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Original paper

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Una nueva especie del género *Aleuoparadoxus* (Hemiptera: Aleyrodidae) de Oaxaca, México

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ABSTRACT. A new species of whitefly is described, *Aleuoparadoxus oaxacensis* Carapia-Ruiz & Sánchez-Flores sp. nov., based on specimens collected on the upper side of leaves of *Guaiaacum coulteri* A. Gray (Zygophyllaceae) in Huatulco, Oaxaca, Mexico. This species does not present tubercles on the inner margin of the caudal ridges and the anterior and posterior halves of the pupa are of similar width and is included in the *sapotae* group as it presents dark brown color and semioval to semicircular form. Microphotographs of pupal morphological structures are provided and separation from similar species is briefly discussed. Also, a key to the Mexican species of *Aleuoparadoxus* is provided.

Key words: whiteflies; Aleyrodinae; host; pupae

RESUMEN. Una nueva especie de mosca blanca es descrita, *Aleuoparadoxus oaxacensis* Carapia-Ruiz & Sánchez-Flores sp. nov., con base en ejemplares recolectados en el haz de las hojas de *Guaiaacum coulteri* A. Gray (Zygophyllaceae) en Huatulco, Oaxaca, México. Esta especie no presenta tubérculos en el margen interno de las crestas caudales y las mitades anterior y



posterior de la pupa con anchura similar y es incluida en el grupo *sapotae* por presentar pupa de color marrón oscuro y forma semioval a semiesférica. Se proporcionan microfotografías de estructuras morfológicas de la pupa y se discute brevemente su separación de especies similares. También se presenta una clave para las especies mexicanas de *Aleuoparadoxus*.

Palabras clave: moscas blancas; Aleyrodinae; hospedero; pupas

INTRODUCTION

The whiteflies genus *Aleuoparadoxus* Quaintance & Baker comprises 13 species described in the New World (Evans, 2008; Ouvrard & Martin, 2019); of these, nine species have been reported for Mexico (Russell, 1947; Evans, 2008; Sánchez-Flores *et al.*, 2017; Carapia-Ruiz & Sánchez-Flores, 2018; García-Ochaeta & Evans, 2020; Sánchez-Flores & Carapia-Ruiz, 2021). The genus is known only from America, most of the described species are from the southwestern United States of America, Mexico, Central America, and the Caribbean, only one species is known from Chile, in South America (Evans, 2008). *Aleuoparadoxus iridescens* was reported from Hawaii and Mexico by García-Ochaeta and Evans (2020), without providing any specific data. Martin (2005) reported five *Aleuoparadoxus* species from Belize, of which three had been previously described and two were undescribed.

This suggests there are still different species of this genus awaiting description. Pupae of whiteflies of the genus *Aleuoparadoxus* were found in Oaxaca, Mexico. After examination, it was found that they did not belong to any of the known species; therefore, the new species is described in the present study.

MATERIALS AND METHODS

Whitefly pupae (Aleyrodidae) were collected on the upper side of the leaves of *Guaiacum coulteri* (Zygophyllaceae) in an urban wooded area of Huatulco, Oaxaca, Mexico (15° 49' 57" N, 96° 19' 1" W, 25 mamsl). The specimens were transferred to the Entomology and Acarology Laboratory of the Escuela de Estudios Superiores de Xalostoc, Universidad Autónoma del Estado de Morelos (ESSX-UAEM). Pupae were mounted on slides and studied using a phase-contrast Motic microscope. The methodology for slides preparation was that proposed by Martin (1987; 2004). Photographs were taken with a Nikon 5200® camera with 18–55 mm lens.

Specimens repositories:

CNIN- Colección Nacional de Insectos, Instituto de Biología, Universidad Nacional Autónoma de México.

OASF- Personal collection of Oscar Ángel Sánchez-Flores, Puebla, Mexico.

VECR- Personal collection of Vicente Emilio Carapia-Ruiz, Morelos, Mexico.

RESULTS AND DISCUSSION

Aleuoparadoxus Quaintance & Balker

This genus presents pupae with dentate margin and dorsal modified and reniform papillae. The pigmentation of the puparium is usually dark, being necessary a clearing process to determine its morphological characters. The submarginal papillae are usually arranged in a row, which secrete wax filaments as it is normally in the genus *Trialeurodes*. The genus *Aleuoparadoxus* is classified in the tribe Trialeurodini.

Aleuoparadoxus oaxacensis Carapia-Ruiz & Sánchez-Flores sp. nov.

<http://zoobank.org/urn:lsid:zoobank.org:act:4949A018-8D53-43BE-B372-7EA144A24759>

Figures 1–10.

Pupa. In situ: dark brown, scattered in the upper side of leaves, apparently flat dorsally. On slide ($n = 5$): oval, 880–920 μm in length, 630–720 μm in width (Fig. 1).

Margin. Dentate, approximately 17–22 rounded teeth, each 100 μm . Each thoracic tracheal pore with two lateral teeth and one middle tooth (Fig. 2), all with their apex at the level of the marginal teeth.

Submargin. Almost uniform in width, about 1/8 the width of pupa. Longitudinal lines mesad of submarginal papillae (Figs. 2, 3), generally in zig-zag-shaped ridges. Transverse lines (submarginal ridges) extending from margin to level of longitudinal lines and submarginal papillae (one ridge per tooth). 18–30 pairs of medium papillae (8–10 μm in diameter) and 33–58 pairs of small papillae (3–4 μm in diameter) in a single row in the submarginal area; 3–5 pairs of medium papillae around the tracheal thoracic pore (Fig. 2).

Dorsum. Cephalothorax: longitudinal molting suture 360–380 μm in length, reaching anterior margin of pupa; transverse molting suture 450–480 μm in length, ending before submarginal line. Slightly curved ocular marks in the subdorsal head zone, 32 μm long and 9 μm wide; two elevated head areas with 4–6 papillae each (Fig. 4); thoracic area with 6–7 pairs of papillae; 2 pairs of papillae in prothorax, 2 pairs of papillae in mesothorax, and 2–3 pairs of papillae in metathorax. Abdomen: subdorsal area (Figs. 2, 3, 6) with irregular transverse lines with 4–6 papillae in abdominal segments VII and VIII (Figs. 5, 7). Abdominal segments I–VI with 1 pair of papillae on its middle area (Fig. 8) and a pair of depressions near the papillae. Abdominal segments with approximate length measurements in the middle part as follows: segment I 62–73 μm , segment II 45–55 μm , segment III 45–55 μm , segment IV 45–55 μm , segment V 45–55 μm , segment VI 40–50 μm , segment VII 33–40 μm , segment VIII 56–67 μm (from suture to anterior margin of vasiform orifice).

Vasiform orifice. Triangular-cordiform, straight-sided, clearly longer than wide, 85–95 μm in length, 60–70 μm in width (Fig. 9). Operculum cordate, 25–35 μm (length) by 38–48 μm (width), occupying almost half of vasiform orifice. Lingula is almost hidden by the operculum. Distance from pupal margin to posterior margin of vasiform orifice: 40–50 μm . Caudal furrow narrow, defined by a pair of lateral developed crests (caudal ridges) ending at caudal setae (Fig. 9).

Chaetotaxy. Cephalic setae 15–25 μm long; A1 and A8 setae present; caudal setae 30–50 μm long, located on the terminal part of the pupa.

Pores. Associated with papillae. Those near large circular papillae (12–22 μm diameter): 4–6 pairs in the cephalic area, 6–7 pairs in the thoracic area, 2 pairs in the subdorsal area, and 6 pairs in submedian area of abdominal segments I–VI. Those near small papillae (3–4 μm diameter): 10 pairs in three rows in the cephalothoracic area, 10 pairs in two rows in the subdorsal area of the

abdomen, one pair on abdominal segment VIII, and about 70 pairs in the submarginal papillae row (Fig. 10).

Venter. Tracheal folds developed, smooth cuticle, and inconspicuous spines and setae at base of legs.

Comments. *Aleuoparadoxus oaxacensis* presents the common habit, as other species in the genus *Aleuoparadoxus*, of the pupae normally found on the upper side of the host's leaves. Other species of the different genera of Aleyrodidae are commonly found on the lower side of the leaves. *Aleuoparadoxus oaxacensis* belongs to the *sapotae* group, which present dark brown color and semioval to semicircular form. This species can be separated from the species *A. truncatus* Russell and *A. punctatus* Quaintance & Baker by the absence of the subdorsal thoracic-abdominal groove. Also, *Aleuoparadoxus oaxacensis* has 4–6 papillae in the subdorsal area of abdominal segments III–VIII, unlike *A. trinidadensis* Russell, which has 15–20 papillae in the same region. Additionally, the new species presents the submargin with a row of papillae of non-uniform size (small papillae group followed by a medium papillae group), inner margin of caudal ridges without tubercles, and body with the posterior half as wide as anterior half; contrastingly, *A. sapotae* Russell presents the submargin with short submarginal ridges, five tubercles at inner margin of caudal ridges, and body with the posterior half wider than anterior half (see Sánchez-Flores & Carapia-Ruiz, 2021). According to Martin (2005) and Garcia-Ochaeta & Evans (2021), more undescribed species of the genus await to be discovered.

Etymology. The specific epithet refers to the state of Oaxaca, where the specimens were collected.

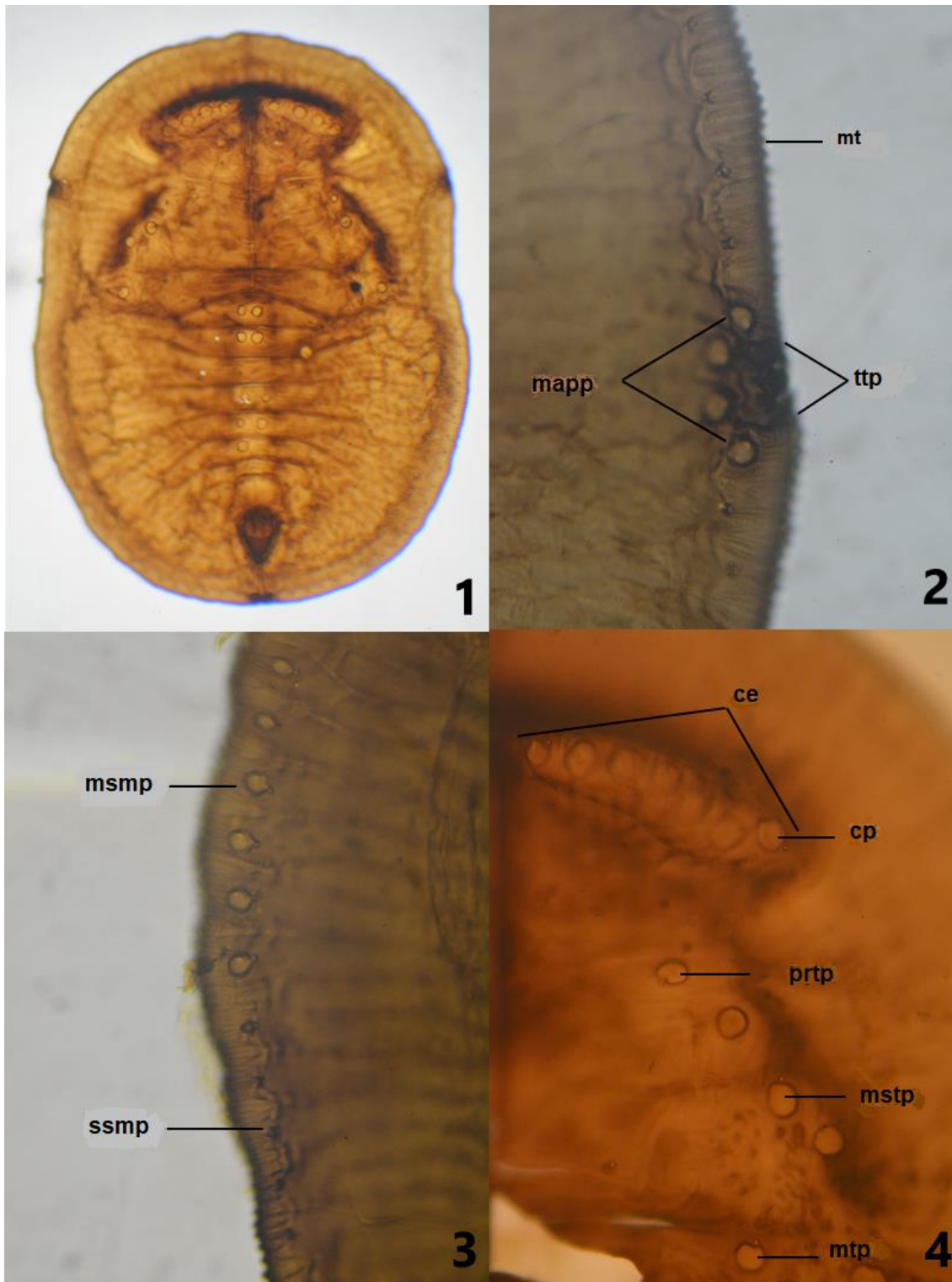
Host plant. *Guaiacum coulteri* A. Gray (Zygophyllaceae), commonly known as "Palo Santo."

Distribution. Mexico, Oaxaca (Huatulco).

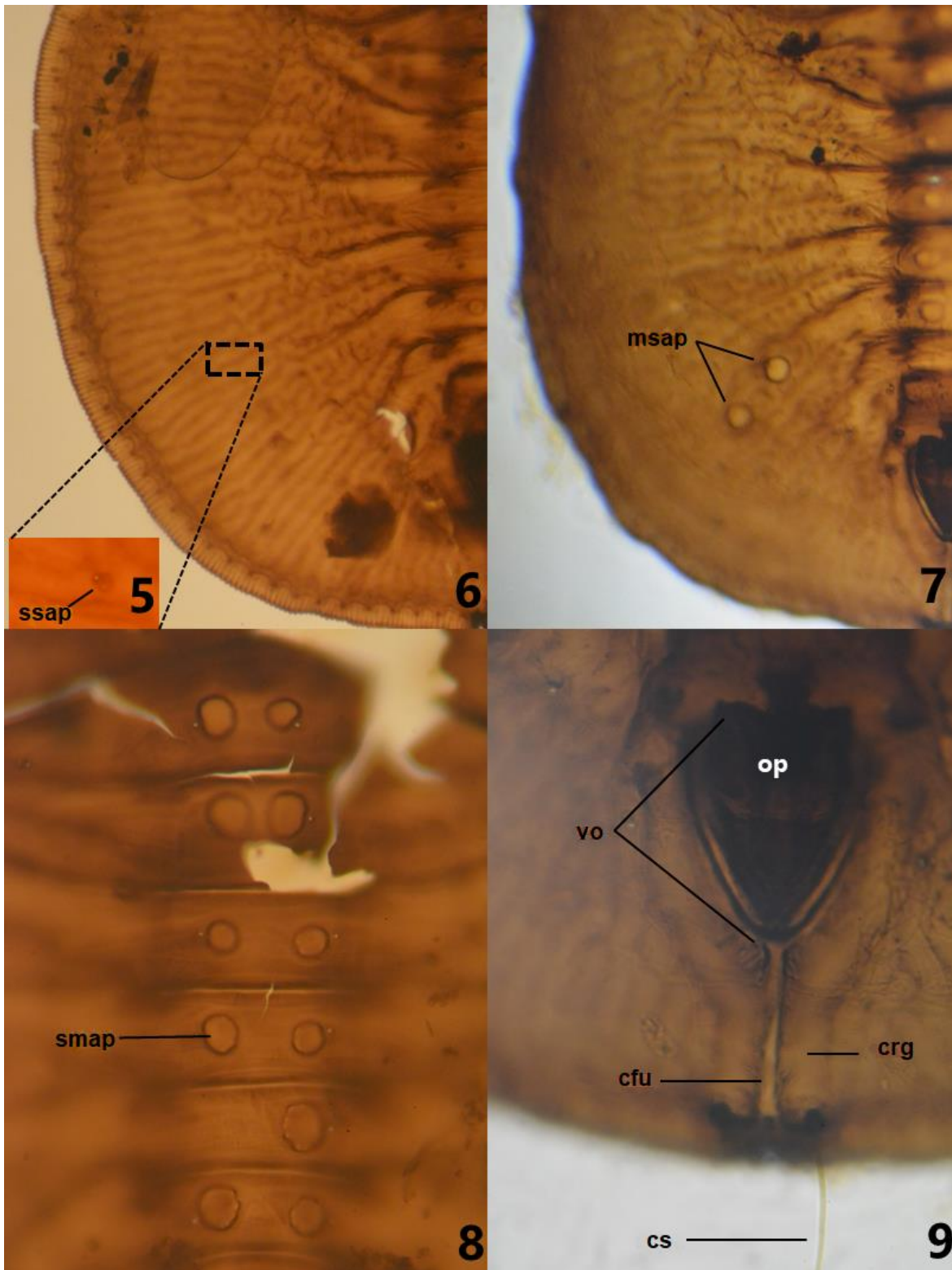
Type material. HOLOTYPE: Pupa. MEXICO: Oaxaca, Huatulco, on leaves of *Guaiacum coulteri*, June 20, 2017, Col. Sánchez-Flores, O. A. (CNIN). PARATYPES: 4 pupae with same data as holotype (1 CNIN; 2 OASF; 1 VECR).

Key to species of *Aleuoparadoxus* from Mexico

1. Submarginal papillae contiguous, elongated 2
- Submarginal papillae separated, not elongated, almost as wide as long 4
- 2(1). Thoracic tracheal pore not differentiated from the margin ***A. arctostaphyli* Russell**
- Thoracic tracheal pore differentiated from the margin, with three large marginal teeth 3
- 3(2). Submarginal papillae clearly elongated, more than twice as long as wide ***A. iridescens* (Bemis)**
- Submarginal papillae slightly elongated, less than twice as long as wide ***A. gardeniae* Russell**
- 4(1). Semitriangular elongated body, posterior half narrower than the anterior half; eye spots absent 5
- Semioval to semicircular body, almost as long as wide, posterior half as wide or wider than anterior half; eye spots present or absent 7
- 5(4). Cephalic area with 2 groups of 3 short papillae each; submedian abdominal papillae almost twice as long as wide ***A. rhodae* Russell**
- Cephalic area with 2 groups of 6–9 large papillae each; submedian abdominal papillae semicircular, almost as long as wide 6



Figures 1–4. Pupa of *Aleuoparadoxus oaxacensis* Carapia-Ruiz & Sánchez-Flores sp. nov. 1) dorsal view, 2) thoracic section, 3) margin and submargin, 4) cephalothoracic area. ce = cephalic elevation, cp = cephalic papillae, mt = marginal teeth, mapp = medium-size around the pore papillae, msmp = medium submarginal papillae, mstp = mesothoracic papillae, mtp = metathoracic papillae, prtp = prothoracic papillae, ttp = thoracic tracheal pore, ssmpp = small submarginal papillae.



Figures 5–9. Pupa of *Aleuoparadoxus oaxacensis* Carapia-Ruiz & Sánchez-Flores sp. nov. 5) detail of subdorsal area, 6 and 7) subdorsal area, 8) abdominal segments, 9) posterior section. cfu = caudal furrow, crg = caudal ridge, cs = caudal seta, smap = submedian abdominal papillae, msap = medium subdorsal abdominal papillae, op = operculum, ssap = small subdorsal abdominal papillae, vo = vasiform orifice.

- 6(5). Cephalic papillae arranged in a transverse row **A. gabrieli** García-Ochaeta & Evans
 — Cephalic papillae arranged randomly, not in a transverse row **A. carapii** García-Ochaeta & Evans
- 7(4). Without eye spots **A. illicola** Russell
 — With eye spots 8
- 8(7). Thorax and abdomen without subdorsal ridge; cephalic area with two groups of 6–8 papillae each 9
 — Thorax and abdomen with a subdorsal ridge; cephalic area without papillae **A. truncatus** Russell
- 9(8). Submargin with non-uniform submarginal ridges; five tubercles on the inner caudal ridges; body with posterior half wider than anterior half **A. sapotae** Russell
 — Submargin with uniform submarginal ridges; without tubercles on the inner caudal ridges; body with posterior half as wide as anterior half **A. oaxacensis** sp. nov.

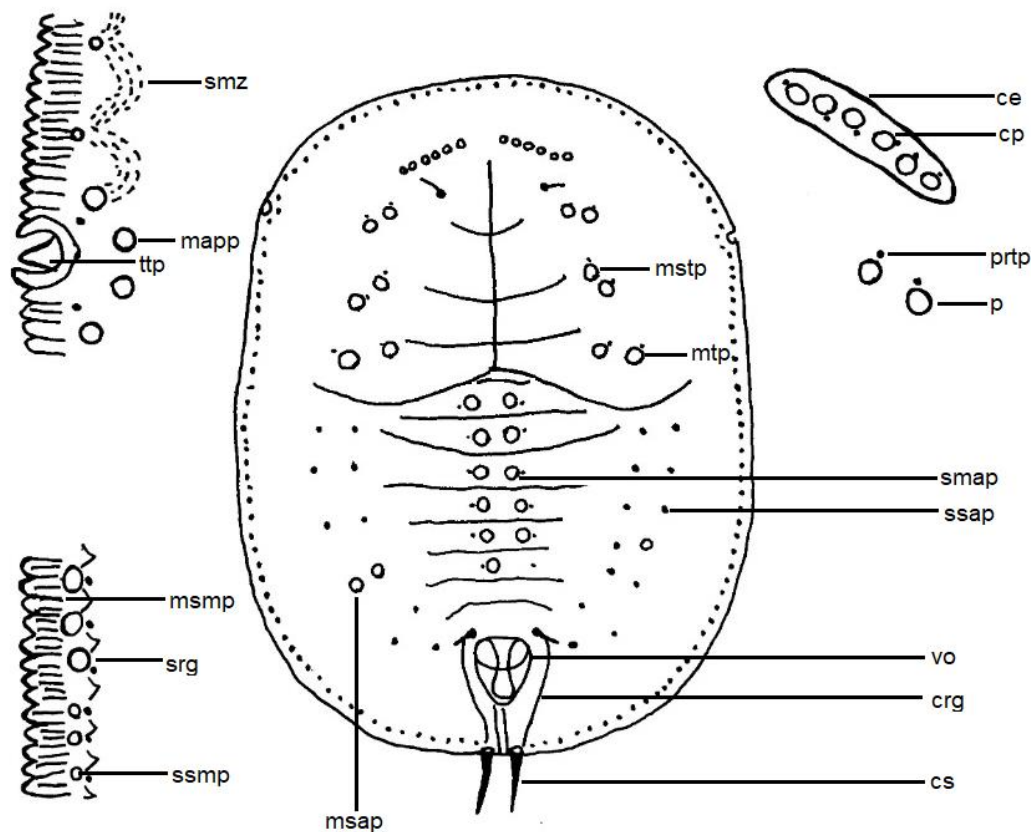


Figure 10. Pupa of *Aleuoparadoxus oaxacensis* Carapia-Ruiz & Sánchez-Flores sp. nov. ce = cephalic elevation, cfu = caudal furrow, cp = cephalic papillae, crg = caudal ridge, cs = caudal seta, mapp = medium-size around the pore papillae, msap = medium-sized subdorsal abdominal papillae, msmp = medium-size submarginal papillae, mstp = mesothoracic papillae, mtp = metathoracic papillae, p = pore, prtp = prothoracic papillae, smap = submedian abdominal papillae, smz = submarginal tubercles in zig-zag, srg = submarginal ridges, ssap = small-sized subdorsal abdominal papillae, ssmp = small-sized submarginal papillae, ttp = thoracic tracheal pore, vo = vasiform orifice.

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