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First record of two insects preying on the red tomato spider mite *Tetranychus evansi* (Acari: Tetranychidae) in Latakia governorate, Syria

Ahmad Malek Dayoub^a, Hazem Dib^{a,b}, Angham Boubou^a

^a Department of Plant Protection, Faculty of Agriculture, Tishreen University, Latakia, Syria.

^b Univ. Avignon, Aix Marseille Univ., CNRS, IRD, IMBE, Pôle Agrosociences, 301 rue Baruch de Spinoza, BP 21239, 84916 Avignon, France.

Short note

ABSTRACT

The red tomato spider mite *Tetranychus evansi* is an important invasive pest of solanaceous plants worldwide. It has been recorded in Syria since 2011 in Latakia governorate, a Mediterranean coastal region. During survey conducted in 2019, the ladybird beetle, *Stethorus gilvifrons* (Mulsant) (Coleoptera: Coccinellidae) and the acarivorous gall midge, *Feltiella acarisuga* (Vallot) (Diptera: Cecidomyiidae) were identified in association with *T. evansi* colonies on tomato and black nightshade from 12 sites in Latakia. Larvae of *F. acarisuga*, and larvae and adults of *S. gilvifrons*, were observed preying on all developmental stages of *T. evansi*. This is the first record of *T. evansi* as a prey of *S. gilvifrons*. A literature review of *Stethorus* and *Feltiella* species previously reported in association with *T. evansi* on solanaceous plants is also provided.

Keywords biological control; spider mites; predation; *Stethorus gilvifrons*; *Feltiella acarisuga*; *Tetranychus evansi*; Solanaceae; Syria

Introduction

The red tomato spider mite *Tetranychus evansi* Baker & Pritchard (Acari: Tetranychidae), has emerged as a new threat to solanaceous crops worldwide (Navajas *et al.* 2013). It is native to South America (Gutierrez and Etienne 1986; Boubou *et al.* 2011), but has largely expanded its geographical distribution, and now is present in 45 countries, including nearly all Mediterranean countries (Migeon and Dorkeld 2020). In Syria, this invasive mite has been recorded since 2011 in Latakia governorate, a Mediterranean coastal area (Zriki *et al.* 2014).

Classical biological control of invasive species by introducing exotic natural enemies is often advocated (Thomas and Reid 2007). However, extensive efforts should be dedicated for exploiting indigenous and/or endemic natural enemies and developing effective biocontrol agents to limit unwanted effects of classical biological control under international exchange rules (Hajek *et al.* 2016). In the case of *T. evansi*, few studies have been done to identify its endemic natural enemies in the invaded areas. In this paper, we recorded for the first time in Latakia governorate two predaceous insects in *T. evansi* colonies collected from wild and cultivated solanaceous plants in 2019.

Materials and methods

Leaves of black night shade, *Solanum nigrum* L. and tomato, *S. lycopersicum* L. (Solanales: Solanaceae) infested with *T. evansi* were randomly collected during autumn 2019 from 12

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Corresponding author
Angham Boubou:
angham.bobo@tishreen.edu.sy

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sites in Latakia governorate (Table 1). In each site, thirty leaves were placed in plastic bags, transported to the laboratory and examined under a stereomicroscope (Micros, Ladybird MZ1240, Austria).

Predatory insect specimens of Coccinellidae (Coleoptera) and Cecidomyiidae (Diptera) were observed in the colonies of *T. evansi* and identified using the identification keys of Kapur (1948) and Gagné (1995), respectively. To identify the coccinellid predators, male genitalia were extracted and slide-mounted in glycerin on a glass slide for examination. For the identification of the cecidomyiid predatory species, leaves carrying mature larvae or cocoons were kept in plastic containers until the emergence of adults. All emerging adults were preserved in 70% ethyl alcohol for further identification. For microscopic examination, some of the ethanol-preserved specimens were cleared and mounted on slides in Hoyer's medium.

Results and discussion

Two species of predatory insects were identified from the colonies of *T. evansi*.



Figure 1 Life stages of *Stethorus gilvifrons* feeding on all developmental stages of *Tetranychus evansi*: A – Larva feeding on adult; B – Pupa; C – Adult feeding on eggs; D – Adult feeding on nymph.

The ladybird beetle, *Stethorus gilvifrons* (Mulsant, 1850)(Coleoptera: Coccinellidae)

All life stages of *S. gilvifrons* were found in association with *T. evansi* colonies on tomato and black nightshade in half of the collected samples (Table 1). Both adults and larvae were observed preying on all developmental stages of *T. evansi* (Fig. 1). This is the first record of *T. evansi* as a prey of *S. gilvifrons* anywhere in the world. This predator is widely distributed in the Middle East and Southern Europe and has been reported to be an effective biocontrol agent of several spider mite species (Biddinger *et al.* 2009; Perumalsamy *et al.* 2010). In Syria, *S. gilvifrons* has been recorded in association with many tetranychid species in several habitats and was considered an effective predator of the red spider mite, *T. urticae* and the citrus red mite *Panonychus citri* (McGregor) (Abou-fakhr hammad 2008; Mofleh 2010; Barbar *et al.* 2016).

Many *Stethorus* species were found associated with *T. evansi* on solanaceous plants in native and invaded areas (Table 2). Among these species, the tropical coccinellid, *S. tridens* Gordon was the only species evaluated under laboratory conditions and considered as a promising agent for the control of *T. evansi* (Fiaboe *et al.* 2007b; Britto *et al.* 2009).

Table 1 Collection records of *Tetranychus evansi* on *Solanum* leaves, with *Stethorus gilvifrons* and *Feltiella acarisuga* predators, from different locations in Latakia governorate (Syria) during autumn 2019.

Location	Collection date	Geographic coordinates	Altitude (m)	Host plant	Number of examined individuals	
					<i>S. gilvifrons</i>	<i>F. acarisuga</i>
Al-Eadiyah	08-IX-2019	35°18'43.1"N 35°57'33.0"E	28	<i>S. nigrum</i>	1 ♂	1 ♂, 1 ♀
Ugarit	13-IX-2019	35°35'51.5"N 35°47'04.0"E	17	<i>S. nigrum</i>		1 ♂
Slanfah	18-IX-2019	35°36'07.4"N 36°10'51.3"E	1110	<i>S. nigrum</i>		1 ♂
Bereen	18-IX-2019	35°35'47.1"N 36°05'59.9"E	644	<i>S. lycopersicum</i>		2 ♂♂, 1 ♀
Al-Dakleyiah	18-IX-2019	35°37'04.0"N 36°04'28.7"E	530	<i>S. nigrum</i>	1 ♂, 1 ♀	3 ♂♂, 3 ♀♀
				<i>S. lycopersicum</i>	1 ♂	
Al-Bassa	27-IX-2019	35°29'58.4"N 35°50'29.8"E	19	<i>S. nigrum</i>		5 ♂♂, 5 ♀♀
Miseet	01-X-2019	35°28'52.3"N 36°07'47.3"E	549	<i>S. nigrum</i>	2 ♂♂, 2 ♀♀	2 ♂♂, 2 ♀♀
Zenio	01-X-2019	35°28'21.1"N 36°08'53.7"E	794	<i>S. lycopersicum</i>		1 ♂
AL-Maghrit	15-XI-2019	35°36'30.1"N 35°49'50.5"E	68	<i>S. nigrum</i>	4 ♂♂, 3 ♀♀	5 ♂♂, 5 ♀♀
Al-Defleh	19-XI-2019	35°50'20.9"N 35°52'11.6"E	20	<i>S. nigrum</i>	2 ♂♂, 2 ♀♀	1 ♂, 1 ♀
Ras Al-Basit	19-XI-2019	35°50'57.6"N 35°51'43.0"E	20	<i>S. nigrum</i>		1 ♂, 1 ♀
Al-Herajiah	19-XI-2019	35°44'59.3"N 35°53'02.5"E	56	<i>S. nigrum</i>		1 ♂, 1 ♀

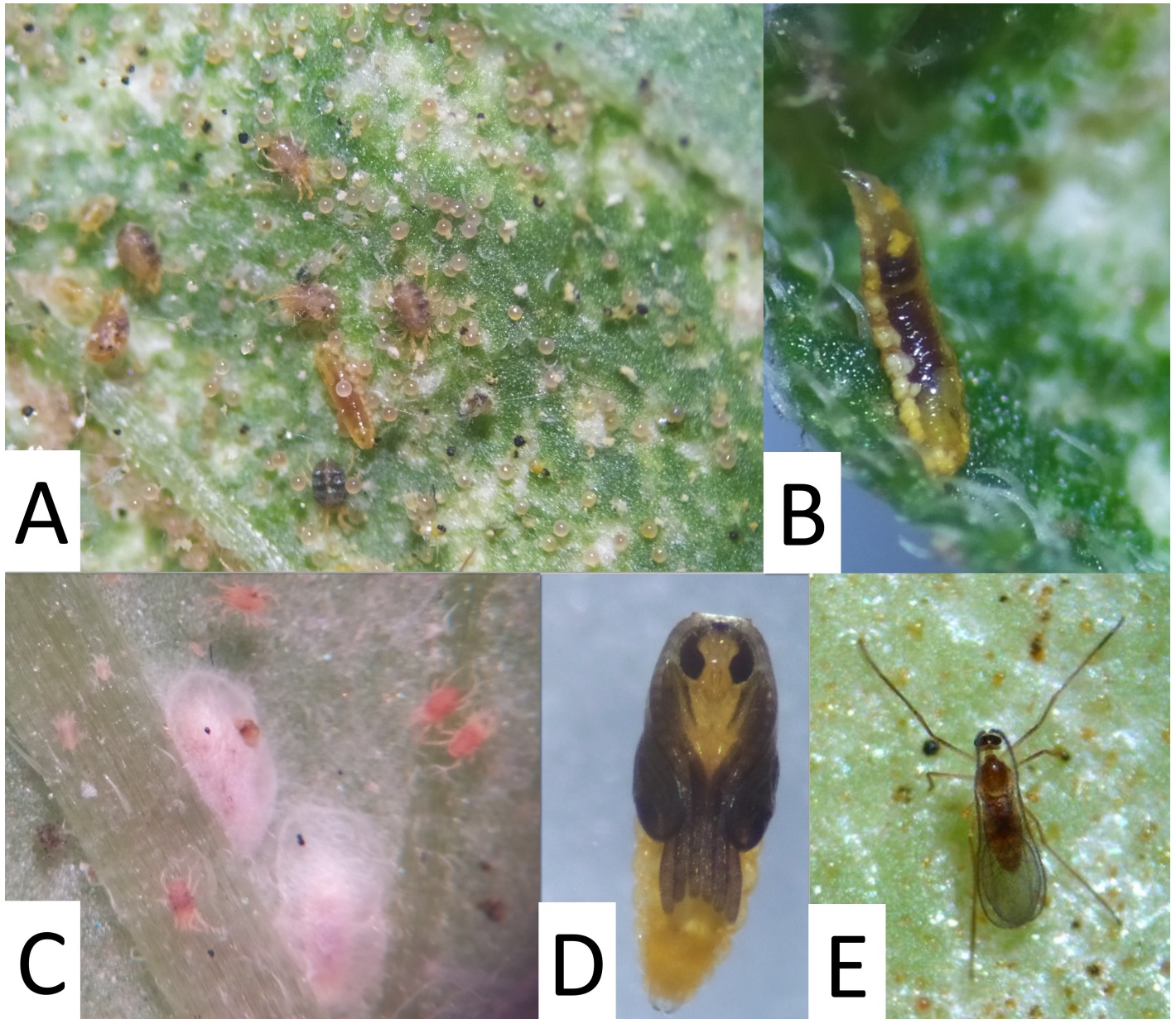


Figure 2 Life stages of *Feltiella acarisuga*: A – Larva in colony of *Tetranychus evansi*; B – Mature larva; C – Cocoons; D – Pupa; E – Adult.

The gall midge *Feltiella acarisuga* (Vallot, 1827) (Diptera: Cecidomyiidae)

Feltiella acarisuga larvae of all instars and pupae were found on leaves infested with *T. evansi* in all collected samples (Table 1). Larvae of this predator have been observed preying on different developmental stages of *T. evansi* (Fig. 2). This species was found together with *S. gilvifrons* on the leaf samples of tomato and black nightshade (Table 1).

Feltiella acarisuga is a cosmopolitan predator that is commercially used as a biocontrol agent against tetranychid mites (Ganaha-Kikumura *et al.* 2012, Gagné and Jaschhof 2017) and has been found in association with *T. evansi* in Spain and Japan (Table 2). Other *Feltiella* species were reported in association with *T. evansi* from different parts of the world (Table 2). In Syria, the occurrence of *F. acarisuga* was reported by Mofleh (2010) in association with *T.*

Table 2 *Stethorus* and *Feltiella* species reported in association with *Tetranychus evansi* on solanaceous plants in native and invaded areas.

Predator	Area (country)	References
<i>S. darwini</i> (Brethes)	Native (Brazil)	(Silva 1954)
<i>S. vinsoni</i> Kapur	Invasive (Mauritius)	(Moutia 1958)
<i>S. tridens</i> Gordon	Native (Brazil)	(Fiaboe <i>et al.</i> 2007a)
<i>S. picipes</i> Casey	Invasive (USA)	(Navajas <i>et al.</i> 2013)
<i>S. punctillum</i> (Weise)	Invasive (Spain)	(Escudero <i>et al.</i> 2005)
<i>F. occidentalis</i> (Felt)	Invasive (USA)	(Gagné 1995)
<i>F. sp. near tetranychii</i> Rubs	Invasive (Mauritius)	(Moutia 1958)
<i>F. carolina</i> (Felt)	Invasive (USA)	(Navajas <i>et al.</i> 2013)
<i>F. curtistylus</i> Gagne	Native (Brazil)	(Gagné 1995)
<i>F. acarivora</i> (Felt)	Invasive (USA)	(Navajas <i>et al.</i> 2013)
<i>F. acarisuga</i>	Invasive (Spain)	(Escudero <i>et al.</i> 2005)
<i>F. acarisuga</i>	Invasive (Japan)	(Abe <i>et al.</i> 2011; Ganaha-Kikumura <i>et al.</i> 2012)

urticae on various plants, including Solanaceae, from different localities of the Syrian coastal region. However, she did not provide any reliable information about the identification of the cecidomyiid. In addition, the voucher specimens are not available anywhere. In the present study, we confirmed the presence of *F. acarisuga* and reported *T. evansi* as a new prey to this species in Syria.

Conclusion

The two predatory insects, *S. gilvifrons* and *F. acarisuga*, appear to be promising biocontrol agents against *T. evansi* because they were found in association with all its life stages. As these two predators are naturally occurring in cultivated (*S. lycopersicum*) and uncultivated (*S. nigrum*) areas along the Syrian coast, further studies are clearly needed to evaluate their potential to regulate *T. evansi* populations.

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