J. Entomol. Res. Soc., 14(2): 09-13, 2012 *ISSN:1302-0250*

A New Species of Cecidomyiid (Diptera, Cecidomyiidae) Predator Associated with Scale Insect (Hemiptera, Coccoidea) Pests of Coffee

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ABSTRACT

A new species of predatory cecidomyiid, *Diadiplosis bellingeri* sp. nov. (Diptera: Cecidomyiidae), is described and illustrated based on specimens collected in association with scale insects (Hemiptera: Coccoidea) on *Coffea arabica* (Rubiaceae) in Espírito Santo, Brazil. *Diadiplosis bellingeri* sp. nov. is distinguished from all other *Diadiplosis* species, by having the following combination of characters: maxillary palps 4-segmented with segments 2 and 3 subequal, claws unidentate, empodium rudimentary, cercus and hypoproct emarginate, gonostyli curved, and aedeagus triangular.

Keywords: Biodiversity, beneficial insects, biological control, *Coffea arabica*, Neotropical

INTRODUCTION

Scale insects (Hemiptera, Coccoidea) are important pests of many agricultural crops. Integrated pest management (IPM) of such insects depends on knowledge of the pest species and natural enemies of the pests commonly present in the crops of specific areas to obtain accurate information on the best management methods available. Unfortunately, relatively little is known of the insect fauna, including scale insects and their natural enemies, such as predatory cecidomyiids, in tropical areas such as the Brazilian State of Espírito Santo (Culik *et al.,* 2007, Culik *et al.,* 2008). Therefore, surveys of scale insects and their natural enemies are being conducted in Espírito Santo to support development of integrated pest management as well as better document the biodiversity in this region.

In this research a new species of *Diadiplosis* Felt, 1911 (Diptera, Cecidomyiidae) associated with scale insects was collected which is described here. *Diadiplosis* is a cosmopolitan genus that contains 28 described species, of which nine are known from the Neotropical region. Little research has been done on members of this genus but most *Diadiplosis* species are known as larval predators of scale insects and several have been associated with whiteflies (Gagné, 2010).

MATERIALS AND METHODS

Samples of scale insect infested fruits and stems were collected from *Coffea arabica* L. (Rubiaceae) in the municipality of Domingos Martins, Espírito Santo, Brazil, during surveys of scale insects and their natural enemies in 2008. The samples were placed in plastic bags and transported to facilities in Vitória for processing. Cecidomyiid adults present in the sample collection bags when they arrived in Vitória were preserved and the samples subsequently maintained at room temperature in the collection bags or in plastic containers covered with linen to allow development and emergence of adult cecidomyiids and other natural enemies associated with the scale insects present. Portions of the samples were also examined to preserve samples of the larvae and pupal exuviae of the cecidomyiids collected as well as associated scale insects. Scale insects associated with cecidomyiids collected from the samples were sent to taxonomic specialists to confirm identifications of scale insect species present. Cecidomyiids specimens were preserved in 70% ethanol and later mounted on slides based on the methodology of Gagné (1994). Type specimens are deposited in the insect collection of the Instituto Capixaba de Pesquisa, Assistência Técnica e Extensão Rural (INCAPER), Vitória, Espírito Santo. Terminology follows that of Harris (1968) and Maia *et al*. (2010). Measurements were recorded using a microscope slide with a scale of 0.01 mm.

RESULTS

One species of cecidomyiid was collected from the scale insect infested plant samples studied in this research. This cecidomyiid was identified as belonging to the genus *Diadiplosis* based on characteristics of the genus including the presence of straplike adult abdominal sclerites and stout claws bent at the basal third, differing from other genera with these characters by not having the eyes completely divided laterally or greatly enlarged on the ventral half (Gagné, 2010). The species of *Diadiplosis* collected in this research differs from all other known *Diadiplosis* species and therefore it is described here.

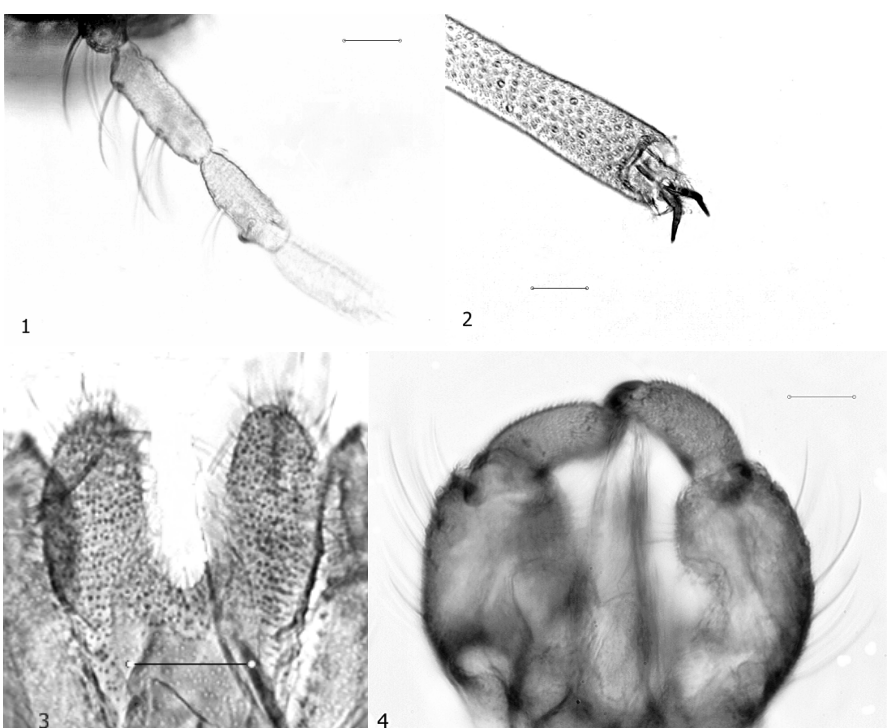
Diagnosis

Diadiplosis bellingeri sp. nov. is distinguished from all other *Diadiplosis* species, by having the following combination of characters: maxillary palps 4-segmented, maxillary palp segments 2 and 3 almost equal in length (Fig. 1), claws unidentate (Fig. 2), empodium rudimentary (shorter than the claw), cercus emarginate, hypoproct emarginate (Fig. 3), gonostyli curved, aedeagus triangular (Fig. 4), cerci of female without an apical, thick group of stout setae.

Description

Adult. Body length: male, 1.33-1.56 mm (n = 2); female, 1.58-1.87 mm (n = 2). Head: antennae with scape obconic, pedicel globose, male flagellomeres, binodal and tricircumfilar, circumfila with loops similar in length; male 5th flagellomere 0.13 mm

in length; female flagellomeres cylindrical, setulose (necks bare), with 2 connected circumfila; male flagellomere 12 with a short apical process. Flagellomeres 1 and 2 connate. Maxillary palps 4-segmented, segments 2 and 3 approximately equal in length. Thorax: Anepimeron setose, other pleural sclerites asetose. Wing length: male, 1.51- 1.65 mm (n = 2); female, 1.62-1.86 mm (n = 2); R1 joining C at approximately wing midlength, M3 present, and CuA forked. Claws stout and bent at the basal third, toothed; empodium rudimentary. Abdomen: Male: tergites 1-7 rectangular, narrow, with a complete row of caudal setae, some lateral setae, 2 basal trichoid sensilla, and scattered scales. Tergite 8 band-like, without setae or scales, with 2 basal trichoid sensilla. Sternites 2-7 rectangular with setae more abundant medially, a complete row of caudal setae, some lateral setae, and 2 basal trichoid sensilla. Sternite 8 unsclerotized. Male terminalia: gonocoxites 0.069 mm long and 0.041 mm wide; gonostyli conspicuously curved, 0.038 mm long and 0.019 mm wide; cercus and hypoproct deeply emarginate, aedeagus triangular, 0.098 mm long, and 0.024 mm wide at the base. Female: ovipositor barely protrusible; cerci elongate-ovoid, separate, and setose.



Figs. 1 - 4. *Diadiplosis bellingeri* sp. nov., diagnostic characters (scale bars = 0.02 mm): 1. Four segmented palp with segments 2 and 3 of similar length, 2. Leg III tarsomere, and bent claw with tooth; 3. Male terminalia (dorsal), with emarginate hypoproct, center; 4. Male terminalia (dorsal), with curved gonostyli and triangular aedeagus, center.

Type material. Holotype: Male, BRAZIL, Espírito Santo, Domingos Martins, 20.371º S 41.064º W, 20.V.2008, col. M. Culik, INCAPER. **Paratypes:** same data as holotype, 2 males and 2 females. Specimens obtained from *Coffea arabica* L. (Rubiaceae) infested with Pseudococcidae and Coccidae (*Saissetia* cf. *coffeae*). Type specimens (5) are deposited in the insect collection of the Instituto Capixaba de Pesquisa, Assistência Técnica e Extensão Rural (INCAPER), Vitória, Espírito Santo.

Etymology. The species is named in honor of Dr. Peter F. Bellinger for his inspiration as an excellent taxonomist and colleague.

Distribution. Known only from the type locality in the municipality of Domingos Martins, Espírito Santo, Brazil.

Biology. This species was collected and reared from a sample of several of *Coffea arabica* twigs heavily infested with mealybugs and soft scale insects located on and between fruits and stems (sample obtained from plants maintained in a greenhouse).

Live appearance. Adult: Body color reddish to tan-gray in alcohol, thorax dark dorsally with a contrasting light area extending medially from the posterior to about the middle of the mesonotum. Antenna brownish with the first 2 segments lighter.

DISCUSSION

Diadiplosis bellingeri sp. nov. differs from all other *Diadiplosis* species, except *D. aleyrodici* (Felt, 1922), *D. japonica* (Grover and Prasad, 1968), and *D. menoni* (Mani, 1944) by having the following combination of characters: maxillary palps 4-segmented, claws unidentate, and hypoproct emarginate. *Diadiplosis bellingeri* differs from *D. aleyrodici* by having a triangular aedeagus in comparison to the short, broad aedeagus of *D. aleyrodici* which is broadly rounded apically. In addition, the cerci of *Diadiplosis bellingeri* females lack an apical, thick group of stout setae which is present on the cerci of *D. aleyrodici* (Felt, 1922). *Diadiplosis bellingeri* can be distinguished from *D. japonica* based on the strongly curved gonostyli of *D. bellingeri*, in contrast to the triangular (tapered) gonostyli of *D. japonica* (Grover and Prasad, 1968). *Diadiplosis bellingeri* differs from *D. menoni* because *D. bellingeri* has maxillary palp segments 2 and 3 almost equal in length, whereas for *D. menoni*, maxillary palp segment 3 is 1.5X longer than palp segment 2; and, the empodium of *D. bellingeri* is rudimentary (shorter than the claw), whereas the empodium of *D. menoni* is longer than the claw (Mani, 1944).

Most of the scale insect species known to occur in Espírito Santo are polyphagous and widely distributed (Culik *et al*., 2007, Culik *et al*., 2008). Thus, they are potential pests of many agricultural crops in many areas. Results of this study document that a variety of scale insect predators, such as *Diadiplosis* species, are present in Espírito Santo, and indicate the importance of using integrated pest management (IPM) methods, and avoiding improper and harmful management practices such as misuse of pesticides, to prevent destruction of beneficial insects and natural enemies that may commonly help control scale insect and other pests in areas such as Espírito

Santo. As predators of scale insects, *Diadiplosis* species are of potential use as natural enemies of pests in economically important crops and results of this study should facilitate and stimulate much needed additional research on these insects to determine their potential effectiveness as biological control agents.

ACKNOWLEDGEMENTS

We thank the Fundação de Amparo à Pesquisa do Espírito Santo - FAPES, Financiadora de Estudos e Projetos - FINEP, and Conselho Nacional de Desenvolvimento Científico e Tecnológico - CNPq. We thank Y. Ben-Dov, ARO Volcani Center, and G. Evans, USDA, for identifying scale insects for us.

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Received: June 21, 2011 Accepted: May 11, 2012