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A new species of *Oecleus* Stål (Hemiptera: Fulgoroidea: Cixiidae) from coconut in Brazil

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Abstract

A new species of cixiid planthopper (Hemiptera: Fulgoroidea) in the genus *Oecleus* Stål, *Oecleus sergipensis* n. sp., is described from Sergipe State, Brazil. This new taxon is associated with coconut (*Cocos nucifera* L.) and date palm (*Phoenix* L). The species was detected in Auchenorrhyncha surveys to find potential vectors of lethal yellowing type syndrome. This is the first report of the genus *Oecleus* in Brazil. Sequence data from the mitochondrial cytochrome c oxidase subunit I (COI) barcoding region was obtained and accessioned into GenBank.

Key words: Cixiidae, Fulgoroidea, Auchenorrhyncha, coconut, lethal yellowing type syndrome, new species

Introduction

The genus *Oecleus* Stål 1862 (Hemiptera: Fulgoroidea: Cixiidae) consists of 64 species, all New World, currently known to be distributed from southern Canada south to Guatemala and El Salvador (Kramer 1977, Bourgoin 2018), with highest diversity in southwestern United States (Bartlett *et al.* 2014). The genus was most recently revised by Kramer (1977). Kramer (1977) considered only species north of Mexico, but reviewed all described species to preclude synonymy. Descriptions of Mesoamerican species can be found in Caldwell (1944a) and Fowler (1904).

Oecleus is the type genus of the tribe Oecleini Muir, 1922 that includes 22 genera, of which 8 are reported from the New World (viz. *Antillixius* Myers 1928, *Haplaxius* Fowler 1904, *Notolathrus* Remes Lenicov 1992, *Nymphocixia* Van Duzee 1923, *Nymphomyndus* Emeljanov 2007, *Oecleus* Stål 1862, *Proclitus* Emeljanov 2007 and *Rhamphixius* Fowler 1904). Of these, only *Haplaxius* is known from Brazil, represented by *Haplaxius crudus* (Van Duzee, 1907). *Haplaxius crudus* has recently been found in coconut plantations in Santa Izabel do Para municipality, State of Para (Silva *et al.* 2018, unpublished data), and previously found in 1988 on oil palm (*Elaeis guineensis* Jacq.) in a plantation in the suburbs of Belem (Louise 1990, Celestino Filho *et al.* 1993). Other genera reported from South America are *Nymphocixia* and *Proclitus* (Muir 1930, Emeljanov 2007, Bartlett *et al.* 2014).

Diagnostic features of the Oecleini include that the bases of the longitudinal veins Sc, R, and M form a common stalk (so that only two veins appear to arise from the basal cell; Muir 1922). Other features of this tribe include the frontoclypeal border is approximately straight, the median ocellus is evident, front (metope) diamond-shaped, and the hind tibia is without lateral teeth and bears a gap in the apical spinules (Emeljanov 2007).

Here we describe a new species of *Oecleus* from Brazil. The specimens were collected as part of a survey of Auchenorrhyncha associated with coconut (*Cocos nucifera* L., Areaceae) to find potential vectors of the

phytoplasma causing lethal yellowing type syndrome, a prioritized quarantine pest absent in Brazil (Laranjeira *et al.* 2017). This study evaluated the diversity of Auchenorrhyncha associated with coconut tree plantations in the states of Alagoas, Bahia, and Sergipe in the Northeastern region (Silva *et al.* 2018, unpublished data).

Materials and methods

Specimens were collected using yellow adhesive traps and with entomological aspirators from Coconut International Bank for Latin America and the Caribbean (ICG-LAC) located in the experimental fields of Neópolis and Itaporanga D'Ajuda, Sergipe, Brazil (by Embrapa). In addition, they were also found in palms of the genus *Phoenix* L. (date palm, Areaceae) at the Augusto Franco Park in the city of Aracaju, Sergipe, Brazil. Subsequently the insects were stored in alcohol and sent to CRB for identification.

Molecular identification. For the insect molecular identification the total DNA was extracted with Dneasy® Plant Mini Kit (Qiagen), diluted and then amplified the initial positions (the barcoding region) of the mitochondrial cytochrome c oxidase subunit I (COI) gene by PCR according to Ceotto *et al.* (2008). The primers used were: 2183 (CAACATTTATTTTGATTTTTGG) and UEA8 (AAAATGTTGAGGGAAAATGTTA) (Ceotto *et al.* 2008). After amplification, the size of the products were confirmed with electrophoresis in 2% agarose gel, stained with ethidium bromide and visualized under UV light. Then the samples were purified with the GFX™ PCR DNA and Gel Purification kit (GE Healthcare®) and sequenced at Myleus Biotechnology Company (Brazil).

Morphological identification. Representative specimens were dry-mounted for deposition in the UDCC and MPEG collections. Mounted specimens were provided with a 2D barcode labels and data captured using “Arthropod Easy Data Capture” (Schuh *et al.* 2010, Schuh 2012, Arthropod Easy Capture 2013) in the NSF sponsored “Tri-Trophic Thematic Collection Network” (<http://tcn.amnh.org/>). These data are visualized at Discover Life (www.discoverlife.org) and are available via the iDigBio (www.idigbio.org) specimen portal. Planthopper nomenclature follows Bartlett *et al.* (2014), except wing venation following Bourgoin *et al.* (2015). Specimens are deposited in:

UDCC—University of Delaware, Dept. of Entomology and Wildlife Ecology, Newark, Delaware, USA;

MPEG—Museu Paraense Emilio Goeldi, São Brás, Belem, Pará, Brazil;

CPATU—Entomological Collection of Embrapa Eastern Amazonia.

Label information of types is quoted, with ‘/’ indicating new line and ‘//’ indicating next label. Photographs and measurements of specimens were taken using a digital imagery system consisting of a Nikon SMZ1500 microscope, Nikon Digital Sight DS-U1 camera, and NIS Elements Imaging software (version 3.0).

Results

Systematics

Genus *Oecleus* Stål, 1862: 306.

Type species *Oecleus seminiger* Stål, 1862: 307.

Diagnostic summary (modified from Kramer 1977). Small to midsize (3.3–8.5 mm); head narrower than pronotum (in dorsal view) with eyes large. Vertex narrow, trough-like and parallel-sided, lateral and anterior margin carinate. Slightly raised; proximally narrowed and distally produced beyond eyes for a variable distance. In lateral view, apex of head acutely or obtusely angled, eyes emarginate, ocellus present under each eye and near midline above frontoclypeal suture. In frontal view, frons elongated and narrowed toward vertex, carina on midline of frons present (sometimes obsolete). Clypeus triangular or subtriangular. Antennae originating from large socket, scape reduced and collar-like, pedicel rounded with sensoria, flagellum beadlike basally and filamentous distally. Pronotum collar-like with irregular ridges, narrowest on midline, indented on posterior margin, carinate on posterior and lateral margins. Mesonotum longer at midline than combined lengths of vertex and pronotum,

mesonotum flattened, usually bearing five longitudinal carinae, sometimes carinae flanking central carina absent or reduced to pigmented lines. Hind tibiae without lateral spines. Forewings clear, rarely with color pattern, veins usually dotted with dark pustules, often bearing setae. Male terminalia with pygofer longest on ventral margin, anal tube elongated, paired slender symmetrical gonostyli ('styles' of Kramer 1977) flanking median lobe of pygofer; gonostyli and basal portion of asymmetrical aedeagus articulated by vertical connective. Aedeagus consisting of a ridged basal phallosome (periandrium, "shaft" of Kramer 1977) and distal, movable retrorse flagellum (endosoma); phallosome with 1 to 3 processes, flagellum with 0 to 2 processes.

Remarks. *Oecleus* is distinctive and can be separated from all other Cixiidae in our fauna by characters of the head in dorsal view. The vertex, is greatly narrowed and trough-like, mainly parallel sided but narrower proximally than apically and is separated from the front by a short transverse carina. These features separate *Oecleus* from all genera in Oecleini except possibly *Rhamphixius*, which (e.g.) has a greatly projected vertex, and possibly *Antillixius*. *Antillixius*, known only from Cuba, which has a sharply pointed head (in lateral view), vertex very deeply trough-like, with the lips of the trough contiguous all the way between the eyes, 3 carinae on the mesonotum, veins of wings without granulations (Myers 1928). *Nymphocixia* and *Nymphomyndus* have the vertex narrow, but the head appears broadly rounded from lateral view.

***Oecleus sergipensis* n. sp.**

(Figures 1–12)

Type locality. Itaporanga D'Ajuda, Sergipe, Brazil.

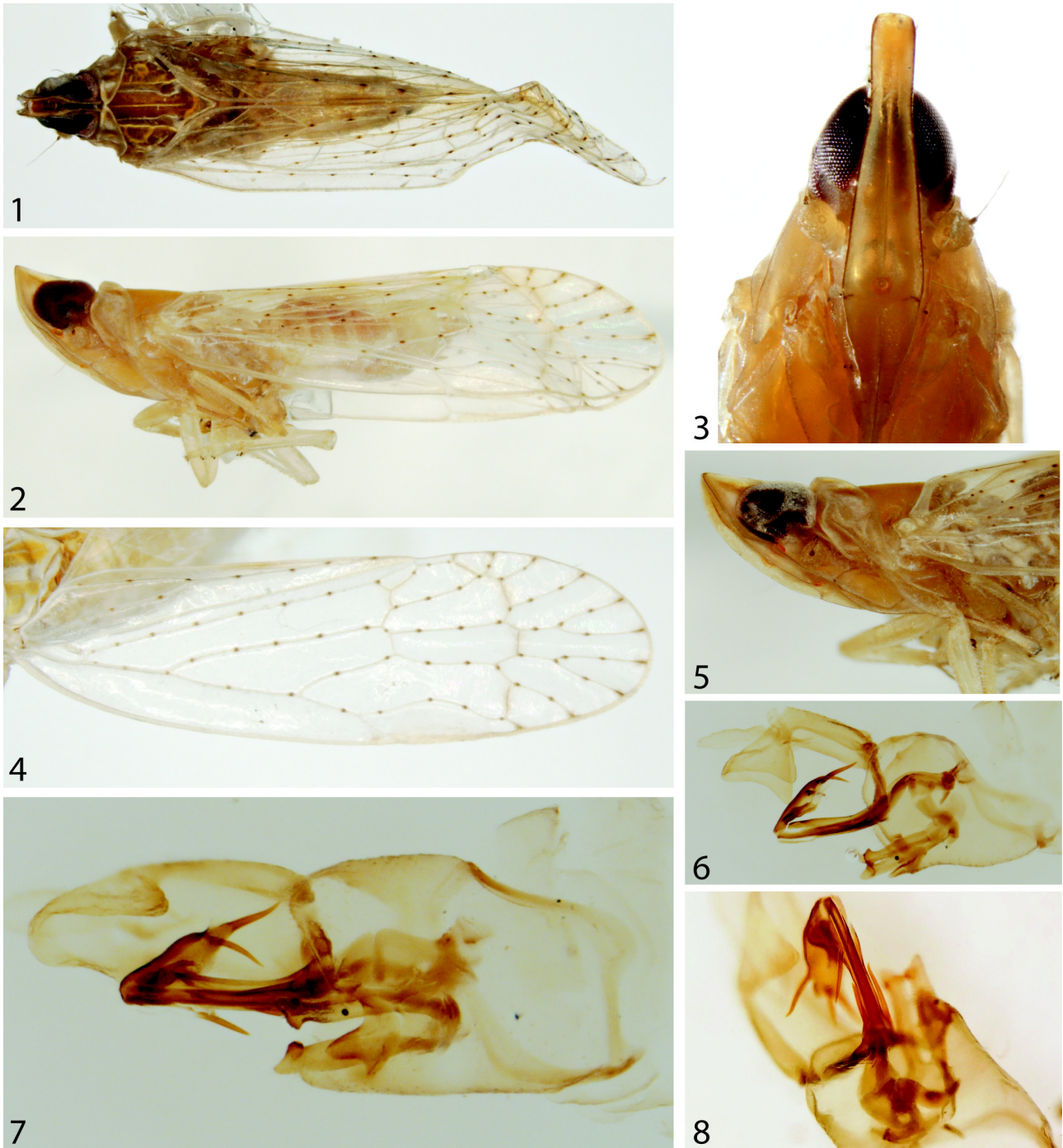
Diagnosis. A pale species, ~5–6 mm, with 5 carinae on the mesonotum and a projected head. Male terminalia with a broad, rounded ventral lobe of the pygofer, 3 processes on the phallosome (2 subbasal—1 on each side—and one near midlength on right side), and 5 flagellar processes. Anal tube very broad and truncate apically, strongly concave ventrally.

Description. *Color.* Ground color of body tan to yellowish-white (Figs. 1–3); legs brownish white; wings clear. *Structure.* Body length (including wings) males \bar{x} = 5.19 mm (4.69–5.57 mm, n=5); females \bar{x} = 5.56 mm (5.18–5.82 mm, n=3). In lateral view, head prolonged about 2/3 length of eyes, acutely pointed, and slightly inclined distally (Fig. 5). Eyes oval, long axis approximately parallel to vertex, distinctly emarginate near antennae. Vertex narrow (Fig. 1), median carinae absent, lateral carinae closely approximated between eyes, distinctly broader distally; apex of head with carina at fastigium. Ocelli present with lateral ocelli below eyes, median just above midline of frontoclypeal suture on median carina of frons. Face with frons elongate (Fig. 3), narrowing slightly from frontoclypeal suture to fastigium; median carinae evident from frontoclypeal suture to above eyes where it becomes obsolete; clypeus with median carina present. Pronotum with anterior margin weakly concave, posterior margin deeply "U" shaped, medially very short and obscuring median carina; lateral carinae diverging, poorly developed. Mesonotum midline longer than head plus pronotum; bearing 5 pale carinae, 3 distinct, lateral-most weak; all nearly straight and approximating posterior mesonotum margin. Wings clear (Fig. 4), veins embrowned with conspicuous pustules. Combined veins Sc+R+MP with long stem extending from leading margin of the basal cell (Fig. 12); Sc+R branched from MP at about 1/3rd length of clavus; combined veins Sc+R with 5 branches reaching wing margin, MP with 5 terminals; CuA apparently with 2 branches; PCu joining with A1 near midlength of clavus (distad of fork of Sc+R and MP).

Male terminalia. Pygofer in lateral view distinctly elongate ventrally and strongly narrowing dorsally (Figs. 6, 9). Median lobe of pygofer broad in ventral view narrowing distally, rounded apically. Phallosome with 3 processes (Figs. 6, 8, 9–11), one elongate process just beyond mid-length of phallosome laterally projected from right side and a pair of subbasal projections closely appressed to the phallosome; flagellum (endosoma) with 5 elongate processes—1 apical, 2 subapical on right side; 2 subbasal (one on each side). Anal tube in lateral view strongly concave ventrally, distally very broad, apex in lateral view truncate with slight concave emargination.

Note. Compared to species illustrated by Caldwell (1944), *O. sergipensis* would appear to be closest to *O. pellucens* Fowler 1904, but differs most obviously in that *O. sergipensis* has an anal tube that is broader distally, a broader and more regularly tapered ventral process on the pygofer, and the presence of a process near the middle of the phallosome on the right side in *O. sergipensis* (longer and apical in *O. pellucens*).

Plant associations: Areaceae: coconut (*Cocos nucifera* L.) and date palm (*Phoenix* L.).

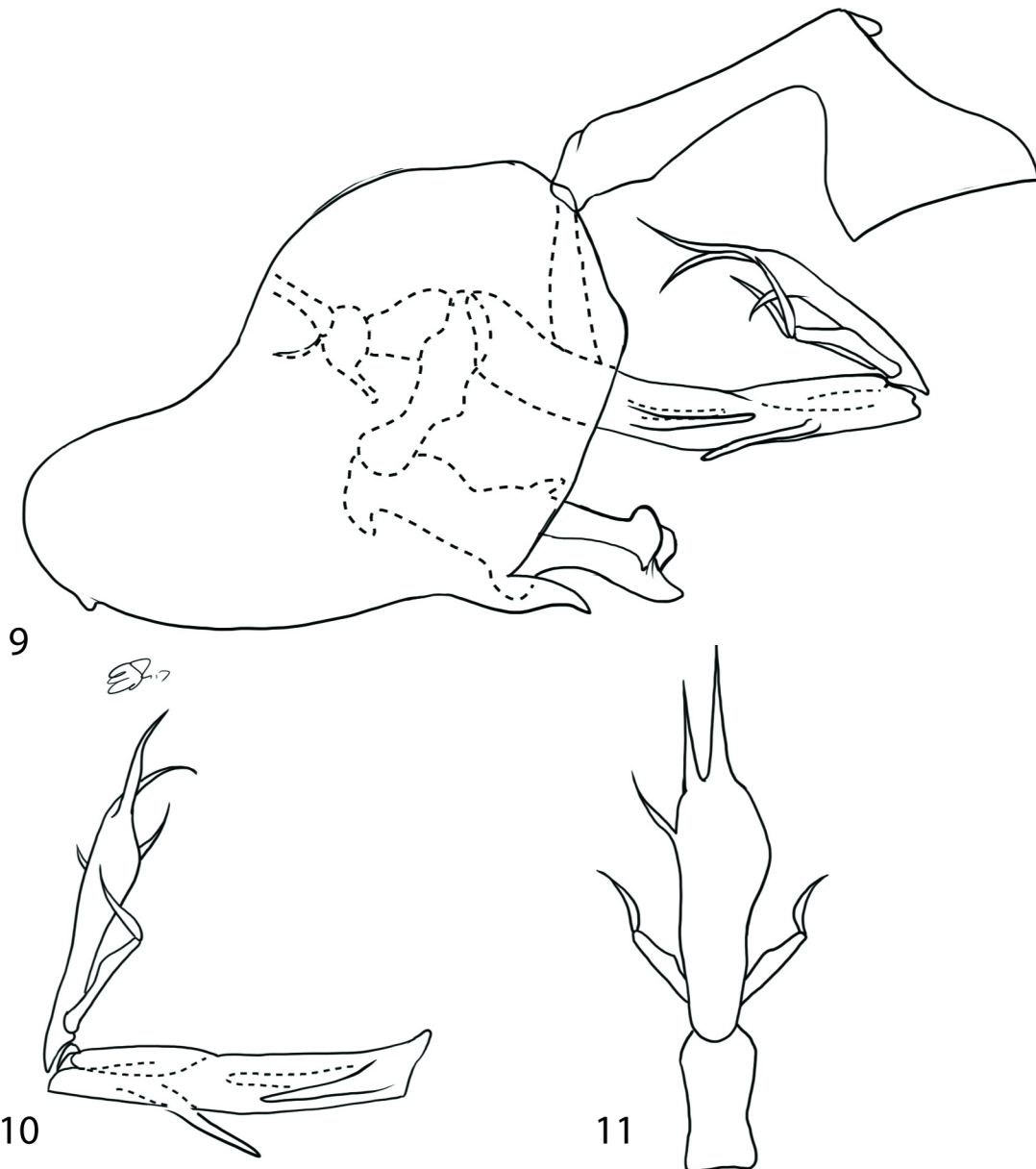


FIGURES 1–8. *Oecleus sergipensis*, all male except 4 female; 1, dorsal view; 2, lateral view; 3, frontal view; 4, left wing; 5, head and thorax, left lateral view; 6, male terminalia, left lateral view; 7, male terminalia, left ventrolateral view (note ventral lobe of pygofer); 8, male terminalia, ventrocaudal view (note closely oppressed spines of phallosome).

Distribution: Brazil (Sergipe).

Etymology. The specific name is a reference to Sergipe State in Brazil where the species was detected, and the name is considered indeclinable.

Specimens examined. Holotype male “Brazil, Sergipe / Itaporanga D’Ajuda, / Eliana Passos; 19 April 2016 / Aspirated from Coconut // Holotype / *Oecleus sergipensis* / Bartlett & Passos”; Paratypes, Itaporanga D’Ajuda [26 November 2015] (4 males, 1 female, MPEG), Itaporanga D’Ajuda [26 November 2015] (4 males, 1 female, CPATU); Neópolis [17 December 2015] (3 males, MPEG); Aracaju [23 November 2015] (10 males) [representatives used for molecular analysis].



FIGURES 9–11. *Oecleus sergipensis*, male terminalia; 9, terminalia, left lateral view; 10, aedeagus and flagellum, right lateral view; 11, phallosome apex and flagellum, caudal view.

Sequence data. A total of 587 bp of CO1 sequence data was obtained and accessioned to GenBank (Accession No.: MH266780). The available sequence data on GenBank does not include homologous sequence data for *Oecleus*. The closest match for the sequence data using a BLAST search was *Haplaxius crudus* (accession HM017492.1) with an 83% identity and 82% query coverage match. This match supports a tribal level relationship among *Oecleus* and *Haplaxius*, but also demonstrates that no similar sequence data is present in GenBank for *Oecleus*. The sequence data obtained in this study is given as follows (5'–3'):

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ccaaaaacttatatcctcctaccagggttggcttaatctctcatatcattatgcaagaacaggtaaaaaggaacattggatcaatcggataattatgcaataa
ttgcaattggagcattagggttgcgtatgagcacatcatatattcacagtaggaatagacattgataccgagcttactttacatcagcaaccataatcatcgcagtacc
aactggaattaaaatttttagatgaatagcaaccatatacggaaacaaaataaagttttcacctcaatactatgagcatcaggatttgatttttcccatggcgatt
aacaggagtaattcttagccaattcatcaattgacatcctacatgaccatactatgtagtgcacatttttttcgtattatcaataggagccccattcctcttatagg

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aagattcatccactgctaccocctattccccacgaatatacccaaaaaaaaaaggattactctccccctcctaataattacaggagcccccttatcctttccccc
ccccttccaagccctc

Remarks. In Kramer (1977), this species might key between *Oecleus rhion* Kramer, 1977 and *O. piperatus* Ball & Klingenberg, 1935, if the direction of “shaft [phallosome] with acute projection on right side near base or middle” is followed; however, *O. sergipensis* bears little resemblance to these species and the projection on the phallosome is different in nature from those illustrated by Kramer (1977) for those two species. Ignoring this, Kramer’s key at couplet 5 might be followed in the direction of ‘[aedeagal] shaft with three processes’, except that in all cases, the processes are near the apex of the phallosome; ignoring these, *O. sergipensis* might key to *Oecleus snowi* Ball, 1905, which is similar in that it is a ‘tawny’ species (as opposed to black); however, *O. snowi* is a large species (Kramer reported males 6.0–7.0 mm., females 7.0–8.5 mm), and differs from *O. sergipensis* in many details. None of the species illustrated in Caldwell (1944) show subbasal processes on the phallosome of the aedeagus.

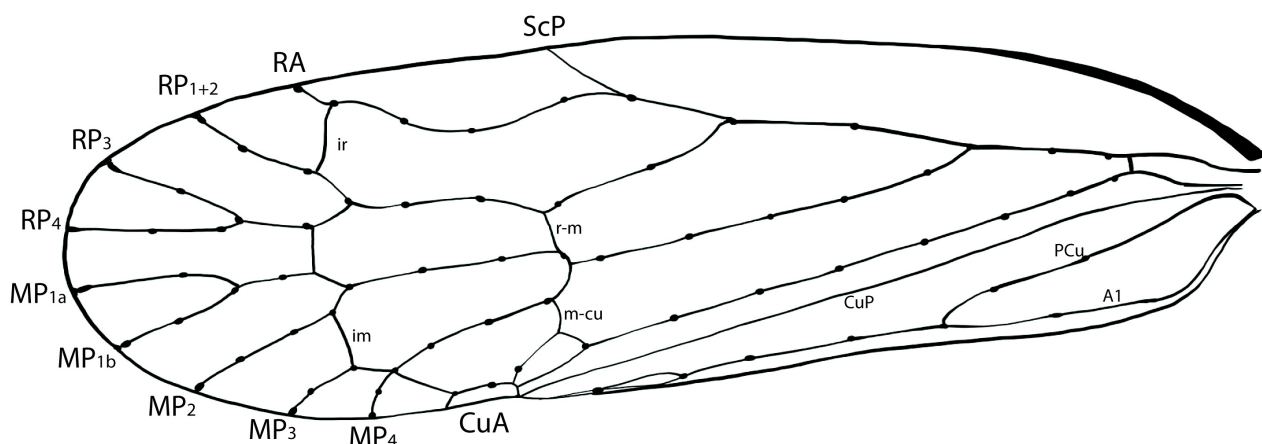


FIGURE 12. *Oecleus sergipensis*, wing venation; A1—first anal vein; CuA—anterior cubitus; CuP—posterior cubitus; im—intermedial transverse veinlet; ir—interradial transverse veinlet; m-cu—medio-cubital transverse veinlet; MP—posterior media; PCu—postcubitus; r-m—radio-medial transverse veinlet; RP—posterior radius; ScP—posterior subcosta.

Discussion

This species is the first *Oecleus* found in Brazil; however, much of the Mesoamerican and South American *Oecleus* fauna has not yet been studied systematically, beyond the work of Fowler (1904) and Caldwell (1944), and it is likely that additional species remain to be discovered. Kramer (1977: 381) noted that "The fauna [of *Oecleus*] south of the United States is a rich one with much taxonomic work yet to be done." Indeed, very little is known about the cixiid fauna of Brazil and it is likely that many additional new species remain to be found. The new species is particularly important as a potential vector of phytoplasmas, including lethal yellowing type syndrome should this disease be conveyed to Brazil.

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