

## Research Article

**An updated checklist and a key for the Typhlocybinae leafhoppers (Hemiptera: Cicadellidae) associated with avocado trees in Mexico**

Lista actualizada y clave para las chicharritas Typhlocybinae (Hemiptera: Cicadellidae) asociadas con árboles de aguacate en México

Jesús Guerrero-Soto<sup>1</sup>, J. Adilson Pinedo-Escatel<sup>2\*</sup> and Braulio Alberto Lemus-Soriano<sup>1</sup>

<sup>1</sup>Facultad de Agrobiología "Presidente Juárez", Universidad Michoacana de San Nicolás de Hidalgo. Paseo Lázaro Cárdenas esq. Berlín s/n, Col. Viveros, C.P. 60170. Uruapan, Michoacán, México.

<sup>2</sup>Departamento de Botánica y Zoología, CUCBA, Universidad de Guadalajara, km 15.5 carretera Guadalajara-Nogales, Las Agujas, Zapopan, C.P. 45110, Apdo. Postal 139, Jalisco, México.

\*Corresponding author: adilson1030@gmail.com

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**Abstract.** The microleafhoppers, Typhlocybinae (Hemiptera: Cicadellidae), known to inhabit avocado trees in Mexico are reviewed. Leafhopper samples were taken using an entomological aspirator and a sweep net on avocado trees in Michoacán state. Three species, *Alconeura cinctella*, *Empoasca angustella* and *Joruma* sp., are newly reported to feed directly on young avocado leaves. An updated checklist and a key for all known species associated with avocado are provided.

**Key words:** Auchenorrhyncha, cicadellids, new records, pest species.

**Resumen.** Las microchicharritas Typhlocybinae (Hemiptera: Cicadellidae), conocidas por habitar árboles de aguacate en México son revisadas. Muestras de chicharritas fueron tomadas usando un aspirador entomológico y una red de barrido sobre árboles de aguacate en el estado de Michoacán. Tres especies, *Alconeura cinctella*, *Empoasca angustella* and *Joruma* sp., son recientemente reportadas por alimentarse directamente de hojas jóvenes de aguacate. Se provee una lista actualizada y una clave para todas las especies conocidas asociadas al aguacate.

**Palabras clave:** Auchenorrhyncha, cicadélidos, especies plaga, nuevos registros.

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## Introduction

Leafhoppers (Hemiptera: Cicadellidae) are well known as one of the major phytosanitary agents transmitting pathogens into cultivated plants worldwide (Weintraub and Beanland 2006). Among true-hoppers (Hemiptera: Auchenorrhyncha), the subfamily Typhlocybinae (Cicadellidae) includes few species known to disseminate diseases which are almost imperceptible until symptoms appear in the host plant, whereas the presence of these microleafhoppers *in situ* often remains unnoticed in harvested fields during crop cycles. Within Mexico, typhlocybines have been considered to be of minor pest-concern but this may be due to scarce knowledge of their true impacts on crops. The high popularity

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of avocado and massive production of this crop in Mexico, the world's largest exporter, necessitates an inventory of potential sap-sucking herbivore threats to the viability of avocado production. In an initial attempt to register leafhopper pests of avocado, Pinedo-Escatel and Blanco-Rodriguez (2016) described one species of the genus *Idona* DeLong collected in Morelos state.

Subsequently, Quezada-Daniel *et al.* (2017) provided data on population dynamics and damage observed in five species feeding directly on avocado trees, *Joruma krausi* Ruppel & DeLong, 1953, *I. minuenda* (Ball, 1921), *Alconeura candida* (Ruppel & DeLong, 1952), *Empoasca angustella* DeLong, 1952, and *E. deskina* DeLong & Guevara, 1954. Most recently, Pinedo-Escatel and Dmitriev (2019) redescribed the microleafhopper *Dikrella mella* Ruppel & DeLong, 1952 which had been previously collected on avocado trees but misidentified. Here we provide an updated species checklist and identification key for the twelve known species of Typhlocybinae known to occur on avocado in Mexico.

## Material and Methods

Adult leafhoppers were captured using an entomological aspirator and a sweep net on young avocado leaves during late summer 2018 to early spring 2019 in Michoacán state, Mexico. All cicadellid specimens obtained were placed in vials with 90% ethyl alcohol. Abdomens of individuals were removed and labelled independently for dissection. Voucher specimens were prepared following the technique of Triplehorn and Johnson (2005) for achenorrhychous samples with the following modifications: male and female abdomens were removed, cleared with hot 10% KOH solution, rinsed with water mixed with ethanol at different concentrations (60-90%), dried 2 minutes and stored in microvials with glycerine. Morphological criteria and terminology follow Dietrich (2005), Rakitov (1998) and Kramer (1950). Specimens were examined under a Carl Zeiss stereomicroscope Stemi 2000c and identified using keys of Young (1952), Pinedo-Escatel and Blanco-Rodriguez (2016), and Pinedo-Escatel and Dmitriev (2019). In quotes of label data, lines are separated by a reversed virgule (\'). Scale bars were obtained by an electronic vernier.

Specimens examined are housed in the following collections:

INHS	Illinois Natural History Survey, Champaign, Illinois, USA.
CAJAPE	Colección de Auchenorrhyncha de J. Adilson Pinedo Escatel, México.
OSUC	C. A. Triplehorn Insect Collection, Columbus, Ohio, USA.
CNIN	Colección Nacional de Insectos del Instituto de Biología, Ciudad de México, México.
CEAM	Colección de Insectos del Colegio de Postgraduados, Texcoco, México.

## Results

### Key to species associated with avocado trees in Mexico (males)

- 1 Hind wing with submarginal vein extended around wing apex along costal margin basad of vein R<sub>2+3</sub> (Fig. 1E) .....Dikraneurini, 2  
 – Hind wing with submarginal vein not extended along costal margin basad of vein R<sub>2+3</sub> (Fig. 1F) .....Empoascini, 3
- 2 Head strongly produced, anterior margin in lateral view sharply angled. Dorsum and forewings with red spots. Aedeagus with posterior preapical processes (Fig. 1H).....*Alconeura candida*  
 – Head weakly produced, anterior margin in lateral view slightly angled. Dorsum and forewings with orange, black or yellow marks but not red. Aedeagus with processes, if present, arising near base of shaft.....6

- 3 Hind wing with apex of vein RP free, connected by crossvein to MA (Fig. 1F). Crown longer than distance between eyes.....*Joruma*, 10  
 – Hind wing with RP and MA confluent, r-m crossvein absent. Crown shorter than distance between eyes.....*Empoasca*, 4
- 4 Aedeagus without processes.....5  
 – Aedeagus with pair of basal processes.....*E. deskina* 5
- 5 Process of segment X (anal hook) short and broad, quadrate.....*E. angustella*  
 – Process of segment X (anal hook) elongate, hooklike.....*E. anoteya*
- 6 Forewing with black spots only on apical cells (Fig. 1A) or unmarked. Hind wing with three apical cells.....11  
 – Forewing with black spots over most of surface (Fig. 1B). Hind wing with two apical cells (Fig. 1 E).....*Idona*, 7
- 7 Head immaculate and pronotum with or without small black spots. Pygofer process black (Figs. 1L, 1M).....8  
 – Head and pronotum with symmetrical large black spots (Fig. 1G). Pygofer process concolorous with lobe (Fig. 1K).....*I. minuenda*
- 8 Pygofer process extended beyond pygofer apex and curved ventrad.....9  
 – Pygofer process not extended beyond apex of lobe, straight and visible above dorsal margin.....*I. gonzalezae*
- 9 Clavus with small spot not reaching margin and veins (Fig. 1D).....*I. floresi*  
 – Clavus with large spot reaching margin and veins (Fig. 1C).....*I. dmitrievi*
- 10 Anterior margin of crown with three black spots. Dorsum with white, black and red marks along forewing.....*J. krausi*  
 – Anterior margin of crown with a diffuse black band. Dorsum entirely pale without any other color added.....*Joruma* sp.
- 11 Aedeagus straight, preatrium about as long as shaft.....*Dikrella mella*  
 – Aedeagus curved dorsad, preatrium inconspicuous.....*Alconeura cinctella*

### Annotated checklist of leafhoppers associated with avocado trees

#### Subfamily Typhlocybinae Tribe Dikraneurini

*Alconeura* Ball & DeLong, 1925  
*Alconeura candida* (Ruppel & DeLong, 1952)  
 (Fig. 1H)

**Distribution.** Morelos: Cuernavaca and Tetela del Volcán.

**Material examined.** (CEAM) 25♀, 2♂, MEXICO, Morelos, Tetela del Volcán, Huerta El Calabazo, 2,195 m, 18°52'3.252"N, 98°44'5.2"W, 19-Oct-2014, ex: *Persea americana*, sweep net, R.M. Quezada-Daniel.

#### *Alconeura cinctella* DeLong & Ruppel, 1951

**Distribution.** Guerrero: Iguala, Chilpancingo, Paso de Vacas, Mezcala, and Pungarabato. Morelos: Tetela del Río and P. de Ixtla. Michoacán: Huetamo and Tingambato.

**Material examined.** 1♀, 1♂ (CAJAPE), MEXICO, Michoacán, Municipio Tingambato, Huerto La Barrenada \ 2,330m \ 19°31'13"N 101°48'57"W \ 21-Junio-2019 \ ex: *Persea americana* var. Hass (Aguacate) \ Trampa de luz \ Col. J. Guerrero-Soto.

**Note.** This is the first record of this species on avocado trees.

*Dikrella Oman*, 1949  
*Dikrella mella Ruppel & DeLong*, 1952  
(Fig. 1A)

**Distribution.** Morelos: Cuernavaca and Tetela del Volcán. Guerrero: Iguala, Oaxaca: Rancho Monter. Michoacán: Uruapan. Chiapas: Vergel.

**Material examined.** HOLOTYPE (OSUC) 1♂, MEXICO, Cuernavaca Mor., X-21-41, K. 57, DeLong, Good, Caldwell and Plummer, D. M. DeLong collection; PARATYPES (OSUC) 2♂, MEXICO, Iguala, Guerrero, IX-11-39, D.M. DeLong collection; (CEAM) 1♂, 2♂ MEXICO, Morelos, Tetela del Volcán, San Miguel, 1,962m, 18°50'27.204"N, 98°44'46.895"W, 30-Ene-2014, ex: *Persea americana*, sweep net, R.M. Quezada-Daniel; (CEAM) 1♀, 1♂, MEXICO, Morelos, Tetela del Volcán, Huerta El Calabazo, 2,195m, 18°52'3.252"N, 98°44'5.2"W, 19-Oct-2014, ex: *Persea americana*, sweep net., R.M. Quezada-Daniel Col.; (CAJAPE) 9♂, 11♀ MEXICO, Morelos, Tetela del Volcán, San Miguel, 1,962 m, 18°50'27.204"N, 98°44'46.895"W, 30-Ene-2014, ex: *Persea americana*, sweepnet, R.M. Quezada-Daniel; (CNIN), 1♂, 1♀ MEXICO, Morelos, Tetela del Volcán, San Miguel \ 1,962 m, 18°50'27.204"N, 98°44'46.895"W, 30-Ene-2014, ex: *Persea americana*, sweep net, R.M. Quezada-Daniel; (CEAM), 1♂ MEXICO, Morelos, Tetela del Volcán, San Miguel, 1,962 m, 18°50'27.204"N, 98°44'46.895"W, 30-Ene-2014, ex: *Persea americana*, sweep net, R.M. Quezada-Daniel; (CAJAPE), 2♀, 1♂ MEXICO, Michoacán, Municipio Tingambato, Huerto La Barrenada, 2,330 m, 19°31'13"N 101°48'57"O, 20-May-2019, ex: *Persea americana* var. Hass (Aguacate), aspirador entomológico, Col. J. Guerrero-Soto.

*Idona DeLong*, 1931  
*Idona dmitrievi Pinedo-Escaté & Blanco-Rodríguez*, 2016  
(Figs. 1B, 1C, 1E, 1I, 1M)

**Distribution.** Morelos: Tetela del Volcán.

**Material examined.** HOLOTYPE (INHS) 1♂, MEXICO, Morelos, Tetela del Volcán, San Miguel. 1,962 m, 18°50'27.204" N, 98°44'46.895" W, 30-Ene-2014. ex: *Persea americana*, sweep net. R. M. Quezada-Daniel Col.; PARATYPE (INHS) 1♀, 1♂, MEXICO, Morelos, Tetela del Volcán, San Miguel. 1,962 m, 18°50'27.204" N, 98°44'46.895" W, 30-Ene-2014. ex: *Persea americana*, sweep net. R.M. Quezada-Daniel Col.; PARATYPE (CZUG) 1♂, MEXICO, Morelos, Tetela del Volcán, San Miguel. 1,962 m, 18°50'27.204" N, 98°44'46.895" W, 30-Ene-2014. ex: *Persea americana*, sweep net. R. M. Quezada-Daniel Col.; PARATYPES (CNIN) 1♀, 1♂, MEXICO, Morelos, Tetela del Volcán, Huerta El Calabazo. 2,195 m, 18°52'3.252" N, 98°44'5.2" W, 19-Oct-2014, ex: *Persea americana*, sweep net. R.M. Quezada-Daniel Col.; (CEAM) 2♀, 2♂, MEXICO, Morelos, Tetela del Volcán, Huerta El Calabazo. 2,195 m, 18°52'3.252" N, 98°44'5.2" W, 19-Oct-2014, ex: *Persea americana*, sweep net. R.M. Quezada-Daniel; (CAJAPE) 1♀, 1♂, MEXICO, Morelos, Tetela del Volcán, Huerta El Calabazo. 2,195 m, 18°52'3.252" N, 98°44'5.2" W, 19-Oct-2014., ex: *Persea americana*, sweep net. R.M. Quezada-Daniel.

*Idona minuenda* (Ball, 1921)  
(Figs. 1G, 1J, 1K)

**Distribution.** Morelos: Tetela del Volcán. Michoacán: Tingambato. Tamaulipas: Ciudad Victoria.

**Material examined.** (CAJAPE) 25♀, 2♂, MEXICO, Morelos, Tetela del Volcán, Huerta El Calabazo, 2,195 m, 18°52'3.252" N, 98°44'5.2" W, 19-Oct-2014., ex: *Persea americana*, sweep net. R.M. Quezada-Daniel; (CEAM) 13♀, 16♂, MEXICO, Morelos, Tetela del Volcán, Huerta El Calabazo, 2,195 m, 18°52'3.252" N, 98°44'5.2" W, 19-Oct-2014, ex: *Persea americana*, sweep net, R.M. Quezada-Daniel.

*Idona floresi Freytag, 2015*  
(Fig. 1D)

**Distribution.** Michoacán: Uruapan.

**Material examined.** (OSUC) 1♀, 1♂, MEXICO, Michoacán, Salvador Escalante, 03-Aug-2012, ex: Aguacate, Graciela González Col.

*Idona gonzalezae Freytag, 2015*  
(Fig. 1L)

**Distribution.** Michoacán: Uruapan and Tingambato.

**Material examined.** 2♀, 1♂ (CAJAPE), MEXICO, Michoacán, Municipio Tingambato, Huerto La Barrenada, 2,330 m, 19°31'13"N, 101°48'57"O, 20-May-2019, ex: *Persea americana* var. Hass (Aguacate), aspirador entomológico, Col. J. Guerrero-Soto; 1♀, 1♂ (OSUC), MEXICO, Michoacán, Salvador Escalante, 03-Aug-2012, ex: Aguacate, Graciela González Col.

**Tribe Empoascini**

*Joruma McAtee, 1924*  
*Joruma krausi Ruppel & DeLong, 1953*  
(Fig. 1F)

**Distribution.** Morelos: Cuernavaca and Tetela del Volcán. Veracruz: Córdoba. Michoacán: Tingambato. Oaxaca: Chiltepec.

**Material examined.** HOLOTYPE (OSUC) 1♂, MEXICO, Cuernavaca Mor., Mexico, III-1945, N.L.H. Krause, D.M. DeLong collection; (CAJAPE) 1♀, 1♂, MEXICO, Michoacán, Municipio Tingambato, Huerto La Barrenada 2,330 m, 19°31'13"N, 101°48'57"O, 20-May-2019, ex: *Persea americana* var. Hass (Aguacate), aspirador entomológico, Col. J. Guerrero-Soto; (CEAM) 12♀, 25♂, MEXICO, Morelos, Tetela del Volcán, Huerta El Calabazo, 2,195 m, 18°52'3.252" N, 98°44'5.2" W, 19-Oct-2014, ex: *Persea americana*, sweep net, R. M. Quezada-Daniel.

*Joruma* sp.

**Distribution.** Michoacán: Tingambato.

**Material examined.** (CAJAPE) 1♀, 1♂ MEXICO, Michoacán, Municipio Tingambato, Huerto La Barrenada, 2,330 m, 19°31'13"N, 101°48'57"O, 20-May-2019, ex: *Persea americana* var. Hass (Aguacate), aspirador entomológico, Col. J. Guerrero-Soto.

**Note.** Two specimens examined are definitely a new species considering features of the female terminalia and combinations of dorsal characteristics of the male. Unfortunately, the abdomen of the only available was broken, so further collecting is needed to provide additional specimens.

Male genitalia are essential for the description of species in this group of insects.

***Empoasca* Walsh, 1862**  
***Empoasca angustella* DeLong, 1952**

**Distribution.** Morelos: Laguna de Zempoala and Tetela del Volcán.

**Material examined.** (CEAM) 6♀, 12♂ MEXICO, Morelos, Tetela del Volcán, Huerta El Calabazo, 2,195 m, 18°52'3.252"N, 98°44'5.2"W, 19-Oct-2014, ex: *Persea americana*, sweep net, R.M. Quezada-Daniel.

***Empoasca anoteya* DeLong & Guevara, 1954**

**Distribution.** Michoacán: Uruapan and Tingambato.

**Material examined.** (CAJAPE) 1♂, MEXICO, Michoacán, Municipio Tingambato, Huerto La Barrenada, 2,330 m, 19°31'13"N, 101°48'57"O, 20-May-2019, ex: *Persea americana* var. Hass (Aguacate), aspirador entomológico, Col. J. Guerrero-Soto.

**Note.** This is the first record of this species on avocado trees.

***Empoasca deskina* DeLong & Guevara, 1954**

**Distribution.** Morelos: Cuernavaca and Tetela del Volcán. Hidalgo: Jacala. Estado de México: Distrito Federal. Veracruz: Orizaba.

**Material examined.** (CEAM) 3♀, 9♂, MEXICO, Morelos, Tetela del Volcán, Huerta El Calabazo, 2,195 m, 18°52'3.252"N, 98°44'5.2"W, 19-Oct-2014, ex: *Persea americana*, sweep net, R. M. Quezada-Daniel.

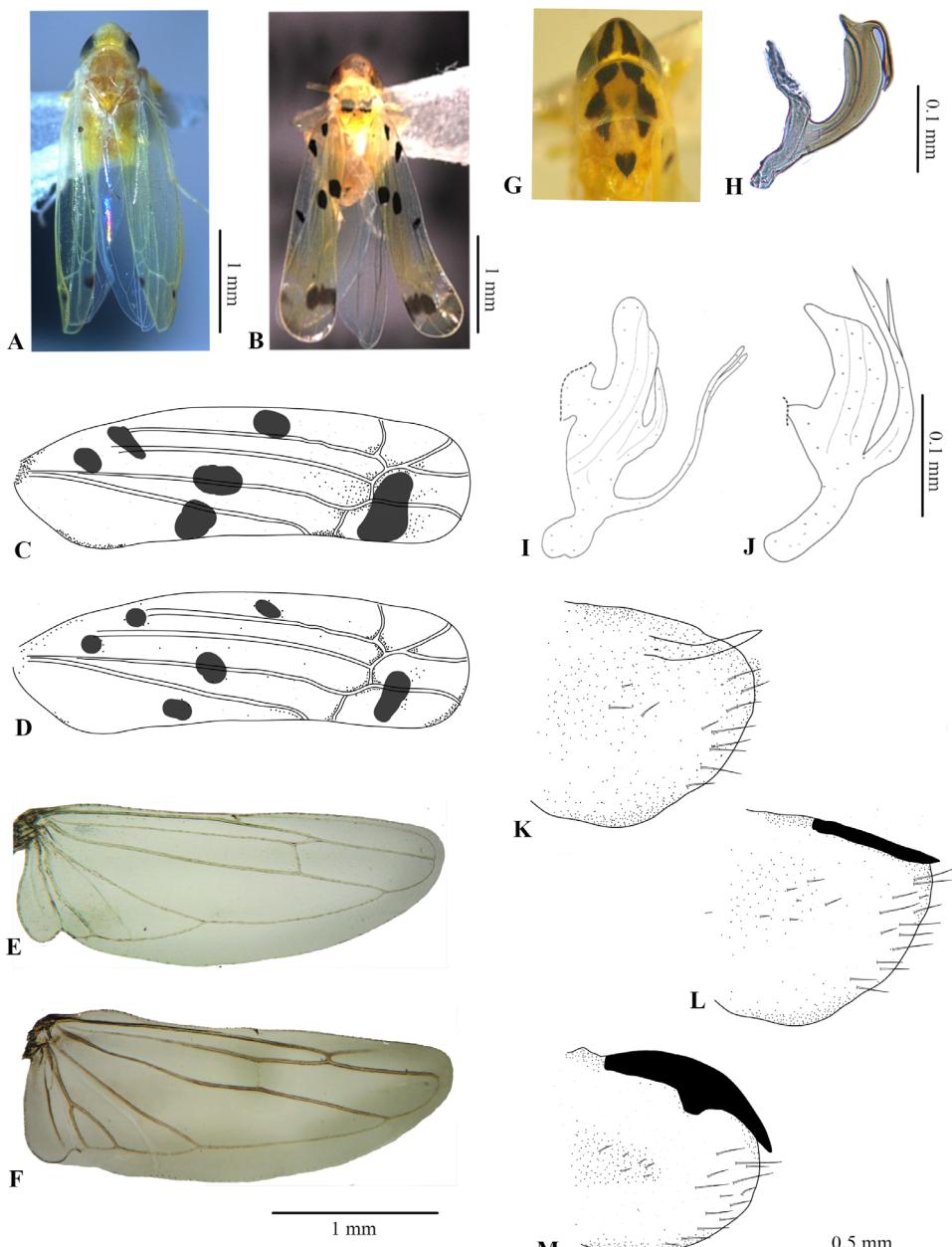
## Discussion

Three species, *Alconeura cinctella*, *Empoasca angustella* and *Joruma* sp., are reported for the first time on avocado trees. In total, twelve typhlocybine species are currently known to inhabit avocado in Mexico. Morelos state has the highest number of associated species followed by Michoacán state. Quezada-Daniel *et al.* (2017) reported mechanical damage of leafhoppers associated with avocado trees, but none of the species have been effectively tested to assess their ability to transmit any pathogenic disease under field or in laboratory conditions. Natural enemies have not been reported and remain unknown. These microleafhoppers may represent a degree of economic importance because the family Cicadellidae comprises ca. 75% of phytoplasma vector species known worldwide (Weintraub and Beanland 2006). The genera *Idona* and *Empoasca* are the most frequent leafhoppers collected in avocado orchards (Pinedo-Escatel and Dmitriev 2019), thus, future research might focus on monitoring populations of species in these genera to evaluate possible impact on avocado production in Mexico and adjacent areas.

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**Figure 1.** Habitus and structures of typhlocybinidae studied. A. *Dikrella mella*, habitus in dorsal view. B. *Idona dmitrievi*, habitus in dorsal view. C. *Idona dmitrievi*, forewing. D. *Idona floresi*, forewing. E. *Idona dmitrievi*, hind wing. F. *Joruma krausi*, hind wing. G. *Idona minuenda*, head and pronotum in dorsal view. H. *Alconeura candida*, aedeagus in lateral view. I. *Idona dmitrievi*, aedeagus in lateral view. J. *Idona minuenda*, aedeagus in lateral view. K. *Idona minuenda*, pygofer in lateral view. L. *Idona gonzalezae*, pygofer in lateral view. M. *Idona dmitrievi*, pygofer in lateral view.

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