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Sección Básica

Artículos de investigación

Cardinal distribution of sucking insects in *Caryocar brasiliense* (Caryocaraceae) in e Cerrado (Brazil)

Insectos chupadores in *Caryocar brasiliense* (Caryocaraceae) en el Cerrado (Brasil)

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Abstract: *Caryocar brasiliense* (Caryocaraceae), a tree characteristic of e Cerrado, is widely distributed and can reach a height of 10 meters with a six-meter-wide canopy. The objective of this study was to study the distribution of sucking insects (Hemiptera) and their natural enemies in the canopies of *C. brasiliense* trees in the Brazilian Cerrado. One rare, nine common, and one constant species of sucking insects and three rare, seven common, and four constant species of natural enemies were observed on *C. brasiliense* trees. The diversity, number of individuals, and species of Hemiptera and their natural enemies were similar in all four cardinal directions of branches of host trees. Abundance of the natural predators *Crematogaster* sp. (Hymenoptera: Formicidae) and *Zelus armillatus* (Hemiptera: Reduviidae) was highest on leaves of the east and north sides of the *C. brasiliense* trees, respectively. A large number of *Crematogaster* sp. was observed on *C. brasiliense*, with a predominance of *Dikrella caryocar* n. sp. (Hemiptera: Cicadellidae) and *Pseudoccocus* sp. (Hemiptera: Pseudococcidae) also being observed. The predators *Trybonia* sp. (Thysanoptera: Phlaeothripidae) and *Chrysoperla* sp. (Neuroptera: Chrysopidae) showed the highest numbers, while the number of *D. caryocar* n. sp. and *Aphis gossypii* (Aphididae) decreased, respectively, in comparison to the control. An increase in the number of sucking insects also increased the number of their natural enemies, and this differential distribution negatively influenced sucking insects. The speed and direction of wind may have affected the distribution of sucking insects on different sides of *C. brasiliense* trees, as higher populations were found on the sides without prevailing winds.

Key words: Canopy. Insect distribution. Leafhoppers. Natural enemies. Pequi.

Resumen: *Caryocar brasiliense* (Caryocaraceae), un árbol símbolo de el Cerrado, tiene una amplia distribución y puede alcanzar los 10 m de altura y 6 m de ancho de copa. El objetivo fue estudiar la distribución de insectos chupadores (Hemiptera) y sus enemigos naturales en la copa de *C. brasiliense* en El Cerrado brasileño. La agrupación de las especies encontrada en la copa de los árboles de *C. brasiliense* mostró 1 y 3 especies raras, 9 y 7 especies comunes y 1 y 4 especies constantes para los insectos chupadores y sus enemigos naturales, respectivamente. La diversidad, el número de individuos y la riqueza de especies de Hemiptera y sus enemigos naturales fueron similares en todas las ramas del árbol huésped, según el muestreo en los puntos cardinales. Los depredadores *Crematogaster* sp. (Hymenoptera: Formicidae) y *Zelus armillatus* (Hemiptera: Reduviidae) fueron más abundante en la ramas orientadas hacia el este y el norte, respectivamente. *Crematogaster* sp. fue dominante en los árboles de *C. brasiliense* con predominio de *Dikrella caryocar* n. sp. (Hemiptera: Cicadellidae) y *Pseudoccocus* sp. (Hemiptera: Pseudococcidae). Los depredadores *Trybonia* sp. (Thysanoptera: Phlaeothripidae) y *Chrysoperla* spp. (Neuroptera: Chrysopidae) fueron mayores y disminuyeron el número de *D. caryocar* n. sp. y *Aphis gossypii* (Aphididae), respectivamente. El incremento de insectos chupadores aumentó la presencia de los enemigos naturales y la distribución diferencial de éstos influyó negativamente en los insectos chupadores. Se concluye que la velocidad y dirección de los vientos pueden afectar la distribución de insectos chupadores en la copa de los árboles de *C. brasiliense*, encontrándose las poblaciones más numerosas en la zona que no es afectada por el viento.

Palabras clave: Copa. La distribución de los insectos. Saltamontes. Enemigos naturales. Pequí.

Introduction

The Brazilian savanna Cerrado, which is characterized by a high diversity and endemism of plants and insects (Bridgewater *et al*. 2004), occupies approximately 23% of the Brazilian territory (Da Silva and Bates 2002). As a result of increasing threats to its biodiversity, this biome has been designated a biodiversity hotspot (Myers *et al*. 2000). The Cerrado is used primarily for grain and cattle production (Aguiar and Camargo 2004), in addition to forest cultivation with exotic species, primarily eucalyptus (Zanuncio *et al*. 2002). Government incentives have facilitated the deforestation of the Cerrado, and its vegetation has been reduced to 20% of the original amount (Klink and Machado 2005). It has a complex mosaic of phytophysiognomies that range from open savanna ("campo limpo") to tall and woody forests of 10-15 meters high, called "cerradão" (Oliveira and Marquis 2002). Large patches of rich Cerrado in southeastern

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Brazil are used for agriculture (primarily soybean and sugar cane), cattle farms and cities (urbanization), with similar uses to those of the Montes Claros region in northern Minas Gerais State.

Caryocar brasiliense Camb. (Caryocaraceae) or "pequí" is a characteristic tree of the Cerrado. It has a wide distribution (Brandão and Gavilanes 1992; Bridgewater *et al*. 2004; Leite *et al*. 2006a) and can reach a height of 10 meters with a six-meter-wide canopy (Leite *et al*. 2006a, 2011a, 2012a). Its fruits have an internal mesocarp that is rich in oil, vitamins, and proteins as well as compounds of medicinal importance. The fruits are used as food, in production of cosmetics and lubricants, and in the pharmaceutical industry (Segall *et al*. 2005; Ferreira and Junqueira 2007; Garcia *et al*. 2007; Khouri *et al*. 2007). Besides, they represent the main income source of many communities that remain in the deforested areas of the Brazilian Cerrado (Leite *et al*. 2006a)**.** Fruit collectors favor leaves, flowers and fruits, and sucking insects (Hemiptera) with a high number of species incur higher damage on isolated trees (Freitas and Oliveira 1996; Oliveira 1997; Boiça *et al*. 2004; Leite *et al*. 2009, 2011a,b,c,d,e, 2012a) and in tree seedlings (Leite *et al*. 2006b). It is necessary to understand the ecology of the insects on this valuable tree, which both occurs naturally and is planted in the Brazilian Cerrado.

The position of branches on a tree affects the abundance of insects due to 1) the wind direction (Feng *et al*. 2005; Leite *et al*. 2011c, d, e), which causes leaf desiccation and the fall of flowers and fruits (Leite *et al*. 2006a); 2) the sun exposure, which may influence the quality of the host plant tissues (Unsicker and Mody 2005); 3) the creation of microclimates, and 4) the impact of herbivores, which prefers the parts of plants that have the smallest presence of natural enemies (enemy-free space) (Unsicker and Mody 2005). The identification of potential pests and their spatial distribution on the crown of forest and agriculture plants is important for sampling plans (Nichols-Orians 1991; Casas and Aiuja 1997; Villanueva and Childers 2005; Evans and Gregoire 2007). Sucking insects are abundant among the fauna in the Cerrado (Pinheiro *et al*. 2002). For the present study, they were reared on *C. brasiliense* to support management programs for pests of this plant and to study their spatial distribution at tree level. The objective was to study the distribution of sucking insects (Hemiptera) and their natural enemies in the canopy of *C. brasiliense* trees in the Brazilian Cerrado.

Material and methods

Study area. This study was conducted in the Municipality of Montes Claros, Minas Gerais State, Brazil (43º55'7.3"W 16º44'55.6"S), at 943 masl, from January to December 2010. The region, called Cerrado, has a dry winter and rainy summer. According to Köppen, its climate is categorized as Aw (tropical) (Vianello and Alves 2000). The vegetation is typical of cerrado (savanna), and the region has a dystrophic yellow red latosoil (sandy texture). In previous studies, a density of thirteen *C. brasiliense* trees was found per hectare in the study area (size around of 50 ha) (Leite *et al*. 2006a, 2011b). "Cerrado" refers to the biome, and "cerrado" refers to the physiognomy (vegetation type); latter is the subject of this paper.

System. The system of study was the "pequi"-herbivores-enemies. The adult *Caryocar brasiliense* trees were 4.07 ± 0.18 m (average ± standard error) high and had an average crown width of 2.87 ± 0.13 m (Leite *et al*. 2006a). The leaves of *C. brasiliense* are alternate and trifoliate and have high trichome density; the flowers are hermaphrodite, but they are mostly cross-pollinated. Fruit production is annual; *C. brasiliense* blooms between July and September (dry period) and fructifies from October to January (rainy season) (Leite *et al*. 2006a). Fruits are drupes with 1-4 seeds, and they weigh 158.49 ± 8.14 g (fresh weigh), with a volume of 314.90 ± 20.93 cm^3 (Leite *et al*. 2006a).

Study design. The design was completely randomized, with 25 replications (25 trees) in the cerrado *sensu stricto*. The distribution of the sucking insects and their arthropod natural enemies was recorded on three leaves (fully expanded), three curl of flowers, and three fruits per cardinal orientation of the branches using a compass (north, south, west, and east) in each tree, monthly, in the morning (7-11 h) by direct visual observation (Horowitz 1993). The distance between the *C. brasiliense* trees evaluated was approximately 50 m, and they were located at least 100 m from the edge; for details of the floristic diversity in this area, see Leite *et al*. (2012a).

The insects were collected from the leaves, flowers and fruits with tweezers, brushes and aspirators and were preserved for identification in vials with 70% alcohol and 30% water.

A total of 900 leaves (samples), 225 flowers (samples) from July to September and 240 fruits (samples) from September to January of *C. brasiliense* were evaluated per cardinal orientation.

Statistical analyses. The abundance, species richness, and diversity of the sucking insects and their natural enemies were calculated per cardinal orientation (average). The diversity was calculated using the formula of Hill (Hill 1973), and the abundance and species richness were calculated using Simpson indices (Townsend *et al*. 2006; Lazo *et al*. 2007). The species of sucking insects and their natural enemies were classified according their frequencies as a) constant (≥ 50%), b) common (≤ 49%), or c) rare (≤ 10%) (Siqueira *et al*. 2008).

The correlations between the diversity index, number of individuals, and species of sucking insects and the abundance and species richness of natural enemies (ants, predator thrips, bugs, spiders, ladybirds, and green lacewings) on the numbers of sucking insects were submitted to analysis of variance (ANOVA) ($P < 0.05$), using a simple regression analysis ($P < 0.05$), and the curves were adjusted for the quadratic function, as required. The effect of the cardinal orientation of the branches on the ecological indices, the number of individuals per species of sucking insects and the natural enemies was tested with ANOVA ($P < 0.05$) and Tukey's test ($P < 0.05$).

Results

One rare, nine commons, and one constant species of sucking insects and three rare, seven common, and four constant species of natural enemies were found on the *C. brasiliense* trees (Table 1). Using Hill's diversity index, the number of individuals and species of sucking insects and their natural enemies were similar ($P > 0.05$) among the cardinal sides of *C. brasiliense* trees (Table 2). There were collected 988 and

Table 1. Order, family, species feeding behavior and abundance of insects during the day-time on *Caryocar brasiliense* trees. Montes Claros, Minas Gerais State, Brazil.

Order	Family	Species	Feeding	Abundance
Coleoptera	Carabidae	*Calosoma* sp.	Predator	Rare-L
	Coccinelidae	*Neocalvia fulgurata* Mulsant	Predator	Common-L
Hemiptera	Aethalionidae	*Aethalium reticulatum* L.	Leaves	Rare-L
			Flowers	Rare-Fl
	Aleyrodidae	*Bemisia tabaci* (Genn.)	Leaves	Common-L
	Aphididae	*Aphis gossypii* (Glover)	Leaves	Common-L
	Cercopidae	*Mahanarva* sp.	Leaves	Common-L
	Cicadellidae	*Dikrella caryocar* n. sp. (Coelho, Leite and Da-Silva)	Leaves	Constant-L
		Frequenamia sp.	Leaves	Common-L
	Geocoridae	*Epipolops* sp.	Predator	Common-L
	Membracidae	*Aconophora* sp.	Leaves	Common-L
			Flowers	Rare-Fl
			Fruits	Common-Fr
		NI*	Leaves	Common-L
	Pentatomidae	*Edessa rufomarginata* De Geer	Leaves	Common-L
	Pseudococcidae	*Pseudococcus* sp.	Leaves	Common-L
	Reduviidae	*Zelus armillatus* (Lep. and Servi)	Predador	Constant-L
Hymenoptera	Formicidae	*Camponotus novograndensis* Mayr	Generalist	Common-L
		Cephalotes minutus (Fabr.)	Generalist	Rare-L
		Crematogaster sp.	Generalist	Constant-L
			Generalist	Constant-Fl
			Generalist	Common-Fr
		Dorymyrmex sp.	Generalist	Rare-L
		Pseudomyrmex termitarius Smith	Predator	Constant-L
			Predator	Rare-Fr
Neuroptera	Chrysopidae	*Chrysoperla* sp.	Predator	Common-L
Thysanoptera	Phlaeothripidae	*Holopothrips* sp.	Predator	Constant-L
		Trybonia intermedius Bagnall	Predator	Common-L
		Trybonia mendesi Moulton	Predator	Common-L
Araneae	**	NI*	Predator	Constant-L
			Predator	Common-Fl

* NI = none identified. ** spiders = *Cheiracanthium inclusum* Hentz (Miturgidae); *Peucetia rubrolineata* (Keyserling) (Oxyopidae); *Anelosimus* sp., *Achaearanea hirta* (Taczanowski) (Theridiidae); *Gastromicans albopilosa* Simon, *Chira bicirculigera* Soares and Camargo, *Rudra humilis* Mello-Leitão, *Thiodina melanogaster* Mello-Leitão and *Lyssomanes pauper* Galiano (Salticidae); *Dictyna* sp. and sp.1 (Dictynidae); *Tmarus* sp. and sp. 1 (Thomisidae); *Argiope argentata* (Fabr.), *Gasteracantha cancriformes*, *Argiope* sp., *Parawixia* sp. and sp. 1 (Araneidae); and Anyphaenidae. L = leaves, Fl = flowers, and Fr = fruits.

1191 total individuals of natural enemies and sucking insects, respectively, and 13 species of natural enemies plus spiders (19 species) and 10 species of sucking insects.

The abundance of most of the sucking species on leaves, flowers, and fruits of *C. brasiliense* trees were similar between the cardinal points (Table 3). The predators, *Crematogaster* sp. (Hymenoptera: Formicidae) (df = 72, F = 4.269, P = 0.00785) and *Zelus armillatus* (Lep. and Servi, 1825) (Hemiptera: Reduviidae) (df = 72, F = 2.794, P = 0.04633) presented the highest abundance on leaves from the east and north sides of *C. brasiliense* trees, respectively (Table 3).

The ant *Crematogaster* sp. was more frequent on *C. brasiliense* trees that had larger numbers of *Dikrella caryocar* n. sp. (Coelho, Leite and Da Silva, 2014) (Hemiptera: Cicadellidae) and *Pseudoccocus* sp. (Hemiptera: Pseudococcidae). The numbers of the predators *Trybonia* sp. (Thysanoptera: Phlaeothripidae) and *Chrysoperla* sp. (Neuroptera: Chrysopidae) was inversely correlated to those of *D. caryocar* n. sp. and *Aphis gossypii* (Glover, 1877) (Aphididae), respectively. This pattern was also observed for the number of individuals of sucking insects and those of their natural enemies (Fig. 1).

Discussion

The similar diversity index and number of individuals and species of Hemiptera and their natural enemies on the different sides of *C. brasiliense* may be explained by the low number of constant species of sucking insects (9.10%) and their natural enemies (28.6%) on this tree. In other words, most of the species were found at low population densities.

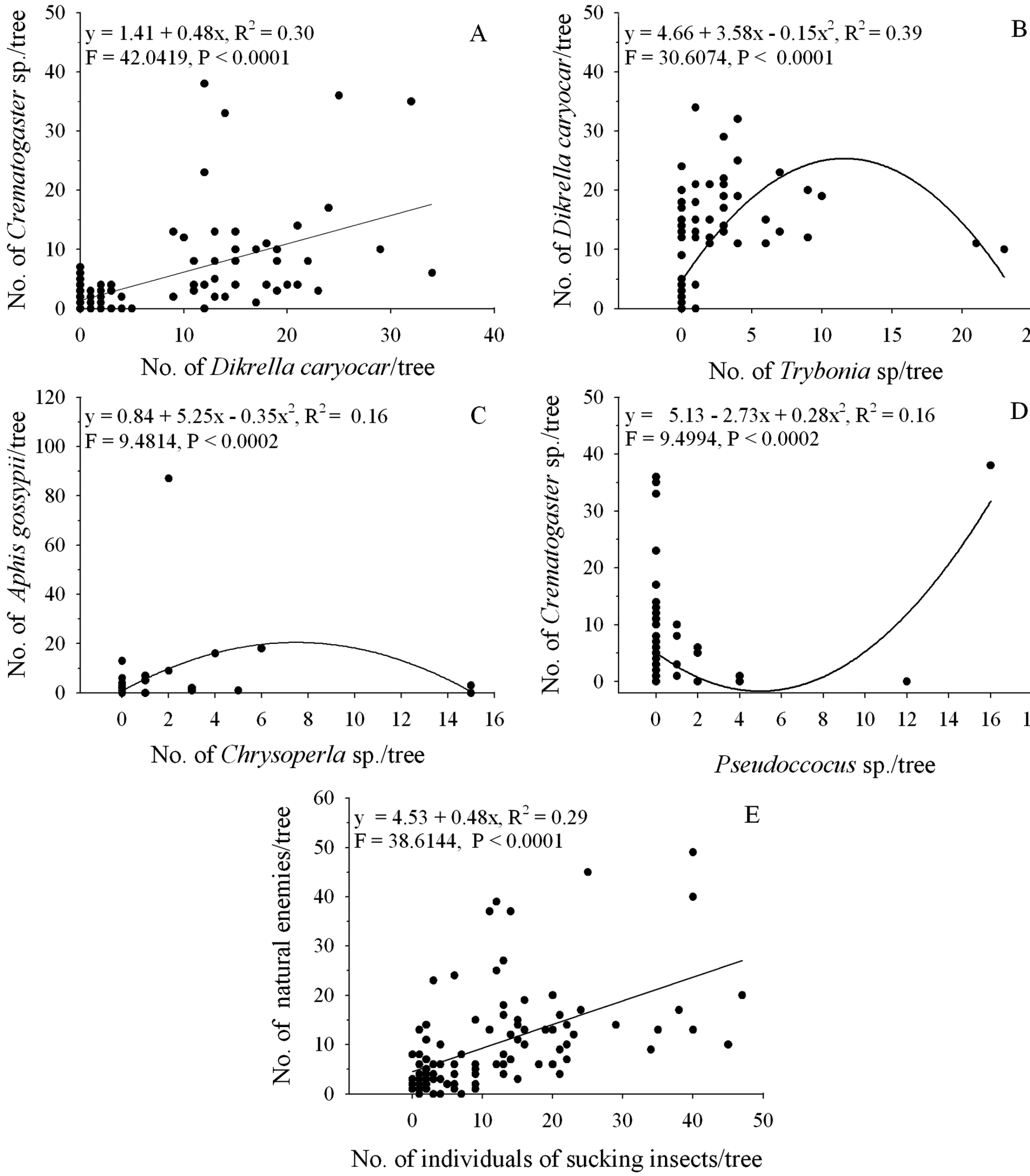

Figure 1. Effect of numbers (mean)/tree of *Dikrella caryocar* n. sp. (**A**) and *Pseudoccocus* sp. (**D**) on those of *Crematogaster* sp. **B.** Numbers of *Trybonia* sp. on those of *Dikrella caryocar* n. sp. **C.** Numbers of *Chrysoperla* sp. on those of *Aphis gossypii*. **E.** Numbers of individuals of sucking insects on those of natural enemies. Montes Claros, Minas Gerais State, Brazil.

It was not possible to detect significant differences among the number of individuals and diversity on different sides in this plant, which may have been due to the higher floristic diversity of the cerrado area. This varies with the insect group considered because the environmental complexity and host plants can influence the diversity of the herbivore arthropods and their natural enemies (Coyle *et al*. 2005; Espírito Santo *et al*. 2007; Lazo *et al*. 2007; Leite *et al*. 2011a, 2012a). In less complex environments, the number of species associated with a given host species may be lower and the abundance of each species is generally higher, thereby increasing the likelihood that herbivores that feed on economically valuable plants will become significant pest (Gratton and Denno 2003; Coyle *et al*. 2005; Lazo *et al*. 2007).

Althrough we did not detect significant differences, the tendency ($P > 0.05$) for a higher diversity index value and more individuals and species of Hemiptera on the west side of *C. brasiliense* trees may be explained by 1) a prevailing wind from the northeast and eastern (Leite *et al*. 2006a, 2009, 2011c, d, e), 2) more sunlight on the north side in the Southern Hemisphere (Vianello and Alves 2000) and 3) avoiding ants and predators, which presented higher numbers in the east and north sides of *C. brasiliense* trees, respectively. The direction of the wind may have influenced the dispersion of insects (Pathak *et al*. 1999; Tixier *et al*. 2000; Auslander *et al*. 2003; Schooley and Wiens 2003; Feng *et al*. 2004, 2005; Leite *et al*. 2009, 2011c, d, e) and pollination. A wind speed greater 2.0 m/seconds reduced the visits of bees to flowers

Table 2. Hill's diversity index, abundance, and richness of Hemiptera and natural enemies/tree (average ± standard error) on different cardinal points of *Caryocar brasiliense*. Montes Claros, Minas Gerais State, Brazil.

Variables	North	South	West	East
	Hemiptera			
Diversity index	2.20 ± 0.27	2.31 ± 0.34	2.82 ± 0.39	1.81 ± 0.20
Abundance	11.92 ± 2.72	10.44 ± 2.08	14.44 ± 3.72	10.84 ± 2.26
Richness	1.48 ± 0.18	1.64 ± 0.20	1.76 ± 0.17	1.32 ± 0.14
	Natural enemies			
Diversity index	4.01 ± 0.45	4.72 ± 0.62	4.86 ± 0.61	5.67 ± 0.81
Abundance	9.96 ± 1.77	8.48 ± 1.74	9.60 ± 2.10	11.48 ± 2.49
Richness	2.48 ± 0.23	2.64 ± 0.27	2.80 ± 0.32	3.08 ± 0.29

Non significant by ANOVA (P > 0.05).

(Dutra and Machado 2001). The desiccant effect of wind is higher in regions that have a low relative humidity and high temperature, which is typical of the cerrado vegetation in the semi-arid north of Minas Gerais State, Brazil, and can reduce the fruit production and photosynthesis and cause the malformation or fall of flowers and fruits (Leite *et al*.

Table 3. Number of sucking insects (Hemiptera) and natural enemies (mean ± standard error) on leaves, flowers and fruits/tree in different sides of *Caryocar brasiliense*. Montes Claros, Minas Gerais State, Brazil.

Genus/Species	North	South	West	East
Sucking Insects				
Aethalium reticulatum-L n.s.	0.04 ± 0.03	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00
Aethalium reticulatum-Fl n.s.	0.00 ± 0.00	0.00 ± 0.00	0.48 ± 0.48	0.24 ± 0.24
Aconophora sp.-L n.s.	0.08 ± 0.05	0.24 ± 0.16	0.28 ± 0.28	0.08 ± 0.07
Aconophora sp.-Fl n.s.	0.16 ± 0.16	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00
Aconophora sp.-Fr n.s.	2.68 ± 1.56	1.44 ± 1.02	0.00 ± 0.00	0.00 ± 0.00
Frequenamia sp.-L n.s.	0.00 ± 0.00	0.04 ± 0.03	0.08 ± 0.05	0.00 ± 0.00
Edessa rufomarginata-L n.s.	0.08 ± 0.05	0.04 ± 0.03	0.48 ± 0.17	0.04 ± 0.03
Membracidae-L n.s.	0.00 ± 0.00	0.04 ± 0.03	0.00 ± 0.00	0.00 ± 0.00
Dikrella caryocar n. sp.-L n.s.	7.24 ± 1.65	6.72 ± 1.44	7.56 ± 1.64	9.28 ± 2.17
Pseudococcus sp.-L n.s.	0.60 ± 0.48	0.24 ± 0.11	0.80 ± 0.65	0.24 ± 0.16
Aphis gossypii-L n.s.	1.00 ± 0.56	1.44 ± 0.80	4.60 ± 3.49	0.88 ± 0.38
Bemisia tabaci-L n.s.	0.00 ± 0.00	0.08 ± 0.05	0.08 ± 0.05	0.04 ± 0.03
Mahanarva sp.-L n.s.	0.04 ± 0.03	0.16 ± 0.09	0.08 ± 0.05	0.04 ± 0.03
Natural enemies				
Crematogaster sp.-L	1.72 ± 0.34 b	2.24 ± 0.47 ab	1.64 ± 0.47 b	3.76 ± 0.95 a
Crematogaster sp.-Fl n.s.	1.72 ± 0.75	1.40 ± 0.88	2.76 ± 1.53	2.48 ± 1.08
Crematogaster sp.-Fr n.s.	0.88 ± 0.36	0.44 ± 0.40	0.44 ± 0.20	0.84 ± 0.58
P. termitarius-L n.s.	0.12 ± 0.06	0.16 ± 0.07	0.24 ± 0.08	0.20 ± 0.08
P. termitarius-Fr n.s.	0.00 ± 0.00	0.04 ± 0.03	0.00 ± 0.00	0.00 ± 0.00
C. novograndensis –L n.s.	0.01 ± 0.01	0.01 ± 0.01	0.04 ± 0.03	0.10 ± 0.05
Cephalotes minutus-L n.s.	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.08 ± 0.05
Dorymyrmex sp. n.s.	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.08 ± 0.05
Spiders-L n.s.	0.68 ± 0.21	0.56 ± 0.16	0.48 ± 0.11	0.60 ± 0.18
Spiders-Fl n.s.	0.00 ± 0.00	0.00 ± 0.00	0.04 ± 0.03	0.08 ± 0.05
Zelus armillatus-L	2.16 ± 1.08 a	0.60 ± 0.27 ab	1.48 ± 0.61ab	0.36 ± 0.15 b
Epipolops sp.-L n.s.	0.16 ± 0.09	0.32 ± 0.17	0.16 ± 0.09	0.20 ± 0.08
Neocalvia fulgurata-L n.s.	0.12 ± 0.08	0.08 ± 0.05	0.16 ± 0.12	0.24 ± 0.14
Chrysoperla sp.-L n.s.	0.84 ± 0.62	0.36 ± 0.25	0.88 ± 0.61	0.28 ± 0.16
Calosoma sp.-L n.s.	0.00 ± 0.00	0.00 ± 0.00	0.08 ± 0.07	0.00 ± 0.00
Holopothrips sp.-L n.s.	0.32 ± 0.09	0.32 ± 0.12	0.28 ± 0.12	0.20 ± 0.08
Trybonia sp.-L n.s.	1.24 ± 0.46	1.96 ± 0.91	0.96 ± 0.39	1.92 ± 0.98

Means followed by the same letter (± standard error) per line did not differ by the test of Tukey (P < 0.05). n.s. = non significant by ANOVA. L = leaves, Fl = flowers, and Fr = fruits.

2006a), both of which influence insect populations. The higher desiccant effect of the wind on the east and north sides of *C. brasiliense* trees may be explained by the sun exposure influencing the quality of the host plants for insects (Fernandes 1990; Unsicker and Mody 2005). The number of species and individuals of insects was lower on the sunny side of the Australian *Melaleuca* trees (Richardson *et al*. 1999).

The lower populations of ants and predators may explain the tendency ($P > 0.05$) of higher ecological parameters of sucking insects on the west sides of *C. brasiliense* trees as spaces that are free of natural enemies. This could make the colonization by sucking insects on north and east sides of the *C. brasiliense* canopy difficult. Predators can respond to a local increase in vegetation complexity and alternative prey with higher efficiency against herbivores (Auslander *et al*. 2003).

The greater number of *Trybonia* sp. and *Chrysoperla* sp. reduced the abundance of *D. caryocar* n. sp. and *A. gossypii*, respectively, on the *C. brasiliense* trees, but the higher populations of *Crematogaster* sp. increased the abundance of *D. caryocar* n. sp. and *Pseudoccocus* sp. Ants and other predators reduced the infestation of *Eunica bechina* Talbot 1928 (Lepidoptera: Nymphalidae) and *Edessa rufomarginata* (De Geer, 1773) (Hemiptera: Pentatomidae), *Prodiplosis floricola* Felt 1907 (Diptera: Cecidomyiidae), petiole gall insects (Hymenoptera: Chalcidoidea) (Freitas and Oliveira 1996; Oliveira 1997), and beetle defoliators (Leite *et al*. 2012b) on this plant. Green lacewings are important predators of aphids as *A. gossypii* (Leite *et al.*, 2006b, 2012c). The positive associations among ants, leafhoppers and aphids are common food-for-protection mutualisms (Moya-Raygoza and Larsen, 2014; Shik *et al.* 2014). The east side of the trees was apparently more unfavorable to insect herbivores in the African Savanna, as greater leaf damage occurred on the west and north sides. This finding can be explained by the species-specific reactions (plants and herbivores) and the biotic environment conditions (Unsicker and Mody 2005). The distribution of herbivores could also reflect the avoidance of predators in addition to reactions to the chemical composition of host plants or the microclimate (Unsicker and Mody 2005).

The sucking insect species that have greater potential to become pests in commercial *C. brasiliense* plantations under natural conditions are *Aethalium reticulatum* L., 1767 (Aetalionidae), *E. rufomarginata*; *D. caryocar* n. sp. and *A. gossypii* due to of their high abundance and status as a common species. *Aethalium reticulatum* and *E. rufomarginata* are pests in *C. brasiliense* trees (Leite *et al*. 2012c), and *D. caryocar* n. sp. and *A. gossypii* are pests in seedling in this culture (Leite *et al*. 2006b). Predators affected these insects on this plant. The high diversity of sucking insects shows the necessity of studying the population dynamics of these organisms in the arboreal systems of the Brazilian savanna.

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