

Systematics, Morphology and Biogeography

A new species of *Sogatella* (Hemiptera: Delphacidae) from temperate Argentina



Roxana Mariani*, Ana María Marino de Remes Lenicov

Universidad Nacional de La Plata, Facultad de Ciencias Naturales y Museo, División Entomología, Buenos Aires, Argentina

ARTICLE INFO

Article history:

Received 19 September 2017

Accepted 3 December 2017

Available online 14 December 2017

Associate Editor: Daniela Takiya

Keywords:

Distribution

Fulgoromorpha

Host plant

Systematics

Taxonomy

ABSTRACT

A new species from Argentina, *Sogatella unidentata* **sp. nov.** (Hemiptera: Delphacidae), is described and illustrated as belonging to the *Sogatella furcifera* group. The main distinctive characteristics are tegmen coloration, shape of aedeagus and number and dispositions of its teeth, and shape of parameres in males; length of the ovipositor, and shape of the gonapophysis IX in females. A key is included to facilitate the comparison of the new species with the closely allied. Furthermore, information on host plants and geographical distribution is provided. This is the southernmost record in the distribution of the *S. furcifera* group.

© 2017 Sociedade Brasileira de Entomologia. Published by Elsevier Editora Ltda. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Introduction

The genus *Sogatella* Fennah, 1956 (Delphacinae, Delphacini) includes 15 species and one subspecies distributed mainly in tropical and subtropical regions of the world (Asche and Wilson, 1990; Bartlett et al., 2014). Several species are important pests of cereal crops such as maize, wheat, and rice in Asia and South and Central America due to the effects of their direct feeding and by their role as vectors of viral diseases (Wilson and Claridge, 1991). *Sogatella* is a fairly small and slender delphacid and is most easily recognized by its white longitudinal stripe extending from the vertex posteriorly onto the mesonotum, more obvious in males than females (Asche and Wilson, 1990). It can be distinguished from delphacid genera by the dorsal margin of the diaphragm of the pygofer forming a broad U-shape, aedeagus compressed, twisted with two rows of spines; phallotreme subapically on the left side and parameres diverging, in most of the species tapering to apex and distally bifurcated.

Three species groups were recognized by Asche and Wilson (1990) based on the form of the male parameres: *Sogatella furcifera* group (*Sogatella camptistylis* Fennah, *Sogatella capensis* (Muir), *S. furcifera* (Horváth), *Sogatella maneto* Fennah, *Sogatella nigeriensis* Muir, *Sogatella petax* Fennah, and *Sogatella yei* Linnavuori), with apical angles quite equally produced, or with the outer one

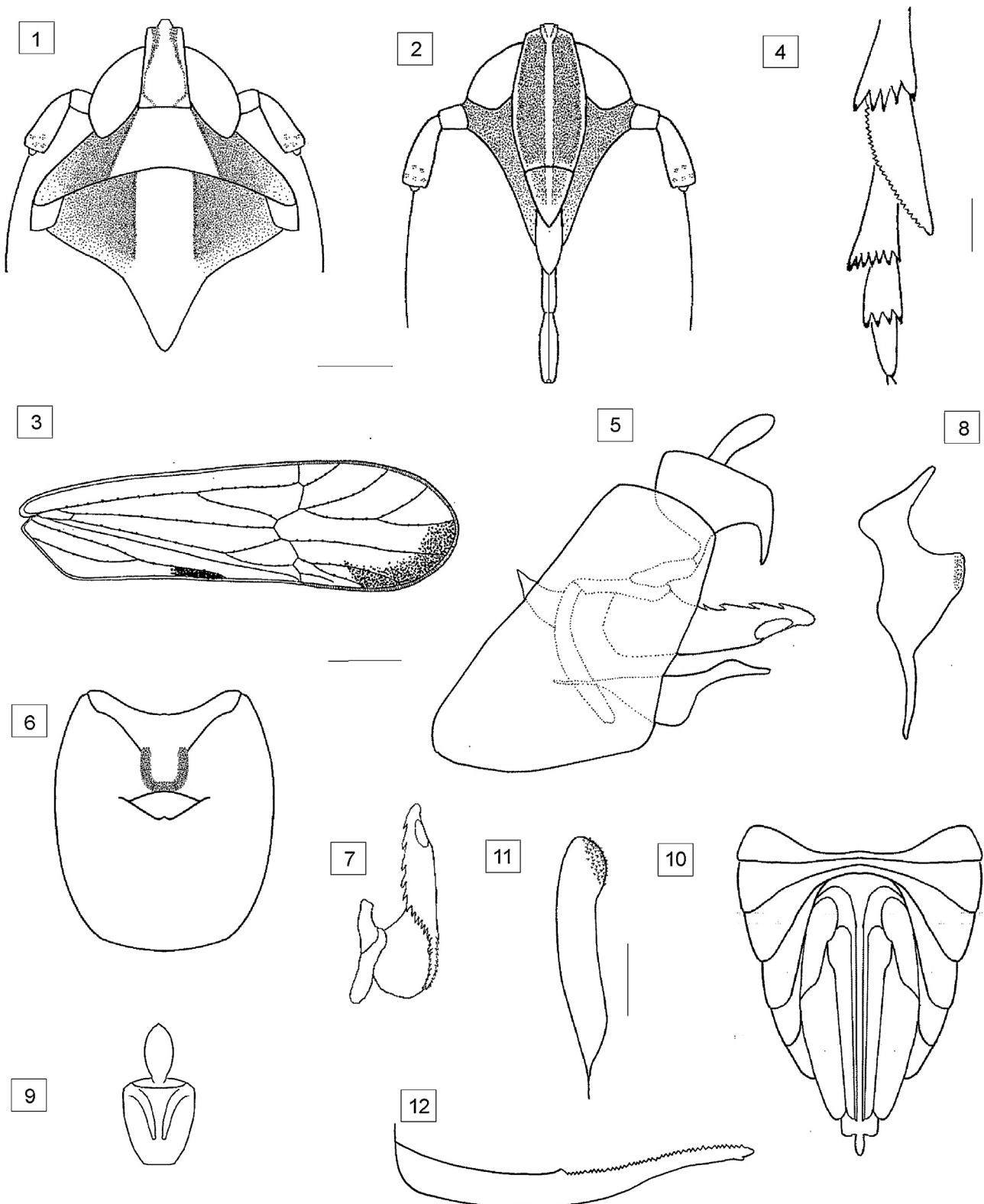
rounded, apical margin shallowly concave or sinuate; *Sogatella kolophon* group (*Sogatella colorata* (Distant), *S. kolophon* (Kirkaldy), *Sogatella molina* (Fennah), *Sogatella nigrigenis* (Jacobi), *Sogatella vibix* (Haupt)), with the apical margin bifurcate, shallowly or deeply concave, inner angle short and stick-like, and the outer angle strongly produced; and *Sogatella albofimbriata* group (*S. albofimbriata* (Muir), *Sogatella krugeri* (Muir)), that are elongated, slender toward apex, with the inner apical angle strongly reduced or absent.

Only two species of *Sogatella* have been recorded from the Americas: *S. kolophon* and *S. molina*. Records of *S. furcifera* from the New World (as Muir and Giffard, 1924; Muir, 1926; Fennah, 1945; Caldwell and Martorell, 1951) were based on misidentifications, in most cases concern *S. kolophon* and *S. molina*, so up to now its presence remains unverified (Asche and Wilson, 1990; Bartlett et al., 2014). *S. kolophon* is a widely distributed pantropical species; in the New World it has been recorded from the USA, Bahamas, Belize, Bermuda Islands, Brazil, Cayman Islands, Costa Rica, Cuba, Dominican Republic, Ecuador, Grenada, Guyana Honduras, Jamaica, Martinique, Mexico, Montserrat, Nicaragua, Peru, Puerto Rico, St. Lucia, Trinidad, Venezuela, and Virgin Islands (Bartlett et al., 2014), as well as, Panama (Bartlett and Kunz, 2015) and Argentina (Remes Lenicov and Virla, 1999). *S. molina* has been recorded from the USA, Bermuda, Cayman Islands, Cuba, Dominican Republic, Honduras, Jamaica, Mexico, Nicaragua, Puerto Rico, Trinidad, and Virgin Islands (Bartlett et al., 2014), Argentina (Remes Lenicov et al., 2014), as well as, Costa Rica and Nicaragua (Bartlett and Kunz, 2015).

Some species of *Sogatella* such as *S. furcifera*, *S. kolophon* and *S. vibix* are recognized as serious pests of wheat, maize and rice in

* Corresponding author.

E-mail: rmariani@fcnym.unlp.edu (R. Mariani).



Figs. 1–12. *Sogatella unidentata* sp. nov. male holotype: (1) head and thorax, dorsal view; (2) head, frontal view; (3) tegmen; (4) apex of metathoracic leg and metatibial spur; (5) male terminalia, lateral view; (6) diaphragm of pygofer, caudal view; (7) aedeagus, lateral view; (8) left paramere, posterior view; (9) anal segment, ventral view; (10) paratype female abdomen, ventral view; (11) left valvifer VIII, ventral view; (12) gonapophysis IX, right lateral view (Scale = 0.1 mm).

Asia and Central and South America, due to their role as vectors of viral diseases or the effects caused by their feeding and oviposition (Wilson and Claridge, 1991). In Argentina, *S. kolophon* and *S. molina* are associated with maize crops affected by the “Mal de Río Cuarto virus disease (MRCV)” (Laguna et al., 2002; Remes Lenicov et al., 2014).

As part of ongoing monitoring studies in Argentinian agroecosystems, several *Sogatella* specimens were collected from crops and wild weeds in different locations in the country; the morphology of these specimens revealed the presence of a new species, *Sogatella unidentata* **sp. nov.** This paper provides a description of both sexes, information on the host plants, geographical distribution, and a key to facilitate the comparison of the new species with the morphologically similar.

Material and methods

A sweep net (40 cm in diameter) was used for sampling adult delphacids in crops and surrounding weeds in northern Argentina. Other specimens included in this study came from Museo de La Plata (MLP), and Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires (FCEyN-UBA) collections. For the description of

the general morphology and terminalia we followed Asche (1985) and Asche and Wilson (1990), respectively; for the nomenclature of the carinae of the vertex and frons, Yang and Yang (1986); and for the female genitalia, Bourgoin (1993).

Male and female genitalia were prepared for microscopic examination according to standard taxonomic techniques (Remes Lenicov and Virla, 1993). Drawings were made with a Leitz-Westzlar microscope with a camera lucida. The measurements, derived from 10 males and 9 females, are given in millimeters and averages expressed as means \pm SE. Abbreviations are as follows: T.L., total length, with wings in repose; B.L., body length; t.l., tegmina length; t.n., number of teeth on metatibial spur. Type specimens were deposited in the MLP collection. Photographs of habitus were taken using a RRID 18 HD digital camera attached to a LEICA EZ5 stereoscopic microscope. Digital images were assembled using Combine ZM open software (Hadley, 2011).

Taxonomy

S. unidentata **sp. nov.** (Figs. 1–16).

Diagnosis: *S. unidentata* **sp. nov.** can be distinguished from the most closely allied species by the combination of the following



Figs. 13–16. *Sogatella unidentata* **sp. nov.** male holotype: (13) habitus, lateral view; (14) head and thorax, dorsal view; (15) head, frontal view; (16) head, ventro-lateral view (Scale = 1 mm, figure 13; Scale = 0.2 mm, Figs. 14–16).

characteristics: head brown with yellow carinae and tegmen with apical portion of M_2 , M_{3+4} and Cu infusate and a dark claval spot as in Fig. 13; male with aedeagus slightly compressed, broadly rounded at base with the shaft slightly twisted and regularly narrow with the apex slightly produced in a curved blunt tip as in Fig. 7, and parameres with the inner apical angle strongly produced in a long digitiform process as in Fig. 8; female with gonapophysis IX (= second valvula) slightly curved at the base, bearing numerous small teeth on distal half as in Fig. 12.

Description. Holotype male. Uniformly brown; carinae of vertex, frons, clypeus and legs, yellow; tegulae and a stripe across vertex and the middle portion of pro- and mesonotum white-yellowish (Figs. 1–2 and Fig. 14–16); tegmen hyaline, apical portion of M_2 , M_{3+4} and Cu infusate, with a dark claval spot (Figs. 3 and 13).

Vertex rectangular, longer than wide (1.5:1), wider at base, narrowing slightly toward apex, projecting beyond eyes about one-third of its length; basal compartment occupying approximately the basal half; carinae prominent, submedian forming a slender triangular area continuing beyond the fastigium (Figs. 1–2 and 14).

Frons more than twice longer than wide (2.2:1), wider near apical margin; lateral margins subparallel, slightly convex at apex; carinae well-developed, median carina narrowly forked at basal sixth. Clypeus subtriangular, as long as wide, median carina weaker apically; lateral carinae reaching genal carinae. Rostrum short, slightly surpassing mesocoxa, shorter than frons (0.5:1), subapical segment longer than the apical one (1.4:1). Antennae with first segment slightly longer than wide, second segment length $2.5 \times$ its width (Figs. 2, 15 and 16).

Pronotum with conspicuous carinae, lateral ones straight, not reaching hind margin. Mesonotal disk longer than vertex plus pronotum (1.33:1), carinae becoming obsolete apically, not reaching hind margin (Figs. 1, 13 and 14). Metatibial spur leaf-like, bearing 23–25 black-tipped regular teeth on trailing margin, metatibiae almost as long as metatarsi; first metatarsomere slightly longer than the second plus third (Fig. 4).

Terminalia: *pygofer* dorsally with deeply concave anal emargination; anal angles rounded in lateral view (Figs. 5 and 6); diaphragm short, dorsal margin with a typical medial U-shaped emargination with the sclerotized border posteriorly projected, ventral margin sinuous with a small medioventral process (Fig. 6). Aedeagus slightly compressed, dorsocaudally directed, wide in the basal third almost twice as wide as the shaft, rounded in profile; shaft rather straight and slightly twisted, $3 \times$ as long as wide, regularly narrow, ending in a slightly ventrally-curved blunt tip; two divergent rows of 14 small teeth ascending from ventro-basal third on both sides to the dorsal third, the left one continuing with an oblique dorsal row of 6 teeth that end subapically, phallotreme subapical on left side (Fig. 7). Suspensorium short, $3 \times$ longer than wide, widely joined to the anal segment. Connective somewhat curved at base, genital chamber transversal, slightly longer than suspensorium and apically embracing the base of the aedeagus (Fig. 5). Parameres relatively long and apically convergent, with inner margin strongly concave, produced and bordered in the middle of its length; external margin sinuous; apical margin obliquely truncate; inner apical angle strongly produced medially in a long digitiform process; outer apical angle rounded (Fig. 8). Anal segment moderately short, collar-like, with a pair of slender, curved, cephalad-directed and moderately-long spine-like processes arising sub-medially from the apical margin; anal style $2 \times$ longer than wide (Fig. 9).

Measurements ($n = 10$): T.L., 3.7 ± 0.02 ; B.L., 2.3 ± 0.02 ; l.t., 3.3 ± 0.01 ; t.n., 23–25.

Female. Color pattern similar to male, ovipositor brown with gonapophysis VIII light brown.

Genitalia: Ovipositor short, reaching anal segment at base (Fig. 10). Sternite VII membranous, finely sculptured. Valvifers VIII

(= gonocoxa VIII) regularly broad, in ventral view separated at rest; cuticle finely denticulated at base (Fig. 11). Gonapophysis IX (= second valvula) slightly curved at base, bearing numerous small teeth on its dorsal margin, becoming bigger and more spread toward distal half (Fig. 12).

Measurements ($n = 9$): T.L., 4.3 ± 0.02 ; B.L., 2.9 ± 0.015 ; l.t., 3.95 ± 0.02 ; t.n., 23–25.

Etymology. The species name refers to the shape of the genital parameres, with the strongly produced inner angle.

Material examined. *Holotype male:* ARGENTINA, Tucumán, Manantial, $26^\circ 51' S$ $65^\circ 17' O$, 31-V-2010, on weed, E. Virla, (MLP). *Paratypes.* ARGENTINA: 1 ♀, same data as holotype (MLP); 2 ♂♂, 1 ♀, Villa Carmela, $26^\circ 75' S$ $65^\circ 28' W$, Tucumán, 29-IV-1999, in *Cynodon* sp., E. Virla (MLP); 2 ♂♂, Pueblo Cazes, $32^\circ 00' S$ $58^\circ 30' W$, Entre Ríos, 19-XI-2005, in *Oryza sativa* L., G. Bonnot (MLP); 1 ♂, La Plata, $34^\circ 56' S$ $57^\circ 57' W$, Buenos Aires, 9-II-2010, on *O. sativa*, R. Mariani col. (MLP); 1 ♂, 1 ♀, Delta INTA, $34^\circ 17' S$ $58^\circ 86' W$, Buenos Aires, I-1973, A. Bachman col. (FCEyN-UBA).

Additional material not included in the type series. ARGENTINA: 1 female, Clorinda, $25^\circ 17' S$ $57^\circ 43' W$, Formosa, I-1979, A. Cicchino (MLP); 1 male, Laguna Oca, $26^\circ 14' S$ $58^\circ 10' W$, Formosa, I-1970, P. Denier (MLP); 1 female, Puerto Iguazú, $25^\circ 36' S$ $54^\circ 49' W$, Misiones, XI-1944, B. Torres (MLP), 1 male and 1 female, Famaillá, $27^\circ 03' S$ $65^\circ 24' W$, Tucumán, I-2012, in *Cynodon* sp. Arguello (MLP), 1 male, El Siambón, $26^\circ 44' S$ $65^\circ 27' W$, Tucumán, 27-VI-1999, E. Virla (MLP), 1 male, Villa Carmela, $26^\circ 75' S$ $65^\circ 28' W$, Tucumán, 15-V-1999, in *Zea mays*, E. Virla (MLP); 1 female, Arroyito, $31^\circ 25' S$ $63^\circ 03' W$, Córdoba, 3-III-2001, in *Cynodon* sp. (MLP), 1 male, 1 female (both with genitalia dissected in vial), Sampacho, $33^\circ 23' S$ $64^\circ 43' W$, Córdoba, 3-I-1985, in bermudagrass, E. Dagoberto (MLP); male, San Lorenzo, $28^\circ 08' S$ $58^\circ 46' W$, Corrientes, 2-III-2001, in weed (MLP); 1 males, 1 female, Villa Elisa, $32^\circ 10' S$ $58^\circ 24' W$, Entre Ríos, 10-X-2005, in weed, G. Bonnot (MLP); 1 male (with genitalia dissected in vial), La Plata, $34^\circ 56' S$ $57^\circ 57' W$, Buenos Aires, 20-XI-1991 in weed (MLP).

Geographical distribution. ARGENTINA: Tucumán, Formosa, Misiones, Córdoba and Buenos Aires provinces.

Host plants. *S. unidentata* sp. nov. was mostly collected in natural communities of grasses, where *Cynodon* prevailed, as well as, from maize (*Z. mays* L.) and rice (*O. sativa* L.).

Remarks. *S. unidentata* sp. nov. is included in the genus *Sogatella* by the combination of the following characteristics according to Asche and Wilson (1990), who studied this genus and related groups based on characters of the male genitalia: the dorsal margin of the diaphragm with a broad U-shape process; aedeagus slightly compressed and twisted with two regular rows of teeth ascending from the ventrodorsal third on both sides to the dorsal third, with the phallotreme situated subapically on the left side. Although species of *Tagosodes* Asche and Wilson, 1990 have similar coloration and external appearance, they can be mainly differentiated for having other configuration on dorsal margin of the diaphragm (not broad U-shape) and the aedeagus more or less straight never twisted and with teeth irregular spaced and/or forming rows.

S. unidentata sp. nov. may be placed in the *S. furcifera* group (Asche and Wilson, 1990) only by the morphological features of the parameres – outer and inner angle of the equally produced or the outer one rounded – although from a biogeographic basis it would seem little feasible. Externally, the new species share with *S. furcifera* and *S. nigeriensis* the dark coloration of the frons and clypeus and the marking of the clavus. The diagnostic characteristic of the parameres, which have outer apical angles entirely rounded, make *S. unidentata* sp. nov. similar to *Sogatella petax* Fennah, 1963 and *S. manetho* Fennah, 1963, a shared feature that is distinguishable from all the other *Sogatella* species. Further studies will be necessary to determine the phylogenetic affinity among species of *Sogatella*.

Key to distinguish males of *Sogatella* (modified from *Asche and Wilson, 1990:7*)

In the present study *S. unidentata* sp. nov. keys to couplet “4” in *Asche and Wilson (1990)* as follows:

3. Apex of clavus in forewing with dark brown marking 4
 - Apex of the clavus without marking; parameres with apical margin undulate, shallowly concave, outer corner forming a pointed process *S. capensis* (Muir)
 4. Parameres with inner and outer apical angles equally produced 5
 - Parameres with inner angle strongly produced in a long digitiform process, outer angle rounded (Fig. 8) *S. unidentata* sp. nov.
 5. Parameres strongly dilated at base with apex relatively small, almost equally bifurcate, diaphragm mediodorsally broadly U-shaped *S. furcifera* (Horváth)
 - Parameres not dilated at base, apical part distally about as broad as base (Fig. 3), U-shaped process of diaphragm rather narrow *S. nigeriensis* (Jacobi)

Conflicts of interest

The authors declare no conflicts of interest.

Acknowledgements

Authors thank A. Bachman (Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires (FCEyN-UBA)) for the loan of specimens, Arnaldo Maciá (CIC: Scientific Research Committee of the Province of Buenos Aires, Argentina) for the English grammar support and Maria F. Rossi Batiz and Cecilia Goretta (Facultad de Ciencias Naturales y Museo – UNLP) for the assistance with the artwork. This work was supported by *Facultad de Ciencias Naturales y Museo* (UNLP), *Consejo Nacional de Investigaciones Científicas y Técnicas* (CONICET), Argentina, Project 11N 623 UNLP and FONCYT-PICT 2007 N° 00143-03.

References

- Asche, M., 1985. Zur Phylogenie der Delphacidae Leach, 1815 (Homoptera, Cicadina, Fulgoromorpha). *Marburg. Entomol. Publ.* 2 (1–2), 1–912.
- Asche, M., Wilson, M.R., 1990. The delphacid genus *Sogatella* and related groups: a revision with special reference to rice-associated species (Homoptera: Fulgoroidea). *Syst. Entomol.* 15, 1–42.
- Bartlett, C.R., O'Brien, L.B., Wilson, S.W., 2014. A review of the planthoppers (Hemiptera: Fulgoroidea) of the United States. *Mem. Am. Entomol. Soc.* 50, 1–287.
- Bartlett, C.R., Kunz, G., 2015. A new genus and species of delphacid planthopper (Hemiptera: Fulgoroidea: Delphacidae) from Central America with a preliminary regional species list. *Zootaxa* 3946, 510–518.
- Bourgoin, T., 1993. Female genitalia in Hemiptera, Fulgoromorpha, morphological and phylogenetic data. *Ann. Soc. Entomol. Fr. (N. S.)* 29 (3), 225–244.
- Caldwell, I.S., Martorell, L.F., 1951. Review of the Auchenorrhynchos (sic) Homoptera of Puerto Rico, Part 11. The Fulgoroidea except Kinnaridae. *J. Agric. Univ. P. R.* 34 (2), 133–269.
- Fennah, R.G., 1945. The Fulgoroidea, or lanternflies of Trinidad and adjacent parts of South America. *Proc. U. S. Natl. Mus.* 95, 411–520.
- Fennah, R.G., 1963. The Delphacid-species-complex known as *Sogatella furcifera* (Horváth) (Homoptera: Fulgoroidea). *Bull. Entomol. Res.* 54, 45–79.
- Hadley, A., 2011. Combine ZP-Free image Stacking Software for Depth of Field Correction. <http://www.hadleyweb.pwp.blueyonder.co.uk/CZM/combinezm.htm> (accessed 21.09.11).
- Laguna, I.G., de Remes Lenicov, A.M.M., Virla, E., Avila, A.O., Giménez Pecci, M.P., Herrera, P., Garay, J., Ploper, D., Mariani, R., 2002. Difusión del virus del Mal de Río Cuarto (MRCV) del maíz, su vector, delfácidos asociados y huéspedes alternativos en la Argentina. *Rev. Soc. Ent. Arg.* 61, 87–97.
- Muir, F.A.G., 1926. Contributions to our knowledge of South American Fulgoroidea (Homoptera). Part I. The Family Delphacidae. *Bull. Expt. Sta. Hawaiian Sugar Planters' Assoc. Entomol. Ser.* 18, 1–51.
- Muir, F.A.G., Giffard, W.M., 1924. Studies in North American Delphacidae. *Bull. Expt. Sta. Hawaiian Sugar Planters' Assoc. Entomol. Ser.* 15, 1–53.
- de Remes Lenicov, A.M.M., Virla, E.G., 1993. Homópteros Auquenorrincos asociados al cultivo de trigo en la República Argentina. I. Análisis preliminar de la importancia relativa de las especies. *Stud. Neotrop. Fauna Environ. (Ecol. Syst.)* 28, 211–222.
- de Remes Lenicov, A.M.M., Virla, E.G., 1999. Delfácidos asociados al cultivo de maíz en la República Argentina (Insecta – Homoptera – Delphacidae). *Rev. Fac. Agr. (La Plata)* 104, 1–15.
- Remes Lenicov, A.M.M., de Maciá, A., Mariani, R., Foieri, A., Brentassi, M.E., Toledo, A., Rossi Batiz, M.F., Paradell, S., 2014. Diversidad de Fulgoromorpha (Insecta-Hemiptera) y fluctuaciones poblacionales de especies vectoras asociadas con el agrosistema maíz en tres áreas agrológicas del NOA. In: X Cong. Nac. Maíz CD, 1–4 pp.
- Wilson, M.R., Claridge, M.F., 1991. Handbook for the Identification of Leafhoppers and Planthoppers of Rice. C.A.B. International, Wallingford UK.
- Yang, C.-T., Yang, C.-T., 1986. Delphacidae of Taiwan (I) Asiracinae and the tribe Tropidocephalini (Homoptera: Fulgoroidea). *Taiwan Mus. Spec. Publ. Ser.* 6, 1–79.