SYSTEMATICS, MORPHOLOGY AND PHYSIOLOGY

A Closer Look at Intraspecific Variation of *Cerataphis brasiliensis* (Hempel) (Hemiptera: Hormaphididae)

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Um Olhar Minucioso na Variação Intra-Específica de *Cerataphis brasiliensis* (Hempel) (Hemiptera: Hormaphididae)

RESUMO - O objetivo desse estudo foi caracterizar *Cerataphis brasiliensis* Hempel, um afídeo de palmeiras nativas de savanas tropicais (cerrado), e registrar a variação intra-específica. Foram encontradas duas formas de fêmeas partenogenéticas viviparas ápteras de *C. brasiliensis*, diferenciadas por caracteres mensuráveis e qualitativos: (i) comprimento dos chifres cefálicos, (ii) número de segmentos da antena, (iii) presença ou ausência de glândulas de cera, (iv) localização do sifúnculo.

PALAVRAS-CHAVE: Afídeo, caráter morfológico, Arecaceae, savana tropical, cerrado

ABSTRACT - The aim of our study was to characterize *Cerataphis brasiliensis* Hempel, an aphid of native palm tree of tropical savannas (cerrado), and to record intraspecific variation. We found two parthenogenetic forms of apterous viviparae females of *C. brasiliensis*. We differentiate the two forms through measurable and qualitative characters: (i) length of cephalic horns, (ii) number of antennal segments, (iii) presence or absence of wax glands, (iv) location of siphunculi.

KEY WORDS: Aphid, morphological character, Arecaceae, tropical savanna, cerrado

In aphids, the occurrence of intra-population polymorphism is very common. This polymorphism is related to two biological characteristics of the life cycle of the insect: (i) the alternation between sexual generations and parthenogenetic generations and (ii) the seasonal alternation among host plants (Hille His Lambers 1953, Stern *et al*. 1995).

The term "form" should be understood, in this work, as an intra-specific variation. Therefore, each form refers to a group of individuals that share similar morphological or diagnostic characters.

The genus *Cerataphis* Lichtenstein is circumtropical but probably originated in Southwest Asia. It is associated with palms, orchids, bamboo and possibly *Styrax* sp. (Eastop 1966). Nine species have been described within the genus (Remaudière & Remaudière 1997; Qiao & Zhang 2001), of which Costa *et al*. (1993) reported three species from Brazil.

Taxonomic problems involving *Cerataphis brasiliensis* (Hempel) and the presence of a second type of apterous viviparae female which appears when the rates infestation are on high levels in the palms of native tropical savanna (*cerrado*) from Mato Grosso state, encouraged this study.

Our work was carried out to present diagnostic characters for both apterous viviparae female forms and its respective nymphs and winged forms, as well to record the occurrence of form 2 in Brazil on native palms of the tropical savanna.

Material and Methods

We used aphids collected every fifteen days on *Mauritiella armata* (Mart.) Burret (Arecaceae) plants at the Bacaba Park in Nova Xavantina, Mato Grosso state, Brazil (14º 41' S e 52º 20' W), from August 2001 to July 2002. Apterous viviparae were slide mounted according to Martin (1983). Aphid colonies exceeding ten individuals were counted fortnightly on seven species of palms: *Mauritiella armata* (Mart.) Burret, *Mauritia flexuosa* L., *Syagrus flexuosa* (Mart.) Becc., *Desmoncus leptoclomus* (Barb. Rodr.), *Oenocarpus distichus* Mart., *Bactris* sp. A, *Bactris* sp. B. The species *Alagoptera* sp., *Attalea geraensis* Barb. Rodr., *Attalea phalerata* Mart, ex Spreng. were also observed along one year, but did not present colonies. During one year, we studied 20 plants of *Styrax* spp. to verify presence or absence of galls on the host plant.

The aphids were separated into forms 1 and 2, based on the analysis of morphological characters such as horn size, number of antennal segments, position of the siphunculi and distribution of the wax glands. The *C. brasiliensis* specimens described by Noordam (1991) and validated by Russell (1996) are here referred to as "form 1" and the second type of parthenogenetic viviparae females named by Van der Goot as "Geschwister der geflügelten" are called "form 2".

The forms were compared with *Cerataphis* slides, collected from *Cocos nucifera* (L). (Arecaceae) in Alagoas state, and from *Butia* sp. (Arecaceae) in Brasilia, Distrito Federal, Brazil, from the "Pe. Jesus Santiago Moure" Entomological Collection (DZUP), Curitiba, Paraná state, Brazil. Eight specimens/month of each form were submitted to morphometric studies based on 24 characters, according to Noordam (1991).

Results

Host plants. The aphids were found on the underside of young leaves on the following palms: *M. armata*, *M. flexuosa*, *S. flexuosa, D. leptoclomus*, *O. distichus, Bactris* sp A and *Bactris* sp B. Winged individuals were found only on *M. armata*, *O. distichus*, e *S. flexuosa*. These palms are found in tropical savanna areas in practically all of the east counties of the state of Mato Grosso, and the presence of *C. brasiliensis* has been recorded in all these counties.

Diagnosis. The following characteristics are sufficient to distinguish form 2 from form 1: (i) antennae with five segments (Fig. 1C), unlike form 1 that presents four segments (Fig. 1B); (ii) short horns, curved and robust (arrow on Fig. 1D), contrasting with form 1 whose horns are long and straight (arrow on Fig. 1B); (iii) siphunculi located on the lateral margin of the body (Fig. 2B), differing from form 1 that has sub-marginal siphunculi (Fig. 2A); (iv) wax glands absent from the IV abdominal segment onwards (arrow on Fig. 2B), unlike form 1 that has wax glands on the entire extension of the body (Fig. 2A).

Parthenogenetic apterous viviparae females. These characteristics are pertinent to both forms: (i) body color variable, from reddish brown to black, with a fringe of white wax around the body when alive; (ii) round body, dorsal-ventrally flattened; (iii) three omattidiums laterally on the head (Fig. 2A); (iv) head and prothorax fused, mesothorax and metathorax not very visible and dorsally flat; (v) rhinaria present on the last segment of the antenna; (vi) round

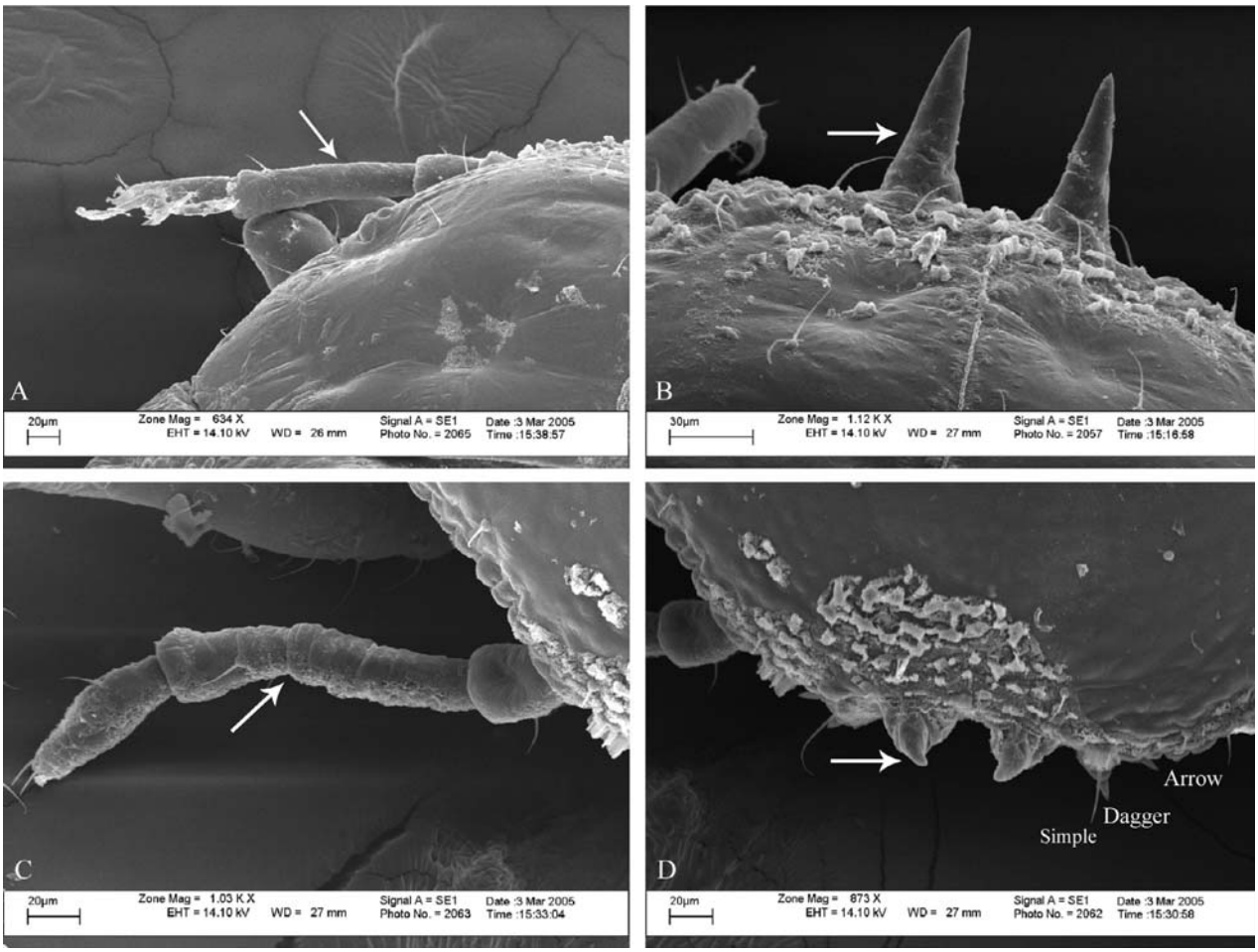

Fig. 1. *C. brasiliensis*: A and B Form 1, C and D Form 2. A. Antenna of Form 1 (arrow showing second antennal segment); B. Long cephalic horns of Form 1 (arrow); C. Antenna of Form 2 (arrow showing division between second and third antennal segment); D. Short cephalic horns of Form 2 (arrow), and position of the ventral cephalic setae (simple, arrow - shaped and dagger - shaped).

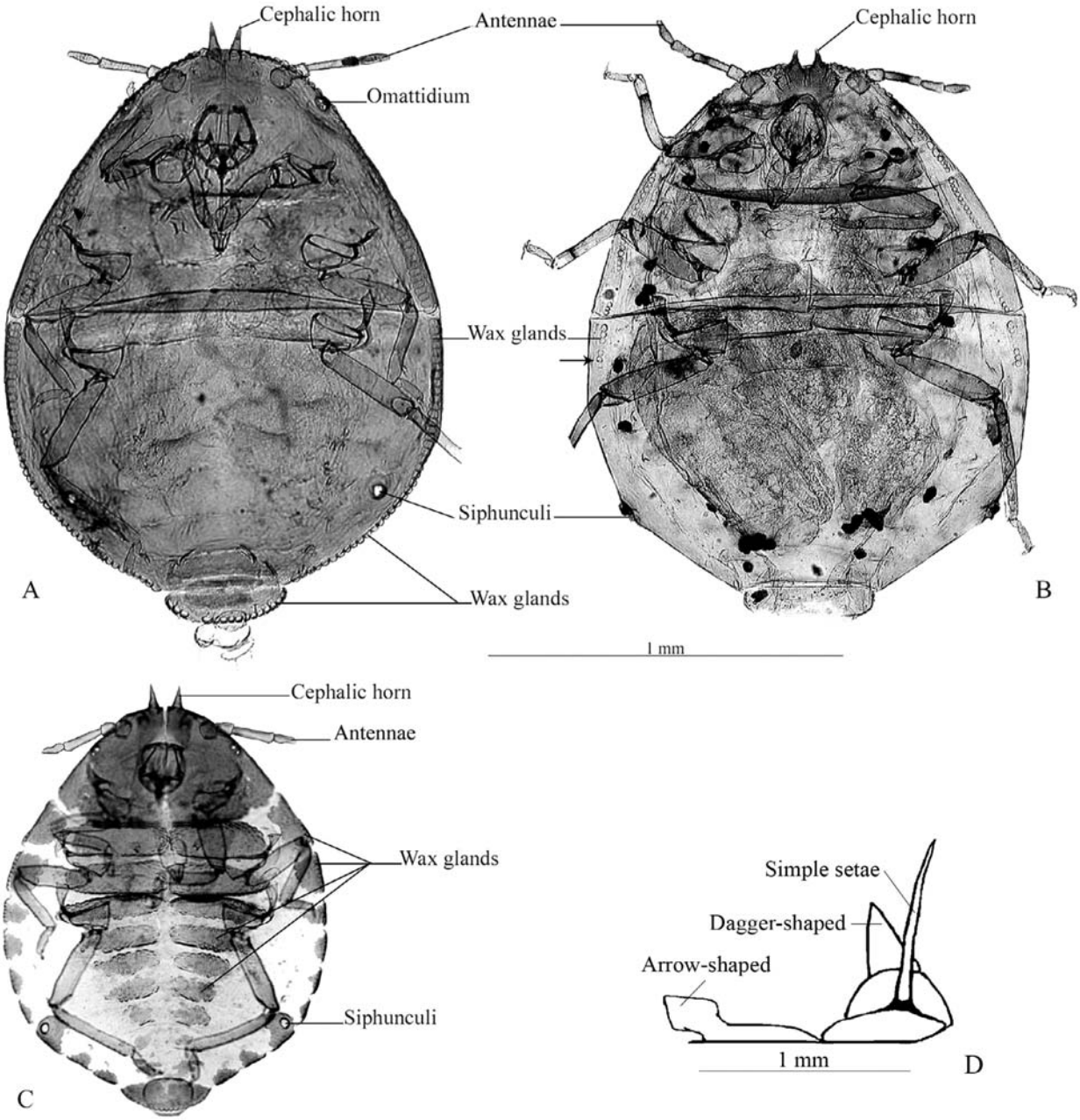

Fig. 2. Parthenogenetic apterous viviparae females of *C. brasiliensis*. A. Form 1; B. Form 2 (arrow showing interruption of wax glands on the last segments); C. Nymphs of Form 1; D. Representation of the proximal (simple), median (arrow - shaped) and distal (dagger - shaped) ventral cephalic setae.

siphunculi, not elongated as in other aphids; (vii) bilobed cauda in all adult specimens.

Nymphs. These characteristics are pertinent to nymphs of both forms: (i) the wax glands are arranged in plates on the margin of the body and in the center of the abdomen (Fig. 2C). (ii) The proximal thorns of the ventral side of the head are dagger-shaped; the medians are shape as arrows, daggers and simple setae (Fig. 2D). The distal setae are simple. (iii) The cauda is round in all young specimens.

Winged form. Parthenogenetic females. Body color variable, from reddish brown to dark brown. Head as in Fig. 3A. Compound eye red. Three ocelli present. The antennae consist of five segments; the third segment is quite long compared to the others (Fig. 3A). Cephalic horns absent. Setae on ventral side of head variable as arrows, daggers or simple setae as in form 2. Forewing and hind wing as in the Figs. 3B and C, respectively. The specimens possess a pair of lateral siphunculi located on the margin of the body, forming two circular pores, with half the circle on the dorsal

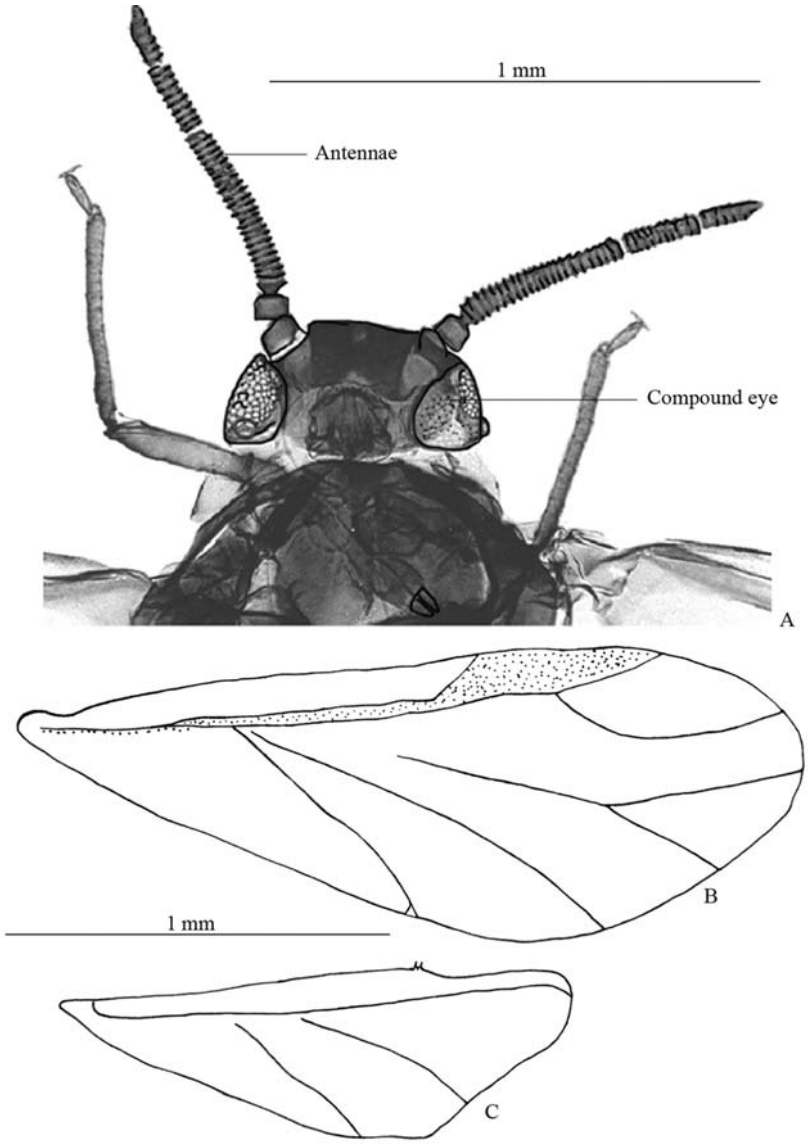

Fig. 3. Parthenogenetic female of *C. brasiliensis*. A. Head and pronotum. B. Right forewing C. Right hindwing.

side and the other half on the ventral side of the abdomen. The subanal plate is bilobed and contains five to nine setae. The subgenital plate is rounded, with 16 to 25 setae. Abdominal segment VIII with six to 12 setae.

Form 1. Parthenogenetic apterous viviparae females. The measurements of form 1 corresponded to the measurements of Noordam (1991) for *C. brasiliensis* (Table 1). The antennae of form 1 consist of four segments (escape, pedicel, and two flagella segments). The third segment is quite long in relation to the others (arrow on Fig. 1A). The cephalic horns are long and straight, wide at the base and gradually thinner until the apices (Fig. 1B). Proximal setae on the ventral side of head are simple, the median ones dagger-shaped, and the distal setae are always simple. The wax glands are juxtaposed and arranged laterally, present on the entire circumference of the body, giving it a crenular appearance, except at the cephalic thorn region (Fig. 2A). The specimens possess a pair of lateral siphunculi submarginal to the body, forming two circular pores on the dorsum of the insect with setae around them (Fig. 2A). Subanal plate with four two eight setae. Subgenital plate with 15 to 25 setae. Abdominal segment VIII with four to 18 setae. **Nymphs:** These present four antennal segments, evident horns; siphunculi submarginal as in the adults (Fig. 2C).

Form 2. Parthenogenetic apterous viviparae females. The measurements of form 2 correspond to the measurements of Noordam (1991) for *C. palmae* (Table 1). The antennae of form 2 consist of five segments (Fig. 1C). The lengths of the third and fourth segments do not show large variation (arrow on Fig. 1C). The cephalic horns are short, curved inwards, robust in

Table 1. Measurements on *C. brasiliensis*.

Characters	Form 2 (n = 74)		Form 1 (n = 92)	
	Mean ± SD	Max. - Min.	Mean ± SD	Max. - Min.
Body length	1.443 ± 0.101	1.220 - 1.750	1.367 ± 0.143	1.110 - 1.770
Hind femur length	0.294 ± 0.021	0.230 - 0.350	0.270 ± 0.030	0.200 - 0.360
Hind tibiae length	0.259 ± 0.068	0.135 - 0.360	0.233 ± 0.059	0.150 - 0.350
Right cephalic horn	0.052 ± 0.011	0.025 - 0.075	0.080 ± 0.012	0.040 - 0.105
Left cephalic horn	0.052 ± 0.014	0.028 - 0.088	0.081 ± 0.013	0.040 - 0.107
III right antennal segment	0.099 ± 0.036	0.065 - 0.163	0.120 ± 0.015	0.088 - 0.163
IV right antennal segment	0.062 ± 0.009	0.040 - 0.083	0.045 ± 0.006	0.028 - 0.063
V right antennal segment	0.039 ± 0.017	0.022 - 0.055	--	--
Right terminal process	0.027 ± 0.003	0.018 - 0.038	0.028 ± 0.004	0.022 - 0.040
III left antennal segment	0.091 ± 0.020	0.055 - 0.163	0.120 ± 0.016	0.085 - 0.160
IV left antennal segment	0.064 ± 0.008	0.043 - 0.087	0.045 ± 0.006	0.028 - 0.063
V left antennal segment	0.042 ± 0.012	0.022 - 0.055	--	--
Left terminal process	0.029 ± 0.006	0.020 - 0.075	0.032 ± 0.031	0.020 - 0.033
Stilet	0.282 ± 0.087	0.255 - 0.353	0.260 ± 0.078	0.230 - 0.422
Last rostral segment	0.069 ± 0.066	0.050 - 0.063	0.053 ± 0.005	0.030 - 0.065
I hind tarsi	0.036 ± 0.003	0.025 - 0.048	0.032 ± 0.004	0.025 - 0.045
II hind tarsi	0.082 ± 0.006	0.068 - 0.093	0.074 ± 0.008	0.045 - 0.095

Standard deviation (SD), maximum (Max.) and minimum (Min.) values in mm.

their extension and abruptly thinner at the apex (arrow on Fig. 1D). Proximal, median and distal setae on the ventral side of the head variable as arrows, daggers or simple setae (Fig. 1D and 2D). The wax glands are also juxtaposed and arranged, located on the head, except in the region of the cephalic horns, on the thorax and on abdominal segments I-III (arrow on Fig. 2B), absent on abdominal segments IV-VIII. The specimens possess a pair of lateral siphunculi located on the margin or border of the body, forming two circular pores, with half the circle on the dorsal side and the other half on the ventral side of the body, surrounded by setae (Fig. 2B). Supraanal plate with five to nine setae, subgenital plate with 16 to 25 setae. Abdominal segment VIII with six to 12 setae. **Nymphs:** The majority of specimens had five antennal segments, the right antenna of some specimens consisted of four segments. Horns short, curved and robust; siphunculi as in the adults.

Discussion

Prior to our work, only *C. brasiliensis* with "long cephalic horns" was recorded from Brazil. We discovered a second form, with "short horns", on native palms of the tropical savanna. The polymorphism found in *C. brasiliensis* can be considered intra-populational because specimens of both forms were found together in the same colony and the same population (Ridley 1993).

Specimens of form 1 of *C. brasiliensis* showed great similarity with the descriptions of *C. palmae* and *C. lataniae* (Noordam 1991), whereas form 2 showed great similarity with *C. variabilis*. The species *C. palmae* and *C. variabilis* are synonyms of *C. brasiliensis* (see Russell 1996), but *C. lataniae* is a valid name. Because of this, we suggest new studies with the populations of *Cerataphis* especially with *in vivo* specimens. The presence of winged individuals was observed during November and July, but only in colonies with high densities of aphids. It was not possible to differentiate forms among the winged individuals.

The presence of galls of *C. brasiliensis* was never observed on *Styrax* spp. plants. The aphids do not alternate host plants in the region of Nova Xavantina, Mato Grosso. The aphids use a wide variety of plants in the Arecaceae family, allowing them to exploit seasonal host plants suitability.

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