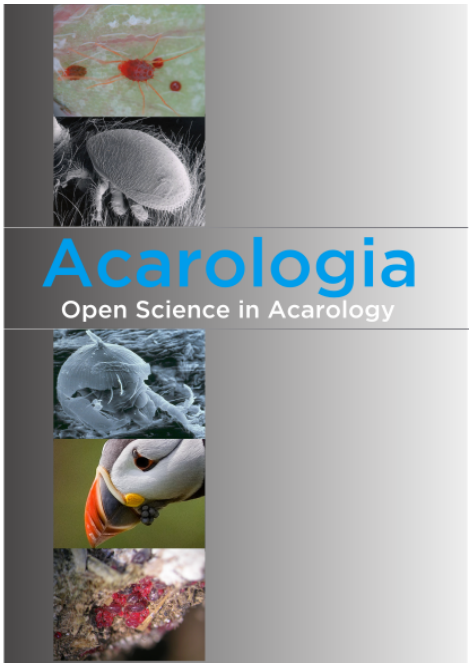

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Complementary description of *Typhlodromus* (*Anthoseius*) *bagdasarjani* Wainstein & Arutunjan (Acari: Mesostigmata: Phytoseiidae) based on specimens from western Iran

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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, eriophyoids, 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-

surements 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
Typhlodrominae Wainstein, 1962: 131; Chant & McMurtry, 1994: 235
Typhlodromini Wainstein, 1962
***Typhlodromus* Scheuten, 1857**
***Anthoseius* De Leon, 1959**

Typhlodromus (*Anthoseius*) *bagdasarjani* Wainstein & Arutunjan

Typhlodromus bagdasarjani Wainstein & Arutunjan, 1967: 1765
Typhlodromus (*Anthoseius*) *bagdasarjani*, Asali Fayaz *et al.* 2013: 370.

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 (*iv1-2*); 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]. Ventrianal 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.

Legs I-IV (Figs. 1E, 6P-S) — Length of legs I-IV: 290 – 310, 250 – 260, 245 – 260 and 320 – 340, respectively. Numbers of setae on femora, genua and tibiae of legs I-IV given in table 1. Basitarsus IV with a knobbed macroseta, 49 – 54 long.

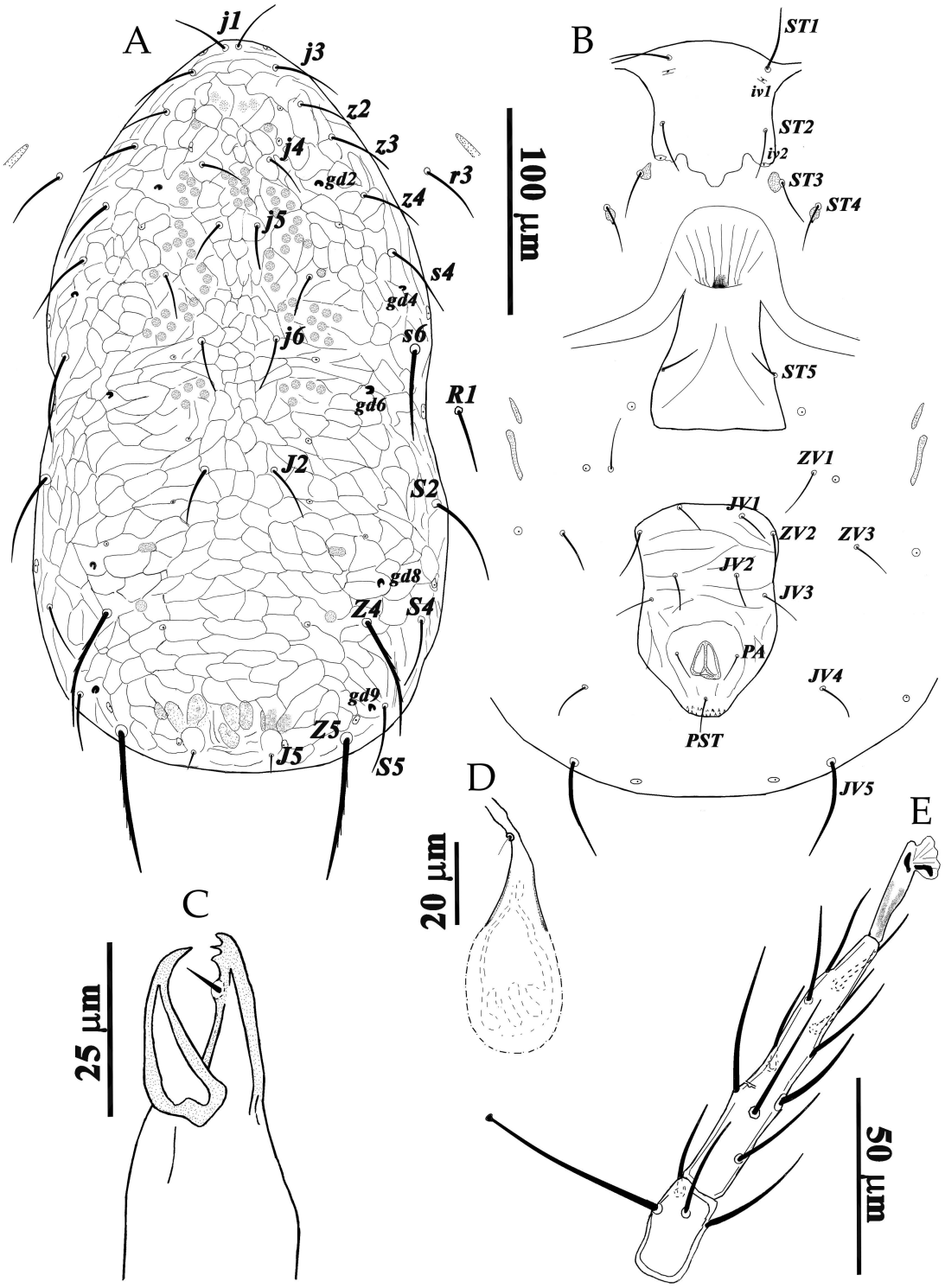

FIGURE 1: *T.* (*A.*) *bagdasarjani* (Adult female): A – Dorsal view of idiosoma; B – Ventral view of idiosoma; C – Chelicera; D – Spermatheca; E – Basitarsus IV.

TABLE 1: Comparison of characters of all stages of *T.* (*A.*) *bagdasarjani* Wainstein & Arutunjan, 1967.

Ch. / Stage	L.	P.	D. (♀)	D. (♂)	A. (♀)	A. (♂)
j1	+	+	+	+	+	+
j3	+	+	+	+	+	+
j4	+	+	+	+	+	+
j5	+	+	+	+	+	+
j6	+	+	+	+	+	+
J2	-	+	+	+	+	+
J5	-	+	+	+	+	+
z2	+	+	+	+	+	+
z3	-	-	+	+	+	+
z4	+	+	+	+	+	+
z5	+	+	+	+	+	+
Z4	+	+	+	+	+	+
Z5	-	+	+	+	+	+
s4	+	+	+	+	+	+
s6	-	+	+	+	+	+
S2	-	+	+	+	+	+
S4	-	+	+	+	+	+
S5	-	+	+	+	+	+
r3	-	+	+	+	+	+
R1	-	+	+	+	+	+
ST1	+	+	+	+	+	+
ST2	+	+	+	+	+	+
ST3	+	+	+	+	+	+
ST4	-	-	+	+	+	+
ST5	-	-	+	+	+	+
JV1	+	+	+	+	+	+
JV2	+	+	+	+	+	+
JV3	-	-	+	+	+	+
JV4	-	-	+	-	+	-
JV5	+	+	+	+	+	+
ZV1	-	-	+	-	+	-
ZV2	+	+	+	+	+	+
ZV3	-	-	+	-	+	-
Spermadactyl	-	-	-	-	-	+
Macrosetae on basitarsus IV	-	+	+	+	+	+
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.

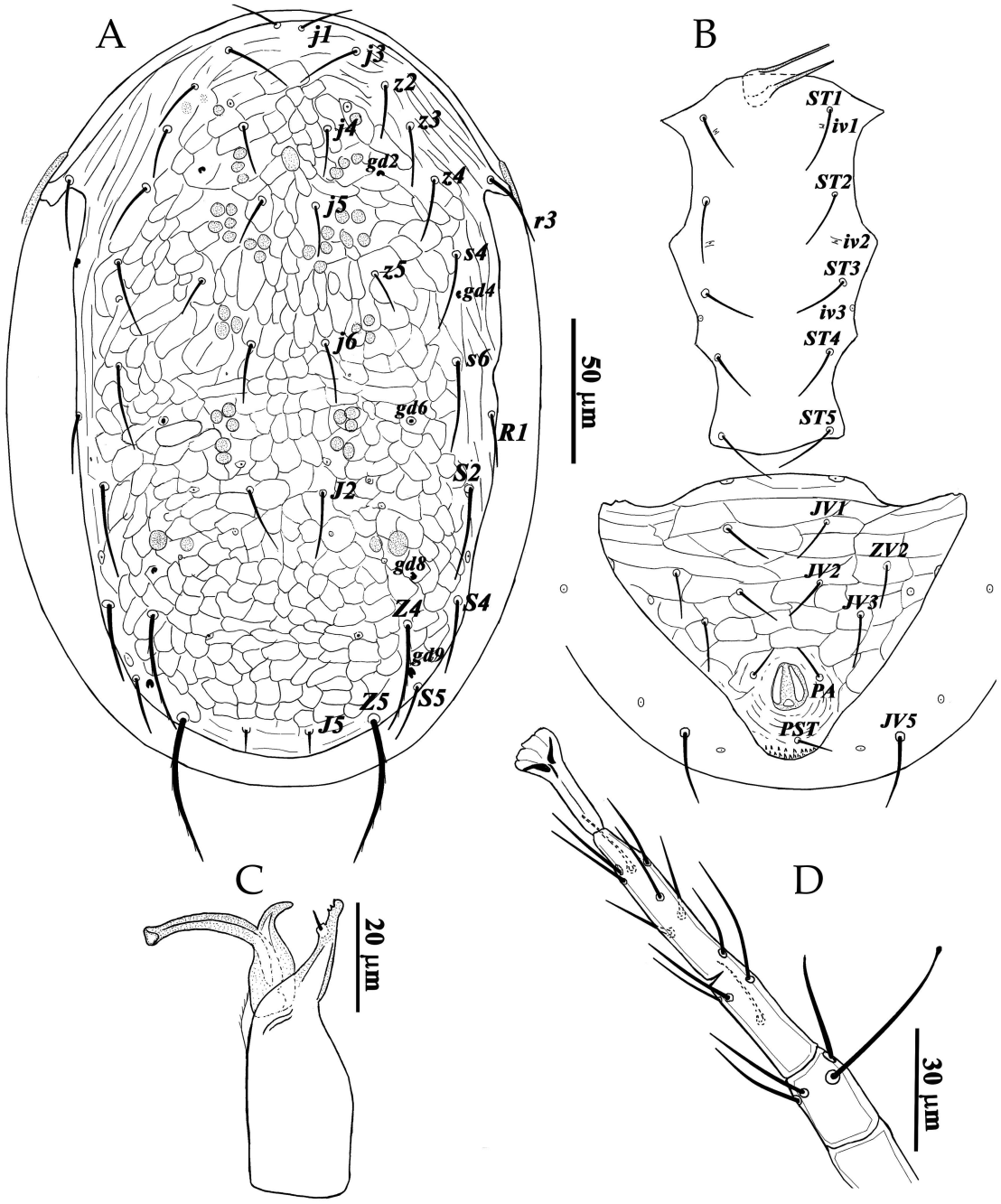

FIGURE 2: *T.* (*A.*) *bagdasarjani* (Adult male): A – Dorsal view of idiosoma; B – Ventral view of idiosoma; C – Chelicera; D – Basitarsus IV.

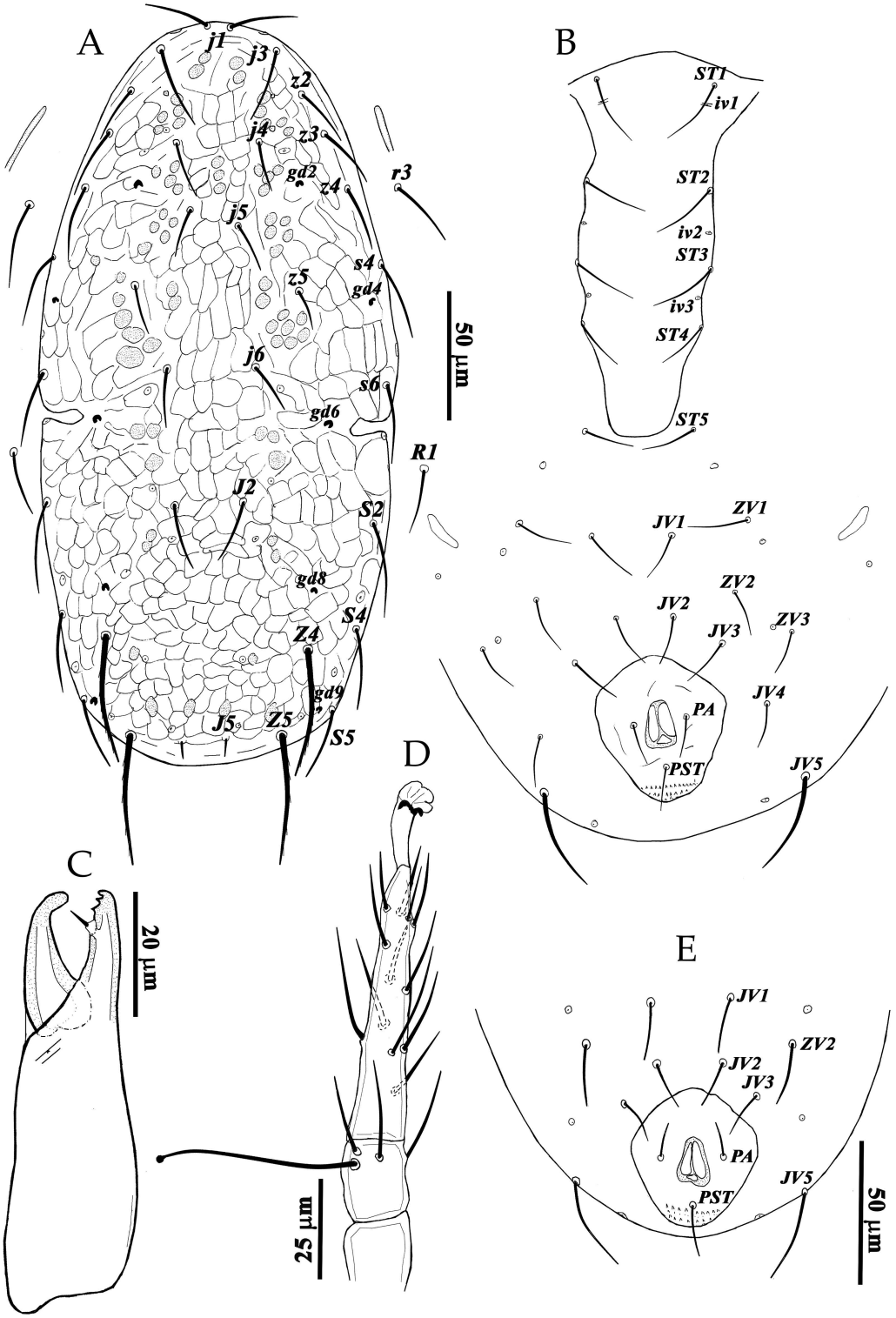

FIGURE 3: *T.* (*A.*) *bagdasarjani* (Deutonymph): A – Dorsal view of idiosoma (♀); B – Ventral view of idiosoma (♀); C – Chelicera (♀); D – Basitarsus IV (♀); E – Ventral view of idiosoma (♂).

Male (Figures 2; 6T-W) (n = 7) — idiosoma oval; setal pattern: 12A:8A/JV-4:ZV-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 138-155 wide at level of setae *JV1*; four pairs of pre-anal setae (*JV1*, *JV2*, *JV3* and *ZV2*); three pairs of lyrifissures; no preanal pores. Opisthogastric cuticle with one pair of setae (*JV5*) and two pairs of lyrifissures. Length of opisthogastric setae: *JV1* 17 – 20, *JV2* 18 – 22, *JV3* 18 – 22, *JV5* 31 – 35, *ZV2* 20 – 23, *PA* 15 – 17 and *PST* 14 – 16.

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, spermadactyl 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) — Sternal 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.

Legs I-IV (Figs. 3D, 6H-K) — Lengths: 245 – 250, 210 – 215, 210 – 217, 300 – 310, respectively. Numbers of setae on femora, genua and tibiae I-IV are given in table 1. Basitarsus IV with a knobbed macroseta, 51 – 55 long.

Deutonymph (male) (Figs. 3E, 6L-O) (n = 7) — The idisomal 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

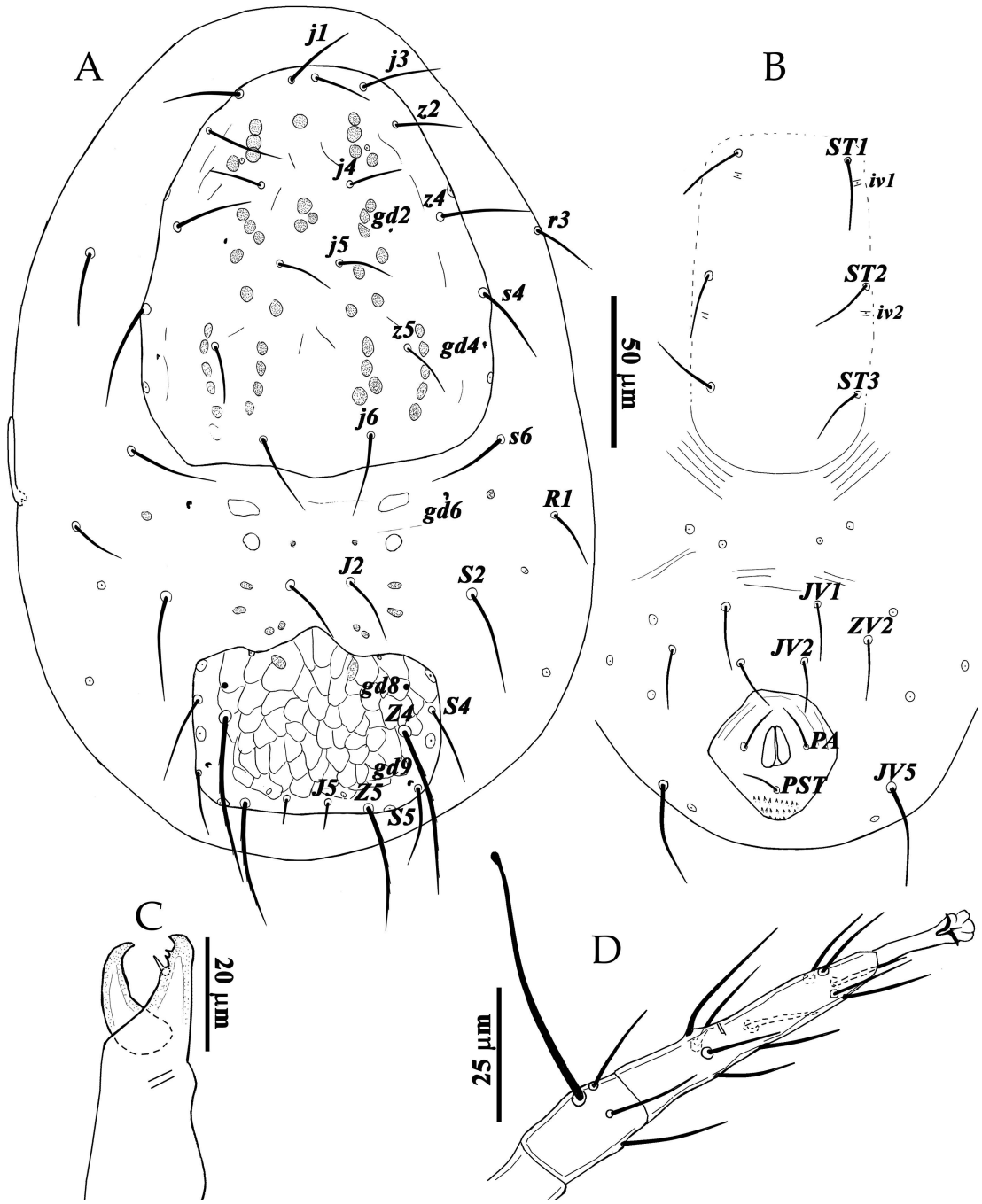

FIGURE 4: *T.* (*A.*) *bagdasarjani* (Protonymph): A – Dorsal view of idiosoma; B – Ventral view of idiosoma; C – Chelicera; D – Basitarsus IV.

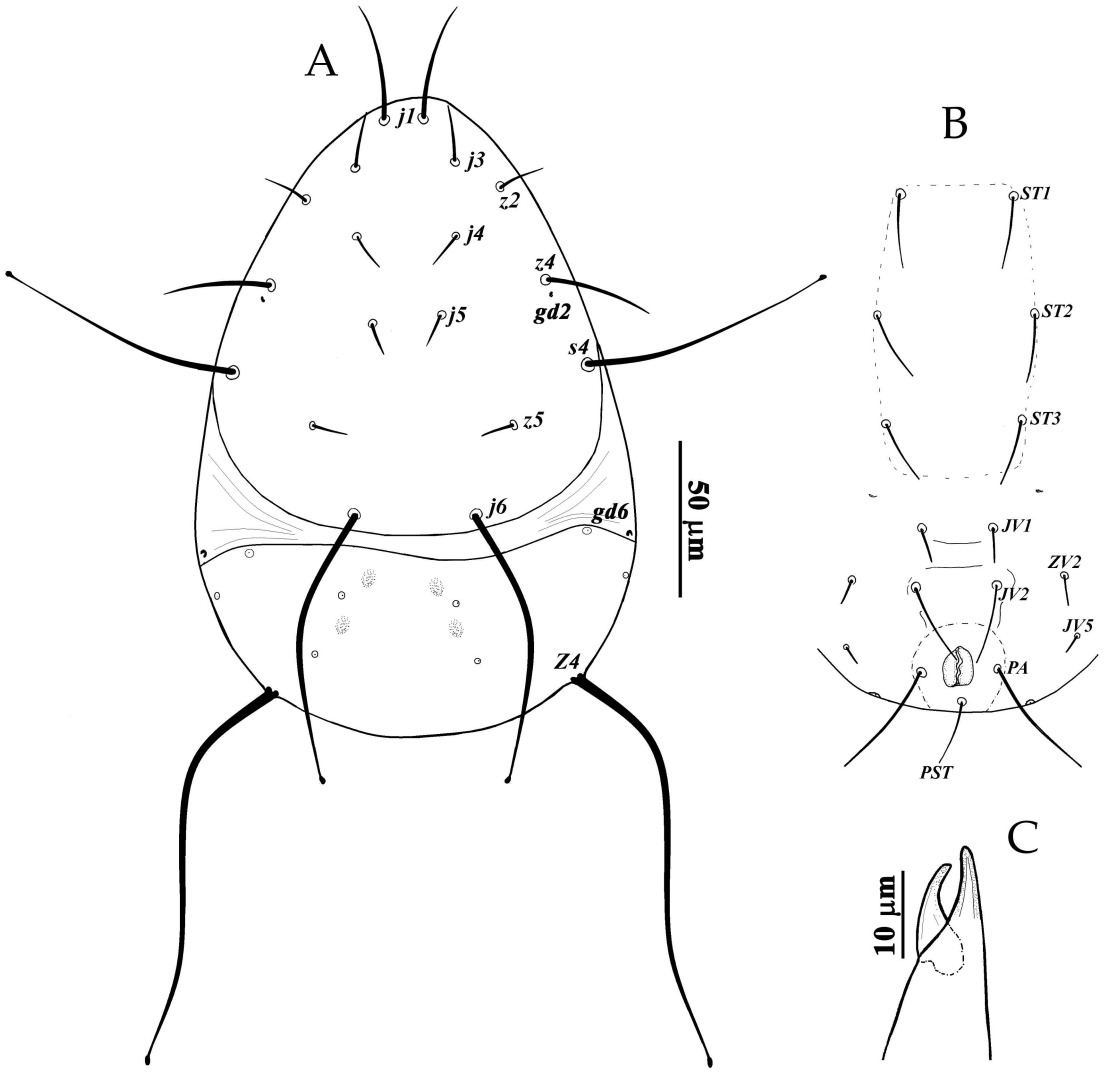

FIGURE 5: *T.* (*A.*) *bagdasarjani* (Larva): A – Dorsal view of idiosoma; B – Ventral view of idiosoma; C – Chelicera.

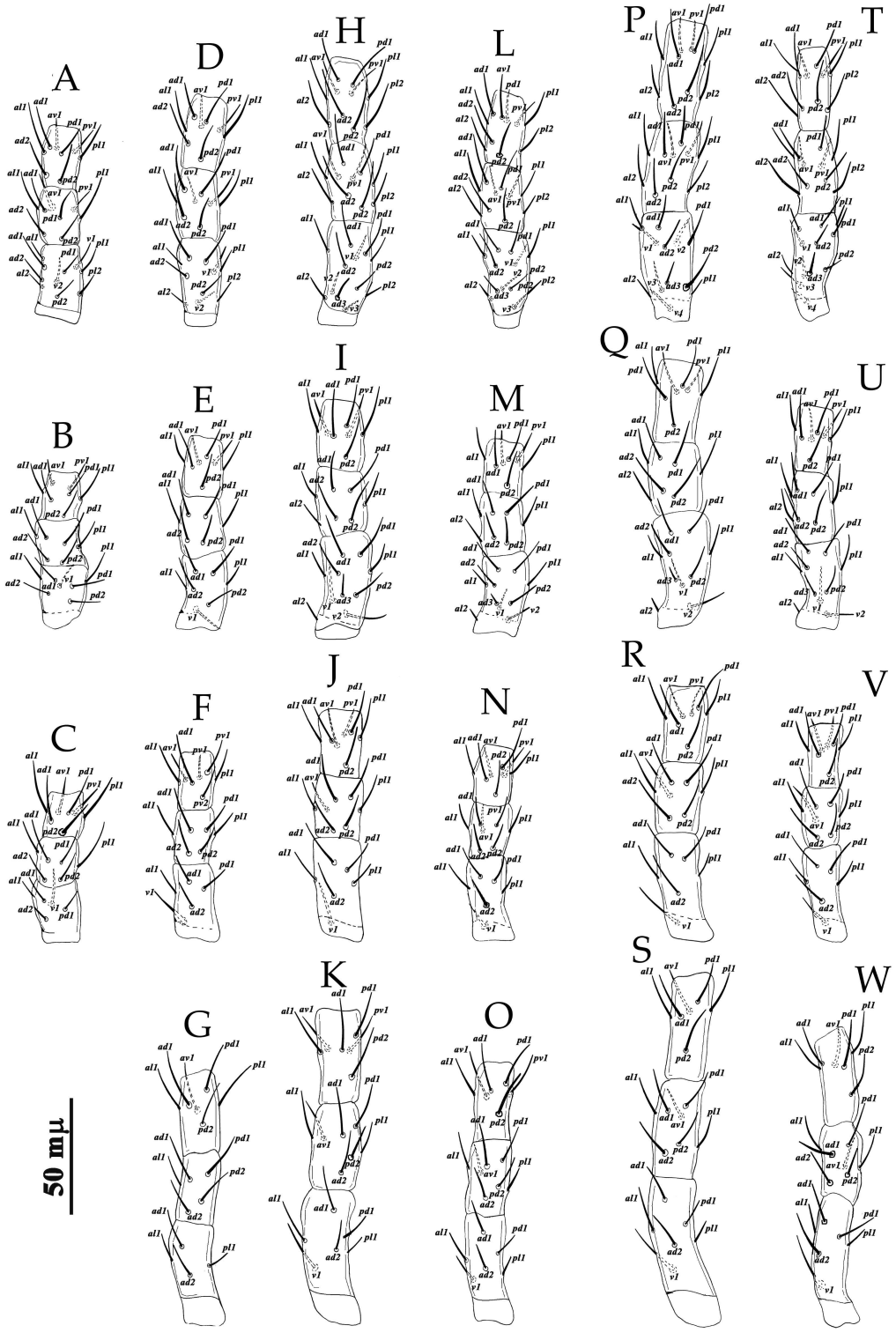

FIGURE 6: *T.* (*A.*) *bagdasarjani* femora, genua and tibiae: A-C – (Larva, legs I-III, respectively); D-G – (Protonymph, legs I-IV, respectively); H-K – (Deutonymph ♀; legs I-IV, respectively); L-O – (Deutonymph ♂; legs I-IV, respectively); P-S – (Adult female; legs I-IV, respectively); T-W – (Adult 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; opisthonotal 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 opisthonotal 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 (*iv1-iv2*). 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 opisthonotal 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*); opisthonotal 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 opisthonotal 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 opisthonotal 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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