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Author(s): Álvaro Castañeda-Vildózola, Rogelio E. Palacios-Torres, Jesús R. Sánchez-Pale, Omar Franco-Mora, Jorge Valdez-Carrasco and Armando Equihua-Martínez

Source: The Coleopterists Bulletin, 71(2):361-363.

Published By: The Coleopterists Society

<https://doi.org/10.1649/0010-065X-71.2.361>

URL: <http://www.bioone.org/doi/full/10.1649/0010-065X-71.2.361>

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SCIENTIFIC NOTE

SYMPATRY OF TWO SPECIES OF *HEILIPUS* GERMAR, 1824 (COLEOPTERA: CURCULIONIDAE) INFESTING AVOCADO (*PERSEA AMERICANA* MILL.) IN CENTRAL MEXICO

ÁLVARO CASTAÑEDA-VILDÓZOLA

Facultad de Ciencias Agrícolas, Universidad Autónoma del Estado de México,
Campus El Cerrillo, C. P. 50200, Toluca, Estado de México, MEXICO
acastanedav@uaemex.mx

ROGELIO E. PALACIOS-TORRES

Ingeniería Agrícola Tropical, Universidad del Papaloapan, Av. Ferrocarril S/N
Col. Ciudad Universitaria, C. P. 68400, Loma Bonita, Oaxaca, MEXICO

JESÚS R. SÁNCHEZ-PALE, OMAR FRANCO-MORA

Facultad de Ciencias Agrícolas, Universidad Autónoma del Estado de México,
Campus El Cerrillo, C. P. 50200, Toluca, Estado de México, MEXICO

JORGE VALDEZ-CARRASCO, AND ARMANDO EQUIHUA-MARTÍNEZ

Colegio de Posgraduados, Posgrado en Fitosanidad, Entomología y Acarología,
C. P. 56230, Montecillo, Texcoco, Estado de México, MEXICO

DOI.org/10.1649/0010-065X-71.2.361

Mexico is cited as the center of origin and diversification of the avocado, *Persea americana* Mill. (Lauraceae). This assertion is supported by the notable genetic diversity of *P. americana* in Mexico, which has given rise to three of the main botanical races: *Persea americana* var. *drymifolia* (Mexican or “criollo” avocado), *P. americana* var. *guatemalensis* (Guatemalan avocado), and *P. americana* var. *americana* (West Indian or “pahua” avocado). These are well known among horticulturists and valued by plant breeders (Galindo-Tovar *et al.* 2008).

Avocado trees are attacked by many species of phytophagous insects, including the stalk-, fruit-, and branch-boring curculionid weevils of the genera *Heilipus* Germar, *Conotrachelus* Dejean, and *Copturus* Schönherr. These insects have apparently evolved with avocado in the center of diversification of this plant (Equihua-Martínez 2001) and have now come to be designated as quarantined pests in the commercial cultivation of avocado, constituting a limiting factor for local and international commercialization (SAGARPA 2002; Peterson and Orden 2008). This situation has required the implementation of diverse pest control strategies in avocado orchards, which have successfully excluded the big avocado seed weevil, *Heilipus lauri* Boheman, and the small avocado seed weevil, *Conotrachelus perseae* Barber, from Michoacán, Mexico’s main avocado-producing

state. However, the species are present in more remote agroecosystems where management programs are virtually nonexistent, converting these areas into natural reservoirs of these weevil pests of avocado.

In Mexico, there are reports of the presence of two species of *Heilipus* that cause damage to avocado: *H. lauri* and the avocado stem weevil borer, *Heilipus albopictus* Champion (Castañeda-Vildózola *et al.* 2013b). However, there is no evidence of interaction between these species or other *Heilipus* species within the same agroecosystem in the Americas. Recently, in Mexico *H. lauri* has been reported interacting in the same agroecosystem with other avocado fruit-boring insects such as *C. perseae* (Castañeda-Vildózola *et al.* 2013a).

In October 2003, we recorded two *Heilipus* species in a backyard orchard of “criollo” avocado trees with no phytosanitary management in the community of El Salitre (18°49′28.1″N, 99°39′50.2″W, 1,685 m elevation), municipality Ixtapan de la Sal, Estado de México. Three specimens of *Heilipus* sp. 1 were boring into stems, and five specimens of *Heilipus* sp. 2 were perforating fruits; both species were attacking the same avocado trees. These beetles were later identified as *H. albopictus* (Figs. 1 and 2) and *H. lauri* (Figs. 3 and 4), using characteristics given in Champion (1902), Barber (1919), and Castañeda-Vildózola *et al.* (2013b).

An additional survey was initiated in the same backyard orchard from January through December 2004. The survey consisted of weekly collections of adults of *H. lauri* by using an entomological net and gathering fallen fruits and seeds on the ground for rearing immature stages. Adults of *H. albopictus* were also collected using an entomological net when it occurred on the foliage and fruits or manually from the stems; eggs and larvae were extracted from damaged stalks. These specimens were brought to the laboratory for quantification and preservation. In total, 813 fruits with damage attributed to *H. lauri* were collected, yielding 125 eggs and 453 larvae. The 45 seeds collected from the ground yielded 32 pupae and 162 adult specimens of *H. lauri*. Sixty-six adults of *H. albopictus* were captured, and 11 eggs and 173 larvae were collected from 18 affected trees. Voucher specimens were deposited in the Insectario de la Facultad de Ciencias Agrícolas de la Universidad Autónoma del Estado de México in Toluca, Estado de México and in the Colección Entomológica del Colegio de Posgraduados, Montecillo, Texcoco, Mexico.

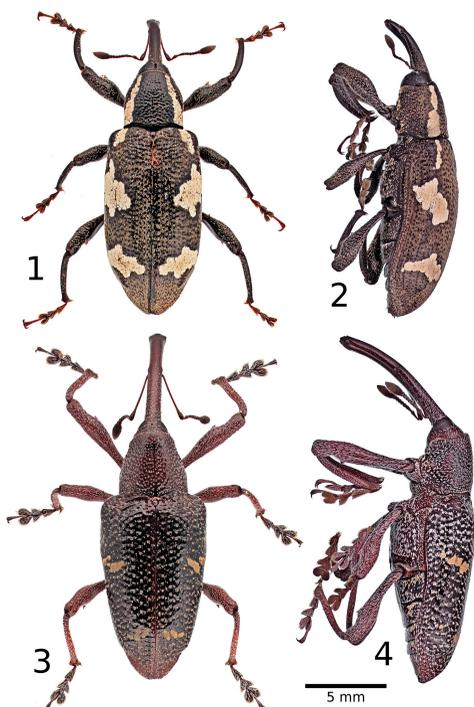
Heilipus lauri was collected at the end of February, when fruits reached 2.0 cm in diameter. A high

incidence of damage and captures of adults occurred in June, July, and August, when fruits were 4–5 cm in diameter. Captures decreased during September and October; by November and December, no adult specimens were captured, and no damaged fruits were detected. During February to May and September to October, this weevil was observed perforating fruits from 08:00 h to 18:00 h. However, it was active on the fruits until 19:00 h from June to August. Infested fruits had one (95%), or occasionally two (5%), larva in the seed. Our results were similar to those of Vanin and Geiger (2005) and Santos-Murgas *et al.* (2014) who reported one to two larvae of *H. trifasciatus* (Fabricius) and *H. odoratus* (Vanin and Gaiger) in seeds of avocado and *Aniba rosaedora* Ducke (Lauraceae). No parasitoids or predators of eggs, larvae, or pupae were recorded in our study. García-Arellano (1962) documented *Bracon* spp. (Braconidae) parasitizing larvae of *H. lauri* with an incidence of 10% parasitism, to date the only report of a parasitoid associated with *Heilipus*.

Adults of *H. albopictus* were active from 09:00 h to 17:00 h. They were present from February to October. From February to May, weevils were collected on the foliage or eating avocado fruits, and from June to October, the beetles were active at the base of stems, making perforations for oviposition. Larval presence occurred from the end of June until April. All stages of development of another avocado stem borer, *Heilipus elegans* Guérin, occur from May to June (Rubio *et al.* 2009), and larvae of *Heilipus apiatus* (Olivier) were recorded only in October (Wolfenbarger 1948). In our study, we recorded 2–24 larvae in single avocado stems. Similarly, Rubio *et al.* (2009) reported up to 30 larvae of *H. elegans* damaging single avocado stems in Colombia. We did not detect any parasitoids or predators of eggs or larvae of *H. albopictus*.

In July 2014, we documented a new site of co-existence between *H. lauri* and *H. albopictus* in the community of Meyuca, Coatepec Harinas in Estado de México (18°55'14.2"N, 99°78'14.3"W, 1,948 m elevation). Twenty-eight trees had symptoms of stalk perforation, and four specimens of *H. albopictus* were collected. In addition, 105 perforated fruits were collected, yielding 21 *H. lauri* specimens. This finding corroborates the possible sympatry of these two species in other avocado orchards of the state of Mexico and implies this occurs possibly in other avocado-producing zones of Mexico.

In addition to the two species of *Heilipus* reported in this study, another six species, *H. apiatus*, *H. trifasciatus*, *H. pittieri* Barber, *H. elegans*, *H. cata-graphus* Germar, and *H. rufipes* Perty, are mentioned as important avocado pests, affecting stalks and fruits throughout the American continent (Castañeda-Vildózola *et al.* 2013b). To our knowledge, we are reporting for the first time the presence of two



Figs. 1-4. *Heilipus* species. 1) *H. albopictus*, dorsal view; 2) *H. albopictus*, lateral view; 3) *H. lauri*, dorsal view; 4) *H. lauri*, lateral view.

Heilipus species damaging the same avocado trees. Our observations demonstrated that the two *Heilipus* species attacked different parts of the avocado tree for ovipositing. *Heilipus lauri* perforated fruits and *H. albopictus* bored stems, but it also perforated fruits for eating. We suggest that no competition occurs for the same resources, and they divide the microhabitat, which allows them to coexist on the same tree. We confirm Lourenção *et al.* (2003) suggestion that the large number of species makes the *Heilipus* genus one of the most destructive insect groups for avocados.

ACKNOWLEDGMENTS

We thank the Secretaría de Investigación y Estudios Avanzados de la Universidad Autónoma del Estado de México for financial support in part to this investigation through project 3796/2014/CID and Lynna Kiere who provided valuable comments on the manuscript.

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(Received 12 August 2016; accepted 18 April 2017. Publication date 27 June 2017.)