

First report of *Heilus freyreissi* (Coleoptera: Curculionidae) attacking avocado and associated with *Colletotricum* sp. in Brazil

Diarily Sebastião dos Reis^{1,*}, Lucas Gonçalves Machado², Ézio Marques da Silva¹, and Flávio Lemes Fernandes¹

Curculionid beetles are pests of many agricultural crops, including avocado *Persea americana* Miller (Lauraceae), which can be attacked by several species of Curculionidae such as *Heilipus* spp. (Vanin & Bená 2015), *Euwallacea* sp. (O'Donnell et al. 2016), *Xyleborus glabratus* Eichhoff (Carrillo et al. 2012), and *Conotrachelus perseae* Barber (Castañeda-Vildózola et al. 2015).

The curculionid genus *Heilus* is represented by 18 species, 4 occurring in Central America and 14 in South America (O'Brien & Wibmer 1982). In Brazil, 11 species are reported, which are distributed throughout all states (Wibmer & O'Brien 1986; CTFB 2017; Splink 2017). To date, the genus *Heilus* has not been reported to cause economic damage to avocado production, and little is known about its hosts and interactions with pathogens.

Here, we report the first recorded occurrence of *Heilus freyreissi* Boheman (Coleoptera: Curculionidae) on avocado. Research on the presence of a new species of *Heilus* feeding on avocado would aid in the development of control strategies and provide basic information on this species.

Adults of the species *H. freyreissi* were found in 3 avocado orchards in the municipality of Rio Paranaíba, state of Minas Gerais, Brazil, in Oct 2016. The first orchard was located at 19.4358°S, 46.2836°W (1,176 masl) and was planted in 2004. The planting had an area of 18 ha and was planted with 'Margarida' cultivar with a spacing of 8 m between rows and 6 m between plants. The 2nd orchard was located at 19.4355°S, 46.2858°W (1,176 masl) and was planted in 2004. The planting had an area of 12 ha and was planted with 'Breda' cultivar, with 8 m spacing between rows and 6 m between plants. The 3rd orchard was located at 19.4122°S, 46.2662°W (1,176 masl) and was planted in 2005. The planting had an area of 15 ha and was planted with cultivar 'Hass' at a spacing of 9 m between rows and 6 m between plants.

The climate of the region is a semi-humid tropical zone with an average annual temperature of 22 °C. The average annual rainfall is 1,500 mm per year, with 2 well-defined seasons: 1 cold and dry (Apr to Sep), and the other hot and rainy (Oct to Mar (Alvares et al. 2013).

For this study, 33 avocado fruits and branches were evaluated in 3 orchards, and the number of fruits and branches with *Heilus* spp. were counted. In the Margarida cultivar, 76% of branches and

fruits had injury, while in the Breda and Hass cultivars, the injury was 100%.

Adult specimens (13 males and 3 females) were collected, stored in a 13 mL vial containing 70% v/v ethyl alcohol, and sent to Dr. Marinez Isaac Marques, Dr. Wesley Oliveira de Sousa, and Aline de Oliveira Lira for identification. The identified specimens were deposited in the Fr. J. S. Moure entomology collection at the Department of Zoology, Federal University of Paraná.

Adult *H. freyreissi* (Fig. 1A) were found commonly in clusters under the bark of avocado tree trunks (Fig. 1C). The pest was observed to attack young, tender, lateral branches (Fig. 1B), the central leaf veins, inflorescences, peduncles, and fruits at the beginning of development (Fig. 2). Lesions in the lateral branches were concentrated at the apex (20 cm from the end) and consisted of an elongated superficial scraping, ranging from 10 to 170 mm (Fig. 2A, B). Fruit injuries were 5 mm in diameter, concentrated in the pericarp (shell) and in the initial portion of the mesocarp (pulp), while no attacks on seeds were observed. Oxidation of perseitol, a 7-carbon alcohol compound released from the injured areas of avocado, resulted in the formation of a white exudate of solid consistency (Fig. 2F) (Hoddle & Hoddle 2008). The attack of the floral peduncle in the inflorescences resulted in injury similar to that on the branches, causing the flowers to fall (Fig. 2D).

For comparison of the injuries inflicted by *H. freyreissi*, the adults were collected in the field and packed in plastic trays containing plant organs without injury. After 3 d, the injuries to the avocado plant organs in the plastic trays were observed to be similar to those in the field. This comparison was made to verify that the injuries were indeed caused by *H. freyreissi* because similar injuries are caused by other curculionid species as well (Lourenção et al. 1984; Lourenção et al. 2003).

An important observation to note is that the injuries occurring on branches, inflorescences, and young fruits were consistently associated with symptoms of anthracnose disease caused by the fungus *Colletotrichum* sp. (Silva-Rojas & Ávila-Quezada 2011). The attacks on fruits often resulted in fruit drop. Healed lesions on avocados could affect its commercial value, especially that of varieties cultivated for export, because it is considered a defect in fruit quality.

¹Universidade Federal de Viçosa Campus Rio Paranaíba, Instituto de Ciências Agrárias, Rio Paranaíba, Minas Gerais 38.810-000, Brasil; E-mail: diarily.reis@gmail.com (D. S. R.), ezio.silva@ufv.br (E. M. S.), flaviofernandes@ufv.br (F. L. F.)

²Grupo Tsuge, Rio Paranaíba, Minas Gerais 38.810-000, Brasil; E-mail: lucasmachado.ufv@gmail.com (L. G. M.)

*Corresponding author; E-mail: diarily.reis@gmail.com

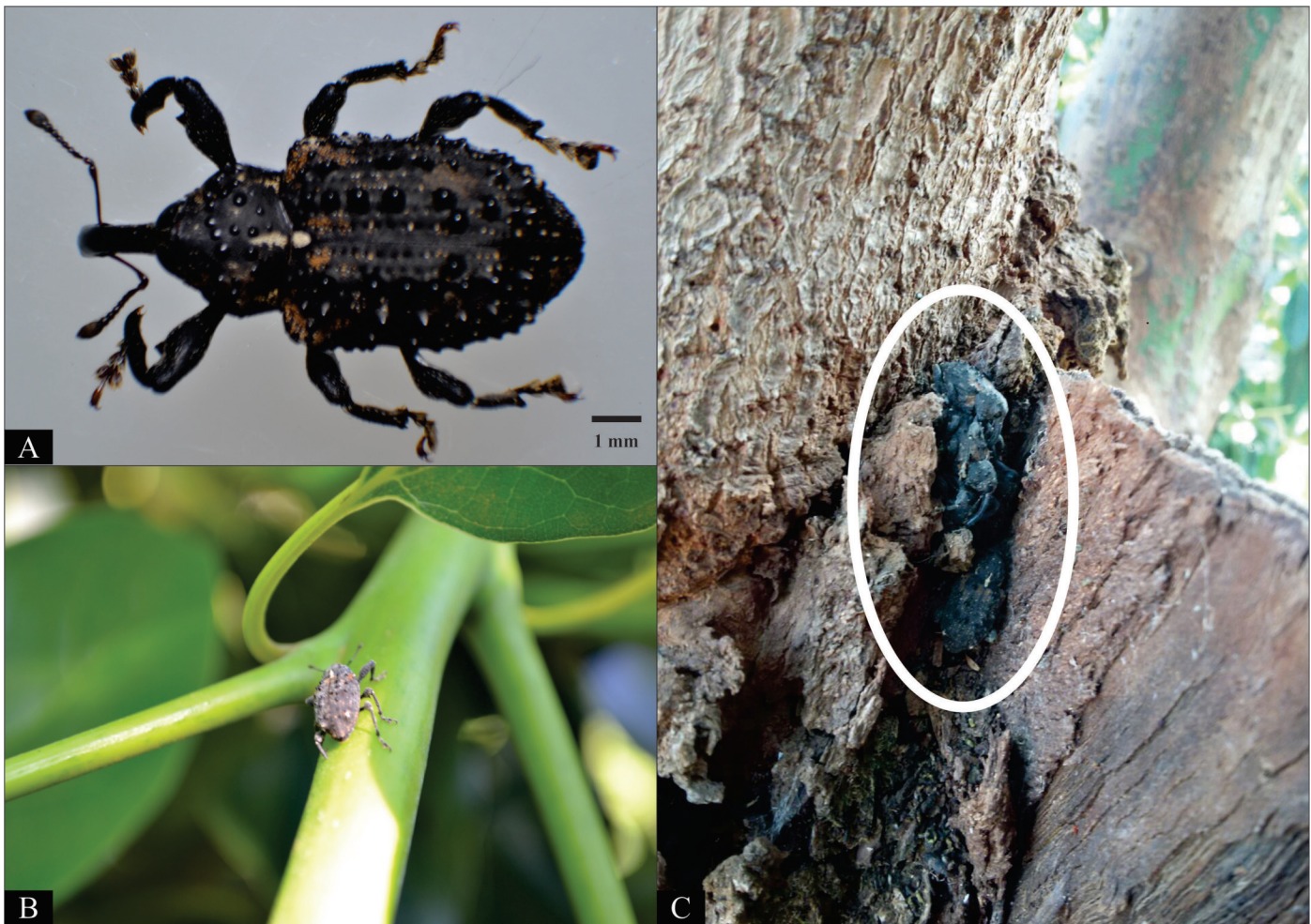


Fig. 1. Adult *Heilus freyreissi* isolated (A, B) and aggregated under the bark of the trunk of an avocado (C). The white ellipse indicates the location of the aggregation of adult beetles.

Insects that are associated with disease transmission in plants require greater attention in terms of their presence and management. Important crops can be attacked by curculionid beetles, which are vectors for disease. *Rhynchophorus palmarum* L. (Coleoptera: Curculionidae) attacks Palmaceae plants and transmits red ring disease of the coconut tree caused by the nematode *Bursaphelenchus cocophilus* Cobb (Nematoda: Aphelenchida: Parasitaphelenchidae) (Giblin-Davis et al. 2013). Similarly, banana crops (*Musa* spp. [Musaceae]) may be attacked by *Cosmopolites sordidus* Germar (Coleoptera: Curculionidae), a potential vector for the fungus *Fusarium oxysporum* Schlechtendahl (Nectriaceae) (Meldrum et al. 2013). In the case of avocado trees, several species of coleopterans can transmit the fungus *Raffaelea lauricola* T. C. Harr., (Ascomycota: Ophiostomataceae), which causes laurel wilt disease (Ploetz et al. 2017). A key point to be highlighted is that *H. freyreissi* attacks various avocado plant organs. Therefore, the injuries can occur at various stages of the crop development cycle, highlighting the necessity for crop management throughout the year.

To our knowledge, this is the first report of *H. freyreissi* as an avocado tree pest. Here, we describe the injuries caused by *H. freyreissi* to different plant organs and its association with the pathogen *Colletotrichum* sp., thus highlighting the potential of this insect to negatively affect avocado production.

We acknowledge Dr. Marinez Isaac Marques, Dr. Wesley Oliveira de Sousa, and Aline de Oliveira Lira for identification of the species. We thank the Tsuge Farm for the partnership and support in the develop-

ment of this work. Funding was provided by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES), Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq), and Fundação de Amparo à Pesquisa do Estado de Minas Gerais (FAPEMIG).

Summary

Curculionid beetles are significant pests of avocado trees (*Persea americana* [Lauraceae]). Adults of *Heilus freyreissi* (Coleoptera: Curculionidae) are reported for the first time on avocado trees, feeding on the tender lateral branches, the central leaf vein, inflorescences, peduncles, and fruits at the beginning of development. These injuries were consistently associated with symptoms of anthracnose disease caused by the fungus *Colletotrichum* sp. Thus, infestation of this insect may be of great economic significance in avocado production, because of its ability to attack various plant organs as well as it being a vector of the pathogen *Colletotrichum* sp.

Key Words: beetle; fungal disease; Molytinae; *Persea americana*; pest

Sumario

Besouros curculionídeos são importantes pragas em árvores de abacate (*Persea americana*). Adultos de *Heilus freyreissi* (Coleoptera:

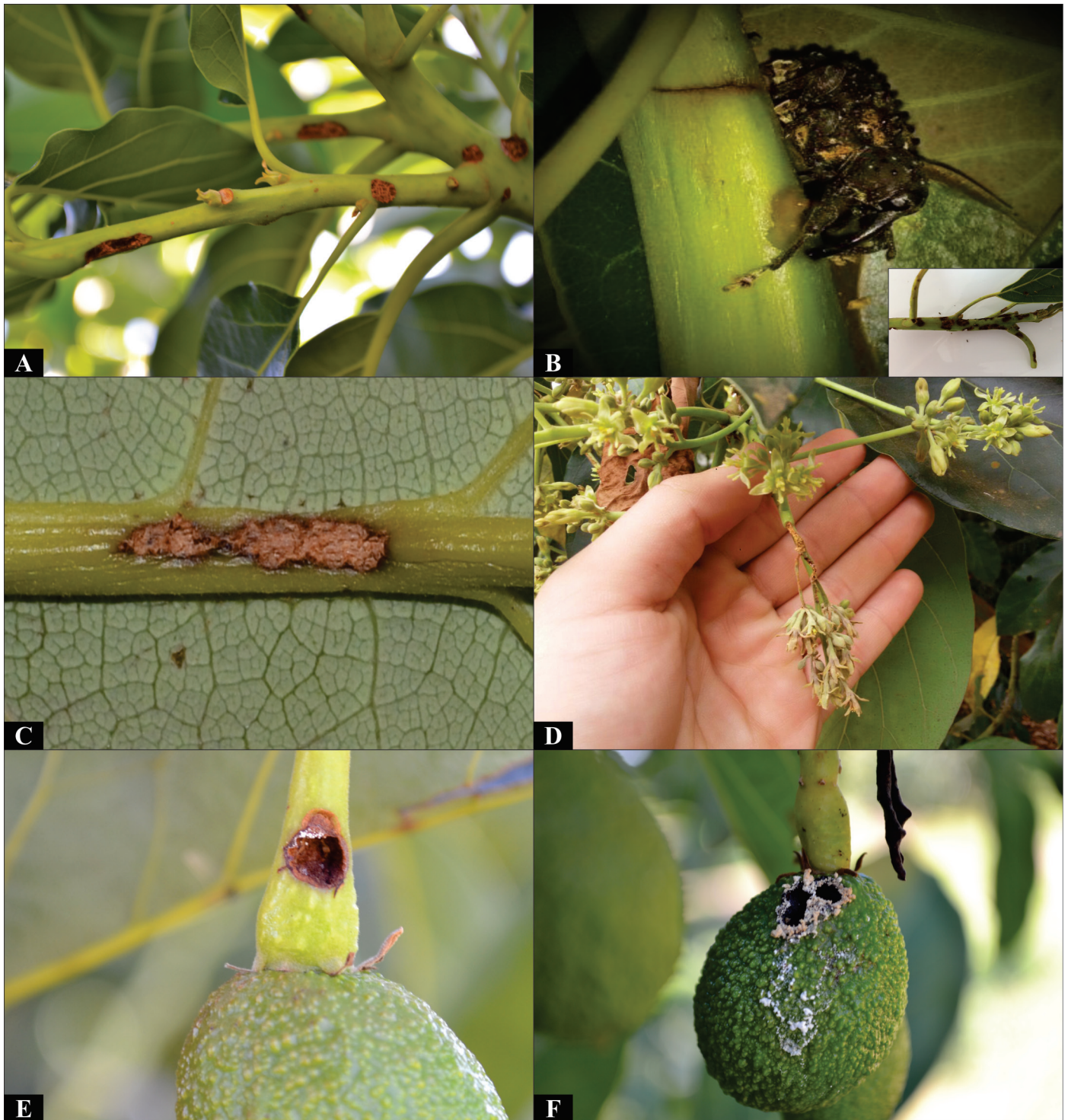


Fig. 2. Injury caused by adults of *Heilus freyreissi* on branches (A, B), avocado central leaf vein (C), inflorescence (D), peduncle (E), and fruit (F).

Curculionidae) foram reportados pela primeira vez se alimentando de ramos laterais jovens, da nervura central das folhas, inflorescências, pedúnculos e frutos no início do desenvolvimento. As injúrias estavam constantemente associadas com sintomas da doença antracnose causada pelo fungo *Colletotrichum* sp. Assim, a infestação desse inseto pode ter grande significância econômica para a produção do abacate, por atacar vários órgãos da planta e ainda estar associado ao patógeno *Colletotrichum* sp.

Palavras Chave: besouro; doença fúngica; Molytinae; *Persea americana*; praga

References Cited

Alvares CA, Stape JL, Sentelhas PC, Gonçalves JLM, Sparovek G. 2013. Köppen's climate classification map for Brazil. Meteorologische Zeitschrift 22: 711–728.

- Carrillo D, Duncan RE, Peña JE. 2012. Ambrosia beetles (Coleoptera: Curculionidae: Scolytinae) that breed in avocado wood in Florida. *Florida Entomologist* 95: 573–579.
- Castañeda-Vildózola Á, Franco-Mora O, Alemán JCR, Ruiz-Montiel C, Váldez-Carrasco J, Equihua-Martínez A. 2015. New distribution records of the small avocado seed weevil, *Conotrachelus perseae* Barber (Coleoptera: Curculionidae), in Mexico and notes on its biology. *The Coleopterists Bulletin* 69: 267–271.
- CTFB. 2017. Lista de espécies válidas encontradas no território nacional. <http://fauna.jbrj.gov.br/fauna/listaBrasil/PrincipalUC/PrincipalUC.do?lingua=pt/> (last accessed 25 Apr 2017).
- Giblin-Davis RM, Kanzaki N, Davies KA. 2013. Nematodes that ride insects: unforeseen consequences of arriving species. *Florida Entomologist* 96: 770–780.
- Hoddle MS, Hoddle CD. 2008. Bioecology of *Stenomoma catenifer* (Lepidoptera: Elachistidae) and associated larval parasitoids reared from Hass avocados in Guatemala. *Journal of Economic Entomology* 101: 692–698.
- Lourenção AL, Rosado-Neto GH, Soares NB. 1984. Ocorrência de adultos de *Heilipus catagraphus* Germar, 1824 (Coleoptera: Curculionidae) danificando frutos de abacateiro. *Bragantia* 43: 249–253.
- Lourenção AL, Soares NB, Rosado-Neto GH. 2003. Ocorrência e danos de larvas de *Heilipus rufipes* Perty (Coleoptera: Curculionidae) em abacateiro (*Persea americana* Mill.) no Estado do Ceará. *Neotropical Entomology* 32: 363–364.
- Meldrum RA, Daly AM, Tran-Nguyen LTT, Aitken EAB. 2013. Are banana weevil borers a vector in spreading *Fusarium oxysporum* f. sp. *cubense* tropical race 4 in banana plantations? *Australasian Plant Pathology* 42: 543–549.
- O'Brien CW, Wibmer GJ. 1982. Annotated checklist of the weevils (Curculionidae *sensu lato*) of North America, Central America, and the West Indies (Coleoptera: Curculionoidea). *Memoirs of the American Entomological Institute* 34.
- O'Donnell K, Libeskind-Hadas R, Hulcr J, Bateman C, Kasson MT, Ploetz RC, Konkol JL, Ploetz JN, Carrillo D, Campbell A, Duncan RE, Liyanage PNH, Eskalen A, Lynch SC, Geiser DM, Freeman S, Mendel Z, Sharon M, Aoki T, Cosse AA, Rooney AP. 2016. Invasive Asian *Fusarium-Euwallacea* ambrosia beetle mutualists pose a serious threat to forests, urban landscapes and the avocado industry. *Phytoparasitica* 44: 435–442.
- Ploetz RC, Konkol JL, Narvaez T, Duncan RE, Saucedo RJ, Campbell A, Mantilla J, Carrillo D, Kendra PE. 2017. Presence and prevalence of *Raffaelea lauricola*, cause of laurel wilt, in different species of ambrosia beetle in Florida, USA. *Journal of Economic Entomology* 110: 347–354.
- Silva-Rojas HV, Ávila-Quezada GD. 2011. Phylogenetic and morphological identification of *Colletotrichum boninense*: a novel causal agent of anthracnose in avocado. *Plant Pathology* 60: 899–908.
- Splink (Species link). 2017. Coleção Entomológica Pe. Jesus Santiago Moure (Coleoptera) - DZUP-Coleoptera. <http://www.splink.org.br/> (last accessed 25 Apr 2017).
- Vanin SA, Bená DC. 2015. A new species of *Heilipus* Germar (Coleoptera: Curculionidae: Molytinae) associated with commercial species of Annonaceae in Brazil, and comments on other species of the genus causing damage to avocado trees in Brazil. *Zootaxa* 3905: 541–556.
- Wibmer GJ, O'Brien CW. 1986. Annotated checklist of the weevils (Curculionidae *sensu lato*) of South America (Coleoptera: Curculionoidea). *Memoirs of the American Entomological Institute* 39.