

Novos registros de duas espécies de insetos galhadores (Diptera, Cecidomyiidae) para o Brasil

New state record of two gall midge species (Diptera, Cecidomyiidae) in Brazil

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Barbara Proença do Nascimento

Doutora em Ciências Biológicas (Zoologia) pelo Museu Nacional/Universidade Federal do Rio de Janeiro

Instituição: Museu Nacional/Universidade Federal do Rio de Janeiro/Laboratório de Diptera Neotropicais

Endereço: Quinta da Boa Vista - São Cristóvão, Rio de Janeiro - RJ, 20940-040

E-mail: bproenca28@gmail.com

Valéria Cid Maia

Doutora em Ciências Biológicas (Zoologia) pelo Museu Nacional/Universidade Federal do Rio de Janeiro

Instituição: Museu Nacional/Universidade Federal do Rio de Janeiro/Laboratório de Diptera Neotropicais

Endereço: Quinta da Boa Vista - São Cristóvão, Rio de Janeiro - RJ, 20940-040

E-mail: maiavid@acd.ufrj.br

RESUMO

Anisodiplosis waltheriae Maia, 2005 e *Asphondylia sanctipetri* Urso-Guimarães & Amorim, 2002 (Insecta, Diptera, Cecidomyiidae) são registradas pela primeira vez para o estado do Mato Grosso (Brasil). As galhas induzidas por esses mosquitos galhadores foram coletadas no Parque Nacional da Chapada dos Guimarães localizado nas cidades de Chapada e Cuiabá no estado do Mato Grosso. Galhas de *A. waltheriae* foram coletadas em setembro de 2011 e as de *A. sanctipetri* em julho de 2012.

Palavras-chave: *Anisodiplosis waltheriae*, *Asphondylia sanctipetri*, Cerrado, galhas de insetos, Parque Nacional da Chapada dos Guimarães.

ABSTRACT

Anisodiplosis waltheriae Maia, 2005 and *Asphondylia sanctipetri* Urso-Guimarães & Amorim, 2002 (Insecta, Diptera, Cecidomyiidae) are registered for the first time in the state of Mato Grosso (Brazil). The galls induced by these gall midges were collected in Parque Nacional da Chapada dos Guimarães, in Chapada and Cuiabá municipalities, in Mato Grosso state, Brazil. *A. waltheriae* galls were collected in September, 2011 and *A. sanctipetri* galls in July, 2012.

Keywords: *Anisodiplosis waltheriae*, *Asphondylia sanctipetri*, Cerrado, insect galls, Parque Nacional da Chapada dos Guimarães.

1 INTRODUCTION

Anisodiplosis Maia, 2005 (Cecidomyiidi) is a monotypic genus described on examined material from Aimorés municipality, in the state of Minas Gerais, Brazil. The only known species, *Anisodiplosis waltheriae* Maia, 2005, induces galls on leaves, buds and inflorescences of *Waltheria indica* L. (Malvaceae). The galls are spherical to conical, covered with short light yellow to light brown trichomes and have one chamber where a single larva can be found (ALMEIDA et al., 2006). *W. indica* is a perennial herbaceous plant considered a common invader of Cerrado (Savanna) areas. It grows spontaneously along side roads, vacant lots and in perennial agriculture forest plantations. This plant is widespread in subtropical and tropical regions, and can be found in all Brazilian territory (FLORA DO BRASIL, 2019; LORENZI; MATOS, 2002).

Unlike *Anisodiplosis*, *Asphondylia* Loew, 1850 (Cecidomyiidi, Asphondyliini, Asphondyliina) is a cosmopolitan genus with 299 species known to the world and among these 18 were described in Brazil: *A. bahiensis* Tavares, 1917 (Bahia); *A. borrieriae* Rübsaamen, 1905 (Rio de Janeiro); *A. canastrae* Urso-Guimarães & Amorim, 2002 (Minas Gerais); *A. communis* Maia & Couri, 1992 (Rio de Janeiro); *A. fructicola* Maia, 2009 (Pará); *A. glomeratae* Gagné, 2001 (Rio de Janeiro and Minas Gerais); *A. gochnatiae* Maia, 2008 (Minas Gerais); *A. maricensis* Maia & Couri, 1992 (Rio de Janeiro); *A. microcapillata* Maia, 2005 (Minas Gerais); *A. moehni* Skuhrava, 1989 (Rio Grande do Sul and Rio de Janeiro); *A. parva* Tavares, 1917 (Bahia); *A. peploniae* Maia, 2001 (Rio de Janeiro); *A. rochae* Tavares, 1918 (Ceará); *A. sanctipetri* Urso-Guimarães & Amorim, 2002 (São Paulo); *A. sennae* Maia & Couri, 1992 (Rio de Janeiro); *A. serrata* Maia, 2004 (Minas Gerais); *A. struthanthi* Rübsaamen, 1915 (Ceará); *A. sulphurea* Tavares, 1909 (Rio Grande do Sul); and *A. ulei* Rübsaamen, 1908 (Rio de Janeiro). Most species induce galls on flowers or flower buds prevent fruiting in many families of plants, but some form complex galls on other plants parts (GAGNÉ; JASCHHOF, 2017).

Asphondylia sanctipetri Urso-Guimarães & Amorim, 2002 induces green and glabrous galls on leaf vein and petiole of *Schefflera morototoni* (Aubl.) Maguire et al. (Araliaceae) a tree commonly known as “morototó” or “mandioqueira”. *S. morototoni* occurs in all Brazilian states and it is very susceptible to fungi and insects attack (OHASHI; LEÃO, 2005).

The objective of this study is to analyze the geographical distribution of *Anisodiplosis waltheriae* and *Asphondylia sanctipetri* in Brazil and check their occurrence by phytogeographical domain.

2 METHODS

Four field works were conducted in Parque Nacional da Chapada dos Guimarães, in Chapada and Cuiabá municipalities, Midwest Region of Brazil, for 15 days each, in September 2011, January and July 2012 and January 2013. During the field works, individuals of *Waltheria indica* and *Schefflera morototoni* were investigated for galls in ten different trails: Andorinhas (15°25'46.01"S 55°50'02.04"W), Caminho das Cachoeiras (15°24'49"S 55°50'34"W), Caminho Vêu da Noiva (15°24'20"S 55°49'47"W), Cidade de Pedra (15°25'40"S 55°49'59"W), Ponto 5 (no geographical coordinates), Rio Claro (15°19'54.16"S 55°51'21.47"W), Trilha interditada (15°24' 34.3"S 055° 50' 05.4"W), Vale da Benção (15°25'10.7"S 055°47.22'9"W), Vale do Eco (15°20'33.37"S 55°47'37.16"W) and Vêu da noiva (15°24'26"S 55°49'54"W).

The galls were photographed with a digital camera, removed from the host, and transported to Laboratório de Diptera in Museu Nacional/Universidade Federal do Rio de Janeiro (MNRJ). Some samples were dissected to obtain larvae and pupae and others were maintained in plastic containers for adults' emergence. The insects obtained were mounted on microscope slides following the methods outlined by Gagné (1994). The species were identified based on host plant and gall morphotype identification, gall midge morphology and comparison with original descriptions. The insects are deposited in the Diptera collection of MNRJ.

The host plants were examined by Dra. Gracialda C. Ferreira and Manoel dos Reis Cordeiro of Universidade Federal Rural da Amazônia (UFRA) for species identification and all exsiccates were deposited in this Institution.

Besides the material collected in field we searched records of galls induced by *A. waltheriae* and *A. sanctipetri* in 82 inventories of insect galls in Brazil, published from 1988 to 2019. Among these inventories, 42 were conducted in Atlantic forest, 26 in Cerrado (Brazilian savanna), seven in Amazon rainforest, four in Caatinga (dry forest) and three in Pantanal.

The maps were made using ArcGIS maps plataforma and Photoshop CS6[®] program.

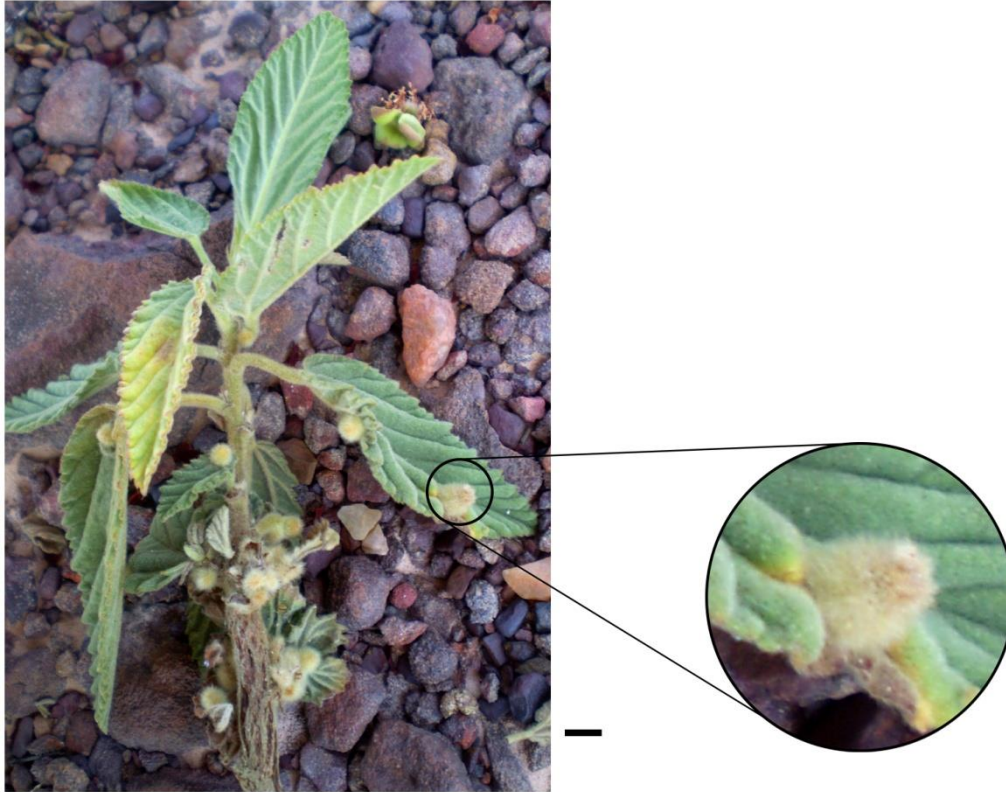
3 RESULTS

Galls of *Anisodiplosis waltheriae* Maia, 2005 and *Asphondylia sanctipetri* Urso-Guimarães & Amorim, 2002 (Insecta, Diptera, Cecidomyiidae) were collected in Parque Nacional da Chapada dos Guimarães (Chapada dos Guimarães National Park). The Park is located in Chapada and Cuiabá municipalities, in Mato Grosso state, Brazil.

The galls of *A. waltheriae* (Figure 1) were collected in Vêu da noiva trail (15°24'26"S 55°49'54"W), on 06 September 2011, on leaves of *Waltheria indica* (Malvaceae), voucher number: 3467 (UFRA). The gall midge was identified based only on host plant and gall morphotype

identification. This is the first record of *Anisodiplosis* in the state of Mato Grosso and in Cerrado areas.

Figure 1. Galls induced by *Anisodiplosis waltheriae* Maia, 2005 on leaves and buds of *Waltheria indica* L. (Malvaceae) collected in Parque Nacional da Chapada dos Guimarães (Mato Grosso, Brazil). Scale bar = 1 cm.



Galls of *A. sanctipetri* (Figure 2) were collected in Andorinhas trail (15°25'46.01"S 55°50'02.04"W) on 11 July 2012, on leaf vein and petiole of *Schefflera morototoni* (Aubl.) Maguire et al. (Araliaceae), voucher number: 3759 (UFRA). We obtained four males, seven females, and one exuvia of *A. sanctipetri* from the galls. The insects were identified as *Asphondylia* by the presence of a needlelike ovipositor (females), two-toothed gonostylus (males) and the presence of upper and lower horns on the pupal frons. We identified the specimen as *Asphondylia sanctipetri* after comparison with the original description: adults with hexagonal eye facets, sinuous circumfila in male and straight in female, 2-segmented palpus, simple tarsal claws, bent beyond midlength and empodia smaller than claws, male with narrow aedeagus, bilobed hypoproct and rounded cerci; pupa with short cephalic setae, long antennal horns with serrated inner edge, simple upper and lower frontal horns, and two strong sclerotized spines between upper and lower frontal horns, short and setiform prothoracic spiracle, abdomen with one simple and continuous row of sclerotized spines. This is the first record of the genus *Asphondylia* in the state of Mato Grosso.

Figure 2. Galls induced by *Asphondylia sanctipetri* Urso-Guimarães & Amorim, 2002 on leaf vein and petiole of *Schefflera morototoni* (Aubl.) Maguire et al (Araliaceae) collected in Parque Nacional da Chapada dos Guimarães (Mato Grosso, Brazil). A: leaf of *Schefflera morototoni*. B: detail of leaf vein gall. C: detail of the petiole gall. Scale bar = 1 cm.



From the galls of *A. sanctipetri* we also obtained one larva of *Trotteria* Kieffer, 1902 (Cecidomyiidae, Lasiapteridi, Trotteriini) as inquiline and one larva and adults of Eulophidae (Hymenoptera) acting as parasitoid. This is the first record of *Trotteria* as inquiline of *A. sanctipetri* galls, and also the first record of this genus to Mato Grosso.

All the specimens collected are deposited in the collection of Diptera in Museu Nacional/Universidade Federal do Rio de Janeiro (UFRJ). The detailed distribution of *A. waltheriae* and *A. sanctipetri* in Brazil, based in gall's inventories and the new records, is shown in tables 1 and 2 respectively.

Table 1. Distribution of *Anisodiplosis waltheriae* Maia, 2005 (Insecta, Diptera, Cecidomyiidae) in Brazil.

Locality	State	Geographic coordinate	Phytogeographical domain	Reference
Aimorés: Fazenda Bulcão Type locality	Minas Gerais	19°26'42"S 41°3'51"W	Atlantic forest	Maia and Fernandes (2005)
The authors did not indicate where the gall was collected	Pernambuco	Not registered	Caatinga (Dry forest)	Santos et al. (2011)
São Tomé das Letras: Cachoeira da Lua trail	Minas Gerais	21°42'11"S 44°56'24"W	Atlantic forest	Maia (2013)
Parque Nacional da Chapada dos Guimarães: Vêu da noiva trail	Mato Grosso	15°24'26"S 55°49'54"W	Cerrado (Savanna)	Present study

Table 2. Distribution of *Asphondylia sanctipetri* Urso-Guimaraes & Amorim 2002 (Insecta, Diptera, Cecidomyiidae) in Brazil.

Locality	State	Geographic coordinate	Phytogeographical domain	Reference
Ribeirão preto: Fazenda Palmeiras Type locality	São Paulo	Not registered	Not registered	Urso-Guimarães & Amorim (2002)
Cabo de Santo Agostinho: Reserva Ecológica Mata de Duas Lagoas (DL)	Pernambuco	8°18'16"S 34°58'17"W	Atlantic forest	Santos et al. (2012)
Recife: Parque Estadual Dois Irmãos (DI)	Pernambuco	8°7'30"S 34°52'30"W	Atlantic forest	Santos et al. (2012)
Delfinópolis: Represa Peixoto	Minas Gerais	20°15'-20°30'S 46°45'-47°00'W	Cerrado (Savanna)	Urso-Guimarães et al. (2003)
Goiânia: Samambaia Campus. Universidade Federal de Goiás (UFG)	Goiás	16°36'13.6"S 49°15'41.58"W	Atlantic forest: semideciduous seasonal forest	Santos et al. (2010)
Goiânia: Campus da Universidade Federal de Goiás	Goiás	16°36'30.1"S 49°15'47.9"W	Cerrado: semideciduous mesophytic forest (Savanna)	Araújo et al. (2007)
Parque Nacional da Chapada dos Guimarães: Andorinhas trail	Mato Grosso	15°25'46.01"S 55°50'02.04"W	Cerrado (Savanna)	Present study

4 DISCUSSION

This is the first record of *Anisodiplosis* and *Asphondylia* species in the state of Mato Grosso. It is also the first record of *Anisodiplosis* to Cerrado areas. This new record is important because the Cecidomyiidae fauna is poorly known in Brazil, especially in Cerrado areas. According to Proença & Maia (2021) among the 129 species of Cecidomyiidae deposited in the type collection, only 19% are from Cerrado.

Mato Grosso is the third largest Brazilian state, in its west-central area. It is the only state in Brazil with the presence of three physiogeographic domains: Amazon rainforest, Cerrado (Savanna) and Pantanal (GOVERNO DE MATO GROSSO, 2019). There is so far five species known to Mato Grosso: four of them were collected at Parque Nacional da Chapada dos Guimarães, *Bruggmannia chapadensis* Proença & Maia, 2018; *Lopesia andirae* Garcia, Lima, Calado & Uso-Guimarães, 2017; *Lopesia chapadensis* Garcia & Urso-Guimarães, 2018 and *Lopesia mataybae* Garcia & Urso-Guimarães, 2018; and one of them from the campus of Universidade Federal de Mato Grosso, *Schizomyia tuiuiu* Urso-Guimaraes & Amorim, 2002. Therefore, this is the sixth record of a Cecidomyiidae species in Mato Grosso.

Anisodiplosis waltheriae was previously recorded in the states of Minas Gerais and Pernambuco, in areas of Atlantic forest and Caatinga (MAIA; FERNANDES, 2005; SANTOS et al., 2011; MAIA, 2013). According to Google Earth (2019) the approximate distance between the new registration site (Parque Nacional da Chapada dos Guimarães) to the previously known locations is 2.174 km to Pernambuco, 1.639 km to Aimorés (MG) and 1.634 km to São Tomé das Letras (MG) (the nearest previous record).

Identifying a species of gall midge, based solely on the morphology of the gall and the identification of the host plant is widely used in the study of insect galls by several authors, as for example Proença and Maia (2015), and Arriola et al. (2016). This is supported by the fact that gall midges have high specificity in relation to their host plant and host organ attacked, being generally monophages. In addition, each inducing species produces a morphologically and structurally unique gall on its host plant, so that gall is considered the inducer's extended phenotype (WEIS et al., 1988; CARNEIRO et al., 2009). This kind of identification is not reliable only when the host plant is not identified at a specific level or when the plant has several similar gall morphotypes. This is not the case of the galler in question because *Waltheria indica* hosts, so far, only two gall midges species, *A. waltheriae* and *Asphondylia waltheriae* Möhn, 1959, the first attacking the leaves and the second the stems.

Asphondylia sanctipetri was previously recorded in the states of São Paulo, Minas Gerais, Goiás and Pernambuco, in areas of Cerrado and Atlantic forest (URSO-GUIMARÃES; AMORIM, 2002; URSO-GUIMARÃES et al., 2003; SANTOS et al., 2010; ARAÚJO et al., 2007; SANTOS et al., 2012). The approximate distance between the new registration site (Parque Nacional da Chapada dos Guimarães) to the previously known locations is 2.416 Km to Recife, 2.402 Km to Cabo de Santo Agostinho (PE), 1.110 km to Delfinópolis (MG), 1.073 km to Ribeirão Preto (SP), and 724 km to Universidade Federal de Goiás (GO) (the nearest previous record) (GOOGLE EARTH, 2019).

According to Gagné and Jaschhof (2017), in Brazil the genus *Asphondylia* is distributed from north to south, occurring in the following states: Pará (PA), Ceará (CE), Bahia (BA), Minas Gerais (MG), Rio de Janeiro (RJ), São Paulo (SP) and Rio Grande do Sul (RS). Described and non described *Asphondylia* species were also recorded in several insect gall inventories at the following sites: Itamonte (MG) by Maia (2014); São Tomé das Letras (MG) by Maia (2013); Serra de São José (MG) by Maia and Fernandes (2004); Serra do Cabral (MG) by Coelho et al. (2013); Bertioga (SP) by Maia et al. (2008); Santa Rita do Passa Quatro (SP) by Urso-Guimarães and Scarelli-Santos (2006); Santa Teresa (ES) by Maia et al. (2014); Carapebus (RJ) by Maia (2001a); Ilha de Cabo Frio (RJ) by Maia and Souza (2013); Ilha da Marambaia (Mangaratiba/RJ) by Rodrigues and Maia (2014); Ilha de Paquetá (RJ) by Pamplona et al. (2000); Maricá (RJ) by Maia (2001a); Grumari (RJ) by Oliveira and Maia (2005); São Francisco de Itabapoana (RJ) by Maia and Carvalho-Fernandes (2015); Jataí (SP) by Saito and Urso-Guimarães (2012); and São Francisco de Paula (RS) by Toma and Mendonça (2013). These results indicate a high plasticity to different biotic and abiotic conditions of *Asphondylia* (FLOR; MAIA, 2017).

Eulophidae wasps were previously recorded as parasitoid of *A. sanctipetri* galls by Santos et al. (2010). Araújo et al. (2007) recorded galls on *S. morototoni* similar to those induced by *A.*

sanctipetri, but indicated Eulophidae wasps as the inducers. Based on the host-insect specificity we suggest that the galls found by these authors are induced by *A. sanctipetri* and the Eulophidae wasps are the parasitoids.

Most species of *Trotteria* live in galls induced by various gall midges of the tribe Asphondyliini, such as *Asphondylia* species, corroborating to our results. There are 23 known species of *Trotteria* to the world, occurring in Holartic, Neotropical and Afrotropical regions. These midges are related to 12 host plants families, such as, Asteraceae, Cannabaceae, Fabaceae, Lamiaceae, Oleaceae, Pedaliaceae, Phytolaccaceae, Rosaceae, Rubiaceae, Sapotaceae, Scrophulariaceae and Sterculiaceae (GAGNÉ; JASCHHOF, 2017). Only one species is known from Brazil, *Trotteria quadridentata* Maia, 2001, described from galls induced by *Youngomyia pouteriae* Maia, 2001 in *Pouteria caimito* var. *laurifolia* (Sapotaceae). *T. quadridentata* was collected in Atlantic forest (Restinga) areas of Maricá municipality in Rio de Janeiro state, Brazil (MAIA, 2001b). *Trotteria* species were found in areas of Cerrado, Atlantic forest and Pantanal phytogeographical domain in three different states: São Paulo: Bertioga (MAIA et al., 2008), Jataí (URSO-GUIMARÃES; SCARELLI-SANTOS, 2006), Sorocaba (ANSALONI et a., 2018); Espírito Santo: Santa Teresa (MAIA et al., 2014); and Mato Grosso do Sul: Aquidauana (URSO-GUIMARÃES et al., 2017) and Corumbá (ASCENDINO; MAIA, 2018).

Both host plants species occur in all Brazilian states, but the distribution of the gall midges are more restrict (Figures 3 and 4). This could be explained by the scarcity of insect galls inventories in many areas in the country. According to Carneiro et al. (2009) the gall midges present a high specificity to their host, inducing a specific gall morphotype to a single host plant. Therefore, according to this hypothesis, we assume that probably *A. waltheriae* and *A. sanctipetri* may occur where their host plant are distributed.

Figure 3. Geographic distribution of *Anisodiplosis waltheriae* Maia, 2005 (Insecta, Diptera, Cecidomyiidae) on leaves and buds of *Waltheria indica* L. (Malvaceae) in Brazil.

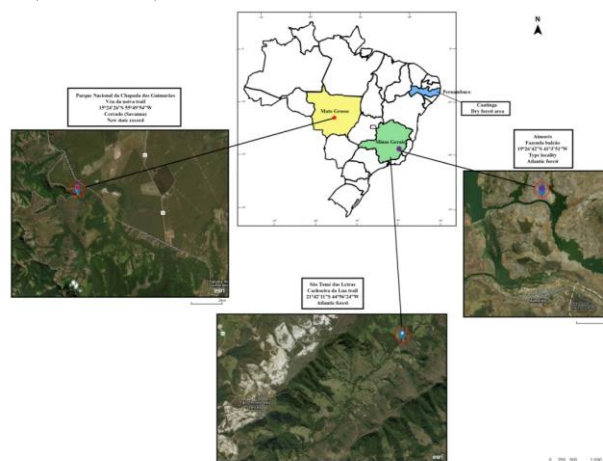
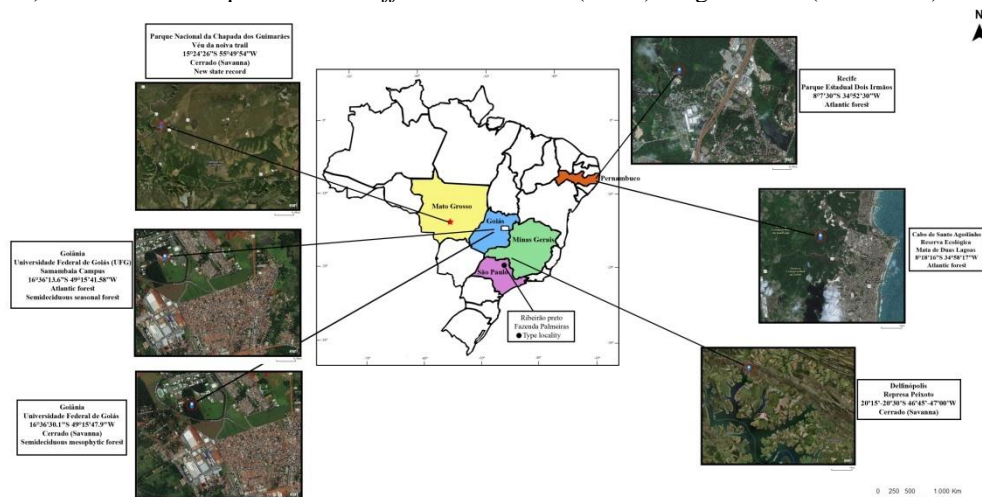


Figure 4. Geographic distribution of *Asphondylia sanctipetri* Urso-Guimaraes & Amorim 2002 (Insecta, Diptera, Cecidomyiidae) on leaf vein and petiole of *Schefflera morototoni* (Aubl.) Maguire et al (Araliaceae) in Brazil.



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Authors' Contributions

BP analyzed the data and wrote the manuscript. VCM collected the galls and wrote the manuscript.

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