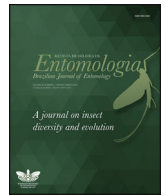




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New species of *Lopesia* Rübsaamen (Diptera: Cecidomyiidae) associated with *Andira humilis* Mart. ex Benth. (Fabaceae)



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ABSTRACT

A new species of *Lopesia* Rübsaamen, 1908 induces leaf galls on *Andira humilis* (Fabaceae) in the Cerrado biome (Brazilian savanna) of Bahia, Mato Grosso and São Paulo states, Brazil. Larva, pupa, female, and male of this new species of gall midge are described and illustrated in this paper.

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Introduction

Lopesia Rübsaamen, 1908 is a genus with 25 described species, mainly distributed in Neotropical region, but also registered in the Nearctic, Afrotropical, and Australasia regions (Gagné and Jaschhof, 2014; Urso-Guimarães et al., 2014; Maia and Monteiro, 2017). *Lopesia* has 20 described species reported to Brazil in Amazonas, Minas Gerais, Rio de Janeiro, Pernambuco, and São Paulo States (Gagné and Jaschhof, 2014; Urso-Guimarães et al., 2014; Maia and Monteiro, 2017).

In Brazil, eleven families of plants are referred as hosts of *Lopesia* galls: Burseraceae, Clusiaceae, Chrysobalanaceae, Erythroxylaceae, Euphorbiaceae, Fabaceae, Melastomataceae, Nyctaginaceae, Sapotaceae (Gagné and Jaschhof, 2014), Pontederiaceae (Urso-Guimarães et al., 2014), and Dilleniaceae (Maia and Monteiro, 2017). Six described species of *Lopesia* are known on Fabaceae, *Lopesia armata* Gagné, 1993 on *Acacia tortilis* (Forsk.) Hayne; *Lopesia nilotica* Gagné, 1993 on *Acacia nilotica* (L.) Willd. ex Del; *Lopesia grandis* Maia, 2001 on *Dalbergia ecastaphyllum* (L.) Taub.; *Lopesia mimosae* Maia, 2010 and *Lopesia pernambucensis* Maia, 2010 on *Mimosa tenuiflora* (Willd.) Poir; and *Lopesia aldinae* Fernandes and Maia, 2010 on *Aldina heterophylla* Spruce ex Benth. (Gagné and

Marohasy, 1993; Maia, 2001; Maia et al., 2010; Fernandes et al., 2010). This is the first report of *Lopesia* inducing galls on *Andira* species.

Here, we described a new species of *Lopesia*, based on material collected in three localities of Cerrado biome (Brazil) from leaf galls on *Andira humilis* Mart. ex Benth. *Andira* species are popularly known as “angelim rasteiro”, “angelim-do-campo” or “mata-barata no campo” (roach killer), due to its use as an insecticide. Also, it is a common tree or shrub endemic to Brazil, found in Amazon Forest, Caatinga, and Cerrado biomes. *Andira* species can reach one meter in height and has demonstrated allelopathic potential (Periotto et al., 2004).

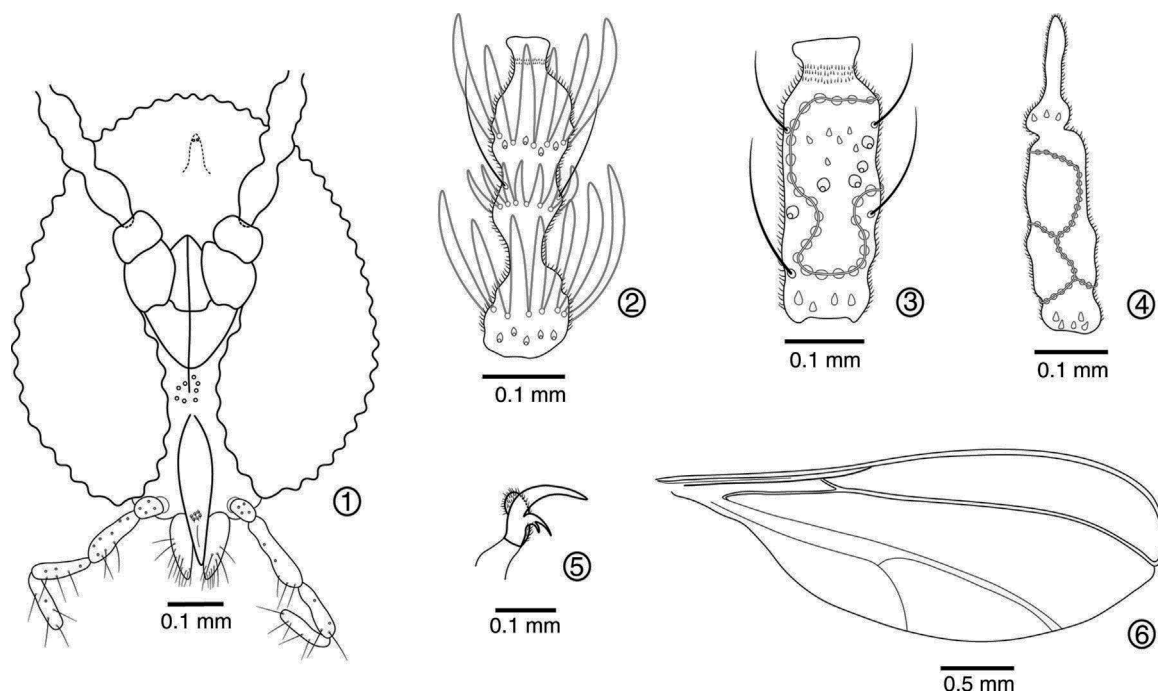
Blister-shaped leaf gall on *Andira humilis* was previously described by Saito and Urso-Guimarães (2012) and Isaías et al. (2014) without association with its inducer. This is the first formal record of a *Lopesia* species inducing galls on *Andira humilis*.

Material and methods

Branches with blister-shaped leaf gall of *Andira humilis* were collected from three localities of the Cerrado biome in Brazil: Parque Nacional da Chapada dos Guimarães (PNCG), Chapada dos Guimarães, Mato Grosso, Brazil (15°26'10" S, 055°47'23" W), during the Sisbiota-Diptera Program, 14-22.i.2013; Estação Ecológica de Jataí (EEJ), Luiz Antônio, São Paulo State (21°36'19.44" S and 47°47'28.86" W), 19-21.iv.2010; and Campus Reitor Edgard Santos

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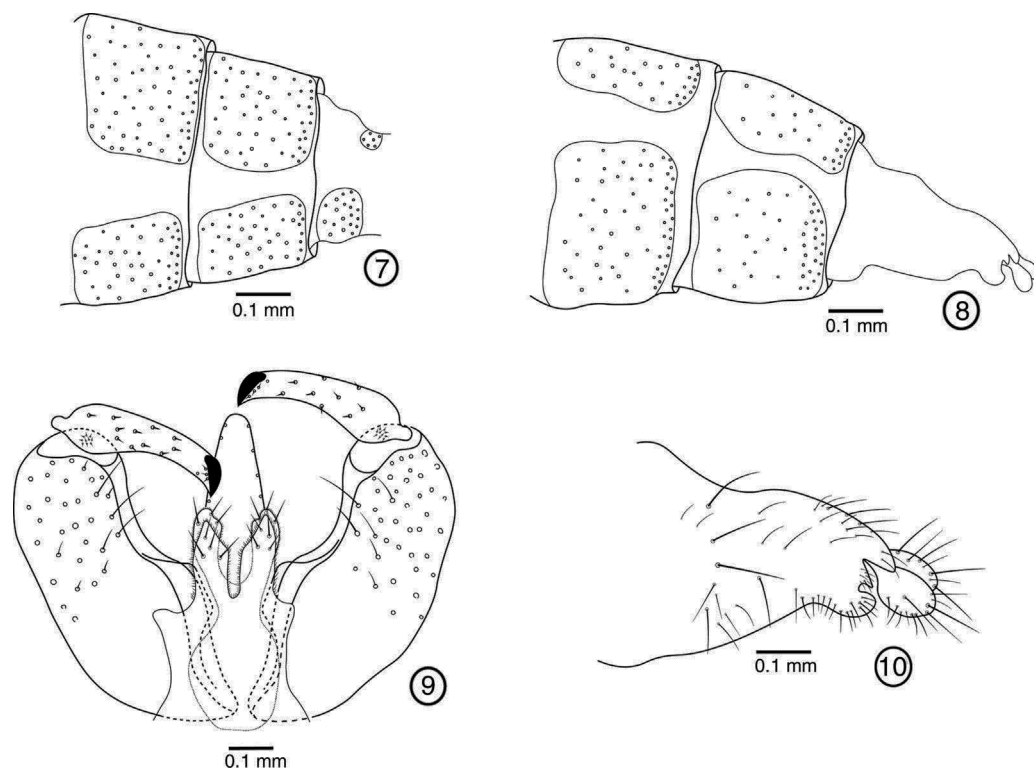
E-mail: carolina.dag@hotmail.com (C.A. Garcia).



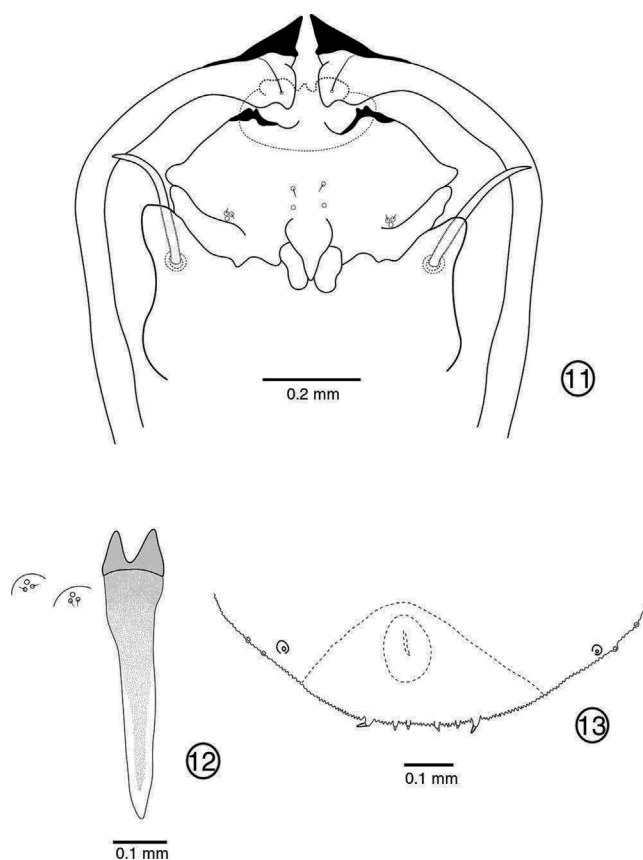
Figs. 1–6. *Lopesia andirae* sp. nov. 1. Male head (frontal view). 2. Third male flagellomere (frontal view). 3. Third female flagellomere (frontal view). 4. Twelfth female flagellomere with apical process. 5. Male tarsal claw and empodia. 6. Male wing.

of the Universidade Federal do Oeste da Bahia (UFOB), Barreiras, Bahia ($12^{\circ}08'51.4''$ S and $45^{\circ}01'17.3''$ W), June 2015. The galls were kept in plastic pots for rearing of insects. Larvae and pupae were obtained by dissecting the galls. All specimens were preserved in 70% alcohol and posteriorly mounted in slides following the technique and terminology of Gagné (1994).

The types are deposited at the *Museu de Zoologia of the Universidade de São Paulo*, São Paulo, Brazil (MZSP). Additional material was deposited at *Coleção do Laboratório de Zoologia* of the *Universidade Federal do Oeste da Bahia*. Ingrid Koch (IB/UNICAMP) and Ana Carolina Devides Castelo (UNESP/Botucatu) identified the plant species.



Figs. 7–10. *Lopesia andirae* sp. nov. 7. Male postabdomen (lateral view). 8. Female postabdomen (ventro-lateral view). 9. Male terminalia (ventral view). 10. Female ovipositor (lateral view).



Figs. 11–13. *Lopesia andirae* sp. nov. 11. Pupal head (ventral view). 12. Prothoracic spatula and lateral papillae. 13. Larval terminal segment (ventral view).

Taxonomy

Cecidomyiidae Macquart, 1838
 Cecidomyiinae Rondani, 1840
Lopesia Rübsaamen, 1908

Diagnosis. R_5 joining C beyond the wing apex; R_s closer to the end of R_1 than to the arculus; palpi three or four-segmented; antennae with binodal and tricircumflar flagellomeres (in male), or interconnected circumfila (in female); tarsal claws curved near basal third, generally toothed; ovipositor short, barely protrusible and female cerci separate (Maia et al., 2010; Maia, 2015).

Description. Adult – Body: 1.4 mm long (male, $n = 14$), 1.9 mm long (female, $n = 18$). Head (Fig. 1): eyes black, holoptic, facets circular, closely adjacent. Occipital process present. Frontoclypeus with 10 setae; labrum triangular with three pairs of setae; hypopharynx of the same shape as labrum; labella elongate-convex, each with several long lateral setae; palpi total length, 0.1 mm, palpi 4-segmented. Antennae total length, 0.8 mm (female); scape and pedicel long and maximum wide, 0.05 mm; scape broader distally; 12 binodal tricircumflar flagellomeres; circumfila whorls irregular in length in males, medial whorls shorter than distal and basal whorls (Fig. 2), cylindrical flagellomeres with interconnected circumfila in females (Fig. 3), apical process present (Fig. 4), setulose necks in both sexes. Thorax: scutum and scutellum brown. Scutum with two rows of dorso-central and one row of notopleural setae; anepimeron with 16 setae; laterotergite with two long trichoid sensilla, other sclerites bare. Legs: tarsal claws bend near midlength and 2-toothed (Fig. 5); empodia shorter than claws. Wing 1.25 mm long and 0.5 mm wide (male, $n = 14$), 1.7 mm long and 0.6 mm wide

(male, $n = 14$); venation as in Fig. 6. Abdomen. Male (Fig. 7): Tergites 1–7 rectangular with a complete row of posterior setae; irregular mesal rows of setae; Tergite 8 setose, weakly sclerotized. Sternites 1–7 as tergites 1–7. Sternite 8 rectangular and setose. Trichoid sensilla absent in tergites and sternites. Female (Fig. 8): Tergites 1–7 rectangular with a complete row of posterior setae; irregular mesal rows of setae; Tergite 8 setose and not sclerotized. Sternites 1–7 as tergites 1–7. Sternite 8 as tergite 8. Trichoid sensilla absent in tergites and sternites. Male terminalia (Fig. 9): gonocoxites splayed; wide and rounded with mesobasal lobe discreet; setae placed only on external surface; gonostylus elongated, wider at base and apically narrow; shorter than gonocoxite, sparsely covered with setae and microsetulae, teeth entire and strong; cercus setose and bilobed (outer lobe little longer than the inner), irregular margin; hypoproct deeply bilobed, setose, and longer than cerci; aedeagus large, elongate, tapering gradually to the apex, and 1.5 longer than hypoproct. Ovipositor (Fig. 10): 0.18 mm long; slightly protrusible, female cerci separate, ovoid and setose; hypoproct short and setose.

Pupa. Yellowish. Body 2.18 mm long ($n = 31$). Head (Fig. 11): antennal horns, 0.12 mm long, triangular, sclerotized, three lateral papillae present, two with setae and one aetose, two pairs of facial papillae present, one pair setose and one aetose. Cephalic setae 0.06 mm long. Thorax: wing reaching third abdominal segment; first pair of legs reaching the posterior margin of fifth abdominal segment, second pair reaching the 1/3 of sixth abdominal segment, and third pairs reaching the posterior margin of sixth abdominal segment. Prothoracic spiracle setiform, 0.16 mm long. Abdomen: abdominal tergites with dorsal spines absent, spicules present. Terminal segment as 0.15 mm long as wide ($n = 31$). Pupation in gall.

Larva 3rd instar. Yellowish. Body 1.5 mm long ($n = 2$). Integument rough. Spatula 2-toothed with long stalk (0.1 mm long), pointed teeth far apart from each other (Fig. 12). Two groups of three papillae per side, two of each group setose and one aetose. Terminal segment convex with three pairs of corniform papillae, one longer than the other two (Fig. 13).

Types. Holotype: Brazil, Mato Grosso, Chapada dos Guimarães (Parque Nacional Chapada dos Guimarães) (15°26'10" S, 055°47'23" W), reared from leaf galls of *Andira humilis*, collected in 14.i.2013, emerged in 17.vii.2013, M.V. Urso-Guimarães col. (♂ MZSP).

Paratypes. Mato Grosso State – Chapada dos Guimarães (Parque Nacional Chapada dos Guimarães) (15°26'10" S, 055°47'23" W): 16 ♂, 15 ♀, 31 pupal exuvia, 2 larvae; reared from leaf galls of *Andira humilis*, collected in 14.i.2013, emerged in 17.vii.2013, M.V. Urso-Guimarães col. (MZSP); Bahia State – Barreiras (12°08'51.4" S and 45°01'17.3" W): 3 ♂, 10 ♀, 3 pupal exuvia, 2 larvae, reared from leaf galls of *Andira humilis*, collected in vi.2015, V.P. Lima col. (UFOB); São Paulo State – Luiz Antônio (21°36'19.44" S and 47°47'28.86" W): leaf galls of *Andira humilis*, collected in 19-21.iv.2010, V.S. Saito and M.V. Urso-Guimarães col.

Etymology. The species name refers to the generic name of the host plant.

Gall and biology (Fig. 14). Blister-shaped, green, and bare leaf gall occurs only on the upper surface of leaf in *Andira humilis* (Fabaceae). Pupation in gall.

Remarks. The new gall midge differs from other known *Lopesia* in having the larval terminal segment with three pairs of corniform papillae, one longer than the other two in a rounded terminal segment and a wide aedeagus in males.

The key to segregation of *Lopesia* species of Rodrigues and Maia (2010) indicates that *L. andirae* sp. nov. resembles *L. elliptica* Maia, 2003, in such characteristics: setulose flagellomere necks, narrow gonocoxites, male binodal flagellomeres, wing with R_s joining R_1



Fig. 14. Leaf galls of *Lopesia andirae* sp. nov. on *Andira humilis* (Fabaceae).

after midlength, and 2-toothed tarsal claws, however, *Lopesia elliptica* has a narrow aedeagus, while the new species presents a large aedeagus.

The pupae of the new species share with *L. similis* Maia, 2004 the antennal horn developed, the conspicuous apical setae, dorsal abdominal spines absent, and cephalic spines absent, but the antennal base of the pupae of *L. similis* has a small denticle, absent in the *L. andirae* sp. nov.

L. andirae sp. nov. is also closely related to *L. singularis* Maia, 2001 and *L. eichhorniae* Urso-Guimarães, 2014 by the following characters: prothoracic spatula with two teeth spaced apart and three pairs of corniform papillae, but both species differs from *L. andirae* sp. nov. in having bilobed terminal segment instead of rounded terminal segment.

It is known that there is a high specificity between gall makers and their host plants. As a result, gall morphotypes associated with host plants are used to distinguish their inducer species. Thus, despite the morphological features shown between *L. andirae* sp. nov. and the species mentioned above, this species induces blister-shaped galls on the upper leaf surface of *Andira humilis* (Fabaceae). *L. elliptica* makes a parenchymatic gall that forms an elliptical distension of the leaf's epidermis of *Calophyllum brasiliense* (Clusiaceae). *L. similis* induces a green leaf with a rolled-margin of *Protium heptaphyllum* (Aubl.) (Burseraceae) (Narahara et al., 2004). The galls of *L. singularis* are induced on *Pouteria venosa* (Mart.) Bahni (Sapotaceae) and *L. eichhorniae* causes swollen rhizome galls on *Eichhornia azurea* (Sw.) Kunth (Pontederiaceae).

The association between the host plant *Andira humilis* (Fabaceae) and the gall maker *Lopesia andirae* sp. nov. is reported for the first time, as well as the geographical distribution of the *Lopesia* genus to Mato Grosso and Bahia States.

Conflicts of interest

The authors declare no conflicts of interest.

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References

- Fernandes, S.P.C., Maia, V.C., Rafael, J.A., 2010. Gall midges (Diptera, Cecidomyiidae) associated with *Aldina heterophylla* Spr. ex Benth. (Fabaceae) from Brazil. *Biota Neotrop.* 10 (1), 161–166.
- Gagné, R.J., Marohasy, J., 1993. The gall midges (Diptera: Cecidomyiidae) of *Acacia* spp. (Mimosaceae) in Kenya. *Insecta Mundi* 7 (1), 77–124.
- Gagné, R.J., 1994. *The Gall Midges of the Neotropical Region*. Cornell University Press, Ithaca, 352 pp.
- Gagné, R.J., Jaschhof, M., 2014. A Catalog of the Cecidomyiidae (Diptera) of the World. Digital Version 2, 3rd ed, Available at <http://www.ars.usda.gov/SP2UserFiles/Place/80420580/Gagne2014WorldCecidomyiidaeCatalog3dEdition.pdf> (accessed 15.04.16).
- Isaias, R.M.S., Carneiro, R.G.S., Santos, J.C., Oliveira, D.C., 2014. Gall morphotypes in the neotropics and the need to standardize them. In: Fernandes, G.W., Santos J.C. (Eds.), *Neotropical Insect Galls*, vol. 1, pp. 15–34.
- Maia, V.C., 2001. New genera and species of gall midges (Diptera, Cecidomyiidae) from three restingas of Rio de Janeiro State, Brazil. *Rev. Bras. Zool.* 18 (1), 1–32.
- Maia, V.C., Fernandes, G.W., Magalhães, H., Santos, J.C., 2010. Two new species of *Lopesia* Rübsaamen (Diptera, Cecidomyiidae) associated with *Mimosa hostilis* (Mimosaceae) in Brazil. *Rev. Bras. Entomol.* 54 (4), 578–583.
- Maia, V.C., 2015. New state record of *Lopesia grandis* Maia, 2001 (Insecta, Diptera, Cecidomyiidae). *Check List* 11 (3), 1621–2015.
- Maia, V.C., Monteiro, R.F., 2017. *Lopesia davillae* (Diptera, Cecidomyiidae), a new species of gall midge from Brazil associated with *Davilla rugosa* (Dilleniaceae). *Braz. J. Biol.* (Epub ahead of print).
- Narahara, K., Maia, V.C., Monteiro, R.F., 2004. Two new species of gall midges (Diptera, Cecidomyiidae) associated with *Protium heptaphyllum* (Aubl.) Marchand (Burseraceae) in Brazil. *Rev. Bras. Entomol.* 48 (4), 485–490.
- Periotto, F., Perez, S.C., Andrade, J.G., Lima, M.I.S., 2004. Efeito alelopático de *Andira humilis* Mart. ex Benth na germinação e no crescimento de *Lactuca sativa* L. e *Raphanus sativus* L. *Acta Bot. Bras.* 18 (3), 425–430.
- Rodrigues, A.R., Maia, V.C., 2010. Two new species of *Lopesia* Rübsaamen (Diptera, Cecidomyiidae) from Brazil, with an identification key of species. *Biota Neotrop.* 10 (1), 85–99.
- Saito, V.S., Urso-Guimarães, M.V., 2012. Characterization of galls, insect galls and associated fauna of Ecological Station of Jataí (Luiz Antônio, SP). *Biota Neotrop.* 12 (3), 99–107.
- Urso-Guimarães, M.V., Pelaez-Rodriguez, M., Trivinho-Strixino, S., 2014. New species of *Lopesia* (Diptera, Cecidomyiidae) associated with *Eichhornia azurea* (Pontederiaceae) from Brazil. *Iheringia Ser. Zool.* 104 (4), 478–483.