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Exophthalmus cupreipes Champion (Coleoptera: Curculionidae) in citrus crops in Mexico

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Abstract

Exophthalmus cupreipes Champion (Coleoptera: Curculionidae) adult weevils were detected feeding on young leaves and shoots of Persian limes (*Citrus latifolia* [Tanaka ex Yu. Tanaka] Tanaka; Rutaceae) in commercial plantations in the states of Veracruz and Tabasco, Mexico. Weevil damage to foliage is apparently not significant enough to cause production losses. However, there are reports of related species included in the *Exophthalmus* genus complex that are considered primary pests of agriculturally important citruses. This study complements the original description by Champion (1911) for adults of both sexes, and provides images of external and internal structures useful for its identification. Moreover, field observations of damage on citrus are presented, and the potential importance as a pest is discussed.

Key Words: citrus green weevil; broad nosed weevil; *Exophthalmus* genus complex

Resumen

Se detectaron adultos de *Exophthalmus cupreipes* Champion (Coleoptera: Curculionidae) alimentándose de hojas jóvenes y brotes de limón persa (*Citrus latifolia* [Tanaka ex Yu. Tanaka] Tanaka; Rutaceae), en plantaciones comerciales de los estados de Veracruz y Tabasco, México. Aparentemente, el daño ocasionado por la alimentación de los picudos en follaje no es significativa para ocasionar pérdidas en la producción, sin embargo, existen reportes de especies incluídas en el complejo de especies del género *Exophthalmus* consideradas plagas primarias de cítricos de importancia agrícola. El presente estudio complementa la descripción original de Champion (1911) para ambos sexos de adultos y provee imágenes de estructuras internas y externas útiles para su identificación. Del mismo modo, se reportan observaciones del daño en cítricos y se discute su potencial como plaga de importancia en este cultivo.

Palabras Clave: picudo verde de los cítricos; complejo del género *Exophthalmus*

The genus *Exophthalmus* Schoenherr (Coleoptera: Curculionidae) is a group native to the Neotropics and is widely distributed from Mexico to the Antilles and several countries of Central and South America (Vaurie 1961; O'Brien & Wibmer 1982; Wibmer & O'Brien 1986; Morrone 1999). This taxon comprises at least 95 described species (Zhang 2016) classified within the subfamily Entiminae (Alonso-Zarazaga & Lyal 1999; Morrone 1999). However, there is some difficulty in distinguishing this genus from related genera grouped within the *Exophthalmus* genus complex, which includes several species belonging to the Eustylini and Geonemini tribes (Vaurie 1961; Franz 2010, 2012).

Exophthalmus adults, like many species of broad-nosed weevils (Entiminae), feed on leaves and shoots as adults, whereas the larvae live in the soil feeding on the roots of several plants (Wright et al. 2003; Oberprieler et al. 2007). The importance of these phytophagous habits is that a large number of species included in the *Exophthalmus* genus complex (e.g., *Diaprepes* Schoenherr, *Pachnaeus* Schoenherr, *Compsus* Schoenherr, *Lachnopus* Schoenherr, *Exophthalmus*; all Coleoptera: Curculionidae) are considered important agricultural pests. Of these, the species that attack commercial citrus plantations in several Central and South American countries are important pests (Vaurie 1961; Schroeder & Beavers 1977; Woodruff 1985; Thomas 2011; O'Brien & Peña 2012).

During entomofaunal inspections in commercial citrus plantations conducted in several citrus-producing regions of Mexico, the presence of the weevil *Exophthalmus cupreipes* Champion (Coleoptera: Curculionidae) was detected in orchards of Persian lime, *Citrus latifolia* (Tanaka ex Yu. Tanaka) Tanaka (Rutaceae). This species of weevil was described and classified in the subfamily Otiorhynchinae (now Entiminae) by Champion (1911). Its presence in Mexico is mentioned textually in "Chiapas, Oaxaca, ?Jalapa, ?Córdoba" (Veracruz). Since that report, there practically has been no further information published on this species.

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It is unknown whether *E. cupreipes* represents a potential phytosanitary problem for citriculture in Mexico, as are other species of this complex in several Neotropical countries. Therefore, the objectives of this study were (1) to complement the existing description of the identifying characteristics of the species, (2) to provide photographs of internal and external structures to facilitate identification, (3) to provide new data on its distribution, and (4) to discuss the damage it causes and its importance in citrus species of agricultural importance.

Materials and Methods

Samples were collected in Persian lime-growing regions of the states of Veracruz and Tabasco, Mexico, where *E. cupreipes* adults were present. Adults were collected by placing an umbrella turned upside down under the Persian lime tree canopy and vigorously shaking the branches to dislodge the insects, which were then collected from the umbrella. Specimens were preserved in 70% alcohol and labeled by place, date, coordinates, and altitude. Taxonomic identification was carried out with keys by Champion (1911).

In the laboratory, specimens were sexed and counted. Photographs of the body and body parts relevant to the diagnosis were taken with a photomicroscope (Carl Zeiss Tessovar, Oberkochen, Baden-Württemberg, Germany). For extraction of genitalia of the 2 sexes (sternite VII and spermatheca of females, and aedeagus and spicula of males), the abdomen was macerated with 10% KOH at 80 °C in a thermoblock (AccuBlock Digital Dry Bath, Edison, New Jersey, USA) for 20 to 30 min.

Specimens were stored in the collection of the Agricultural Entomology of the Colegio de Postgraduados Campus Montecillo (Texcoco, Estado de Mexico, Mexico); other specimens were donated to the following collections: Colección Entomológica del Instituto de Fitosanidad (CEAM), Colegio de Postgraduados, Campus Montecillo (Texcoco, Estado de Mexico, Mexico); Colección de Curculionoidea (Insecta: Coleoptera) de la Universidad Autónoma de Querétaro (Santiago de Querétaro, Querétaro, Mexico), y Colección Entomológica del Centro Nacional de Referencia Fitosanitaria del Servicio Nacional de Sanidad, Inocuidad y Calidad Agroalimentaria (Tecámac, Estado de Mexico, Mexico).

Results

Exophthalmus cupreipes adults vary greatly in size; generally, the male is smaller than the female (males about 1 cm, females about 1.4 cm). The body is oval shaped, narrower toward the posterior. The sexes can be differentiated by observing the fifth abdominal sternite. In males, the terminal margin is rounded, while in females it is pointed (Fig. 1).

The body is densely covered by iridescent scales; head and legs are copper-colored, and the rest of the body parts are green with golden tones. The cuticle is black or dark brown. The scales of specimens preserved in alcohol change to bluish tones.

The rostrum is longer than wide; the scrobe is long and descends until before the frontal-inferior margin of the eye. Eyes partially encroaching on head and somewhat elongated (Fig. 2A & B). Vibrissae in the lateral pronotum are absent; pronotum slightly flat dorsally; scutelum well developed; humeri rounded, evident (Fig. 2 C). As described by Champion (1911), the elytra have a pair of posteromedian supplementary stria, between striae 5 and 6. However, this is difficult to observe externally because of the abundant scales, but was easily seen internally (Fig. 2E). Legs of all segments without spines in femora and tibiae without denticles (Fig. 2D).

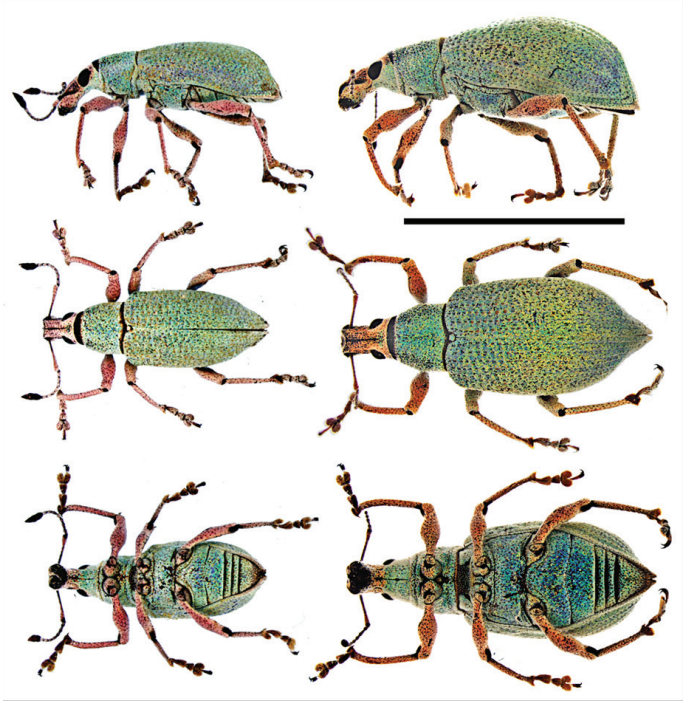


Fig. 1. Lateral, dorsal, and ventral view of *Exophthalmus cupreipes* male (left) and female (right). Bar = 1 cm.

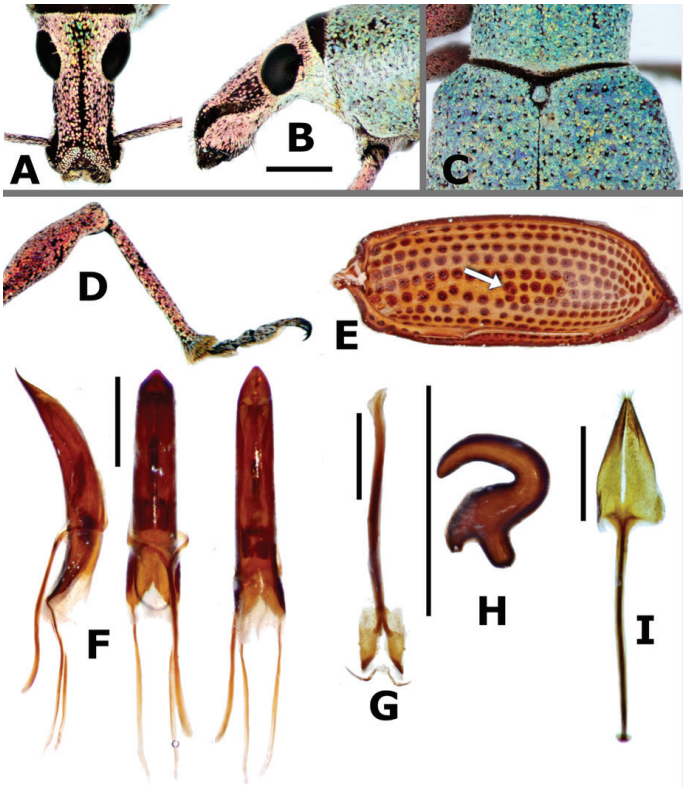


Fig. 2. *Exophthalmus cupreipes*. (A) Rostrum dorsal view, (B) rostrum lateral view, (C) base of the pronotum and elytra, (D) metathoracic leg, (E) internal view of elytron (arrow points to supplementary striae), (F) lateral, ventral, and dorsal view of penis (median lobe), (G) sternite IX (spiculum gastrale), (H) spermatheca, (I) sternite VII. Bar = 1 mm.

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Genitalia of both sexes are elongated and highly sclerotized. Penis (median lobe) moderately curved, and slightly narrower toward the apex (Fig. 2F). Sternite IX (spiculum gastrale) (Fig. 2G) as long as, or slightly longer than, the penis. Shape of spermatheca and sternite VII in Fig. 2 H & I.

Exophthalmus cupreipes was collected on Persian lime in diverse locations in the states of Veracruz and Tabasco (Table 1). Both states are found on the Gulf of Mexico coast and have a mostly hot-humid and hot-subhumid climate. The total number of captured specimens was 116, 61 males and 55 females.

According to our observations, *E. cupreipes* adults are found during daylight h on foliage and feed only on young leaves and shoots of Persian lime trees (Fig 3A), and females oviposit multiple eggs between 2 citrus leaves cemented together with a clear exudate (Fig. 3B).

Discussion

Other species of *Exophthalmus* listed for Mexico are *Exophthalmus egrestis* Boheman, *Exophthalmus albidus* Champion, *Exophthalmus albolineatus* Champion, *Exophthalmus carinirostris* Boheman, *Exophthalmus clathratus* Champion, *Exophthalmus duplicatus* Champion, *Exophthalmus fasciatus* Champion, *Exophthalmus interpositus* Champion, *Exophthalmus lunaris* Champion, *Exophthalmus nubilus* Rosenschoeld, *Exophthalmus opulentus* Boheman, *Exophthalmus roralis* Boheman, *Exophthalmus verecundus* Chevrolat, and *Exophthalmus vermiculatus* Champion (all Coleoptera: Curculionidae) (O'Brien and Wibmer 1982; Morrone 1999).

Champion (1911) mentions that *E. cupreipes* is easily distinguished from similar species such as *E. opulentus* Champion and *Exophthalmus vitticollis* Champion (Coleoptera: Curculionidae) by the V-shaped protuberance that limits the naked nasal plate. In our study area, other species of Entiminae associated with Persian lime were detected; however, none exhibited characteristics that could confuse it with *E. cupreipes*.

The information obtained to date in this study, together with the data provided by Champion (1911) (Chiapas and Oaxaca states), suggests that *E. cupreipes* is limited in its distribution to southeastern Mexico. The potential risk of this weevil is that the lime-growing regions where it was collected are among the most important in terms citrus of production and cultivated area in Mexico.

The damage to foliage is apparently not severe enough to cause production losses, and to date it has not been demonstrated whether the larvae of this weevil feed on citrus roots. However, it is well-known that several species of the *Exophthalmus* genus complex are considered major pests of citrus.

A similar oviposition behavior has been observed in other species of the *Exophthalmus* genus complex, including *Exophthalmus* spp. (Vaurie 1961; Thomas 2011), *Diaprepes abbreviatus* L. (Coleoptera: Curculionidae) (Peña et al. 2007; Weissling et al. 2019), and *Compsus* sp. (Peñaloza & Díaz-Riveros 2004).

Howden (1995), lists 11 oviposition categories of Curculionoidea, of which category 2 is described as "eggs placed on leaf surface, covered with exudate." However, in a further extension of this behavior, *E. cupreipes* cements the eggs between 2 leaves, a difference that could be considered a unique oviposition category.

Dixon (1954), cited by Vaurie (1961), mentions that in Jamaica several species of *Exophthalmus* are among the most important citrus, because both adults and larvae feed on the plant, and the latter are more damaging because they affect the roots. The same author states that in sufficient quantities, larvae can damage the main roots and alter the flow of mineral salts to the higher parts of the host, causing the leaves to develop chlorotic appearance, becoming yellow and wilted. According to Vaurie (1961), the 4 species in Jamaica that attack citrus are *Exophthalmus vittatus* Linnaeus, *Exophthalmus similis* Drury, *Exophthalmus impressus* (Fabricius), and *Exophthalmus farr* Vaurie (all Coleoptera: Curculionidae). Another example of this genus is *Exophthalmus jekelianus* White (Coleoptera: Curculionidae), which in Costa Rica is considered the second most important pest of *Coffea arabica* L. (Rubiaceae) after *Hypothenemus hampei* Wood & Bright (Coleoptera: Curculionidae) (Henderson & Roitberg 2006).

Among the genera related to *Exophthalmus*, several are considered to be of agricultural importance. *Diaprepes abbreviatus* L. is one of the most destructive pests in citrus plantations, as well as in several food and ornamental crops in the United States (California, Texas, and Florida) and countries of the Caribbean (Lapointe 2004; Simpson et al. 2006; Jetter & Godfrey 2009; Peña & Amalin 2011). In Colombia, *Compsus obliquatus* Hustache and *Compsus viridivittatus* Guérin-Méneville (both Coleoptera: Curculionidae) also are considered citrus pests (O'Brien & Peña 2012).

Another group that includes several species of broad-nosed weevils belonging to the Naupactini tribe affect foliage and roots of *Citrus* spp. (Rutaceae) plantations cultivated in Brazil (Lanteri et al. 2002; Guedes et al. 2005). Within the tribe Cyphicerini, *Myllocerus undecimpustulatus undatus* Marshall (Coleoptera: Curculionidae) is an invasive, polyphagous pest native to southern Sri Lanka (George et al. 2015). This species was introduced accidentally into Florida, USA, where it has many reported host plants, including ornamentals, fruit trees, and Valencia oranges (Thomas 2005, Arévalo & Stansly 2009).

It is likely that control methods (mainly pyrethroids, neonicotinoids, and essential oils) used to manage populations of the Asian citrus psyllid, *Diaphorina citri* Kuwayama (Hemiptera: Liviidae), and the mites *Brevipal-*

Table 1. Distribution of *Exophthalmus cupreipes* in Veracruz and Tabasco collected on commercial persian lime (*Citrus latifolia*) plantations.

State	Collection date	Municipality	Coordinates	Altitude (masl)	Number of specimens
Veracruz	29 Aug 2018	Amatlán de los Reyes	18.8587056°N; 96.8615500°W	641	5 female; 9 male
	29 Aug 2018	Cuitláhuac	18.8363139°N; 96.7385889°W	399	4 female; 2 male
	27 Sep 2018	Martínez de la Torre	20.1034472°N; 97.0402944°W	73	5 female; 2 male
	27 Sep 2018		20.0313250°N; 97.0090333°W	140	13 female; 8 male
	27 Sep 2018		20.0364778°N; 97.0129694°W	133	21 female; 17 male
	28 Sep 2018		20.1142778°N; 96.9836667°W	19	0 female; 3 male
	28 Sep 2018		20.1822806°N; 97.0650750°W	90	2 female; 0 male
Tabasco	28 Aug 2018	Huimanguillo	17.7296139°N; 93.4619639°W	48	6 female; 8 male
	25 Oct 2018		17.7102917°N; 93.4704333°W	55	3 female; 1 male
	25 Oct 2018		17.8403611°N; 93.6207500°W	30	2 female; 5 male

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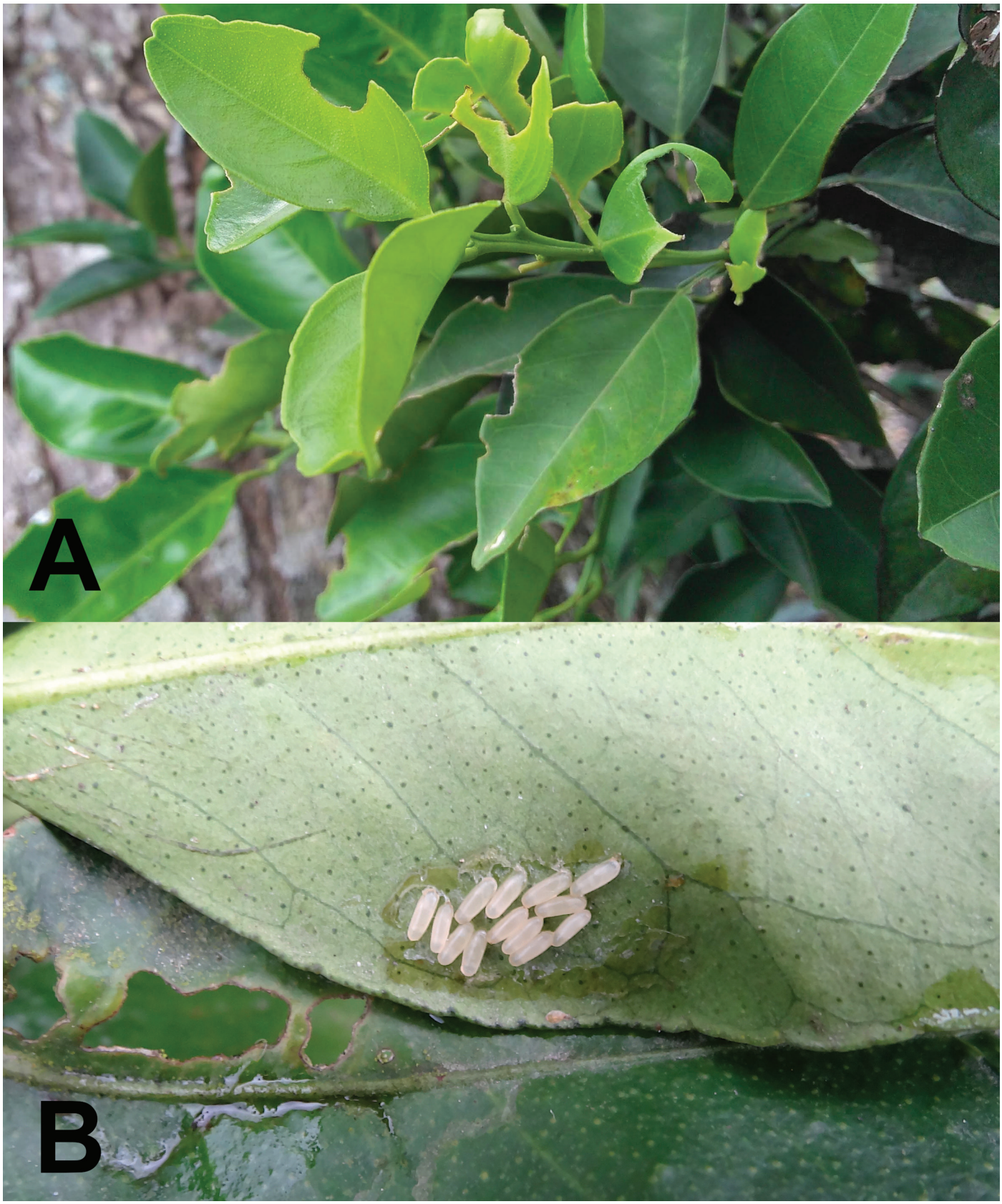


Fig. 3. *Exophthalmus cupreipes* herbivory (A) and mass eggs (B) on Persian lime leaves.

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pus spp. (Acari: Tenuipalpidae) in the study region also reduce populations of *E. cupreipes* adults, although this needs further study.

We propose giving *E. cupreipes* the common name "citrus green weevil" ("picudo verde de los cítricos" in Spanish) to facilitate reference for use by growers and technical personnel.

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