



## Three new species of *Kerria* (Hemiptera: Coccoidea: Tachardiidae) from India

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### Abstract

Three new species of *Kerria* Targioni-Tozzetti from India, namely *Kerria pennyae* Ahmad & Ramamurthy **sp. nov.** on *Schleichera oleosa* from Orissa, *Kerria dubeyi* Ahmad & Ramamurthy **sp. nov.** on *Ficus bengalensis* from Bangalore and *Kerria varshmei* Ahmad & Ramamurthy **sp. nov.** on *Ziziphus mauritiana* from Punjab are described and illustrated, and a key is provided to species of *Kerria* known from India.

**Key words:** *Kerria*, new species, lac insects, key, India

### Introduction

Lac insects are morphologically distinctive scale insects (Hemiptera: Coccoidea) belonging to the family Tachardiidae, secreting a resinous secretion that forms a test over the body (Chamberlin, 1923; Varshney, 1976). This family includes nine genera and 96 species with 24 species representing 4.7% of the total Coccoidea in India (Ben-Dov *et al.*, 2013). Some members of this family are commercially exploited for their resin, wax and dyes (Varshney, 1976; Ramani *et al.*, 2007). Ahmad *et al.* (2013) recently described three new species from India and also gave a key to all the species known from India and adjoining countries.

In this paper, three further new species of *Kerria* are described and illustrated with line diagrams and scanning electron microscopic images. The species are compared to their congeners based on the morphology of the adult female, with an updated key to the species of *Kerria* from India.

### Material and methods

The specimens used in this study are from the lac insect cultures maintained at the field gene bank of Indian Institute of Natural Resins and Gums (IINRG), Ranchi (2319'51"N, 8522'18"E; Elevation ~2080ft). The samples had been drawn from the cultures maintained as lines on *Flemingia macrophylla* grown under potted conditions. Adult female specimens, collected and preserved in ethyl alcohol, were prepared as permanent mounts following the method of Varshney (1976) except that a new polychromatic stain, prepared with phosphomolybdic acid, orange G, aniline blue (WS) with acid fuchsin in distilled water, was used. This enabled differential staining of the cuticular features. The preserved specimens were treated in 10% KOH, rinsed in 5–8 changes of distilled water, and the internal contents cleaned through a small lateral incision in the integument in 1% glacial acetic acid. Cleared specimens were stained in polychromatic stain, and then passed through increasingly strong solutions of ethyl alcohol to dehydrate them. Once dehydrated, they passed through several grades of xylene, before mounting in DPX and then dried on a hot plate at 45–60°C for 48 hr. Each illustration is a generalization of several specimens, and drawings of the whole mounts were prepared using a drawing tube attached to either a Leica DM

500 compound microscope or a Leica MZ16A stereozoom microscope; images of cleared mature females were made using a Leica M205FA fitted with Leica DFC425C digital camera. In addition, in order to study the characteristic features of the adult females, scanning electron microscope (SEM) studies were undertaken with a Zeiss EVOMA10 scanning electron microscope at 20 KV and 10 Pa between 258x–2.99 Kx after 24 nm palladium coating.

The format of the description and the terms used are those of Chamberlin (1923), Kondo & Gullan (2007) and Ahmad *et al.* (2013). Descriptions of adult females are based on slide-mounted specimens. Body width (as the greatest width) given in measurements is as follows: at apex (at clypeolabral shield) and at base (near the anal tubercle). All the measurements are given as a range in microns. For each lot of material, the collection data and the number of slides with the total number of specimens are shown as follows: three adult females on one slide as “1(3 ad♀♀)”, and the depository in parentheses. Voucher specimens are deposited in the Australian National Insect Collection, CSIRO, Canberra, Australia (ANIC); Bohart Museum of Entomology, Department of Entomology, University of California, Davis, California, USA (BME); and National Pusa Collection, Division of Entomology, Indian Agricultural Research Institute, New Delhi (NPC). The abbreviation for the National Agricultural Innovation Project is NAIP.



**FIGURES 1–3.** Cleaned adult females after removal of tests. 1, *K. pennyae* Ahmad & Ramamurthy, **sp. nov.**; 2, *K. dubeyi* Ahmad & Ramamurthy, **sp. nov.**; and 3, *K. varshneyi* Ahmad & Ramamurthy, **sp. nov.**

## Description of new species

### *Kerria pennyae* Ahmad & Ramamurthy **sp. nov.**

**Material studied:** **Holotype** ♀: **India: Sundargarh, Orissa**, 09.xi.2010, *Schleichera oleosa* (Sapindaceae), 1 slide (1 ad♀), coll. NAIP (Line no. LIK0003) (NPC). **Paratype** ♀♀: Data as for holotype, 2 slides (6 ad♀♀), coll. NAIP (Line no. LIK0003) (NPC); 1 slide (3 ad♀♀) (ANIC); 1 slide (2 ad♀♀) (BME).

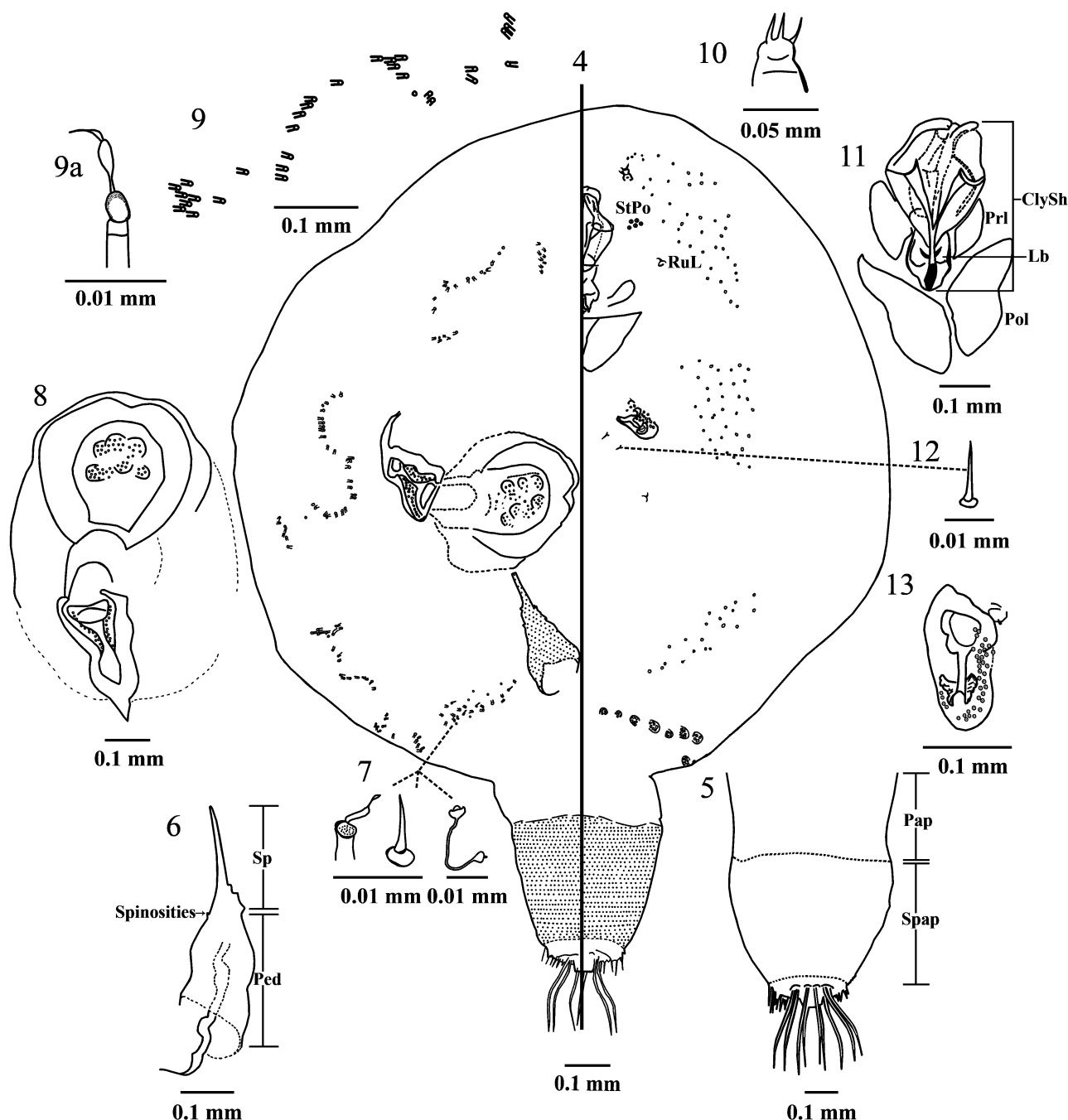
### **Adult female (Figs 1, 4–21)**

**Unmounted material.** Lac test yellow to light brown. Tests occur in aggregations; live mature females globular and yellow. Cleaned female after removal of test shown in Figure 1.

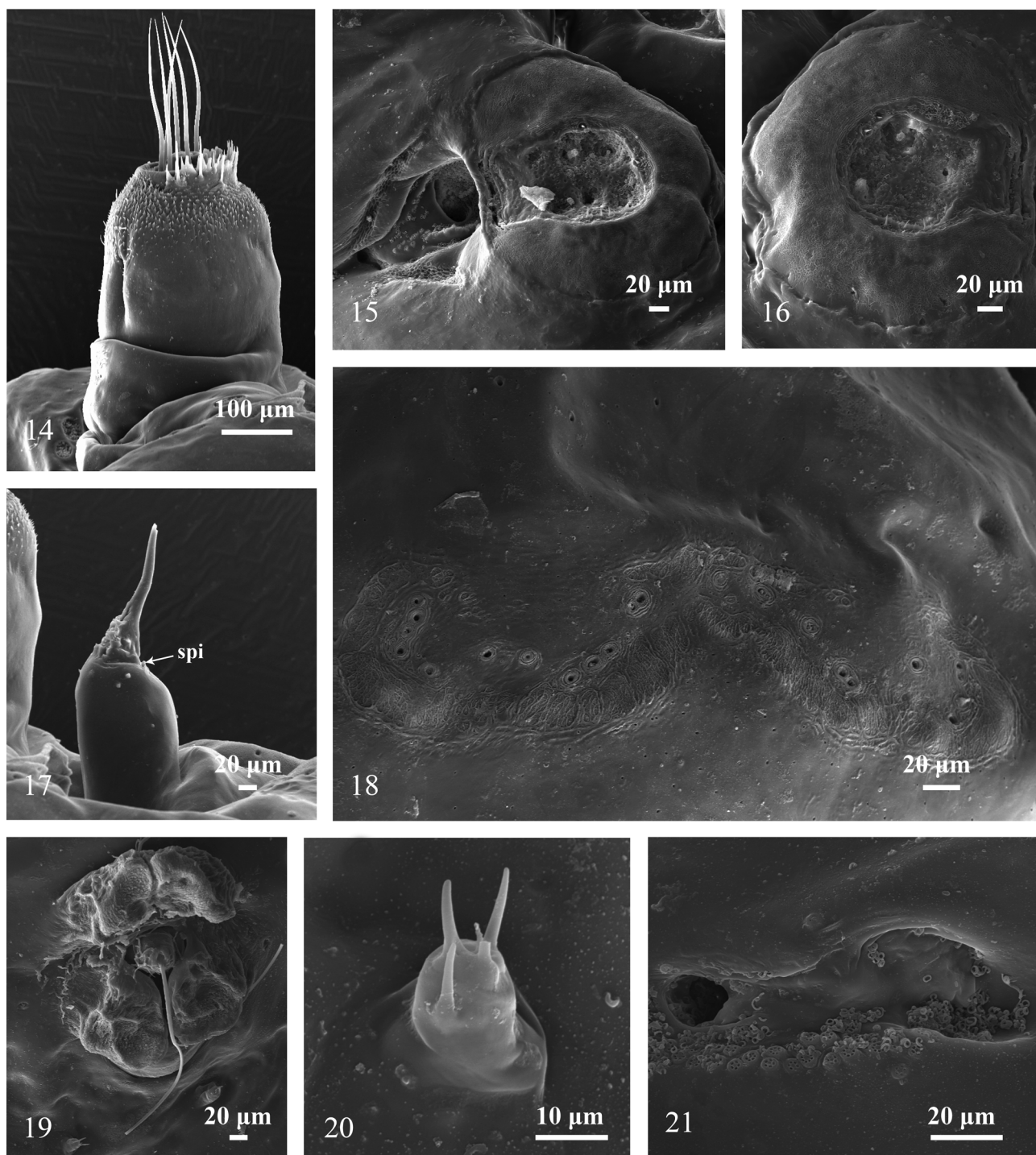
**Mounted material.** Body globular, 1.56–2.06 mm long, 1.01–1.81 mm wide at apex, 1.51–2.14 mm wide at middle and 0.97–1.52 mm wide at base (n=10).

**Dorsum:** Brachia sessile, club-shaped and slightly sclerotized, 280–450 µm long. Brachial plate circular, 275–310 µm wide; brachial crater shallow, central, sub-circular, 155–190 µm wide, with a defined rim, dimples small, obscure, 5 or 6 in number. Anterior spiracle apodeme 225–325 µm long, peritreme 135–180 µm wide; spiracle 65–165 µm away from brachial crater. Ratio of distance of anterior spiracles from crater rim to width of brachial plate 1:1.88. Ratio of length of anterior spiracle to width of brachial plate 1:0.95. Dorsal spine well developed 295–460 µm long and 110–135 µm wide at base; pedicel large, slender, more sclerotized, 150–275 µm long; spine 135–185

$\mu\text{m}$  long and slightly sclerotized, with 2 or 3 spinosities at its base. Ratio of length of pedicel to length of spine 1:0.67. Ratio of total length of dorsal spine to width of brachial plate 1:0.68. Anal tubercle elongated, well developed; pre-anal plate membranous, 300–480  $\mu\text{m}$  long, 350–470  $\mu\text{m}$  wide; supra-anal plate heavily sclerotized, smooth near apex, 320–420  $\mu\text{m}$  long, 320–370  $\mu\text{m}$  wide, ratio of length of supra-anal plate to width of plate 1:0.88. Ratio of length of supra-anal plate to length of brachia 1:1.07. Anal fringe plates short, fringe maximum length 50–80  $\mu\text{m}$ . Anal ring 6 sectored with 10 setae. Dorsal duct clusters present as a row of ducts on both sides between dorsal spine and base of anal tubercle, each cluster with 10–12 tubular ducts plus some dorsal setae and a few spermatoid ducts.



**FIGURES 4–13.** *Kerria pennyae* Ahmad & Ramamurthy, **sp. nov.** 4, whole mount, StPo- Star pores, RuL- rudimentary leg. 5, anal tubercle, Pap- Pre-anal plate, Spap- Supra-anal plate. 6, dorsal spine, Ped- Pedicel, Sp- Spine. 7, dorsal duct cluster with a single tubular duct, dorsal seta and spermatoid duct. 8, brachia with anterior spiracle. 9, marginal duct cluster. 9a, single duct magnified. 10, antenna. 11, Mouthparts, ClySh- Clypeolabral shield, Lb- Labium, Prl- Pre oral lobe, Pol- Post oral lobe. 12, ventral seta. 13, posterior spiracle.



**FIGURES 14–21.** *Kerria pennyae* Ahmad & Ramamurthy, **sp. nov.**, scanning electron micrographs. 14, anal tubercle. 15, brachia with anterior spiracle. 16, brachial plate with dimple. 17, dorsal spine with spinosities (spi) indicated by arrow. 18, marginal duct cluster. 19, mouthparts. 20, antenna. 21, posterior spiracle.

**Venter:** Antennae 20–30 µm long, segmentation obscure perhaps 3 segmented, apical segment blunt, with 3 long fleshy setae and 2 short hair-like setae. Clypeolabral shield 280–310 µm long, 140–170 µm wide. Labium 2 segmented. Pre-oral lobes elongated, membranous, present along sides of clypeolabral shield. Post-oral lobes each 140–240 µm long, membranous, dome-shaped. Legs present and vestigial, each small and one-segmented, with a rudimentary claw. Posterior spiracles each 75–90 µm long, smaller than anterior spiracles, born on a sclerotized plate, with 28–53 spiracular pores present along anterior margin of spiracle. Marginal duct clusters distinct, 3 on each side, each cluster arranged in a convoluted line consisting of 28–32 ducts without any surrounding

sclerotization. Perivulvar pore clusters: 8–10 on each side of anal tubercle, circular in shape, each pore with 12–15 loculi. Ventral duct clusters irregular in shape, with a cluster on either side of mouthparts, another laterad to each posterior spiracle and a posterior pair in abdomen. Star pores: 2–5 present near mouthparts.

**Comments.** *Kerria pennyae* Ahmad & Ramamurthy sp. nov., is similar to *Kerria chamberlini* Varshney in having: (i) an elongated, conical, supra-anal plate, and (ii) brachia wide, sloping down, merging with body. However, it differs in having (character states in *K. chamberlini* in brackets): (i) 28–32 ducts in each marginal duct cluster (33–40 ducts), (ii) distance of anterior spiracle from brachial crater 65–165  $\mu\text{m}$  (0  $\mu\text{m}$ ) and (iii) length of pedicel subequal or greater than spine (length of pedicel shorter than spine).

**Etymology.** This species is named after Dr. Penny J. Gullan in gratitude for her guidance in our work on lac insects of India.

### *Kerria dubeyi* Ahmad & Ramamurthy sp. nov.

**Holotype** ♀: India: Bangalore, Karnataka, 09.xi.2010, *Ficus bengalensis* (Moraceae), 1 slide (1 ad♀), coll. NAIP (Line no. LIK0008) (NPC). **Paratype** ♀♀: Data as for holotype, 2 slides (6 ad♀♀), coll. NAIP (Line no. LIK0008) (NPC); 1 slide (3 ad♀♀) (ANIC); 1 slide (2 ad♀♀) (BME).

### Adult female (Figs 2, 22–39)

**Unmounted material.** Lac test brown. Tests occur in aggregations; live mature females small, globular and crimson. Cleaned female removed from test shown in Figure 2.

**Mounted material.** Body globular, 1.15–2.40 mm long, 0.95–1.50 mm wide at apex, 1.07–2.22 mm wide at middle and 0.60–1.30 mm wide at base (n=10).

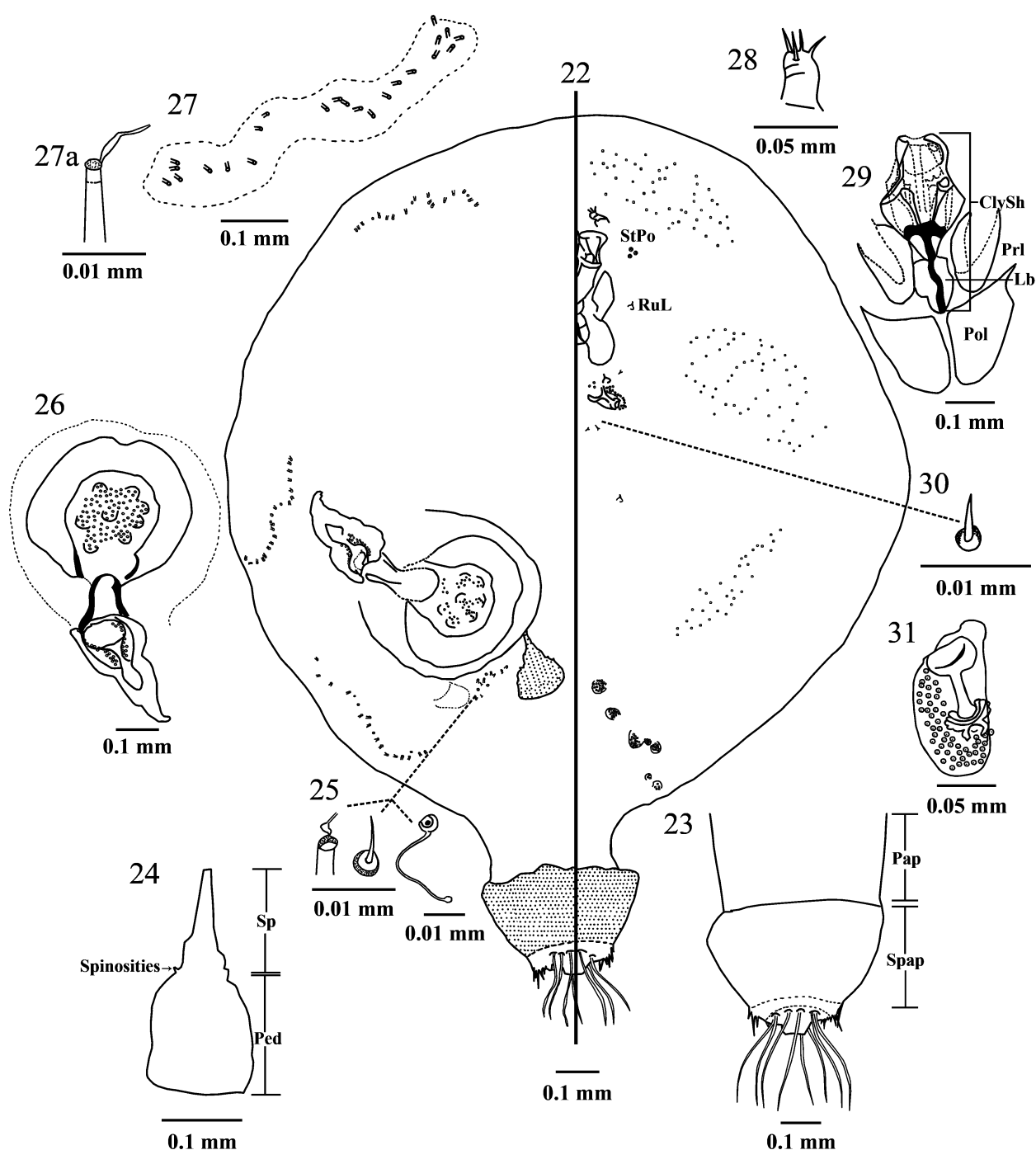
**Dorsum:** Brachia sessile, club-shaped and slightly sclerotized, 310–500  $\mu\text{m}$  long. Brachial plate circular, 315–365  $\mu\text{m}$  wide; brachial crater shallow, central, sub-circular, 175–215  $\mu\text{m}$  wide, with a defined rim, dimples large, distinct, 7 or 8 in number. Anterior spiracle apodeme 215–315  $\mu\text{m}$  long and peritreme 120–165  $\mu\text{m}$  wide; 0–160  $\mu\text{m}$  away from brachial crater. Ratio of distance of anterior spiracles from crater rim to width of brachial plate 1:2.28. Ratio of length of anterior spiracle to width of brachial plate 1:1.16. Dorsal spine well developed 150–280  $\mu\text{m}$  long and 105–155  $\mu\text{m}$  wide at base; pedicel large, square, slightly sclerotized, 75–150  $\mu\text{m}$  long; spine 60–145  $\mu\text{m}$  long and slightly sclerotized with 1 or 2 spinosities at its base. Ratio of length of pedicel to length of spine 1:0.97. Ratio of total length of dorsal spine to width of brachial plate 1:1.30. Anal tubercle abbreviated, well developed; pre-anal plate membranous, 130–400  $\mu\text{m}$  long, 270–460  $\mu\text{m}$  wide; supra-anal plate heavily sclerotized, hispid near apex, 220–320  $\mu\text{m}$  long, 230–350  $\mu\text{m}$  wide, ratio of length of supra-anal plate to width of plate 1:1.09. Ratio of length of supra-anal plate to length of brachia 1:1.56. Anal fringe plates short, fringe maximum length 45–75  $\mu\text{m}$ . Anal ring 6 sectored with 10 setae. Dorsal duct clusters present as a row of ducts on both sides between dorsal spine and base of anal tubercle, each cluster with 18–22 tubular ducts plus some dorsal setae and a few spermatoid ducts.

**Venter:** Antennae 25–45  $\mu\text{m}$  long, segmentation obscure, perhaps 3 segmented, apical segment blunt, with 3 long fleshy and 2 short hair-like setae. Clypeolabral shield 270–340  $\mu\text{m}$  long, 130–170  $\mu\text{m}$  wide. Labium 2 segmented. Pre-oral lobes elongated, membranous, present along sides of clypeolabral shield. Post-oral lobes each 100–200  $\mu\text{m}$  long, membranous, dome-shaped. Legs present and vestigial, one-segmented with rudimentary claw. Posterior spiracles, each 75–90  $\mu\text{m}$  long, smaller than anterior spiracles, on a sclerotized plate; with 44–60 spiracular pores present along anterior margin of spiracle. Marginal duct clusters distinct, 3 on each side, each cluster arranged in a convoluted line consisting of 25–27 ducts with slight surrounding sclerotization. Perivulvar pore clusters: 7 or 8 on each side of anal tubercle, circular in shape, each pore with 13–20 loculi. Ventral duct clusters irregular in shape; with a cluster on either side of mouthparts, another laterad to each posterior spiracle and a posterior pair in abdomen. Star pores: 1–9 present near mouthparts.

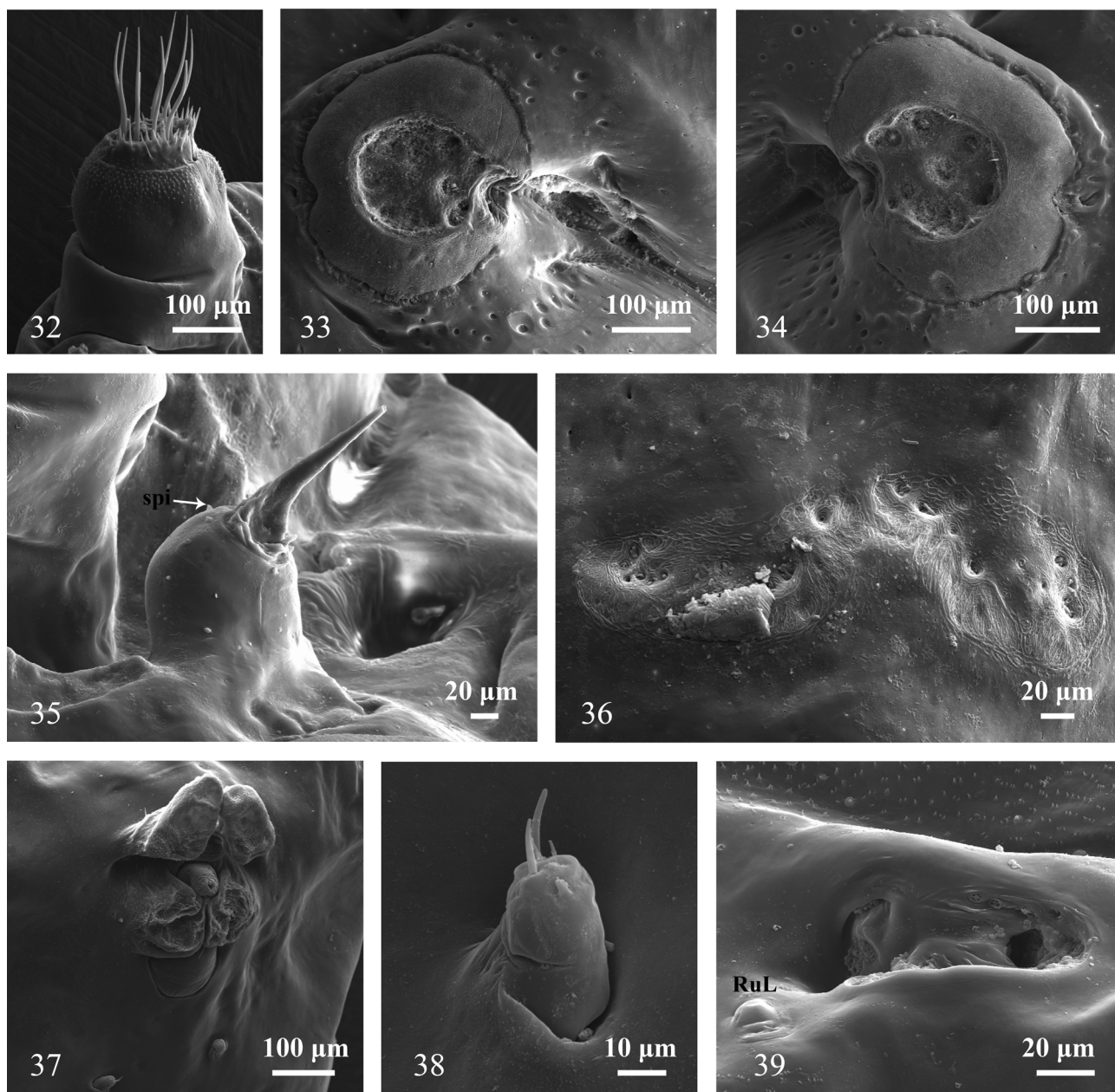
**Comments.** *Kerria dubeyi* Ahmad & Ramamurthy sp. nov. is similar to *Kerria albizziae* (Green) in having: (i) an abbreviated supra-anal plate, (ii) short brachia, (iii) 7 or 8 dimples on a circular brachial plate, and (iv) anterior spiracle close to brachial plate. However, it differs in having (character states for *K. albizziae* in brackets): (i) length of pedicel subequal to or greater than spine (pedicel shorter than spine), and (ii) 25–27 ducts in each marginal duct cluster (10–15).

**Etymology.** This species is named after Dr. O. P. Dubey, former ADG (Plant Protection), ICAR, New Delhi

and Chairman, Consortium Advisory Committee (CAC) of the NAIP subproject in recognition of his moral support and interest in the taxonomic studies.



**FIGURES 22–31.** *Kerria dubeyi* Ahmad & Ramamurthy, **sp. nov.** 22, whole mount, StPo- Star pores, RuL- rudimentary leg. 23, anal tubercle, Pap- Pre-anal plate, Spap- Supra-anal plate. 24, dorsal spine, Ped- Pedicel, Sp- Spine. 25, dorsal duct cluster with a single tubular duct, dorsal seta and spermatoid duct. 26, brachia with anterior spiracle. 27, marginal duct cluster. 27a, single duct magnified. 28, antenna. 29, Mouthparts, ClySh- Clypeolabral shield, Lb- Labium, Prl- Pre oral lobe, Pol- Post oral lobe. 30, ventral seta. 31, posterior spiracle.



**FIGURES 32–39.** *Kerria dubeyi* Ahmad & Ramamurthy, *sp. nov.*, scanning electron micrographs. 32, anal tubercle. 33, brachia with anterior spiracle. 34, brachial plate with dimples. 35, dorsal spine with spinosities (spi) indicated by arrow. 36, marginal duct cluster. 37, mouthparts. 38, antenna. 39, posterior spiracle, RuL- rudimentary leg.

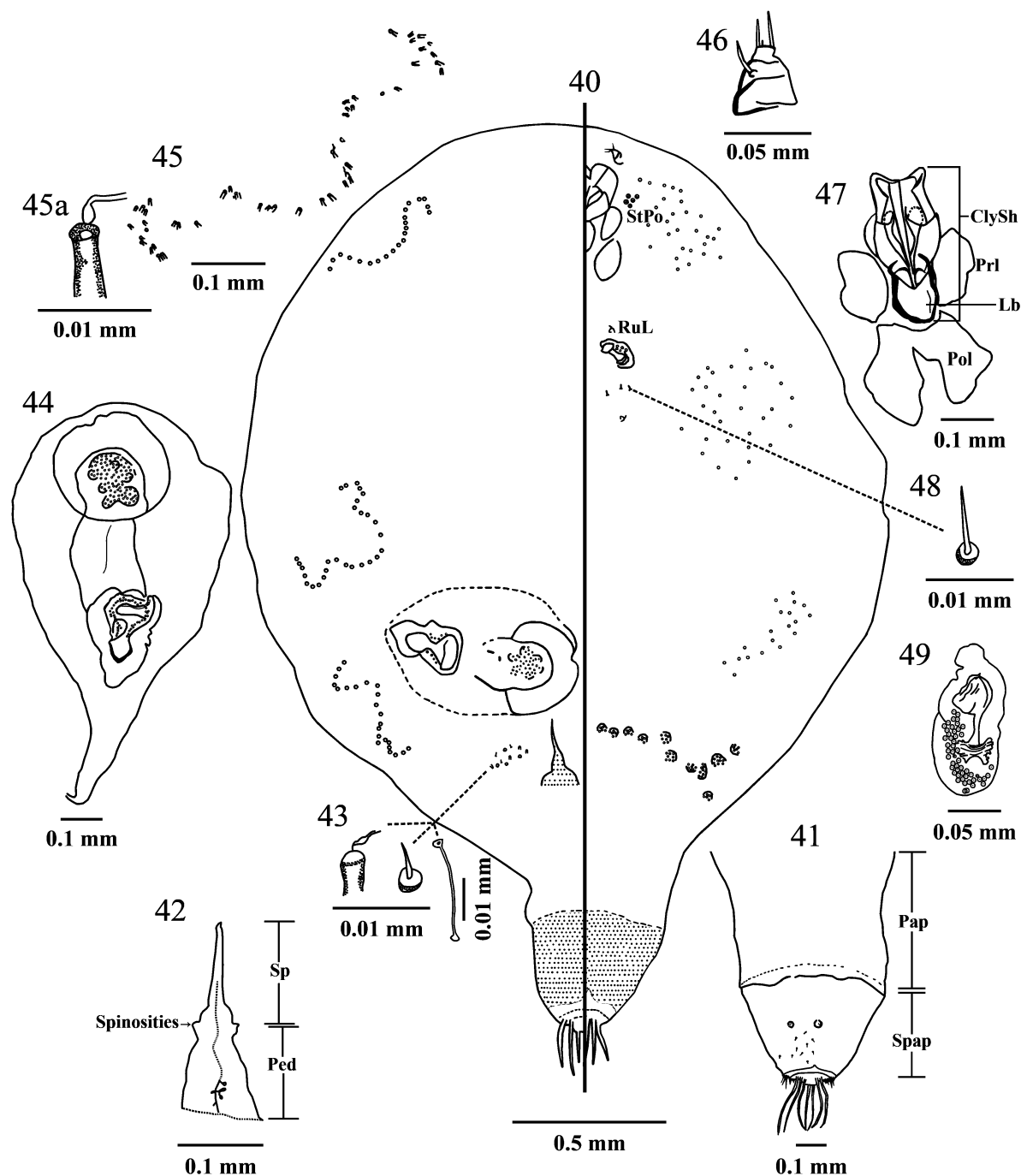
***Kerria varshneyi* Ahmad & Ramamurthy *sp. nov.***

**Holotype** ♀: **India: Patiala, Punjab**, 31.x.2009, *Ziziphus mauritiana* (Rhamnaceae), 1 slide (1 ad♀), coll. NAIP (Line no. LIK0063) (NPC). **Paratype** ♀♀: Data as for holotype, 2 slides (6 ad♀♀), coll. NAIP (Line no. LIK0063) (NPC); 1 slide (3 ad♀♀) (ANIC); 1 slide (2 ad♀♀) (BME).

**Adult female (Figs 3, 40–57)**

**Unmounted material.** Lac test brown. Tests occur in aggregations; live mature females globular and crimson. Cleaned female removed from test shown in Figure 3.

**Mounted material.** Body globular to elongated, 1.77–3.65 mm long, 1.86–2.42 mm wide at apex, 2.35–3.23 mm wide at middle and 1.34–2.47 mm wide at base (n=10).

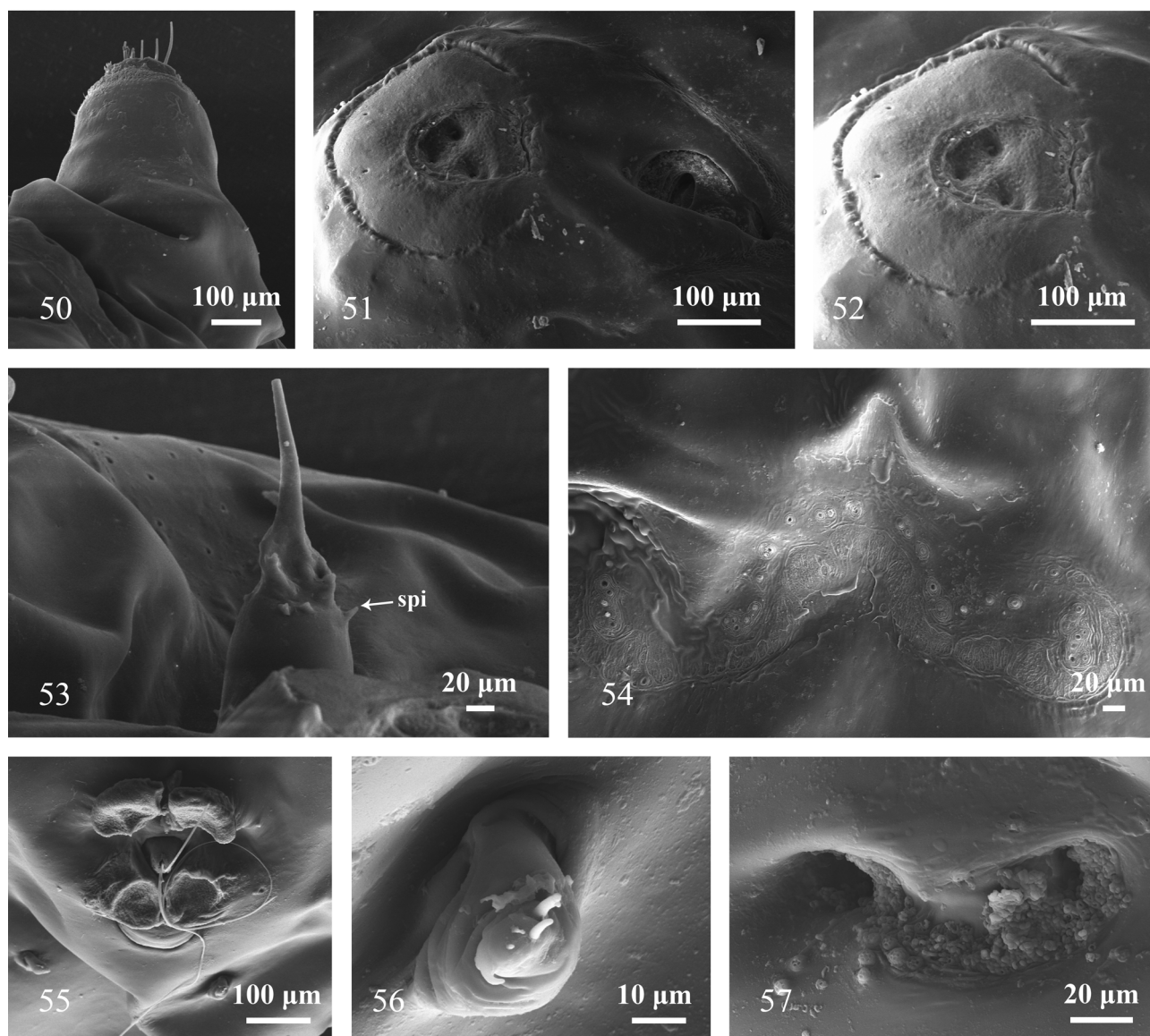


**FIGURES 40–49.** *Kerria varshneyi* Ahmad & Ramamurthy, *sp. nov.* 40, whole mount, StPo- Star pores, RuL- rudimentary leg. 41, anal tubercle, Pap- Pre-anal plate, Spap- Supra-anal plate. 42, dorsal spine, Ped- Pedicel, Sp- Spine. 43, dorsal duct cluster with a single tubular duct, dorsal seta and spermatoid duct. 44, brachia with anterior spiracle. 45, marginal duct cluster. 45a, single duct magnified. 46, antenna. 47, Mouthparts, ClySh- Clypeolabral shield, Lb- Labium, Prl- Pre oral lobe, Pol- Post oral lobe. 48, ventral seta. 49, posterior spiracle.

**Dorsum:** Brachia sessile, club-shaped and slightly sclerotized, 400–530  $\mu\text{m}$  long. Brachial plate circular, 290–325  $\mu\text{m}$  wide; brachial crater shallow, central, sub-circular, 150–180  $\mu\text{m}$  wide, with a defined rim; dimples large, distinct, 4 or 5 in number. Anterior spiracle apodeme 250–295  $\mu\text{m}$  long and peritreme 160–200  $\mu\text{m}$  wide, 90–215  $\mu\text{m}$  away from brachial crater. Ratio of distance of anterior spiracles from crater rim to width of brachial plate 1:1.15. Ratio of length of anterior spiracle to width of brachial plate 1:1.10. Dorsal spine well developed 190–235  $\mu\text{m}$  long and 90–130  $\mu\text{m}$  wide at base; pedicel small, bulbous, more sclerotized, 75–100  $\mu\text{m}$  long; spine 115–145  $\mu\text{m}$  long and slightly sclerotized, with 2 or 3 spinosities at its base. Ratio of length of pedicel to length of spine



1:1.45. Ratio of total length of dorsal spine to width of brachial plate 1:1.38. Anal tubercle elongated, well developed; pre-anal plate membranous, 250–810  $\mu\text{m}$  long, 480–590  $\mu\text{m}$  wide; supra-anal plate heavily sclerotized, hispid near apex, 360–480  $\mu\text{m}$  long, 360–430  $\mu\text{m}$  wide, ratio of length of supra-anal plate to width of plate -1:0.89. Ratio of length of supra-anal plate to length of brachia 1:1.10. Anal fringe plates short, fringe maximum length 30–70  $\mu\text{m}$ . Anal ring 6 sectored with 10 setae. Dorsal duct clusters present as a row of ducts on both sides between dorsal spine and base of anal tubercle, each cluster with 8–10 tubular ducts plus some dorsal setae and spermatoid ducts.



**FIGURES 50–57.** *Kerria varshneyi* Ahmad & Ramamurthy, **sp. nov.**, scanning electron micrographs. 50, anal tubercle. 51, brachia with anterior spiracle. 52, brachial plate with dimples. 53, dorsal spine with spinosities (spi) indicated by arrow. 54, marginal duct cluster. 55, mouthparts. 56, antenna. 57, posterior spiracle.

**Venter:** Antennae 40–55  $\mu\text{m}$  long, segmentation obscure perhaps 3 segmented, apical segment pointed, with 3 long fleshy setae and 2 short hair-like setae. Clypeolabral shield 280–320  $\mu\text{m}$  long, 140–170  $\mu\text{m}$  wide. Labium 2 segmented. Pre-oral lobes elongated, membranous, present along sides of clypeolabral shield. Post-oral lobes each 130–200  $\mu\text{m}$  long, membranous, dome-shaped. Legs present and vestigial, small and one-segmented, with rudimentary claw. Posterior spiracles, each 85–100  $\mu\text{m}$  long, smaller than anterior spiracles, born on a sclerotized plate; with 54–70 spiracular pores present along anterior margin of spiracle. Marginal duct clusters distinct, 3 on each side, each cluster arranged in a convoluted line consisting of 39–42 ducts without any surrounding sclerotization. Perivulvar pore clusters: 11 or 12 on each side of anal tubercle, circular in shape, each pore with 15–

20 loculi. Ventral duct clusters irregular in shape; with a cluster on either side of mouthparts, another laterad to each posterior spiracle and a posterior pair in abdomen. Star pores: 2–11 present near mouthparts.

**Comments.** *Kerria varshneyi* Ahmad & Ramamurthy **sp. nov.** is similar to *Kerria chamberlini* Varshney in having: (i) an elongated, conical, supra-anal plate, and (ii) brachia wide sloping down and merging with body. *Kerria varshneyi* differs in having (character states for *K. chamberlini* in brackets): (i) 4 or 5 dimples on brachial plate (generally 7), (ii) distance between anterior spiracle and brachial plate is 90–215  $\mu\text{m}$  (0  $\mu\text{m}$ ), and (iii) perivulvar pore clusters numbering 11–12 on each side of base of anal tubercle (5–8).

**Etymology.** This new species is named after Dr. R. K. Varshney, in honour of his contributions to the lac insects of India and his valuable guidance in our studies on lac insects as a member of CAC of the NAIP subproject.

### An updated key to adult female *Kerria* species from India.

(Modified of Ahmad *et al.*, 2013).

1. Anal tubercle (supra-anal plate) elongate, distinctly longer than broad ..... 2
- Anal tubercle (supra-anal plate) abbreviated, length subequal to width or broader than long ..... 12
2. Brachial plate present on an elevated brachia ..... 3
- Brachial plate sessile ..... *ebrachiata*(Chamberlin)
3. Canellar bands present as a chitinous extension below anterior spiracles ..... 4
- Canellar bands absent ..... 5
4. Distance of anterior spiracle from brachial plate 2x width of brachial plate; anterior spiracle with apodeme shorter (137–172  $\mu\text{m}$ ) than length of brachial plate (172–206  $\mu\text{m}$ ); dorsal spine 189–224  $\mu\text{m}$  long ..... *chinensis* (Mahdihassan)
- Distance of anterior spiracle from brachial plate 1.2x width of brachial plate; anterior spiracle with apodeme longer (258–310  $\mu\text{m}$ ) than length of brachial plate (103–137  $\mu\text{m}$ ); dorsal spine 172–189  $\mu\text{m}$  long ..... *nepalensis* Varshney
5. Length of brachia distinctly greater than length of supra-anal plate ..... 6
- Length of brachia subequal to or shorter than length of supra-anal plate ..... 10
6. With 8 or 9 perivulvar pore clusters on each side of anal tubercle; posterior spiracle 75–90  $\mu\text{m}$  long, without a sclerotized plate ..... *maduraiensis* Ahmad & Ramamurthy
- With more than 10 perivulvar pore clusters on each side of anal tubercle; posterior spiracle >90  $\mu\text{m}$  long, with a sclerotized plate ..... 7
7. Brachia club-shaped; anterior spiracle with apodeme shorter than width of brachial plate ..... *varshneyi* Ahmad & Ramamurthy **sp.nov.**
- Brachia cylindrical-shaped; anterior spiracle with apodeme longer than width of brachial plate ..... 8
8. Brachial plate with 10–12 distinct dimples; each marginal duct cluster with 25–30 ducts; supra-anal plate smooth *lacca* (Kerr)
- Brachial plate with 4–12 indistinct dimples; each marginal duct cluster with >30 ducts; supra-anal plate hispid ..... 9
9. Brachial plate with 5 or fewer indistinct dimples; brachial crater 200–245  $\mu\text{m}$  wide; each marginal duct cluster with 49–53 ducts and surrounded by sclerotization ..... *thrissurensis* Ahmad & Ramamurthy
- Brachial plate with 10–12 indistinct dimples; brachial crater 110–175  $\mu\text{m}$  wide; each marginal duct cluster with <40 ducts and without any surrounding sclerotization ..... *yunnanensis* Ou & Hong
10. Dorsal spine shorter than width of brachial crater; supra-anal plate hispid; antennae with 4 apical setae ..... *indicola* (Kapur)
- Dorsal spine longer than width of brachial crater; supra-anal plate smooth; antennae with 3 apical setae ..... 11
11. Each marginal duct cluster with 28–32 ducts; anterior spiracle 65–165  $\mu\text{m}$  from brachial plate; length of pedicel subequal or longer than that of spine ..... *penmyae* Ahmad & Ramamurthy **sp. nov.**
- Each marginal duct cluster with 33–40 ducts; anterior spiracle touching brachial plate (0  $\mu\text{m}$ ); length of pedicel distinctly shorter than that of spine ..... *chamberlini* Varshney
12. Distance of anterior spiracle from brachial plate 17–34  $\mu\text{m}$ ; each marginal duct cluster with 10–15 ducts on an ovate reticulate plate ..... *albizziae* (Green)
- Distance of anterior spiracle from brachial plate greater than 34  $\mu\text{m}$ ; each marginal duct cluster with more than 20 ducts, without an ovate reticulate plate ..... 13
13. Brachial plate diameter equal to or greater than length of supra-anal plate ..... 14
- Brachial plate diameter distinctly less than length of supra-anal plate ..... 19
14. Brachial crater not in centre of plate; crater rim open; dimples small and obscure ..... *sindica* (Mahdihassan)
- Brachial crater in centre of plate; crater rim closed; dimples large and distinct ..... 15
15. Brachial plate large, 315–365  $\mu\text{m}$  in diameter; each marginal duct cluster with 24–26 ducts surrounded by sclerotization; with 7 or 8 perivulvar pore clusters on each side of anal tubercle ..... *dubeyi* Ahmad & Ramamurthy **sp. nov.**
- Brachial plate smaller (<315  $\mu\text{m}$  in diameter); each marginal duct cluster with >26 ducts, with or without a sclerotisation; with > 8 perivulvar pore clusters on each side of anal tubercle ..... 16
16. Brachial plate 189–310  $\mu\text{m}$  in diameter; antenna 42–50  $\mu\text{m}$  long ..... *fici* (Green)
- Brachial plate <180  $\mu\text{m}$  in diameter; antenna less than 40  $\mu\text{m}$  long ..... 17
17. Brachia elevated, cylindrical; dorsal spine distinctly shorter than length of pedicel ..... *pusana* (Misra)

- Brachia elevated and club-shaped; dorsal spine subequal to or longer than pedicel ..... 18
- 18. Length of brachia subequal to that of supra-anal plate; distance of anterior spiracle from brachial plate 206–325  $\mu\text{m}$  .....  
..... *sharda* Mishra & Sushil
- Length of brachia distinctly greater than that of supra-anal plate; distance of anterior spiracle from brachial plate 189–205  $\mu\text{m}$   
..... *brancheata* Varshney
- 19. Brachial crater not defined; perivulvar pore clusters 68–70 in number ..... *rangoonensis* (Chamberlin)
- Brachial crater well defined; perivulvar pore clusters fewer than 60 ..... 20
- 20. Marginal duct clusters of duplex type; with large nuclear and small secondary ducts; with 58 perivulvar pore clusters .....  
..... *greeni* (Chamberlin)
- Marginal duct clusters of simplex type; no large nuclear ducts present; with fewer than 50 perivulvar pore clusters ..... 21
- 21. Marginal duct clusters present on a weakly-marked, oval, sclerotized plate; perivulvar pore clusters secondarily clustered . . .  
..... *meridionalis* (Chamberlin)
- Marginal duct cluster without a sclerotized plate; perivulvar pore clusters without secondary clusters ..... 22
- 22. Length of dorsal spine equal to width of brachial plate; length of anterior spiracle equal to or less than width of brachial plate; antennae one segmented with 4 long setae on apex ..... *javana* (Chamberlin)
- Length of dorsal spine 1.16x longer than width of brachial plate; length of anterior spiracle 1.3x longer than width of brachial plate; antennae 3 segmented with 3 long setae on apex ..... *manipurensis* Ahmad & Ramamurthy

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