

# Six new species of *Allorhogas* (Hymenoptera, Braconidae, Doryctinae) from south and southeast Brazil with host-plant record

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## Abstract

Six new Brazilian species of the gall-associated Doryctinae genus *Allorhogas* are described and illustrated: *A. copaiba* **sp. nov.**, *A. ilexaffinis* **sp. nov.**, *A. inquilinus* **sp. nov.**, *A. quarentenus* **sp. nov.**, *A. vassumunga* **sp. nov.** and *A. viridis* **sp. nov.** We provide host plant records for five of these species, three and one of which are new host plant genera (*Ilex* L., *Copaifera* L. and *Eugenia* P. Micheli ex L.) and new host plant family (Aquifoliaceae) records, respectively. *Allorhogas inquilinus* **sp. nov.**, whose biology was previously reported, represents the first confirmed case of phytophagous inquilinism in the genus. An updated key to Brazilian species of *Allorhogas* is provided.

## Keywords

Gall-association, Ichneumonoidea, inquilinism, Neotropics, phytophagous

\* These authors contributed equally to the article.

## Introduction

*Allorhogas* Gahan (1912) is a braconid genus belonging to the subfamily Doryctinae, whose species have been reported to be mainly distributed in the Nearctic and Neotropical regions from south and northeast U.S. to central Argentina (Yu et al. 2016; Zaldívar-Riverón et al. 2014, 2018; Samacá-Sáenz et al. 2020). This genus currently contains 58 recognised species (Yu et al. 2016; Zaldívar-Riverón et al. 2018; Joele et al. 2019; Samacá-Sáenz et al. 2020), of which 50 are Neotropical and six Nearctic. The remaining two species were described from Iraq in the Middle East (*A. semitemporalis* Fischer) (Fischer 1960) and India (Shaikh and Chatterjee 2020), though their generic placement is considerably doubtful based on the provided information.

The Doryctinae is mostly represented by parasitoid species. However, *Allorhogas* belongs to a clade composed of nine genera whose species are associated with members of various vascular plant families (Zaldívar-Riverón et al. 2007, 2014). Species of *Allorhogas* whose host records have been confirmed or reported from reliable observations have been reared from leaf and stem galls and fruits of species belonging to eleven plant families (Moreira et al. 2017; Zaldívar-Riverón et al. 2018). These records have also revealed the existence of different strategies of phytophagy within the genus, including gall induction on seeds, stems, fruits and floral buds (Macêdo and Monteiro 1989; Marsh 2002; Centrella and Shaw 2010; Zaldívar-Riverón et al. 2018; Joele et al. 2019), seed predation (Zaldívar-Riverón et al. 2018) and phytophagous inquilineism on galls made by other insects (Moreira et al. 2017). Moreover, some species of *Allorhogas* have been suggested to be parasitoids of other insects associated to galls (Marsh 2002; Centrella and Shaw 2013; Martínez and Zaldívar-Riverón 2013), though this has not been based on reliable rearing records and alternatively they could also be phytophagous inquilines.

Recent molecular phylogenetic studies have shown that *Allorhogas* is polyphyletic (Zaldívar-Riverón et al. 2014; Samacá-Sáenz et al. 2019), and a taxonomic revision of the genus is in progress. *Allorhogas*, as currently known, appears to be particularly species-rich in Brazil based on material deposited in national collections, though only 11 species have been described to date for this country (Zaldívar-Riverón et al. 2018; Joele et al. 2019). Here we describe six new species of *Allorhogas* from south and southeast Brazil with host plant records for five of them, including three new host plant genera and a new host plant family (Aquifoliaceae). One of the new species was previously reported to be associated with stem galls made by an undetermined cecidosid lepidopteran on a species of the plant family Anacardiaceae, representing the only confirmed case of phytophagous inquilineism in *Allorhogas* (Moreira et al. 2017).

## Methods

The type material of the six species described here was obtained after examination of specimens deposited in the Coleção Taxonômica do Departamento de Ecologia e

Biologia Evolutiva (DCBU) at Universidade Federal de São Carlos (UFSCar) in São Carlos, SP, Brazil. All holotypes and half of paratypes are deposited in the DCBU, whereas the remaining paratypes are deposited in the Colección Nacional de Insectos (CNIN), Instituto de Biología, Universidad Autónoma de México (IBUNAM). The terminology employed for the body and wing venation features follows Sharkey and Wharton (1997), and for the surface sculpture features follows Marsh (2002). Colour digital pictures were taken with an MC170 HD video camera attached to a Leica M205C stereomicroscope and the Leica Application Suite version 4.12. SEM digital pictures of uncoated specimens were taken with a FEI Quanta 250 SEM in a low vacuum mode.

## Taxonomic part

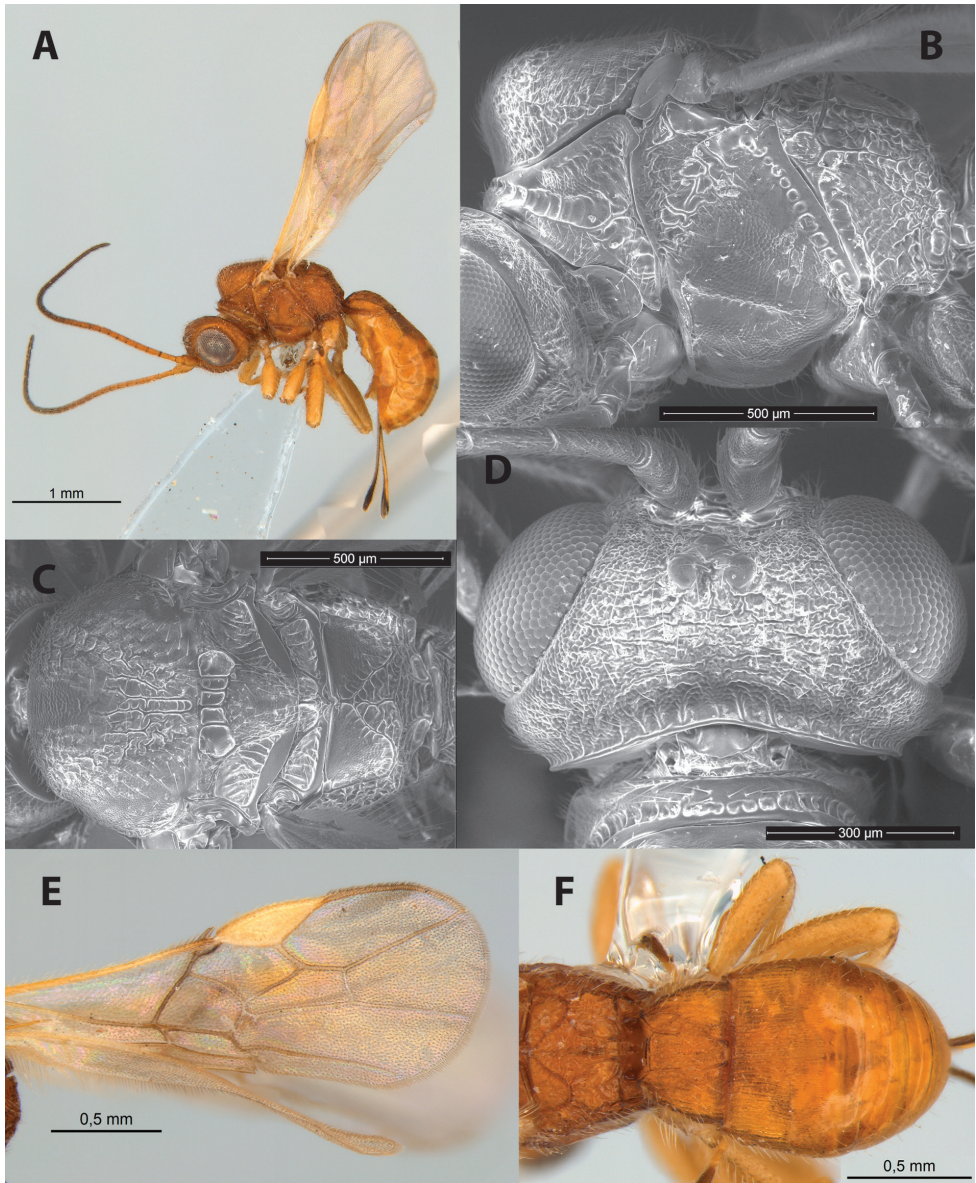
### *Allorhogas copaiba* sp. nov.

<http://zoobank.org/A050367F-42BF-4D25-B73A-226E0BA48524>

**Diagnosis.** This new species and *A. inquilinus* sp. nov. (described below) are the only two known species of *Allorhogas* from Brazil with vertex and frons rugose. However, *A. copaiba* sp. nov. can be distinguished from the latter and the remaining species of *Allorhogas* from this country by having the following combination of morphological features: 1) frons and vertex striate-rugose and coriaceous (strongly rugose-coriaceous in *A. inquilinus* sp. nov., usually coriaceous in the remaining species); 2) first metasomal tergite longitudinally costate-rugose and coriaceous (generally longitudinally costate-coriaceous in the remaining species); and 3) vein 2RS distal with m-cu (interstitial with m-cu in *A. inquilinus* sp. nov., variable in the remaining species).

**Description. Female.** Body size 2.9 mm (Fig. 1A), forewing 2.3 mm. **Colour:** body entirely honey yellow; palpi pale yellow; scape and pedicel honey yellow; basal two third flagellomeres honey yellow, turning dark brown to apex; eyes silverish; legs yellow; apical tarsomere and tarsal claws black; wings hyaline, stigma yellow; veins yellow to brown; ovipositor sheaths brown to dark brown, ovipositor honey yellow, apex strongly sclerotised.

**Head:** transverse in dorsal view, 2.1 times wider than its median length (dorsal view) (Fig. 1D), 0.7 times as long as high (lateral view); occipital carina complete and reaching hypostomal carina before mandible; post ocellar line (POL) 0.8 times as long as ocellar diameter (OD), 0.5 times ocular ocellar line (OOL); frons and vertex striate-rugose and coriaceous, temple and gena rugulose-coriaceous; face rugose, rugose-coriaceous laterally, with a coriaceous area medially; area surrounding eyes, clypeus and gena with large pilosity; clypeus coriaceous-rugulose; frons excavation distinct but not defined by sharp lateral margins; eye 1.3 times longer than wide; eye width 1.6 times longer than temple in dorsal view; malar space 0.4 times eye height and 1.3 longer than width of hypoclypeal depression; mandibles bidentate; antenna with 27 flagellomeres, first flagellomere about 3.7 times longer than wide, 1.1 times longer than second one.



**Figure 1.** *Allorbogas copaiba* sp. nov. (**A, E, F** female, holotype **B, C, D** female, paratype) **A** habitus, lateral view **B** mesosoma, lateral view **C** mesosoma, dorsal view **D** head, dorsal view **E** wings **F** metasoma, dorsal view.

**Mesosoma:** 1.4 times longer than high (Fig. 1B) and 1.7 times longer than wide (Fig. 1C); pronotal collar visible in dorsal view, pronotal furrow wide, deep, scrobiculate-slightly coriaceous; mesoscutum transverse in dorsal view, its median length 0.7 times its width; mesoscutal lobes coriaceous, transversally rugose laterally, median lobe with an indistinct median longitudinal furrow; notauli scrobiculate-rugose, not meeting, reaching the end of scutellum in a longitudinally rugose area; scutellar disc

coriaceous, prescutellar furrow with four transverse carinae; mesopleuron coriaceous; subalar groove wide, scrobiculate-rugose; precoxal sulcus wide deep, smooth-coriaceous, running along two thirds of mesopleuron; metapleuron rugose-areolate; propodeum coriaceous basally, with two distinct diverging carinae, rugose-areolate apically in areolar area.

**Wings:** forewing 3.0 times longer than wide (Fig. 1E). Pterostigma 2.2 times as long as wide and 0.7 times as long as R. Vein r 0.7 times as long as 3RSa, 0.2 times as long as 3RSb, and as long as r-m. Vein 2RS distal with m-cu, vein RS+Mb absent. Hindwing vein M + CU 0.6 times as long as 1 M, m-cu slightly curved towards wing apex.

**Legs:** hind coxa with a distinct basoventral tooth. Hind femur 3.0 times longer than wide.

**Metasoma:** first tergite 1.3 times wider than long, longitudinally costate-rugose and coriaceous; anteriorly delimited by an indistinct transverse carina, with two parallel longitudinal carinae running to apex (Fig. 1F). Second tergite longitudinally costate-coriaceous, line between second and third tergites distinct and straight; third tergite longitudinally costate-coriaceous on basal half, smooth and polished on apical half; remaining tergites smooth and polished. Ovipositor sheaths 0.9 times as long as metasoma.

**Variation.** Body size 2.8–3.0 mm. Antenna with 24–27 flagellomeres.

**Male.** Similar to female. Body size 2.8–3.0 mm. Antenna with 24–27 flagellomeres. Hind femur swollen, 2.6 times longer than wide. Prescutellar furrow with three transverse carinae.

**Holotype.** Female (DCBU 420486). Brasil, São Carlos SP; 16.VI.2001; A. M. P. Dias col.; de galhas de *Copaifera langsdorffii* (UFSCar).

**Paratypes.** (DCBU 420487-91; IBUNAM). Same data as holotype, three females, three males.

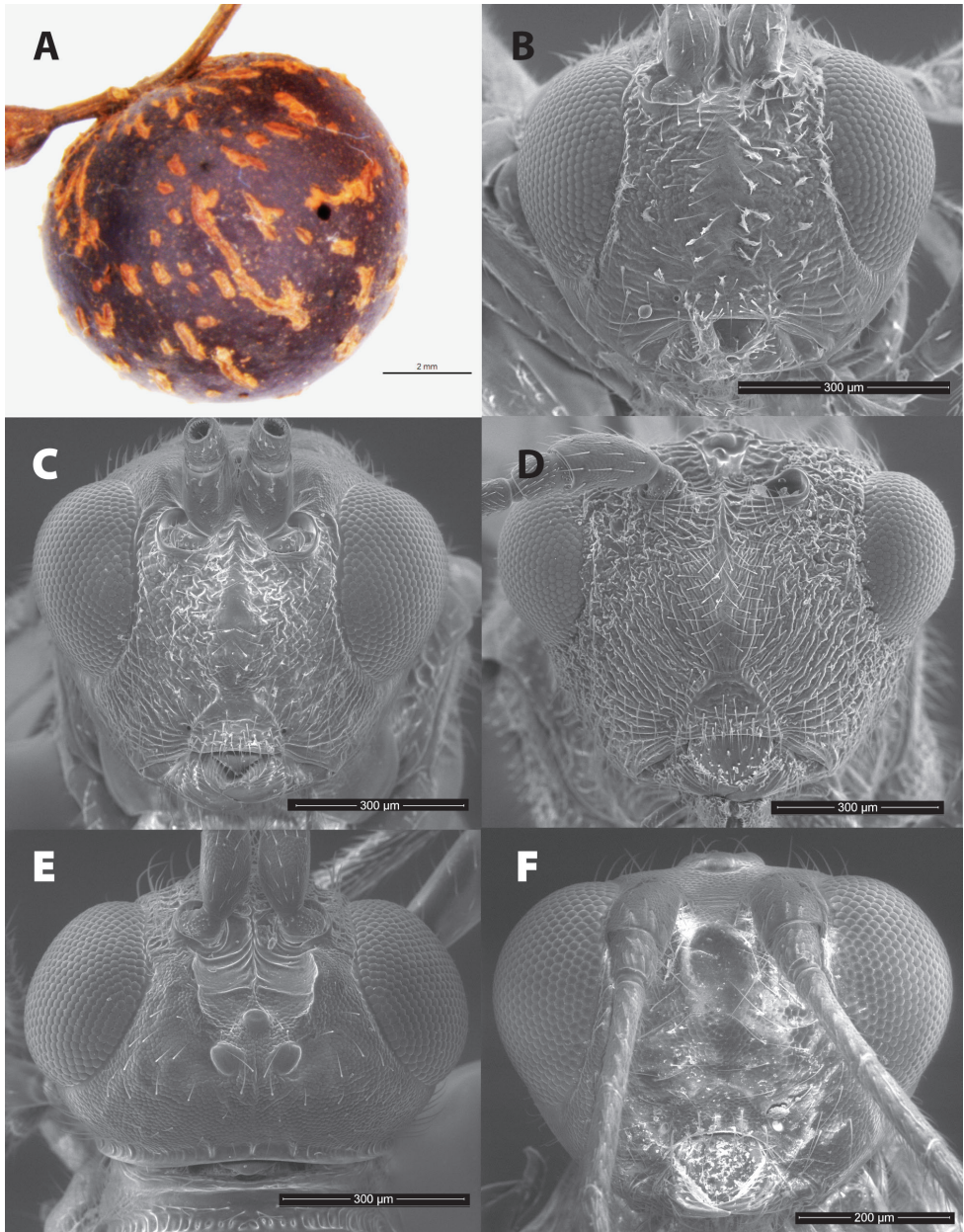
**Biology.** The type specimens of *A. copaiba* were reared from spherical galls on stems and buds of *Copaifera langsdorffii* Desf. (Fabaceae) (Fig. 2A). The inducer of this gall is unknown. These spherical galls are brown, glabrous and relatively big (about 2 cm of diameter). *Copaifera langsdorffii* has been reported to contain 23 different gall morphotypes (Costa et al. 2010).

**Etymology.** The name of this species refers to its association with the vascular plant genus *Copaifera*, whose common name in Brazil is Copaíba.

### *Allorhogas ilexaffinis* sp. nov.

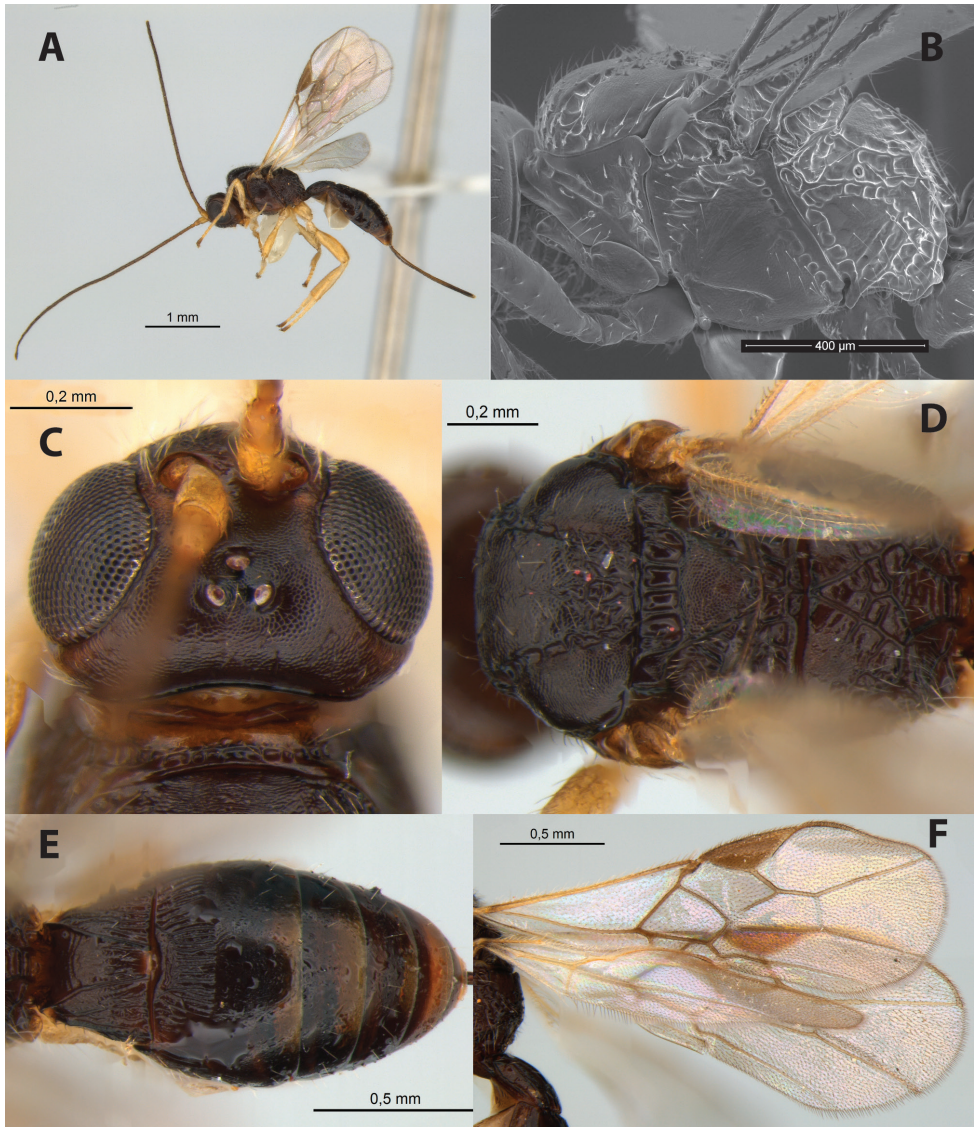
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**Diagnosis.** This new species could be distinguished from the remaining species of *Allorhogas* from Brazil by having the following combination of features: 1) mesosoma brown to dark brown; 2) first and second metasomal tergites costate, smooth between carinae, remaining tergites smooth and polished (first and second tergites costate but with coriaceous sculpture between carinae and third tergite also sculptured in other Brazilian species with dark brown colour).



**Figure 2.** **A** spherical gall on a stem of *Copaifera langsdorffii* Desf. (Fabaceae) from where *A. copaiba* sp. nov. was reared **B** *A. ilexaffinis* sp. nov., head, frontal view **C** *A. quarentenus* sp. nov., head, frontal view **D** *A. inquilinus* sp. nov., head, frontal view **E** *A. vassununga* sp. nov., head, dorsal view **F** *A. viridis* sp. nov., head, frontal view.

**Description. Female.** Body size 2.7 mm (Fig. 3A), forewing 2.4 mm. **Colour:** head brown, temple, gena and clypeus light brown; palpi pale yellow; scape and pedicel yellow; basal flagellomeres brown, turning black to apex; eyes dark brown to black;



**Figure 3.** *Allorbogas ilexaffinis* sp. nov. (A, C–F female, holotype B female, paratype) A habitus, lateral, view B mesosoma, lateral view C head, dorsal view D mesosoma, dorsal view E metasoma, dorsal view F wings.

mesosoma dark brown, lower part of mesopleuron brown; metasoma brown to dark brown; legs pale yellow; tarsal claws black; wings hyaline, forewing veins brown to light brown, stigma brown; hindwing veins pale yellow; ovipositor sheaths dark brown to black, ovipositor brown, apex strongly sclerotised.

**Head:** transverse in dorsal view, 1.5 times wider than its median length (dorsal view) (Fig. 3C), 0.6 times as long as high (lateral view); occipital carina complete and reaching hypostomal carina before mandible; post ocellar line (POL) as long than ocellar diameter (OD), 0.5 times ocular ocellar line (OOL); frons, vertex, temple,

gena and clypeus coriaceous; face sparsely pilose, coriaceous, transversally rugose laterobasally (Fig. 2B), with a smooth median area; area surrounding clypeus and gena with large pilosity; clypeus coriaceous; frons excavation distinct but not defined by sharp lateral margins; eye 1.3 times longer than wide; eye width 2.0 times longer than temple in dorsal view; malar space 0.3 times eye height and 1.7 longer than width of hypoclypeal depression; mandibles tridentate, teeth short and relatively equal in size; antenna with 26 flagellomeres, first flagellomere about 3.6 times longer than wide, 1.3 times longer than second one.

**Mesosoma:** 1.6 times longer than high (Fig. 3B) and 1.6 times longer than wide (Fig. 3D); pronotal collar short but visible in dorsal view, pronotal furrow scrobiculate-coriaceous; mesoscutum transverse in dorsal view, its median length 0.7 times its width; mesoscutal lobes coriaceous, median lobe with an indistinct median longitudinally rugose stripe, notauli scrobiculate, not meeting, reaching the end of scutellum in a longitudinally rugose area; scutellar disc coriaceous, prescutellar furrow with five transverse carinae; mesopleuron coriaceous, anterior part slightly transversally costate; subalar groove wide, scrobiculate; precoxal sulcus wide deep, coriaceous and slightly scrobiculate, running along two thirds of mesopleuron; metapleuron coriaceous-slightly rugose medially, scrobiculate along edges; propodeum basally coriaceous, with two distinct diverging carinae, rugose laterally and apically in areolar area.

**Wings:** forewing 2.7 times longer than wide (Fig. 3F). Pterostigma 2.8 times as long as wide and 0.7 times as long as R. Vein r 0.9 times as long as 3RSa, 0.2 times as long as 3RSb, and as long as r-m. Vein 2RS interstitial with m-cu, vein RS+Mb absent. Hindwing vein M + CU 0.7 times as long as 1 M, m-cu slightly curved towards wing apex.

**Legs:** hind coxa with a distinct basoventral tooth. Hind femur 3.2 times longer than wide.

**Metasoma:** first tergite 1.3 times wider than long, longitudinally costate, smooth between carinae; with two subparallel longitudinal carinae running to apex, anteriorly delimited by an indistinct transverse carina (Fig. 3E). Second tergite longitudinally costate, smooth between carinae; line between second and third tergites distinct and straight; remaining tergites smooth and polished. Ovipositor sheaths 1.1 times longer than metasoma.

**Variation.** Body size 2.7–2.9 mm. Head and mesosoma brown to dark brown. Antenna with 25–26 flagellomeres.

**Male.** Similar to female. Body size 2.6–2.7 mm. Antenna with 28 flagellomeres. Hind femur swollen, 2.6 times longer than wide.

**Holotype.** Female (DCBU 420470). Brasil, SP, Descalvado, Fazenda Itaúna; 21°54'06"S, 47°37'26"W; 24-II-2005; N.W.Perioto, e eq. cols.; ex. frutos de *Ilex affinis* Gardner (Aquifoliaceae).

**Paratypes.** (DCBU 420459, 420471; IBUNAM). One male, three females, same data as holotype.

**Biology.** The type specimens of this species were reared from fruits of *Ilex affinis* Gardner (Aquifoliaceae).

**Etymology.** The name of this species refers to the host plant species where the type specimens were reared.



***Allorhogas inquilinus* sp. nov.**

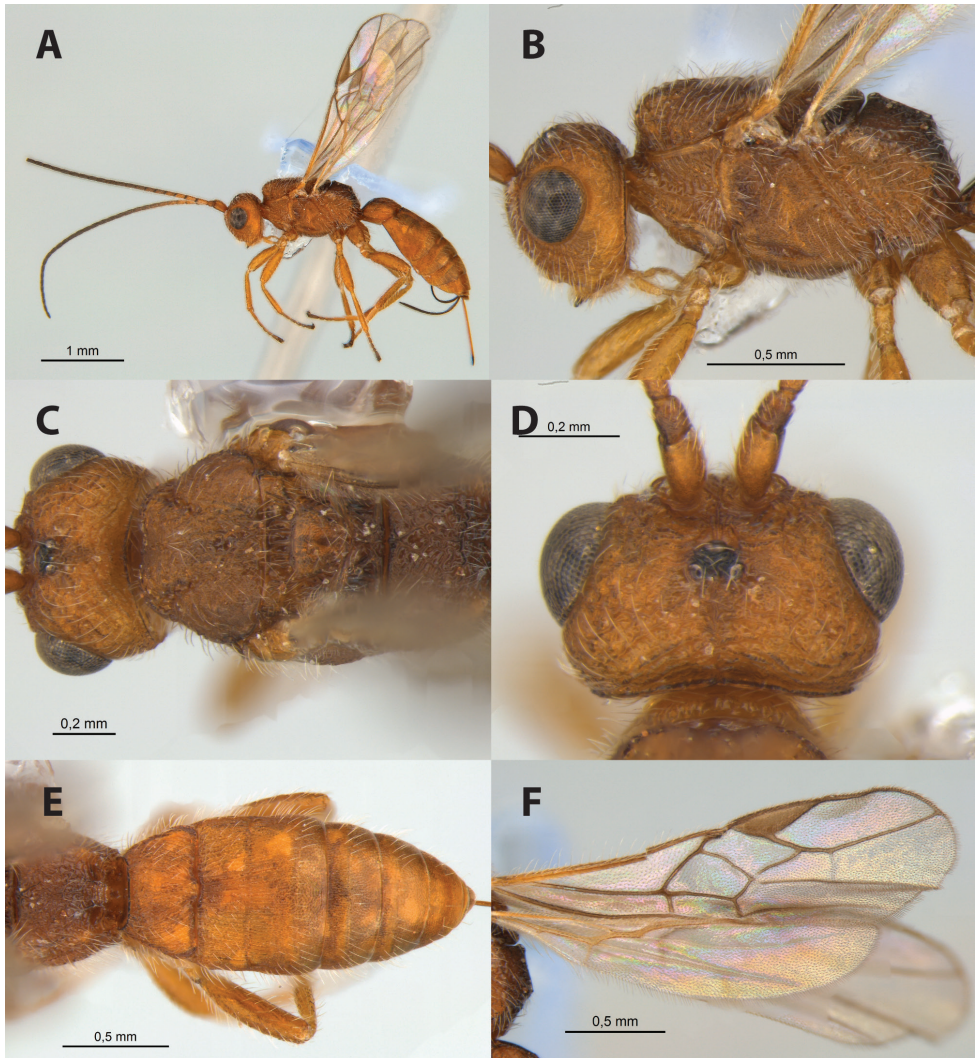
<http://zoobank.org/75E631BD-773B-41E1-AE36-DC8621F2F4BF>

**Diagnosis.** This is a morphologically distinctive species, which could be distinguished from the remaining described members of *Allorhogas* from Brazil by having: 1) eyes small, malar space 0.8 times eye height (eyes larger, malar space less than 0.8 times eye height in the remaining species); 2) frons and vertex strongly rugose-coriaceous (generally coriaceous in the remaining species; striate-rugose and coriaceous in *A. copaiba*); 3) face coriaceous with longitudinal v-shape striation (variable but never with this sculpture in the remaining species); 4) propodeum entirely strongly rugose-areolate, with two indistinct diverging carinae (at least partially coriaceous and with distinct diverging carinae in the remaining species); 5) hindwing with vein m-cu almost straight, slightly curved towards wing base (slightly curved towards apex in the remaining species); 6) apical half of third and remaining metasomal tergites punctate-slightly costate (usually smooth in the remaining species).

**Description. Female.** Body size 3.3 mm (Fig. 4A), forewing 2.3 mm. **Colour:** body entirely honey yellow; scape, pedicel and first four flagellomeres honey yellow, remaining flagellomeres dark brown; eyes silverish black; palpi yellow; legs honey yellow, tarsi brown; tarsal claws black; wings hyaline; forewing veins brown, stigma brown; hindwing veins honey yellow; ovipositor sheaths black, ovipositor honey yellow, apex strongly sclerotised.

**Head:** transverse in dorsal view, 2.4 times wider than its median length (dorsal view) (Fig. 4B, D), and 0.6 times as long as high (lateral view); occipital carina complete and reaching hypostomal carina before mandible; post ocellar line (POL) as long as ocellar diameter (OD), 0.3 times ocular ocellar line (OOL); frons and vertex strongly rugose-coriaceous, temple and gena coriaceous-slightly rugulose; face pilose, costate-rugose in longitudinal v-shape and coriaceous (Fig. 2D); area surrounding clypeus and gena with large, dense pilosity; clypeus transversally costate-rugose; frons excavation distinct but not defined by sharp lateral margins; eye 1.1 times longer than wide; eye width 1.9 times longer than temple in dorsal view; malar space 0.8 times eye height and 2.0 times longer than width of hypoclypeal depression; mandibles bidentate; antenna with 29 flagellomeres, first flagellomere about 3.0 times longer than wide, 1.3 times longer than second flagellomere.

**Mesosoma:** 1.6 times longer than high (Fig. 4B) and 1.4 times longer than wide (Fig. 4C); pronotal collar short but visible in dorsal view, pronotal furrow wide, scrobiculate; mesoscutum transverse in dorsal view, its median length 0.8 times its width; mesoscutal lobes rugose-coriaceous, with large, dense pilosity; median mesoscutal lobe with a wide furrow that turns more distinct basally; notauli wide, deep and rugose-scrobiculate, not meeting, reaching the end of scutellum in a rugose area; scutellar disc coriaceous, prescutellar furrow with five transverse carinae; mesopleuron transversally rugose-coriaceous anteriorly, coriaceous medially and basally; subalar groove wide and rugose-scrobiculate; precoxal sulcus wide, scrobiculate-coriaceous, running along 0.6 of mesopleuron; metapleuron entirely rugose-areolate; propodeum entirely strongly rugose-areolate and slightly coriaceous basally, with two indistinct diverging carinae.



**Figure 4.** *Allorbogas inquilinus* sp. nov. (female, holotype) **A** habitus, lateral, view **B** head and mesosoma, lateral view **C** head and metasoma, dorsal view **D** head, dorsal view **E** metasoma, dorsal view **F** wings.

**Wings:** forewing 3.2 times longer than wide (Fig. 4F). Pterostigma 4.0 times as long as wide and 0.7 times as long as R. Vein r as long as 3RSa, 0.3 times as long as 3RSb, and as long as r-m. Vein 2RS interstitial with m-cu, vein RS+Mb absent. Hindwing vein M + CU as long as 1 M, vein m-cu almost straight, slightly curved towards wing base.

**Legs:** hind coxa with distinct, pointed basoventral tooth, with large, dense pilosity, ventrally rugose. Hind femur 3.3 times longer than wide.

**Metasoma:** first tergite 1.7 times wider than long, costate, slightly punctate laterally, with two longitudinal carinae only distinct at base; transverse basal carina distinct (Fig. 4E). Second and basal half of third tergite costate-slightly punctate, line between

second and third tergites distinct and straight; apical half of third and remaining tergites punctate-slightly costate. Ovipositor sheaths 0.6 times as long as metasoma.

**Variation.** Body size 3.0–4.0 mm. Antenna with 28–31 flagellomeres.

**Male.** Similar to female. Body size 4.0 mm. Antenna with 30 flagellomeres. Hind femur swollen, about 3.0 times longer than wide.

**Holotype.** Female (DCBU 420452). Brasil, RD, Santo Antonio da Patrulha, Coxilha das Lombas; from galls of *Cecidonium pampeanus* (Lepidoptera, Cecidosidae), 18.IV.2015; G. R.P. Moreira & S. L. Bordignon col.

**Paratypes.** (DCBU420453–58, 420472; IBUNAM). 1 male, 4 females, 1 specimen without metasoma (DCBU 420457). Same data as holotype.

**Biology.** A detailed description of the feeding biology of *A. inquilinus* was previously reported by Moreira et al. (2017). This species was confirmed by the authors as a gregarious inquiline of stem galls made by the cecidosid moth *Cecidonium pampeanus* Moreira & Gonçalves on *Schinus weinmannifolius* Mart. ex Engl. (Anacardiaceae).

**Etymology.** The epithet of this species is a reference to its inquiline biology.

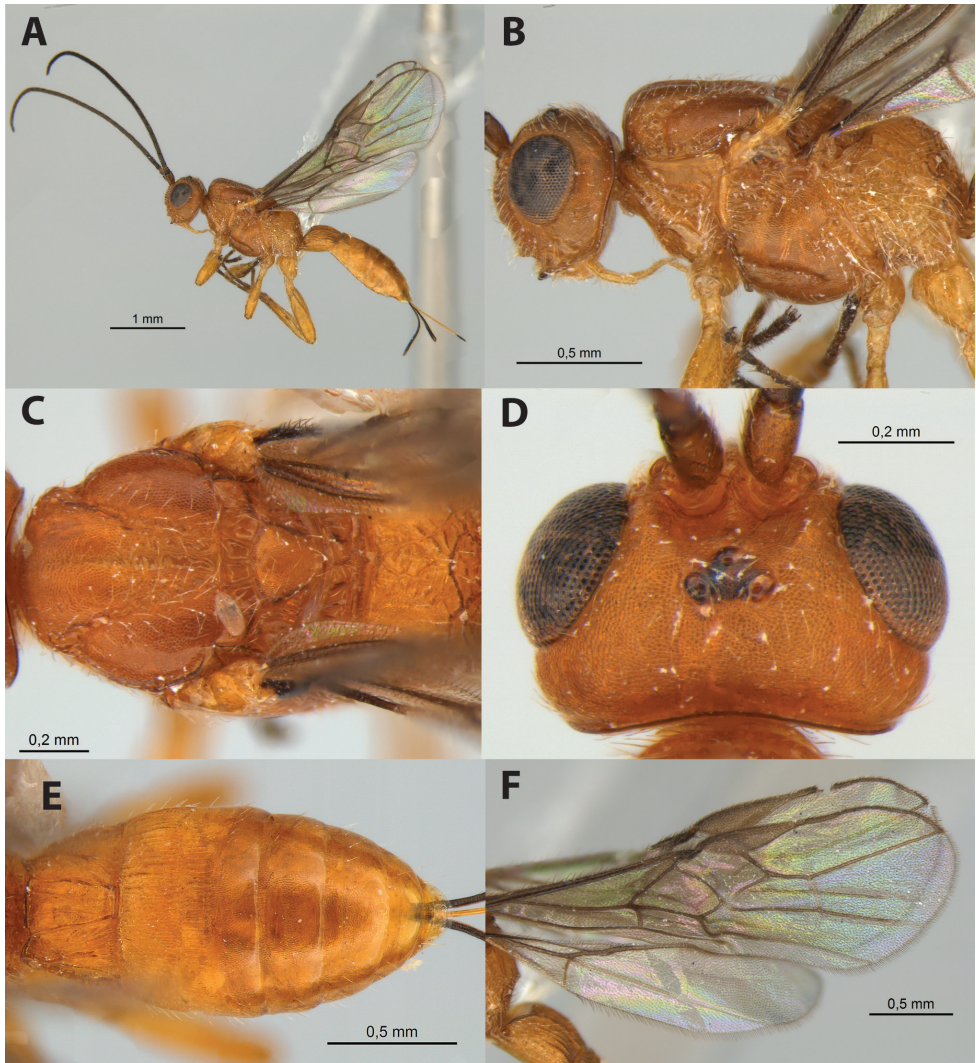
#### *Allorhogas quarentenus* sp. nov.

<http://zoobank.org/7D93D458-2EE4-4F93-B117-AB12B7AD0DA1>

**Diagnosis.** This new species is morphologically similar to the following species that also have been associated with legumes, with the first being described from Costa Rica and the remaining four from Brazil: *A. infuscotarsus* Marsh, *A. brasiliensis* Marsh, *A. mineiro* Zaldívar-Riverón & Martínez, *A. spermaphagus* Marsh and *A. vulgaris* Zaldívar-Riverón & Martínez. *Allorhogas quarentenus* can be distinguished from the latter five species by its dark brown tarsi (only hind tarsus brown in *A. infuscotarsus*; yellow to honey yellow in the remaining species). Moreover, it can be distinguished from *A. infuscotarsus* and *A. mineiro* by having its ovipositor sheaths 0.6 times as long as metasoma (0.33 and 1.1–1.3 in the latter species, respectively); from *A. brasiliensis* by having 24–27 flagellomeres and forewing m-cu interstitial with 2RS (32–32 flagellomeres and forewing m-cu basal to 2RS in *A. brasiliensis*); and from *A. spermaphagus* by having the propodeum basally coriaceous (rugulose-coriaceous in *A. spermaphagus*).

**Description. Female.** Body size 3.5 mm (Fig. 5A), forewing 3.0 mm. **Colour:** body entirely honey yellow, scape honey yellow, pedicel brown, flagellomeres brown to dark brown; eyes silverish black; palpi yellow; legs yellow to honey yellow, tarsi dark brown; tarsal claws dark brown to black; wings hyaline, fore and hindwing veins dark brown basally, light brown apically, stigma brown; ovipositor sheaths dark brown to black, ovipositor honey yellow, apex strongly sclerotised.

**Head:** transverse in dorsal view, 1.8 times wider than its median length (dorsal view) (Fig. 5B, D), 0.7 times as long as high (lateral view); occipital carina complete and reaching hypostomal carina before mandible; post ocellar line (POL) as long than ocellar diameter (OD), 0.6 times ocular ocellar line (OOL); frons, vertex, temple and gena coriaceous; face sparsely pilose, rugose-coriaceous, raised and smooth-coriaceous



**Figure 5.** *Allorhogas quarentenus* sp. nov. (female, holotype) **A** habitus, lateral, view **B** head and mesosoma, lateral view **C** head and metasoma, dorsal view **D** head, dorsal view **E** metasoma, dorsal view **F** wings.

medially (Fig. 2C); clypeus transversally rugose-coriaceous; area surrounding clypeus and gena pilose; frons excavation distinct but not defined by sharp lateral margins; eye 1.5 times longer than wide; eye width 2.0 times longer than temple in dorsal view; malar space 0.5 times eye height and 2.1 longer than width of hypoclypeal depression; mandibles tridentate, inner tooth considerably small and blunt; antenna with 27 flagellomeres, first flagellomere about 2.8 times longer than wide, 1.2 times longer than second one.

**Mesosoma:** 1.8 times longer than high (Fig. 5B) and 1.5 times longer than wide (Fig. 5C); pronotal collar short but visible in dorsal view, pronotal furrow slightly scro-

biculate; mesoscutum transverse in dorsal view, its median length 0.8 times its width; mesoscutal lobes coriaceous, median lobe with indistinct median line; notauli wide, deep and scrobiculate, not meeting, reaching the end of scutellum in a rugose area with two distinct longitudinal carinae; scutellar disc coriaceous, prescutellar furrow with three transverse carinae; mesopleuron coriaceous, subalar groove wide, scrobiculate; precoxal sulcus wide, deep and coriaceous, running along two thirds of mesopleuron; metapleuron rugose-areolate, with sparse, large setae; propodeum basally coriaceous, with two distinct diverging carinae, rugose-areolate laterally and apically in areolar area.

**Wings:** forewing 2.8 times longer than wide (Fig. 5F). Pterostigma 3.6 times as long as wide and 0.8 times as long as R vein. Vein r as long as 3RSa, 0.3 times as long as 3RSb, and as long as r-m. Vein 2RS interstitial with m-cu, vein RS+Mb absent. Hindwing vein M + CU 0.9 times as long as 1 M, m-cu slightly curved towards wing apex.

**Legs:** hind coxa with distinct, pointed basoventral tooth. Hind femur 3.7 times longer than wide.

**Metasoma:** first tergite 1.6 times wider than long, longitudinally costate-rugulose and coriaceous, with costate carinae partially indistinct basally, smooth medio-apically, with two distinct longitudinal subparallel carinae; basally delimited by a transverse carina (Fig. 5E). Second tergite longitudinally costate, line between second and third tergites distinct and slightly sinuate, third tergite longitudinally costate-rugulose on basal half, slightly punctate on apical half; remaining tergites slightly punctate to smooth. Ovipositor sheaths 0.6 times as long as metasoma.

**Variation.** Body size 3.1–3.8 mm. Metasoma honey yellow to yellow. Most part of lateral mesoscutal lobes dark brown (four specimens). Fore and middle tarsi honey yellow, brown or dark brown. Antenna with 24–27 flagellomeres. Prescutellar furrow with 2–3 transverse carinae.

**Male.** Similar to female. Body size 2.7–3.1 mm. Most part of lateral mesoscutal lobes dark brown (one specimen). Antenna with 25–27 flagellomeres. Hind femur swollen, 2.3–2.9 times longer than wide.

**Holotype.** Female (DCBU 420473). Brasil, SP, Paraibuna; Feb.2012; frutos de *Inga* sp.

**Paratypes.** (DCBU 420475-84; IBUNAM). 6 females, 1 male, same data as holotype; 8 females, 3 males. Brasil, MG, Janaúba, 15°49'41"S, 43°16'27"W; AM-161, 23.I.2019, 28.I.2019, 12.II.2019; B. R. Abreu col.

**Biology.** The type specimens of *A. quarentenus* were reared from legumes of an undetermined species of *Inga*.

**Etymology.** The name of this species refers to the COVID-19 pandemics with its subsequent undefined quarantine, which occurred while the authors were describing it.

**Remarks.** Specimens of *A. quarentenus* and *A. vulgaris* could be either uniformly honey yellow or with dark brown areas. However, in the former species they are only present along the lateral mesoscutal lobes (also present in the basal areas of propodeum and central areas of second to fourth tergites in *A. vulgaris*).

***Allorhogas vassununga* sp. nov.**

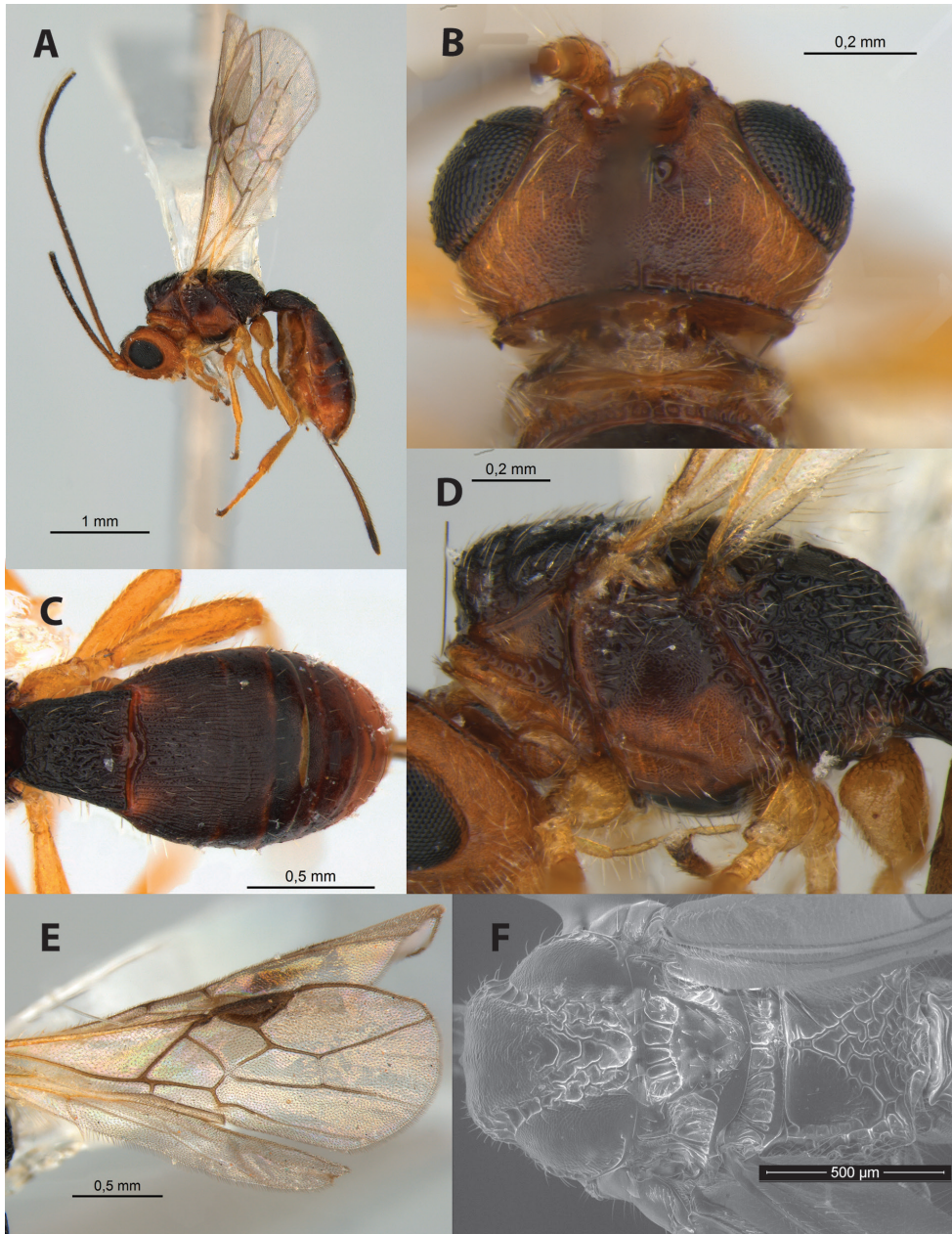
<http://zoobank.org/91524D1C-2D7D-46AF-9F13-44A0DCFAF0DF>

**Diagnosis.** This new species can be distinguished from the remaining described species of *Allorhogas* from Brazil by having the following combination of morphological features: 1) first metasomal tergite longitudinally costate-rugose, with two longitudinal carinae only distinct at base (sculpture variable, often with longitudinal carinae running along the entire tergite in the remaining species); 2) frons excavation defined by sharp lateral margins and a median longitudinal carina (frons excavation with or without sharp lateral margins and median longitudinal carina in the remaining species); 3) mesosoma and metasoma mostly dark brown to black, mesopleuron medially and posteriorly and sixth to remaining tergites honey yellow (always with a different colour pattern in the remaining species).

**Description. Female.** Body size 3.4 mm (Fig. 6A), forewing 2.7 mm. **Colour:** head honey yellow, frons and vertex brown; scape, pedicel and first and second flagellomeres honey yellow, remaining flagellomeres dark brown; palpi honey yellow; eyes black; mesoscutum, propodeum and metapleuron dark brown to black; pronotum honey yellow; mesopleuron dark brown to black anteriorly, turning honey yellow medially and posteriorly; venter of mesosoma dark brown to black; first metasomal tergite dark brown to black, second to fifth tergites dark brown to black, honey yellow along their edges; remaining tergites mostly honey yellow; legs honey yellow; tarsal claws dark brown to black; wings hyaline; forewing veins brown, stigma brown; hindwing veins yellow to light brown; ovipositor sheaths brown on two thirds, turning black to apex; ovipositor honey yellow, apex strongly sclerotised.

**Head:** slightly transverse in dorsal view, 2.0 times wider than its median length (dorsal view) (Figs 2E, 6B), and 1.6 times as long as high (lateral view); occipital carina complete and reaching hypostomal carina before mandible; post ocellar line (POL) as long as ocellar diameter (OD), 0.6 times ocular ocellar line (OOL); frons, vertex, temple and gena coriaceous; face coriaceous, laterally rugulose-coriaceous; area surrounding clypeus and gena with large, dense pilosity; frons excavation distinct, defined by sharp lateral margins and a median longitudinal carina; eye 1.4 times longer than wide; eye width 2.5 times longer than temple in dorsal view; malar space 0.4 times eye height and 1.8 times longer than width of hypoclypeal depression; mandibles bidentate; antenna with 28 flagellomeres, first flagellomere about 2.4 times longer than wide, 1.3 times longer than second flagellomere.

**Mesosoma:** 1.9 times longer than high (Fig. 6D) and 1.5 times longer than wide (Fig. 6F); pronotal collar short but visible in dorsal view, pronotal furrow wide, deep and scrobiculate; mesoscutum transverse in dorsal view, its median length 0.8 times its width; mesoscutal lobes coriaceous, notauli scrobiculate, not meeting, reaching the end of scutellum in a strongly-rugose area; scutellar disc slightly coriaceous, prescutellar furrow with four transverse carinae; mesopleuron coriaceous, subalar groove wide and scrobiculate; precoxal sulcus wide, deep, coriaceous-slightly scrobiculate, running along 0.5 of mesopleuron; metapleuron areolate-rugose; propodeum basally coriaceous, with two distinct diverging carinae, areolate-rugose apically in areolar area.



**Figure 6.** *Allorbogas vassununga* sp. nov. (**A–E** female, holotype **F** female paratype) **A** habitus, lateral view **B** head, dorsal view **C** metasoma, dorsal view **D** metasoma lateral view **E** wings **F** mesosoma, dorsal view.

**Wings:** forewing 2.7 times longer than wide (Fig. 6E). Pterostigma 3.0 times as long as wide and 0.8 times as long as R. Vein r 0.5 times as long as 3RSa, 0.2 times as long as 3RSb, and 0.8 times as long as r-m. Vein 2RS interstitial with m-cu, vein RS+Mb absent. Hindwing vein M + CU 0.9 times as long as 1 M, m-cu distinctly curved towards wing apex.

**Legs:** hind coxa with distinct, pointed basoventral tooth. Hind femur 4.1 times longer than wide.

**Metasoma:** first tergite 1.3 times wider than long, longitudinally costate-rugose, with two longitudinal carinae only distinct at base, anteriorly delimited by a transverse carina (Fig. 6C). Second and basal half of third tergite longitudinally costate, line between second and third tergites indistinct, slightly sinuate; apical half of third and remaining tergites slightly punctate. Ovipositor sheaths 0.6 times as long as metasoma.

**Variation.** Body size 3.0–3.4 mm. Antenna with 28–30 flagellomeres.

**Male.** Similar to female. Body size 3.6 mm. Antenna with 29 flagellomeres. Hind femur swollen, about 3.6 times longer than wide.

**Holotype.** Female (DCBU 420468). Brasil, SP, Santa Rita do Passa Quatro, Parque Estadual de Vassununga, “Cerrado Pé-do-Gigante”; armadilha Malaise 1; 27.II.2006; A. M. Pentead-Dias col.

**Paratypes.** (DCBU 420467–69 IBUNAM). 4 females, 1 male. Same data as holotype.

**Biology.** Unknown.

**Etymology.** The name of this new species refers to the locality where the type specimens were collected, Parque Estadual de Vassununga, in the state of São Paulo, Brazil.

### *Allorhogas viridis* sp. nov.

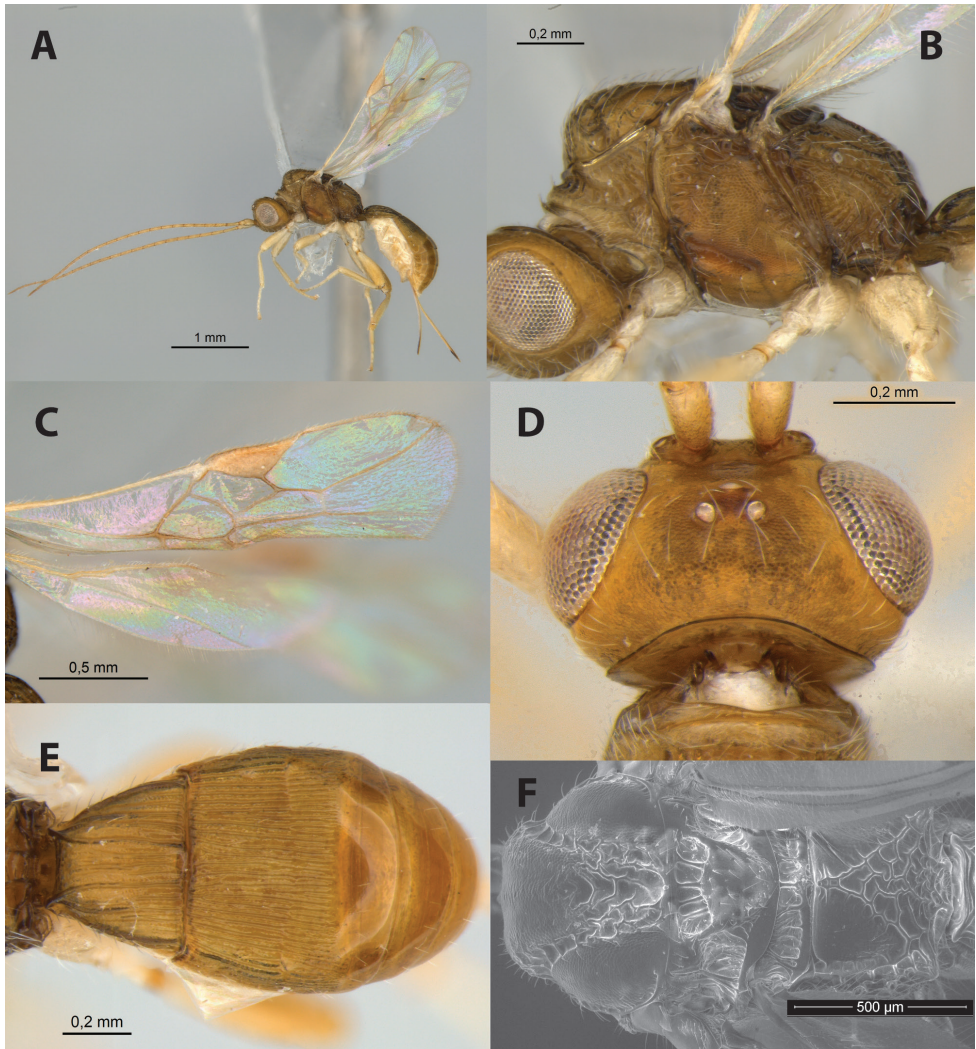
<http://zoobank.org/B1096E96-3979-42F0-AAC8-A073111C8A3A>

**Diagnosis.** This new species could be distinguished from the remaining described species of *Allorhogas* by having the following combination of morphological features: 1) body greenish pale yellow (never greenish pale yellow in the remaining species); 2) claws white (dark in the remaining species); 3) anterior half of notauli strongly scrobiculate and distinct, posterior half less sculptured and distinct, not meeting, reaching the end of scutellum in a smooth-rugose area with two subparallel longitudinal carinae (notauli usually entirely distinct, without such longitudinal carinae in the remaining species); 4) vein 2RS distal with m-cu, vein RS+Mb absent (variable in the remaining species).

**Description. Female.** Body size 2.9 mm (Fig. 7A), forewing 2.4 mm. **Colour:** body greenish honey yellow, scutellar area surrounding scutellar disc brown; eyes silver; scape, pedicel and flagellomeres pale yellow; palpi white; precoxal sulcus honey yellow; legs whitish yellow, claws white; wings hyaline, fore and hindwing veins and pterostigma pale yellow; ovipositor sheaths pale yellow, turning dark brown to apex, ovipositor pale yellow, apex strongly sclerotised.

**Head:** transverse in dorsal view, 1.7 times wider than its median length (dorsal view) (Fig. 7D), 1.1 times as long as high (lateral view); occipital carina complete and reaching hypostomal carina before mandible; post ocellar line (POL) as long than ocellar diameter (OD), 0.5 times ocular ocellar line (OOL); frons, vertex, temple, gena and clypeus coriaceous; face sparsely pilose, coriaceous, slightly rugulose medially (Fig. 2F);





**Figure 7.** *Allorbogas viridis* sp. nov. (A–E female, holotype F female, paratype) **A** habitus, lateral view; **B** head and mesosoma, lateral view **C** wings **D** head, dorsal view **E** metasoma, dorsal view **F** mesosoma, dorsal view.

frons excavation slightly distinct, not defined by sharp lateral margins; eye 1.2 times longer than wide; eye width 3.0 times longer than temple in dorsal view; malar space 0.4 times eye height and 1.4 longer than width of hypoclypeal depression; mandibles bidentate; antenna with 22 flagellomeres, first flagellomere about 4.3 times longer than wide, 1.2 times longer than second one.

**Mesosoma:** 1.7 times longer than high (Fig. 7B) and 1.5 times longer than wide (Fig. 7F); pronotal collar short but visible in dorsal view, pronotal furrow wide, deep and scrobiculate; mesoscutum transverse in dorsal view, its median length 0.8 times its width; mesoscutal lobes coriaceous; median lobe with an indistinct median longi-

tudinal elevated stripe; notauli wide, deep and scrobiculate on basal half, narrowing and obscuring towards apical half, not meeting, reaching the end of scutellum in a rugose area; scutellar disc coriaceous; prescutellar furrow with five transverse carinae; mesopleuron coriaceous, transversally rugose antero-basally; subalar groove wide and rugose-scrobiculate; precoxal sulcus wide, deep and coriaceous, running along 0.6 of mesopleuron; metapleuron coriaceous-rugose medially, rugose-areolate along edges; propodeum basally coriaceous, with two distinct diverging carinae, rugose-areolate and slightly coriaceous apically and apically in areolar area.

**Wings:** forewing 3.0 times longer than wide (Fig. 7C). Pterostigma 2.4 times as long as wide and 0.6 times as long as R. Vein r 0.4 times as long as 3RSa, 0.1 times as long as 3RSb, and 0.8 times as long as r-m. Vein 2RS distal with m-cu, vein RS+Mb absent. Hindwing vein M + CU 0.7 times as long as 1 M, m-cu slightly curved towards wing apex.

**Legs:** hind coxa coriaceous, striate ventrally with distinct, pointed basoventral tooth. Hind femur 3.2 times longer than wide.

**Metasoma:** first tergite 0.9 times as wide as long, longitudinally costate, with two indistinct longitudinal subparallel carinae, with a basal transverse carina (Fig. 7E). Second and basal two thirds of third tergite longitudinally costate, line between second and third tergites distinct and slightly sinuate, apical third of third and remaining tergites smooth and polished. Ovipositor sheaths as long as metasoma.

**Variation.** Body size 2.5–2.9 mm. Prescutellar furrow with 4–5 transverse carinae.

**Male.** Similar to female. Body slightly darker in one specimen. Body size 2.8–2.9 mm. Antenna with 22–23 flagellomeres. Hind femur swollen, 2.2–2.6 times longer than wide.

**Holotype.** Female (DCBU 420460). Brazil, Rio de Janeiro, Barra de Maricá, Restinga; 17.VII.1997; V. Maia col.; ex. galhas cônicas de *Stephomyia rotundifoliorum* em *Eugenia rotundifolia*.

**Paratypes.** (DCBU 420461–65; IBUNAM). 4 females, 3 males, same data as holotype; 12.XII.1997.

**Biology.** The type specimens of *A. viridis* were reared from conical galls apparently made by an undetermined cecidomyiid dipteran on leaves of *Eugenia rotundifolia* Casar. (Myrtaceae). These galls are cylindrical, unilocular, externally brown and internally white (Maia 1993).

**Etymology.** The epithet of this species derives from the Latin word *viridi* (green), in reference to its distinctive greenish colour.

## Updated key to species of *Allorhogas* from Brazil

- 1 Mesosoma compact, 1.2–1.5 times longer than high; pronotal collar short, not visible in dorsal view; propodeum almost entirely oblique in lateral view (associated to Melastomataceae fruits or floral buds) ..... **2**
- Mesosoma longer, at least 1.7 times longer than high; propodeum not oblique in lateral view..... **4**

- 2 (1) Mesoscutal lobes coriaceous, without rugose areas surrounding notauli; hind femur and tibia brown ..... *A. granivorus* Zaldívar-Riverón & Martínez
- Mesoscutal lobes coriaceous, with rugose areas surrounding notauli; hind legs entirely honey yellow ..... 3
- 3 (2) Ovipositor length about 0.2 times as long as metasoma; antenna with 20–21 flagellomeres; head, mesosoma and metasoma mostly dark brown, with some black areas ..... *A. uberlandiense* Joelle & Zaldívar-Riverón
- Ovipositor length about 0.5 times as long as metasoma; antenna with 22–25 flagellomeres; head, mesosoma and metasoma black ..... *A. clidemiae* Martínez & Zaldívar-Riverón
- 4 (2) Ovipositor shorter than first metasomal tergite ..... 5
- Ovipositor longer, at least 0.5 length of metasoma ..... 6
- 5(4) Malar space 2/5 eye height ..... *A. dyspistus* Marsh
- Malar space half as long as eye height ..... *A. muesebecki* (Guimarães)
- 6(4) Vertex and frons with marked rugose sculpture ..... 7
- Vertex and frons mainly coriaceous, without distinct rugose sculpture ..... 8
- 7(6) Frons and vertex striate-rugose and coriaceous; vein 2RS distal with m-cu ..... *A. copaiba* sp. nov.
- Frons and vertex strongly rugose-coriaceous; vein 2RS interstitial with m-cu ..... *A. inquilinus* sp. nov.
- 8(6) Body greenish pale yellow, tarsal claws white ..... *A. viridis* sp. nov.
- Body not greenish pale yellow, tarsal claws dark ..... 9
- 9(8) Forewing m-cu arising distal to 2RS ..... *A. heringeri* (Guimarães)
- Forewing m-cu arising basal or interstitial to 2RS ..... 10
- 10(9) Forewing m-cu arising basal to 2RS, thus vein RS +Mb distinct ..... 11
- Forewing vein m-cu interstitial to 2RS, RS +Mb not distinguishable ..... 12
- 11(10) Body length 4.0–4.5 mm, 32–33 flagellomeres ..... *A. brasiliensis* (Marsh)
- Body length 2.9–3.1 mm, 25–28 flagellomeres ..... *A. vulgaris* Zaldívar-Riverón & Martínez
- 12(10) Body mostly dark brown to black, with some areas brown to honey yellow .... 13
- Body honey yellow to light brown ..... 14
- 13(12) First metasomal tergite with two longitudinal carinae only distinct at base; frons excavation defined by sharp lateral margins and a median longitudinal carina ..... *A. vassununga* sp. nov.
- First metasomal tergite with two subparallel longitudinal carinae running to apex; frons excavation distinct but not defined by sharp lateral margins, without a median longitudinal carina ..... *A. ilexaffinis* sp. nov.
- 14(12) Forewing vein r 0.7 times as long as 3RSa ..... *A. taua* Penteadó-Dias & Carvalho
- Forewing vein r about as long as vein 3RSa ..... 15
- 15(14) Tarsi dark brown ..... *A. quarentenus* sp. nov.
- Tarsi entirely yellow ..... 16

- 16(15) Ovipositor sheaths 1.1–1.3 times the length of metasoma .....  
 .....*A. mineiro* Zaldívar-Riverón & Martínez  
 – Ovipositor sheaths 0.7 times the length of metasoma .....  
 .....*A. spermaphagus* Marsh

## Discussion

The conserved external morphology in *Allorhogas* makes rearing records an important diagnostic feature to distinguish its species, since they appear to be highly specific to their host plants. This study increases to 17 the number of described species of *Allorhogas* from Brazil, and to 12 the number of host plant families that are associated with this genus. The plant association reported for *A. ilexaffinis* to fruits of *Ilex affinis* represents the first record for a member of the plant family Aquifoliaceae. Moreover, *Copaifera* L. (Fabaceae) and *Eugenia* P. Micheli ex L. (Myrtaceae), which are associated with *A. copaiba* and *A. viridis*, respectively, are new host genus records for *Allorhogas*.

Of the six species described here, only the feeding biology of *A. inquilinus* could be confirmed. This represents the first confirmed record of a gregarious inquiline species in *Allorhogas*, and the only described species that is associated with the plant family Anacardiaceae. The galls where the type specimens of *A. copaiba* were reared also contained an undetermined lepidopteran moth species, and thus we presume that this could be the actual gall former in the system. Interestingly, *A. inquilinus* and *A. copaiba* are morphologically similar, sharing some unique features within the genus (e.g. vertex and frons with distinct rugose sculpture). *Allorhogas viridis* was, on the other hand, reared from leaf galls made by an undetermined cecidomyiid dipteran, though its feeding biology remains unknown.

Of all the previously proposed morphological synapomorphies of *Allorhogas* (Marsh 1993, 2002) only two, a distinctly excavated frons and first metasomal tergite with a basal transversal carina, appear to occur in all of its species. The hindwing vein m-cu slightly curved towards its apex, on the other hand, is present in most *Allorhogas* species, though in some of them (e.g. *A. marshi*, *A. inquilinus*) could be straight or slightly curved towards the wing base. Further taxonomic studies will help to determine the actual species composition of this genus.

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We especially thank Gilson R. P. Moreira for donating the type material of *A. inquilinus*; we also thank Luciana Bueno dos Reis Fernandes for taking the SEM and stereo microscope digital photographs at DEBE/UFSCar; Cristina Mayorga, Guillermina Ortega and Susana Guzmán for their help with the curation of the type specimens at the IBUNAM. This work was funded by a grant given by CNPq, CAPES and FAPESP (project INCT-HYMPAR) to AMPD.

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