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Complementary description of *Typhlodromus (Anthoseius) bagdasarjani* Wainstein & Arutunjan (Acari: Mesostigmata: Phytoseiidae) based on specimens from western Iran

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**ABSTRACT** — This paper reports the morphological characteristics of immatures and adults of *Typhlodromus (Anthoseius) bagdasarjani* Wainstein & Arutunjan, 1967 (Phytoseiidae) collected from plum trees, *Prunus domestica* L. (Rosaceae), infected with two-spotted spider mites (Tetranychidae) in the Hamedan region, Western Iran. The genders of the deutonymphal stage can be determined by the number of paired setae in the opisthogaster (eight in females vs. five in males).

**KEYWORDS** — Mite; Mesostigmata; Phytoseiid; predator; mobile stages

**ZOOBANK** — 27786316-848A-47BA-B5DF-5D66835C6A6A

**INTRODUCTION**

*Typhlodromus* is the largest phytoseiid genus (457 described species according to Demite et al., 2016). The idiosomal and leg chaetotaxy of immature phytoseiid stages have been studied by different authors [e.g. Chant (1958); Rowell and Chant (1979), Aponte and McMurtry 1987 and Ueckermann and Loots (1988)]. *Typhlodromus (Anthoseius) bagdasarjani* Wainstein & Arutunjan, 1967 was described from fruit trees in the Asni region, near Yerevan, Armenia (Moreas et al. 2004; Demite et al. 2016). It has also been reported from neighbouring Azerbaijan, Iran, Turkey and Turkmenistan. In Iran, it has been recorded in association with spider mites, erio-phyoids, tydeids, thrips and whiteflies (Daneshvar 1978, 1993; Rahmani et al. 2010; Sadeghi Namaghi 2010; Shirkhani et al. 2011; Asali Fayaz and Khanjani, 2012; Asali Fayaz et al. 2011, 2013; Panahi Laeen et al. 2014; Javadi Khederi and Khanjani 2014).

According to McMurtry et al. (2013), this species is categorized as a generalist predator (Type III lifestyle). Mobile immature stages of this species have been reported by some authors, who did not providing information about their measurements (Arutunjan 1970, 1972, 1977; Denmark and Welbourn 2002).

The objective of this paper is to provide mea-
as measurements of immature and adults of T. (A.) bagdasarjani.

**Materials and Methods**

The specimens used in this study were obtained from a laboratory colony initiated with specimens collected from plum trees, Prunus domestica L. (Rosaceae), infested by the two-spotted spider mites (Tetranychus urticae Koch; Tetranychidae) in Hamedan region, Western Iran. The mites were mounted on microscope slides in Hoyer’s medium for examination under an Olympus BX51 phase and differential interference contrast microscope. Illustrations were done with the aid of a camera Lucida apparatus attached to the microscope and measurements were done with a graded ocular; measurements are given in micrometers. Leg lengths do not include pre-tarsus. The classification system used follows that of Chant and McMurtry (2007). The setal notations follow Rowell et al. (1978) and Rowell & Chant (1979); dorsal and ventral setal patterns are provided according to Chant and Yoshida-Shaul (1989 and 1991); organotaxy follows Athias-Henriot (1975) and leg chaetotaxy, Evans (1963).

**Results**

Phytoseiidae Berlese, 1916: 33


Typhlodromini Wainstein, 1962

*Typhlodromus* Scheuten, 1857

*Anthoseius* De Leon, 1959

*Typhlodromus* (Anthoseius) bagdasarjani

Wainstein & Arutunjan

*Typhlodromus bagdasarjani* Wainstein & Arutunjan, 1967: 1765


Diagnosis (Female) — Dorsal shield with five pairs of solenostomes (gd2, gd4, gd6, gd8, gd9); dorsal setae Z5 pointed apically; ventrianal shield with four pairs of preanal setae and without preanal pores; movable cheliceral digit toothless; calyx of spermatheca fundibular; basitarsus IV with a knobbed macroseta.

**Female** (Figures 1; 6P-S) (n = 6) — Idiosoma oval; setal pattern: 12A:8A/JV:ZV. All idiosomal and leg setae smooth, except Z4 and Z5, barbed.

Dorsum (Fig. 1A) — Dorsal shield reticulated, 345-365 long, 170 – 190 wide at level of R1, with 18 pairs of setae and five pairs of solenostomes (gd2, gd4, gd6, gd8, gd9) and 14 pairs of lyrifissures. Length of setae: j1 24 – 26, j3 31 – 35, j4 19 – 22, j5 18 – 21, j6 25 – 28, J2 27 – 30, j5 9 – 10, z2 25 – 27, z3 28 – 30, z4 29 – 33, z5 20 – 23, Z4 53 – 55, Z5 68 – 73, s4 35 – 38, s6 37 – 40, s2 41 – 44, S4 35 – 38, S5 29 – 32, r3 31 – 33, R1 28 – 30.

Venter (Fig. 1B) — Sternal shield smooth, posterior margin with median lobe and with two pairs of setae of similar lengths [ST1 (30 – 32), ST2 (30 – 33)] and two pairs of lyrifissures (io1-2); setae ST3 30 – 34 and ST4 28 – 32 long and each set on a platelet, the latter with one small lyrifissure. Genital shield 115 – 130 long, 65 – 75 wide at level of base setae ST5, Setae ST5 31 – 33 long. Two pairs of elongate metapodal platelet [30 – 33 and 14 – 17 long]. Ventripalp shield reticulated, 115 – 120 long and 80 – 90 at level of setae ZV2, with four pairs of preanal setae JV1 23 – 25, JV2 21 – 23, JV3 22 – 25, ZV2 25 – 26 long and without preanal pores; para anal setae PA 18 – 20 and post anal seta PST 18 – 20 long. Opisthogastric cuticle bearing four pairs of setae, JV4 23 – 25 and JV5 53 – 58, ZV1 28 – 31, ZV3 22 – 25, long, all smooth, and four pairs of lyrifissures.

Peritreme (Fig. 1A) — Extending almost to level of seta z3, 85 – 100 long.

Chelicera (Fig. 1C) — Chelicera 115 – 130 long; fixed digit 26 – 28 long, with two teeth; pilus dentilis 4 long; movable digit 23 – 25 long and toothless.

Spermatheca (Fig. 1D) — Calyx fundibular, 16 – 20 long and 9 – 10 wide at junction with vesicle.

FIGURE 1: *T. (A.) bagdasarjani* (Adult female): A – Dorsal view of idiosoma; B – Ventral view of idiosoma; C – Chelicera; D – Spermatheca; E – Basitarsus IV.
Table 1: Comparison of characters of all stages of *T. (A.) bagdasarjani* Wainstein & Arutunjan, 1967.

<table>
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<th>Ch. / Stage</th>
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- Female. Numbers of setae.

Femora I-IV* 10,7,5,- 10,7,5,4 12,10,6,6 12,10,6,6 12,10,6,6 12,10,6,6
Genua I-IV* 8,6,6,- 8,6,6,5 10,7,7,7 10,7,7,7 10,7,7,7 10,7,7,7
Tibiae I-IV* 8,7,7,- 8,7,7,6 10,7,7,6 10,7,7,6 10,7,7,6 10,7,7,6

*: Numbers of setae.
FIGURE 2: T. (A.) bagdasarjani (Adult male): A – Dorsal view of idiosoma; B – Ventral view of idiosoma; C – Chelicera; D – Basitarsus IV.
FIGURE 3: *T. (A.) bagdasari* (Deutonymph): A – Dorsal view of idiosoma (♀); B – Ventral view of idiosoma (♀); C – Chelicera (♀); D – Basitarsus IV (♀); E – Ventral view of idiosoma (♂).
Male (Figures 2; 6T-W) (n = 7) — Idiosoma oval; setal pattern: 12A:8A/JV4-ZV1-1, 3. All idiosomal and leg setae smooth, except Z4 and Z5, barbed.

Dorsum (Fig. 2A) — Dorsal shield reticulated, 270-290 long, 155 – 180 wide at level of R1, with 20 pairs of setae and five pairs of solenostomes (gd2, gd4, gd6, gd8, gd9) and 10 pairs of lyrifissures. Length of setae: j1 20 – 24, j3 25 – 30, j4 17 – 20, j5 16 – 18, j6 17 – 20, j2 22 – 23, j5 8 – 10, z2 17 – 22, z3 23 – 25, z4 26 – 30, z5 16 – 18, z4 45 – 52, z5 47 – 55, s4 26 – 30, s6 30 – 34, s2 33 – 37, s4 25 – 30, s5 23 – 27, r3 24 – 28, R1 20 – 24.

Venter (Fig. 2B) — Sternogenital shield smooth, anterior and posterior margins convex; five pairs of setae subequal in lengths (ST1 24 – 27, ST2 24 – 27, ST3 23 – 25, ST4 23 – 25, ST5 23 – 24); three pairs of lyrifissures (iV1-iV3). Ventrianal shield reticulated, subtriangular; anterior margin convex, 108 – 117 long and 12 pairs of lyrifissures. Length of opisthogastric setae: JV1 pre-anal setae (lyrifissures 23 – 25, PST 15 – 17 and 18 – 22, JV1 18 – 20, JV2 18 – 21, JV3 18 – 20, JV4 17 – 20, JV5 40 – 44, ZV1 18 – 21, ZV2 18-21, ZV3 15 – 18, PA 15 – 17, PST 15 – 17.

Peritreme (Fig. 2A) — Extending to slightly beyond insertion of z4, 70 – 80 long.

Chelicera (Fig. 2C) — Chelicera 105 – 115 long; fixed digit 21 – 23 long, with two teeth; pilus dentilis 3 – 4 long; movable digit 19 – 22 long and toothless, spermacastyl 23 – 27 long, arched and slightly inflated distally.

Legs I-IV (Figs. 2D, 6T-W) — Lengths: 220 – 230, 205 – 210, 190 – 195, 265 – 275, respectively. Numbers of setae on femora, genua and tibiae I-IV are given in table 1. Basitarsus IV with a knobbed macroseta, 38 – 43 long.

Deutonymph (female) (Figs. 3A-D, 6H-K) (n = 8) — Idiosoma oval. All idiosomal and leg setae smooth, except Z4 and Z5, barbed.

Dorsum (Fig. 3A) — Dorsal shield reticulated, with mediolateral incision, 275 – 290 long, 137 – 145 wide at level of setae R1, with 18 pairs of setae and five pairs of solenostomes (gd2, gd4, gd6, gd8, gd9) and 12 pairs of lyrifissures. Length of setae: j1 22 – 25, j3 27-33, j4 17 – 20, j5 18 – 21, j6 24 – 25, j2 22 – 25, j5 7 – 10, z2 21 – 25, z3 23 – 27, z4 27 – 31, z5 17 – 20, z4 50 – 55, Z5 50 – 57, s4 30 – 35, s6 30 – 36, s2 35 – 40, s4 30 – 35, s5 27 – 31, r3 27 – 31, R1 23 – 27.

Venter (Fig. 3B) — Sternial shield smooth, anterior margin convex, with four pairs of setae subequal in lengths (ST1 25 – 27, ST2 25 – 27, ST3 22 – 25, ST4 20 – 22), three pairs of lyrifissures (iV1-iV3); fifth sternal seta (ST5) set on soft integument, 22 – 25 long; a pair of fine elongate metapodal shields 15 – 20 long. Opisthogastric cuticle with eight pairs of setae (JV1-JV5, ZV1-ZV3) and four pairs of lyrifissures. Length of opisthogastric setae: JV1 18 – 20, JV2 18 – 21, JV3 18 – 20, JV4 17 – 20, JV5 40 – 44, ZV1 18 – 21, ZV2 18-21, ZV3 15 – 18, PA 15 – 17, PST 15 – 17.

Peritreme (Fig. 3A) — Extending to level between z2-z3, 130 – 140 long.

Chelicera (Fig. 3C) — Chelicera 125 – 129 long; fixed digit 23 – 24 long, with two teeth; pilus dentilis 4 long; movable digit 20 long and toothless.


Deutonymph (male) (Figs. 3E, 6L-O) (n = 7) — The idiosomal and cheliceral characters are similar to female deutonymph however it can be distinguished by characteristics of the opisthogastric region (Fig. 3E). Opisthogastric cuticle with five pairs of setae (JV1-JV3, JV5, ZV2) and three pairs of lyrifissures. Length of opisthogastric setae: JV1 17 – 20, JV2 17 – 20, JV3 16 – 18, JV5 32 – 38, ZV2 16 – 20, PA 15, PST 15 – 17.

Legs I-IV (Figs. 6L-O) — Lengths: 230 – 240, 185 – 190, 196 – 205, 260 – 270, respectively. Numbers of setae on femora, genua, tibiae and tarsi of legs I-IV are given in table 1.

Protonymph (Figs. 4, 6D-G) (n = 8) — Idiosoma oval. All idiosomal and leg setae smooth, except Z4 and Z5, barbed.

Dorsum (Fig. 4A) — Separate podonotal and opisthonotal shields; podonotal shield smooth, 130 – 140 long and 110 – 120 wide at level of s4, with
FIGURE 4: *T. (A.) bagdasarjani* (Protonymph): A – Dorsal view of idiosoma; B – Ventral view of idiosoma; C – Chelicera; D – Basitarsus IV.
FIGURE 5: T. (A.) bagdasarjani (Larva): A – Dorsal view of idiosoma; B – Ventral view of idiosoma; C – Chelicera.
Figure 6: T. (A.) bagdasarjani femora, genua and tibiae: A-C – (Larva, legs I-III, respectively); D-G – (Protonymph, legs I-IV, respectively); H-K – (Deutonymph ♀; legs I-IV, respectively); L-O – (Deutonymph ♂; legs I-IV, respectively); P-S – (Adult female; legs I-IV, respectively); T-W – (Adult male; legs I-IV, respectively).
nine pairs of setae (j1, j3, j4, j5, j6, z2, z4, z5, s4), two pairs of solenostomes (gd2, gd4) and three pairs of lyrifissures; opisthonal shield reticulated, 48 – 60 long, 75 – 90 wide at level of s4, with five pairs of setae and two pairs solenostomes (gd8, gd9) and five pairs of lyrifissures; setae j2, s6, S2, r3 and R1 on soft integument (fig. 4A). Length of setae: j1 22 – 27, j3 27 – 31, j4 18 – 20, j5 18 – 20, j6 23 – 27, j2 20 – 24, j5 7 – 9, z2 18 – 22, z4 27 – 30, z5 16 – 18, Z4 50 – 55, Z5 42 – 46, s4 30 – 35, s6 26 – 30, S2 34 – 37, S4 25 – 31, S5 20 – 25, r3 23 – 27, R1 19 – 23. Unsclerotized cuticle between podonotal and opisthonal shields with several pairs of small, irregular plates and with a pair of solenostome (gd6).

Venter (Fig. 4B) — Sternal shield smooth, with three pairs of setae subequal in lengths (ST1 23 – 28, ST2 22 – 25, ST3 24 – 25) and two pairs of lyrifissures (io1-io2). Opisthogastric cuticle with four pairs of smooth setae ( JV1-2, JV5, ZV2) and six pair of lyrifissures on small platelets. Anal opening surrounded with 3 setae (PA and PST). Length of opisthogastric setae: JV1 19-22, JV2 17 – 21, JV5 30 – 33, ZV2 19 – 21, PA 14 – 15, PST 14 – 15.

Peritreme (Fig. 4A) — Vestigial; extending to level between setae S5-6, 25 – 30 long.

Chelicera (Fig. 4C) — Chelicera 85 – 100 long; fixed digit 18 – 20 long, with two teeth; pilus dentilis 2 – 3 long; movable digit 14 – 17 long, toothless.

Legs I-IV (Figs. 4D, 6D-G) — Lengths: 235 – 240, 190 – 200, 190 – 195 and 250 – 255, respectively. Numbers of setae on femora, genua and tibiae I-IV are given in table 1. Basitarsus IV with a knobbed macroseta, 48 – 53 long.

Larva (Fig. 5; 6A-C) (n = 6) — Idiosoma oval. All idiosomal and leg setae smooth.

Dorsum (Fig. 5A) — Separate podonotal and opisthontal shields, both smooth; podonotal shield 126 – 135 long and 115 – 130 wide at level of setae s4, with nine pairs of setae (j1, j3, j4, j5, j6, z2, z4, z5, s4) and one pair of solenostome (gd2); opisthontal shield 55 – 70 long, 110 – 130 wide at level of solenostome gd6 and four pairs of lyrifissures, with a pair of setae (Z4). Length of setae: j1 35 – 40, j3 18 – 20, j4 10 – 12, j5 9 – 11, j6 75 – 84, z2 12 – 14, z4 33 – 38, z5 9 – 10, Z4 135 – 145, s4 72 – 79. Setae s4, j6 long and knobbed distally and Z4 whip-like and knobbed distally. Unsclerotized cuticle between podonotal and opisthontal shields with a pair of solenostome (gd6).

Venter (Fig. 5B) — Sternal shield smooth, and with three pairs of setae of subequal lengths (ST1 20 – 25, ST2 20 – 24, ST3 20 – 22). Opisthogastric cuticle with four pairs of smooth setae (JV1-2, JV5, ZV2) and a pair of lyrifissures. Length of opisthogastric setae: JV1 11 – 14, JV2 23 – 26, JV5 6, ZV2 8 – 10, PA 31 – 35, PST 21 – 23.

Chelicera (Fig. 5C) — Chelicera 60 – 70 long; fixed and movable digits 13 – 15 and 10 – 12 long, respectively, both toothless.

Legs I-III (Figs. 6A-C) — Lengths: 215 – 220, 160 – 170 and 160 – 165, respectively. Numbers of setae on femur, genu and tibia I-III are given in table 1.

Remarks — Unlike previous studies, measurements of idiosomal setae and organotaxy are given in this study for adult males and mobile immature stages. Shape and arrangement of idiosomal setae closely resemble the re-description of Arutunjan (1977), with slight differences, e.g. larva with an entire opisthontal shield in this study but divided in that study. Femur I of larva and protonymph with 10 setae as opposed to nine setae in Arutunjan (1970, 1972).

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