

Asphondylia fructicola, a new species of Cecidomyiidae (Diptera) associated with *Solanum* sp. (Solanaceae) from Brazil

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ABSTRACT. *Asphondylia fructicola*, a new species of Cecidomyiidae (Diptera) associated with *Solanum* sp. (Solanaceae) from Brazil. *Asphondylia fructicola* **sp. nov.** is described and illustrated on the basis of the larva, pupa, male, female, and gall. This species induces galls on fruits of *Solanum* sp. (Solanaceae) in Amazonia, Brazil.

KEYWORDS. *Asphondylia*; insect galls; taxonomy.

RESUMO. *Asphondylia fructicola*, uma nova espécie de Cecidomyiidae (Diptera) associada com *Solanum* sp. (Solanaceae) do Brasil. *Asphondylia fructicola* **sp. nov.** é descrita e ilustrada com base na larva, pupa, macho, fêmea e galha. Essa espécie induz galhas nos frutos de *Solanum* sp. (Solanaceae) na Amazônia, Brasil.

PALAVRAS-CHAVE. *Asphondylia*; galhas de insetos; taxonomia.

Recent studies have shown that the Amazonian tropical rain forest is rich in gall inducing insects (Julião *et al.* 2005), hence contradicting previous accounts on the galls in the region (Price *et al.* 1998). Otherwise, the knowledge on these species taxonomy, phylogeny, and host affiliations is poorly understood at present. In an attempt to begin and stimulate such studies we report on a new species of *Asphondylia* (Diptera: Cecidomyiidae) inducing galls on *Solanum* sp. (Solanaceae) in the largest tropical rain forest of the world, in the Brazilian Amazonia. The host plant was found in an reforested area, where it is relatively abundant and possibly an invader species.

The gall midge that induces galls on *Solanum* sp. belongs to *Asphondylia* Loew, 1850. This cosmopolitan genus includes 272 described species of gallers, of which most induce galls on flowers, fruits and less often on leaves and stems (Gagné 2004, Carneiro *et al.*, personal communication). The genus is characterized by a needlelike ovipositor, two-toothed gonostylus, three-segmented palpi and presence of upper and generally lower horns on the pupal frons (Gagné 1994).

Asphondylia species have been recorded on 66 plant families, being most frequent on Asteraceae, Fabaceae and Chenopodiaceae (Gagné 2004). Ten species are associated with Solanaceae (Gagné 2004; Maia & Fernandes 2005), six of them induce galls on *Solanum* species: *Asphondylia beguni* Mani, 1953 (distr.: India; host plant: *Solanum melongena*); *A. obscura* Kolesik, 2000 (distr.: Australia, host plant: *Solanum physalifolium* var. *nitidibaccatum* and *Solanum chenopodioides*); *A. paucidentata* Kolesik, 2000 (distr.: Australia, host plant: *Solanum aviculare* and *S. linearifolium*); *A. solani* Tavares, 1908 (distr.: Mozambique, host plant: *Solanum* sp.); *A. sturtiana* Kolesik, 2000 (distr.: Australia, host

plant: *Solanum sturtianum*); and *A. trabutii* Marchal, 1896 (distr.: Algeria and Italy; host plant: *Solanum tuberosum*).

In the Neotropical region, only *Asphondylia cestri* Möhn, 1959 is associated with Solanaceae, but it induces galls on *Cestrum nocturnum* (Raat Ki Rani). Other Neotropical species belonging to distinct genera induce galls on *Solanum* spp., namely: *Neolasioptera exigua* Möhn, 1964 (distr.: El Salvador; host plant: *S. umbellatum*); *Lasioptera kallstroemia* Felt, 1935 (distr.: USA, Mexico, Guatemala, Nicaragua; host plant: *Solanum* spp.); and *Prodiplosis longifolia* (distr.: USA, Colombia, Ecuador, Peru; host plant: *S. esculentum* and *S. tuberosum* and others host plant family).

In Brazil, 14 species of *Asphondylia* have been recorded, none on Solanaceae.

MATERIAL AND METHODS

Samples of galls were taken from plantations of a native species of *Solanum* L. (Solanaceae) in the Plateau Papagaio (01°36' 58.2 S and 56°24' 14.4W) at the nursery of the Mineração Rio do Norte SA, Porto Trombetas, Pará State, Brazil in October 2005. We collected attacked fruits for rearing of immature and adults of the galling species, and parasitoids from 50 individuals of *Solanum* sp. The material was taken to the laboratory for rearing of insects. Sampled material was maintained at constant room temperature and humidity. Larvae were obtained by dissection of galls under a stereoscopic microscope. Pupal exuviae and adults were obtained by keeping galled fruits of *Solanum* sp. in plastic pots layered at the bottom with damp cotton and covered by fine nylon mesh. The pots were inspected daily for adult emergence. Immature stages and adults were fixed in 70% ethanol and then mounted

on slides, following the methodology described by Gagné (1994). The specimens (including the types) are deposited in the Diptera collection of Museu Nacional, Rio de Janeiro (MNRJ). Morphological terminology for immature stages and adults follows Gagné (1994).

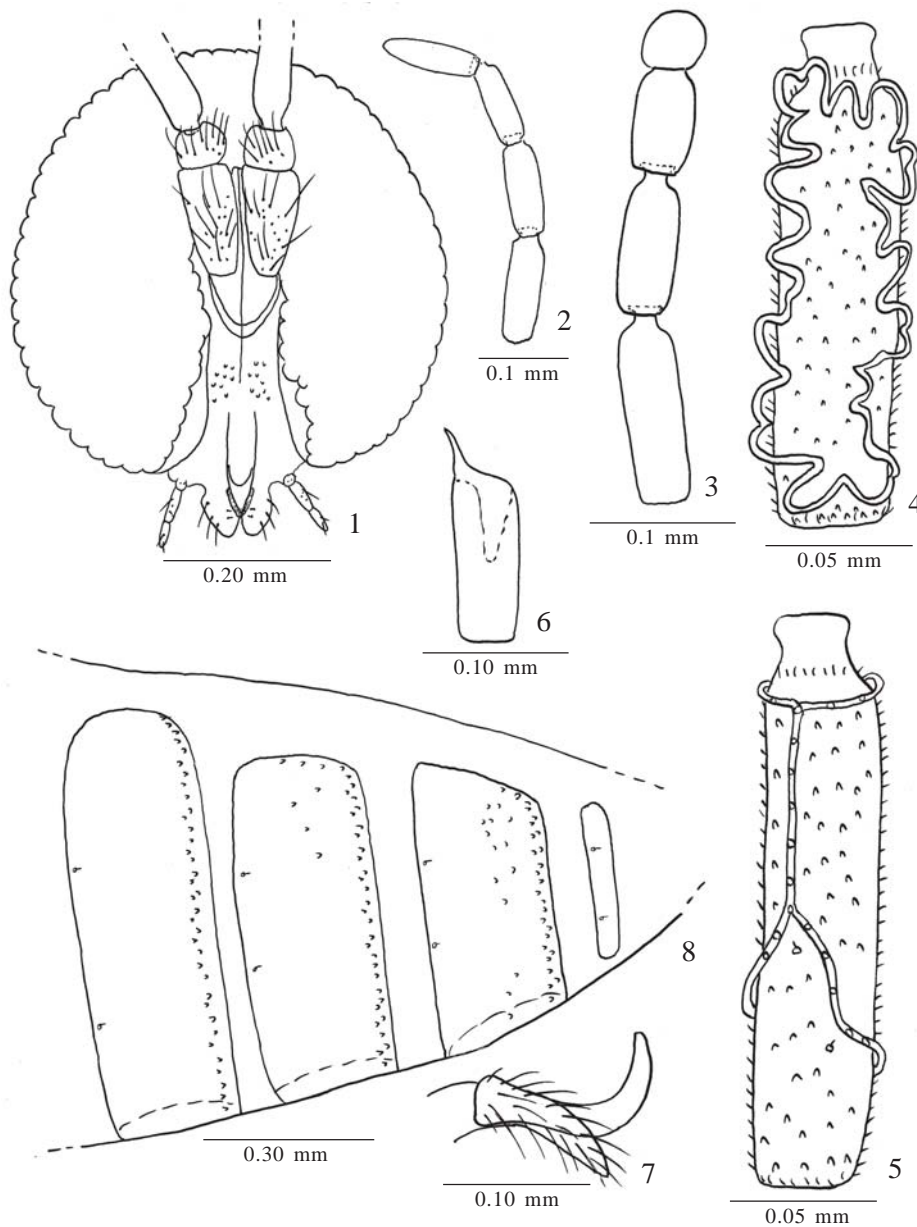
Additionally, we randomly selected 100 galled fruits of 50 plants in the field, which were placed in plastic bags and taken to the laboratory to record gall size (diameter) and weight. The parasitoid mortality factor (for details see Fernandes & Price 1992) acting upon the galling larva, the abundance of larvae, pupae, adults and the presence of lodgers were also measured. The data were analyzed by basic statistical analyses (StatSoft 2001). The field and laboratory work were done by G.

W. Fernandes, J. C. Santos and collaborators while the taxonomy and descriptions of the new species were made by V. C. Maia.

Asphondylia fructicola Maia, sp. nov.

(Figs. 1–18)

Diagnosis. Adults: eye facets hexagonal, frontoclypeus with 14-22 setae in male and 16-20 in female; empodia well developed, as long as bend in claws or longer; male tergite 8 band-like with only two basal trichoid sensilla; female sternite 7 0.50-0.55 mm long, 1.66-1.76 as long as sternite 6; ovipositor: needle part 1.60-1.75 mm long and 3.0-3.3 as long as sternite 7.

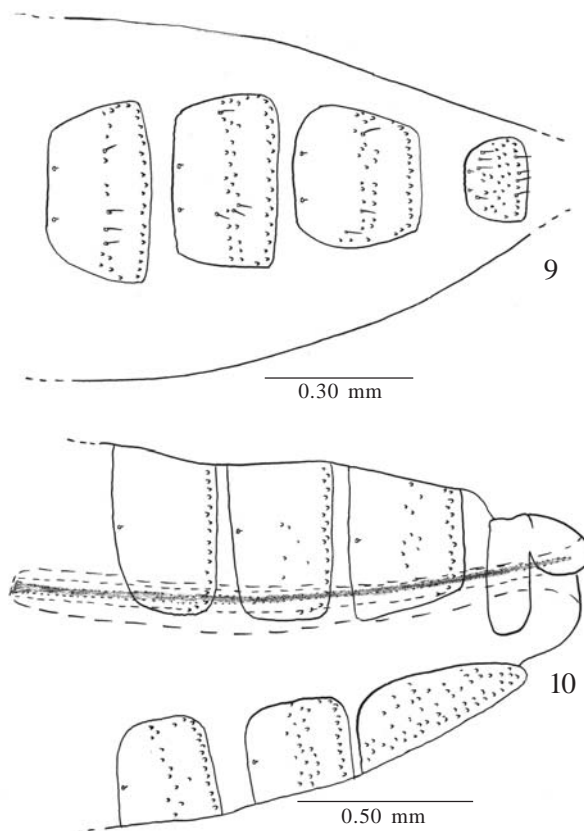


Figs. 1–8. *Asphondylia fructicola*, sp. nov.: 1, male head, frontal view; 2, male flagellomeres 9–12; 3, female flagellomeres 9–12; 4, male flagellomere 5; 5, female flagellomere 5; 6, male, midleg, first tarsomere; 7, female, midleg, tarsal claw and empodium, lateral view; 8, male abdominal segments 5–8, dorsal view.

Pupa: prothoracic spiracle setiform, curved, 0.16-0.17 mm long; antennal horn triangular with internal margin serrated, 0.30-0.33 mm long (from antennal base to apex); upper frontal horn simple, 0.05-0.06 mm long; lower frontal horn trilobed, 0.03-0.04 mm long; abdominal segments 2-8 with two transverse rows of crescent dorsal spines; segment 9 with scattered crescent dorsal spines. Larva: spatula 4-toothed; three setose lateral papillae on each side of spatula; four pairs of terminal papillae.

Adult. Body length: 3.1-3.8 mm in male (n=9); 3.7-4.0 mm in female (from vertex to bilobed structure at posterior end of tergite 8) (n=4). Head (Fig.1): eye facets hexagonal closely appressed. Antenna: scape obconical elongate, 0.11-0.16 mm long, 2.4-1.7 as long as wide and 2.1-2.75 as long as pedicel in male (n=11), 0.14-0.16 mm long, 2.1-2.6 as long as wide and 2.1-3.0 as long as pedicel in female (n=5); pedicel short globose 0.04-0.06 mm long and 0.81-1.0 as long as wide in male, 0.05-0.07 mm long and 0.88-0.89 as long as wide in female; male flagellomeres 1-12 and female flagellomeres 1-11 cylindrical; female flagellomere 12 globose; flagellomere neck short and bare. Flagellomeres 1 and 2 not connate. Flagellomere 1: 0.19-0.28 mm long, 4.0-6.2 as long as wide and 1.46-1.83 as long as scape in male (n=11); 0.27-0.30 mm long, 7.5-8.3 as long as wide and 1.75-2.0 as long as scape in female (n=5); flagellomere 9: 0.14-0.15 mm long, 3.5-4.0 as long as wide and about as long as flagellomere 10 in male (n=11), 0.12-0.13 mm long, 3.27-3.69 as long as wide and 1.18-1.30 as long as flagellomere 10 in female (n=5); flagellomere 10: 0.14-0.15 mm long, 3.5-4.0 and as long as wide and about as long as flagellomere 11 in male (n=11); 0.10-0.11 mm long, 2.3-2.8 as long as wide in female and 1.57-1.67 as long as flagellomere 11 (n=11); flagellomere 11: 0.13-0.14 mm long, 3.7-4.0 as long as wide and about as long as flagellomere 12 in male (n=11), 0.06-0.07 mm long, 1.2-2.0 as long as wide and 1.5-1.75 as long as flagellomere 12 in female (n=5); flagellomere 12: 0.12-0.13 mm long and 3.0-4.1 as long as wide in male (n=11); 0.04 mm long and 0.9-1.1 as long as wide in female (n=5). Proportions of last four male and female flagellomeres as in Figs.2-3, respectively. Circumfila anastomosing in male (Fig.4) and as two interconnected rings in female (Fig.5). Frontoclypeus with 14-22 setae in male and 16-20 in female. Labrum long-attenuate. Hypopharynx of the same shape of labrum, with long anteriorly directed lateral setulae. Labella elongate-convex, each with some lateral setae and two pairs of short mesal setae. Palpus with three setose segments: segment one globose, 0.020-0.025 mm long and 1.0-1.55 as long as wide in male (n=8), 0.020-0.030 mm long, 0.83-1.85 as long as wide; segment 2 claviform, 0.025-0.04 mm long, 1.72-2.25 as long as wide and 1.5-2.0 as long as segment one in male (n=6), 0.04-0.05 mm long, 1.76-2.27 as long as wide and 1.5-2.25 as long as segment one in female (n=5); segment 3 mm claviform, 0.04-0.055 mm long, 2.4-4.4 as long as wide and 1.25-1.80 as long as segment 2 in male (n=8), 0.05-0.075 mm long, 2.6-4.4 as long as wide and 1.20-1.87 as long as segment one in female (n=5).

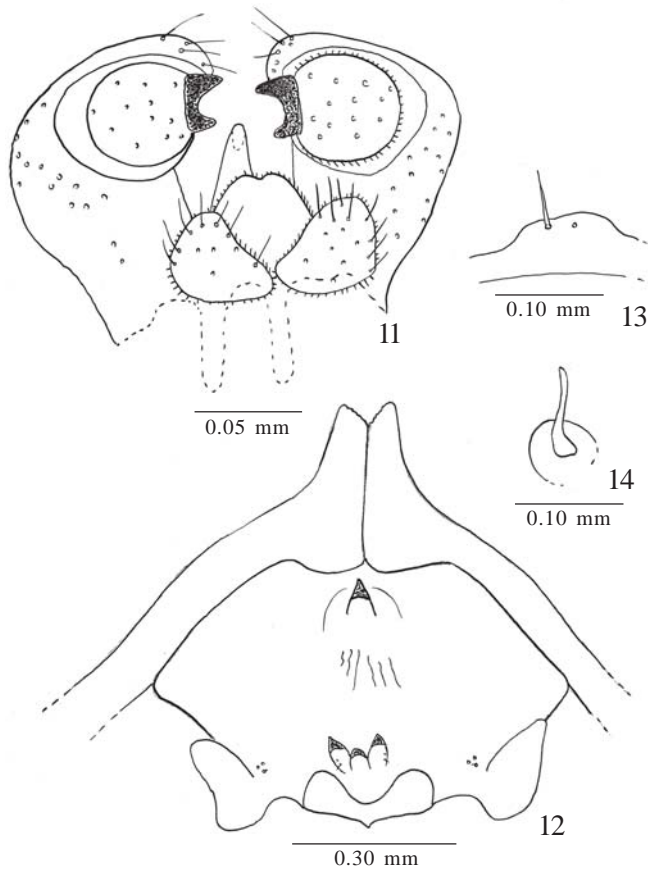
Thorax: Anepimeron setose, other pleural sclerites aetose.



Figs. 9-10. *Asphondylia fructicola*, **sp. nov.**; 9, male abdominal segments 5-8, ventral view; 10, female abdominal segment 5 to end, lateral view.

Wing length (from arculus to apex): 2.0-2.4 mm in male (n=5), 2.7-2.85 mm in female (n=4). First tarsomere with apical projection 0.03 mm long in both sexes, thinner in male (n=10) (Fig. 6). Tarsal claws simple, robust, curved beyond midlength; empodia well developed, as long as bend in claws or longer (Fig.7).

Abdomen: Male (Figs.8-9): tergites 1-7 rectangular with complete row of posterior setae, several lateral setae, two basal trichoid sensilla and elsewhere with scattered scales. Tergite 8 band-like with only two basal trichoid sensilla as vestiture. Sternites 2-7 rectangular with setae more abundant at midlength, complete row of posterior setae, several lateral setae, two basal trichoid sensilla and elsewhere with scattered scales. Sternite 8 ovoid with several scattered setae more concentrated caudally and two basal trichoid sensilla. Female (Fig.10): tergites 1-8 as tergite 1-7 in male; sternites 2-6 as sternites 2-6 in male. Sternite 7 ovoid, 0.50-0.55 mm long, 1.66-1.76 as long as sternite 6, with scattered setae and two basal trichoid sensilla. Sternite 8 not sclerotized. Male terminalia (Fig.11): gonocoxites wide and setose, 0.13-0.14 mm long, 0.08-0.095 mm wide and 1.47-1.68 as long as wide (n=3), with small apical lobe; gonostylus short, ovoid, and setose, 0.065-0.07 mm long, 0.045-0.05 mm wide, 1.3-1.55 as long as wide (n=2); cercus reniform or triangular, completely separate and setose,



Figs. 11–14. *Asphondylia fructicola*, **sp. nov.**; 11, male terminalia, dorsal view; 12, pupa, head, frontal view; 13, pupa, cephalic seta, dorsal view; 14, pupa, prothoracic spiracle.

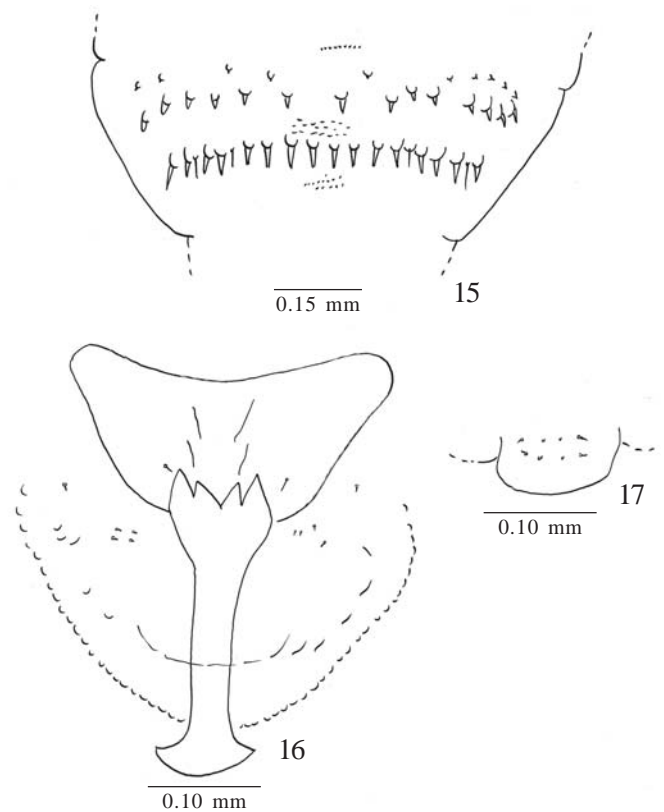
0.045–0.05 mm long (n=3); hypoproct bilobed and setose; parameres absent; aedeagus triangular, tapering gradually towards apex and pointed apically. Ovipositor: needle part 1.60–1.75 mm long (n=4) and 3.0–3.3 as long as sternite 7 (n=4).

Pupa. Color: brownish. Length: 3.1–3.9 mm (n=6). Head (Fig. 12): antennal horn triangular with internal margin serrated, and 0.30–0.33 mm long (from antennal base to apex) (n=5); cephalic setae 0.055–0.06 mm long (Fig. 13) (n=6); upper frontal horn simple, 0.05–0.06 mm long (n=5); lower frontal horn trilobed, 0.03–0.04 mm long (n=4); two pairs of lower facial papillae: one pair setose, seta 0.02 mm long (n=4), the other asetose; three pairs of lateral facial papillae: one pair setose, seta 0.01 mm long (n=4), the others without setae. Upper cephalic margin thickened laterally. Thorax: prothoracic spiracle setiform, curved, 0.16–0.17 mm long (n=4) (Fig. 14). Abdomen (Fig. 15): segments 2–8 with two transverse rows of crescent dorsal spines. Segment 9 with scattered crescent dorsal spines.

Larva. Body elongate and cylindrical. Length: 3.3–3.7 mm (n=4). Integument rough. Spatula with four well developed teeth, the outer ones longer than the inner; surrounding area pigmented; sternal papillae setose (setae 0.015 mm long, n=4),

three setose lateral papillae on each side of spatula, one papillae longer than the others, the longest 0.008 mm long, the others 0.005 mm long (n=3) (Fig. 16). Terminal segment short, convex, with four pairs of terminal papillae, being to setose and the others bare (Fig. 17).

Gall (Fig. 18). Galls develop on fruits of *Solanum* sp. Galled fruits are conspicuous due to their size and distinct ruptures on the fruit cortex. The galls are green, covered with short, whitish trichomes, and multiple chambered. Several larvae are found inside the gall, each one in a separate chamber. At the beginning of gall formation, it is similar in shape with young fruits. As the gall matures, it becomes enlarged and globose. Many cracks appear on the gall walls in which eventually inquiline arthropods such as cockroaches, ants, homopterous, and coleopterans live. The *A. fructicola* fruit galls studied had a diameter of 20.84 ± 4.67 mm ($\bar{x} \pm SD$; min.=10.00 and max.=32.60, n=100) and an average weight of 3.09 ± 1.77 g ($\bar{x} \pm SD$; min.=0.38 and max.=8.79, n=100). The proportion of individuals found at the same time during the study in the fruit galls was as follow: larva 40.27% (n=60); pupa 32.89% (n=49); adult 1.34% (n=2) and parasitized larvae 25.50% (n=38). Other studies of *Asphondylia* species inducing galls in fruit have been done, for instance, *A. aucubae* Yukawa et Ohsaki on a dioecious shrub *Aucuba japonica* Thunberg (Aucubaceae) (Imai & Ohsaki 2004).



Figs. 15–17. *Asphondylia fructicola*, **sp. nov.**; 15, pupa, abdominal segment 8, dorsal view; 16, larva, spatula and associated papillae, ventral view; 17, Larva, terminal segment, dorsal view.



Fig. 18. Gall induced by *Asphondylia fructicola*, **sp. nov.**, general aspect.

Material Examined. Holotype male, fruit galls on *Solanum* sp., BRAZIL. Pará, Porto Trombetas, X.2005, G. W. Fernandes col.. MNRJ. Paratypes: same data as holotype, 10 males, 5 females, 8 pupal exuviae, and 4 larvae.

Etymology. The name *fructicola* refers to the organ plant where the gall midge larva lives.

Remarks. *Asphondylia fructicola* is unique in having the combination of the following characters: empodia well developed, as long as bend in claws or longer; male tergite 8 band-like with only two basal trichoid sensilla; female sternite 7 1.66-1.76 as long as sternite 6; ovipositor: needle part 1.60-1.75 mm long and 3.0-3.3 as long as sternite 7. prothoracic spiracle 0.16-0.17 mm long; antennal horn triangular with internal margin serrated, 0.30-0.33 mm long; upper frontal horn simple, 0.05-0.06 mm long; lower frontal horn trilobed, 0.03-0.04 mm long; abdominal segments 2-8 with two transverse rows of crescent dorsal spines; segment 9 with scattered crescent dorsal spines; spatula 4-toothed; three setose lateral papillae on each side of spatula; four pairs of terminal papillae.

It differs from *A. cestri*, the only other Neotropical species of *Asphondylia* associated with Solanaceae by: 1) body length: 2.4-2.5mm in male and 2.7-2.8mm in female of *A. cestri*, 3.1-3.8 mm in male and 3.7-4.0mm in female of *A. fructicola*; 2)

proportions of the last three female flagellomeres: flagellomere 10: 0.08mm long in *A. cestri* and 0.10-0.11mm long in *A. fructicola*; flagellomere 11: 0.058 mm long in *A. cestri* and 0.06-0.07mm long in *A. fructicola*; and flagellomere 12: 0.01 mm long in *A. cestri* and 0.04 mm long in *A. fructicola*; 3) empodium longer in *A. fructicola* than in *A. cestri* (see Figure 86 of Möhn 1959); and 4) spatula with teeth more pointed in *A. fructicola* than in *A. cestri* (see Figure 87 of Möhn 1959), the two lateral teeth are conspicuously longer than the mesal ones only in the new species.

Acknowledgments. We thank D. Braga for field help. This study was supported by the Mineração Rio do Norte, Planta Tecnologia Ambiental, CNPq (30 4851/2004-3), FAPERJ (Fundação de Amparo à Pesquisa do Estado do Rio de Janeiro, E-26/171.290/2006) and CNPq (Conselho Nacional de Desenvolvimento Científico e Tecnológico, Proc. 472084/2007-0 e 301197/2007-5). We also thank the administration of the Flona Saracá-Taquera – IBAMA National Forest for logistical support.

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