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Two new species of the palm-feeding planthopper genus *Agoo* (Hemiptera: Fulgoroidea: Derbidae) from southern Mexico

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Abstract

Two new species of the genus *Agoo* Bahder & Bartlett, *A. kizini* Pinedo-Escatel & Blanco-Rodríguez **sp. nov.** from the Yucatán Peninsula and *A. palmalopezi* Pinedo-Escatel & Blanco-Rodríguez **sp. nov.** from the state of Tabasco, Mexico are described and illustrated. Sequence data for the 18S rRNA and COX1 genes of *A. kizini* are provided and a distributional map of both species is also given. Specimens were found in association with palms, representing the first record of *Agoo* in Mexico.

Key words: Derbinae, Cenchreini, Arecaceae, Yucatán Peninsula, Tabasco

Resumen

Se describen e ilustran dos nuevas especies del género *Agoo* Bahder & Bartlett, *A. kizini* Pinedo-Escatel & Blanco-Rodríguez **sp. nov.** de la península de Yucatán y *A. palmalopezi* Pinedo-Escatel & Blanco-Rodríguez **sp. nov.** del estado de Tabasco, México. Se proporcionan secuencias de los genes ARNr 18S y COX1 de *A. kizini* al igual que un mapa de distribución de ambas especies. Los especímenes se encontraron en asociación con palmas, lo que representa el primer registro de *Agoo* para México.

Palabras clave: Derbinae, Cenchreini, Arecaceae, Península de Yucatán, Tabasco.

Introduction

The family Derbidae is a mid-sized family in terms of species number within the suborder Auchenorrhyncha (Insecta: Hemiptera) with about 1,725 valid species worldwide placed in 166 genera and 22 tribes. The second most speciose subfamily is Derbinae (474 spp.) and its third largest tribe is Cenchreini with 240 valid species. Despite the large number of species recorded for this family, key aspects such as general biology and life cycles are largely unknown, with a broad exception of some economic taxa (*e.g.*, the derbid planthopper *Cedusa hedusa* McAtee, 1924). While the true diversity of the family is still far from complete, the tropical zones have the highest level of diversity.

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Agoo Bahder & Bartlett, 2019 was described with *A. xavieri* (Bahder & Bartlett 2019) representing the type species from Costa Rica. The genus has grown rapidly in numbers over Neotropical countries, including the West Indies; it now holds eleven species in only six years (Cantanhede *et al*. 2024, Barrantes *et al.* 2025), and it appears that such numbers will continue increasing. Palms (Arecaceae) have been documented as main hosts for the adult stages of *Agoo* species (Bahder *et al*. 2019, 2020a), and this planthopper group has received attention in the context of identifying potential vectors of phytoplasma diseases affecting economically important palms (Dollet *et al*. 2020). Research on this topic has been conducted in Central America, South America, and the West Indies (Bahder *et al*. 2020b, 2020c, Cantanhede *et al*. 2024), opposite to the United States and Mexico, which have been scarcely explored even for other Derbidae. In Mexico, the Yucatán Peninsula is a particularly interesting region due to the abundance of both native (including endemic) and exotic palms (Quero Rico & Flores 2004), its proximity to regions where some Derbidae, including *Agoo,* have recently been discovered (*e.g.* Costa Rica, Jamaica), and its history of more than 45 years since the arrival of lethal yellowing (LY), the most important coconut disease in the Americas, which is associated with '*Candidatus* Phytoplasma palmae' (Palma-Cancino *et al*. 2023).

Because of the renewed interest in palm lethal decline phytoplasma vector research, a survey of palm-associated Auchenorrhyncha fauna was conducted on the borders of Tabasco State and the Yucatán Peninsula in Mexico, from November 2020 to December 2021. During this survey, specimens taken represent two new species in the genus *Agoo*. For species herein described supplemental molecular data of the 18S rRNA and the cytochrome c oxidase subunit I (COX1) genes are given to support placement.

Materials and Methods

Overall criteria and terminology followed Bahder *et al*. (2019) and O'Brien & Wilson (1985).

Specimen preparation. Whole male abdomen of specimens studied were removed and cleared following standard protocol for planthoppers based on a heating solution running about 20 minutes then neutralizing any remaining KOH with acetic acid after washing with pure water. All abdomens with their dissected genitalia were individually stored in glycerin in glycerin and pinned beneath pinned beneath each respective specimen. Pinned specimen labels are fully quoted verbatim in a single continuous line.

Body color is described from both, dry pinned and live specimens. The total length was measured using an ocular micrometer mounted to the stereo microscope from the anterior margin of crown to apex of wings at rest. All digital habitus photographs were taken using a camera mounted on a Carl Zeiss stereo microscope Stemi 2000c. Images from multiple focal planes were stacked using Helicon Focus software and vectorized using GIMP illustrator. A distributional map was generated using QGIS software version 3.40 and referenced using information from the specimen´s labels.

All studied material is deposited at Colección Nacional de Insectos, Instituto de Biología, Universidad Nacional Autónoma de México, Mexico City, Mexico (CNIN).

Molecular procedures. Data for the first taxon was obtained following a previously described DNA extraction protocol for planthoppers (Harrison *et al*. 1996). Subsequently, fragments of about 1500 and 700 bp of the 18S rRNA and the COX1 genes were amplified using primer pairs 18S/Forward and 18S/Reverse (Bahder *et al*. 2019) and LCO1490 and HC02198 (Folmer *et al*. 1994), respectively. PCR reactions were performed in a C1000 thermal cycler (Bio-Rad). The reaction mix contained 1 µL of DNA template (a 1:10 dilution of total DNA), 0.4 µM of each primer, 12.5 µL of DreamTaq Hot Start PCR Master Mix 2X (Thermo Scientific) and nuclease-free water to a final volume of 25 µL. The thermal cycling conditions of Bahder *et al*. (2019) were followed with minor modifications: amplification cycles were reduced to 30 and the annealing temperature was adjusted to 56 °C for the 18S rRNA protocol and to 44 °C for the COX1 protocol. The PCR products were excised from 1.5% agarose gels and purified with the QIAquick Gel Extraction Kit (QIAGEN). The purified products were sent to the Laboratorio Nacional de Biotecnología Agrícola, Médica y Ambiental (San Luis Potosí, Mexico) for direct sequencing with the 18S/Forward, 18S/Reverse, LCO1490 and HC02198 primers.

Chromas software version 2.6.6 was used to edit and assemble consensus sequences for both loci. Nucleotide BLAST searches (BLASTN algorithm, available at blast.ncbi.nlm.nih.gov/Blast.cgi) were then performed and other 18S rRNA and COX1 gene sequences from the genus *Agoo* and related taxa were downloaded from the GenBank database to conduct phylogeny tests with MEGA software version 11.0.13 (Tamura *et al*. 2021). Lastly, bootstrap

consensus trees (inferred from 1000 replicates) based on 18S rRNA, COX1 and concatenated data from both loci of the taxa analyzed were constructed using the Maximum Likelihood method and the K2+G (18S rRNA) and GTR+G+I (COX1, concatenated) nucleotide substitution models.

Taxonomy

Family Derbidae Spinola 1839

Subfamily Derbinae Spinola 1839

Tribe Cenchreini Muir 1913

Genus *Agoo* Bahder & Bartlett 2019

Diagnosis. Head projected anteriorly and broadly rounded in lateral view. Frons elongated and narrow, vertex subtriangular, frons and vertex with sensorial pits presented on lateral margins; lacking transverse medial carina and lateral carina foliate; clypeus with visible medial carina; pronotum with paranotal region foliated; medioventral process of pygofer in ventral view broad with distant rounded apex; phallic symmetrical (Bahder *et al*. 2019, 2020a).

Distribution. Brazil, Costa Rica, Cuba, Jamaica, Trinidad and Tobago, USA and Mexico **nov. rec.**

List of species of *Agoo*

Agoo argutiola Bahder & Bartlett, 2020: 729	Brazil
Agoo beani Bahder & Bartlett, 2020: 258	Jamaica
Agoo cocoana (Rodríguez-Léon & Hidalgo-Gato, 2005): 138	Cuba
Agoo dahliana Bahder & Bartlett, 2020: 529	Costa Rica
Agoo fulvus (Van Duzee, 1909): 195	Cuba; Panama; USA
Agoo galbina Cantanhede, Viegas & Ale-Rocha, 2024: 2	Brazil
Agoo keili Bahder & Bartlett, 2025: 116	Costa Rica
Agoo kizini Pinedo-Escatel & Blanco-Rodríguez **sp. nov.**	Mexico
Agoo luzdenia Bahder & Bartlett, 2020: 413	Costa Rica
Agoo palmalopezi Pinedo-Escatel & Blanco-Rodríguez **sp. nov.**	Mexico
Agoo rubrimarginatus (Fennah, 1945): 529	Trinidad and Tobago
Agoo spina Bahder & Bartlett, 2020: 733	Brazil
Agoo xavieri (Bahder & Bartlett, 2019): 506	Costa Rica

Agoo kizini Pinedo-Escatel & Blanco-Rodríguez sp. nov.

Figs 1–3

Diagnosis. Forewing mostly pale with translucent regions, subapical small black dot present, apical margin light orange. Posterior margin of pygofer nearly linear, posterodorsal margin broadly rounded. Tenth segment strongly projected and pointed in lateral view. Aedeagus symmetrical with four pairs of processes including a single elongate subquadrate projection medially and a single acute spine at base.

FIGURE 1. Photography *in situ* of *Agoo kizini* Pinedo-Escatel & Blanco-Rodríguez **sp. nov.** on a *Sabal mexicana* leaf, taken by Pablo J. Palma-Cancino.

Description. *Coloration*. In life (Fig. 1), the overall color is pale with yellowish rostrum; pronotum pallid; mesonotum white to yellow with brownish symmetrical marks. Forewings basally and subapically fuscous with translucent areas, subapical black spot present among medial branches. Female paler than males to males.

Structure. Head narrower than pronotum, as long as pronotum at midlength. Vertex in dorsal view subtriangular, widest at posterior margin; lateral margins foliate and each with single row of sensorial pits, disc depressed, lacking median carina; anterior margin narrow, concave in dorsal view; head in lateral view rounded from posterior margin of vertex to frontoclypeal suture (Fig. 2A–B). In frontal view, frons with lateral margins well-developed, weakly sinuate (Fig. 2A). Clypeus elongate, narrowing towards the base, triangular. Lateral margins weakly carinate, bearing distinct median carina. Eye hemispherical, strongly emarginate on mesobasal margin above antenna. Lateral ocelli distinct below eye near midline. Antennal scape short, not extending beyond eyes, pedicel ovate bearing many irregularly arranged sensory plaques.

Thorax. Pronotum in dorsal view parabolic, 1.3× wider than long, lateral margins rounded with median quadrate elongation on midline, posterior margin concave, median carina weakly marked, lateral carinae appear concurrent with anterior lateral pronotal margin; paradiscal broadly foliate behind antennae forming large fossae, projected laterad 1.2× size of eyes, partially surrounding antennae. Mesonotum at midline 1.2× exceeding length of pronotum, tricarinate and median carina absent posteriorly, lateral carinae medially curved reaching hind margin. Forewing elongated ending oval-shaped; apex of clavus near wing midlength; MP fused with ScP+R near apex of basal cell.

Male terminalia. Anal tube in lateral view strongly pointed caudad, narrowed and acute apex, extending beyond posterior margin of gonostyli, apex beyond paraproct 1.5× longer than epiproct and paraproct combined; paraproct longer than epiproct. Pygofer taller than long, in lateral view moderately narrow; broadly rounded at dorsal margin, well-sclerotized, narrowest medially, anterior margin strongly convex and posterior margin slightly sinuate (Fig. 3A); medioventral process subtriangular in ventral view, wider than long with acute pointed apex. Gonostyli in lateral view spatulate, apex 2× wider than base; first dorsal tooth small and second slightly lobulate directed dorsad in lateral view (Fig. 3C); basal margin in ventral view strongly lobulate medially (Fig. 3B). Aedeagus symmetrical,

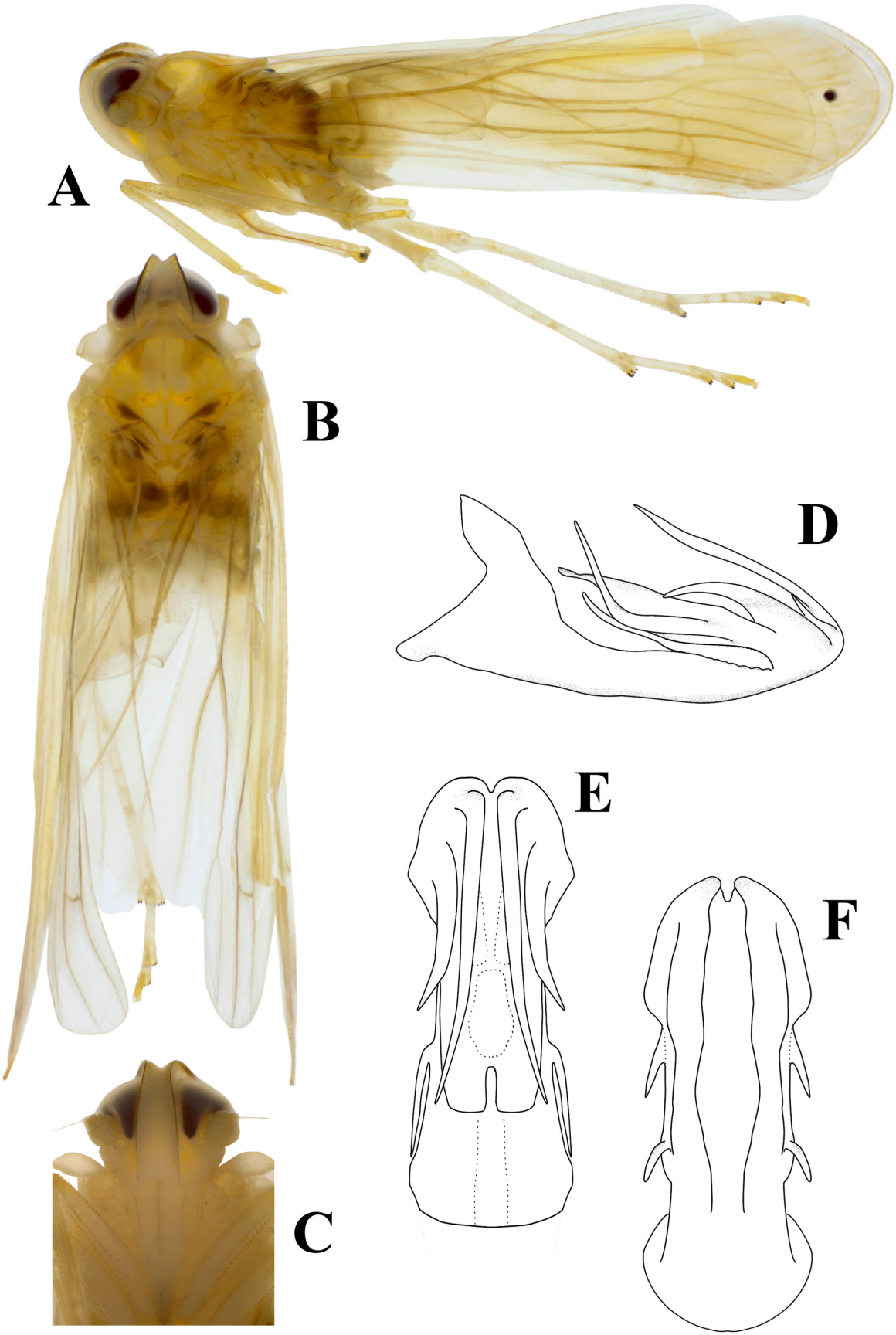

FIGURE 2. External and internal habitus of *Agoo kizini* Pinedo-Escatel & Blanco-Rodríguez **sp. nov.** (**A**) Habitus, lateral view. (**B**) Habitus, dorsal view. (**C**) Habitus, anterior view. (**D**) Aedeagus, lateral view. (**E**–**F**) Aedeagus, dorsal and ventral view, respectively.

FIGURE 3. Male terminalia of *Agoo kizini* Pinedo-Escatel & Blanco-Rodríguez **sp. nov.**; (**A**) Male capsule, lateral view. (**B**) Male capsule, ventral view. (**C**) Gonostyli, lateral view. (**D**–**E**) Aedeagus in lateral, dorsal, and ventral view, respectively.

shaft straight, slightly curved dorsad apically; four pairs and two single processes running directed cephalad; two slender processes arising near to apex (outer short and inner elongated), next pair stout strongly curved ventrad at ⅓ of length, last pair curved dorsad and disposed medially, first single process long and spatulate notched posteriorly; last single process apically curved dorsad (Figs 2D–F,3D–F).

Distribution. Mexican states of Yucatán (Mérida and Tixkokob) and Quintana Roo (Bacalar and Puerto Aventuras), Fig. 7.

Plant associations. Adults were collected on palm leaves of species commonly found in urban areas of southeastern Mexico, including *Adonidia merrillii*, *Cocos nucifera*, *Livistona chinensis*, *Pritchardia pacifica*, *Sabal mexicana*, *Thrinax radiata*, and *Washingtonia robusta* (Fig. 8A–B).

Etymology. The epithet of the new species, a noun in apposition, is named after the god Ah Puch, also known as Kizin ("The stinky one") in Mayan mythology, king of Xibalba (underworld).

Measurements. Total body length: males 6.8–7.0 mm and females 7.3–7.6 mm.

Material examined. *Holotype* ♂ (CNIN)—MEXICO: Quintana Roo, Bacalar, 8 diciembre 2021, 18°40'34"N 88°23'51"W, 14 msnm, trampa aspiradora sobre follaje, Palma-Cancino, P. Col. *Paratypes* 3♂ and 2♀; 1♂, 2♀ (CNIN)—Similar data as holotype; 1♂ (CNIN)—MEXICO: Quintana Roo, Solidaridad, Puerto Aventuras, 31 diciembre 2020, 20°29'36"N 87°14'09"W, 4 msnm, trampa aspiradora sobre follaje, Palma-Cancino, P. Col.; 1♂ (CNIN)—MEXICO: Yucatán, Tixkokob, Tixkokob, 4 agosto 2021, 21°00'13"N 89°23'58"W, 11 msnm, trampa aspiradora sobre follaje, Palma-Cancino, P. Col.; 1♀ (CNIN)—MEXICO: Yucatán, Mérida, Mérida, 3 noviembre 2020, 21°01'43"N 89°37'37"W, 10 msnm, trampa aspiradora sobre follaje, Palma-Cancino, P. Col.

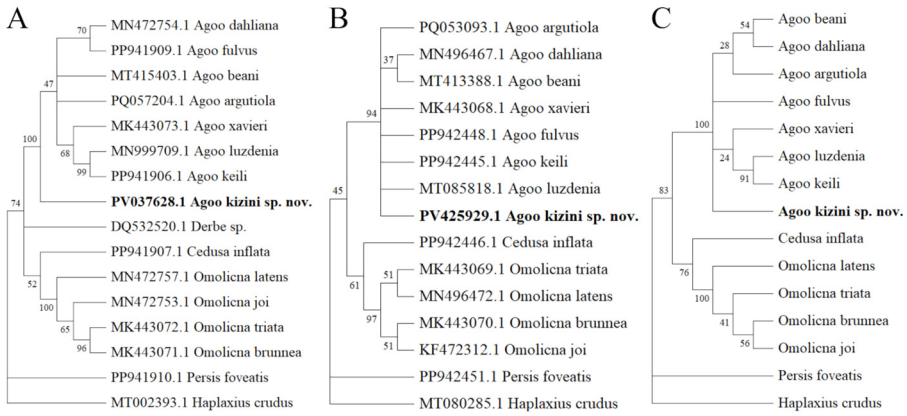

FIGURE 4. Maximum likelihood bootstrap consensus tree inferred from 1000 replicates, depicting phylogenetic relationships between *Agoo kizini* Pinedo-Escatel & Blanco-Rodríguez **sp. nov.**, other species in *Agoo* and other Derbidae, based on; (**A**) 18S rRNA gene, (**B**) COX1 gene and (**C**) concatenated 18S rRNA and COX1 gene sequences. The cixiid *Haplaxius crudus* (Van Duzee, 1907) was used as an outgroup.

DNA analysis. Partial sequences of the 18S rRNA (1397 bp) and COX1 (690 bp) genes were obtained and deposited in GenBank (Accession Nos. PV037628 and PV425929, respectively). According to BLAST results, sequence identity with other *Agoo* species based on 18S rRNA were 98.07% with *A. xavieri* (Acc. MK443073), 97.78% with *A. luzdenia* and *A. dahliana* (Accs. MN999709 and MN472754), 97.50% with *A. keili* (Acc. PP941906), 96.44% with *A. argutiola* (Acc. PQ057204), 95.84% with *A. fulvus* (Acc. PP941909) and 92.69% with *A. beani* (Acc. MT415403). The highest sequence identity with a non-*Agoo* species was 95.95% with a *Derbe* sp. from French Guiana (Acc. DQ532520). Likewise, sequence identity with other *Agoo* species based on COX1 were 86.65% with *A. keili* (Acc. PP942445), 85.06% with *A. fulvus* (Acc. PP942448), 84.42% with *A. luzdenia* (Acc. MT085818), 84.01% with *A. beani* (Acc. MT413388), 83.93 with *A. dahliana* (Acc. MN496467), 83.91% with *A. xavieri* (Acc. MK443068) and 82.10% with *A. argutiola* (Acc. PQ053093). The highest sequence identity with a non-*Agoo* species was 83.78% with *Scolops viridis* Ball, 1909 from the United States (Acc. KF919913). Comparison with *A. cocoana*, *A. galbina*, *A. palmalopezi*, *A. rubrimarginatus*, and *A. spina* was limited by these taxa lacking available sequences. Additionally, the placement of *A. kizini* within *Agoo* was strengthened by the bootstrap consensus trees generated with Maximum Likelihood (Fig. 4 A–C), with support values for the clade of 94 (COX1) and 100 (18S rRNA, concatenated).

Remarks. The new taxon is similar to *A. dahliana* and *A. luzdenia* based on the general appearance of aedeagus but differs easily from those based on the arrangement of aedeagal spines and body coloration (Fig. 2A–B).

Agoo palmalopezi Pinedo-Escatel & Blanco-Rodríguez sp. nov.

Figs 5–6

Diagnosis. Forewing brownish with translucent regions and apical margin bold orange. Posterior margin of pygofer somewhat rounded and posterodorsal margin broadly rounded. Tenth segment strongly projected and pointed in lateral view. Aedeagus symmetrical with three long pairs of processes, one pair directed caudad and a single spatulate projection.

Description. *Coloration*. Pinned specimens are brownish with pale and yellowish rostrum; pronotum brownish; mesonotum brown with medial symmetrical pale band. Forewings brownish, translucent, veins pale. Female color lighter than male.

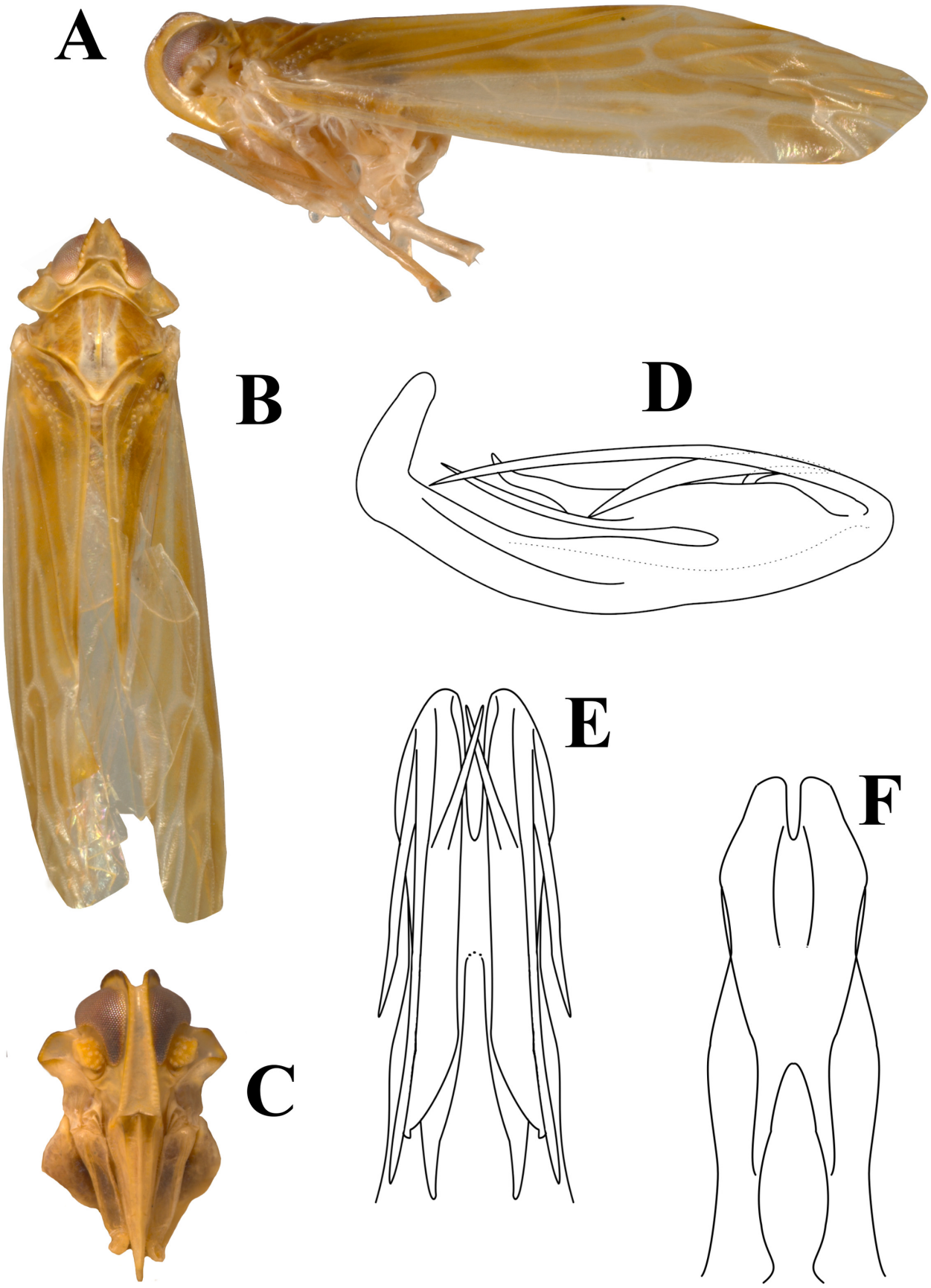

FIGURE 5. External and internal habitus of *Agoo palmalopezi* Pinedo-Escatel & Blanco-Rodríguez **sp. nov.** (**A**) Habitus, lateral view. (**B**) Habitus, dorsal view. (**C**) Habitus, anterior view. (**D**) Aedeagus, lateral view. (**E**–**F**) Aedeagus, dorsal and ventral view, respectively.

FIGURE 6. Male terminalia of *Agoo palmalopezi* Pinedo-Escatel & Blanco-Rodríguez **sp. nov.**; (**A**) Male capsule, lateral view. (**B**) Male capsule, ventral view. (**C**) Gonostyli, lateral view. (**D**–**E**) Aedeagus in lateral, dorsal, and ventral view, respectively.

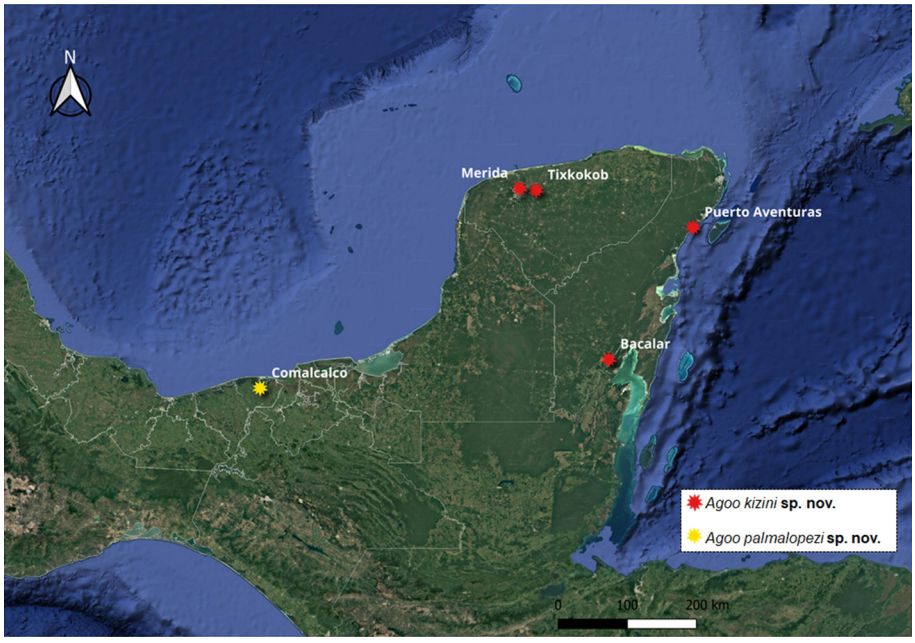

FIGURE 7. Map of distribution of *Agoo* species known to occur in Mexico.

Structure. Head narrower than pronotum, 1.2× longer than midlength of pronotum. Vertex in dorsal view subpentagonal, widest near posterior margin; lateral margins strongly foliate and each with linear single row of sensorial pits, disc strongly depressed, lacking median carina; anterior margin narrow concave in dorsal view; head in lateral view rounded from posterior margin of vertex to frontoclypeal suture (Fig. 5A–B). Frons with lateral margins well-developed and strongly sinuate from anterior view (Fig. 5A, C). Clypeus elongate narrowing towards the base, triangular. Lateral margins carinate, distinct median carina present. Eye hemispherical, strongly emarginate on mesobasal margin above antenna. Lateral ocelli weakly visible below eye near midline. Antennal scape short and similar in distance to eyes, pedicel ovate bearing many irregularly arranged sensory plaques (Fig. 5C).

Thorax. Pronotum in dorsal view parabolic, 1.5× wider than long, lateral margins pointed with median quadrate elongation on midline, posterior margin slightly concave, median carina evident, lateral carinae appear concurrent with anterior lateral pronotal margin; paradiscal broadly foliate behind antennae forming large fossae, projected laterad 1.5× size of eyes, completely surrounding antennae. Mesonotum at midline 1.4× exceeding length of pronotum, tricarinate, and median carina absent posteriorly, rugose, lateral carinae medially curved reaching hind margin. Forewing elongated ending oval-shaped; apex of clavus near wing midlength.

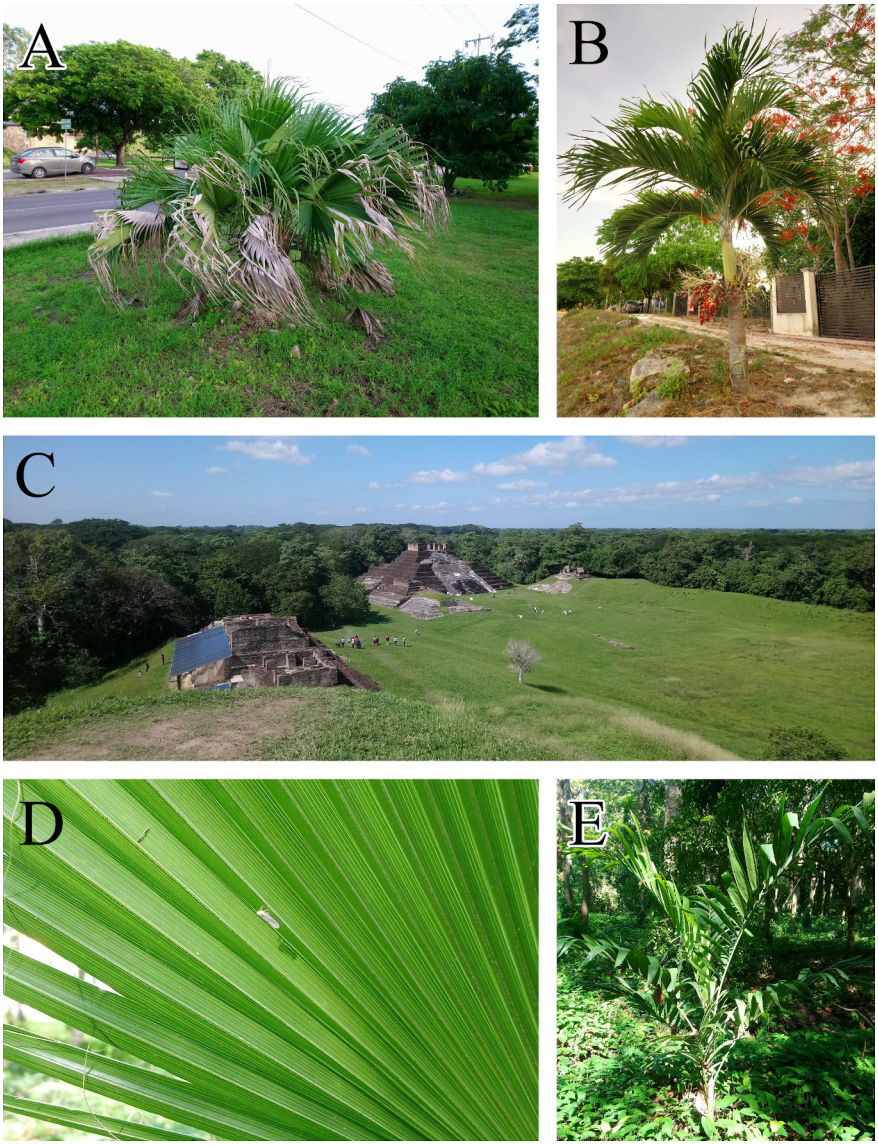

FIGURE 8. Habitats where studied specimens were collected. (**A**) *Livistona chinensis* where *Agoo kizini* Pinedo-Escatel & Blanco-Rodríguez **sp. nov.** was collected in Mérida, Yucatán (urban area). (**B**) *Adonidia merrillii* where *A. kizini* was collected in Bacalar, Quintana Roo (semi-urban area). (**C**) Landscape view of the archaeological site of Comalcalco, in Comalcalco Municipality, Tabasco, where *Agoo palmalopezi* Pinedo-Escatel & Blanco-Rodríguez **sp. nov.** was collected. (**D**) *A. palmalopezi* on a *Washingtonia robusta*. (**E**) *A. merrillii* in the Comalcalco archaeological site; palms in this site were surrounded by extensive vegetation cover.

FIGURE 9. Several *Agoo kizini* Pinedo-Escatel & Blanco-Rodríguez **sp. nov.** on a *Pritchardia pacifica* leaf.

Male terminalia. Anal tube in lateral view strongly pointed caudad, narrowed and acute apex, slightly longer than posterior margin of gonostyli, apex beyond paraproct 1.3× longer than epiproct and paraproct combined; paraproct longer than epiproct. Pygofer 2× taller than long, in lateral view moderately uniform with subparallel

margins; dorsally gently rounded and well-sclerotized, widest basally, anterior margin slightly convex and posterior margin rounded (Fig. 6 A); medioventral process subtriangular in ventral view, longer than long with acute pointed apex. Gonostyli in lateral view spatulate, apex 2× wider than base; first dorsal tooth stout and small while second pointed directed dorsad in lateral view (Fig. 6C); basal margin in ventral view strongly lobulate medially ending square-shaped with well sclerotized tooth (Fig. 6B). Aedeagus size prominent respecting male capsule, symmetrical, shaft straight gently curved; three long pairs of processes directed cephalad, one pair directed caudad and a single long spatulate projection (Figs 5D–F, 6D–F).

Distribution. Mexican state of Tabasco (Comalcalco), Fig. 7.

Plant associations. Adults were collected on leaves of *Washingtonia robusta* (Fig. 8E)

Etymology. The epithet of this species is dedicated to David Jesús Palma López, a soil scientist from Tabasco with a distinguished 40-year career and father of the first author.

Measurements. Total body length: males 6.7–7.2 mm and females unknown.

Material examined. *Holotype* ♂ (CNIN)—MEXICO: Tabasco, Comalcalco, Zona Arqueológica Comalcalco, 26 diciembre 2021, 18°16'47"N 93°12'13"W, 16 msnm, trampa aspiradora sobre follaje, Palma-Cancino, P. Col.; *Paratype* ♂ (CNIN)—MEXICO: Tabasco, Comalcalco, Zona Arqueológica Comalcalco, 26 diciembre 2021, 18°16'47"N 93°12'13"W, 16 msnm, trampa aspiradora sobre follaje, Palma-Cancino, P. Col.

Remarks. The new taxon is similar to *A. dahliana* in terminalia, but aedeagus differs substantially in number and arrangement of spines.

Discussion

The genus *Agoo*, as evidenced here and in other recent studies, is one of the main palm-feeding Auchenorrhyncha taxa that occurs in many Neotropical regions (Rodríguez-León & Hidalgo-Gato 2005, Bahder *et al*. 2020c, Dollet *et al*. 2020, Barrantes *et al*. 2025). The discovery of these new species are an indicative of the need to further explore the diversity of palm-associated Auchenorrhyncha fauna in Mexico, where no previous studies had been conducted.

Present data was raised by recent outbreaks of LY-type diseases occurring in central Mexico (Ortiz-García *et al*. 2024, Palma-Cancino *et al*. 2025), where no putative vectors have yet been identified. Also, Derbidae have not been shown to transmit '*Ca.* Phytoplasma palmae', but in Jamaica was proven as capable by harboring this pathogen (Brown *et al*. 2006). In this context, *A. kizini* **sp. nov.** is of particular interest given its association with some of the principal hosts of '*Ca.* Phytoplasma palmae' and its abundance in palms relative to other Auchenorrhyncha in the studied areas (Fig. 9).

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