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José Francisco García Ochaeta

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José Francisco García-Ochaeta
Laboratorio de Diagnóstico Fitosanitario, Ministerio de Agricultura, Ganadería y Alimentación, Petén, Guatemala

Anil Kumar Dubey
Zoological Survey of India, M- Block, New Alipore, Kolkata, West Bengal, India 700053

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Description of a new species of *Aleuroparadoxus* Quaintance and Baker (Hemiptera: Aleyrodidae) from Guatemala

José Francisco García-Ochaeta
Laboratorio de Diagnóstico Fitosanitario, Ministerio de Agricultura, Ganadería y Alimentación, Petén, Guatemala
jfranciscogarciaochaeta@gmail.com
https://orcid.org/0000-0001-8300-7846

Anil Kumar Dubey
Zoological Survey of India, M- Block, New Alipore, Kolkata, West Bengal, India 700053
anil.2kd@gmail.com
https://orcid.org/0000-0003-0831-9780

Abstract. Puparia of a new whitefly, *Aleuroparadoxus marisae* García-Ochaeta and Dubey, **new species** (Hemiptera: Aleyrodidae), collected on leaves of *Brosimum alicastrum* Sw. in Santa Ana, Petén, Guatemala, and on *Pimenta dioica* (L). Merr. in Calzada Mopán, Dolores, Petén are described and illustrated. Drawings of morphological structures and differential diagnosis of the puparium are provided, and differences from congeners are discussed. A key to puparia of the *Aleuroparadoxus* Quaintance and Baker species is included.

Key words. Aleyrodinae, new species, whitefly, *Brosimum alicastrum*, *Pimenta dioica.*

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Introduction

The whitefly genus *Aleuroparadoxus* Quaintance and Baker, 1914 comprises 13 described species worldwide (García-Ochaeta and Evans 2020), which belong to the tribe Trialeurodini of the subfamily Aleyrodinae. The genus is distributed only in the New World, with most species described from the southwestern United States, Mexico, and Central America (García-Ochaeta and Evans 2020; Sánchez-Flores and Carapia-Ruiz 2021). Puparia of *Aleuroparadoxus* species are recognizable in having generally flat, plate-shaped, subdorsal papillae with modified margins in the tracheal pore opening areas, cordate vasiform orifice, and short caudal furrow. Martin (2005) reported that the puparia of *Aleuroparadoxus* species are found individually on leaves in Belize. Herein, a new species from Guatemala, *Aleuroparadoxus marisae* **new species,** is described and illustrated. The new species description brings the total number of *Aleuroparadoxus* species to five from Guatemala.

Materials and Methods

Puparia of the *Aleuroparadoxus marisae* **new species** used for the descriptions (holotype and paratypes) were collected on leaves of *Brosimum alicastrum* Sw. (Moraceae) and *Pimenta dioica* (L.) Merrill (Myrtaceae) trees in Guatemala. They were examined under a stereoscopic microscope and then slide mounted following the methodology of Wilkey (1962) and modified by Hodges and Evans (2005). Canada balsam was used for permanent preparations; puparia were identified using a compound microscope (Leica DM 2500) with magnifications of 40×, 400× and 1000×. The specimens were collected by the first author and deposited in UVGC (Collection of Arthropods of the Universidad del Valle de Guatemala) and in the United States Museum of Natural History (USNM) in Beltsville, Maryland, USA.

Results

Taxonomy

Aleuroparadoxus Quaintance and Baker, 1914

Aleuroparadoxus Quaintance and Baker 1914: 104. Type species: *Aleyrodes iridescens* Bemis 1904: 487–489, by monotypy.

Distribution. New World. Nearctic (4 species); Neotropical (14 species) (see Table 1).

Hosts. Various trees and shrubs (Table 1).

Diagnosis. *Aleuroparadoxus* comprises species with the following combination of characters: puparium ovoid to slightly wider than long; cuticle usually dark brown to black with little wax secretion; margin crenulate, modified at thoracic tracheal openings; dorsal papillae present, usually with a submarginal row and others present on

Table 1. Distribution of *Aleuroparadoxus* species and their host plants (updated from García-Ochaeta and Evans 2020). Bold text indicates locality and host plant data associated with the holotype. Int.: Described from mounted intercepted from an unstated locality in Mexico.

Species	USA	Mexico	Central America	Caribbean	South America	Hosts
iridescens group						
arctostaphyli	**CA**, OR, NV	Baja California, Coahuila				***Arctostaphylos***, *Arbutus*, *Ceanothus* sp., *Lindleya*
gardeniae	TX	**Jalisco**	Costa Rica, El Salvador, Guatemala	Cuba		*Citrus, Coffea*, *Diospyros*, ***Gardenia***, *Hibiscus*
iridescens	**CA**, HI	Baja California				*Arctostaphylos*, *Gardenia,* ***Heteromeles***, *Psidium*, *Rhamnus*, *Salvia, Solanum*, *Umbellularia*
rhodae group						
carapiai		Int.				***Citrus*** sp.
chomeliae			**Panama**			***Chomelia***
gabrieli		Int.	**Guatemala**			*Coffea*, *Persea*, ***Pimenta***
rhodae		Int.	Belize			*Eugenia*, ***Gardenia***
sapotae group						
elmarrojasi			**Guatemala**			***Pimenta***
ilicicola	**AL,** LA	Int.				***Ilex***, *Psidium*
marisae			**Guatemala**			***Brosimum***, *Pimenta*
punctatus					**Chile**	*Azara, Colliguaja*, ***Lithraea***, *Quillaja*, *Schinus*
sapotae		Tamaulipas	**Belize,** Guatemala			***Achras***, *Manilkara*, *Pimenta*, *Randia*
trinidadensis				**Trinidad**		***Davilla***
truncatus		Chiapas	**Honduras** Belize			***Davilla***, *Eugenia*, *Lonchocarpus*
Total = 14 species	4	9	8	1	1	

dorsal disc, the papillae variably developed, but generally somewhat flat, plate-like; transverse moulting suture reaching submargin; median length of abdominal segments VI and VII similar; each cephalic seta situated on the lateral apex of a superficial thumb-shaped ridge; submargin of cephalothorax with seven pairs of setae; submargin of abdomen with eight pairs of setae; vasiform orifice cordate, entirely occupied by the operculum, with its floor divided in half in most species, with posterior half often reticulate, and head of lingula lobed, but covered by operculum; with a short apical groove, defined by a pair of variably developed caudal ridges ending in a pair of caudal setae; ventrally, the tracheal folds well defined and the legs aligned mesally by a band of blunt spines (Martin 2005).

Aleuroparadoxus marisae García-Ochaeta and Dubey, new species

(Fig. 1–5)

Type material. Holotype puparium. Guatemala: Petén, Santa Ana, puparium on *Brosimum alicastrum*, 11.VI.2018, 16.808315° N, 89.827173° W, Col. José García, (deposited in the UVGC). Paratypes: 10 puparia, 5 puparia on 5 slides, data as the holotype (deposited in the UVGC); 2 puparia on 2 slides, data as the holotype (deposited in the USNM); 2 puparia on 2 slides, same information except collection date, 7.VII.2021; 1 puparium

Figure 1. *Aleuroparadoxus marisae* **sp. nov.** puparium on a leaf of *Brosimum alicastrum*.

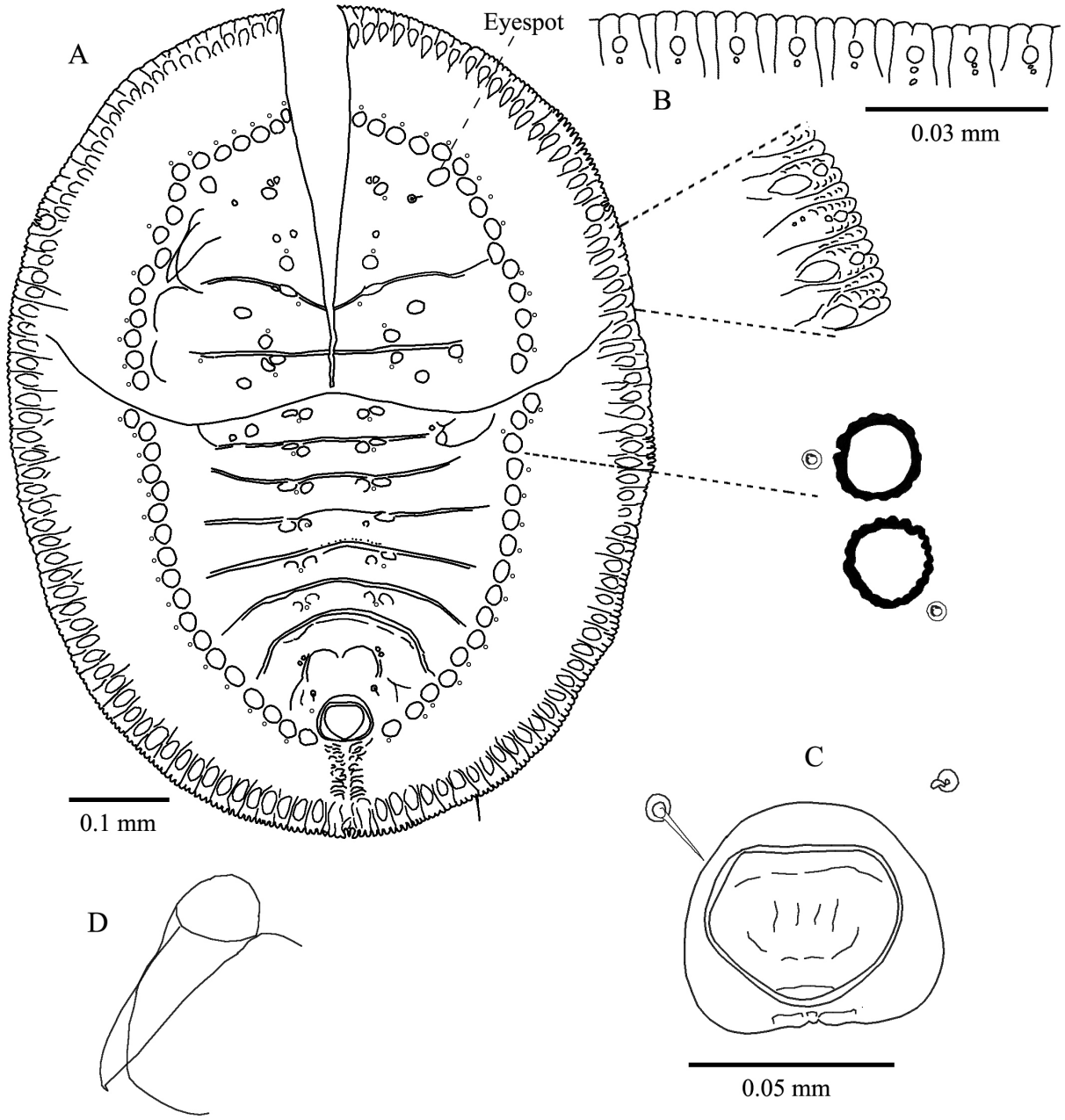


Figure 2. *Aleuroparadoxus marisae* **sp. nov.**, line drawing. **A)** Holotype puparium. **B)** Margin. **C)** Vasiform orifice. **D)** Antenna.

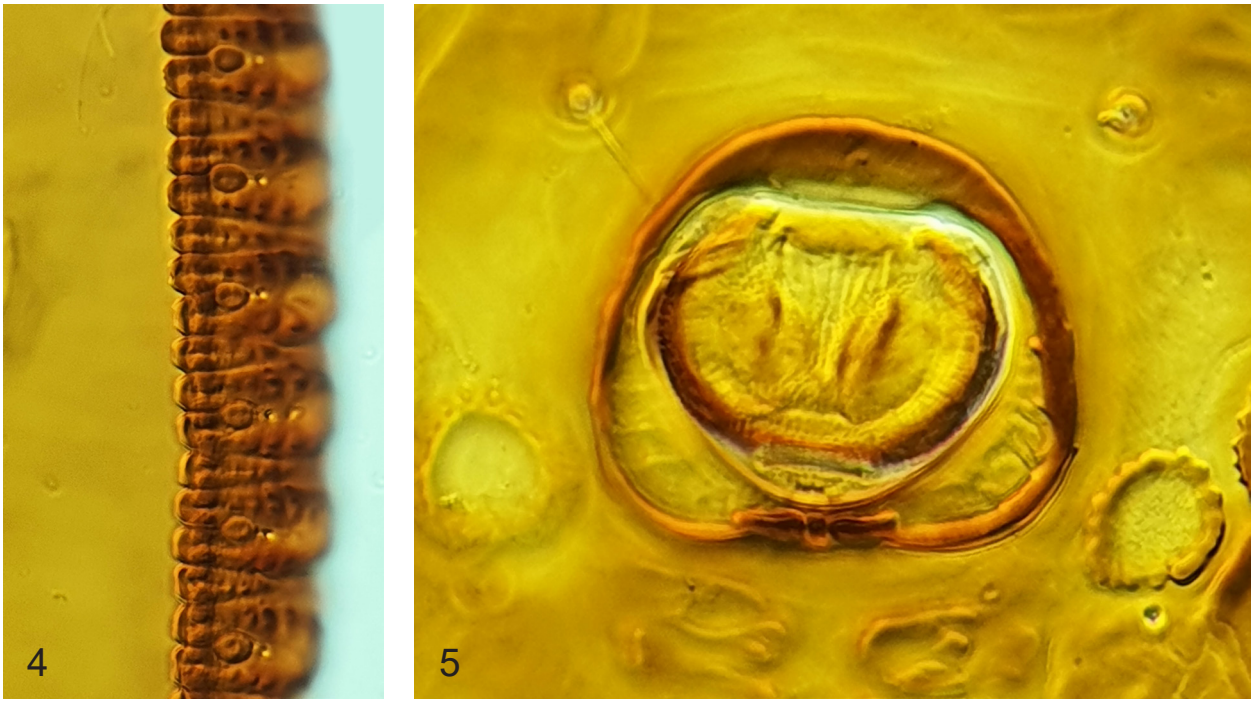
on *Pimenta dioica*, Guatemala: Petén, Dolores, Calzada Mopán, 16.679534° N, 89.417516° W, 21.III.2019. Col. José García (deposited in the UVGC).

Diagnosis. The puparium of *Aleuroparadoxus marisae* **new species** (Fig. 2–3) resembles that of *A. trinidadensis* Russell, but differs from it in having a row of subcircular papillae on the subdorsal area which extends from cephalus to the vasiform orifice, subcircular eyes, and a subtrapezial vasiform orifice.

Description. Puparium. Oval, black (Fig. 1); 950–1365 µm long, 744–1128 µm wide, 1.2× longer than wide.

Dorsum. Marginal teeth short, broad with rounded apices, margin modified at the thoracic and caudal tracheal openings, having a central tooth with an acute apex and a pair of curved teeth adjacent to it, and with

Figure 3. *Aleuroparadoxus marisae* **sp. nov.**, pupal holotype on slide.



Figures 4–5. *Aleuroparadoxus marisae* **sp. nov. 4)** Margin and submargin. **5)** Vasiform orifice.

a semicircular impression just medial at the spiracular opening. Submargin with 64–88 slightly raised conical papillae, located in a single row, with a pair of pores associated with each papilla, including 27–33 in the cephalothorax and 37–50 in the abdomen, the uniform papillae located at a distance between 3.5–4.5×, the diameter of a papilla, each papilla 1.5× longer than wide (Fig. 4). Subdorsal area about 3.7× wider than submarginal area, with many fine stripes, extending to lateral margin, its submedial margin (subdorsal or submedian line) demarcated by a row (sometimes doubled) of subcircular papillae 18–22 µm in diameter, flat on top, with small blunt spines on their edges, associated with a pore on submargin side, extending from the cephalothorax to the vasiform orifice on the submedian area. Submedian area rough, smooth on median area of the abdomen. Longitudinal moulting suture reaching the margin and transverse moulting suture reaching the submargin, near submarginal papillae. A pair of subcircular eyespots about the same size as the subcircular papillae present on the submedian area. Cephalus with a pair of subcircular papillae and a pair of depressions. Submedian pockets present on pro-, meso-, and metathoracic segments, each with two pairs of oval submedian depressions, metathorax sometimes with only one pair of depressions. Each submedian depression is associated with a minute pore. Abdomen 1.1–1.3× times longer than length of cephalothorax; a pair of submedian pockets present on abdominal segments; submedian depressions present on abdominal segments I to VI (absent on segment VII and VIII), each depression associated with a minute pore, located in a row down the center. Median length of abdominal segments I–VII measured as: I 46–71, II 38–62, III 38–68, IV 39–61, V 35 –62, VI 33–55, VII 39–66, and VIII 73–86 µm.

Vasiform orifice. Subtrapezoidal (Fig. 5), 0.8–0.9× long as wide, 53–70 µm long, 66–77 µm wide; operculum semicircular, covering 0.8× of the orifice, completely covering the lingula; distance from the vasiform orifice to the caudal margin of the puparium approximately 2× the length of the vasiform orifice; caudal furrow about as wide as deep, caudal ridges with rough sculpture.

Venter. Antennae reaching bases of prothoracic legs; thoracic and caudal tracheal folds conspicuous, without stipples. A pair of ventral abdominal setae present, located anterior to the vasiform orifice.

Chaetotaxy. Anterior and posterior marginal setae present; cephalic, first abdominal, eighth abdominal and caudal setae present, eighth abdominal setae cephalolateral to vasiform orifice. The base of each middle and hind leg with a seta. All setae with acute apices.

Distribution. Neotropical: Guatemala.

Host plants. Moraceae: *Brosimum alicastrum*, Myrtaceae: *Pimenta dioica.*

Etymology. The epithet is named in dedication to the sister of the first author Marisa Janeth García Ochaeta, for her unconditional support at all times.

Remarks. *Aleuroparadoxus marisae* **new species** belongs to the '*sapotae*' group and is the only species collected on a host of the Moraceae family. The puparium of the new species differs from all *Aleuroparadoxus* species in having prominent eyespots, the posterior part of the vasiform orifice wider than the anterior, and the wall of the vasiform orifice dorsally flat, forming a shallow surface.

Key to the puparia of the *Aleuroparadoxus* species

(modified from Garcia-Ochaeta and Evans 2020)

1. Submarginal papillae greatly elongated, bullet-shaped, each 2.1–3.5× as long as wide; nearly contiguous, with a maximum distance between each less than half (0.1–0.4×) the width of a papilla; eyespots absent ..... **(*iridescens* group) 2**

— Submarginal papillae not so elongated, each 0.5–1.4× (up to 2.0× only in *A. punctatus*) longer than wide, round, oval or flame-shaped, not contiguous, with a maximum distance between each 0.9–1.6× the width of a papilla; with or without eyespots **4**

2(1). Thoracic spiracular opening undifferentiated from the lateral margin; submarginal papillae 2.8–3.5× as long as wide; head usually with a row of 4 large, round papillae of similar size about equidistant; body papillae large, round kidney shaped; USA (California, Nevada, Oregon); Mexico ..... ***A. arctostaphyli* Russell**

— Thoracic spiracular opening differentiated from the lateral margin, like a trident; submarginal papillae 2.0× as long as wide; head usually with a row of 6 large or medium, round kidney-shaped papillae, most other body papillae large or medium, nearly round kidney-shaped **3**

3(2). Most of the kidney-shaped dorsal papillae are very large and round; each thoracic spiracular opening with a group of small pores; USA (California, Hawaii), Mexico ..... ***A. iridescens* (Bemis)**

— Almost all dorsal kidney-shaped papillae are medium round; each thoracic spiracular opening without a group of small pores; USA (TX); Mexico; Guatemala; El Salvador; Costa Rica; Cuba ..... ***A. gardeniae* Russell**

4(1). Body elongated elliptic, 1.5–1.7× as long as wide; eyespots absent ..... **(*rhodae* group) 5**

— Body oval wider than long, 0.9–1.4× as long as wide; eyespots present or absent ... **(*sapotae* group) 8**

rhodae group

5(4). Body entirely clear, elongate oval ~1.6× as long as wide and not tapering posteriorly; very inconspicuous submarginal papillae, head with a row of 8 small round papillae equidistant from each other; submedian abdominal papillae kidney-shaped very small (about the size of a setae base and in more than one row); Panama ..... ***A. chomeliae* Russell**

— Body sclerotized and brown or black (at least the central part), elongated oval ~1.5–1.7× longer than wide and tapering posteriorly; conspicuous submarginal papillae; head papillae variable (but not as in *A. chomeliae*), median abdominal papillae kidney-shaped, greatly elongated; submedian abdominal papillae small or large and in a row **6**

6(5). Submedian abdominal papillae small round kidney shaped; cephalus with 2 groups of 3 medium-sized, almost round kidney-shaped papillae in a row, plus a pair of very small central papillae posterior to the groups (8 in total); body about 1.6× as long as wide; light color with brown central part, not thinning much after; Belize; Mexico ..... ***A. rhodae* Russell**

— Submedian abdominal papillae medium to large round kidney-shaped; head with 7–8 pairs of large (rarely 9), elongated papillae, each up to 2× as long as wide; body about 1.8× as long as wide; uniform brown or black color, thinning much after; median and submedian abdominal papillae large elongated to round, deeply incised **7**

7(6). Head with 6–9 pairs of highly elongate kidney-shaped dorsal papillae, up to 3× as long as wide, arranged in a row; elongated median papillae on A1 much smaller than those on A2, those on A3–A6 subequal to and larger than those on A2; central part of abdomen and submedian part of thorax darker than lateral parts; Guatemala; Mexico ..... ***A. gabrieli*** **García-Ochaeta and Evans**

— Head with 6–7 pairs of less elongate kidney-shaped dorsal papillae, each 2× as long as wide, arranged in more than one row; median papillae rounder than elongated, on A1–A6 subequal in size; central part of abdomen, median and submedian thorax and lateral margin darker than other parts; Mexico ..... ***A. carapiai*** **García-Ochaeta and Evans**

sapotae **group**

8(4). No eyespots; submarginal papillae flame-shaped; small submedian kidney-shaped papillae; body oval, 1.3–1.4× as long as wide **9**

— With conspicuous eyespots; submarginal papillae round or oval, not flame-shaped (except in *A. elmarrojasi*); variable submedian papillae; body oval or round, 0.9–1.4× as long as wide **10**

9(8). Body with a submarginal ridge on thorax and abdomen, ending in a "V" shape on rear margin; submarginal papillae 2.0× as long as wide; Chile ..... ***A. punctatus*** **Russell**

— Body without a submarginal ridge on the thorax and abdomen, ending in a "V" shape on the posterior margin; submarginal papillae 1.4× as long as wide; USA (AL, LA); Mexico **...** ***A. ilicicola*** **Russell**

10(8). Body oval or nearly round, 0.9–1.0× as long as wide; very dark with light spots; cephalus with a row of 8 pairs of rectangular papillae, almost glued together; submargin reticulate, abdominal segments with a single row of very small kidney-shaped papillae; Belize; Guatemala; Mexico ..... ***A. sapotae*** **Russell**

— Body oval, 1.1–1.2× as long as wide; brown without light spots; cephalus with round reniform papillae, not attached; submargin rough or streaked, abdominal segments with a single row of very small kidney-shaped papillae or with one or more than one row of large papillae **11**

11(10). Body without a submarginal ridge on thorax and abdomen, terminating in a "V" shape at posterior margin, conspicuous large subcircular submedian papillae, in one or two rows on abdominal segments or over entire submedial band from cephalothorax to vasiform orifice **12**

— Body with a submarginal ridge on the thorax and abdomen, ending in a "V" shape on the posterior margin, very small and inconspicuous round submedian papillae, in a row on the submedian suture; cephalus with 3 pairs or less of round and very small papillae **13**

12(11). Submedian subcircular papillae in double rows on basal segments of abdomen; cephalus with 3–6 pairs of medium papillae in a single row; vasiform orifice widely chordate; Trinidad ..... ***A. trinidadensis*** **Russell**

— Submedian subcircular papillae, in a row (sometimes doubled) running from the cephalothorax to the vasiform orifice; subtrapezoidal vasiform orifice; Guatemala ..... ***A. marisae*** **García-Ochaeta and Dubey, sp. nov.**

13(12). Anterior area of the vasiform foramen without a round structure; cephalus with 3 pairs of papillae in 2 groups; rough submarginal area; Belize; Honduras; Mexico ..... ***A. truncatus*** **Russell**

— Anterior area of the vasiform orifice with a round structure; head without papillae, but 10–12 very small papillae present below dark suture of head; striped submarginal area; Guatemala ..... ***A. elmarrojasi*** **García-Ochaeta and Evans**

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