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ARTICLE

A newly described gall midge (Diptera, Cecidomyiidae) on medicinal *Solidago chilensis* Meyen in Paraná, Brazil

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Abstract. The Brazilian arnica *Solidago chilensis* Meyen (Asteraceae), a plant traditionally used in ethnopharmacology for trauma treatment, is widely distributed across South America, including all regions of Brazil. This study aimed to identify and characterize gall-inducing insects associated with fused *S. chilensis* flowers. Flower branches were collected twice in March 2023 from Paraná, Brazil. The branches were dried and examined under a stereomicroscope, with galls subjected to micro-computed tomography (µCT). In the second collection, fresh branches were examined for the morphological characterization of floral heads. Galled flowers were removed and divided into three groups: 1) placed in an emergence chamber to obtain adults, 2) dissected to extract larvae and pupae, and 3) fixed in ethanol for µCT analysis. Macroscopic examination revealed two flower types for *S. chilensis:* hermaphroditic disc flowers (fused or non-fused) and ray flowers (ligulate). The gall-inducing insect was identified as *Asphondylia paranaensis* **sp. nov.** (Diptera: Cecidomyiidae), a new species, and was described and illustrated based on its larval, pupal, male, female, and gall morphologies. The µCT provided novel insights into the pupal stage, and exuvia within the flower. This study highlights the importance of identifying new species, particularly medicinal plants, because gall-inducing insects may alter a plant's metabolism and chemical composition, potentially influencing its biological properties. Further studies are required to assess the ecological and pharmacological effects of these interactions.

Keywords. Asteraceae; Pupal exuvia; Flower galls; Micro-computed tomography (µCT).

INTRODUCTION

The genus *Asphondylia* Loew, 1850 belongs to the family Cecidomyiidae, commonly known as the gall midges. These insects are distinguished by their ability to induce gall formation in various plant tissues, including leaves, stems, and flowers (Dorchin *et al.,* 2015; Flor & Maia, 2017; Gagné & Jaschhof, 2025). Galls arise as a plant response to insect infestation and exhibit considerable variations in shape and size. The diversity within the genus *Asphondylia* underscores its capacity to parasitize a broad spectrum of host plants, thereby playing a significant ecological role in the environments they inhabit (Maia & Mascarenhas, 2022). In addition to morphological changes, gall induction can also affect the chemical composition and metabolic profile of host plants, with potential ecological and pharmacological consequences.

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The presence of galls affects the composition of secondary metabolites, resulting in qualitative and quantitative differences in the essential oils across various plant parts (Flamini *et al.,* 2004; De Alcantara Guimarães *et al.,* 2013). The synthesis and accumulation of new chemical compounds in *Eremanthus erythropappus* (DC) McLeisch (Asteraceae) inhibit the production of previously identified compounds. The original phytotoxic properties of the host stems, combined with the neosynthesis of compounds triggered by gall stimuli, can be redirected to provide defensive benefits to gall-inducing insects (Castro-Jorge *et al.,* 2022).

In nine species of the genus *Solidago* L. (Asteraceae), *Asphondylia*-induced gall formation on the leaves, stems, and flowers has been documented in North America. Additionally, pupae exhibit specific characteristics that are useful for species differentiation, including the features of the final segment, spiracles, and horns (Dorchin *et al.,* 2015).

In Brazil, *Asphondylia* spp. are found in ten states: Bahia, Ceará, Pará, Sergipe, Espírito Santo, Minas Gerais, Rio de Janeiro, São Paulo, Santa Catarina, and Rio Grande do Sul (Flor & Maia, 2017; Maia & Flor, 2020; Maia & Oliveira, 2021; Maia & Mascarenhas, 2022; Maia *et al.,* 2023, Maia, 2025). Twenty species of Asteraceae host fifty-eight gall morphotypes that are induced by this cecidomyiid. Among them, only 20 species have been identified, whereas the others have been recorded as morphospecies of *Asphondylia* (Flor & Maia, 2017).

Solidago chilensis Meyen (Brazilian arnica) is a member of the Asteraceae family (Lorenzi, 2000), native to the southern region of South America (Lorenzi & Matos, 2002), and is distributed throughout Brazil (Borges, 2020; Rodrigues & Souza, 2021), with particular prevalence in Paraná (Forzza *et al.,* 2010). Commonly known as "arnica" or "Brazilian arnica," it is widely used in ethnopharmacology for treating bruises (Maia *et al.,* 2011; Bieski *et al.,* 2015; Magalhães *et al.,* 2021; Maia *et al.,* 2021) and inflammation, woundhealing, and as a muscle relaxant (Brasileiro *et al.,* 2006; Ribeiro *et al.,* 2017). Additionally, *S. chilensis* is available in herbalist shops and is registered on the National List of Medicinal Plants of Interest to the Unified Health System (RENISUS) under the synonymous name *Solidago microglossa DC* (Agência Saúde, 2009). Therefore, the aim of this study was to evaluate the occurrence of galls in *Solidago chilensis* in Paraná State.

MATERIAL AND METHODS

Plant identification

The project was registered with the National Genetic Heritage Management System and Associated Traditional Knowledge (SisGen A8C1C62). Inflorescences of *Solidago chilensis* were collected twice during March 2023 (23.327693W, 51.205714S) in Londrina, PR, Brazil, and a specimen was exsiccated for deposition in the Herbarium of the State University of Londrina UEL under registration number FUEL 54685.

Morphological study of *Solidago chilensis* flowers

Five inflorescence branches of *S. chilensis* were collected and dried in a forced-air oven at 40°C for three days. After drying, the heads of five panicles were examined under a stereomicroscope, where the disk and ray flowers were separated, and the presence of galled disk flowers was recorded. Dried inflorescences containing galls were subjected to micro-computed tomography (µCT). Five additional inflorescence branches of *S. chilensis* were collected from the same population for the morphological characterization of fresh head flower types. Fresh samples were examined under a stereomicroscope to document the morphology of the disks and ray flowers.

Processing of *Solidago chilensis* fused flowers

The floral heads were separated from 20 panicles of five branches, and fused flowers of the *S. chilensis* disc that showed macroscopic changes (galls) were separated into three groups: 1) Ten galled flowers were placed in an emergence chamber; 2) 30 flowers with galls were subjected to extirpation and removal of their contents. From these contents, nine pupae were placed in the emergence chamber, and other larvae and pupae found were photographed and fixed in ethanol p.a.; 3) Two fused flowers were fixed in ethanol p.a. and subjected to µCT.

Gall midge rearing and phenological study

The pupae and gall flowers were placed in an emergence chamber consisting of Petri dishes containing a slightly moistened piece of filter paper to maintain humidity levels conducive to insect development. The chamber was maintained at 25 ± 1°C, with a photoperiod of natural daylight conditions. The chambers were monitored daily for 10 days to observe the emergence of adult insects.

Upon emergence, adult gall midges were briefly exposed to a low temperature (-20°C) for 30 to 50 seconds to immobilize them, facilitating safe handling and transfer. The adults were then placed in separate containers and maintained under the same environmental conditions as those in the germination chamber for an additional day to complete individual development.

Gall midge morphological studies

Specimens of the gall-inducer were prepared and mounted on microscope slides following the methods outlined in Gagné (1994). The genus was identified using his key to genera. The new species was proposed after comparison with literature data (host plants, gall morphology and cecidomyiid descriptions). All specimens were deposited at the Entomological Collection of the Museu Nacional/Universidade Federal do Rio de Janeiro (MNRJ), Brazil.

Morphological studies were performed using optical stereomicroscopy and microscopy. Measurements were performed using ImageJ software (1.52a) and an Opticam OPT 120003 12.0, camera coupled to an Opticam Microscopy microscope (0500R, Doral, FL, USA). All drawings were edited using Corel DRAW®. The adult morphological terminology follows Cumming & Wood (2009), and the larval and pupal stages follow Gagné (1994).

Measurements were done using a microscope slide with scale from 0.01 to 5.0 mm. Length of wings was measured from the arculus to the apex; total length of females from vertex to posterior margin of the 8th abdominal segment.

The new species was compared with the other Neotropical species that also induce galls on Asteraceae based on the original descriptions as well as on the examination of specimens from the MNRJ.

Micro-computed tomography

Micro-computed tomography measurements were performed using a 1172 SkyScan-Bruker scanner. The tube voltage and current were set to 30 kV and 175 uA, respectively. The sample was rotated 180° with an angular step of 0.25°, generating 720 projections. The voxel size was 1.5 × 1.5 × 1.5 µm. The projections were reconstructed using NRecon software, and the generated images were analyzed using CTVox software.

RESULTS

Flower characterization

Macroscopic examination revealed two types of flowers in *S. chilensis* (Fig. 1): fused disc (Fig. 1E.2), non-fused disc (Fig. 1E.3), and ray (Fig. 1E.4) flowers, with the latter being lingulate in shape. The fusion state of disc flowers varies according to the developmental stage and collection time, and does not represent a distinct floral type. Additionally, some of the fused disc flowers exhibited tumorous growth or galls induced by parasites (Fig. 1D, red circle, and Fig. 1E.1), which were characterized by an enlarged central region, reduced height compared with normal flowers, and noticeable swelling at the base.

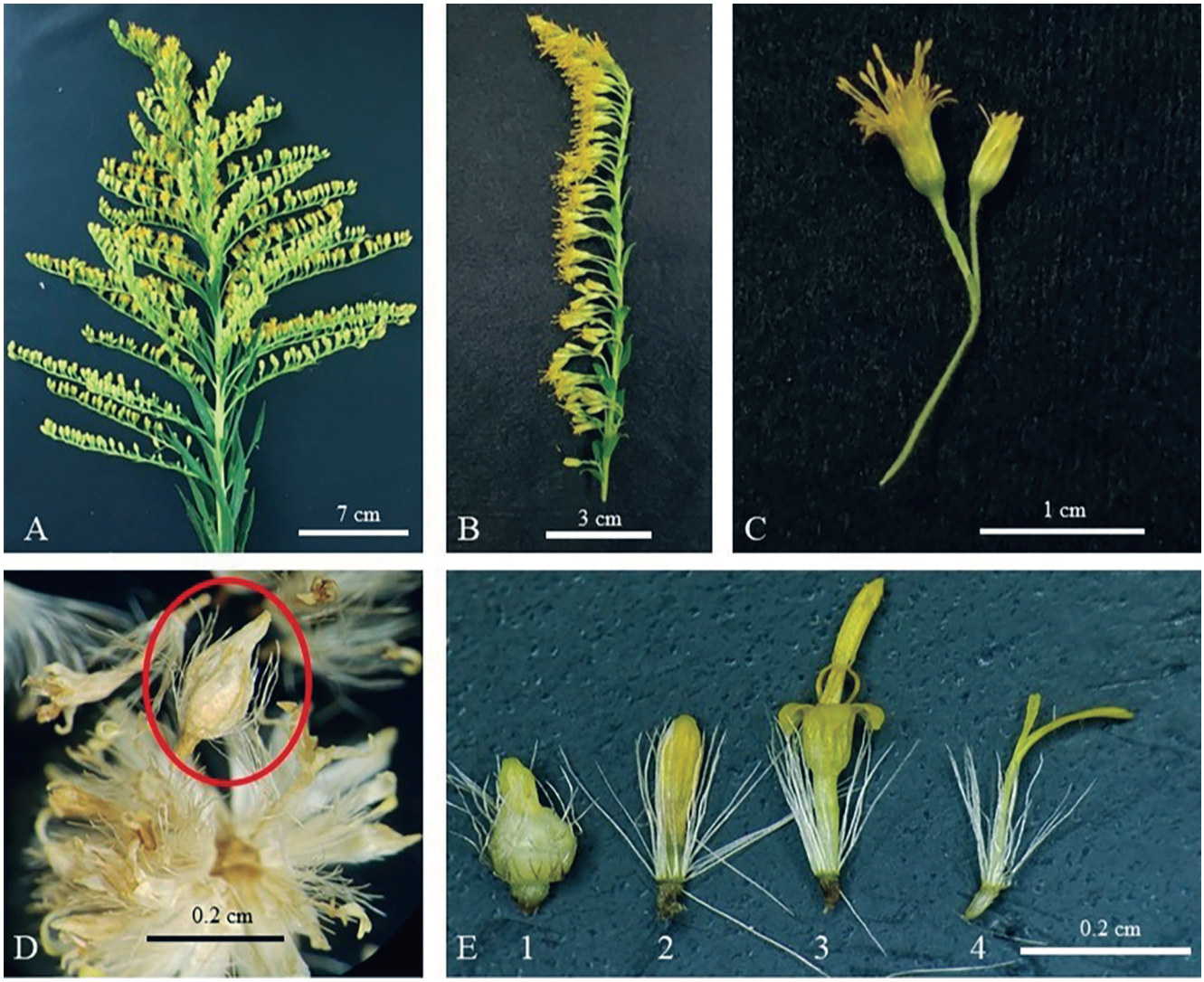

Figure 1. Inflorescence and floral features in *Solidago chilensis* (Asteraceae). (A) Branch, (B) Panicle, (C) Floral head, (D) Dried floral gall (red circle), (E) (1-4). Types of flowers: (E.1) Galled fused disc flower, (E.2) Fused disc flower (hermaphroditic), (E.3) Non-fused disc flower (Hermaphroditic), (E.4) Ray flower (ligulate flower).

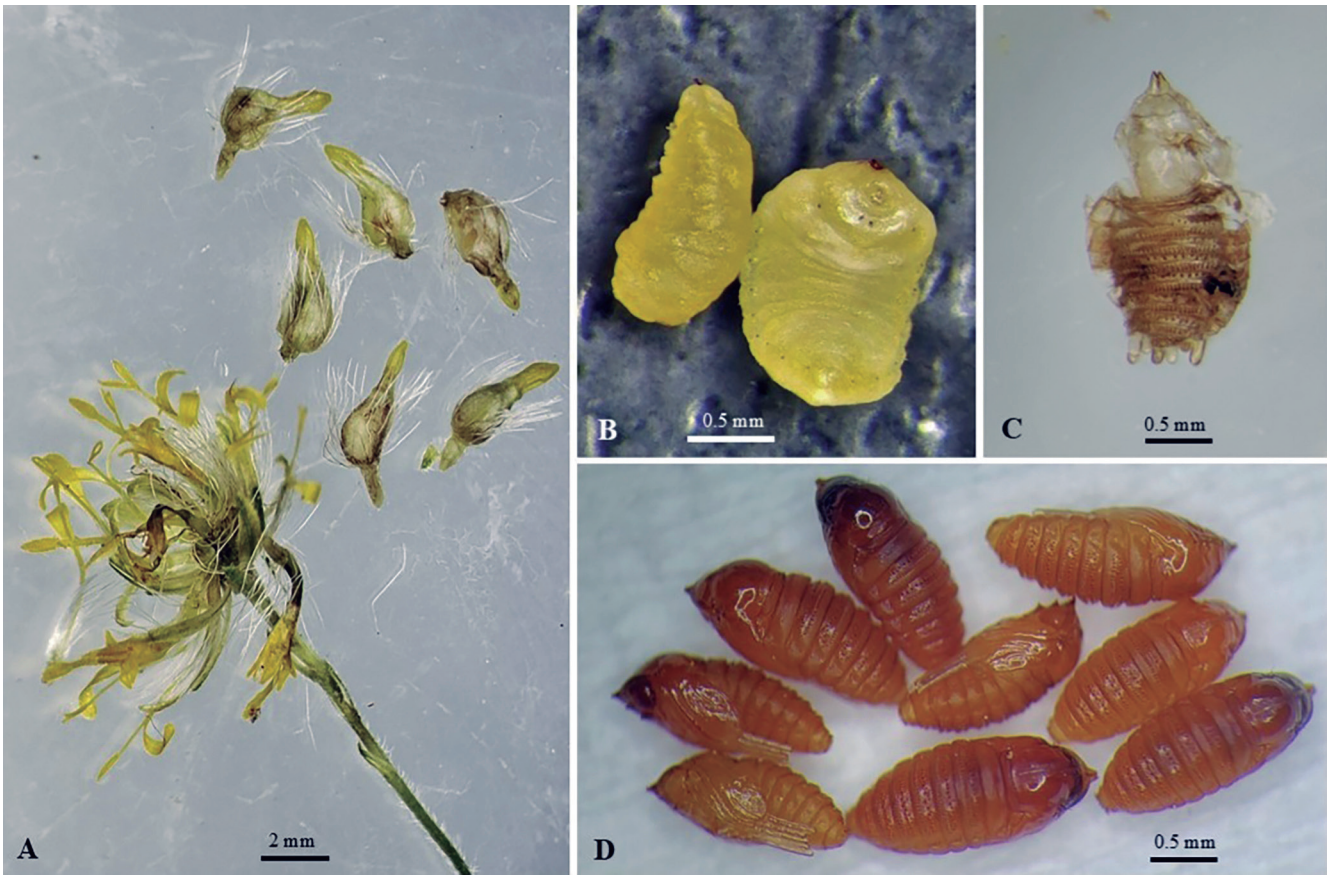

Figure 2. Exploring *Solidago chilensis* (Asteraceae) floral head. (A) Maximum gall occurrence. Contents within fused flower gall-inducer (Diptera: Cecidomyiidae). (B) Larvae, (C) Pupal exuvia, (D) Pupae.

The maximum number of galls observed on a single flower head was six (Fig. 2A). Of the 30 flowers with galls, two larvae (Fig. 2B) and 17 pupae were extracted. Nine of these pupae were placed in an emergence chamber (Fig. 2D). The other seven flowers exhibited only the exuvia stage internally (Fig. 2C), and four flowers did not contain anything.

***Asphondylia paranaensis* Matos & Maia, sp. nov.**

Diagnosis: Male hypoproct barely bilobed; ovipositor with needle part about 2.75 length of seventh sternite; pupa: antennal horn pointed apically, upper facial horn single and short, lower frontal horn with three aligned teeth, eighth abdominal segment with 9-11 aligned dorsal spines in the posterior row, larva: spatula with four conical teeth, lateral teeth barely longer than middle teeth, three setose lateral papillae on each side of spatula.

Male (Fig. 3A-E): Body: 1.80-1.85-mm long (N = 2). **Head:** 0.32-mm long, 0.27-0.28-mm wide (N = 2), eye facets circular, closely appressed; antennae: first and second flagellomeres not fused, scape obovate, setose, 0.07-0.09-mm long, 0.06 mm wide (N = 3); pedicel globose, setose, 0.05-mm long, 0.04-0.05-mm wide (N = 2); first to twelfth flagellomeres cylindrical, all 0.03-mm wide, circumfila longitudinally wavy, dense, anastomosing, equally spread along segments; first flagellomere longer than others, 0.17-mm long (N = 2), second flagellomere 0.14-mm long (N = 2), third to seventh flagellomeres 0.13-0.14 mm (N = 2), eighth to ninth flagellomeres 0.14-mm long (N = 1), and tenth to twelfth flagellomeres missing, proportion flagellomere neck node 1:15; frons with 30 setae (N = 2); mouthparts (N = 1): labrum long, attenuated, 0.06-mm long; hypopharynx of the same shape as labrum, with long, anteriorly directed lateral setulae, 0.10-mm long; labella elongate and convex, 0.05-mm long, with lateral and mesal setae; palpus 0.13-mm long: first segment globoid, 0.02-mm long, second segment cylindrical, 0.04-mm long, and third segment cylindrical or claviform, 0.07-mm long, all segments with setae. **Thorax:** scutum with two dorsocentral rows of setae, setae more abundant anteriorly and posteriorly, two groups of lateral setae more abundant anteriorly, extending from base to distal margin, and scales intermixed; scutellum with scattered discal setae; anepimeron setose; remaining pleural sclerites bare; legs: tarsal claws curved beyond mid-length, isomorphic, and empodium as long as claws; wing: length 1.70-1.85 mm (N = 3). **Abdomen:** trichoid sensilla not visible; first to seventh tergites sclerotized, rectangular with a posterior row of setae, few scattered lateral and mostly covered elsewhere with scales, eighth tergite bare, narrow; second to eighth sternites more sclerotized than tergites, rectangular, with a posterior row of setae, several mesal and lateral setae, and mostly covered elsewhere with

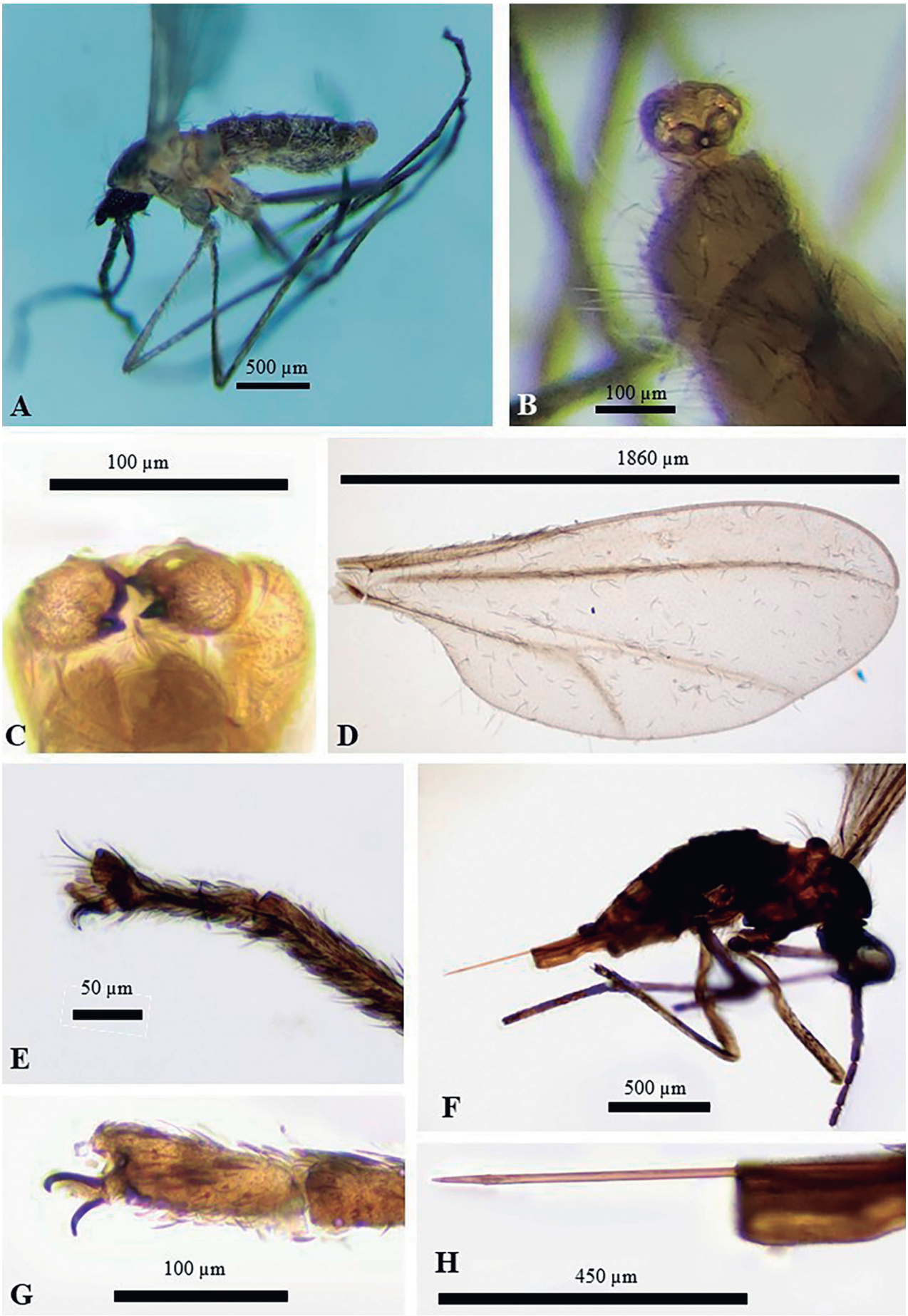

Figure 3. *Asphondylia paranaensis* **sp. nov.** (Diptera: Cecidomyiidae), male adult insect. (A) Lateral view, (B) Terminalia, ventral view, (C) Terminalia, dorsal view, (D) Wing, (E) Foreleg claw, lateral view; female adult insect. (F) Lateral view, (G) Foreleg claws, lateral view, (H) Ovipositor, lateral view.

scales; eighth sternite with scattered setae and mostly covered elsewhere with scales. **Terminalia:** gonocoxite short and stout, 0.11-0.10-mm long, 0.07-0.08-mm wide (N = 3); gonostylus ovoid, 0.03-mm long, 0.04-mm wide (N = 3); hypoproct barely bilobed.

Female (Fig. 3F-G): Body length: 1.80-1.90 mm (N = 2). **Head:** 0.31-mm long, 0.30-mm wide (N = 1), antennae: scape 0.07-0.09-mm long, 0.05-mm wide (N = 2), pedicel 0.05-0.07-mm long, 0.05-0.07-mm wide (N = 2), first to eleventh flagellomeres cylindrical, all 0.04-mm wide, circumfila straight as in Fig. 5C, flagellomeres 1 and 2 not fused, first flagellomere 0.18-0.19-mm long (N = 2), second flagellomere 0.13-0.14-mm long (N = 2), third flagellomere 0.12-0.13-mm long (N = 2), fourth flagellomere 0.12-mm long (N = 2), fifth flagellomere 0.12-mm long (N = 2), sixth to eighth flagellomeres 0.11-mm long (N = 1), ninth to tenth flagellomeres 0.09-mm long (N = 1), eleventh flagellomere 0.06-mm long (N = 1), and twelfth flagellomere 0.05-mm long (N = 1); mouthparts: labrum 0.08-mm long (N = 1), hypopharynx 0.12-mm long (N = 1), labellum 0.04-mm long (N = 1), and palpus 0.13-mm long (N = 2): fifth segment globoid, 0.02-mm long, and second and third segments cylindrical, 0.04- and 0.07-mm long, respectively. **Thorax:** wing length: 1.80-2.10 mm (N = 2); tarsal claw more robust than in male. **Abdomen:** trichoid sensillae not visible, first to seventh tergites as in male, eighth tergite with posterior margin with lobes 0.11-mm long (N = 1), second to sixth sternites as in male, seventh sternite rectangular, 0.40-mm long, 2.0 × length of sixth sternite (N = 1), setose, and mostly covered elsewhere with scales; eighth sternite not sclerotized; ovipositor: needle part 1.10-mm long (N = 1), 2.75 × length of seventh sternite (N = 1). Other characteristics as in male.

Pupa (Fig. 4B-F): Color: brownish. Body length: 1.90-2.15 mm (N = 1). **Head:** face with lateral projection; antennal horn 0.14-0.16-mm long (N = 2), conical, pointed, inner margin serrated, distal part shorter than basal part; apical seta 0.03-mm long (N = 2); upper facial horn simple and conical, 0.02-mm long (N = 1); three lower facial horns aligned, 0.01-mm long (N = 1); two pairs of lower facial papillae: one pair setose, the other bare; three pairs of lateral facial papillae: one pair setose, two bare; and upper cephalic margin thickened laterally. **Thorax:** wrinkled integument; prothoracic spiracle, 0.08-mm long, shorter than antennal basal width, setiform, and curved (N = 1). **Abdomen:** segments 2-8 with transverse rows of crescent dorsal spines at basal half; posterior row with 22-25 spines in the second segment, 22-27 in the third, 21-28 in the fourth, 21-26 in the fifth, 16-24 in the sixth, 13-18 in the seventh, and 9-11 in the eighth (N = 2). The lowest number of spines was observed in male pupae, whereas the highest was observed in female pupae.

Larva (Fig. 4A): Body: 1.149 mm (N = 1); head 0.05-mm long, 0.07-mm wide (N = 1). Spatula quadridentate, 0.18-mm long (N = 1); lateral teeth barely longer and thinner than mesal teeth (N = 1); and three setose lateral papillae on each side of the spatula. Terminal segment 0.07-mm long (N = 1). Terminal segments with no papillae visible on slides.

Material examined: Holotype male, BRAZIL: Paraná, Londrina (23.327693W, 51.205714S), III.2024, Matos, R.L.N. col. (MNRJ-ENT1-71197). Paratypes: same data as holotype: two males (MNRJ-ENT1-71195, MNRJ-ENT1-71196), two females (MNRJ-ENT1-71193, MNRJ-ENT1-71194), two pupae (MNRJ-ENT1-71198), one larva of third instar (MNRJ-ENT1-71199).
Etymology: The name *"paranaensis"* is a toponym which refers to the state where the type-material was collected.

Geographic distribution: Brazil, Paraná, Londrina.

Remarks: Twenty-six species of *Asphondylia* associated with the family Asteraceae are known in the Neotropical region. Nine of them are Neotropical: *A. cipo* Urso-Guimarães, 2018, Brazil, on *Lessingianthus warmingianus* (Baker) H. Rob.; *A. gaucha* Maia, 2023, Brazil, on *Vernonanthura discolor* (Sprengel) H. Rob; *A. glomeratae* Gagné, 2001, Brazil, on *Mikania glomerata* Spreng.; *A. gochnatiae* Maia, 2008, Brazil, on *Moquiniastrum polymorphum* (Less.) G. Sancho; *A. ingaiensis* Maia, 2023, Brazil, on *Moquiniastrum barrosoa* (Cabrera) G. Sancho; *A. mineira* Maia, 2023, Brazil, on *Vernonanthura polyanthes* (Sprengel) Vega & Dematteis; *A. moehni* Skuhravá, 1989, Brazil, on *M. glomerata; A. serrata* Maia, 2004, Brazil, on *Eremanthus erythropappus* (DC.) MacLeish, and *A. ulei* Rübsaamen, 1908, Brazil, on *Mikania* sp. *Asphondylia paranaensis* (Fig. 5) was the first species identified in the genus *Solidago.*

Biological data of the galling insect

This species may achieve several generations between December and the end of March, during which time galls are formed on *S. chilensis* flowers. Gall formation begins at flowering onset. Typically, infested flower buds do not exhibit any external signs of injury. Inside the closed bud, the larva feeds on the reproductive organs and developing flowers, resulting in the development of a gall above the ovary.

Larvae and pupae might be observed within flowers from December to March, with adult emergence likely to occur just before the end of the flowering period. In the four galled, fused flowers, no pupae were observed, probably because the pupal exuviae trapped themselves in the adult insect during the emergence process, when they were involuntarily removed from the flower. This pattern is consistent with previously described behavior in Cecidomyiidae, where pupal exuviae often remain partially exposed or retained within galls or floral tissues due to the dorsal spines on the pupal integument. Such structures likely aid in anchoring the exuviae during adult emergence (Gagné, 1994) (Fig. 6A-B).

The pupae of *Asphondylia paranaensis* had a bright brown color and were at different stages of development; it was possible to observe the difference mainly in

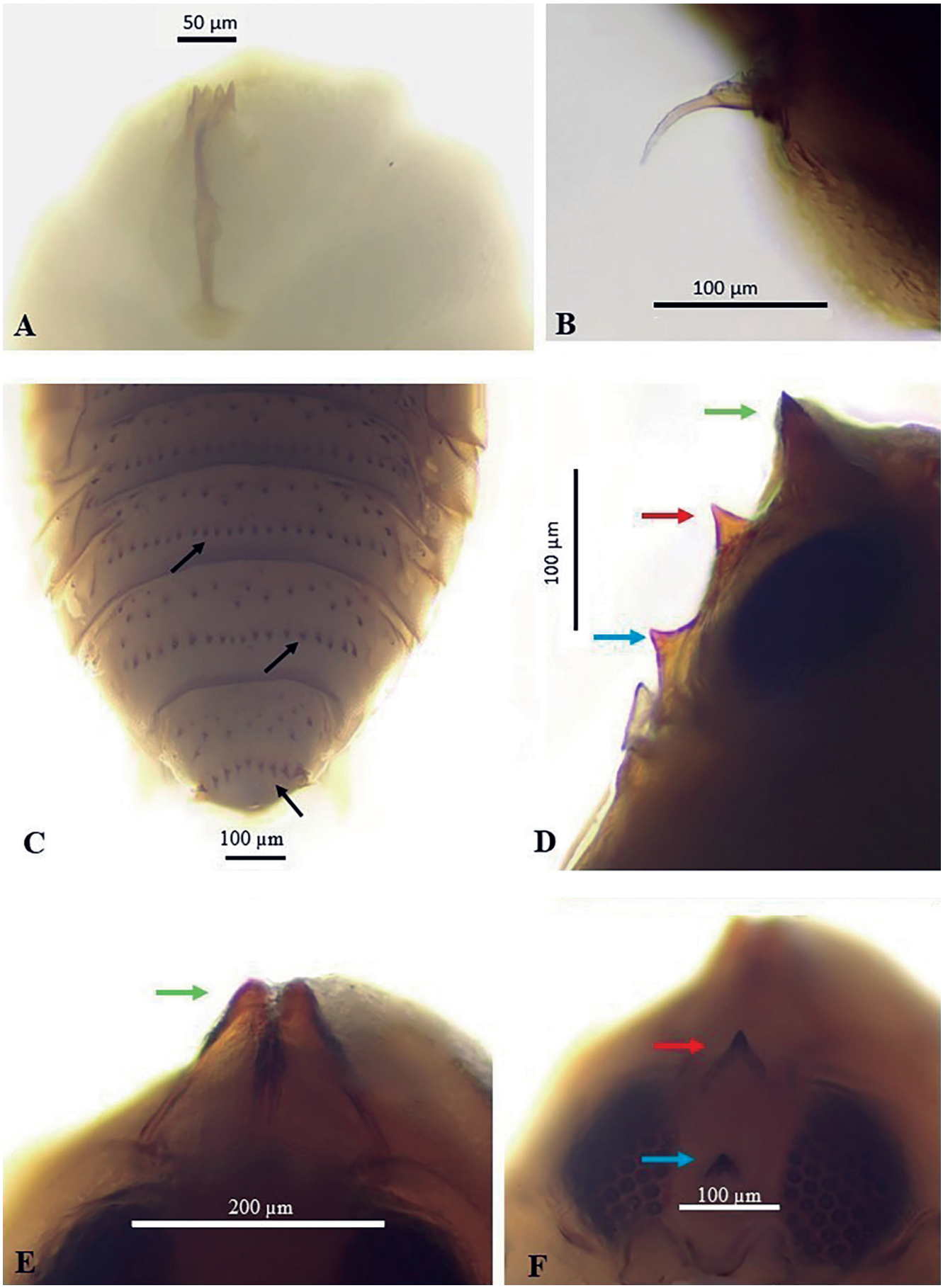

Figure 4. *Asphondylia paranaensis,* **sp. nov.** (Diptera: Cecidomyiidae) removed from fused flower of *Solidago chilensis* (Asteraceae). Larvae (A) Prothoracic spatula; Pupal. (B) prothoracic spiracle, (C) terminal segments in dorsal view, and black arrows indicate dorsal spines, (D) Pupal head, lateral view, (E, F) Pupal head, frontal view. Antennal horns (green arrow), upper facial horn simple (red arrow), lower facial horn (blue arrow).

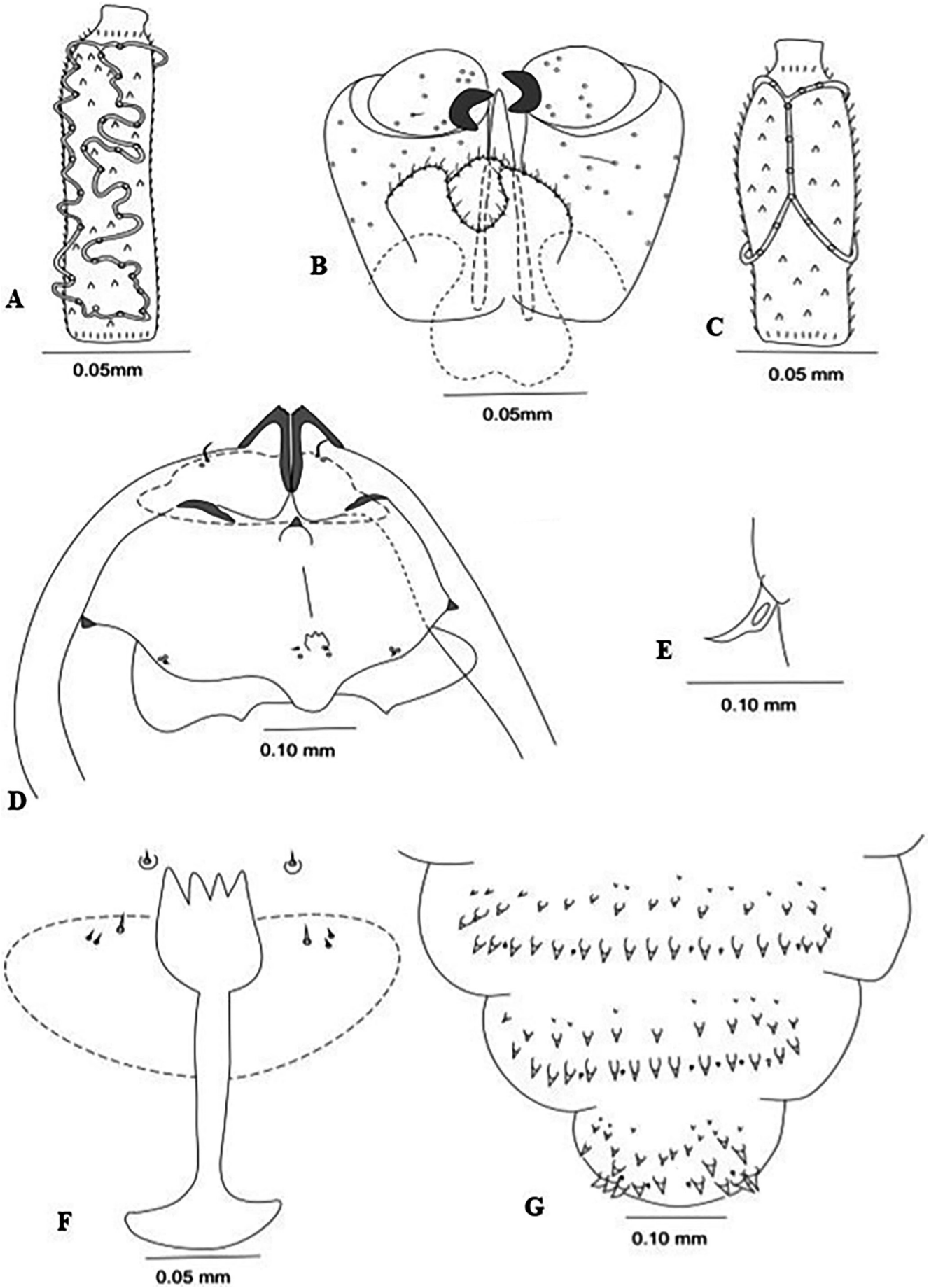

Figure 5. *Asphondylia paranaensis,* **sp. nov.** (Diptera, Cecidomyiidae). (A) Male 5th antennal flagellomere, (B) Male, terminalia, dorsal view, (C) Female 5th antennal flagellomere, (D) Pupa head, frontal view, (E) Pupal prothoracic spiracle, (F) Larval spatula and associated papillae, (G) Pupal terminal segments, dorsal view.

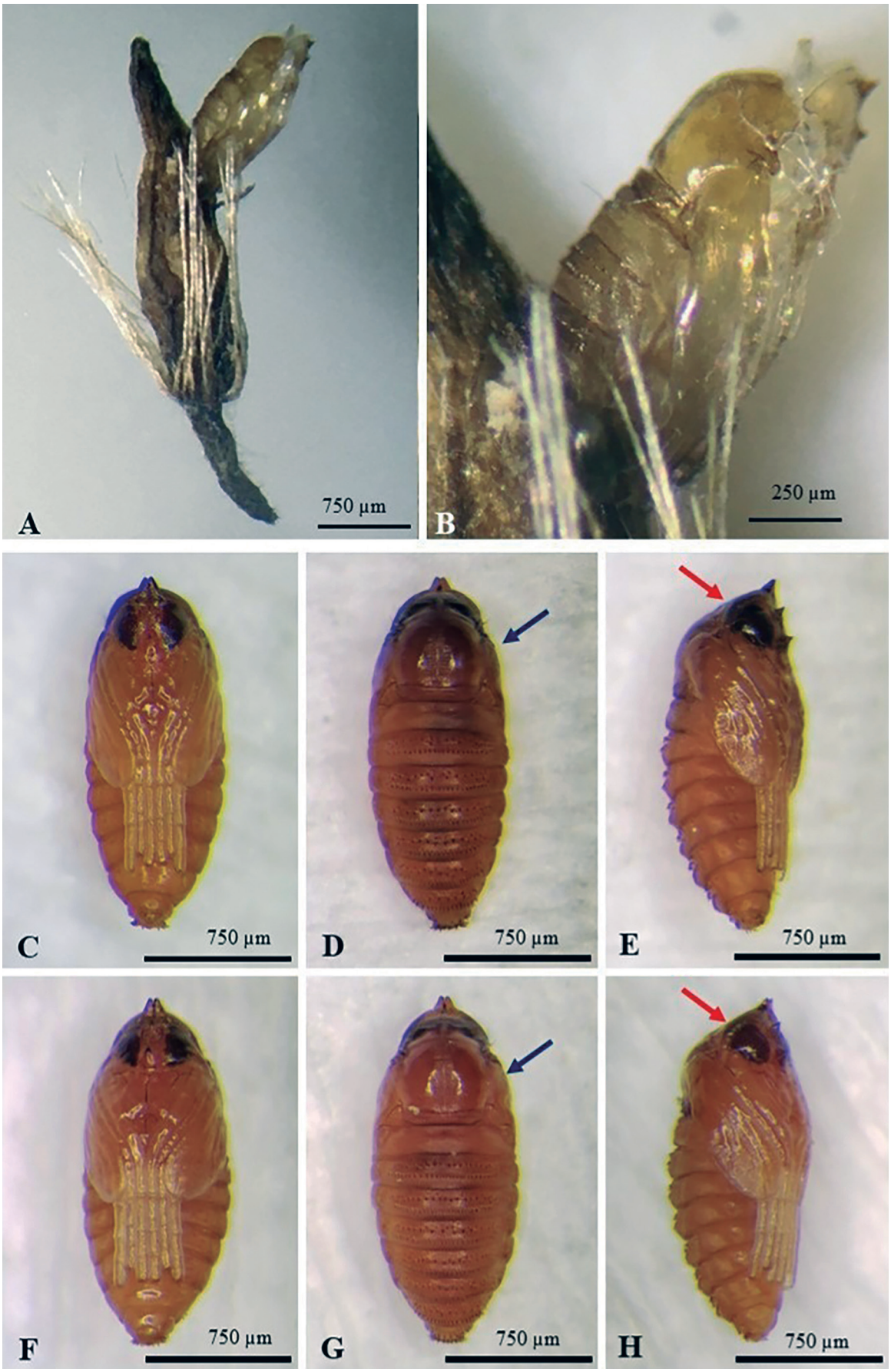

Figure 6. (A) Pupal exuvia of the gall-inducer (Diptera: Cecidomyiidae) trapped in the flower of *Solidago chilensis* (Asteraceae) after adult emergence, (B) Close-up of the pupal exuvia and a portion of the flower. Comparison between two different stages of development of *Asphondylia paranaensis* pupae. (C-E) Most developed, (F-H) Less developed, (C, F) Pupa in ventral, (D, G) Dorsal view, (E, H) Lateral view. Blue arrow indicates the color of the back of the pupae, and the red arrow indicates the color of the eyes.

the color of the compound eyes and back; the younger pupae were a light brown color, while in the more developed pupae, the coloration was darker (Fig. 6C-H).

Gall description, biology, and development of immature

The galls were, on average, 1-2 mm wide and 2-3 mm high. The galls on the flowers varied in size and, upon maturation, were characterized by bulging of the petals and distinctive brown coloration in some areas. Each flower typically harbors a single larva or pupa, with the anterior region of the insect toward the apex of the floral structure. The µCT technique allowed for the complete observation of the pupae inside the flower. It could be confirmed that the position of the pupal head always faced the apex of the flower. Furthermore, employing the µCT technique, we observed that one of the galls contained only the exuvia, while another contained a pupa still in the developmental stage (Fig. 7). The exuviae can be characterized by abdominal retraction in relation to the apex of the leg and detachment of the thoracic dorsal integument in the ecdysis lines. In the pupae, there was no sign of detachment of the tegument, and the apex of the abdomen exceeded the apex of the legs.

DISCUSSION

The new species is compared to other Neotropical species found on Asteraceae.

Body length (adults): The males and females of *Asphondylia paranaensis* are conspicuously shorter than those of the other species (*A. cipo:* 3.50-6.20 mm, *A. gaucha:* 3.20-4.60 mm, *A. glomeratae:* 2.70-3.50 mm, *A. gochnatiae:* 3.50-4.40 mm, *A. ingaiensis:* 3.40-4.60 mm, *A. mineira:* 3.80-5.50 mm, *A. moehni:* 4.10-4.50, *A. serrata:* 3.70-5.50 mm, *A. paranaensis,* **sp. nov.**: 1.80-1.90 mm). Adults of *A. ulei* are unknown.

Antennae (adults): The scape of *Asphondylia paranaensis* is only 1.2-1.4 times longer than the pedicel (in both sexes), while in the other species, the scape are twice or more the length of the pedicel.

Male terminalia: a) The aedegus is clearly longer in *Asphondylia paranaensis* than in the other species; b) the hypoproct is slightly bilobed in the new species (as in *A. ingaiensis* and *A. mineira*), while in the others it is more deeply bilobed.

Relative length of the ovipositor: In *Asphondylia paranaensis,* the needle part of the ovipositor is 2.75 times the length of the 7th sternite. In all other species this value is smaller (*A. cipo:* no data, *A. gaucha:* 2.0-2.20, *A. glomeratae:* 0.55, *A. gochnatiae:* 2.59-2.66, *A. ingaiensis:* 2.08-2.42, *A. mineira:* 1.70-1.90, *A. moehni:* 0.55, *A. serrata:* 0.58).

Antennal horns (pupa): The antennal horns are more pointed apically in *Asphondylia paranaensis,* as well as in *A. cipo, A. gaucha, A. glomerata,* and *A. moehni* than in the other species.

Upper frontal horn (pupa): In the new species, as well as in *A. cipo, A. gochnatiae, A. ingaiensis, A. mineira,* and *A. serrata,* the upper frontal horns are shorter than those of the other species.

Lower facial horn (pupa): In the new species, the three teeth are aligned. This condition is also observed only in *A. glomeratae* and *A. gochnatiae.* All other species have three misaligned teeth, except *A. ulei* whose lower facial horn has a single tooth.

Prothoracic spiracle (pupa): Among the species studied, *A. paranaensis, A. gaucha, A. glomerata* and *A. moehni* have the shortest prothoracic spiracles (*A. cipo:* 0.12 mm long, *A. gaucha:* 0.08 mm, *A. glomeratae:* 0.08 mm, *A. gochnatiae:* 0.09-0.12 mm, *A. ingaiensis:* 0.13-0.14 mm, *A. mineira:* 0.14-0.16 mm, *A. moehni:* 0.07 mm, *A. serrata:*

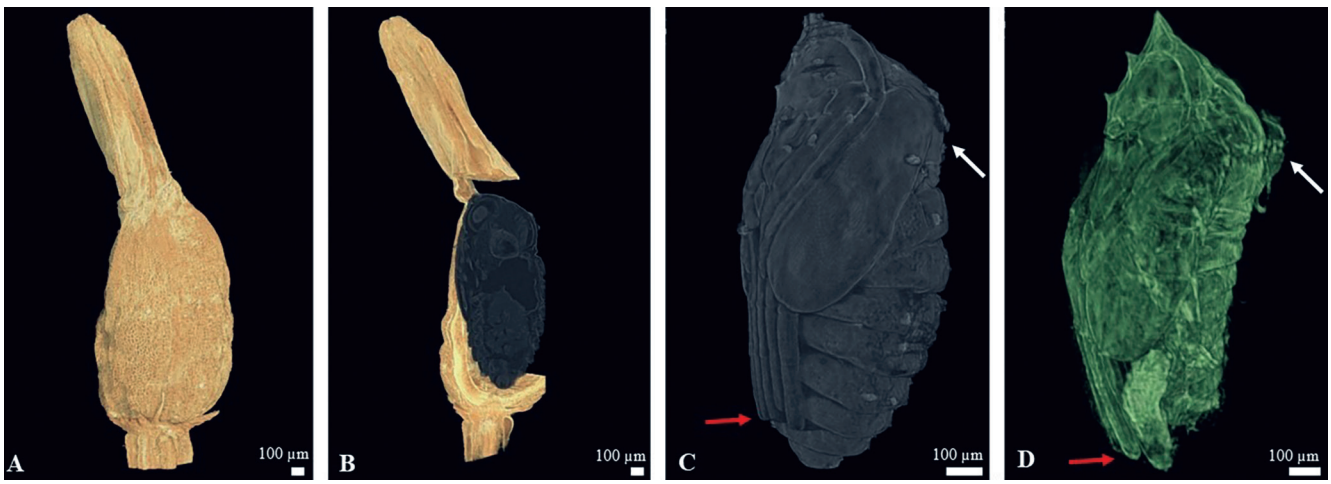

Figure 7. Observation of gall inducer (Diptera: Cecidomyiidae) in the *Solidago chilensis* flower (Asteraceae) using micro-computed tomography (µCT). (A) Flower gall, (B) Pupae and flower gall transversion section, (C) Pupae, (D) Pupal exuvia. The red arrow indicates apex of the leg and white arrow thoracic dorsal integument.

0.15-0.17 mm, *A. paranaensis,* **sp. nov.:** 0.08 mm, *A. ulei*: 0.10 mm).

Dorsal spines (pupa): On the last abdominal segment, the distal row of spines includes the largest number of spines, all well developed, and they are aligned, forming a straight row.

Prothoracic spatula (larva): The middle teeth are slightly shorter than the lateral teeth in the new species, as well as in *A. gochnatiae* and *A. mineira*. In the others, the middle teeth are conspicuously shorter, except in *A. glomeratae,* whose middle and lateral teeth are subequal in length. However, the incision among each tooth is similar only in the new species and in *A. glomeratae*.

Lateral papillae: The new species has three setose lateral papillae on each side of the spatula. This arrangement of papillae is also found in *A. cipo, A. mineira,* and *A. serrata*. In the other species, there are four setose lateral papillae on each side of the spatula, except in *A. ulei,* with five.

Host plant: *A. paranaensis* is the only neotropical species associated with the genus *Solidago*.

Host organ: The new species is the single one that induces galls on flowers. The others induce galls on leaves (on blade – *A. ingaiensis, A. serrata,* and *A. ulei;* on veins and petioles – *A. glomeratae;* on blade and petioles – *A. gochnatiae*), stems (*A. gaucha* and *A. mineira*), and stems and leaf petioles (*A. cipo* and *A. moehni*).

CONCLUSION

A new species, *Asphondylia paranaensis* Matos & Maia, is described based on galls induced on *Solidago chilensis* in Paraná State, Brazil. This finding represents both the first record of the genus *Asphondylia* in this region and its first documented association with this host plant, contributing to the known diversity of gall-inducing insects within the genus. Additionally, complementary techniques, such as µCT, could enhance the observation and detailed analysis of the interactions between the gall-inducing insect and parasitized plant.

Gall-inducing insects can alter the metabolism and chemical composition of host plants, potentially influencing their biological effects. Further studies are needed to assess the peak infestation period, occurrence of the species in other regions, and their impact on secondary metabolite concentrations.

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