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-Soto1, J. Adilson Pinedo-Escatel2* and Braulio Alberto Lemus-Soriano1

1Facultad 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.
2Departamento 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

ZooBank: urn:lsid:zoobank.org:pub: 8F8ADFF4-9ADC-4F74-BFF1-C97C01338A25
https://doi.org/10.35249/rche.46.2.20.17

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: Auchenorrhycha, 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: Auchenorrhycha, cicadélidos, especies plaga, nuevos registros.

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...
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 auchenorrhynchous 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:

| Collection   | Name                                      |
|--------------|-------------------------------------------|
| 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 R2+3 (Fig. 1E) ..........................................................Dikraneurini, 2

- Hind wing with submarginal vein not extended along costal margin basad of vein R2+3 (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* 6

- 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)..........................................................I. minuenda
– Head and pronotum with symmetrical large black spots (Fig. 1G). Pygofer process concolorous with lobe (Fig. 1K)..................................................I. gonzalezae
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. floresi
9 Clavus with small spot not reaching margin and veins (Fig. 1D)..............I. dmitrievi
– Clavus with large spot reaching margin and veins (Fig. 1C).................J. krausi
10 Anterior margin of crown with three black spots. Dorsum with white, black and red marks along forewing.........................................................Joruma sp.
– Anterior margin of crown with a diffuse black band. Dorsum entirely pale without any other color added..........................................................Joruma
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”O \ 21-Junio-2019 \ ex: Persea americana var. Hass (Aguacate) \ Trampa de luz \ Col. J. Guerrero-Soto.
Guerrero-Soto et al.: Checklist and key to Mexican Typhlocybines on avocado trees.

**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*, sweep net, R.M. Quezada-Daniel; (CEAM) 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-Escatel & 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, 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. 1,962 m, 18°50’27.204” 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′2.3252″ 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.

**Acknowledgement**

We are indebted to Mildred Ireana Torres Ramirez for comments during development of the manuscript. Christopher Dietrich and Brendan Morris (INHS) provided helpful comments to improve the manuscript. Guerrero-Soto and Lemus-Soriano gratefully
acknowledge space provided to complete this research by Facultad de Agrobiología “Presidente Juárez”, Universidad Michoacana de San Nicolás de Hidalgo. J.A. Pinedo-Escatel was supported by CONACYT [CVU: 705854] and BEMARENA Ph.D. graduate department of Universidad de Guadalajara at Centro Universitario de Ciencias Biológicas y Agropecuarias, Zapopan, Jalisco, México.

Figure 1. Habitus and structures of typhlocybines 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.
Literatura Citada

Dietrich, C.H. (2005) Key to the families of Cicadomorpha and subfamilies and tribes of Cicadellidae (Hemiptera: Auchenorrhyncha). *Florida Entomologist*, 88(4): 502-517. http://dx.doi.org/10.1653/0015-4040(2005)88[502:KTTFOC]2.0.CO;2

Kramer, S. (1950) The morphology and phylogeny of Auchenorrhynchous Homoptera (Insecta). *Illinois Biological Monographs*, 20(4): 1-111. http://dx.doi.org/10.5962/bhl.title.50340

Pinedo-Escatel, J.A. and Blanco-Rodríguez, E. (2016) A new species of *Idona* DeLong (Hemiptera: Cicadellidae: Typhlocybinae) from Mexico, with an annotated list of species. *Zootaxa*, 4114(3): 320-330. http://dx.doi.org/10.11646/zootaxa.4114.3.7

Pinedo-Escatel, J.A. and Dmitriev, D. (2019) Redescription of the Dikraneurini leafhopper *Dikrella mella* Ruppel & DeLong, 1952 (Hemiptera, Cicadellidae) with a synoptic checklist of leafhoppers on avocado trees in Mexico. *Zookeys*, 857: 17-27. https://doi.org/10.3897/zookeys.857.33910

Quezada-Daniel, R.M., Bautista-Martínez, N., González-Santarosa, M.G., Valdez-Carrasco, J.M., Pinedo-Escatel, J.A. and Turcios-Palomo, L.A. (2017) Leafhopper species associated with avocados at Morelos, Mexico. *Southwestern Entomologist*, 42(1): 103-110. https://doi.org/10.3958/059.042.0109

Rakitov, R.A. (1998) On differentiation of cicadellid leg chaetotaxy (Homoptera: Auchenorrhyncha: Membracoidea). *Russian Entomological Journal*, 6(3-4): 7-27.

Triplehorn, C.A. and Johnson, N.F. (2005) Borror and DeLong’s introduction to the study of insects. Belmont, CA, Thomson, 864 pp.

Weintraub, P.G and Beanland, L. (2006) Insect vectors of phytoplasmas. *Annual Review of Entomology* 51: 91-111. https://doi.org/10.1146/annurev.ento.51.110104.151039

Young, D.A. (1952) A reclassification of western hemisphere Typhlocybinae (Homoptera: Cicadellidae). *University of Kansas Science Bulletin*, 35: 1-217. https://doi.org/10.5962/bhl.part.4327