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Phytoseiidae (Acari: Mesostigmata) of Syria: new records and first description of the male of *Eharius stathakisi* Döker

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Original research

ABSTRACT

Surveys of Phytoseiidae (Acari: Mesostigmata) were conducted at three locations in Latakia governorate, Syria, in 2020 and 2021. Among the nine species collected, two [*Eharius chergui* (Athias-Henriot) and *Typhloseiulus simplex* (Chant)] are new records for Syrian Phytoseiidae fauna, and three species (*Eharius stathakisi* Döker, *Graminaseius recebi* Döker, Kazak & Karut and *Neoseiulus sekeroglui* Döker & Stathakis) are measured and are discovered for the first time after their original descriptions. The male of *E. stathakisi* was discovered, described and illustrated for the first time. All phytoseiid taxa reported from Syria to the present are tabulated.

Keywords survey; predatory mites; Phytoseiidae; Syria
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Introduction

With more than 2500 valid species, the family Phytoseiidae (Acari: Mesostigmata) is the most common and the widespread predatory mite family inhabiting plants, all over the world (Demite *et al.* 2021). They are widely studied due to their important role as biocontrol agents of phytophagous mites and other small arthropods such as thrips and whiteflies (McMurtry and Croft 1997; McMurtry *et al.* 2013). Phytoseiid mite fauna has been poorly investigated in Syria. As of 2011, only six species were known that follows *Euseius scutalis* (Athias-Henriot), *Neoseiulus fallacis* (Garman), *Typhlodromus* (*Typhlodromus*) *pyri* Scheuten and *T.* (*T.*) *cotoneastri* Wainstein were recorded in previous studies (Al-Abdulla 2001; Kerheili 2009), and *Typhlodromus* (*Anthoseius*) *porathi* Swirski & Amitai and *Eharius hermonensis* Amitai & Swirski listed in the world catalog of this family (Moraes *et al.* 2004). The number of recorded phytoseiid species has progressively increased since 2011 and reached 27 especially from citrus orchards as well as natural vegetation (Barbar 2013, 2014, 2016, 2018; Ebraheem *et al.* 2022).

The goal herein was to identify Phytoseiidae species occurring on some natural vegetation in Latakia governorate in 2020 and 2021 and to tabulate all phytoseiid taxa reported from Syria.

Material and methods

Surveys were conducted on 16 March, 14 and 23 April 2020, and on 20 April 2021. Phytoseiid mites were collected from soil litter and from leaves of wild vegetation at three different sites in Latakia governorate, Syria: Attabiyyat (35°30′24″ N, 35°46′49″ E); Alhafah (35°60′21″ N, 36°11′50″ E); Slanfeh (35°60′70″ N, 36°22′17″ E). Mites were removed from leaves using the "dipping-checking-washing-filtering" method (Boller 1984). For collecting mites from

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litter, materials were placed on a sieve (with 5 mesh/cm) and shaken over a black plastic sheet (1.5 m^2). Fallen mites were hand picked off sheet into a vial with 70% alcohol. Mites were then mounted on slides in Hoyer's medium, and then dried in an oven at 40 °C for three days. The specimens were examined using an Olympus® CH20 microscope at 400 and 1000 X magnification. Measurements were made using the scale of a reticule installed on the eyepiece lens, provided in micrometres (µm) and presented with the mean followed by the range in parenthesis. Mite body parts were documented, when necessary, using a mobile phone camera (13 megapixels) fixed on the eyepiece lens and images were transferred to the professional quality vector graphics software (Inkscape ® 0.92) which was installed on a computer for actual drawing.

The generic and subgeneric concepts used in this paper follow those of Chant and McMurtry (2007). Morphological characteristics were compared with original descriptions or re-descriptions. The setal nomenclature system adopted was that of Lindquist and Evans (1965) and Lindquist (1994) as adapted by Rowell *et al.* (1978) and Chant and Yoshida-Shaul (1992) for the dorsum, and by Chant and Yoshida-Shaul (1991) for the venter. The notation for solenostomes and poroids is based on Athias-Henriot (1975). Numbers of teeth on the fixed and movable cheliceral digits do not include the respective apical hook (Kreiter *et al.* 2021). The specimens were deposited in the Arthropod Collection of the Department of Plant Protection, Faculty of Agriculture, Al-Baath University, Homs, Syria.

Results and Discussion

A total of nine phytoseiid mite species had been found during the present study, all presented thereafter. This result increases the number of known Syrian phytoseiid to 32 species (Table 1), of which five species are recorded for the first time from Syria and three of them were measured as they constitute the second international record.

New recorded species

Eharius chergui (Athias-Henriot)

Specimens collected — Attabiyyat: 15 ♀♀ and one ♂ on *Marrubium vulgare* L. (Lamiaceae), 23 April 2020.

Remarks — This is the first record of this species from Syria. It has been observed in some Mediterranean countries, Iran, and USA (Demite *et al.* 2021).

Eharius stathakisi Döker

Specimens collected — Alhafah: five ♀♀ and two ♂♂ on *Marrubium vulgare* L. (Lamiaceae), 20 April 2021.

Female (n = 5).

Dorsum — Length of dorsal shield 305 (280–322), width (at level of *s4*) 122 (120–126). Setae *r3*, *Z4* and *Z5* knobbed apically. Measurements of dorsal setae as follows: *j1* 12 (12–13), *j3* 29 (28–31), *j4* 19 (17–20), *j5* (15), *j6* 16 (15–18), *J2* 18 (17–20), *J5* 6 (5–7), *z2* 29 (29–30), *z4* 36 (34–37), *z5* 15 (15–16), *Z1* 25 (24–26), *Z4* 30 (30–31), *Z5* 35 (30–40), *s4* 35 (34–36), *S2* 29 (29–30), *S5* 9 (8–10), *r3* 32 (29–35) and *R1* 17 (15–20).

Peritreme — Short, reaching to level of z4.

Venter — Distances between *st1– st1* 44 (40–49), *st2–st2* 52 (48–56), *st3–st3* 59 (58–61), *st1–st3* 73 (70–76), *st4–st4* 69 (68–70), *st5–st5* 46 (42–50). Length of ventrianal shield 88 (77–98), width at level of *ZV2* 40 (38–42), width at level of anus 51 (50–52). Setae *JV5* 13 (13–14).

Chelicera — Fixed digit 23 (22–25) long with two teeth and *pilus dentilis*; movable digit 19 (18–20) long without teeth.

Spermatheca — Calyx cup-shaped 4 (4–6) in length.

Legs — Length of legs (basis of coxae to basis of claws): leg I 230 (220–239); leg II 175 (170–179); leg III 164 (157–172); leg IV 203 (200–207). Leg IV without macrosetae.

Description of the adult male of *Eharius stathakisi* Döker (n = 2) (Figures 1-3)

Dorsal setal pattern 10A:8C (*r3* and *R1* on shield). Dorsal shield oval, sclerotized, smooth, with three pairs of solenostomes (*gd2*, *gd6* and *gd9*) and ten pairs of poroids (*id2*, *id5*, *id6*, *idm1*, *idm2*, *idm3*, *idm4*, *idm5*, *idm6* and *idl1*). All dorsal setae smooth except for *Z5* which is slightly serrated. Setae *r3*, *Z4* and *Z5* knobbed apically, others are pointed.

Dorsum — (Figure 1). Length of dorsal shield (266–285), width (138–145). Measurements of dorsal setae of the two specimens as follows: *j1* (12–15), *j3* (20–23), *j4* (15), *j5* (10–13), *j6* (13–15), *J2* (13–14), *J5* (5), *z2* (20–24), *z4* (25–27), *z5* (10–12), *Z1* (18), *Z4* (21), *Z5* (25–30), *s4* (25–27), *S2* (20–21), *S5* (10–11), *r3* (18–20) and *R1* (12–15).

Peritreme — (Figure 1). Longer than that of female and reaches to level between seta *r3* and *z4*.

Venter — (Figure 2). Ventral setal pattern 11, JV-3, 4:ZV-1, 3. Sternogenital shield smooth, with five pairs of setae (*st1*-*st5*) and three pairs of poroids. Distances between *st1–st1* (43–45), *st2–st2* (43–45), *st3–st3* (44–50), *st4–st4* (47–44), *st5–st5* (32), *st1–st5* (110). Ventrianal shield

Table 1 Phytoseiid mite species reported from Syria in the present study and previous records (new records **in bold**)

Sub-family	Species	References
Amblyseiinae	*Amblyseius swirskii* Athias-Henriot*	Barbar (2013, 2014 & 2017)
	***Eharius chergui* (Athias-Henriot)**	Present study
	Eharius hermonensis Amitai & Swirski (1980)	Amitai & Swirski (1980)
	***Eharius stathakisi* Döker**	Present study
	Euseius finlandicus (Oudemans)	Ebraheem *et al*. (2022)
	Euseius scutalis (Athias-Henriot)	Kerheili (2009);Barbar (2013 & 2014)
	Euseius stipulatus (Athias-Henriot)	Barbar (2013 & 2014)
	Graminaseius recebi* Döker, Kazak & Karut*	Present study; Barbar (2013)
	Iphiseius degenerans (Berlese)	Barbar (2013 & 2014)
	Neoseiulus barkeri Hughes	Barbar (2013)
	Neoseiulus bicaudus (Wainstein)	Barbar (2014)
	Neoseiulus californicus (McGregor)	Barbar (2014)
	Neoseiulus fallacis (Garman)	Kerheili (2009)
	***Neoseiulus sekeroglui* Döker & Stathakis**	Present study
	Neoseiulus sharonensis (Rivnay & Swirski)	Barbar (2017)
	Phytoseiulus persimilis Athias-Henriot	Barbar (2013, 2014, 2016 & 2017)
	Proprioseiopsis messor (Wainstein)	Barbar (2013, 2014 & 2016)
	Typhloseiella isotricha (Athias-Henriot)	Barbar (2016)
Phytoeiinae	*Phytoseius finitimus* Ribaga	Present study; Barbar (2013, 2014, 2016 & 2017)
Typhlodrominae	*Paraseiulus talbii* (Athias-Henriot)	Barbar (2013 & 2016)
	Paraseiulus triporus (Chant & Yoshida-Shaul)	Barbar (2013 & 2016)
	Typhlodromus (*Anthoseius*) *foenilis* Oudemans	Barbar (2013 & 2014)
	Typhlodromus (*Anthoseius*) *porathi* Swirski & Amitai	Swirski and Amitai (1967)
	Typhlodromus (*Anthoseius*) *recki* Wainstein	Barbar (2016 & 2017)
	Typhlodromus (*Anthoseius*) *rhenanus* (Oudemans)	Present study; Barbar (2013 & 2014)
	Typhlodromus (*Anthoseius*) *rickeri* Chant	Barbar (2014 & 2016)
	Typhlodromus (*Anthoseius*) *thesbites* (Swirski & Amitai)	Barbar (2013)
	Typhlodromus (*Typhlodromus*) *athiasae* Porath & Swirski	Barbar (2013, 2014, 2016 & 2017)
	Typhlodromus (*Typhlodromus*) *cotoneastri* Wainstein	Present study; Al-Abdulla (2001); Keirheili (2009); Ebraheem *et al*. (2022)
	Tuphlodromus (*Typhlodromus*) *ernesti* Ragusa & Swirski	Present study, Barbar (2018)
	Typhlodromus (*Typhlodromus*) *pyri* Scheuten	Present study; Al-Abdulla (2001); Ebraheem *et al*. (2022)
	***Typhloseiulus simplex* (Chant)**	Present study

*misidentified as *Amblyseius andersoni* (Chant) (Barbar 2013 & 2014).

** misidentified as *Graminaseius graminis* (Chant) (Barbar 2013).

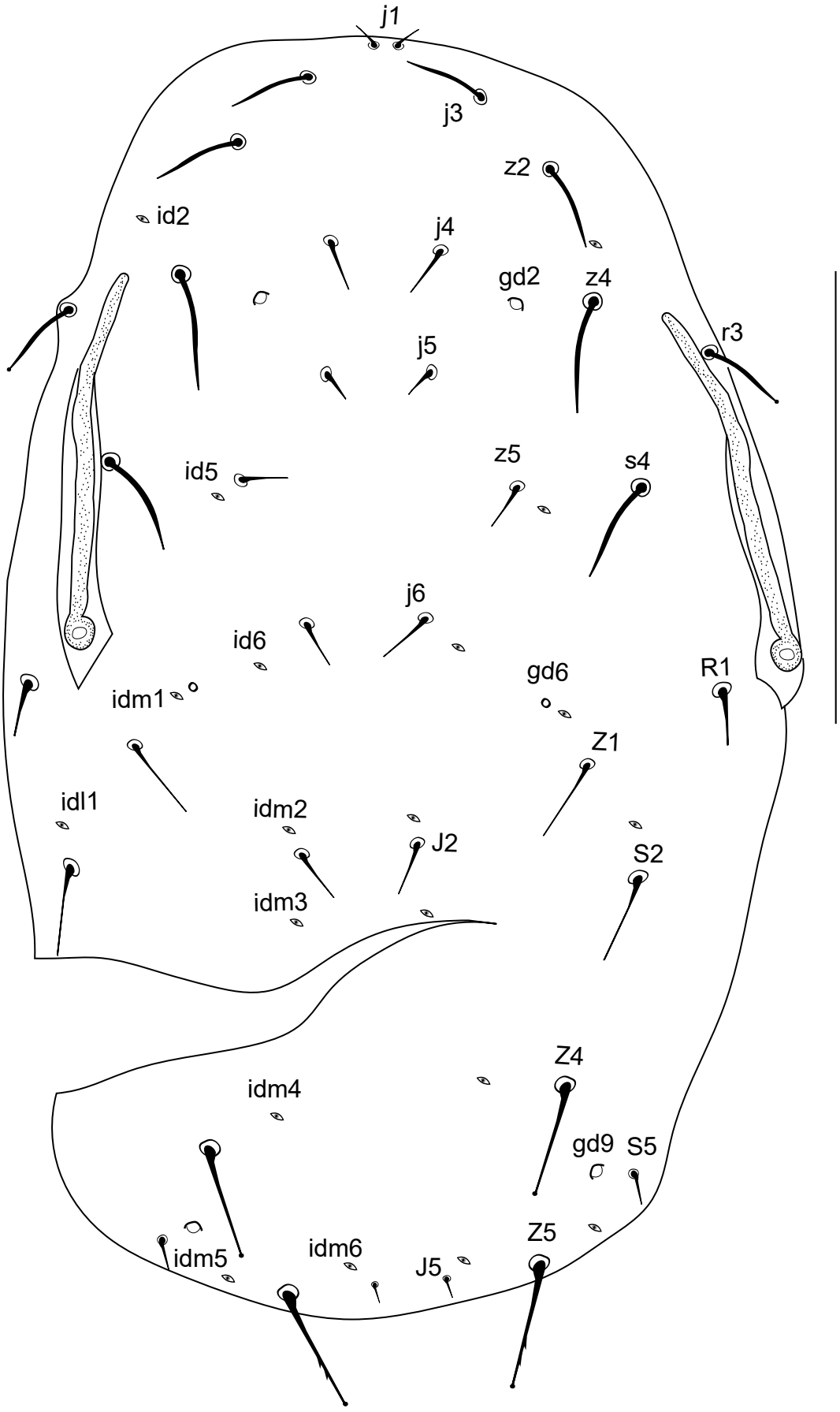

Figure 1 Dorsal shield and peritreme of the male of *Eharius stathakisi* Döker. Scale bar = 80 µm.

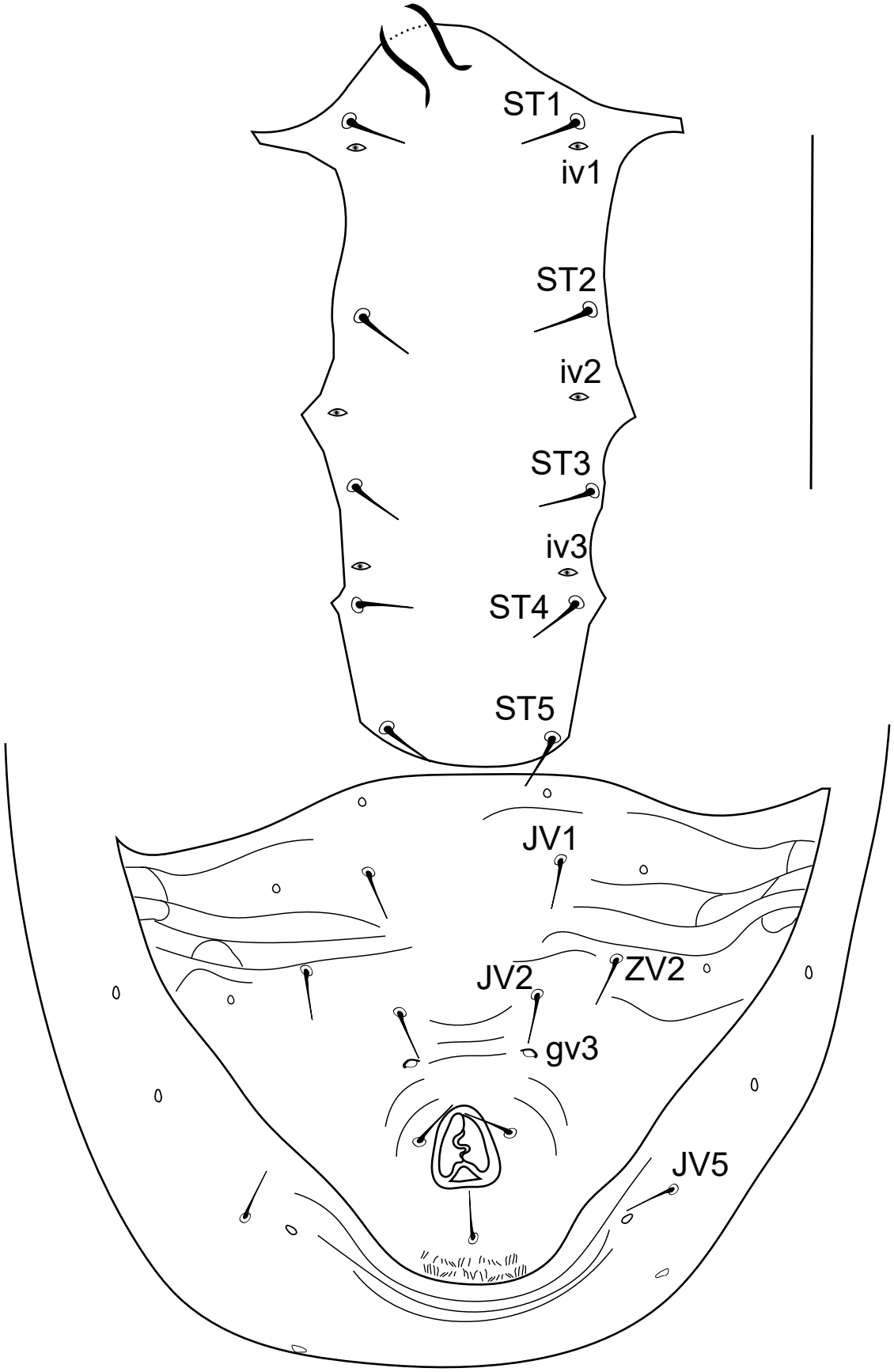

Figure 2 Ventral shields of the male of *Eharius stathakisi* Döker. Scale bar = 50 μm.

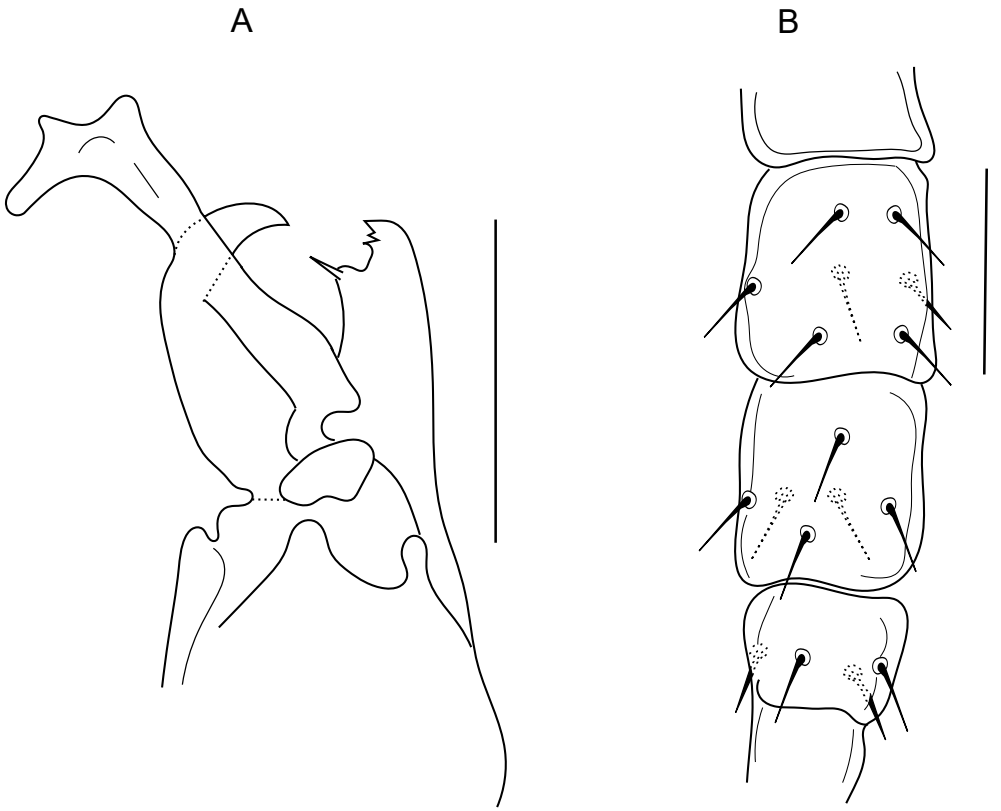

Figure 3 Male of *Eharius stathakisi* Döker, A. chelicera and spermatodactyl; B. leg IV. Scale bar = 20 µm (A) and 25 µm (B).

subtriangular, with few reticulations, three pairs of setae (*JV1*, *JV2*, and *ZV2*) and one pair crateriform *gv3* posterior to *JV2* setae. Length of ventrianal shield (105), width at level of *ZV2* (102–116), width at level of anus (63–74). Setae *JV5* (7–9). All ventral setae smooth.

Chelicera — (Figure 3A). Fixed digit (18–19) long with two teeth and *pilus dentilis*; movable digit (16–17) long without teeth.

Spermatodactyl — (Figure 3A). L-shaped, shaft 16 long, heel round, foot 7–9 long, with rounded toe.

Legs — (Figure 3B). Length of legs (basis of coxae to basis of claws): leg I (218–223); leg II (168–170); leg III (150–161); leg IV (218–219). GeII, GeIII and GeIV with eight, seven and seven setae, respectively; leg IV without macrosetae.

Remarks — This is the second international record of this species. Morphological characteristics of the Syrian female specimens are very close to those in the original description except for seta (*j6*) which is longer (15–18) in Syrian specimens (*vs.* shorter 9–11 in the original description) (Döker 2018). However, this seta could be wrongly measured considering the scale accompanied the illustration in the original description.

Graminaseius recebi Döker, Kazak & Karut

Specimens collected — Attabiyyat: ten ♀♀ females on *Salvia fruticosa* Miller (Lamiaceae), 14 April 2020.

Female (n = 8).

Dorsum — Length of dorsal shield 348 (327–372), width (at level of *s4*) 195 (190–202). Measurements of dorsal setae: *j1* 27 (26–29), *j3* 42 (40–45), *j4* 19 (17–23), *j5* 17 (15–18), *j6* 17 (15–19), *J2* 18 (16–19), *J5* 10 (9–11), *z2* 40 (37–42), *z4* 45 (42–50), *z5* 16 (15–18), *Z1* 19

(18–21), *Z4* 64 (61–68), *Z5* 79 (75– 83), *s4* 63 (60–67), *S2* 50 (49–52), *S4* 24 (22–27), *S5* 16 (13–20), *r3* 40 (38–43), and *R1* 32 (30–34).

Peritreme — Long, extending to level setae *j1*.

Venter — Distances between *st1–st1* 59 (58–61), *st2–st2* 71 (70–72), *st3–st3* 81 (78–84), *st1–st3* 66 (65–69), *st4–st4* 77 (75–80), *st5–st5* 65 (60–70). Ventrianal shield reticulated with three pairs of pre-anal setae (*JV1*, *JV2*, and *ZV2*), and with a pair of small solenostomes (*gv3*) [distance *gv3–gv3* 38 (35–42)]. Length of ventrianal shield 125 (118–132), width at level of *ZV2* 100 (94–106), width at level of anus 80 (75–85). Setae *JV5* 66 (63–70).

Chelicera — Fixed digit 32 (32–34) long with three teeth and *pilus dentilis*; movable digit 31 (30–32) long with one tooth.

Spermatheca — As described by Döker *et al.* (2019), 21 (19–23) in length.

Legs — Measurements of macrosetae on leg IV as follows: *SgeIV* 50 (46–55), *StiIV* 36 (32–42) and *StIV* 74 (71–77).

Remarks — This is the second international record of this species. Morphological characteristics of the Syrian specimens are very close to those in the original description (Döker *et al.* 2019). A single female of this species has been previously collected from Syria in 2013 and has been identified as *Graminaseius graminis* (Chant) (Barbar 2013). This misidentification was due to the lack of enough specimens to check. According to the paper of Döker *et al.* (2019), *G. recebi* could be differentiated from *G. graminis* by having several longer dorsal setae (i.e. *j4*, *j5*, *j6*, *J2*, *z2*, *z4*, *z5*, *Z1*, *S2*, and *S4*) and more teeth on fixed digit (four teeth). Consequently, all the specimens collected from Syria are *G. recebi*, even if the maximum and /or the minimum lengths of setae mentioned above are slightly out of the range of setae given in the original description of *G. recebi* (Döker *et al.* 2019) and fewer teeth on fixed digit (three teeth in Syrian specimens *vs.* four teeth in *G. recebi*).

Neoseiulus sekeroglui Döker & Stathakis

Specimens collected — Attabiyyat: one ♀ from ground litter under *Pinus halepensis* Miller (Pinaceae), 16 March 2020; Slanfeh: one ♀ on *Centaurea calcitrapa* L. (Asteraceae), 20 April 2021.

Female (n = 2).

Dorsum — Length of dorsal shield (333–350), width (distance between bases of *s4*) (163–185). Measurements of dorsal setae as follows: *j1* (14–15), *j3* (27–28), *j4* (16–18), *j5* 17, *j6* 17, *J2* 18, *J5* (12–14), *z2* (21–23), *z4* 26, *z5* 16, *Z1* 25, *Z4* (42–48), *Z5* 64, *s4* (36–38), *S2* (34–35), *S4* (31–34), *S5* (23–25), *r3* (22–25) and *R1* (21–22).

Peritreme — Extending to level of setae *j1*.

Venter — Distances between *st1–st1* 55, *st2–st2* (64–67), *st3–st3* (72–73), *st1–st3* (65–68), *st4–st4* (65–68), *st5–st5* (62–68). Ventrianal shield pentagonal, with three pairs of pre-anal setae (*JV1*, *JV2* and *ZV2*), and one pair of small solenostomes posteromedian to *JV2*. Length of ventrianal shield (114–118), width at level of *ZV2* 106, width at level of anus (85–87). Setae *JV5* (45–55) in length.

Chelicera — Fixed digit (32–33) long with four teeth and *pilus dentilis*; movable digit (29–31) long with one tooth.

Spermatheca — As described by Döker *et al.* (2014), 20 in length.

Legs — Measurement of the macroseta on leg IV, *StIV* (68–75).

Remarks — This is the second international record of this species. Morphological characteristics of the Syrian specimens fit well with those in the original description (Döker *et al.* 2014).

Typhloseiulus simplex (Chant)

Specimens collected — Alhafah: six ♀♀ on *Quercus calliprinos* Webb (Fagaceae), 20 April 2021.

Remarks — This is the first record of this species from Syria. It was recorded in several European countries and found also in Iran (Demite *et al.* 2021).

Other collected phytoseiid mite species

Typhlodromus (*Typhlodromus*) *cotoneastri* Wainstein

Specimens collected — Slanfeh: one ♀ on *Primula vulgaris* Hudson (Primulaceae), 20 April 2021. This species has already been observed in several apple orchards in Syria (Al-Abdulla 2001; Kerheili 2009).

Typhlodromus (*Typhlodromus*) *ernesti* Ragusa & Swirski

Specimens collected — Slanfeh: two ♀♀ on *Juniperus oxycedrus* L. (Cupressaceae), one ♀ on *Pinus halepensis* Miller (Pinaceae), and one ♀ on *Quercus calliprinos* Webb (Fagaceae), 20 April 2021; Alhafah: three ♀♀ on *P. halepensis*, 20 April 2021.

Remarks — This species has already been observed on *P. halepensis* at Borj-Islam in Latakia governorate (Syria) (Barbar 2018).

Typhlodromus (*Typhlodromus*) *pyri* Scheuten

Specimens collected — Slanfeh: three ♀♀ on *Quercus calliprinos* Webb (Fagaceae), and three ♀♀ on *Primula vulgaris* Hudson (Primulaceae), 20 April 2021; Alhafah: two ♀♀ on *Marrubium vulgare* L. (Lamiaceae), 20 April 2021.

Remarks — This species has already been observed on apple in the south of Syria (Al-Abdulla *et al.*, 2020) and also on *Castanea* sp., *P. halepensis* in Hama governorate (Ebraheem *et al.*, 2022).

Typhlodromus (*Anthoseius*) *rhenanus* (Oudemans)

Specimens collected — Attabiyyat: 12 ♀♀ and two ♂♂ on *Marrubium vulgare* L. (Lamiaceae), 23 April 2020; Slanfeh: one ♀ on *Centaurea calcitrapa* L. (Asteraceae), 20 April 2021.

Remarks — This species has already been observed on several host plants in Latakia governorate (Barbar 2013). Ventrianal shield of one collected female is abnormal by having only three pairs of ventrianal setae *JV1*, *JV2* and *JV3*, and seta *ZV3* is absent in the left side, (Figure 4).

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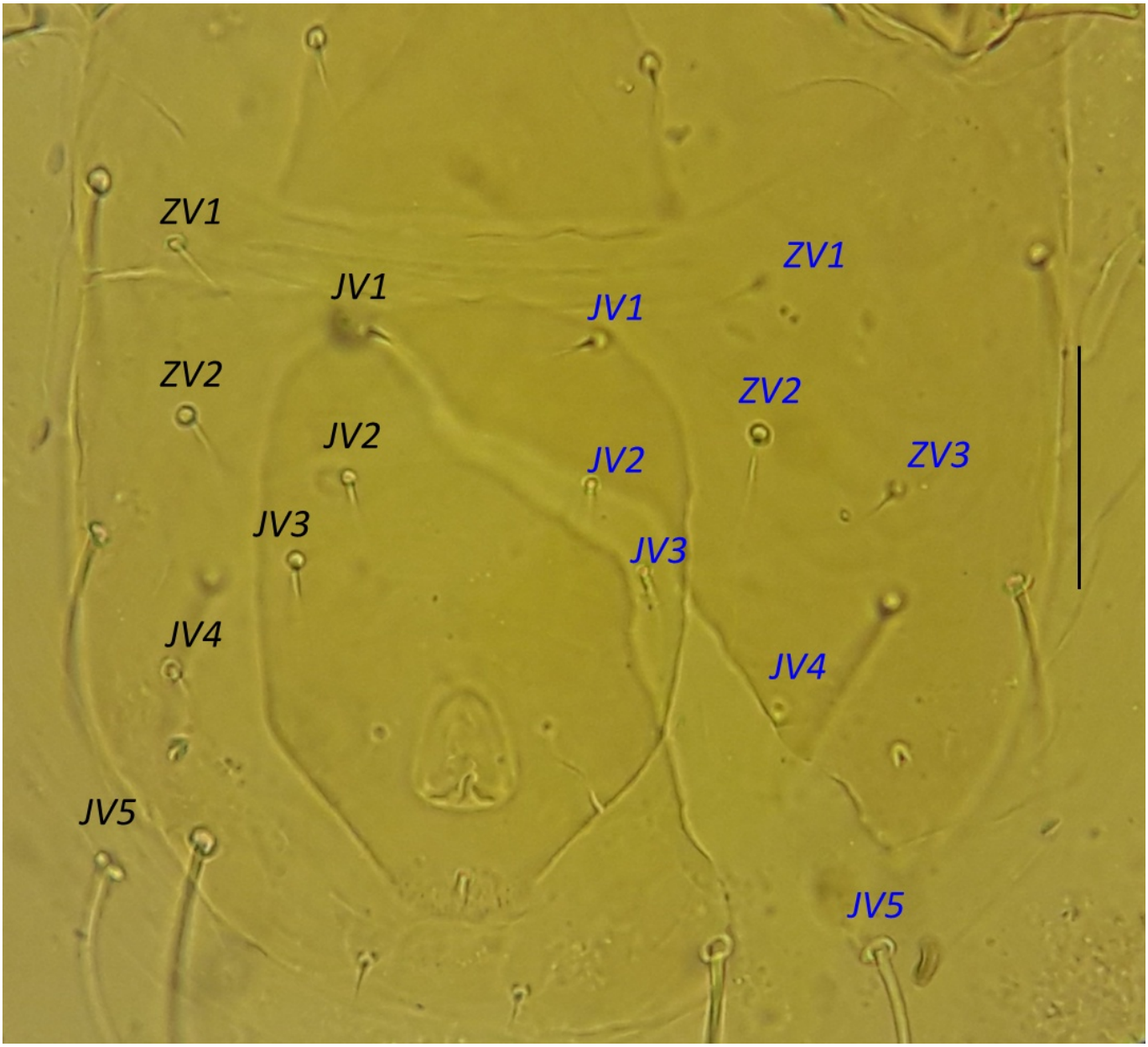

Figure 4 Ventrianal shield and its surrounding area of the female of *Typhlodromus pyri* Scheuten. Scale bar = 50 µm.

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