



<http://dx.doi.org/10.11646/zootaxa.3872.3.4>

<http://zoobank.org/urn:lsid:zoobank.org:pub:9CCEAC1C-F58A-40E6-8349-D081976E12A5>

Remarkable morphological features of taxonomic interest in the female genitalia of five *Erythrogonia* species (Hemiptera: Cicadomorpha: Cicadellidae)

RACHEL A. CARVALHO & GABRIEL MEJDALANI

Departamento de Entomologia, Museu Nacional, Universidade Federal do Rio de Janeiro (UFRJ), Quinta da Boa Vista, São Cristóvão, 20940-040, Rio de Janeiro—RJ, Brasil. E-mail: rachel_alexandre@yahoo.com.br, mejdalan@acd.ufrj.br

Abstract

The female genitalia of the Cicadellidae (leafhoppers) are usually considered more morphologically conservative (*i.e.*, less variable) than the male genitalia at the generic and specific levels. However, various recent publications on the Cicadellinae (sharpshooters) have demonstrated the existence of useful characters in the female genitalia for the recognition of genera and species. Here we describe, illustrate, compare, and discuss peculiar processes, sclerites, and other features of the first pair of valvifers, sternite VIII, and ovipositor valvulae I and II of five species of the sharpshooter genus *Erythrogonia* (*E. calva* (Taschenberg, 1884), *E. hertha* Medler, 1963, *E. phoenicea* (Signoret, 1853), *E. proterva* Melichar, 1926, and *E. sexguttata* (Fabricius, 1803)). This genus includes currently the highest species diversity among the New World Cicadellinae, an agriculturally important subfamily. Comparative notes on other genera of the Cicadellini are added. In agreement with other recent publications, our results challenge the view that the morphology of the female genitalia is almost always conservative in the Cicadellidae.

Key words: Auchenorrhyncha, Membracoidea, Cicadellinae, sharpshooter, taxonomy

Introduction

Traditionally, the taxonomy of the Cicadellidae (leafhoppers) at the generic and specific levels is based mostly on characters of the male genitalia. The female genital characters are usually considered more conservative (*i.e.*, less variable) at these levels than those of the male genitalia. Thus, the latter could be considered more useful than the former for the recognition of genera and species. However, there are still few studies dealing with the comparative morphology of the female genitalia of the Cicadellidae (*e.g.*, Nielson 1965; Hamilton 1970; Hill 1970; Davis 1975; Mejdalani 1995, 1998; Hummel *et al.* 2006; Zahniser & Dietrich 2008; Leal *et al.* 2009). The data presented in these studies, although preliminary, highlighted various features of potential taxonomic interest in the female genitalia.

The sharpshooter genus *Erythrogonia* (type species: *Cicada laeta* Fabricius, 1787) was proposed by Melichar (1926) based on features of color pattern and external morphology; no descriptions of the “internal” genital structures of males and females were given and the work was published entirely without illustrations (Medler 1963; Wilson & Turner 2007). Medler (1963) published a comprehensive revision of *Erythrogonia*, including a key to species, descriptions and illustrations of the external morphology, color pattern, male genitalia, and female abdominal sternite VII. Young (1977), in his monograph of the New World Cicadellini, observed that, due to the comprehensiveness of Medler’s (1963) work, a new review of *Erythrogonia* was not necessary at that time. However, Young (1977) provided a more detailed description of the genus, included three new species, and associated males to two species known previously only from females.

According to Young (1977), *Erythrogonia* comprises 68 valid species, being currently the largest genus within the New World Cicadellinae. However, 69 species were listed in the Cicadellinae catalogue of McKamey (2007). Among the latter, *E. bicolor* Metcalf, 1949 and *E. elegantula* (Germar, 1821) were treated by Young (1977) as *incertae sedis* because he did not find specimens that could be associated with these names. *Erythrogonia dorsalis*

of the first valvifers of *Zaruma decolorata* Young, 1977. Rodrigues and Mejdalani (2009) described an elongate rectangular sclerite associated to the superior portion of the first valvifers of *Aguatala compsa* Young, 1977. Mejdalani *et al.* (2011) reported the presence of a lobular projection at the posteroventral portion of the first valvifers of *Tacora saturata* Young, 1977. A ventral lobe was also observed by Meng and Yang (2012) at the first valvifers of *Seasogonia* Young, 1986 species. Interspecific differences of form in the first valvifers of *Teleogonia* Melichar, 1925 and *Jakrama* Young, 1977 species were illustrated by Young (1977) and of *Balacha* species, by Takiya and Mejdalani (2004). In the five *Erythrogonia* species herein compared, interspecific differences of form were also observed (Figs 8, 22, 36, 50, 59). In addition, the first valvifers of *E. phoenicea* and *E. calva* are connected to each other by a triangular sclerite (Figs 7 and 21, TRS) and bear a conspicuous hooklike process directed ventrally (Figs 8 and 22, HPR). The functions of the sclerite and process, which are both conspicuous structures, are unknown.

Bases of ovipositor valvulae. Young (1977) reported the occurrence of interspecific variation in the form of the basal portion of the first valvulae of several genera of the Cicadellini (*Teleogonia* Melichar, 1925, *Scoposcartula* Young, 1977, *Jakrama* Young, 1977, and *Macunolla* Young, 1977). He also reported interspecific variations in the basal portion of the second valvulae of *Neiva* Melichar, 1925. For comparative purposes, the basal portion of the valvulae is usually observed in ventral view. Leal *et al.* (2009) described an interspecifically variable “prevalvifer area” located at the base of the first valvulae in the genus *Scoposcartula*. Although we did not find a “prevalvifer area” in the first valvulae of *Erythrogonia*, our results demonstrate the occurrence of interspecific variations in the form of the basal portion, including the presence of distinct projections (*e.g.*, *E. phoenicea*, Figs 5 and 6) and concavities (*e.g.*, *E. sexguttata*, Figs 57–59). Additionally, we observed distinct median sclerites (SCL), which are associated with the bases of the valvulae, in *E. phoenicea* (Fig. 9), *E. calva* (Fig. 23), *E. proterva* (Fig. 52), and *E. sexguttata* (Fig. 55). Such peculiar sclerites have not been observed in our previous studies on females of other Cicadellinae genera.

Concluding remarks

Our results on *Erythrogonia* challenge the view that the morphology of the female genitalia is usually conservative in the Cicadellidae. In order to facilitate the identification of female specimens, it is suggested here that, whenever possible, taxonomists should treat the female genitalia in detail in descriptions of new taxa or redescriptions. Accordingly, we have included female genitalia characters in the diagnoses of the *Erythrogonia* species herein treated. Although these species are distinct from each other externally, some species complexes were recognized within *Erythrogonia* by Medler (1963; *e.g.*, *E. sexguttata* was included in the *laeta* complex). The species included in a given complex are very similar to one another externally and currently can only be distinguished by means of male genital characters. The recognition of female diagnostic features can make the identification of these species easier. The common practice of describing and illustrating only the female sternite VII is not sufficient, given recent studies that show significant variation in ovipositor structure even among closely related species. Studies like those of Nielson (1965), Hill (1970), and Davis (1975) provided a sound basis for the comparative study of the leafhopper female genitalia.

Acknowledgments

Daniela M. Takiya (DZRJ) and Rodney R. Cavichioli (DZUP) kindly loaned specimens employed in this study. Rachel A. Carvalho received a fellowship from Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) during her doctoral studies and currently has a postdoctoral fellowship provided jointly by Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) and Fundação de Amparo à Pesquisa do Estado do Rio de Janeiro (FAPERJ). Gabriel Mejdalani is a research productivity fellow from CNPq (process 301.391/2011-4). This research was supported in part by grants from FAPERJ to Nelson Ferreira-Jr (process E-26/111.181/2011) and the authors.

References

- Carvalho, R.A., Mejdalani, G. & Takiya, D.M. (2011) Phylogenetic placement and taxonomy of the Neotropical sharpshooter genus *Desamera* Young, with description of its sister group, *Ciccamera* gen. nov. (Hemiptera: Cicadellidae: Cicadellinae). *Systematics and Biodiversity*, 9, 59–75.
<http://dx.doi.org/10.1080/14772000.2011.558644>
- Davis, R.B. (1975) Classification of selected higher categories of auchenorrhynchous Homoptera (Cicadellidae and Aetalionidae). *Technical Bulletin of the United States Department of Agriculture*, 1494, 1–52.
- Felix, M. & Mejdalani, G. (2003) Two new species of *Coronigoniella* Young from Brazil with taxonomic and distributional notes on the genus (Hemiptera: Cicadellidae: Cicadellinae). *Studies on Neotropical Fauna and Environment*, 38, 235–243.
<http://dx.doi.org/10.1076/snfe.38.3.235.28170>
- Hamilton, K.G.A. (1970) The genus *Cuerna* (Homoptera: Cicadellidae) in Canada. *Canadian Entomologist*, 102, 425–441.
<http://dx.doi.org/10.4039/Ent102425-4>
- Hill, B.G. (1970) *Comparative morphological study of selected higher categories of leafhoppers (Homoptera: Cicadellidae)*. Ph.D. dissertation, North Carolina State University, Raleigh, xi + 187 pp.
- Hummel, N.A., Zalom, F.G. & Peng, C.Y.S. (2006) Structure of female genitalia of glassy-winged sharpshooter, *Homalodisca coagulata* (Say) (Hemiptera: Cicadellidae). *Arthropod Structure and Development*, 35, 111–125.
<http://dx.doi.org/10.1016/j.asd.2006.05.001>
- Leal, A.H., Mejdalani, G., Cavichioli, R.R. & Carvalho, R.A. (2009) Taxonomy and phylogeny of the leafhopper genus *Scoposcartula* (Insecta: Hemiptera: Cicadellidae). *Systematics and Biodiversity*, 7, 215–233.
<http://dx.doi.org/10.1017/S1477200009002990>
- McKamey, S.H. (2007) Taxonomic catalogue of the leafhoppers (Membracoidea). Part 1. Cicadellinae. *Memoirs of the American Entomological Institute*, 78, 1–394.
- Medler, J.T. (1963) A review of the genus *Erythrogonia* Melichar (Homoptera, Cicadellidae). *Miscellaneous Publications of the Entomological Society of America*, 4, 1–33.
- Mejdalani, G. (1995) *Scopogonia paula* Young, 1977: morphology of the female genitalia and comparative notes on the *Juliaca* generic group (Homoptera, Cicadellidae). *Revista Brasileira de Entomologia*, 39, 193–202.
- Mejdalani, G. (1998) Morfologia externa dos Cicadellinae (Homoptera, Cicadellidae): comparação entre *Versigonia ruficauda* (Walker) (Cicadellini) e *Tretogonia cribrata* Melichar (Proconiini), com notas sobre outras espécies e análise da terminologia. *Revista Brasileira de Zoologia*, 15, 451–544.
<http://dx.doi.org/10.1590/S0101-81751998000200015>
- Mejdalani, G., Takiya, D.M. & Carvalho, R.A. (2006) Notes on Neotropical Proconiini (Hemiptera: Cicadellidae: Cicadellinae), IV: lectotype designations of *Aulacizes* Amyot & Audinet-Serville species described by Germar and revalidation of *A. erythrocephala* (Germar, 1821). *Arthropod Systematics and Phylogeny*, 64, 105–111.
- Mejdalani, G., Silva, R.S. & Garcia, C. (2011) Descriptions of a new Brazilian *Tacora* species and the female of *T. saturata*, and a key to the species of the genus (Insecta, Hemiptera, Cicadellidae, Cicadellini). *ZooKeys*, 160, 59–71.
<http://dx.doi.org/10.3897/zookeys.160.2080>
- Melichar, L. (1926) Monographie der Cicadellinen III. *Annales Historico-Naturales Musei Nationalis Hungarici*, 23, 273–394.
- Meng, Z.-H. & Yang, M.-F. (2012) Female genitalia of *Seasogonia* Young from China, with a new synonym and a new record (Hemiptera, Cicadellidae, Cicadellini). *ZooKeys*, 164, 25–40.
<http://dx.doi.org/10.3897/zookeys.164.2132>
- Nielson, M.W. (1965) A revision of the genus *Cuerna* (Homoptera, Cicadellidae). *Technical Bulletin of the United States Department of Agriculture*, 1318, 1–48.
- Oman, P.W. (1949) The Nearctic leafhoppers (Homoptera: Cicadellidae). A generic classification and check list. *Memoirs of the Entomological Society of Washington*, 3, 1–253.
- Oman, P.W., Knight, W.J. & Nielson, M.W. (1990) *Leafhoppers (Cicadellidae): a bibliography, generic check-list and index to the World literature 1956–1985*. CAB International Institute of Entomology, Wallingford, Oxon, 368 pp.
- Redak, R.A., Purcell, A.H., Lopes, J.R.S., Blua, M.J., Mizell, III R.F. & Andersen, P.C. (2004) The biology of xylem fluid-feeding insect vectors of *Xylella fastidiosa* and their relation to disease epidemiology. *Annual Review of Entomology*, 49, 243–270.
<http://dx.doi.org/10.1146/annurev.ento.49.061802.123403>
- Rodrigues, L.G.N. & Mejdalani, G. (2009) Description of the *Aguatala compsa* Young (Hemiptera: Cicadellidae: Cicadellinae) female. *Neotropical Entomology*, 38, 508–511.
<http://dx.doi.org/10.1590/S1519-566X2009000400012>
- Scudder, G.G.E. (1961) The comparative morphology of the insect ovipositor. *Transactions of the Royal Entomological Society of London*, 113, 25–40.
<http://dx.doi.org/10.1111/j.1365-2311.1961.tb00800.x>
- Scudder, G.G.E. (1971) Comparative morphology of insect genitalia. *Annual Review of Entomology*, 16, 379–406.
<http://dx.doi.org/10.1146/annurev.en.16.010171.002115>
- Silva, R.S., Cavichioli, R.R. & Mejdalani, G. (2013) Descriptions of two new Brazilian *Subrasaca* species and redescriptions of *S. flavolineata* (Signoret, 1855) and *S. curvovittata* (Stål, 1862) comb. nov. (Hemiptera: Cicadellidae: Cicadellini).

- Zootaxa*, 3637 (4), 450–461.
<http://dx.doi.org/10.11646/zootaxa.3637.4.4>
- Snodgrass, R.E. (1933) Morphology of the insect abdomen. Part II. The genital ducts and the ovipositor. *Smithsonian Miscellaneous Collections*, 89, 1–148.
- Snodgrass, R.E. (1935) *Principles of insect morphology*. McGraw-Hill, New York, ix + 667 pp.
- Takiya, D.M., Mejdalani, G. & Felix, M. (2001) A new genus and species of Cicadellini (Hemiptera Cicadellidae Cicadellinae) from Southeastern Brazil. *Tropical Zoology*, 14, 175–183.
<http://dx.doi.org/10.1080/03946975.2001.10531150>
- Takiya, D.M. & Mejdalani, G. (2004) Taxonomic revision and phylogenetic analysis of the sharpshooter genus *Balacha* Melichar (Hemiptera: Cicadellidae: Cicadellini). *Systematic Entomology*, 29, 69–99.
<http://dx.doi.org/10.1111/j.1365-3113.2004.00231.x>
- Takiya, D.M., Cavichioli, R.R. & McKamey, S.H. (2006) Brazilian sharpshooters of the genus *Homalodisca* Stål, 1869 (Hemiptera, Cicadellidae): notes, new records, key to species, first description of the male of *H. ignota* Melichar, 1924, and a new Northeastern species. *Zootaxa*, 1249, 23–36.
- Wilson, M.R. & Turner, J.A. (2007) Progress in the study of sharpshooter leafhoppers (Hemiptera: Auchenorrhyncha: Cicadellidae) over 150 years: monographs, museums and individuals. *Tijdschrift voor Entomologie*, 150, 289–303.
<http://dx.doi.org/10.1163/22119434-900000231>
- Wilson, M.R., Turner, J.A. & McKamey, S.H. (2009) Sharpshooter leafhoppers of the world (Hemiptera: Cicadellidae subfamily Cicadellinae). National Museum Wales. Available from: <http://naturalhistory.museumwales.ac.uk/sharpshooters/home.php> (Accessed 1 July 2014)
- Young, D.A. (1968) Taxonomic study of the Cicadellinae (Homoptera, Cicadellidae). Part 1, Proconiini. *Bulletin of the United States National Museum*, 261, 1–287.
<http://dx.doi.org/10.5479/si.03629236.261.1>
- Young, D.A. (1977) Taxonomic study of the Cicadellinae (Homoptera: Cicadellidae). Part 2. New World Cicadellini and the genus *Cicadella*. *Technical Bulletin of the North Carolina Agricultural Experiment Station*, 239, vi + 1135 pp.
- Young, D.A. (1986) Taxonomic study of the Cicadellinae (Homoptera: Cicadellidae). Part 3. Old World Cicadellini. *Technical Bulletin of the North Carolina Agricultural Experiment Station*, 281, 1–639.
- Young, D.A. & Beirne, B.P. (1958) A taxonomic revision of the leafhopper genus *Flexamia* and a new related genus (Homoptera: Cicadellidae). *Technical Bulletin of the United States Department of Agriculture*, 1173, 1–53.
- Zahniser, J.N. & Dietrich, C.H. (2008) Phylogeny of the leafhopper subfamily Deltocephalinae (Insecta: Auchenorrhyncha: Cicadellidae) and related subfamilies based on morphology. *Systematics and Biodiversity*, 6, 1–24.
<http://dx.doi.org/10.1017/S1477200007002617>