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The immature stages of *Pulvinaria tenuivalvata* (Newstead) (Hemiptera: Coccidae)

Abstract - The soft scale *Pulvinaria tenuivalvata* (Newstead) was discovered in Egypt in 1992 and, within a few years, has become the major pest of sugarcane, especially in Upper Egypt. This paper describes the 1st-instar nymph and 2nd- and 3rd-instar female nymphs of this species and provides a key for their separation.

Key words: *Pulvinaria tenuivalvata*, *Saccharolecanium krugeri*, Coccoidea.

INTRODUCTION

Pulvinaria tenuivalvata (Newstead), the red-striped soft scale, is currently the major pest of sugarcane in Egypt and attacks the leaves, causing a major reduction in yield due the removal of sap, and through to the production of honeydew and the associated growth of sooty moulds which reduce photosynthesis and respiration.

This species was originally considered to represent *Pulvinaria elongata* Newstead (Karem *et al.*, 1992). Later, it was reidentified as *Saccharolecanium krugeri* (Zehntner) (Ali *et al.*, 1997) but has now been shown to be *Pulvinaria tenuivalvata* (Newstead) (Watson & Foldi, 2001).

P. tenuivalvata was described by Newstead (1911) as *Lecanium tenuivalvatum* off citronella grass and elephant grass in Uganda. The adult female has since been redescribed and illustrated by De Lotto (1965) and Williams (1982). Williams (1982) also provided a key for the separation of the five *Pulvinaria* species found on Gramineae, namely *P. iceryi* (Signoret), *P. sorghicola* De Lotto, *P. elongata* Newstead, *P. tenuivalvata* (Newstead) and *P. saccharia* De Lotto. Williams commented on the great similarity of these five species.

It has become clear that, for a proper understanding of most scale insect biology, it is important to be able to identify the nymphal stages (Howell, 1980; 1981). This paper describes the crawler and 2nd- and 3rd-nymphal females of this insect as collected off sugar-cane in Egypt.

Pulvinaria tenuivalvata (Newstead)

First-instar nymph (Fig. 1)

(Described from 10 1st-instar nymphs in fair condition).

Mounted material. Body elongate oval, perhaps slightly more rounded at head end;

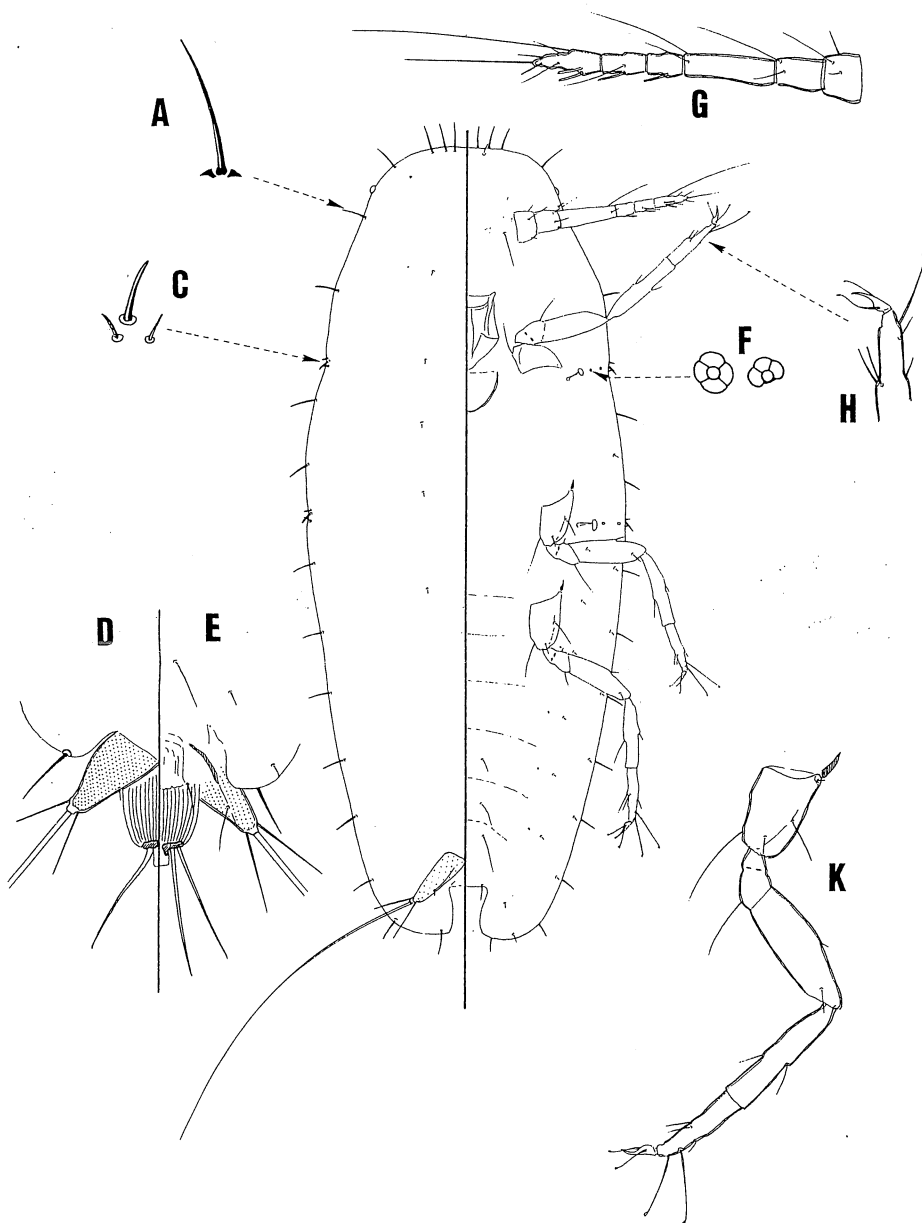


Fig. 1 - First-instar nymph of *Pulvinaria tenuivalvata* (Newstead). A: marginal seta; B: dorsal microductule; C: stigmatic cleft + stigmatic spines; D: anal plates; E: ventral anal area; F: spiracular disc-pores; G: antenna; H: prothoracic tarsus + claw; J: preantennal pore; K: metathoracic leg (or claw); L: ventral microduct; M: preanal disc-pore.

stigmatic clefts shallow; anal cleft distinct. Length 445-890mm, width 185-200mm.

Dorsum. Derm membranous. Dorsal setae: 5 pairs of setose setae (each 5-7mm long) present: with pairs medially on head, approximately over mouthparts, posterior to labium, and more or less over meso- and metacoxae. Dorsal pores: apparently absent apart from a pair of minute pores anteriorly on head slightly anterior to eyespots, probably trilocular pores. Anal plates slightly elongate and generally diverging posteriorly; length of each plate 50-53mm long, each about 25mm wide; each with a small seta on inner margin, two longer setae near apex, each about 23-27mm long and an extremely long apical segment, up to 280mm long. Anogenital fold with 1 pair of setae along anterior margin (20mm long) and 1 pair laterally (about 25mm long). Anal ring lying just anterior to anal plates, with six setae, each 40-55mm long.

Margin. Marginal setae finely spinose, with 8 anteriorly between eyespots (median 6 all pointing anteriorly), 2 between each eyespot and anterior stigmatic clefts, 2 laterally between stigmatic clefts and 8 on each side of abdomen; length 16-25mm, longest on head. With three stigmatic spines per stigmatic cleft: lateral spines each very short, about 5mm long, median spine longer and curved posteriorly, 11-14mm long. Eyespot 8-9mm wide on margin.

Venter. Preanal disc-pores absent. Spiracular disc-pores each with 4-5 loculi; with 2 in each anterior band and 2-3 in each posterior band. Ventral microducts: extremely hard to discern but possibly with 1 on each side of most abdominal segments. Ventral setae: with pairs of long setae on abdominal segments V, VI and VII, longest about 28-34mm long. Setae apparently absent medially on abdominal segments II, III and IV and near each pro-, meso- or metacoxa; with one pair of interantennal setae, length 25mm; with one seta on either side of anal cleft; with 0-1 submarginal seta between each lateral stigmatic cleft; with a pair of slightly longer submarginal setae at anterior end; with a medio-lateral band of small setae placed segmentally on either side of each abdominal segment. Each spiracular peritreme 6-8mm wide. Legs well developed; length of metathoracic leg: coxa 43-46mm, trochanter + femur 73-78mm, tibia 51-58mm, tarsus 38-40mm and claw 15-16mm; each coxa with 3 setae, length of each innermost coxal seta 25-28mm; each trochanter with 2 setae, longest 36-45mm; each femur with 1 seta, tibia with 2 setae and tarsus with 3 setae; tarsal digitules on meso- and metathoracic legs similar in shape and length and significantly longer than claw; with one tarsal digitule on prothoracic leg setose; claw without a denticle and rather long and thin. Antennae six-segmented, third segment longest; total length 129-138mm; with long setae on segments 1, 2, 3 and 6; with (on each antenna) 3 setae on scape, 2 setae on pedicel, 3 setae on segment III, 1 fleshy seta on seg. IV, 1 fleshy setae + 1 setose seta on seg. V, and 3 fleshy setae + 5 spinose/setose setae on seg. VI; length of apical seta about 60-70mm; length of outer long seta 130-150mm. Length of clypeolabral shield 75mm; labium probably with 4 pairs setae.

Second-instar female (Fig. 2)

(Described from seven 2nd-instar nymphs in fair to good condition)

Mounted material. Body distinctly elongate oval, broadest in anterior abdominal

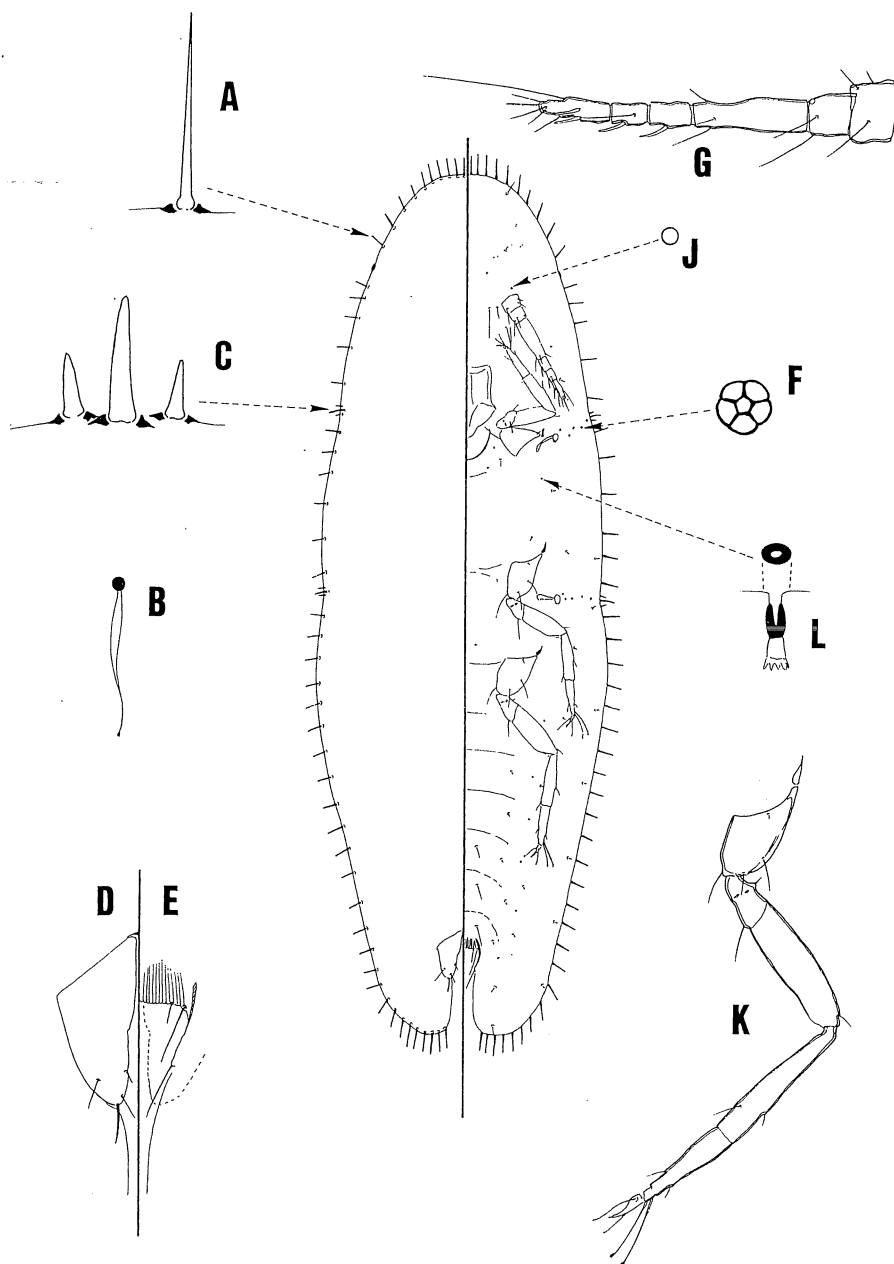


Fig. 2 - Second-instar nymph of *Pulvinaria tenuivalvata* (Newstead). For letters, see Fig. 1.

segment; with shallow stigmatic clefts; anal cleft about 1/13th body length. Length 1.1-1.7mm; width 385-600mm.

Dorsum. Derm membranous. Dorsal setae absent. Dorsal microductules extremely small, possibly most frequent submarginally. Anal plates together quadrate, inner margins of each plate diverging towards apex; each plate 64-80mm long, combined width 63-86mm; plates without minute pores on dorsal surface; length of each seta: inner margin (about 1/3rd from apex) 8-14mm, inner margin near apex 11-17mm, apical 20-24mm and outer margin seta 15-17mm. With 2 setae along anterior margin of ano-genital fold, longest 21-24mm long, and with a single seta on each margin; lateral supporting apodeme small. Anal tube extending a short distance anterior to anal plates; anal ring with six setae.

Margin. Marginal setae each finely spinose, with a broad basal socket: with 20-23 between eyespots on head, 4-7 between each eyespot and anterior stigmatic clefts, 5-7 laterally between stigmatic clefts, and 23-27 on each side of abdomen; length 11-38mm, longest anteriorly and posteriorly, where setae tend to point anteriorly and posteriorly; absent from margins of anal cleft. Stigmatic clefts each with 3 stigmatic spines; each lateral spine rather conical and 5-12mm long; each median spine curving slightly posteriorly, 10-15mm long. Eyespots marginal, each about 9-11mm wide.

Venter. Preanal disc-pores absent. Spiracular disc-pores each with mainly 5 loculi, in bands 1-2 pore wide between spiracles and margin; with 4-6 in each band. Ventral microducts sparse, perhaps absent medially on abdomen. With 1 preantennal pore anterior to each scape. Other ventral pores absent. Ventral tubular ducts absent. Ventral setae: posterior lobe setae 8-20mm long; with pairs of long setae on abdominal segments V, VI, VII and occasionally IV, longest 30-42mm long; usually with a single pair of short setae mediolaterally on each abdominal segment; with a single seta associated with each pro- meso- and metacoxa, length of each procoxal seta about 5mm; with two pairs of inter-antennal setae; longest 30-37mm; with a single seta on each side of anal cleft; with only a single submarginal seta laterally between each stigmatic area; with a pair of longer submarginal setae at anterior end. Width of each spiracular peritreme 11-15mm. Legs well developed; tibio-tarsal segmentation indistinct, even occasionally absent; lengths on metathoracic leg: coxa 58-67mm, trochanter + femur 92-103mm, tibia + tarsus 117-130mm, claw 13-15mm; each coxa with 4 setae, longest 28-30mm; each trochanter with 1 long seta, length 38-42mm, each femur with possibly only 1 seta, tibia with 2 setae and tarsus with 3 setae; tarsus without a campaniform pore; tarsal digitules significantly longer than claw, each similar in shape and length; claw digitules both very fine and longer than claw; claw with a small denticle. Antennae well developed and six-segmented; length 159-167mm; 3rd segment longest; setae on each antenna: scape: 3; pedicel: 2; III: 3; IV: 1 fleshy setae; V: 1 fleshy seta + 1 setose seta; VI (apical): 3 fleshy setae + 5 setose/spinose setae: length of apical seta 15-28mm; length of outer long setose seta on apical segment about 66-80mm. Length of clypeolabral shield 96-100mm long; labium with 4 pairs of setae.

Third-instar female (Fig. 3)

(Described from a three specimens in fair to good condition).

Mounted material. Body very elongate oval, rounded at both ends; with shallow stigmatic clefts; anal cleft about 1/10th body length. Length 1.75-1.95 mm; width 640-650mm.

Dorsum. Derm membranous. Dorsal setae absent. Dorsal microductules sparse throughout. Anal plates quadrate, inner margins more or less parallel; each plate 100-106mm long, combined width 100-118mm; without minute pores on dorsal surface; length of anal plate setae: inner margin (about 1/3rd from apex) 17mm, inner margin near apex 19-24mm, apical 25-36mm and outer margin seta 17-19mm. With 2 pairs of setae on anterior margin of ano-genital fold, longest 41-50mm long; and 2 setae on each lateral margin; supporting apodeme well developed. Anal tube extending well anterior to anal plates; anal ring with perhaps 4 pairs of setae.

Margin. Marginal setae finely spinose, each with a well-developed basal socket; with 35-37 setae anteriorly between eyespots, 11-14 between each eyespot and anterior stigmatic cleft, 11-15 laterally between stigmatic clefts, and 35-47 on each side of abdomen; length 12-42mm, longest anteriorly and posteriorly; absent from margins of anal cleft. Stigmatic clefts each with 3 stigmatic spines: lateral spines each conical and 7-20mm long, median spine curving posteriorly, more or less parallel sided, slightly pointed; each 16-42mm long. Eyespot 12-13mm wide just on dorsum.

Venter. Preanal disc-pores: a single, 6-loculate disc-pore present anterior to anal opening on one specimen. Spiracular disc-pores each with mainly 5 loculi, in bands about 1-2 pores wide between each spiracle and margin; with 7-9 in each anterior band and 7-11 in each posterior band. Ventral microducts of one type, small; sparse marginally and on head and thorax but absent medially on posterior abdominal segments and between antennae and mouthparts. With a single preantennal pore near base of each antenna. Ventral tubular ducts absent. Ventral setae: posterior lobe setae each 10-23mm long; with 1-4 setae on either side of anterior end of anal cleft; long setae present medially on abdominal segments V, VI and VII, longest 43-62mm long; other segments with 2 short setae medially; with 1-2 short setae near each meso- and metacoxa, but a longer seta near each procoxa, length 16-25mm; with 2-3 pairs of inter-antennal setae, longest about 50-52mm long; with 2 submarginal seta laterally between each stigmatic area; with a pair of longer submarginal setae anteriorly on head; other small setae distributed in more or less 2 rows mediolaterally on abdomen and with medially and mediolaterally on thorax and head. Width of anterior spiracular peritreme 18-20mm; posterior peritremes 21-25mm. Legs well developed, tibio-tarsal segmentation absent on some legs and reasonably distinct on others; lengths on metathoracic leg: coxa 92-95mm, trochanter + femur 104-132mm, tibia + tarsus 165-178mm, claw 22-24mm; each coxa with 4-5 setae, length of innermost long seta on each metacoxa about 40-43mm; each trochanter with 2 setae, longest 42-47mm long; each femur with 2 setae, tibia with 2 setae and tarsus with 3-4 setae; tarsal campaniform pore absent; tarsal digitules both distinctly longer than claw; claw digitules dissimilar, one significantly broader than other with a larger capitate apex, subequal in length

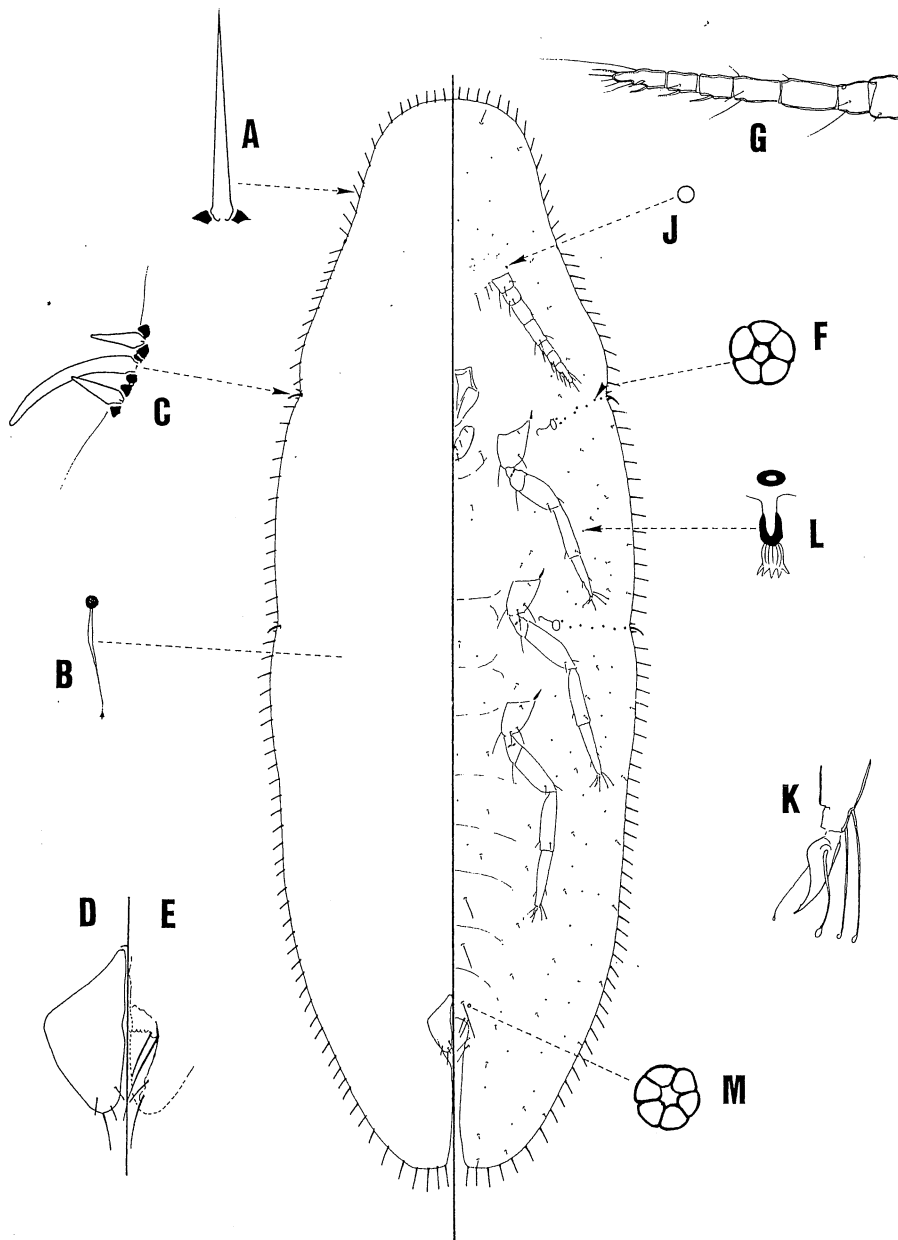


Fig. 3 - Third-instar nymph of *Pulvinaria tenuivalvata* (Newstead). For letters, see Fig. 1.

and slightly longer than claw; claw with a small denticle. Antennae well developed, 7-segmented although sometimes 6-segmented with a pseudo-articulation; total length 207-240mm; setae on each segment: scape: 3; pedicel: 2; III: 1; IV: 2; V: 1 fleshy seta; VI: 1 fleshy setae + 1 setose seta; VII: 3 fleshy setae + 5 setose or spinose setae; length of apical seta 13-42mm; length of outer long seta on apical segment 66-98mm. Length of clypeolabral shield 120-125mm; labium with 4 pairs of setae.

Second-instar male

No material of this stage was available, but it is almost certain that, if this species is not parthenogenetic, the nymph of the 2nd-instar male will have dorsal tubular ducts, at least as two groups mediolaterally on abdominal segment IV, and most probably in two longitudinal mediolateral lines running from the anal area to above the mouthparts, possibly with 2-3 pairs of lines running from this radially to the margin. Tubular ducts may also be present along the margin ventrally but possibly not along the posterior margins of abdomen. The structure of the dorsal and ventral tubular ducts will be different.

Material examined: EGYPT: Luxor, Quena Governorate, and Atfeeh, Giza Governorate, on sugarcane, 1999, Dec. 2000, Sept. 2001, coll. M.W. Ghabbour (ARC, Dokki-Giza) (Nat. Mus. Wales, Cardiff): 26 slides with 5 adult females, 3 3rd instar females, 7 2nd instar females + 30 crawlers.

POSSIBLE KEY TO INSTARS

1. Tubular ducts abundant ventrally in a submarginal band; preanal disc-pores frequent across most abdominal segments adult female
 - Tubular ducts either absent ventrally, or only present marginally; preanal disc-pores either absent or very few, restricted to abdominal segment VII 2
2. Tubular ducts present on dorsum 2nd-instar male
 - Tubular ducts absent altogether 3
3. Antennae 7-segmented; with more than 10 marginal setae laterally between stigmatic clefts 3rd-instar female
 - Antennae 6-segmented; with fewer than 10 marginal setae laterally between stigmatic clefts 4
4. Apical seta on each anal plate much longer than length of anal plates; dorsal setae present submedially on head and thorax; with 2 marginal setae present laterally between stigmatic clefts 1st-instar nymph
 - Apical seta on each anal plate much shorter than length of anal plate; dorsal setae absent; with 5+ marginal setae laterally between stigmatic clefts 2nd-instar female.

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