

Insect galls on *Mikania glomerata* (Asteraceae) in an area of Atlantic Forest in Viçosa (Minas Gerais, Brazil)

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Abstract: *Mikania glomerata* (Asteraceae) hosts eight gall midge species (Diptera: Cecidomyiidae), each one responsible for a different gall morphotype. In a survey conducted in Recanto das Cigarras, Viçosa, Minas Gerais state (Brazil), we found three of these eight gall midges: *Liodiplosis cylindrica*, *L. spherica*, and *Asphondylia glomeratae*, each exhibiting a low infestation rate. This study offers an updated geographic distribution of these three gall midge species, recorded for the first time in Minas Gerais state.

Key words: gall midge; galling insects; plant-insect interaction; Cecidomyiidae

Mikania glomerata Spreng. (Asteraceae), commonly known as “guaco”, is native to Brazil, Uruguay, Argentina, and Paraguay, and used in folk medicine to treat rheumatism and respiratory diseases (Celeghini et al. 2006; Agra et al. 2008). In Brazil, it occurs in the Northeast, Southeast, and South regions, in the Cerrado and Atlantic forest biomes (Ritter and Miotto 2005). It is a shrubby climbing plant, woody, with cylindrical and slender stem, and without tendrils. The leaves are opposite, triangular, shiny green, slightly dark in the adaxial surface, and the flowers are yellowish and white (Vidal et al. 2006).

This plant is attacked by eight species of gall midges (Diptera, Cecidomyiidae), *Alycaulus globulus* Gagné, 2001, *Asphondylia glomeratae* Gagné, 2001, *Asphondylia moehni* Skuhrová, 1989, *Liodiplosis conica* Gagné, 2001, *L. cylindrica* Gagné, 2001, *L. spherica* Gagné, 2001, *Mikania-diplosis annulipes* Gagné, 2001, and *Perasphondylia mikaniae* Gagné, 2001. Each of these species induces a different gall morphotype (Gagné et al. 2001). In spite of being described from the state of Rio de Janeiro, these gallers occur also in the state of São Paulo (Maia et al. 2008). Mendonça et al. (2014) recorded a spherical, green, woody, glabrous, leaf and stem gall induced by a

Cecidomyiidae, but the gall midge species was not identified by the authors. Although this gall regards those induce by *L. spherica*, except for the woody tegument, we cannot affirm that this species is the inducer of the gall found by Mendonça et al. (2014). It would be necessary to obtain material from the inducer to make a more accurate identification.

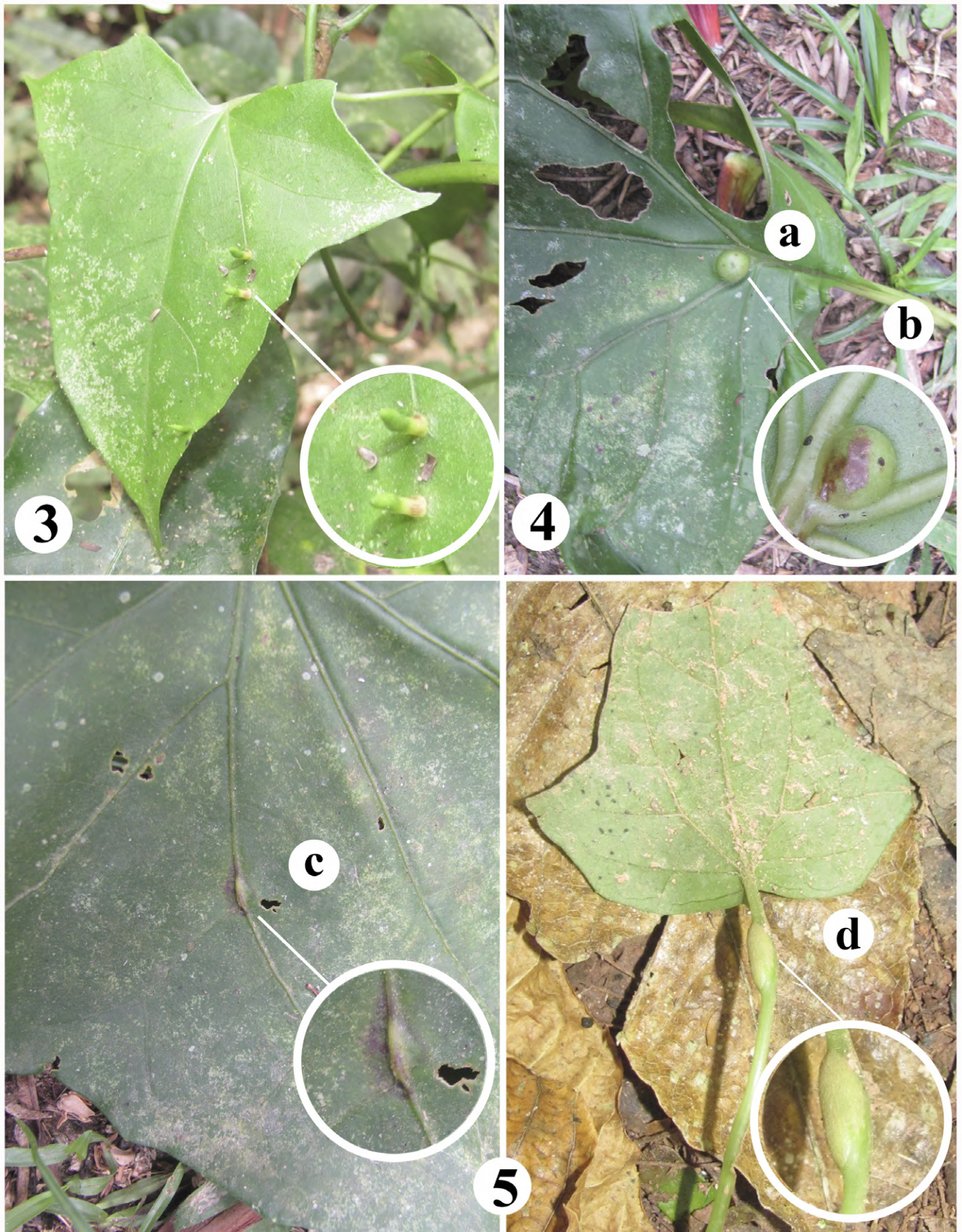
So, until now, these species have been recorded in only two states, Rio de Janeiro and São Paulo.

The objective of this study is to contribute to the knowledge of the geographic distribution and abundance patterns of the gall midges associated with *Mikania glomerata*.

We surveyed an Atlantic Forest area, known as Recanto das Cigarras (Figure 1), situated in the Campus of the Universidade Federal de Viçosa, in Minas Gerais state (Brazil) (Figure 2). The vegetation along the main trail “Mata da Biologia” was examined in search for the host plant and insect galls. The geographic coordinates and altitude of the beginning and the end of the trail were obtained using GPS (datum: SIRGAS2000) (20°45'24" S, 042°51'39" W, altitude: 699 m; 20°45'21" S, 042°51'28" W, altitude: 729 m). The map was made based on an original map from IBGE (2015).



Figures 1 and 2. The collection site of this study, Recanto das Cigarras in Universidade Federal de Viçosa, Minas Gerais (Brazil). **1.** The main trail. **2.** The entrance of the trail.



Figures 3–5. Insect galls induced by three different species of Cecidomyiidae (Insecta: Diptera) on *Mikania glomerata* Spreng. (Asteraceae) at Recanto das Cigarras trail (Viçosa, Minas Gerais, Brazil). **3.** Cylindrical leaf gall induced by *Liodiplosis cylindrica* Gagné, 2001. **4.** Spherical leaf gall induced by *Liodiplosis spherica* Gagné, 2001 - (a) on the leaf's upper surface, (b) on lower surface. **5.** Fusiform gall induced by *Asphondylia glomeratae* Gagné, 2001 - (c) on vein, (d) on petiole.

The number of individuals of *Mikania glomerata* was verified as well as the number of each gall morphotype in 20 leaves per individual (20 leaf blades and 20 petioles). Galls were photographed using a digital camera. Samples of each morphotype were collected and transported individually in labeled plastic bags. The fieldwork was done by the authors for four hours on 13 August 2015.

In the laboratory, the galls were dried and then deposited as voucher material (number 224629) in the Herbário do Museu Nacional (MNRJ). As each galling species induces a distinct morphologically gall, the gall is considered as a taxonomical character and can be used to indicate the presence of the galler (Carneiro et al. 2009).

Seven individuals of *Mikania glomerata* were found in the investigated area. Four of them were galled. Three gall morphotypes were found: 1) spherical leaf gall induced by *Liodiplosis spherica* Gagné, 2001 (Figure 3); 2) cylindrical leaf gall induced by *Liodiplosis cylindrica* Gagné, 2001 (Diptera, Cecidomyiidae) (Figure 4); and 3) fusiform petiole and vein gall induced by *Asphondylia glomeratae* Gagné, 2001 (Diptera, Cecidomyiidae) (Figure 5).

The gall morphotypes were deposited in the Cecidomyiidae collection of Museu Nacional (MNRJ), and were labeled as follows:

1) Viçosa, MG. (Brasil); Trilha Recanto das Cigarras; 12.XIII.2015; *Liodiplosis spherica* Gagné, 2001; spherical leaf gall on *Mikania glomerata*; Proença & Maia coll.

2) Viçosa, MG. (Brasil); Trilha Recanto das Cigarras; 12.XIII.2015; *Liodiplosis cylindrica* Gagné, 2001; cylindrical leaf gall on *Mikania glomerata*; Proença & Maia coll.

3) Viçosa, MG. (Brasil); Trilha Recanto das Cigarras; 12.XIII.2015; *Asphondylia glomeratae* Gagné, 2001; fusiform petiole and vein gall on *Mikania glomerata*; Proença & Maia coll.

All morphotypes were scarce. We found only six cylindrical galls in three individuals, two petiole galls in two individuals (one per individual), one vein gall in one individual, and one spherical gall in a single individual (Table 1), totaling 10 galls. There was no simultaneous occurrence of different gall morphotypes in a same leaf

blade or even in the petiole and leaf blade. Petiole/vein and spherical galls occurred individually (only one gall per leaf), while the cylindrical ones occurred gregariously (three or two galls in the same leaf) or individually. The infestation rate was low: among the total of leaf blades ($n=80$), only five were galled (6.25%), whereas among the petioles ($n=80$), only two were galled (about 2.5%).

Although *Mikania glomerata* hosts eight galling species in Brazil, only three were found in the present study: *Asphondylia glomeratae*, *Liodiplosis cylindrica*, and *L. spherica*, and they are recorded for the first time in the state of Minas Gerais. The previous records included the states of Rio de Janeiro and São Paulo (Table 2). The updated geographic distribution of *Asphondylia glomeratae*, *Liodiplosis cylindrica* and *L. spherica* in Brazil is shown in Figure 6.

All three species presented a wide distribution occurring in both restinga and ombrophilous forest areas. *Asphondylia glomeratae* had the most restricted geographical distribution, occurring in only five of the 10 localities already sampled by other authors, as shown in Table 2. *Liodiplosis cylindrica* and *L. spherica* presented similar distribution being found in seven of these 10 localities, including the present study. Parque Nacional da Tijuca (Rio de Janeiro/RJ) and Reserva Biológica de Poço das Antas (Silva Jardim/RJ) were the unique localities not shared by these species, until now. Parque Nacional do Itatiaia (Itatiaia/RJ), Restinga de Bertioaga (Bertioaga/SP) and Recanto das Cigarras (Viçosa/MG) were the only sites where the three gall midge species were found (Table 2).

These results show the importance of sampling new localities to establish the geographic distribution limits of the galling insects. These data are primordial to future biogeographic studies as well as to the knowledge of the local biodiversity fauna.

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Table 1. Abundance of insect galls on *Mikania glomerata* (Asteraceae) in Recanto das Cigarras (Viçosa, Minas Gerais, Brazil).

<i>Mikania glomerata</i>	Number of gall morphotypes			Total of galls
	Cylindrical leaf gall	Spherical leaf gall	Fusiform petiole/vein gall	
Specimen 1	02 (01 leaf)	01 (01 leaf)	01 petiole gall (01 petiole)	04
Specimen 2	03 (01 leaf)	0	0	03
Specimen 3	01 (01 leaf)	0	0	01
Specimen 4	0	0	01 petiole gall (01 petiole) 01 vein gall (01 leaf)	02
Specimen 5	0	0	0	0
Specimen 6	0	0	0	0
Specimen 7	0	0	0	0
Total	06	01	03	10

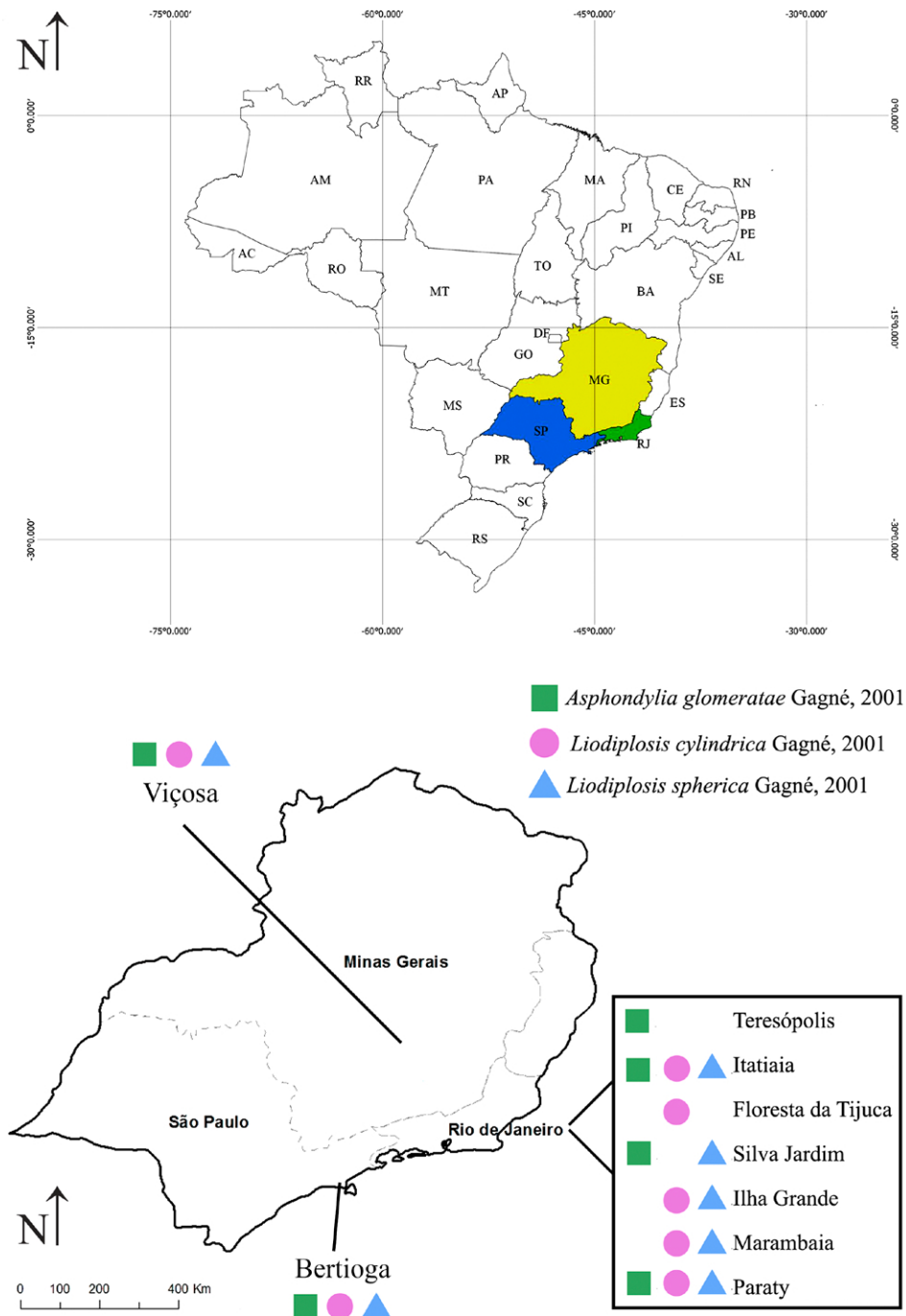


Figure 6. Current geographic distribution of *Liodiplosis spherica* Gagné, 2001 (spherical gall), *Liodiplosis cylindrica* Gagné, 2001 (cylindrical gall) and *Asphondylia glomeratae* Gagné, 2001 (fusiform gall) in Brazil.

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Table 2. Distribution of *Asphondylia glomeratae* Gagné, 2001; *Liodiplosis cylindrica* Gagné, 2001 and *Liodiplosis spherica* Gagné, 2001 (Diptera: Cecidomyiidae) on *Mikania glomerata*, *Mikania cf. glomerata* and *Mikania cf. biformis* (Asteraceae) in Brazil. MG- Minas Gerais; RJ-Rio de Janeiro; SP - São Paulo.

Gall midge species			Host Plants associated	Localities	Biome/physiognomy	Geographic coordinates	References
<i>Asphondylia glomeratae</i>	<i>Liodiplosis cylindrica</i>	<i>Liodiplosis spherica</i>					
X	X	X	<i>Mikania glomerata</i> Spreng.	Recanto das Cigarras (Viçosa/MG)	Atlantic Forest/Semideciduous forest	20°45'24" S 042°51'39" W	Present study
	X	X	<i>Mikania glomerata</i> Spreng.	Vila de Trindade (Paraty/RJ)	Atlantic forest/Restinga	23°21'03" S 044°43'26" W	Carvalho-Fernandes and Maia 2011
X			<i>Mikania glomerata</i> Spreng.	Paraty (RJ)	Not informed	Not informed	Gagné et al. 2001
X	X	X	<i>Mikania Willd</i> sp.	Parque Nacional do Itatiaia (Itatiaia/RJ)	Atlantic forest/Ombrophilous forest	22°22'11" S 044°37'42" W	Gagné et al. 2001
X		X	<i>Mikania glomerata</i> Spreng.	Reserva Biológica Poço das Antas (Silva Jardim/RJ)	Atlantic forest/Ombrophilous forest	22°30'15" S 042°16'15" W	Gagné et al. 2001
	X		<i>Mikania glomerata</i> Spreng.	Parque Nacional da Tijuca (Rio de Janeiro/RJ)	Atlantic forest/Ombrophilous forest	22°57'47" S 043°14'40" W	Gagné et al. 2001
X			<i>Mikania glomerata</i> Spreng.	Teresópolis (RJ)	Atlantic forest/Ombrophilous forest	Not informed	Gagné et al. 2001
X	X	X	<i>Mikania cf. biformis</i> DC	Restinga de Bertioiga (Bertioiga/SP)	Atlantic forest/Restinga	23°51'16" S 046°08'19" W	Maia et al. 2008.
	X	X	<i>Mikania Willd</i> sp.	Reserva Biológica Estadual da Praia do Sul (Ilha Grande/RJ)	Atlantic forest/Restinga	23°11'14" S 044°19'06" W	Maia and Oliveira 2010
	X	X	<i>Mikania glomerata</i> Spreng. <i>Mikania cf. biformis</i> DC	Trindade (Paraty/RJ)	Atlantic forest/Restinga	Not informed	Maia 2013
	X	X	<i>Mikania cf. biformis</i> DC	Ilha da Marambaia (Mangaratiba, RJ)	Atlantic forest/Restinga	23°03'22" S 043°58'51" W	Rodrigues et al. 2014

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