

# Two new ectoparasitic species of *Aulacothrips* Hood, 1952 (Thysanoptera: Heterothripidae) associated with ant-tended treehoppers (Hemiptera)

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Received: 27 August 2014 / Accepted: 18 September 2014  
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**Abstract** *Aulacothrips* Hood, 1952 is a remarkable South American genus of ectoparasitic thrips which feed on gregarious ant-tended hemipterans (Hemiptera: Auchenorrhyncha). Here we describe two new species of this genus infesting membracid treehoppers in Colombia and Brazilian Amazon, and provide a key to the five *Aulacothrips* spp. now recognised. *Aulacothrips levinotus* n. sp. is unique in having pronotum with only two pairs of major setae; and *Aulacothrips tenuis* n. sp. has unusually long abdominal tergite IX. These findings will be helpful for understanding the species diversification in this genus, bringing a new perspective on the diversity of *Aulacothrips* spp. and their myrmecophilous hemipteran hosts.

## Introduction

The remarkable ectoparasitic life-style exhibited by species of *Aulacothrips* Hood, 1952 (Heterothripidae) was firstly reported by Izzo et al. (2002) when *Aulacothrips dictyotus* Hood, 1952 was observed infesting nymphs and adults of *Aetalion reticulatum* (L.) (Hemiptera, Aetalionidae) in Brazil. The ectoparasitic life-cycle of these thrips is very dependent on the hemipteran body, and subsequent analysis of the tegument in *Ae. reticulatum* revealed the injuries produced by thrips mouth parts (Cavalleri et al., 2010). Thrips infestation also promotes significant alteration of the behaviour of the hemipteran hosts, making them feed in lower frequencies and displaying a great variety of self-cleaning behaviours (Cavalleri, 2012).

A few years later, a second species of *Aulacothrips* was described from the Brazilian savannah, also parasitic on hemipterans but exhibiting a distinct host and feeding strategy (Cavalleri et al., 2010). In contrast to *A. dictyotus*, which is a highly specific ectoparasite, *A. minor* Cavalleri, Kaminski & Mendonça, 2010 has a wide host range, infesting many species of ant-tended treehoppers of the family Membracidae. Finally, *A. amazonicus* Cavalleri, Kaminski & Mendonça, 2012 was recently described from the Amazonian rainforest attacking membracids tended by ants, *Dolichoderus bispinosus* (Olivier) (Dolichoderinae) (Cavalleri et al., 2012).

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*Aulacothrips* spp. diversity might be largely overlooked by collectors due to their unusual life-style and microhabitat. Thrips can occur in large numbers among hemipteran aggregations, but adults are usually found at low densities. The larvae are normally observed attached to the ventral surface of the nymphs, and beneath the wings of adults, and phoresy might occur to some degree (Alves-Silva & Del-Claro, 2011). Moreover, given the great diversity of treehoppers in South America (see Wood & Olmstead, 1984), new associations are expected to be found in the Neotropics, particularly in the poorly studied lowland wet forests.

Here we describe two new species of *Aulacothrips* from South America, both infesting ant-tended treehoppers in tropical areas, and provide an illustrated key to the five species in the genus and a generic diagnosis modified after Cavalleri et al. (2010).

## Materials and methods

All specimens were fixed in 70% ethanol and mounted on microscope slides containing Canada Balsam using a standard procedure (Mound & Marullo, 1996). Photographs were taken under a Nikon AZ100 microscope and images were edited using Corel X5 software. All measurements are in micrometres.

## Genus *Aulacothrips* Hood, 1952

### Diagnosis

Antennae 9-segmented, segments III and IV greatly enlarged; each with a linear and convoluted sensorium. Head longer than wide; three pairs of ocellar setae present, pair II well developed, capitate; post-ocular setae II long, capitate. Pronotum with two to seven pairs of stout, long setae; metascutum triangular, reticulate; paired metanotal campaniform sensilla placed at posterior third; tarsi 2-segmented; fore wing narrow but base greatly swollen. Abdominal tergites II–VIII with a median furrow, margined with two pairs of long, stout wing-retaining setae; posterior margin of tergites with a toothed craspedum laterally, but with a fringe of independent microtrichia medially. Male with a minute pore plate on sternite VII, situated at the antecostal ridge. *Type species*: *A. dictyotus* Hood, 1952 (by monotypy).

## *Aulacothrips levinotus* n. sp.

*Type-host*: *Horiola* cf. *picta* (Membracidae: Tragopini), breeding on *Theobroma speciosum* Willd. ex Spreng. (Sterculiaceae).

*Type-locality*: Itaituba (04°21'N, 56°13'W), Pará, Brazil; 20.x.2013, col. Cavalleri, A.

*Type-material*: Holotype female deposited in the Universidade Federal do Rio Grande do Sul (UFRGS), Brazil (accession number UFRGS 4140).

*Etymology*: The specific epithet refers to the unusually low number of long setae on the pronotum and abdominal tergites of the new species.

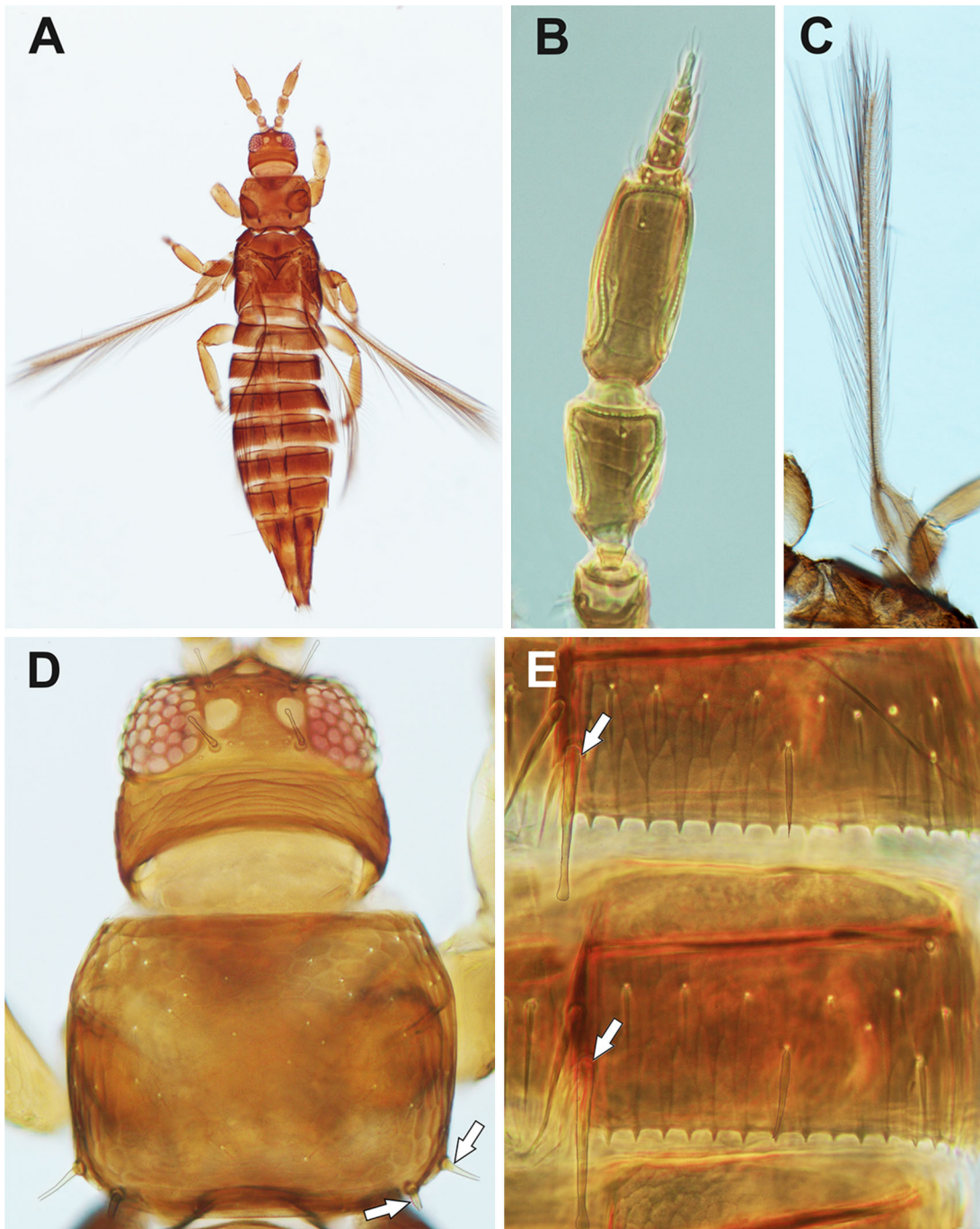
### Description (Fig. 1A–E)

#### *Female macroptera*

Body extensively dark brown, including legs and antennae (Fig. 1A); fore wing blackish brown, not paler at base; median dark line present (Fig. 1C); major setae light brown.

Head wider than long (Fig. 1D); ocellar area weakly reticulated; antennae 9-segmented, III and IV enlarged with continuous porous sensoria, curving laterally toward base but not forming loops on dorsal and ventral surface (Fig. 1B); segment III conical. Pronotum slightly wider than long, lacking sculpture medially but weakly reticulate at margins; 2 pairs of long, capitate posteroangular setae and c.30 small discal setae (Fig. 1D); transverse apodeme present on anterior third. Abdominal tergites with weak polygonal reticulation, bearing toothed craspedum on posterior margin; tergites II–VIII with median furrow bearing pair of long, pointed setae medially, lateral margin of furrow with 2 pairs of stout setae, posterior margin with fringe of small microtrichia medially; tergites II–VII with only 1 pair of long, capitate discal setae (Fig. 1E); IX with many long, pointed discal setae. Abdominal sternites II–VIII with c.6 pairs of stout, flattened setae placed laterally, IX with c.10 such setae on each side.

Measurements of female holotype: Length about 1,380 (distended); head length 100, greatest width across cheeks 145; ocellar setae II length 28, interval 45; eye dorsal length 60; pronotum median length 162, width 210; mesonotum width 162; fore wing length 695, median width 20; metascutal triangle length 62, major width 80; tergite IX length 117, basal width 125;



**Fig. 1** *Aulacothrips levinotus* n. sp. A, Female; B, Antenna, dorsal view; C, Fore wing; D, Head and pronotum (arrows indicate the two pairs of pronotal setae); E, Female, abdominal tergites II–III

tergite X length 62, basal width 52; antennal segments III–IX length (width): 60 (basal width 22, apical width 35), 75 (45), 8, 10, 10, 10, 12.

*Male*: Unknown.

#### Remarks

The single known female of *A. levinotus* was observed living among nymphs and adults of *Horiola* sp., which

were being tended by *Azteca* spp. ants (Dolichoderinae). It is closely related to *A. amazonicus*, and both exhibit reduced sensorial areas on antennal segments III and IV. This new taxon is remarkable in having only two pairs of long setae on the pronotum and in the smaller number of major discal setae on the abdominal tergites; these might represent a plesiotypic condition for this genus.

### *Aulacothrips tenuis* n. sp.

*Type-host*: cf. *Amastris* sp. (Membracidae: Amastrini), breeding on *Byrsonima* sp. (Malpighiaceae).

*Type-locality*: Purificación (03°45'N, 74°53'W), Colombia; 22.ii.2013, col. Kaminski, L. A.

*Type-material*: Holotype female and one male paratype are deposited in the Universidade Federal do Rio Grande do Sul (UFRGS; accession numbers UFRGS 2655 and 2656); one female paratype is also available at the Instituto de Ciencias Naturales (ICN), Universidad Nacional de Colombia, Bogota.

*Etymology*: The specific epithet refers to the unusual slender abdomen of the new species.

### Description (Fig. 2A–G)

#### *Female macroptera*

Body extensively dark brown (Fig. 2A), including legs and antennae, pedicel of the antennal segment III and segment IX paler; fore wings blackish brown but paler at base, with a dark line (Fig. 2D); major setae light brown.

Head wider than long (Fig. 2E); ocellar area weakly reticulated; antennae 9-segmented, III and IV enlarged with continuous porous sensoria, forming numerous loops (Fig. 2C), suture among segments VI–IX scarcely visible; III conical. Pronotum smooth, slightly wider than long; 4 pairs of long, capitate setae (1 arising anteriorly and 3 at posterior margin) and c.30 small discal setae (Fig. 2E); transverse apodeme present on anterior third. Abdominal tergites with polygonal reticulation, bearing well-developed toothed craspedum; tergites II–VIII with median furrow bearing pair of long, pointed setae medially, lateral margin of furrow with 2 pairs of stout setae, posterior margin with fringe of small microtrichia medially; tergites II–VII with 3 pairs of long, capitate discal setae arranged in transverse row; IX c.1.2 times

as long as wide, with many long, pointed discal setae (Fig. 2F). Abdominal sternites II–VIII with c.5 pairs of stout, flattened setae placed laterally, sternite IX with c.6 such setae each side (Fig. 2G).

Measurements of female holotype: Length about 1,700 (distended); head length 122, greatest width across cheeks 155; ocellar setae II length 30, interval 60; eye dorsal length 65; pronotum median length 180, width 223; mesonotum width 200; fore wing length 800, median width 20; metascutal triangle length 67, major width 82; tergite IX length 150, basal width 140; tergite X length 77, basal width 77; antennal segments III–IX length (width): 80 (basal width 25, apical width 36), 107 (32), 8, 10, 8, 10, 9.

#### *Male macroptera*

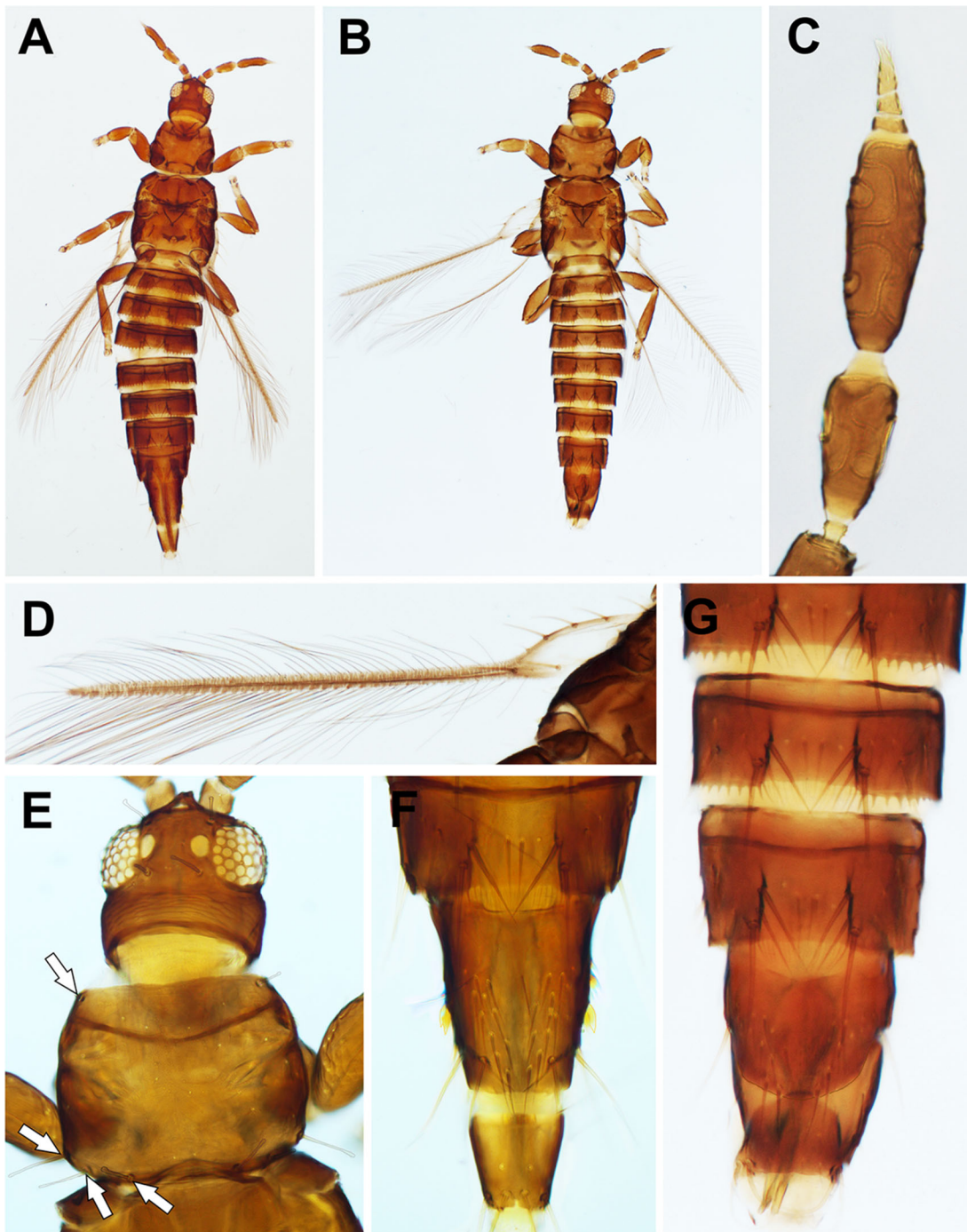
Smaller and slightly paler than female (Fig. 2B); posterior margin of abdominal tergite VIII with only 1 pair of long, capitate setae, almost reaching posterior margin of tergite X; posterior margin of tergite IX extending toward X (Fig. 2F); tergite X with 2 pairs of long, curved, weakly-expanded setae; antecostal ridge of sternite VII with small circular pore plate c.3 in diameter, not covered by sternite VI; IX with many short, flattened setae laterally.

Measurements of paratype male: Length 1,420; head length 125, greatest width across cheeks 143; pronotum median length 173, width 215; tergite IX length 82, basal width 120; tergite X length 57, basal width 62; genitalia length 175; antennal segments III–IX length (width): 77 (basal width 22, apical width 33), 93 (33), 8, 12, 11, 6, 10.

### Remarks

Adults and larvae of this new species were found infesting small Amastrini nymphs tended by *Crematogaster* spp. ants (Myrmicinae). It is related to the species of the *Aulacothrips* group that infest membracids in South America: *A. amazonicus*, *A. levinotus* and *A. minor*. The shape of the antennal sensoria on segments III and IV in *A. tenuis* is similar to that found in *A. minor*, and the posterior margin of tergite IX in males is also prolonged toward segment X. Moreover, both have uniformly brown colour and the enlarged base of the fore wing is paler. However, *A. tenuis* is distinctive in having only four major setae on pronotum, lacking the midlateral and major discal setae. The

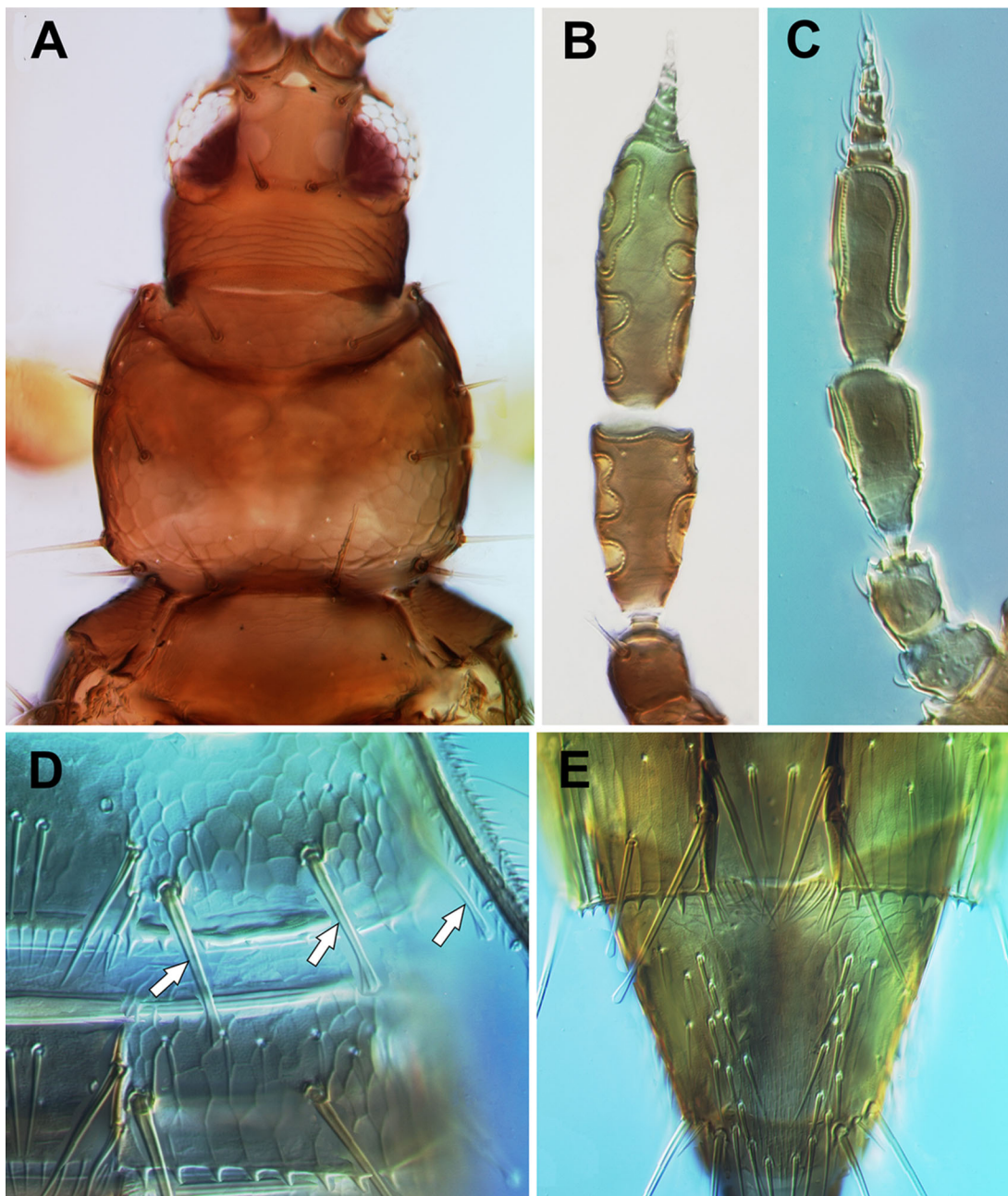




**Fig. 2** *Aulacothrips tenuis* n. sp. A, Female; B, Male; C, Antenna, dorsal view; D, Male, fore wing; E, Head and pronotum; F, Female, abdominal tergites VIII–X; G, Male, abdominal tergites VI–X

abdominal segments in the new species are also slender, particularly tergite IX, which is remarkably longer than wide. Furthermore, there are numerous stout lateral

setae on abdominal segment IX, and these are brownish-yellow in colour, contrasting with the homologous pale setae found in the other *Aulacothrips* spp.



**Fig. 3** Diagnostic characters of *Aulacothrips* spp. A, *A. dictyotus*, head and pronotum; B, *A. minor*, antenna; C–E, *A. amazonicus*, C, Antenna; D, Male, abdominal tergites II–III (arrows indicate the three pairs of stout discal setae); E, Female, abdominal tergites VIII–IX

### Key to the species of *Aulacothrips*

1a Pronotum with two pairs of major setae (postero-angulars) (Fig. 1D); abdominal tergites with only

one pair of long and expanded discal setae arising medially (Fig. 1E) ..... *A. levinotus* n. sp.  
1b Pronotum with at least four pairs of major setae (Fig. 3A); tergites with three pairs of long and





**Fig. 4** Aggregation of *Harmonides dispar* (Fabricius) (Membracidae: Amastrini) tended by worker ants (*Azteca* spp.) from Porto de Mós, Pará State, northern Brazil. Note the presence of two natural enemies in the same aggregation: an unidentified ectoparasitic *Aulacothrips* (white arrow) and a carnivore caterpillar of the butterfly *Setabis* sp. (Riodinidae) preying on treehopper (black arrow)

- expanded discal setae arising in a median line (Fig. 3D) ..... 2
- 2a Pronotum with four pairs of major setae (Fig. 2E); female abdominal tergite IX about 1.2 times as long as wide (Fig. 2F) ..... *A. tenuis* n. sp.
- 2b Pronotum with seven pairs of major setae (Fig. 3A); female abdominal tergite IX wider than long (Fig. 3E) ..... 3
- 3a Sensoria on antennal segments III–IV curved laterally towards base but without loops on dorsal and ventral surface of these two segments; two pairs of long mid-lateral setae aligned to pronotal lateral margin (Fig. 3C); male largely yellowish brown ..... *A. amazonicus* Cavalleri et al., 2012
- 3b Sensoria on III–IV longer and forming several loops over the entire surfaces of these segments (Fig. 3B); only one pair of long mid-lateral setae aligned to pronotal lateral margin (second pair arising almost medially); male uniformly brown ..... 4
- 4a Antennal segment III conical dorsally, basal third clearly narrower than apical third; sensorial areas with loops wide apart from each other on dorsal surface (Fig. 3B); female abdominal segment IX with 3–9 short, hyaline, flattened setae placed laterally in one or two rows; associated with gregarious membracids (Hemiptera) ..... *A. minor* Cavalleri et al., 2010
- 4b Antennal segment III cylindrical dorsally, with slightly convex sides; sensorial areas extending largely on both surfaces, almost touching each other medially; female abdominal segment IX without a row of short, flattened setae, in few cases bearing only one or two minute and sparse setae; associated with *Aetalion reticulatum* (Hemiptera) ..... *A. dictyotus* Hood, 1952

## Discussion

The discovery of the taxa described above brings a new perspective to the ectoparasitism in *Aulacothrips* spp., which is now known to be widespread from southern Brazil through Amazonian lowlands to the valleys of western Colombia. Moreover, these findings indicate a new degree of interaction between the ectoparasitic thrips and associated ant-treehopper

systems. The first two species described in this genus, *A. dictyotus* and *A. minor*, are known to infest treehopper aggregations facultatively tended by larger-bodied ants ( $\geq 1.0$  cm), and they have not been found in aggregations tended by small ants (Cavalleri et al., 2010; our unpublished results).

Del-Claro et al. (1997) suggested the existence of a relationship between ant size and the ability to find and exclude thrips on the foliage. These authors also pointed out that small-bodied ants are able to access and prey on thrips even in small hideaways. The same phenomenon is likely to occur in *A. dictyotus* and *A. minor* when attacking their hosts. On the other hand, both species described in this paper are associated with treehoppers tended by small ants ( $\leq 0.5$  mm) of the genera *Azteca* and *Crematogaster*. Besides body size, these ants also have distinct ecology, being recognised by their high capacity for recruitment and monopolising of resources, i.e. these ants are top dominants (see Fiedler, 2001; Ribeiro et al., 2013). Myrmecophilous systems involving such top dominant ants are known for their high degree of specificity, which often requires behavioural, chemical, and/or morphological adaptations of the participants to enable them to coexist with the ants (e.g. Kaminski et al., 2013). Identifying the degree of specialisation of the interactions among *Aulacothrips*-treehoppers-ants, and detecting the mechanisms that allow the coexistence of ectoparasitic thrips in these multitrophic systems (Fig. 4) seems a promising topic for future research.

**Acknowledgements** We are grateful to Sebastian Sendoya for his help in the field work in Colombia, and to Olivia Evangelista for her help with treehopper identifications. Financial support was provided by the Fundação de Amparo à Pesquisa do Estado do Rio Grande do Sul. LAK was supported by Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP 10/51340-8) and Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES 3200-14-0).

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