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Ontogenetic redescription of *Bryobia rubrioculus* (Scheuten, 1857) (Acari: Tetranychidae) from Iran

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Abstract

Bryobia rubrioculus (Scheuten, 1857), is one of the most important pests of spider mites in Hamedan province, western Iran. This species found on aerial part of deciduous and coniferous trees. All mobile stages (larvae, protonymph, deutonymph and adult female) of *B. rubrioculus* were reared on sweet cherry leaf in germinator under controlled condition and redescription in the present study. Furthermore, a key to Iranian species of the genus *Bryobia* is presented.

Key words: Tetranychidae, brown mite, re-description, mobile stages, Iran.

INTRODUCTION

Bryobia Koch, 1836 is the largest genus in phytophagous subfamily Bryobiinae and contains several species of significant economic importance in many parts of the world (Hatzinikolis & Emmanouel, 1991). They have the largest body size in the family Tetranychidae and the adults are easily visible with the naked eyes. Up to now seven species of the genus have been recorded in Iran (Khanjani *et al.*, 2008; Beyzavi *et al.*, 2013; Mahdavi *et al.*, 2013), namely, *Bryobia praetiosa* Koch, 1836; *B. rubrioculus* Scheuten, 1857; *B. neopraetiosa* Meyer, 1974; *B. karooensis* Meyer, 1974; *B. chrysocomae* Meyer, 1974; *B. tuttlei* Smiley and Baker, 1995; *B. mirmoayedii* Khanjani *et al.*, 2008.

The brown apple mite (*Bryobia rubrioculus*) firstly was described by Scheuten (1857) from Germany, which described it as *Sannio rubrioculus*; then Van Eynhoven (1956) collected this species and placed it in the genus *Bryobia*. *B. rubrioculus* (Scheuten, 1857) is one of the major pests of fruit trees in western Iran, especially in Hamedan province. The highest population of the brown mite was observed on the sweet cherry in western Iran as a predominant pest mite (Khanjani & Haddad Irani-Nejad 2006; Honarparvar *et al.*, 2013). Because the economic importance of *B. rubrioculus* in Iran, and also the unavailability of an appropriate description of it, in the present paper female and immature stages of the species are re-described and all details of morphology such as measurements of setae and number of setae on legs segments in these stages are presented. Furthermore, a key to Iranian species of the genus *Bryobia* is presented.

MATERIAL AND METHODS

In late June 2016, the brown mite was collected from sweet cherry orchards (beating method) in Hamedan province, Heydareh village (34° 48' N; 48° 28' E) and reared for two generations in germinator under controlled condition: 25 ± 0.5 °C, 16:8 (L: D), and 60 ± 5 RH, in the lab of Bu Ali-Sina university, Hamedan Iran. In the laboratory the different stages of mite were collected from the leaf discs and directly mounted on permanent microscope slides in Hoyer's medium under a

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stereomicroscope, and then the slides were dried in an oven (50°C). All life stages of *Bryobia* specimens were examined under an Olympus BX51 phase contrast and Differential Interference Contrast microscope. All drawings were hand-made with a camera Lucida. The terminology and abbreviations in the morphological descriptions follow Lindquist (1985). All measurements are given in micrometers (μm). Type materials are deposited in the Collection of the Acarology Laboratory, University of Bu-Ali Sina (CALBS), Hamedan, Iran.

RESULTS

Family Tetranychidae Donnadieu, 1875

Subfamily Bryobiinae Berlese, 1913

Tribe Bryobiini Reck, 1952

Genus *Bryobia* Koch, 1836

Genus *Bryobia* is characterized as follows: body ovate to obovate; prodorsum with four pairs of setae (*vi*, *ve*, *sci* and *sce*) of which the anterior two pairs are placed on lobed projections; opisthosoma with three pairs of dorso-central setae (*c*₁, *d*₁, *e*₁), dorso central seta *f*₁ located in lateral position; two pairs of dorsosublateral setae (*c*₂, *d*₂); 7 pairs of dorsolateral setae (*c*₃, *d*₃, *e*₂, *e*₃, *f*₁, *f*₂, *h*₁); peritreme either simple or anastomosing distally. Coxal formula 2-1-1-1; genu I with 8 setae; all true claws, or those of tarsi II- IV, uncinatand provided with tenent hairs; empodium padlike. Intercoxal areas are distinct in having setae *3a* and *4a*; pregenital area with one pair of aggenital setae (*ag*); genital area with two pairs of setae (*g*₁- *g*₂) and three pairs of anal setae (*ps*₁-3) (Gonzalez, 1977; Hatzinikolis & Emmanouel, 1991).

Bryobia rubrioculus (Scheuten, 1857)

Female (Figs. 1-16; n= 5): Color in life greenish-brown. Length of body excluding gnathosoma 522-545 (from the tip of *v*₁ to the tip of *h*₁), including gnathosoma 620-670; width 338-370.

Dorsum (Figs. 1-2). Prodorsum with four pairs of setae, with developed anterior lobes (Figs. 1-2). Outer propodosomal lobes length 20-23 and width 22-26; inner lobes larger than outer lobes 29-35 and width 15-18, with cone-shaped projection (Fig. 2), incision between median lobes narrow and deep. Basal width of propodosomal lobes about 110-117. *v*₂ setae about 1.30 the size of *v*₁. Dorsal body setae spatulate, palmate, rough, serrate, inserted on tubercles, subequal in length, *v*₁ is the shortest. Striation transverse under propodosomal lobes, longitudinal between *sc*₁ and *c*₁, transverse between *c*₁ and *d*₁, Opisthosomal area with fine arched reticulation, length of dorsal setae: *v*₁ 16-17; *v*₂ 20-22; *sc*₁ 18-21; *sc*₂ 20-21; *c*₁ 19-20; *c*₂ 20-21; *c*₃ 18-20; *d*₁ 19-21; *d*₂ 20-21; *d*₃ 20-22; *e*₁ 19-20; *e*₂ 20-21; *e*₃ 20-21; *f*₁ 20-21; *f*₂ 20-21; *h*₁ 19-22. Distances between setae: *v*₁-*v*₁ 7-10; *v*₁-*v*₂ 30-35; *v*₁-*c*₁ 205-217; *v*₂-*v*₂ 75-80; *v*₂-*sc*₁ 100-109; *sc*₁-*sc*₁ 200-215; *sc*₁-*sc*₂ 47-56; *sc*₂-*sc*₂ 285-312; *c*₁-*c*₁ 72-78; *c*₁-*c*₂ 92-104; *c*₂-*c*₃ 32-43; *c*₂-*d*₂ 50-62; *c*₂-*c*₂ 275-294; *c*₃-*c*₃ 345-358; *c*₁-*d*₁ 55-73; *d*₁-*d*₂ 95-115; *d*₂-*d*₂ 270-289; *d*₂-*d*₃ 28-35; *d*₂-*e*₂ 95-114; *d*₃-*d*₃ 265-280; *c*₂-*d*₂ 50-62; *e*₁-*e*₁ 30-35; *e*₁-*e*₂ 100-115; *e*₂-*e*₂ 235-248; *e*₂-*e*₃ 26-31; *e*₂-*f*₂ 120-135; *e*₃-*e*₃ 220-238; *e*₁-*f*₁ 132-143; *f*₁-*f*₁ 142-154; *f*₁-*f*₂ 18-23; *f*₁-*h*₁ 57-64; *h*₁-*h*₁ 37-45.

Gnathosoma (Figs 3-5). Gnathosoma 115-125 long (from base of infracapitulum to tip of palp) and 118-125 wide. Stylophore rounded, cleft mediobasally, length equal with width (Fig. 4). Subcapitulum with two pairs of adoral setae (*or*₁- *or*₂) and one capitular seta *m* 33-37 (Fig. 3); Palp 80-85 (from trochanter to tip of tarsus), six segmented, palp tarsus with three simple setae, one solenidion and three eupathidia; palp tibia with three setae and one claw; palp genu with one seta; palp femur with one robust seta; trochanter without setae; coxa with one spiniform seta (Fig. 5). Peritreme anastomosed distally in stretched oval shape: length 23-26, width 10-11 (Fig. 6).

Venter (Figs. 7-8). Striation transverse between *1a* and *3a*, cuticle between *3a* and *4a* without striation, anogenital area striation V-shaped (Fig. 7). Anogenital area with one pair of aggenital setae, two pairs of genital setae (*g*₁₋₂), three pairs of pseudanal setae (*ps*₁₋₃) and two pairs of ventrocaudal (*h*₂₋₃) setae. Length of ventral setae: *1a* 42-47; *1b* 41-46; *1c* 17-20; *2b* 25-27; *3a* 42-45; *3c* 31-36; *4a* 35-41; *4c* 33-35; *ag* 39-45; *g*₁ 40-44; *g*₂ 39-42; *Ps*₁ 35-37; *Ps*₂ 36-39; *Ps*₃ 38-41; *h*₂ 28-32; *h*₃ 34-37 (Figs. 8).

Legs (Figs. 9–16). Leg I 638–658 long (measured from coxa to tarsus) subequal with body length, leg II 358–380, leg III 349–365, leg IV 445–462 (Figs. 9–13). Length of segments of leg I as follows: femur 175–183, genu 75–82, tibia 123–138, tarsus 118–129 (Figs. 9–10). Setal formulae of legs I–IV segments as follows: coxae 2+elcp-1-1-1; trochanters 1-1-1-1; femora 17-8-5-4; genua 8-5-5-5; tibiae 14 +1φρ-10-9-9; tarsi 18+6 ω+2 duplexes-14+3 ω+1 duplex (Fig 15)-13+1 duplex (Fig 16) -14+1 ω. Claws on tarsi I–IV uncinata, with one pair of tenent hairs, empodium on tarsus I with one pair and empodia II–IV with several tenent hairs (Fig. 14). In tarsus III, associated setae serrated (19–21), and with a solenidion forming duplex, the solenidion member longer (26–27) and proximal (Fig. 16), tarsus IV with solenidion well separated from tactile.

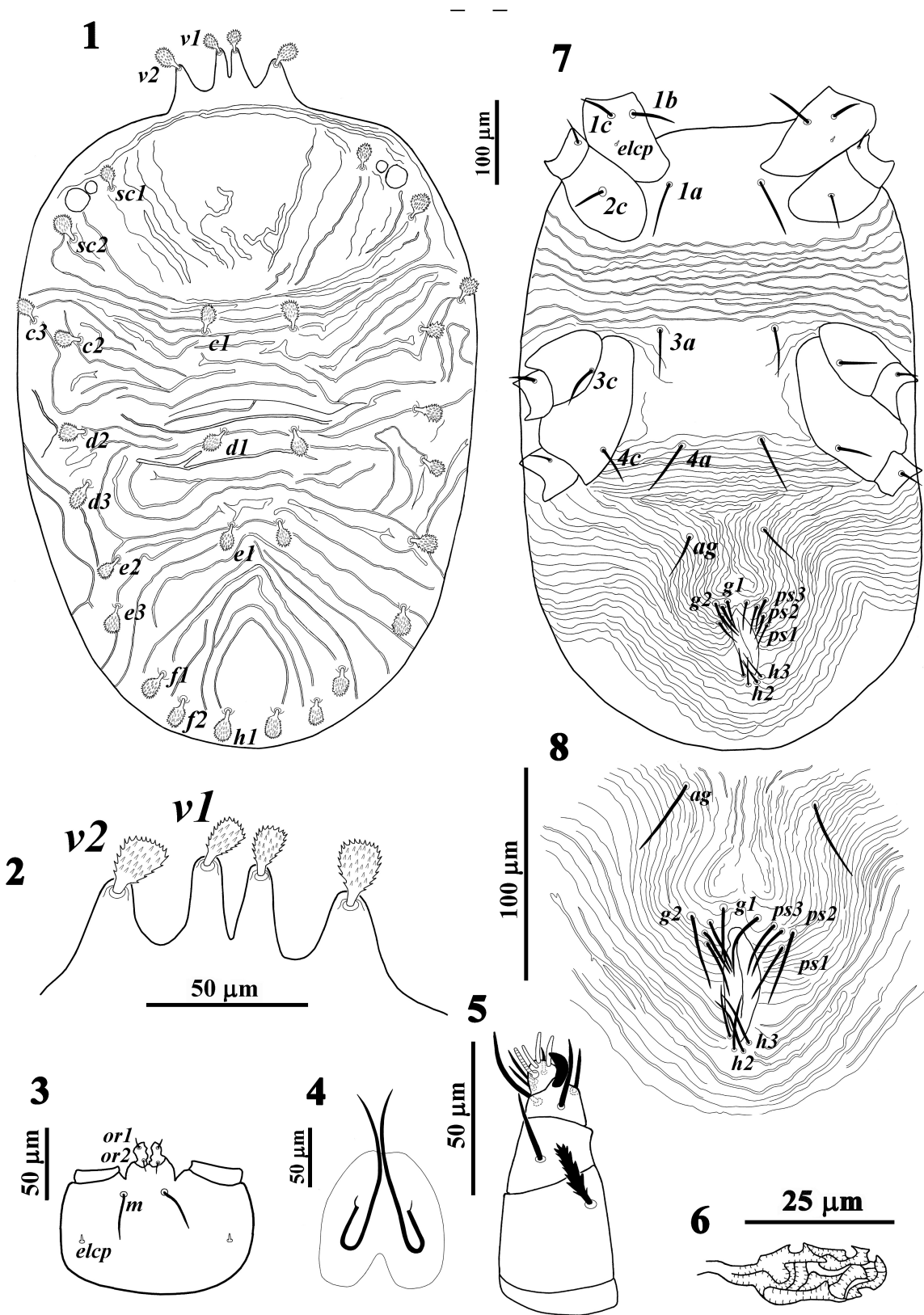
Deutonymph (Figs. 17–23; n= 5): Color in life dark brown. Length of body excluding gnathosoma 393–428, including gnathosoma 488–527; width 338–360.

Dorsum (Figs. 17–18). Prodorsal lobes similar in shape to females, outer propodosomal lobes length 13–16 and width 17–18; inner lobes larger than outer lobes 19–21 and width 13–14, with cone-shaped projection (Fig. 18), basal width of propodosomal lobes about 80–85. Dorsal body setae like to female. Lengths of dorsal setae: v_1 13–16; v_2 20–22; sc_1 17–18; sc_2 19–21; c_1 19–20; c_2 18–22; c_3 19–20; d_1 18–20; d_2 19–20; d_3 20–21; e_1 19–20; e_2 20–21; e_3 19–21; f_1 19–21; f_2 19–22; h_1 17–19. Distances between setae: v_1-v_1 9–13; v_1-v_2 17–22; v_1-c_1 171–179; v_2-v_2 51–55; v_2-sc_1 77–84; sc_1-sc_1 152–160; sc_1-sc_2 40–44; sc_2-sc_2 200–217; c_1-c_1 60–64; c_1-c_2 71–80; c_2-c_3 31–40; c_2-d_2 40–47; c_2-c_2 210–220; c_3-c_3 275–290; c_1-d_1 45–51; d_1-d_2 83–89; d_2-d_2 208–214; d_2-d_3 25–29; d_2-e_2 79–87; d_3-d_3 211–222; c_2-d_2 39–46; e_1-e_1 24–29; e_1-e_2 78–85; e_2-e_2 190–198; e_2-e_3 20–28; e_2-f_2 88–95; e_3-e_3 180–200; e_1-f_1 100–108; f_1-f_1 118–125; f_1-f_2 15–18; f_1-h_1 44–53; h_1-h_1 32–39.

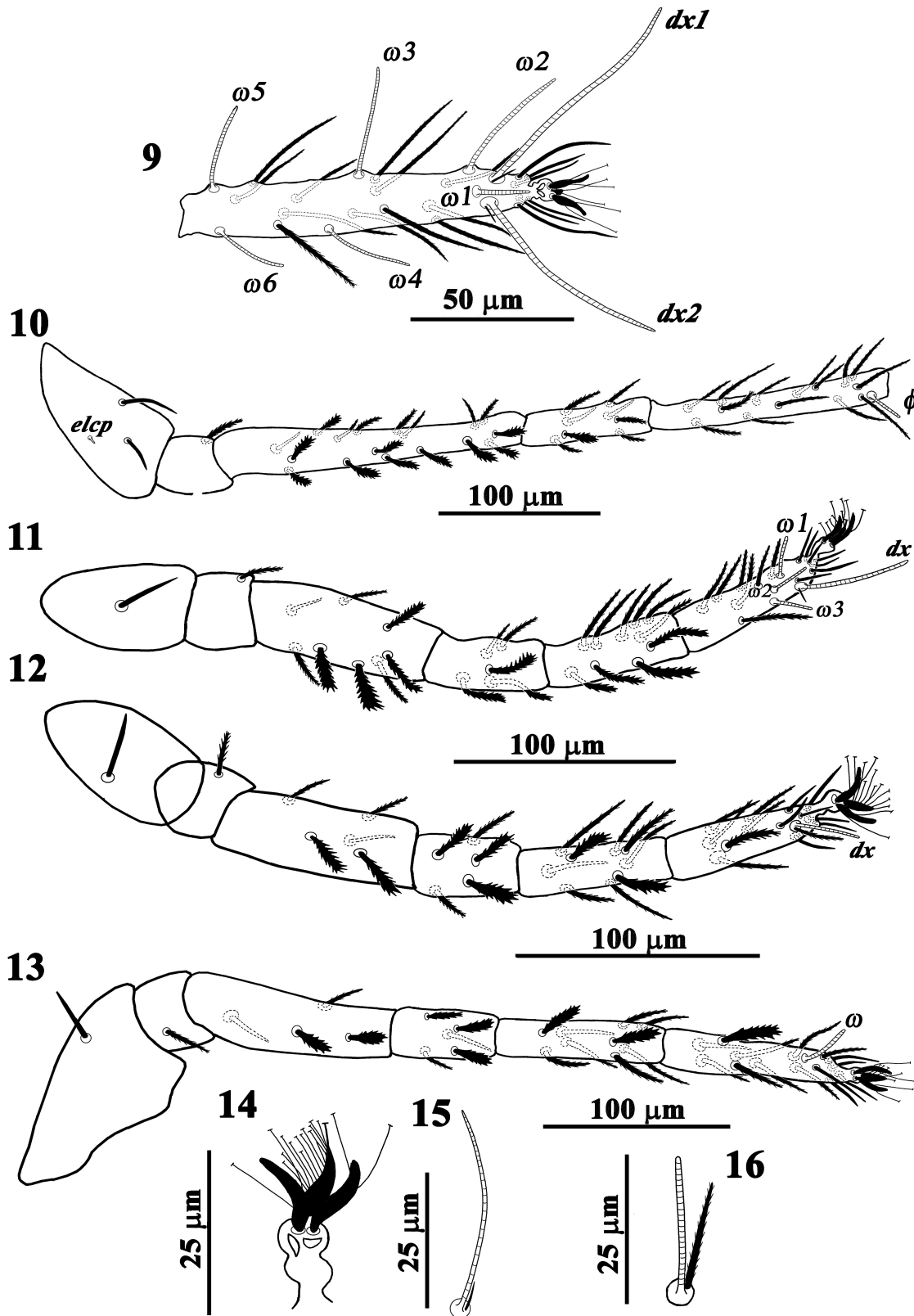
Gnathosoma. Gnathosoma 95–100 long (from base of infracapitulum to tip of palp) and 93–97 wide. Stylophore rounded, cleft mediobasally, length equal with width. Subcapitulum with two pairs of adoral setae (or_1 – or_2) and one capitular seta m 22–26; Palp 67–70 (from trochanter to tip of tarsus), six segmented, and its chaetotaxy same with female. Peritreme anastomosed distally in an oval enlargement: 20–22 length, 8–9 width.

Venter. Anogenital area (Fig. 19) with one pair of aggenital setae, one pair of genital setae (g_1), three pairs of pseudanal setae (ps_{1-3}) and two pairs of ventrocaudal (h_{2-3}) setae. Length of ventral setae: $1a$ 28–30; $1b$ 32–35; $1c$ 15–17; $2b$ 16–18; $3a$ 27–28; $3c$ 20–22; $4a$ 19–22; $4c$ 16–17; ag 18–20; g_1 15–17; Ps_1 14–17; Ps_2 13–15; Ps_3 16–18; h_2 16–18; h_3 19–20.

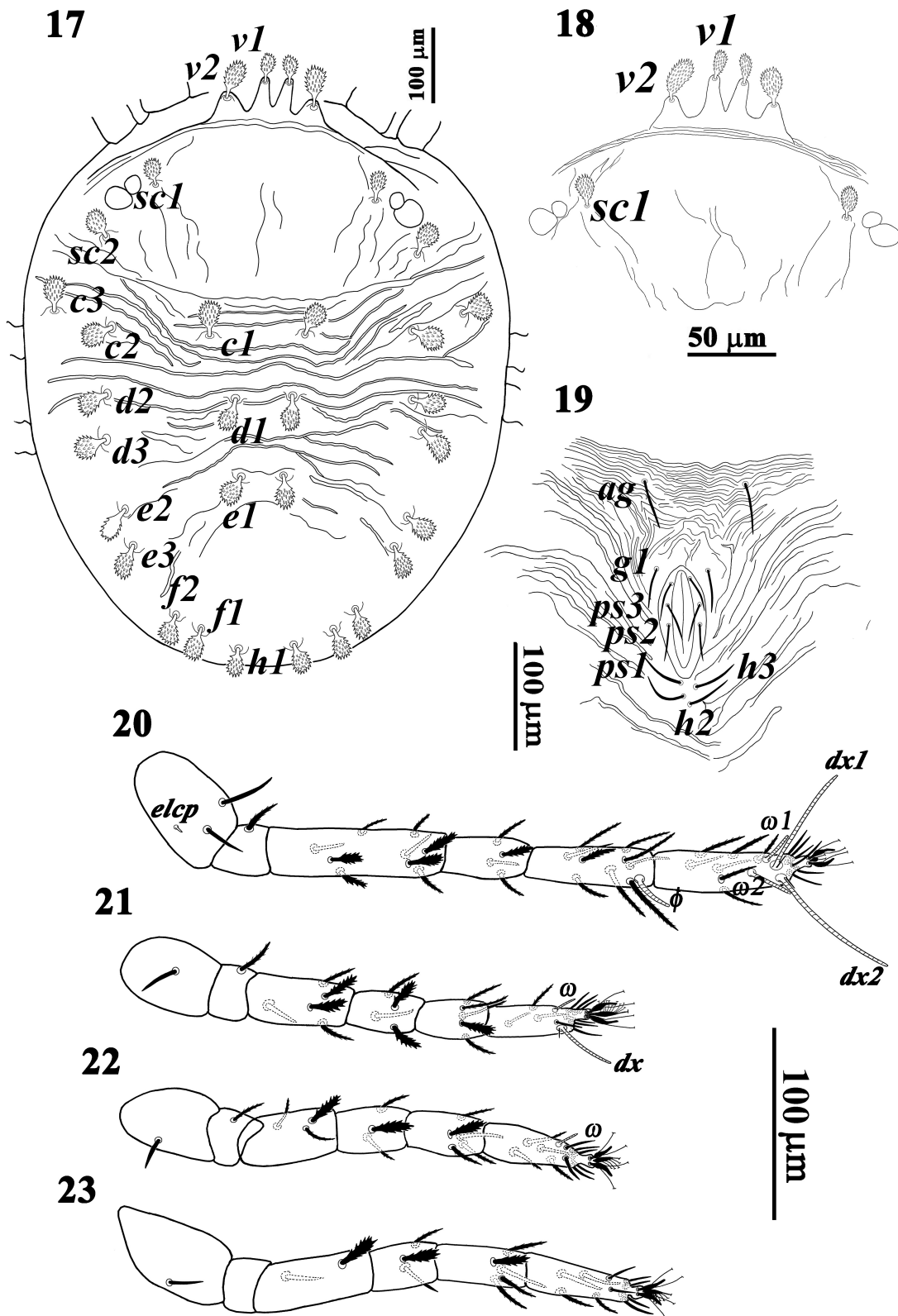
Legs (Figs. 20–23). Length of legs I–IV respectively (measured from coxa to tarsus), 353–370; 230–240; 245–253; 275–284. Length of segments of leg I as follows: femur 98–102; genu 44–49; tibia 63–67; tarsus 76–82. Setal formulae of legs segments as follows: coxae 2+elcp-1-1-1; trochanters 1-1-1-0; femora 9 [8]-5-3-2; genua 4-4-3-3; tibiae 9 +1φρ-5-5-5; tarsi 13+2ω+2 duplexes-10+1ω+1 duplex-10+1ω-10.



FIGURES 1-8. *Bryobia rubrioculus* (Scheuten 1857) (female): 1. Dorsal view; 2. Propodosomal lobes; 3. Gnathosoma; 4. Stylophore; 5. Palp; 6. Peritrem; 7. Ventral view; 8. Anogenital area.



FIGURES 9-16. *Bryobia rubrioculus* (Scheuten 1857) (female): 9. Tarsus I; 10. Leg I; 11. Leg II; 12. Leg III; 13. Leg IV; 14. Claws and empodia II-IV; 15. Duplex setae II; 16. Duplex setae III.



FIGURES 17-23. *Bryobia rubrioculus* (Scheuten 1857) (deutonymph): 17. Dorsal view; 18. Propodosomal lobes; 19. Anogenital area; 20. Leg I; 21. Leg II; 22. Leg III; 23. Leg IV.

Protonymph (Figs. 24-30; n= 5): In life, color can change from olive green to dark brown. Length of body excluding gnathosoma 325–345, including gnathosoma 410–423; width 290–300.

Dorsum (Figs. 24-25). Prodorsum with four pairs of setae, with weakly developed anterior lobes, outer propodosomal lobes length 6–8 and width 13–14; inner lobes larger than outer lobes 8–11 and width 8–9, basal width of propodosomal lobes about 70–72 (Fig. 25). First propodosomal setae about half the length of the second one, all setae inserted on small tubercles. Lengths of dorsal setae: v_1 9–10; v_2 19–21; sc_1 15–16; sc_2 17–18; c_1 18–20; c_2 17–18; c_3 16–18; d_1 17–18; d_2 17–19; d_3 18–19; e_1 17–19; e_2 18–19; e_3 18–19; f_1 16–17; f_2 17–18; h_1 17–18. Distances between setae: v_1-v_1 11–12; v_1-v_2 16–19; v_1-c_1 137–149; v_2-v_2 42–47; v_2-sc_1 59–67; sc_1-sc_1 132–142; sc_1-sc_2 36–42; sc_2-sc_2 194–200; c_1-c_1 51–55; c_1-c_2 66–71; c_2-c_3 33–38; c_2-d_2 33–40; c_2-c_2 188–200; c_3-c_3 263–275; c_1-d_1 46–53; d_1-d_2 33–37; d_1-d_2 68–72; d_2-d_2 185–197; d_2-d_3 19–21; d_2-e_2 64–70; d_3-d_3 187–196; c_2-d_2 36–40; e_1-e_1 18–20; e_1-e_2 69–71; e_2-e_2 162–169; e_2-e_3 18–21; e_2-f_2 80–85; e_3-e_3 152–157; e_1-f_1 77–81; f_1-f_1 100–105; f_1-f_2 10–15; f_1-h_1 38–42; h_1-h_1 21–23.

Gnathosoma- Gnathosoma 73–85 long (from base of infracapitulum to tip of palp) and 75–80 wide. Subcapitulum with two pairs of adoral setae (or_1 – or_2) and one capitular seta m 16–18; Palp 60–65 (from trochanter to tip of tarsus) and chaetotaxy same with female. Peritreme 14–15 length and 6–7 width.

Venter. Anogenital area (Fig. 26) with one pair of aggenital setae, three pairs of pseudanal setae (ps_{1-3}) and two pairs of ventrocaudal (h_{2-3}) setae. Length of ventral setae: $1a$ 23–25; $1b$ 28–30; $1c$ 14–15; $2b$ 12–14; $3a$ 22–25; $3c$ 14–15; ag 13–16; Ps_1 9–10; Ps_2 10–12; Ps_3 11–12; h_2 10–11; h_3 11–12.

Legs (Figs. 27-30). Length of legs I–IV respectively (measured from coxa to tarsus): 283–292; 194–204; 205–210; 216–230. Length of segments of leg I as follows: femur 69–73; genu 36–38; tibia 44–46; tarsus 63–66. Setal formulae of legs segments as follows: coxae 2+elcp-1-1-0; trochanters 0-0-0-0; femora 3-3-2-2; genua 4-4-2-2; tibiae 5 +1 ϕ p-5-5-5; tarsi 9+1 ω +2 duplexes-8+1 ω +1 duplex-8-6.

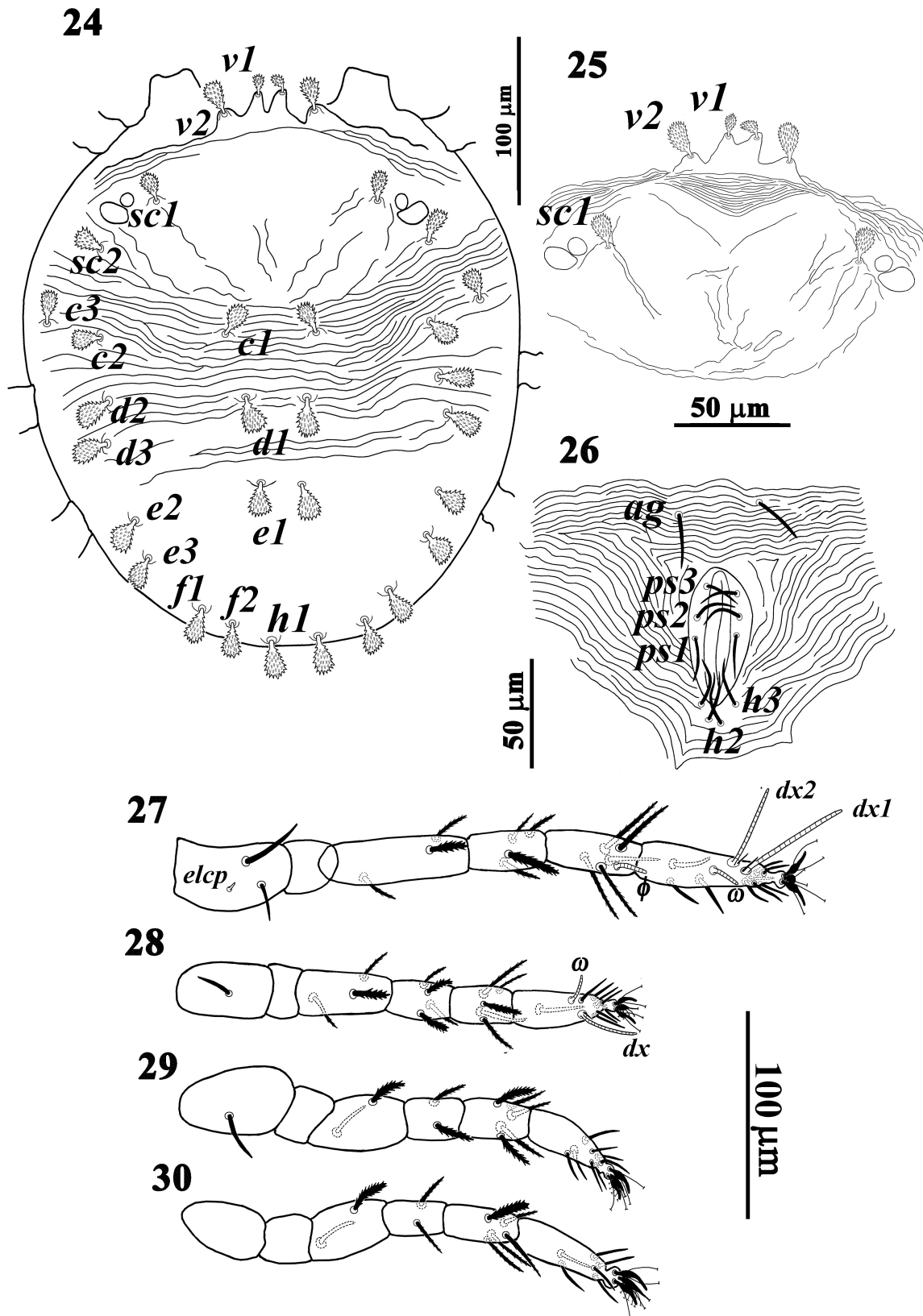
Larva (31-36; n= 5): Larva is rounded, almost disk like, and orange green colored. Length of body excluding gnathosoma 258–265, including gnathosoma 333–343; width 238–248.

Dorsum (Figs. 31-32). Prodorsum without lob, with four pairs of setae, (Fig. 32). Lengths of dorsal setae: v_1 9–10; v_2 16–18; sc_1 17–19; sc_2 17–19; c_1 17–19; c_2 17–19; c_3 14–16; d_1 18–19; d_2 19–20; d_3 18–20; e_1 20–22; e_2 19–20; e_3 19–20; f_1 20–21; f_2 20–22; h_1 20–22. Distances between setae: v_1-v_1 8–12; v_1-v_2 11–14; v_1-c_1 78–91; v_2-v_2 39–43; v_2-sc_1 32–41; sc_1-sc_1 101–110; sc_1-sc_2 32–41; sc_2-sc_2 155–161; c_1-c_1 48–53; c_1-c_2 48–57; c_2-c_3 33–43; c_2-d_2 20–29; c_2-c_2 155–160; c_3-c_3 230–239; c_1-d_1 37–45; d_1-d_2 28–30; d_1-d_2 62–66; d_2-d_2 163–168; d_2-d_3 15–19; d_2-e_2 52–60; d_3-d_3 168–175; c_2-d_2 22–28; e_1-e_1 15–19; e_1-e_2 56–63; e_2-e_2 142–158; e_2-e_3 11–17; e_2-f_2 55–65; e_3-e_3 133–139; e_1-f_1 48–53; f_1-f_1 68–72; f_1-f_2 6–10; f_1-h_1 22–28; h_1-h_1 11–16.

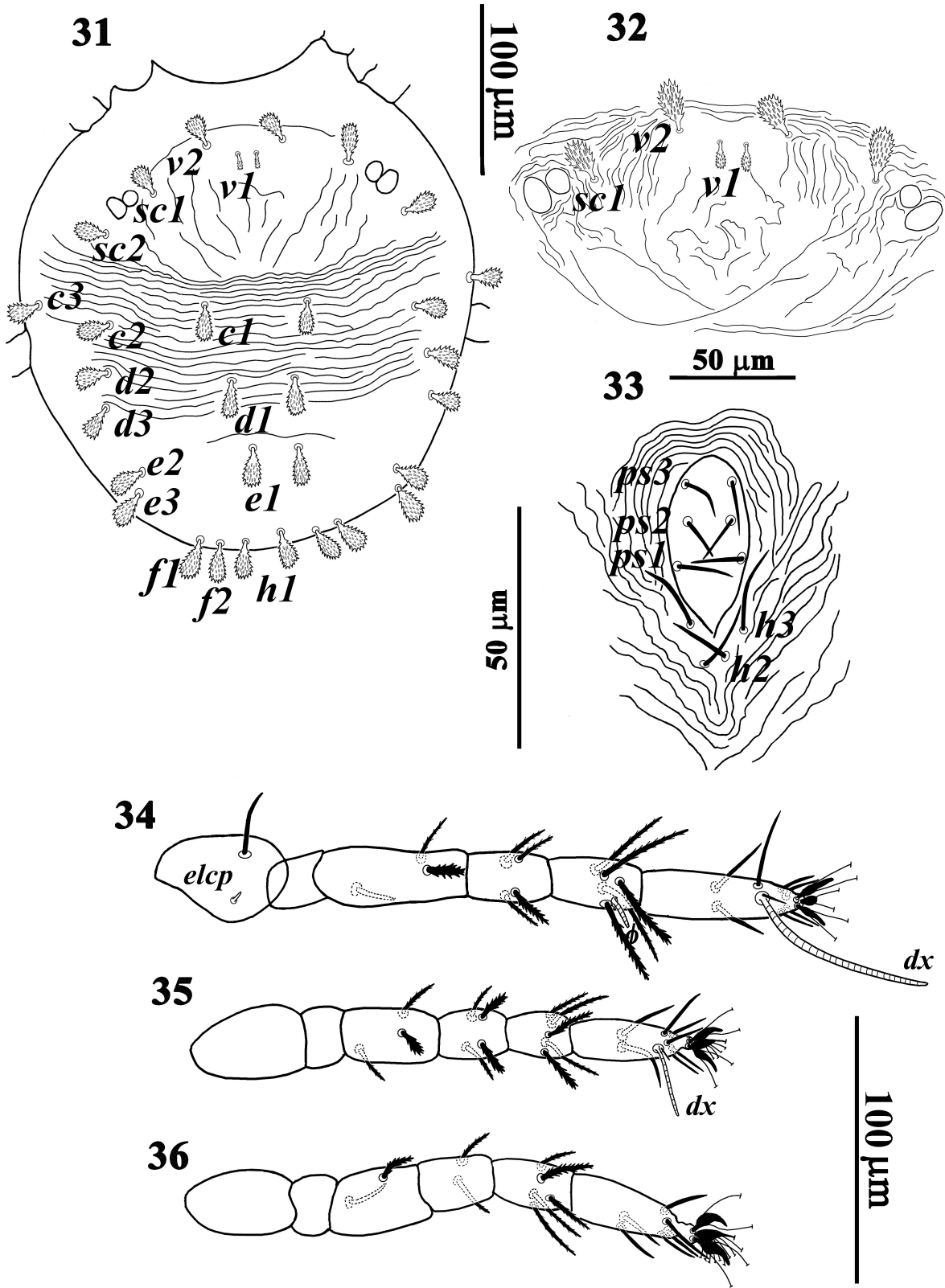
Gnathosoma- Gnathosoma 70–78 long (from base of infracapitulum to tip of palp) and 70–74 wide. Subcapitulum with two pairs of adoral setae (or_1 – or_2) and without capitular seta; Palp 52–55 long, number of palp segment and setae are same with adult female. Peritreme 9–11 length and 5–6 width.

Venter. Anogenital area (Fig. 33) with three pairs of pseudanal setae (ps_{1-3}) and two pairs of ventrocaudal (h_{2-3}) setae. Length of ventral setae: $1a$ 20–22; $1b$ 24–25; $3a$ 20–21; Ps_1 9–10; Ps_2 9–10; Ps_3 8–9; h_2 10–13; h_3 12–14.

Legs (Figs. 34-36). Length of legs I–III: 231–245; 175–184; 181–190. Length of segments of leg I as follows: femur 55–58; genu 29–32; tibia 35–36; tarsus 57–60. Setal formulae of leg segments as follows: coxae 1+elcp-0-0; trochanters 0-0-0-0; femora 3-3-2-2; genua 4-4-2-2; tibiae 5 +1 ϕ p-5-5-5; tarsi 7+1 duplexes-7+ 1 duplex-6.



FIGURES 24-30. *Bryobia rubrioculus* (Scheuten 1857) (protonymph): 24. Dorsal view; 25. propodosomal lobes; 26. Anogenital area; 27. Leg I; 28. Leg II; 29. Leg III; 30. Leg IV.



FIGURES 31-36. *Bryobia rubrioculus* (Scheuten 1857) (larva): 31. Dorsal view; 32. propodosomal view; 33. Anogenital area; 34. Leg I; 35. Leg II; 36. Leg III.

DISCUSSION

Bryobia rubrioculus (Scheuten, 1857) is one of the most important pests on fruit trees in Iran, especially in Hamedan province. Forasmuch as the original description of the species (Scheuten, 1857) is old and unavailable, also prior re-descriptions don't provide complete information about it, so we decided to re-describe the mobile stages of this species in detailed. This re-description resemble the re-description by Meyer (1987) from South Africa in having most same characters but it differs by: (Female): measurements of dorsal setae 16–22; peritrem length 23–26 and 10–11 width; femur I with 17 setae in Iranian specimens opposed to dorsal setae 25–27; peritrem length 19 and 9 width; femur I with 16–18 setae in South Africa specimens.

Key to species of the Iranin *Bryobia* (♀):

1. Prodorsal lobes poorly developed2
– Prodorsal lobes well developed3
2. Empodium I with a pair of tenent hairs and femur I of female with 8 setae.....
.....***B. tuttlei* Smiley & Baker, 1995**
– Empodium I with four pair of tenent hairs and femur I of female with 10-11 setae.....
.....***B. karoensis* Meyer, 1974**
3. Tarsi III and IV each with pair of duplex setae.....4
– Tarsus III with a pair of duplex setae; solenidion on tarsus IV well separated from tactile setae5
4. Dorsal body setae of female 33 µm long; dorsal body setae of larva 21-28; prodorsum with outer lobes triangular; femur I with 18-22 setae.....***B. praetiosa* Koch, 1836**
– Dorsal body setae of female 25-30 µm long; dorsal body setae of larva 14-18; prodorsum with outer lobes teat-like; femur I with 21-25 setae.....***B. neopraetiosa* Meyer, 1974**
5. Empodium I with a pair of tenent hair 6
– Empodium I with ten pair of tenent hair.....***B. mirmoayedii* Khanjani et al. 2008**
6. Femur I with 12-13 setae; end of peritrem branches..... ***B. chrysocomae* Meyer, 1974**
– Femur I with 17 setae; end of peritrem sausage-like structure..... ***B. rubrioculus* Scheuten, 1857**

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