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

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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 Eriophyiidae and Tenuipalpidae mites on olive trees.

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

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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, Eriophyiidae, Tenuipalpidae and Tetranychidae for phytophagous mites, and Phytoseiidae for predatory mites (Table 2).

During this study, two species of Eriophyiidae 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: Eriophyiidae

Mite species of the family Eriophyiidae (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 (Palwal 1980) but no microorganism transmission has been proved on olive trees. 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					
<i>Oxyceus maxwelli</i>	+	+	+	+	+
<i>Aceria oleae</i>	+	+	+	+	+
Tenuipalpidae					
<i>Brevipalpus olivicola*</i>	+	+			
<i>Brevipalpus oleae*</i>					+
Tetranychidae					
<i>Bryobia</i> sp.*					+
Phytoseiidae					
<i>Euseius scutalis</i>		+		+	
<i>Euseius finlandicus</i> *		+			
<i>Euseius stipulatus</i>		+		+	+
<i>Euseius gallicus</i>		+			
<i>Phytoseius finitimus</i>		+			+
<i>Iphiseius degenerans</i>				+	
<i>Neoseiulus californicus</i>				+	
<i>Kampimodromus aberrans</i>	+			+	
<i>Typhlodromus (Anthoseius) athenas</i>	+	+	+	+	+
<i>Typhlodromus (Anthoseius) mathieui</i> *				+	
<i>Typhlodromus (Anthoseius) kasachstanicus</i>			+		
<i>Typhlodromus (Typhlodromus) phialatus</i>				+	
<i>Typhlodromus (Typhlodromus) exhilaratus</i>	+		+		+
<i>Phytoseiulus persimilis</i>		+			+

***Oxyceus maxwelli* (Keifer 1939)**

Oxypleurites maxwelli Keifer, 1939: 152.

Oxyceus maxwelli Keifer, 1961: 7.

Common name — olive leaf and flower mite.

Distribution — *Oxyceus maxwelli* is recorded from Algeria, Armenia, Australia, Brazil, California, Egypt, Greece, Italy, Portugal and Spain (Vaccante 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 under-surfaces 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, Spain, 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 europaea* 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* genus associated to *Olea europaea* 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 the 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 (McMurtry 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, *Frankliniella 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 chelicera. 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

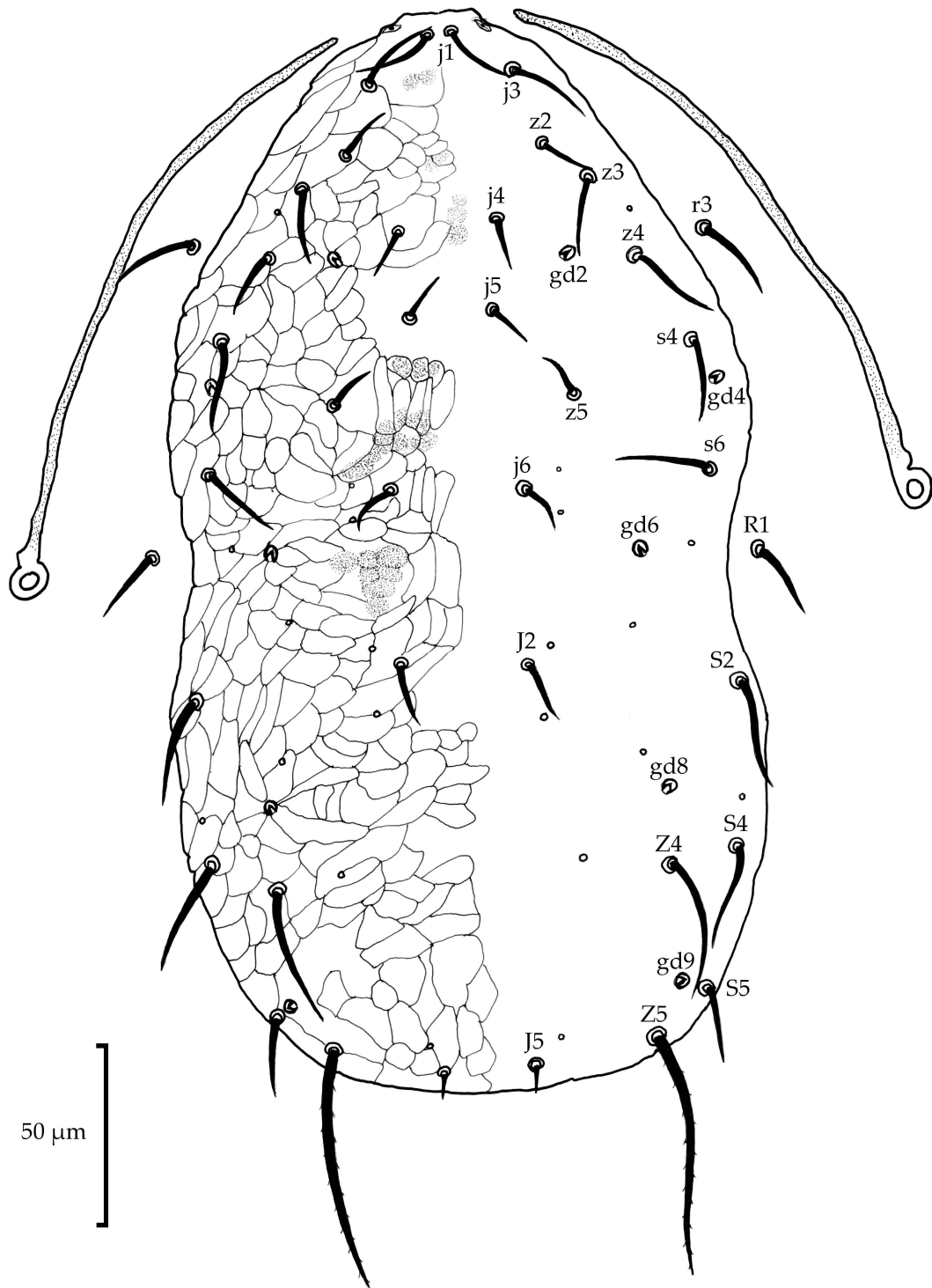


FIGURE 1: Dorsal shield and peritreme of the female of *Typhlodromus (Anthoseius) mathieui* n. sp.



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

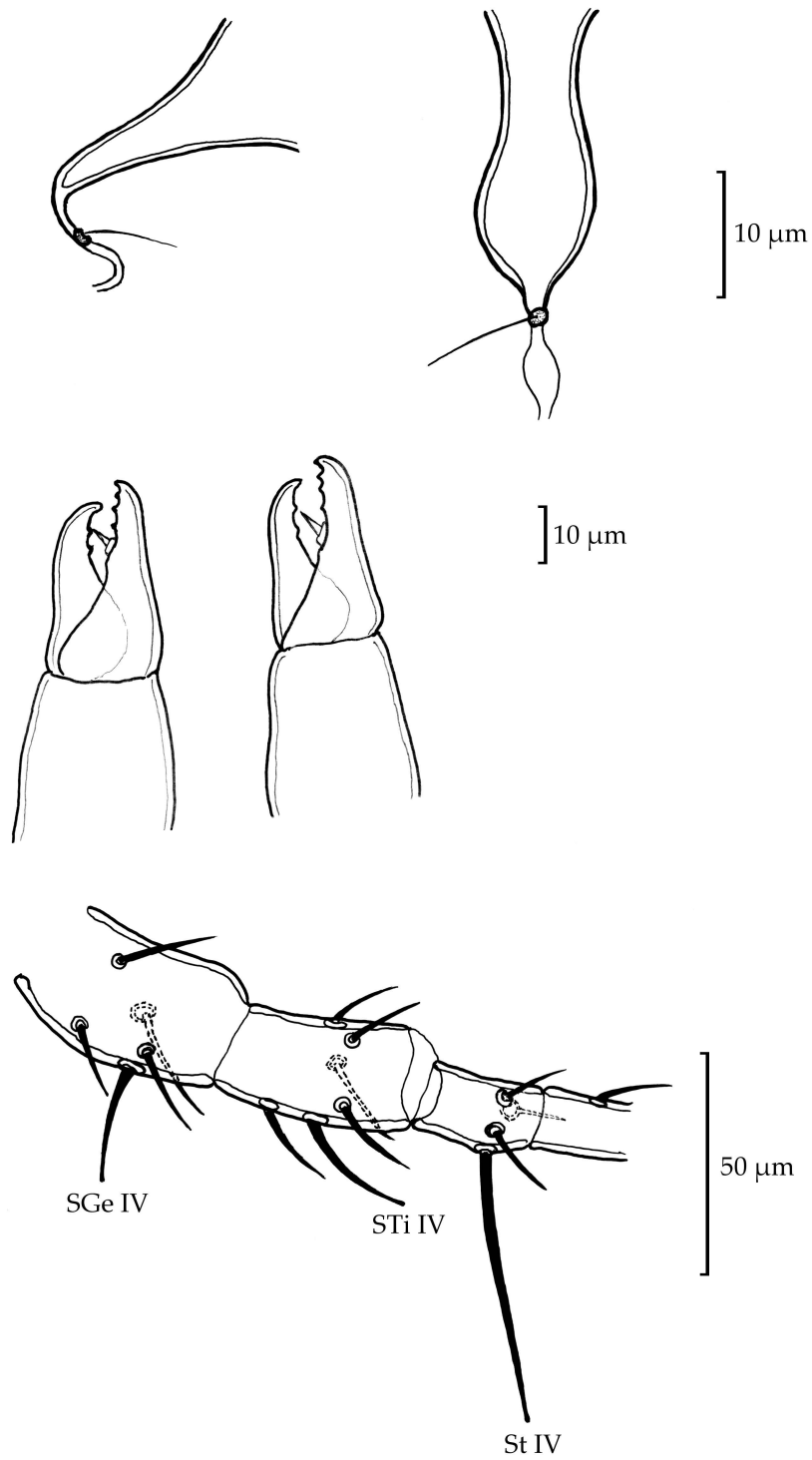


FIGURE 3: Calyx of the spermatheca (a), Chelicera (b) and Macrosetae on leg IV (c) of the female of *Typhlodromus (Anthoseius) mathieui* n. sp.

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 popular (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-Shaul, 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 cuticle (rarely on the shield) **Typhlodrominae:** 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 j_3 or between j_3 and z_2 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 S_4 absent 9

8'. (3') Setae S_4 present 10

9. (8) Setae J_2, S_2 absent, female ventrianal shield reduced, setae j_6 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 J_2, S_2 present, female ventrianal shield elongated with three preanal setae, short distance between the bases of setae Z_1 reaching S_2 . Setae j_6 not long *Kampidromus aberrans*

10. (8') Ratio setae s_4 : $Z_1 < 3.0:1.0$; s_4, Z_4 , and Z_5 not greatly longer than other setae Female ventrianal shield not reduced and/or markedly wider at anus level, without a marked waist. J_2 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 Z_4 longer than S_4 , J_2 longer than S_5 *Neoseiulus californicus*

12. (2') Setae S_5 present *Typhlodromus (Anthoseius)*..... 13

12'. (2') Setae S_5 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 peculiar 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. Calyx of the spermatheca squared basally, with a short neck.....
 *Typhlodromus (Typhlodromus) exhilaratus*

14. (12') Basitarsus IV with a macroseta having bulbous tip. Calyx 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 *Oxyencus 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), Typhlodrominae (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.

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