## SYSTEMATICS, MORPHOLOGY AND PHYSIOLOGY

# Brochosomes-for-Eggs of the Proconiini (Hemiptera: Cicadellidae, Cicadellinae) Species Associated with Orchards of *Citrus sinensis* (L.) Osbeck in Rio Grande do Sul, Brazil

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Brocossomos de Ovos de Espécies de Proconiini (Hemiptera: Cicadellidae, Cicadellinae) Associadas com Pomares de *Citrus sinensis* (L.) Osbeck no Rio Grande do Sul

RESUMO - Brocossomos são corpos ultramicroscópicos, reticulados, produzidos pelos tubos de Malpighi das cigarrinhas. São geralmente esféricos (brocossomos de tegumento) ou alongados (brocossomos de ovos). Neste estudo, as espécies de Proconiini foram identificadas de acordo com seus brocossomos de ovos. As características e uma chave para a identificação dos brocossomos também foram discutidas. Os espécimes foram coletados em nove pomares de *Citrus sinensis* ('Valencia'), com o uso da armadilha adesiva de cor amarela. Os pomares estão localizados em sete municípios do Rio Grande do Sul: Tenente Portela, Ijuí, Jaguari, Harmonia, Taquari, Montenegro e Pelotas. Os dados foram coletados de outubro de 1999 a dezembro de 2000 e de outubro de 2001 a março de 2002. Foram identificadas sete espécies capazes de produzir brocossomos de ovos: *Acrogonia citrina* Marucci & Cavichioli, *Homalodisca ignorata* Melichar, *Molomea consolida* Shröder, *Molomea lineiceps* Young, *Molomea magna* (Walker), *Oncometopia facialis* (Signoret), e *Oncometopia fusca* Melichar. Este estudo demonstra que a diversidade de brocossomos de ovos pode ser uma ferramenta útil para a identificação de espécies de Proconiini.

PALAVRAS-CHAVE: Material gredoso, cigarrinha, oviposição, taxonomia

ABSTRACT - Brochosomes are ultramicroscopic reticulate bodies produced by the Malpighian tubules of leafhoppers. Brochosomes are usually either spherical (brochosomes-for-integument) or elongated (brochosomes-for-eggs). In this study, the Proconiini species were diagnosed according to their brochosomes-for-eggs. Brochosome-for-eggs traits and dichotomous key were also discussed. The specimens were collected in nine orchards of *Citrus sinensis* (Valencia orange), using yellow sticky traps. The orchards are located in seven counties in the state of Rio Grande do Sul: Tenente Portela, Ijuí, Jaguari, Harmonia, Taquari, Montenegro, and Pelotas. Data were collected from October 1999 to December 2000, and from October 2001 to March 2002. Seven species capable of producing brochosomes-for-eggs were identified: *Acrogonia citrina* Marucci & Cavichioli, *Homalodisca ignorata* Melichar, *Molomea consolida* Shröder, *Molomea lineiceps* Young, *Molomea magna* (Walker), *Oncometopia facialis* (Signoret), and *Oncometopia fusca* Melichar. This study shows that the diversity among brochosomes-for-eggs was a useful tool to identify the Proconiini species.

KEY WORDS: Chalky material, oviposition, taxonomy

Proconiini leafhoppers (Fig. 1) have been diagnosed in citrus orchards in Brazil, as vectors of CVC (Citrus Variegated Chlorosis), a disease caused by the bacteria *Xylella fastidiosa* Wells *et al.* (occurring only in the xylem of plants) (Marucci *et al*. 2002). Brochosomes were first diagnosed by Tulloch *et al*. (1952), and were described and named one year later, by Tullock and Shapiro (1953). Brochosomes are reticulate microscopic bodies produced by the Malphigian tubules, excreted by the

anus, and present in several species of leafhoppers (Day & Briggs 1958, Vidano & Arzone 1984, Hix 2001). Brochosomes have a lipoproteic chemical composition (Mejdalani 2000, Hix 2001, Rakitov 2002).

Despite their variety in size, shape and structure, brochosomes can be classified in two functional types: (a) brochosomes-for-integument and (b) brochosomes-for-eggs. The brochosomes-for-integument (Figs. 2A and 3A-B) are usually spherical (0.2-0.6 µm), and can land and cover nymph, female, and male leafhoppers with the help of macrosetae in their hindlegs (posteroventral tibial row). The brochosomes-for-eggs (Figs. 2B-H, 3C-H, and 4) are elongated (1.0-20µm), and form convex masses on the wings of female leafhoppers only. The hindleg macrosetae of these brochosomes can fix and remove the eggs from the wings of female leafhoppers, and spread them either over the eggs, or on the scars caused on the leaf, for endophytic oviposition (Rakitov 1995, 1998, 1999; Mejdalani 2000; Hix 2001). Egg-laying sites are easily found when large amounts of brochosomes are deposited (as described above) on the eggs, as a fine layer of the foliar epidermis (Rakitov 2000).

Brochosomes-for-integument protect leafhoppers against excessive humidity and honeydew (Rakitov 1998, Mejdalani 2000). Brochosomes-for-eggs seem to account for the following functions: (a) prevention of egg dehydration; (b) protection against ultraviolet rays; (c) protection against parasites and predators; (d) signalization to other females that a leaf was already oviposited; and (e) antimicrobial activities (Hix 2001, Rakitov 2002). Pollard & Yonce (1965) showed the effect of macroseta length of Proconiini metathoracic tibiae on sexual dimorphism, where females producing brochosomes-for-eggs had longer macrosetae than those of corresponding males. Rakitov (1998) also studied chaetotaxy occurring in the legs of several species of leafhoppers, and concluded that these legs were responsible not only for locomotion but also for covering the integument and eggs with brochosomes, by the action of their modified setae.

The species mentioned earlier, as being both CVC vectors and producers of brochosomes-for-eggs, are: *Acrogonia citrina* Marucci & Cavichioli, *Acrogonia virescens* (Metcalf), *Homalodisca ignorata* Melichar and *Oncometopia facialis* (Signoret) (Almeida & Lopes 1999, Marucci *et al.* 2002, Parra *et al.* 2003).

Brochosomes production is considered a specific feature of Cicadellidae, and may represent an outstanding innovation, which has played an important role in the development and diversification of this group (Rakitov 1999).

This study had the following objectives: (1) to identify the species of Proconiini that produce brochosomes-for-eggs, occurring in orchards of *Citrus sinensis* (L.) Osbeck ('Valencia' oranges) in the state of Rio Grande do Sul; (2) to develop a dichotomic key for species that produce these brochosomes; and (3) to relate each brochosomes structure to its respective species.

## Materials and Methods

The specimens were collected from October 1999 to December 2000, using yellow sticky traps (Azevedo-Filho & Prates-Junior 2000). Specimens were taken from eight orchards of *C. sinensis* located in six counties, in the state of Rio Grande do Sul: two orchards in Tenente Portela, two in Jaguari, and one in each of the following: Ijuí, Harmonia, Taquari, and Pelotas. New samples were collected between October 2001 and March 2002, in Taquari and Montenegro (one orchard per county). After collection, Proconiini specimens containing brochosomes-for-eggs were placed in glass containers filled with ethylic ether (for removal of the glue from the sticky trap), immersed in alcohol at 70%, and mounted with entomological pins.

Proconiini specimens were diagnosed by using a dichotomous key, descriptions and redescriptions (Schröder 1959; Young 1968; Emmrich 1975, 1984; Marucci *et al*. 2002). Insects were drawn using a stereoscopic microscope equipped with a camera lucida.

Small samples of brochosomes were collected from the convex masses located on the forewings using a histological needle, and fixed on a stub with a sticky carbon tape. Next, the samples went through a process of metallization, underwent analyses, and were photographed with a scanning electron microscope (SEM). Brochosomes were measured (µm) by means of computer resources available in SEM. Measurements (median length and width) correspond to the mean of 10 samples.

Specimens were taken to the Museu de Ciência e Tecnologia da Pontifícia Universidade Católica do Rio Grande do Sul (MCTP), in Porto Alegre, RS, Brazil.

## Results and Discussion

The data showed that seven Proconiini species produced brochosomes-for-eggs in orchards of *C. sinensis,* in Rio Grande do Sul: (1) *A. citrina*, (2) *H. ignorata,* (3) *M. consolida,* (4) *M. lineiceps,* (5) *M. magna,* (6) *O. facialis,* and (7) *O. fusca.*

The brochosomes-for-eggs analyzed were highly diversified; however, each species had a specific structure, which allowed for identification.

### Dichotomous Key for Leafhoppers Occurring in Citrus Orchards, Based on Brochosomes-for-Eggs

1. Filiform brochosomes…….....……...……2
1'. Fusiform brochosomes……..……5
2. Reticulate extremities…….……..…….....……3
2'. Smooth extremities…….……...……4
3. Presence of depressed areas (Figs. 2D and 3G-H).....
.....*M. consolida*
3'. Absence of depressed areas (Figs. 2F and 4C-D).....
.....…….....……*M. magna*
4. Presence of conspicuous orifice (Figs. 2C and 3E-F).....
....…….....……*H. ignorata*
4'. Absence of conspicuous orifice (Figs. 2B and 3C-D).....
.....…….....……..*A. citrina*
5. Reticulate (Figs. 2E and 4A-B)……*M. lineiceps*
5'. Reticulate with smooth apex……..6
6. Transition line between the reticulate and the smooth areas, inclined (Figs. 2G and 4E-F)…….....…….*O. facialis*

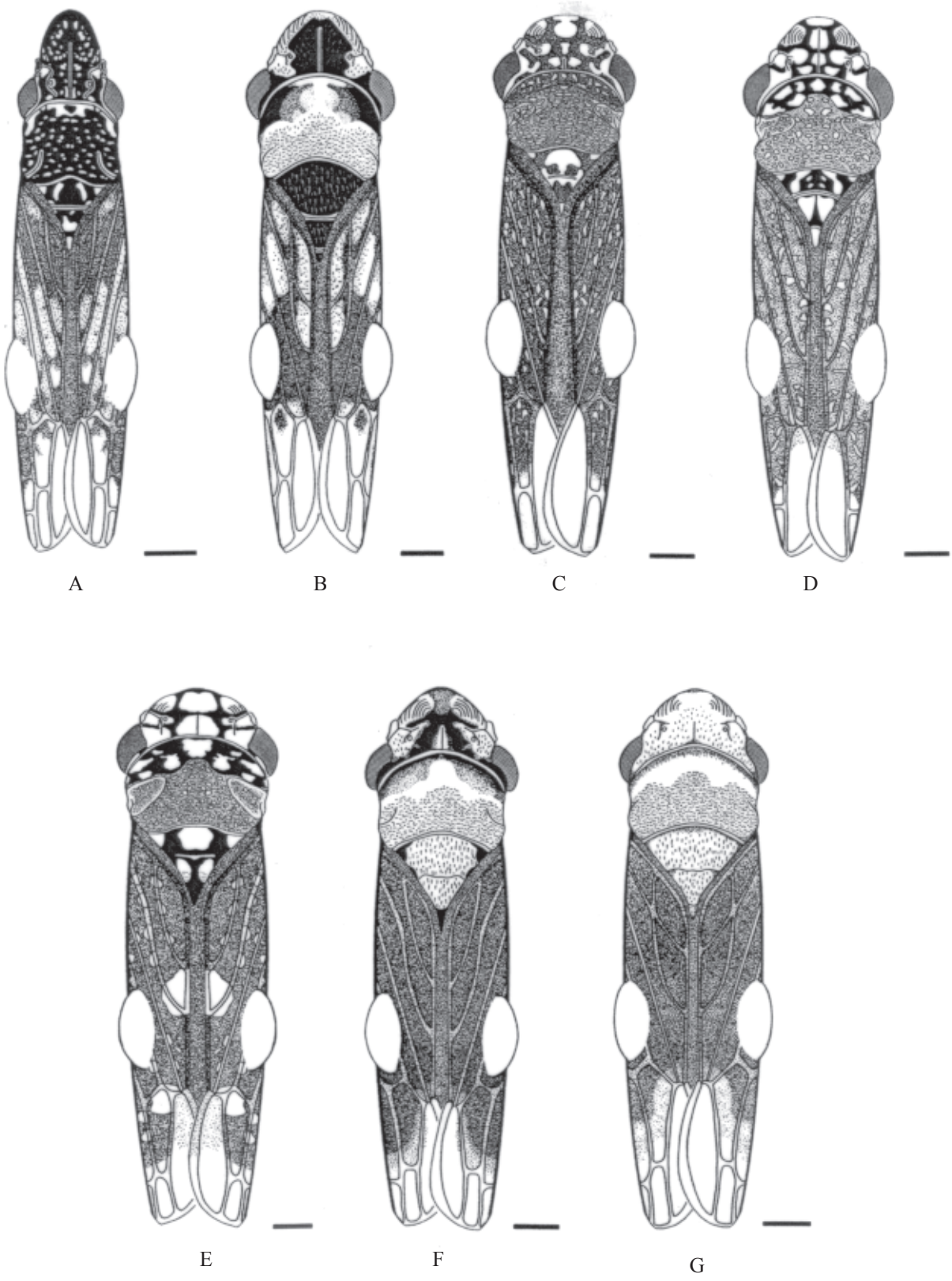


Figure 1. Proconiini females with masses of brochosomes attached to forewings (dorsal view). A. *A. citrina*; B. *H. ignorata*; C. *M. consolida*; D. *M. lineiceps*; E. *M. magna*; F. *O. facialis*; G. *O. fusca*. Scale = 1 mm.

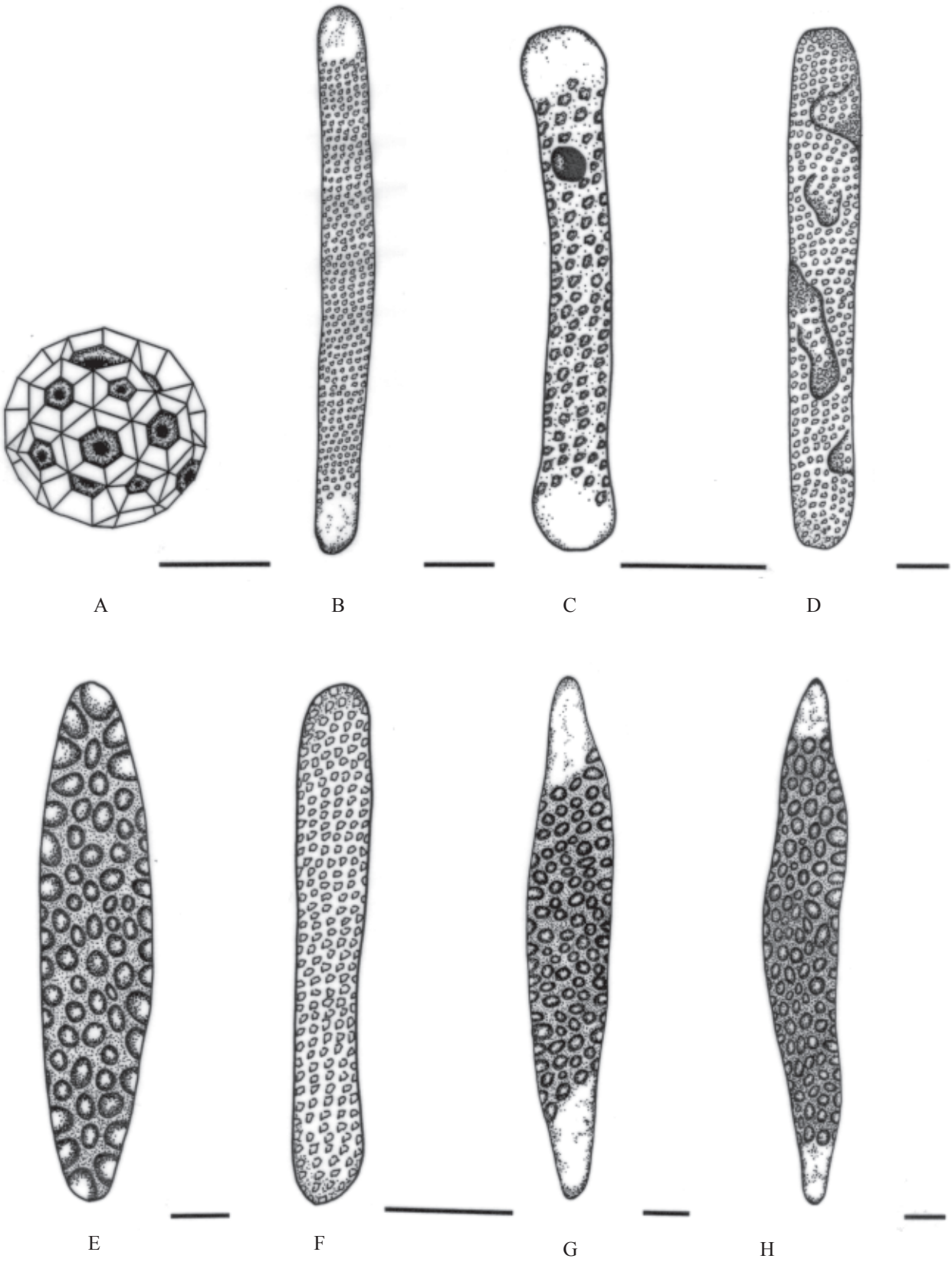


Figure 2. Brochosomes of Proconiini. (A: brochosome-for-integument; B-H: brochosomes-for-eggs). A. *O. fusca*; B. *A. citrina*; C. *H. ignorata*; D. *M. consolida*; E. *M. lineiceps*; F. *M. magna*; G. *O. facialis*; H. *O. fusca*. Scales: A = 0.25 mm; B-H= 1 mm.

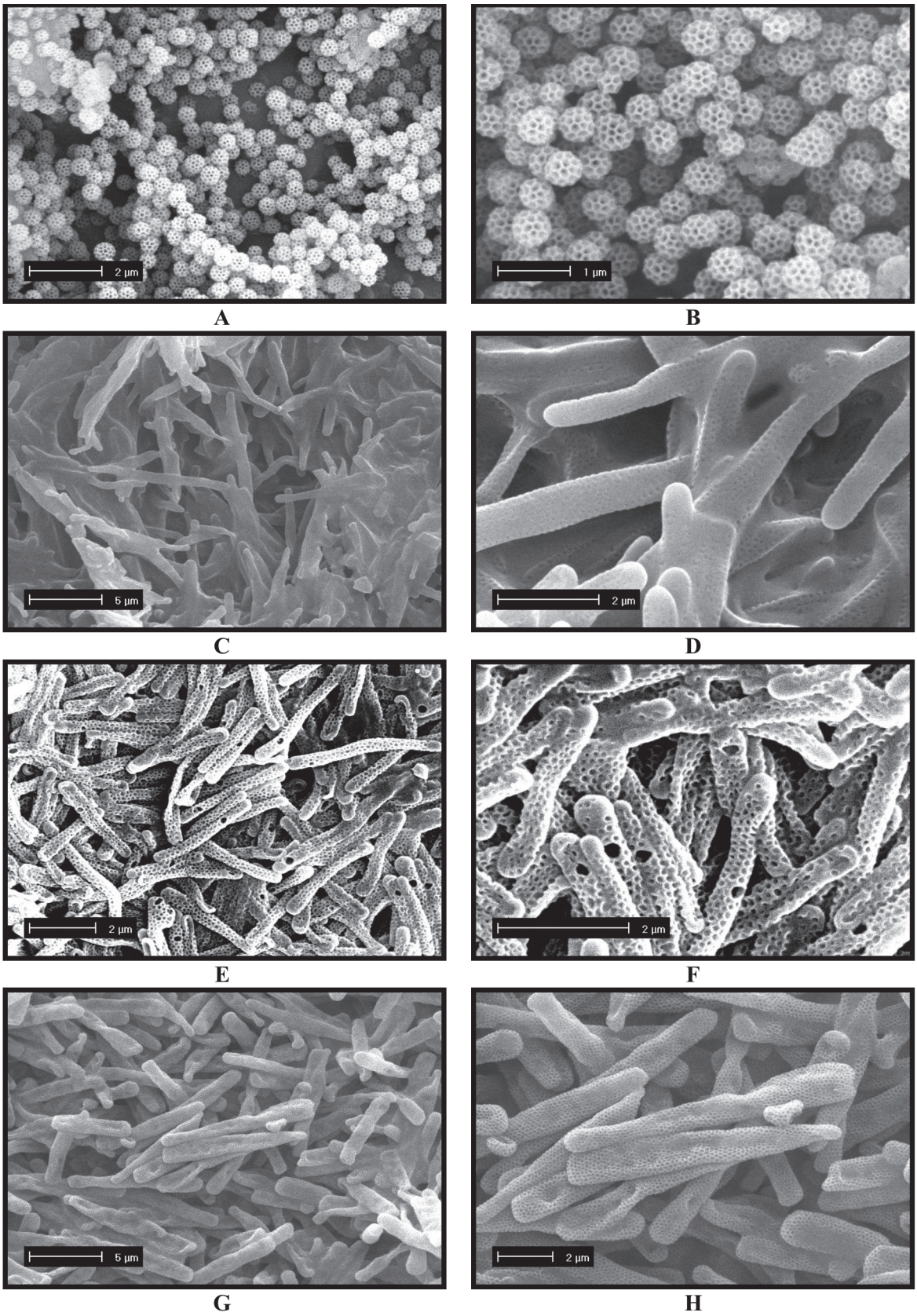


Figure 3. Brochosomes of Proconiini (A-B: brochosomes-for-integument; C-H: brochosomes-for-eggs). A-B. *O. fusca*; C-D. *A. citrina*; E-F. *H. ignorata*; G-H. *M. consolida.*

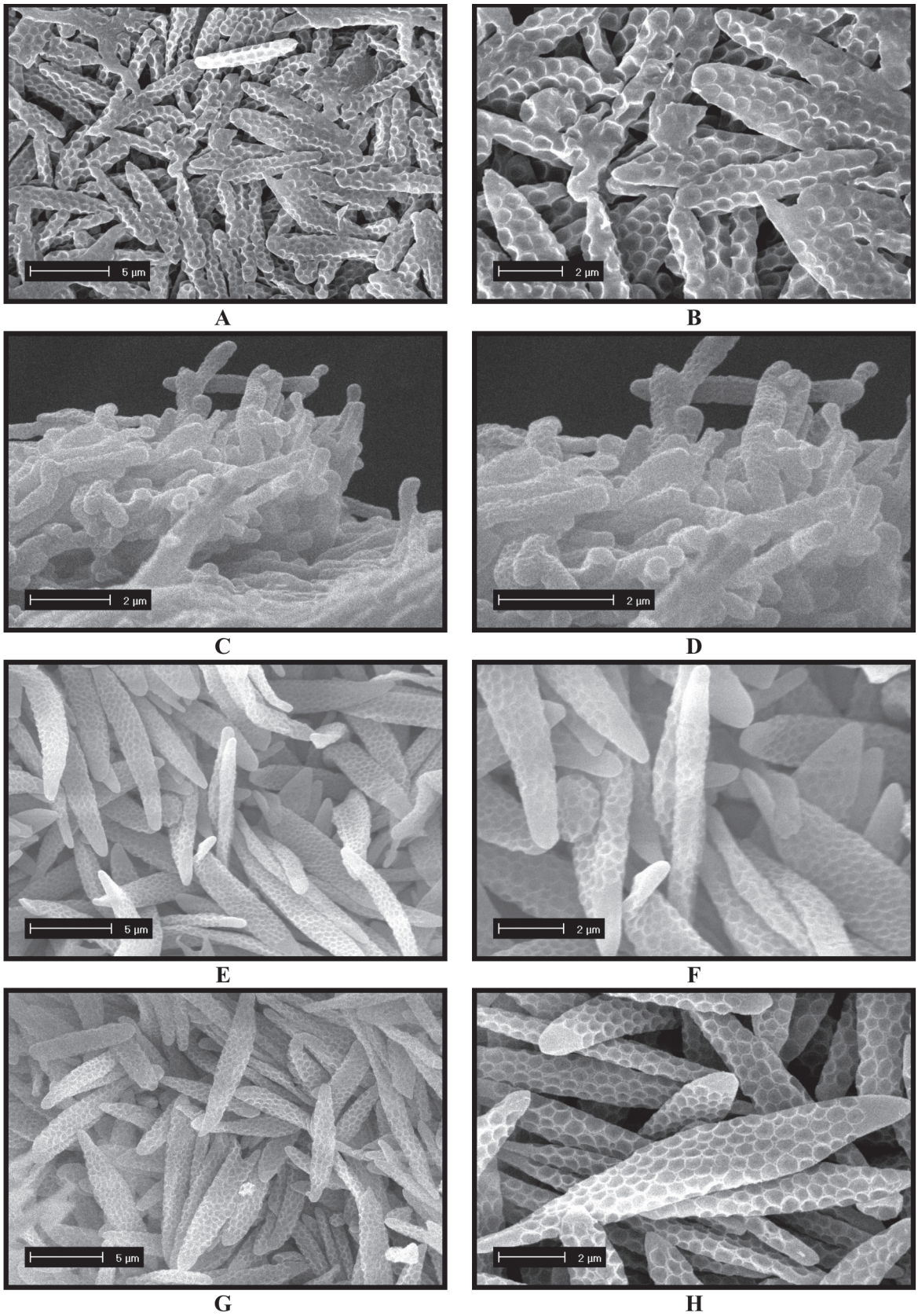


Figure 4. Brochosomes-for-eggs of Proconiini. A-B. *M. lineiceps*; C-D. *M. magna*; E-F. *O. facialis*; G-H. *O. fusca*.

6'. Transition line between the reticulate and the smooth areas, straight (Figs. 2H and 4G-H)……..……*O. fusca*

***Acrogonia citrina* Marucci & Cavichioli, 2002**
(Figs. 1A, 2B, and 3C-D)

**Brochosomes-for-Eggs.** Length: 9.64 µm; width: 0.82 µm. General aspect: filiform, reticulate, smooth extremities (Figs. 2B and 3C-D).

**Material Examined.** BRAZIL. *Rio Grande do Sul*: Tenente Portela, iii.2000 (V.M. Soares), one female (MCTP); Jaguari, ii.2000 (R.F. Martini), two females (MCTP).

**Comment.** Although very impregnated with the glue from the sticky traps, structures were similar to *H. ignorata* but without the orifice.

***Homalodisca ignorata* Melichar, 1924**
(Figs. 1B, 2C, and 3E-F)

**Brochosomes-for-Eggs.** Length: 3.78 µm; width: 0.48 µm. General aspect: filiform, reticulate, with smooth extremities, and slightly dilated; conspicuous orifice (Figs. 2C and 3E-F).

**Material Examined.** BRAZIL. *Rio Grande do Sul*: Taquari, 23.i.2001 (C.E. Pulz), one female (MCTP); Montenegro, 04-19.xii.2001 (A.P. Ott), two females (MCTP).

**Comment.** Similar to brochosomes-for-eggs of *Homalodisca coagulata* (Say) (Hix 2001); however, can be easily differentiated by the large number of reticules and by the conspicuous orifice.

***Molomea consolida* Schröder, 1959**
(Figs. 1C, 2D, and 3G-H)

**Brochosomes-for-Eggs.** Length: 10.41 µm; width: 1.15 µm. General aspect: filiform and reticulate, with depressed areas located irregularly (Figs. 2D and 3G-H).

**Material Examined.** BRAZIL. *Rio Grande do Sul*: Tenente Portela, x.1999 (V.M. Soares), one female (MCTP); *idem*, i.2000 (V. M. Soares), two females (MCTP).

**Comment.** Although similar to brochosomes of *M. magna*, are larger and have depressed areas.

***Molomea lineiceps* Young, 1968**
(Figs. 1D, 2E, and 4A-B)

**Brochosomes-for-Eggs.** Length: 6.89 µm; width: 1.02 µm. General aspect: fusiform and reticulate (Figs. 2E and 4A-B).

**Material Examined.** BRAZIL. *Rio Grande do Sul*: Tenente Portela, viii.2000 (V.M. Soares), one female (MCTP); Ijuí, i.2000 (E.K. Arno), one female (MCTP); *idem*, x.2000 (E.K. Arno), one female (MCTP); Jaguari, vii.2000 (R.F. Martini), one female (MCTP); *idem*, ix.2000 (R.F. Martini), one female (MCTP); *idem,* xii.2000 (R.F. Martini), one female (MCTP).
**Comment.** Different from brochosomes-for-eggs of *M. consolida* and *M. magna* in form but similar to brochosomes-for-eggs of *Oncometopia orbona* (Fabricius), as discussed by Rakitov (2000, 2002).

***Molomea magna* (Walker, 1851)**
(Figs. 1E, 2F, and 4C-D)

**Brochosomes-for-Eggs.** Length: 3.54 µm; width: 0.53 µm. General aspect: filiform and reticulate (Figs. 2F and 4C-D).

**Material Examined.** BRAZIL. *Rio Grande do Sul*: Pelotas, xii.2000 (E.A. Rossetto), one female (MCTP).

**Comment.** Similar to *M. consolida* brochosomes-for-eggs but significantly smaller and without depressed areas.

***Oncometopia facialis* (Signoret, 1854)**
(Figs. 1F, 2G, and 4E-F)

**Brochosomes-for-Eggs.** Length: 12.62 µm; width: 2.31 µm. General aspect: fusiform, reticulate, with smooth extremities and transition lines between the reticulate and the smooth areas, inclined (Figs. 2G and 4E-F).

**Material Examined.** BRAZIL. *Rio Grande do Sul*: Tenente Portela, viii.2000 (V.M. Soares), one female (MCTP); *idem*, ix.2000 (V.M. Soares), one female (MCTP); Ijuí, ii.2000 (E.K. Arno), one female (MCTP); Jaguari, i.2000 (R.F. Martini), one female (MCTP); *idem*, ii.2000 (R.F. Martini), one female (MCTP); Harmonia, i.2000 (L.H. Moraes), one female (MCTP); *idem*, ii.2000 (L.H. Moraes), one female (MCTP).

**Comment.** Similar to brochosomes-for-eggs found in *O. orbona* (Rakitov 2000, 2002) and *M. lineiceps*, the difference being in the smooth extremities.

***Oncometopia fusca* Melichar, 1925**
(Figs. 1G, 2H, and 4G-H)

**Brochosomes-for-Eggs.** Length: 9.13 µm; width: 1.61 µm. General aspect: fusiform, reticulate, with smooth extremities and straight transition line between the reticulate and the smooth areas (Figs. 2H and 4G-H).

**Material Examined.** BRAZIL. *Rio Grande do Sul*: Montenegro, 23.i.2001 (C.E. Pulz), two females (MCTP); *idem*, 16.i-07.ii.2002 (A.P. Ott), one female (MCTP).

**Comment.** Similar to the structures found in *O. facialis* but different in the straight transition line between the reticulate area and the smooth extremity.

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