ENTOMOLOGICAL Communications

Entomological Communications, 4, 2022: ec04029
doi: 10.37486/2675-1305.ec04029
e-ISSN: 2675-1305
Open Access Full Text Article

Scientific Note

Vegetation structure define mite assemblage on plants: a case study in Cerrado biome

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Edited by: Fernando Jacinavicius

Received: Juy 13, 2022. Accepted: August 24, 2022. Published: September 01, 2022.

Abstract. We compared abundance and richness of mites on *Miconia albicans* (Sw.) Steud. (Melastomataceae) found in Cerrado grassland (CGR) and in Cerrado *sensu stricto* (CSS), in order to evaluate the effect of plant physiognomy on mite assemblage structure, in the Parque Nacional das Emas, Goiás State, Brazil, a biological reserve of Cerrado biome. In total, 453 mites of 44 species belonging to 14 families were collected. Stigmaeidae was the most abundant predatory mite family, represented by a single unidentified *Agistemus* species. Among phytophagous mites, species of *Lorryia* (Tydeidae) were the most common. *Lorryia turrialbensis* Baker, 1968 is reported for the first time on a Cerrado plant species. We concluded that the Cerrado phytophysiognomy can determine the organization of mite assemblages since CSS sheltered higher species richness and abundance of mites on *M. albicans* due to has more habitat complexity, species richness and abundance of plants than CGR. Therefore, CSS can provide more food resources, microhabitats for shelter and oviposition favoring the occurrence and populational development of plant mites.

Keywords: Acariformes, habitat complexity, *Miconia albicans*, Parasitiformes, plant physiognomy.

Plants have great importance in organization and composition of associated arthropods that use plants as food sources and protection sites from natural enemies and abiotic factors (Gunnarsson 1996; Romero & Vasconcellos-Neto 2005). Higher environment complexity (with plant diversity and abundance) results in increased substrate dimension and reduced spatial competition, which in turn results to increased species richness of animal assemblages (MacArthur & MacArthur 1961), including arthropods (Castagneyrol & Jactel 2012). Experimental works have shown this type of relation for invertebrates (Langelloto & Denno 2004).

The Cerrado, a Brazilian vegetation type similar to the savannah, comprises great structural vegetation complexity resulting from its varied plant physiognomies. Each physiognomy is related to particular sets of relative humidity conditions, temperature, sunlight incidence at distinct levels, and floristic composition, richness and abundance (Araújo & Santos 2008; Ferreira et al. 2015). Hence, each physiognomy might allow the colonization and persistence of animal communities of different composition. However, the relation between the Cerrado physiognomy and the prevailing mite (Arachnida: Acari) diversity has not been adequately studied. The objective of this publication is to report the results of a study of this type. The expectation was to find higher mite abundance and richness in Cerrado ecosystems with higher plant diversity and abundance.

The study was conducted in the "Parque Nacional das Emas (PNE)" (17º49'-19º28'S; 52º39'-53º10'W, at the central administration area), one of the largest natural reserves of Brazilian pristine Cerrado, located in Goiás state, in central Brazil (Ramos-Neto & Pivello 2000). The climatic type of the park is classified as Aw (Köppen classification), characterized by two well defined seasons, namely dry (April to September) and wet (October to March); annual average temperature of 22-24º C, and annual rainfall of 1,500-1,750 mm (ICMBIO 2004).

We evaluated two phytophysiognomies, namely Cerrado *sensu stricto* and Cerrado grassland, which differ in terms of vegetation structure and microclimate. Each of these represent 25.1% and 68.1% of the total PNE area, respectively (Ramos-Neto & Pivello 2000). The first is classified as a savannah-type formation, composed of abundant trees and shrubs, in addition to subshrubs and weeds. The second is characterized by sparse trees and shrubs, with denser stands of grassy cover forming a continuous herbaceous stratum (Ribeiro & Walter 2008).

A total of 20 plots of 10 x 10m were delineated as study site, at 88 m to 22 km from each other, nine in the Cerrado *sensu stricto* (CSS) area and 11 in the grassland Cerrado area (CGR).

Miconia albicans (Sw.) Steud. (Melastomataceae) was choose as target-plant for sampling, for its high abundance at PNE and for occurring in all plots. This plant is a shrub that bears plenty of green leaves throughout the year, each of which with plenty of trichomes (Iglesias & Fonseca 2022). In each plot, a plant of this species, as close as possible to the plot center was selected and marked so that, at each sampling date, samples were taken from the same plants. One sample (10 full grown leaves taken at random from the median section of each plant) was collected from each plant in January and another in Abril 2015. Each sample was introduced into a plastic bottle (1,400 mL in capacity) containing 200 mL of 70% ethanol. The bottles were shaken vigorously for 30 seconds in order to kill and dislodge the mites. In the laboratory, the ethanol was transferred to Petri dishes and examined under dissecting microscopes to collect the mites. All mites found were mounting on microscope slides with Hoyer's medium, except Oribatida, which were kept in 70% ethanol for later study. Mites were identified and quantified under light microscope with phase contrast (Model Zeiss Axio Lab 1) using identification keys (e.g., Moraes & Flecthmann 2008; Krantz & Walter 2009) and works on species descriptions and/or revisions of groups.

We considered host plant as sample unit for all statistical tests (CGR: n = 11; CSS: n = 9). Generalized linear models (GLM) were performed to test the effect of plant physiognomy on mite richness and abundance. We considered plant physiognomy, where sample plots were established, as categorical fixed-effect variable. The response variable in the GLM were abundance and richness of mite species on *M. albicans.* We used *gvlma* package to test model assumptions (Pena & Slate 2019). Poisson distributions were performed for models with non-normal distribution of residuals. Graphs were built using *ggpplot2* package (Wickham 2016). All analyses were performed in R software environment (R Core Team 2022).

In total, 453 mites of 44 species and 14 families were collected (Tab. 1). Of these, 107 mites of 26 species were found in CGR and 346 mites of 34 species were found in CSS. Tydeidae and Tarsonemidae were the families most abundant and with highest richness in both physiognomies. Both families were more abundant and had higher species richness in CSS.

Table 1. Mites on *Miconia albicans* sampled in two plant physiognomies of Cerrado at Parque Nacional das Emas, GO, Brazil: (CGR) Cerrado Grassland; (CSS) Cerrado *sensu stricto*.

Family	Specie	FH*	CGR	CSS	Total
Acaridae	Unidentified sp.1	?	0	4	4
	Unidentified sp.2	?	2	2	4
	Unidentified sp.3	?	2	1	3
	Unidentified sp.4	?	3	13	16
	Unidentified sp.5	?	0	1	1
Ascidae	*Asca* sp.1	Pr	4	1	5
	Asca sp.2	Pr	2	0	2
	Asca sp.3	Pr	1	3	4
	Imatures and/ or unidentified	?	0	1	1
Astigmata	Unidentified sp.	?	0	4	4
Diptilomiopidae	*Diptilomiopus* sp.	Ph	1	7	8
Eriophyidae	*Aceria* sp.	Ph	6	1	7
	Calacarus sp.	Ph	0	1	1
	Dichopelmus sp.	Ph	7	13	20
	Paraciota sp.	Ph	0	1	1
	Imatures and/ or unidentified	Ph	0	2	2
Eupodidae	Unidentified sp.	?	3	2	5
Iolinidae	*Parapronematus* sp.	Pr	0	2	2
	Imatures and/ or unidentified	Pr	1	1	2
Oribatida	Oribatida sp.	?	2	19	21
Phytoseiidae	*Amblyseius neochiapensis*	Pr	2	0	2
	Euseius citrifolius	Pr	1	0	1
	Iphiseiodes zuluagai	Pr	0	11	11
	Imatures and/ or unidentified*	Pr	5	7	12
Stigmaeidae	*Agistemus* sp.	Pr	13	4	17
	Imatures and/ or unidentified*	Pr	1	0	1
Tarsonemidae	*Daidalotarsonemus folisetae*	Ph	0	2	2
	Daidalotarsonemus sp.	Ph	0	11	11
	Deleonia sp.	Un	0	1	1
	Metatarsonemus sp.	Un	0	2	2
	Tarsonemus sp.1	My	5	40	45
	Tarsonemus sp.2	My	0	16	16
	Tarsonemus sp.3	My	1	0	1
	Xenotarsonemus sp.1	?	11	2	13
	Xenotarsonemus sp.2	?	1	0	1
	Imatures and/ or unidentified	?	14	56	70
Tenuipalpidae	*Brevipalpus* sp.	Ph	2	0	2
	Phytoptipalpus sp.	Ph	1	0	1
	Tenuipalpus sp.	Ph	1	0	1
Tetranychidae	*Mononychellus* sp.	Ph	1	0	1
Tydeidae	*Idiolorryia* sp.1	?	0	12	12
	Idiolorryia sp.2	?	0	1	1
	Lorryia formosa	Ph	0	1	1
	Lorryia sp.1	Ph	1	22	23
	Lorryia sp.2	Ph	5	49	54
	Lorryia sp.3	Ph	2	1	3
	Lorryia turrialbensis	Ph	1	4	5
	Neolorryia sp.	?	0	7	7
	Paralorryia sp.	?	1	0	1
	Tydeus sp.	?	0	2	2
	Imatures and/ or unidentified	?	2	10	12
Unidentified			2	6	8
Abundance			**107**	**346**	**453**
Richness			**26**	**34**	**44**

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*(FH) Feeding habits of species. (Pr) Predator (Krantz & Walter 2009; Moraes & Fletchamnn 2008; McMurtry et al. 2013), (Ph) Phytophagous (Krantz & Walter 2009; Moraes & Flechtmann 2008; Hernandes et al. 2006; Lofego et al. 2005), (My) Mycophagous (Krantz & Walter 2009), and (?) unknown feeding habit.

Stigmaeidae was the most abundant predatory mite family, representing 38.6% of all predators. Stigmaeidae was represented by a single, unidentified *Agistemus* species. Phytoseiidae accounted for 31.8% of the predatory mites, and was represented by three species, namely *Amblyseius neochiapensis* Lofego, Moraes & McMurtry, 2000, *Euseius citrifolius* Denmark & Muma, 1970 and *Iphiseiodes zuluagai* Denmark & Muma, 1972. The same phytoseiid species had been previously recorded on several native Cerrado plant species (Lofego et al. 2004; Demite et al. 2009; 2017; Rezende & Lofego 2011). The phytoseiids have great economic relevance because some species are widely used commercially for the control of plant pests (McMurtry et al. 2013).

Among phytophagous mites, species of *Lorryia* (Tydeidae) were rather common, especially an unidentified species. Identified *Lorryia* species were *Lorryia formosa* Cooreman, 1958 in CSS and *Lorryia turrialbensis* Baker, 1968 in both physiognomies. *Lorryia formosa* was previously recorded from *Bauhinia longifolia* (Bong.) Steud. (Leguminosae) and *Solanum lycocarpum* A. St.-Hil. (Solanaceae) in remnants of Cerrado nears to rubber tree crops in Mato Grosso state (Demite et al. 2009), and on *Qualea grandiflora* Mart. (Vochysiaceae) in Goiás, Mato Grosso do Sul and Minas Gerais states from Cerrado remnants near to soybean crops (Rezende et al. 2014). *Lorryia turrialbensis* Baker, 1968 is here reported for the first time on Cerrado plant species. This species was previously reported in Brazil on Annonaceae species from northeast region, Alagoas and Pernambuco states (Sousa et al. 2015), and on *Hevea* species from Acre, Amazonas, Bahia, Maranhão, Mato Grosso and São Paulo states (Nuvoloni et al. 2020). *Daidalotarsonemus folisetae* Lofego & Ochoa, 2005 is another collected phytophagous species, only in CSS. This species was originally described from a myrtaceous Cerrado plant from São Paulo state (Lofego et al. 2005), but it was also collected in Cerrado areas of Minas Gerais state (Rezende et al. 2014). The remaining phytophagous mites collected in relevance belong to the Eriophyidae, especially an unidentified *Dichopelmus* species.

The mite abundance and species richness differed according to the physiognomy type (Tab. 2). The physiognomy CSS sheltered higher mite species richness and abundance than CGR (Fig. 1).

Table 2. Results of GLM applied to test the relationship of abundance and richness of mite species on *M. albicans* to the Cerrado physiognomy.

	Species richness		Mite abundance	
	Estimate	Standard error	Estimate	Standard error
Intercept	4.546***	0.907	2.009***	0.110
Plant physiognomy CSS	5.010**	1.352	1.367***	0.127
Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1				

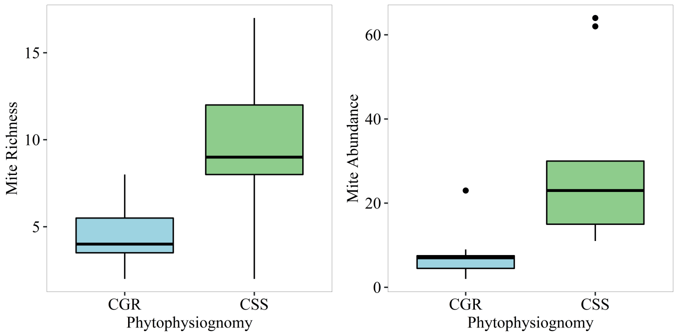

Figure 1. Richness (Left) and abundance (Right) of mites on *M. albicans* sampled in two phytophysiognomy from Parque Nacional da Emas, GO, Brazil. CGR: Cerrado grassland; CSS: Cerrado *sensu stricto*.

As we expected, on *M. albicans* sheltered higher species abundance and richness in the Cerrado *sensu stricto* (where the vegetation is more complex) than in the Cerrado grassland. That is related to the expected existence of more food resources and microhabitats for shelter and oviposition of the surrounding environment of the Cerrado *sensu stricto* than in the Cerrado grassland (Ratter et al. 1997). This type of result matches the results of previous works that demonstrated a positive effect of plant species diversity on arthropod abundance and richness (e.g., Lewinsohn et al. 2005; Fleck & Fonseca 2007; Costa et al. 2010).

We verified here that the Cerrado physiognomy can determine the organization of mite assemblages on *M. albicans* plants. Moreover, *M. albicans* sheltered a high species richness and abundance of mites, including predatory species. These results highlighted the importance in preserving natural areas for mite species conservation, especially beneficial species.

Acknowledgments

This work was funded by PELD (Long-Term Ecological Research Program CNPq/FAPEG 441276/2020-2, 441214/2016-9, 420051/2016-3), CNPq - Conselho Nacional de Desenvolvimento Científico e Tecnológico (process 456538/2014-3) and FAPEG - Fundação de Amparo à Pesquisa do Estado de Goiás (CH 07/2014 - UNIVERSAL, process 201410267001741). PRD received a schorlarship (PNPD) from the "*Coordenação de Aperfeiçoamento de Pessoal de Nível Superior*" (CAPES) (process 88882.314486/2013-0).

Authors' Contributions

VSM. Data analysis, project design and manuscript writing, **SNN.** Field sampling, data sampling and identification of mites, **PRD.** Identification of mites, data analysis and manuscript writing, **RDD.** Identification of mites, project design and manuscript writing

Conflict of Interest Statement

The authors declare no potential conflict of interest.

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