurtry J.A. 1994 — A review of the subfamilies Phytoseiinae and Typhlodrominae — Int. J. Acarol. 20: 223-310. doi:10.1080/01647959408684022

Chant D.A., McMurtry J.A. 2005 — A review of the Subfamily Amblyseiinae Muma (Acari: Phytoseiidae): Part VI. The tribe Euseiini n. tribe, subtribes Typhlodromalina n. subtribe, Euseiina n. subtribe, and Ricoseiina n. subtribe — Int. J. Acarol. 31: 187-224. doi:10.1080/01647950508684424

Chant D.A., McMurtry J.A. 2006 — A review of subfamily Amblyseiinae Muma (Acari: Phytoseiidae): Part IX. An overview — Int. J. Acarol. 32: 1-27. doi:10.1080/01647950608684453

Chant D.A., McMurtry J.A. 2007 — Illustrated keys and diagnoses for the genera and sub genera of the Phytoseiidae of the World — Indira Publishing House, 220 pp.

Chant D.A., Yoshida Shaul E. 1986 — The subfamily Chantiinnae in the family Phytoseiidae in the family Phytoseiidae (Acari: Gamasina) — Can. J. Zool. 64: 2024-2034. doi:10.1139/z86-306

Chant D.A., Yoshida Shaul E. 1987 — A review of the *pyri* species group in the genus *Typhlodromus* Scheuten (Acari: Phytoseiidae) — Can. J. Zool. 65: 1770-1804. doi:10.1139/z87-272

De Leon D. 1959 — Seven new *Typhlodromus* from Mexico with collection notes on three other species (Acarina: Phytoseiidae) — Fla Entomol. 52: 113-121.

De Leon D. 1965 — A note on *Neoseiulus* Hughes 1948 and new synonymy (Acarina: Phytoseiidae) — Proceed. Entomol. Soc. Wash. 67: 23.

Denmark H.A. 1966. — Revision of the genus Phytoseius Ribaga, 1904 (Acarina: Phytoseiidae) — Fla. Dept. Agric. Div. Plant Industry Bull., 6: 1-105.

Denmark H.A., Evans G.A., Aguilar H., Vargas C., Ochoa R. 1999 — *Phytoseiidae of Central America* (*Acari*: *Mesostigmata*) — Indira Publishing House, West Bloomfield, Michigan, USA, 125 pp.

Denmark H.A., Welbourn, W.C. 2002 — Revision of the genera *Amblydromella* Muma and *Anthoseius* De Leon (Acari: Phytoseiidae) — Int. J. Acarol. 28: 291-316. doi:10.1080/01647950208684308

Donnadieu A.L. 1875 — Recherches pour servir à l'histoire des Tétranyques — *Thèse Faculté des Sciences de Lyon, France*: 1-131 [in French].

Dosse G. 1958 — Uber einige neue Raubmilbenarten — Pflanzenschutz Berichte 21: 44-61.

Duso C. 1992 — Role of *Amblyseius aberrans* (Oudemans), *Typhlodromus pyri* Scheuten and *Amblyseius andersoni* (Chant) (Acari, Phytoseiidae) in vineyards. III. Influence of the variety characteristics on the success of *A. aberrans* and *T. pyri* releases — J. Appl. Entomol. 114: 455-462. doi:10.1111/j.1439-0418.1992.tb01151.x

Duso C., Fontana P. 2002 — On the identity of *Phytoseius plumifer* (Canestrini & Fanzago, 1876) (Acari: Phytoseiidae) — Acarologia 42: 127-136.

Duso C., Moretto S. 1994 — Osservazioni preliminari sui comportamento dell'acaro predatore *Phytoseius plumifer* (Can. et Fanz.) — Mem. Soc. Entomol. It., 72: 533-540.

Ehara S., Amano H. 1998 — A revision of the mites family Phytoseiidae in Japan (Acari: Gamasina), with remarks on its biology — Species diversity, 3: 25-73.

Ehara S., Okada Y., Kato H. 1994 — Contributiion to the knowledge of the mite family Phytoseiidae in Japan (Acari: Gamasina) — J. Fac. Educ., Tottori University, Nat. Sci. 42: 119-160.

Elhadi F., Birger R. 1999 — A New Approach to the Control of the Olive Mite *Aceria* (*Eriophyes*) *oleae* Nalepa in Olive Trees — III International Symposium on Olive Growing. Cordoba, Spain. Acta Hortic. 474: 555-557.

Evans G.O. 1952 — On a new predatory mite of economic importance — Bull. Entomol. Res. 43: 397-401. doi:10.1017/S0007485300040566

Evans G.O. 1953 — On some mites of the genus *Typhlodromus* Scheuten — 1857, from S. E. Asia. Annu. Mag. Nat. Hist. 6: 449-467. doi:10.1080/00222935308654444

Evans G.O. 1958 — A revision of the British Aceosejinae (Acarina: Mesostigmata) — Proceed. Zool. Soc. London 131: 177-229. doi:10.1111/j.1096-3642.1958.tb00685.x

Ferragut F., Costa-Comelles J., Garcia-Mari F. 1988 — Population dynamics of the phytoseiid *Euseius stipulatus* (Athias-Henriot) and its prey *Panonychus citri* (McGregor) (Acari: Phytoseiidae, Tetranychidae), in Spanish citrus — Bol. San. Veg., Plagas 4: 45-54.

Ferragut F., Costa-Comelles J., Gomez Bernardo J., Garcia Mari F. 1985 — Contribucion al conocimiento de los acaros fitoseidos (Gamasida: Phytoseiidae) de los cultivos espanoles — Actas II Congreso Iberico Entomol, Lisboa: 223-231.

Ferragut F., Garcia Mari F., Costa-Comelles J., Laborda R. 1987 — Influence of food and temperature on development and oviposition of *Euseius stipulatus* and *Typhlodromus phialatus* — Exp. Appl. Acarol., 3: 317-330. doi:10.1007/BF01193168

Ferragut F., Laborda R., Costa-Comelles J. 1992 — Feeding behaviour of *Euseius stipulatus* and *Typhlodromus phialatus* on the citrus red mite *Panonychus citri* (Acari: Phytoseiidae, Tetranychidae) — Entomophaga, 37: 537-543. doi:10.1007/BF02372323

Gerson U., Weintraub P.G. 2007 — Mites for the control of pests in protected cultivation — Pest Manag. Sc. 63(7): 658-676.

Ghai S., Menon M.G.R. 1969 — Taxonomic studies on Indian mites of the family Phytoseiidae. II. Two new genera and species of Phytoseiidae — Orient. Ins. 3: 347-352.

Grissa-Lebdi K. 2003 — Etude éco-démographique des acariens phytophages, *Tetranychus urticae, Panonychus ulmi, Eotetranychus pruni* et du prédateur, *Neoseiulus californicus* (Acari, Tetranychidae, Phytoseiidae) et lutte biologique en vergers de pommiers — Thèse de Doctorat d'Etat en Sciences Agronomiques, INAT, 278 pp.

Gutierrez J., Helle W., Bolland H.R. 1970 — Étude cytogénétique et réflexions phylogénétiques sur la famille des Tetranychidae Donnadieu — Acarologia 12(4): 723-751.

Hatzinikolis E.N. 1981 — The mites of olive trees in Greece — DG VI Agriculture F/4 Coordination De La Recherche Agronomique: 188-194.

Hatzinikolis E.N. 1986 — Contribution to the description, record and onomatology of *Aceria oleae* (Nalepa, 1900) (Acari: Eriophyidae) — Entomologia Hellenica 4(2): 49-54.

Hatzinikolis E.N. 1987 — A Revision of Tenuipalpid Mites of Greece (Acari: Tenuipalpidae) — Entomologia Hellenica 5: 47-60.

Hatzinikolis E.N., Emmanouel, N.G. 1990 —*A new species, Bryobia attica (Acari: Tetranychidae) from Greece* — Entomologia Hellenica 8: 47-51.

Hirschmann W. 1962 — Gangsystematik der Parasitiformes. Acarologie Schriftenreihe fur Vergleichende Milbenkunde — Hirschmann-Verlag, Furth/bay 5(5-6): 80.

Karg W. 1983 — Systematische untersuchung der Gattungen und Untergattungen der Raubmilben familie Phytoseiidae Berlese mit der beschreibung von 8 neuen Arten — Mitt. Zool. Mus. Berl. 59: 293-328.

Kasap I., Ekerog E.S. 2004 — Life history of *Euseius scutalis* feeding on citrus red mite *Panonychus citri* at various temperatures — BioControl 49: 645-654.

Keifer H.H. 1939 — Eriophyid Studies III — Bull. Calif. Depart. Agric. 28: 144-162.

Keifer H.H. 1961 — Eriophyid Studies B-2 — Special Publication, State Bureau of Entomology, California Department of Agriculture: 1-20.

Koch C.L. 1836 — Deutsche Crustacea, Myriopoda, Arachnida — Fasc. 1.

Kolodochka L.A. 1978 — Manual for the Identification of Plant-Inhabiting Phytoseiid mites — Akademii Nauk Ukrainian SSR, Instituta Zoologii, Naukova Dumka, Kiev, Ukraine 79 pp.

Kolodochka L.A. 1998 — Two new tribes and the main results of a revision of Paleartic phytoseiid mites (Parasitiformes, Phytoseiidae) with the family system concept — Vestn. Zool. 32: 51-63 [in Russian].

Kolokytha P.D., Fantinou A.A., Papadoulis G.T. 2011 — Temperature and diet effects on immature development of predatory mite *Typhlodromus athenas* Swirski and Ragusa (Acari: Phyotseiidae) — Environ. Entomol. 40(6): 1577-1584. doi:10.1603/EN11098

Krantz G. W., Walter D. E. 2009 — A Manual of Acarology — (3rd ed.): 807 pp.

Kreiter S., Auger P., Lebdi Grissa K., Tixier M.-S., Chermiti B., Dali M. 2002a — Plant inhabiting mites (Acari: Prostigmata, Mesostigmata) of some Northern Tunisian crops — Acarologia 42: 389-402.

Kreiter S., Tixier M.-S., Auger P., Lebdi Grissa K. 2006 — Phytoseiid mites (Acari: Mesostigmata) of southern Tunisia — Acarologia, 46: 5-13.

Kreiter S., Tixier M.-S., Auger P., Weber M. 2000 — Phytoseiid mites of vineyards in France — Acarologia 41: 75-94

Kreiter S., Tixier M.-S., Ferragut F., Allam L., Lebdi Grissa K. 2004 — Preliminary observations on the diversity of phytoseiid mites in the Maghreb and comparisons to the fauna of Canaria — Phytophaga 14: 477-484.

Kreiter S., Tixier M.-S., Sahraoui H., Lebdi Grissa K., Ben Chaabane S., Chatti A., Chermiti B., Khoualdia O., Ksantini M. 2010 — Phytoseiid mites (Acari: Mesostigmata) from Tunisia: Catalogue, biogeography and key for identification — Tun. J. Plant Prot. 5: 151-178.

McGregor E.A. 1954 — Two new mites in the genus *Typhlodromus* (Acarina: Phytoseiidae) — Bull. South Calif. Acad. Sc. 3: 89-92.

McMurtry J.A. 1977 — Some predaceous mites (Phytoseiidae) on citrus in the Mediterranean region — Entomophaga 22: 19-30.

McMurtry J.A., Croft B.A. 1997 — Life-styles of phytoseiid mites and their roles in biological control — Annu. Rev. Entomol. 42: 291-321. doi:10.1146/annurev.ento.42.1.291

McMurtry J.A., Moraes G.J. de, Famah Sourassou N. 2013 — Revision of the lifestyles of phytoseiid mites (Acari:

Phytoseiidae) and implications for biological control strategies — Syst. Appl. Acarol. 18: 297-320. doi:10.11158/saa.18.4.1

Meyer-Smith M.K.P. 1974 — A revision of the Tetranychidae of Africa (Acari) with a key to the genera of the world — Dept. Agric: Tech. Serv., Ent. Mem. 36: 1-291.

Mi-arro M. & Kreiter S. 2012 — Fitoseidos en los vinedos de la denominacion Vino de Calidad de Cangas (Asturias) — Boletinde Sanidad Vegetal, Plagas, 38 :73-82.

Moraes G.J. de, McMurtry J.A., Denmark H.A. 1986 — A catalog of the mite family Phytoseiidae. References to Taxonomy, Synonymy, Distribution and Habitat — Embrapa ed. and Pub., Brasilia, 353 pp.

Moraes G.J. de, McMurtry J.A., Denmark H.A., Campos C.B. 2004 — A revised catalog of the mite family Phytoseiidae — Zootaxa 434: 1-494.

Moyano R.A., Pina T., Ferragut F., Urbaneja A. 2009 — Comparative life-history traits of three phytoseiid mites associated with *Tetranychus urticae* (Acari: Tetranychidae) colonies in clementine orchards in eastern Spain: implications for biological control — Exp. Appl. Acarol. 47(2): 121-132. doi:10.1007/s10493-008-9197-z

Muma M.H. 1961 — Subfamilies, genera, and species of Phytoseiidae (Acarina: Mesostigmata) — Fla. St. Mus. Bull. 5: 267-302.

Muma M.H., Denmark H.A. 1968 — Some generic descriptions and name changes in the family Phytoseiidae (Acarina: Mesostigmata) — Fla. Entomol. 51: 229-240. doi:10.2307/3493424

Nesbitt H.H.J. 1951 — A taxonomic study of the Phytoseiinae predaceous upon Tetranychidae of economic importance — Zool. Verh. 12: 1-96.

Nalepa A. 1900 — Zur Kenntniss der Gattung Eriophyes Sieb — Nal. Denkschr. Kais. Akad, Wissen., Math. Naturw. Kl. Wien 68: 201-218.

Nalepa A. 1905 — Neue Gallmilben (27. Fortsetzung) — Nal. Denkschr. Kais. Akad, Wissen., Math. Naturw. Kl. Wien 42(16): 268.

Navia D., Ochoa R., Welbourn C., Ferragut F. 2010 — Adventive eriophyoid mites: a global review of their impact, pathways, prevention and challenges — Exp Appl Acarol. 51:225-255. doi:10.1007/s10493-009-9327-2

Nomikou M., Janssen A., Sabelis M.W. 2003 — Phytoseiid predator of whitefly feeds on plant tissue — Exp. Appl. Acarol. 31: 27-36. doi:10.1023/B:APPA.0000005150.33813.04

Oudemans A.C. 1915 — Acarologische Aanteekeningen — LVI. Entomologische Berichten, 4: 180-188. doi:10.5962/bhl.part.1128

Oudemans A.C. 1929 — Acarologische Aanteekeningen — XCIX. Entomologische Berichten 8: 11-20.

Oudemans A.C. 1930 — Acarologische Aanteekeningen — CI. Entomol. Berich. 8: 48-53.

Paliwal Y. C. 1980 — Relationship of wheat streak mosaic and barley stripe masaic viruses to vector and non-vector Eriophyid mites — Arch. Virol. 63: 123-132. doi:10.1007/BF01320769

Papaioannou-Souliotis P., Ragusa di Chiara S., Tsolakis C. 1994 — Phytophagous mites and their predators observed on cultivated plants in Greece during 1975-1990 — Annales Institut Phytopathologique Benaki, N.S., 17: 35-86.

Pegazzano F., Castagnoli M. 1972 — Brevipalpus olivicola sp. n. (Acarina, Tenuipalpidae). Description and notes on its biology — Redia 53: 139-149.

Pijnakker J., De Souza A., Wäckers F. 2014 — Euseius gallicus, a bodyguard for roses — Integrated Control in Protected Crops, Temperate Climate IOBC-WPRS Bulletin 102: 191-195

Pritchard A.E., Baker E.W. 1955 — A revision of the spider mite family Tetranychidae — Pacif. Coast. Entomol. Soc. Mem. 2: 1-472.

Ragusa S. 1977 — Notes on phytoseiid mites in Sicily with a description of a new species of *Typhlodromus* (Acarina: Mesostigmata) — Acarologia 18: 379-392.

Ragusa S., Tsolakis H. 1996 — A survey of phytoseiid mites (Phytoseiidae) associated with various plants in Sicily — *In*: Proceedings Acarology IX, Columbus, Ohio (USA), Vol. 1 (Eds R. Mitchell, D. Horn, G. Needham, W. Welbourn.): 253-256.

Rasmy A.H., El-Banhawy E.M. 1974 — The phytoseiid mite, *Phytoseius plumifer* as a predator of the eriophid mite, *Aceria ficus* (Acarina) — Entomophaga 19:427-430.

Rasmy A.H., El-Banhawy E.M. 1975 — Biology and predatory efficincy of two phytoseiid mites as affected by long term pollen feeding — Entomophaga 20:93-95.

Reck G.F. 1952 — Some principles on the classification of tetranychid mites — Akad. Nauk Gruz. SSR, 13: 420-425 [in Russian].

Ribaga C. 1904 — Gamasidi planticoli — Riv. Patol. Veg. 10: 175-178.

Ros V.I.D. 2009 — Evolutionary consequences of reproductive parasites in spider mites — Entomologische Berichten 70(5): 154-161.

Russo L.F. 1972 — *Oxypleurites maxwelli* Keifer (Acarina: Eriophyidae) in Campania — Bollettino del Laboratorio di Entomologia Agraria 'Filippo Sivestri' Portici. 30: 165-168.

Sahraoui H., Lebdi Grissa K., Kreiter S., Douin M., Tixier M.-S. 2012 — Phytoseiid mites (Acari: Mesostigmata)

of Tunisian Citrus orchards — Acarologia 52: 433-452. doi:10.1051/acarologia/20122072

Schausberger P. 1997 — Inter- and intraspecific predation on immaturesby adult females in *Euseius finlandicus*, *Typhlodromus pyri* and *Kampimodromus aberrans* (Acari: Phytoseiidae) — Exp. Appl. Acarol. 21: 131-150. doi:10.1023/A:1018478418010

Scheuten A. 1857 — Einiges uber Milben — Archiv. Nat. 23: 104-112.

Schuster R.O., Pritchard A.E. 1963 — Phytoseiid mites of California — Hilgardia 34: 191-285.

Swirski E., Amitai S. (1997a) Notes on phytoseiid mites (Mesostigmata: Phytoseiidae) of Mt. Carmel (Israel), with descriptions of two new species. Israel Journal of Entomology, 31, 1-20.

Swirski E., Amitai S. 1997 — Notes on phytoseiid mites (Mesostigmata: Phytoseiidae) of Mt. Carmel (Israel), with descriptions of two new species — Israel J. Entomol. 31: 1-20.

Swirski E., Ragusa S. 1976 — Notes on predacious mites of Greece, with a description of five new species — Phytoparasitica 4: 101-122.

Tixier M.-S., Kreiter S., Allam L., Ouahbi A., Hmimina H. 2003 — Phytoseiid and tetranychid mites (Acari: Mesostigmata) of some Moroccan crops — Acarologia 43: 87-97.

Tixier M.-S., Baldassar A., Duso C., Kreiter S. 2013 — Phytoseiidae in European grape (*Vitis vinifera* L.): bio-ecological aspects and keys to species (Acari: Mesostigmata) — Zootaxa 3721(2): 101-142. doi:10.11646/zootaxa.3721.2.1

Tixier M.-S., Kreiter S., Auger P. 2002 — Colonisation ofvineyards by *Kampimodromus aberrans* (Acari: Phytoseiidae): dispersal from surrounding plant habitats as indicated by RAPDmarker studies — Agric. Forest Entomol. 4: 255-264. doi:10.1046/j.1461-9563.2002.00154.x

Tixier M.-S., Kreiter S., Okassa M., Cheval B. 2010 — A new species of the genus *Euseius* Wainstein (Acari: Phytoseiidae) from France — J. Natur. Hist. 44: 241-254. doi:10.1080/00222930903383529

Tixier M.-S. 2013 — Statistical approaches to assess interspecific differences for morphological continuous characters: the case study of the family Phytoseiidae (Acari: Mesostigmata) — Zoologica Scripta, 42, 327-334. doi:10.1111/zsc.12004

Tuttle D.M., Baker E.W. 1968 — Spider mites of Southwestern United States and a revision of the family Tetranychidae — Univ. Ariz. Press. 143 pp.

Tseng Y.H. 1976 — Systematics of the mite family Phytoseiidae from Taiwan, with a revised key to genera of the world (II) — J. Agric. Assoc. China, New Series, Taiwan 94: 85-128.

Ueckermann E.A., Loots G.C. 1988 — The African species of the subgenera *Anthoseius* De Leon and *Amblyseius* Berlese (Acari: Phytoseiidae) — Entomol. Mem. Dep. Agric. Water Supply, Rep. South Afr. 73: 1-168.

Vacante V. 2016 — The handbook of mites of economic plants: Identification, bio-ecology and control— Centre for Agriculture and Biosciences International (CABI), Oxfordshire, UK. 890 pp.

Van der Merwe G.G. 1968 — A taxonomic study of the family Phytoseiidae (Acari) in South Africa with contributions to the biology of two species — Entomol. Mem., South Africa Dep. Agric. Techn. Serv. 18: 1-198.

Van Lenteren J.P. 2012 — The state of commercial augmentative biological control: plenty of natural enemies, but a frustrating lack of uptake — BioControl 57, 1-20.

Van Lenteren J. C., Woets J. 1988 — Biological and integrated pest control in greenhouses — Annu. Rev. Entomol. 33: 239-269. doi:10.1146/annurev.en.33.010188.001323

Vantornhout I., Minnaert H.L., Tirry L., Clercq P. de 2004 — Effect of pollen, natural prey and factitious prey on the development of *Iphiseius degenerans* — BioControl 49: 627-644.

Vantornhout I., Minnaert H.L., Tirry L., Clercq P. de 2005 — Infuence of diet on life table parameters of *Iphiseius degenerans* — Exp. Appl. Acarol. 35: 183-195. doi:10.1007/s10493-004-3940-x

Vitzthum H. von 1941 — Acarina. *In*: Bronns, H.G. (Ed.), Klassen und Ordnungen des Tierreichs — Akademischer Verlag Leipzig, Germany: 764-767.

Wainstein B.A. 1958 — New species of mites of the genus *Typhlodromus* from Georgia — Soobshcheniya Akademii Nauk Gruzinskoy SSR 21: 201-207.

Wainstein B.A. 1959 — New subgenus and species of the genus *Phytoseius* Ribaga, 1902 (Phytoseiidae: Parasitiformes) — Zool. Zh. 38: 1361-1365.

Wainstein B.A. 1960 — Tetranychoid mites of Kazakhstan (with revision of the family) — Kazakh. Akad. Selsk. nauk. Nauch.-Issled. Inst. Zash. Rast. Trudy 5: 1-276.

Wainstein B.A. 1962 — Révision du genre *Typhlodromus* Scheuten, 1857 et systématique de la famille des Phytoseiidae (Berlese 1916) (Acarina: Parasitiformes) — Acarologia 4: 5-30.

Wainstein B.A. 1972 — New species of the family Phytoseiidae (Parasitiformes) — Zool. Zh. 51: 1407-1411.

Wainstein B.A. 1973 — Systematic status of the genus *Evansoseius* Sheals in the family Phytoseiidae (Parasitiformes) — Zoologicheskii Zhurnal 52: 274-277.

Wright R.J. 2004 — Retail suppliers of beneficial organisms — Nebraska Cooperative Extension NF94-182, Cooperative Extension, Institute of Agriculture and Natural Resources, University of Nebraska-Lincoln, http://ianrpubs.unl.edu/insects/nf182.htm.

COPYRIGHT