GABRIEL PAIOLA

DETERMINATION OF SCOLYTINAE AND PLATYPODINAE (COLEOPTERA: CURCULIONIDAE) FLIGHT AREA USING STICKY TRAPS

Dissertation submitted to the Entomology Graduate Program of the Universidade Federal de Viçosa in partial fulfillment of the requirements for the degree of *Magister Scientiae.*

Advisor: José Cola Zanuncio

Co-advisors: Carlos Alberto Hector Flechtmann
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ABSTRACT

PAIOLA, Gabriel, M.Sc, Universidade Federal de Viçosa, February, 2022. **Determination of Scolytinae and Platypodinae (Coleoptera: Curculionidae) flight area using sticky traps.** Advisor: José Cola Zanuncio. Co-advisors: Carlos Alberto Hector Flechtmann and José Eduardo Serrão.

The flight behavior and related aspects of Scolytinae and Platypodinae are poorly known and are commonly studied with baited flight intercept traps with different models and designs, with trapping varying between their models. We built an ethanol-baited sticky window trap with concentric circles that simulates different sizes of panels of intercept traps, to determine how accurately the targeted beetles can find the attractant source. The traps were positioned at different angles in relation to the predominant wind direction, to establish if the beetles fly upwind while searching for the attractant. The sticky window trap was not adequate to define if the Scolytinae, Platypodinae, Bostrichidae and Cerambycidae fly upwin trying to reach the attractant source. Most beetles were more trapped in the periphery of the trap, and the wind modeling indicated that the wind in both sides of the trap spread out, likely dragging the ethanol to the edges of the trap, hence changing the shape of the attractant plume.

Keywords: Ambrosia beetles. Trap efficiency. Upwind flight. Wind modeling.

RESUMO

PAIOLA, Gabriel, M.Sc., Universidade Federal de Viçosa, fevereiro de 2022. **Determinação da área de voo de Scolytinae e Platypodinae (Coleoptera: Curculionidae) usando armadilhas adesivas.** Orientador: José Cola Zanuncio. Coorientador: Carlos Alberto Hector Flechtmann e José Eduardo Serrão.

O comportamento e aspectos relacionados de voo de Scolytinae e Platypodinae são pouco conhecidos, e são estudados com armadilhas de interceptação de diferentes modelos e designs. Uma armadilha de janela adesiva iscada com etanol e com circulos concêntricos simulando diferentes tamanhos de paineis de intercepção das armadilhas foi construída para determinar a acurácia dos besouros em encontrar a fonte de atrativo. As armadilhas foram posicionadas em diferentes angulos em relação a direção predominante do vento, para verificar se os besouros voam em direção contrária ao vento na busca do atrativo. As armadilhas de janela adesivas não são adequadas para verificar se Scolytinae, Platypodinae, Bostrichidae, e Cerambycidae voam em direção contrária ao vento na busca da fonte de atrativo. A maioria dos besouros foi mais interceptada na periferia da armadilha e a modelagem indicou que o vento se espalha em ambos os lados da armadilha, provavelmente, arrastando o etanol para as bordas da mesma, alterando a forma da pluma de atrativo.

Palavras-chave: Besouros da ambrosia. Eficiência de armadilhas. Modelamento do vento. Voo contrário ao vento.

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SUMMARY

1. INTRODUCTION

The flight of Scolytinae and Platypodinae is mainly to finding new hosts oriented by clues emitted by conspecifics (pheromones) or hosts (kairomones). The flight is usually upwind and not continuous, and may last a few hours traveling for several meters (Atkinson et al., 1988; Byers, 1983; Byers, 1988; Byers, 1989a; Byers, 2013; Chen et al., 2010; Flechtmann et al., 1995; Kirkendall et al., 2015; McMullen & Atkins, 1962; Wood & Bushing, 1963;). The peak flight activity of most species is during the day with population levels varying over the year (Flechtmann et al., 1995; Hanula et al., 2008; Hulcr et al., 2008; Ohrn et al., 2014; Prochazka et al., 2018; Reding et al., 2013).

Flight intercept traps (FITs) are commonly and efficiently used to study the flight behavior of borer beetles. The models of FITs differ in their architecture and developed to survey different species of these beetles (Bouget et al., 2009; Byers, 1988; Covre et al., 2021; Flechtmann et al., 1995; Hosking & Knight, 1975; Kuhns et al., 2014; Ohrn et al., 2014; Prochazka et al., 2018; Ranger et al., 2016; Reding et al., 2011; Reding et al., 2013). The size of the vane, as found in the window trap (Chapman & Kinghorn, 1955) is a change in FITs architecture compared to the ESALQ-84 (Berti-Filho & Flechtmann, 1986). The efficiency to capture insects and the estimation of local fauna vary with these traps (Paiola & Flechtmann, 2018).

Most studies about the flight of these beetles were developed with traps. However, their flight pattern or the route when they are near to the attractive lure in FITs (before being trapped) needs further studies. The small size difficults the study of flight for these beetles in the laboratory and in the field (Byers, 1988; Byers & Löfqvist, 1989; Atkins, 1966; Byers, 1989; Evenden & Whitehouse, 2014; Wood & Bushing, 1963).

FITs studies are important to understand the bioecology of Scolytinae and Platypodinae, and improving the efficacy, regarding the number of beetles collected, the monitoring and improve control measures (Bouget et al., 2009; Byers, 1989a; Flechtmann et al., 2001; Hanula et al., 2011; Hanula et al., 2016; Kendra et al., 2020; Klingeman et al., 2017; Ranger et al., 2016; Reding et al., 2011; Vanderlaan & Ginzel, 2013).

The understanding of how beetles locate a lure or the point where it is located in a trap during their flight towards the attractant could improve the effectiveness of traps to capture Scolytinae and Platypodinae. A sticky window trap divided into sections was developed to determine the accuracy of how different bark and ambrosia beetles species fly toward the lure, and the faces was positioned perpendicular to the predominant wind direction to verify if these beetles fly upwind inside a forest to locate the lure.

2. MATERIAL AND METHODS

2.1. Study Site

The experiment was developed at the Experimental Farm of Extension UNESP University, campus of Ilha Solteira, and in Selvíria, state of Mato Grosso do Sul, Brazil. The study area was a cerradão fragment (cerrado physiognomy) in advanced stage of regeneration (20°23'2.14"S 51°24'42.22"W).

2.2. Traps

Sticky window traps (SWTs) were built with a translucid polyethylene 1 m x 1 m panel. A 3 cm hole in diameter was cut at the center of the panel (1.5 m above ground) to place and facilitate dispersal of the attractive ethanol 96%. Nine concentric circles, represented by the letters A to I, 5 cm apart from each other were drawn from the center of this panel. The intercept area of 78 cm^2 of the letter A (smallest diameter) is similar to the most FIT trap used in Brazil (Flechtmann et al., 2001), while the largest diameter (I) was 6,361 cm^2, equivalent to the most common size in window traps abroad (Chapman, Kinghorn, 1955). Each SWT was covered with a transparent plastic sheet with the same size as the panel, and greased with sticky glue (Colly Química Indústria e Comércio Ltda, Mombuca, state of São Paulo) on both sides. The plastic cover was replaced by a new one and greased with new glue every time the glue lost its viability (about every seven weeks) (Appendix: Fig. 1).

Four lured and a control (no lure) SWT were placed inside the fragment with their panels perpendicular to the predominant wind direction, which was north-northwest (Mesquita Filho, 2009), One side of the panel was faced southern (upwind), while the other was faced northern (downwind). Lured traps ran for 54 weeks, from August 2020 to August 2021 and the control for 52 weeks, from September 2020 to August 2021. An extra lured trap works as wind direction control with its panel positioned parallel to the wind direction, and ran for 25 weeks, from March to August 2021.

The number of beetles trapped above and below parts of the panel considering the middle the central hole, in the baited traps positioned perpendicular to the predominant wind direction, was counted from March 2021 in the subsequent 26 weeks, to evaluate if beetles present differences in caught that could affect the results related to the patterns of flight height between beetles species.

Traps were placed randomly in the collecting site, ca. 30 apart from each other. Beetles trapped on the sticky glue were individually removed from each circle and cleaned in the lab with d-limonene solution before being identified and quantified.

2.3. Wind Direction and Wind Speed

An anemometer sensitive to measure wind speeds below 1 m/s and direction inside the fragment was built using a 40 cm x 40 cm, 3-mm thick masonite board. In the smoother part of the board center a 3 cm diameter circle was drawn, and more externally another with 15-cm diameter. The cardinal points north, south, east and west and the intercardinal northeast, southeast, northwest and southwest were marked on the larger circle. The board was set on the top of a tripod 1.5 high (same height of the lure) with its north marked using a compass and leveled with a two-way bubble level (Appendix: Fig. 2). A 5-mm diameter polystyrene ball with a smooth surface and weighing on average of 0.9 mm was placed on the smaller circle and recorded with a cellular phone its trajectory until it crossed from smaller circle border to the larger one. The wind speed and direction were obtained with the time spent for the wind-blown ball to cross the circles lines. Wind speed was not constant throughout measurements. Thus, a wind speed of zero was registered if the ball placed in the smaller circle did not move within three minutes. Observations in cases the ball stopped moving in the middle of its course or with inconsistent route, without a clear direction, were discarded.

The anemometer was placed near each of the six traps inside the fragment and five measurements, from July 2021 to August 2021, were taken per position in the mornings and afternoons of beetle trapping collecting dates.

Temperature, relative humidity, rain and wind speed and direction outside the forest in the pasture area, were obtained from a Campbell weather station of the FEIS/UNESP, distant 430 from the fragment (20º22'45.36"S 51º24'38.84"W).

2.4. Wind Modeling

A symmetric model based on the geometry of the panel was developed. This geometry was designed in the software Ansys SpaceClaim© 19.0. The volume of control around the trap was built assuming a width of 5.5 m, 7.0 m height and 15 m length. The trap was positioned 1 m from the ground and 5 m from the inlet in the computational domain. The trap surface was more refined than the rest of the domain when the grid was generated, allowing to better characterize the fluid dynamic phenomena. A dynamic boundary layer was developed based on the prism-elements on solid surfaces. The numeric simulation was performed in a stationary regime using the Ansys Fluent© 19.0 software. The Dirichlet boundary condition with a constant wind speed of 0.09 m/s was considered in the computational domain's inlet. The lateral and superior faces of the computational domain were considered as symmetrical to mitigate the wall effects on the trap. The lower side (facing the ground) was considered as impermeable without sliding boundary condition. The low free-stream wind speed used in the modeling suggests a laminar flow model. However, the separation of the flow on the edges of the panel and the recirculation generated in the trap side facing downwind difficulted the numeric convergence. The standard k-epsilon as the closure model was used for this reason.

2.5. Experimental Design

The data of beetle numbers collected were transformed into $\sqrt{(x + 0.5)}$ (Phillips, 1990) to remove heteroscedasticity, Beetle collection, wind speed and wind direction were compared using generalized linear models (Proc GLM) and treatment means separated by the Tukey test (SAS Institute, 1990).

3. RESULTS

Fifty-two, six, nine, 20 and eight species of Scolytinae, Platypodinae, Bostrichidae, Cerambycidae and Cleridae, respectively, were collected. The most abundant species were included in the analyses, being 11, three, two, two and one of Scolytinae, Platypodinae, Bostrichidae, Cerambycidae and Cleridae, respectively (Tables 1, 2, 3).

Coptoborus tolimanus and *Hypothenemus javanus* were the only species included in the analysis with similar numbers collected between ethanol-baited and unbaited traps, while all others were more trapped in ethanol-baited traps (Table 03).

The average wind direction was north-northwest (Table 4). However, the frequency of the wind direction shifts after each burst confirms that the most frequent ones were westbound (Figure 1), and not north-northwest as assumed. The wind direction was consistently more unidirectional in the open pasture, and more fragmented and blowing into several directions inside the fragment (Figure 1). The wind speed was higher in the pasture than inside the fragment (Table 5).

The wind flow modeled in the same conditions inside the fragment confirms that the wind hitting the trap panel (downwind) changed direction, evenly moving from the center towards the edges of the panel in all sides. On the other side of the panel however it recirculates due to the flow fragmentation at the edges of the panel creating a transversal vortex, which results in the same previous behavior: the direction of airflow going from the center towards the edges of the panel in all sides (Figure 2).

Xyleborus affinis, *Xyleborus ferrugineus*, total Scolytinae, *Euplatypus parallelus*, total Platypodinae and *Compsa quadriguttata* were more trapped in the southern side of the traps and *Hypothenemus obscurus* and *Megaphloeus mucoreus* in the northern side (Table 6). No differences were found for the unbaited E-W trap between north- and south-faced sides (Table 6). The other baited trap with one side facing east and the other west (N-S axis traps) captured only *H. obscurus*, *X. ferrugineus* and total Platypodinae, with higher numbers in the west-faced side than in the east-faced side (Table 6). *Hylocurus retusipennis* was the only species more trapped in the N-S trap while several were more trapped in the E-W traps (Table 3).

The numbers of the vast majority of the species trapped in the baited E-W traps were higher in the outer trap circles, H or H-I (Table 7). The general pattern was similar between sides (Tables 8, 9). *Xyleborus ferrugineus* and total Scolytinae were more trapped in the H-I circles when the whole trap (Table 10) and the southern side were analyzed (Table 11). The numbers of all other species and comparisons within the northern side of the E-W unbaited trap were similar among catches. More beetles, including *H. retusipennis*, *X. ferrugineus*, total Scolytinae, *Xyloperthella picea* and total Bostrichidae were trapped in the I or H-I circles, but without differences when results of the baited N-S trap were considered (Table 12). More specimens of total Scolytinae ($F_{8,189} = 6.07$, $p < 0.0001$), *X. picea* ($F_{8,189} = 2.21$, $p = 0.0284$) and total Bostrichidae ($F_{8,189} = 2.69$, $p = 0.0080$) were more trapped in the western trap side, and *X. ferrugineus* ($F_{8,189} = 3.20$, $p = 0.0019$) and total Scolytinae ($F_{8,189} = 6.11$, $p < 0.0001$) (data not shown) in the eastern trap side.

The corrections of the numbers of beetles per trap area (in cm^2) confirms higher numbers of beetles in the outer circles in baited E-W traps, but no differences among circles were found for a higher number of species (Table 13). No difference among circles was obtained when the southern side (upwind) was considered, when compared to the northern side (downwind) (Tables 14 and 15, respectively). In both cases, more specimens were trapped in the outer circles.

The grouping of the areas in circles A-E (1,963 cm^2), F-G (1,885 cm^2) and H-I (2,513 cm^2) reduced the differences when comparing beetle numbers per trap. Again, the most species were more trapped in the H-I group when both sides were combined (Table 16), and also when each N/S side was analyzed separately in baited E-W traps (Table 17 and 18). The results were similar in the unbaited E-W trap with higher numbers of *Coptoborus tolimanus* ($F_{2,86} = 3.53$, $p = 0.0297$), *X. ferrugineus* ($F_{2,86} = 10.67$, $p < 0.0001$) and total Scolytinae ($F_{2,86} = 13.87$, $p < 0.0001$) in the H-I group, without differences for all other species among groups (data not shown; $p > 0.05$). Similar results were observed for the N-S baited trap and when differences were present, more beetles were trapped in the H-I group (Table 19).

A higher total Bostrichidae numbers were in the E-W baited traps in the area above the panel central opening, while *X. affinis* was most caught in that below the opening and no differences were found for all other species (Table 20). No differences for all species were found when those analyses were done per trap side (Table 21). The numbers of beetles in both areas were similar for the unbaited E-W trap and also for the baited N-S trap (data not shown; $p > 0.05$).

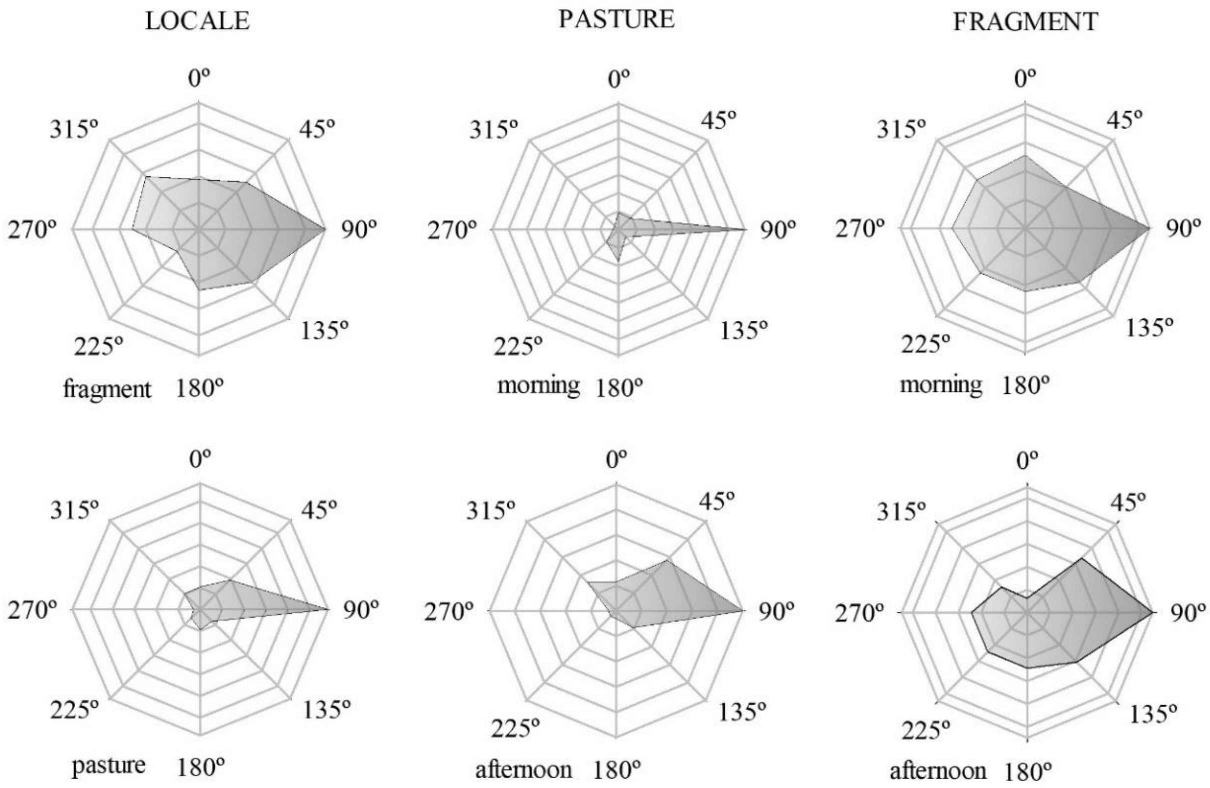


Figure 1. Radar graphs showing local wind direction frequency and in the pasture and fragment, and in the morning and afternoon periods. Selvíria, Mato Grosso do Sul, Brazil, July to August 2021.

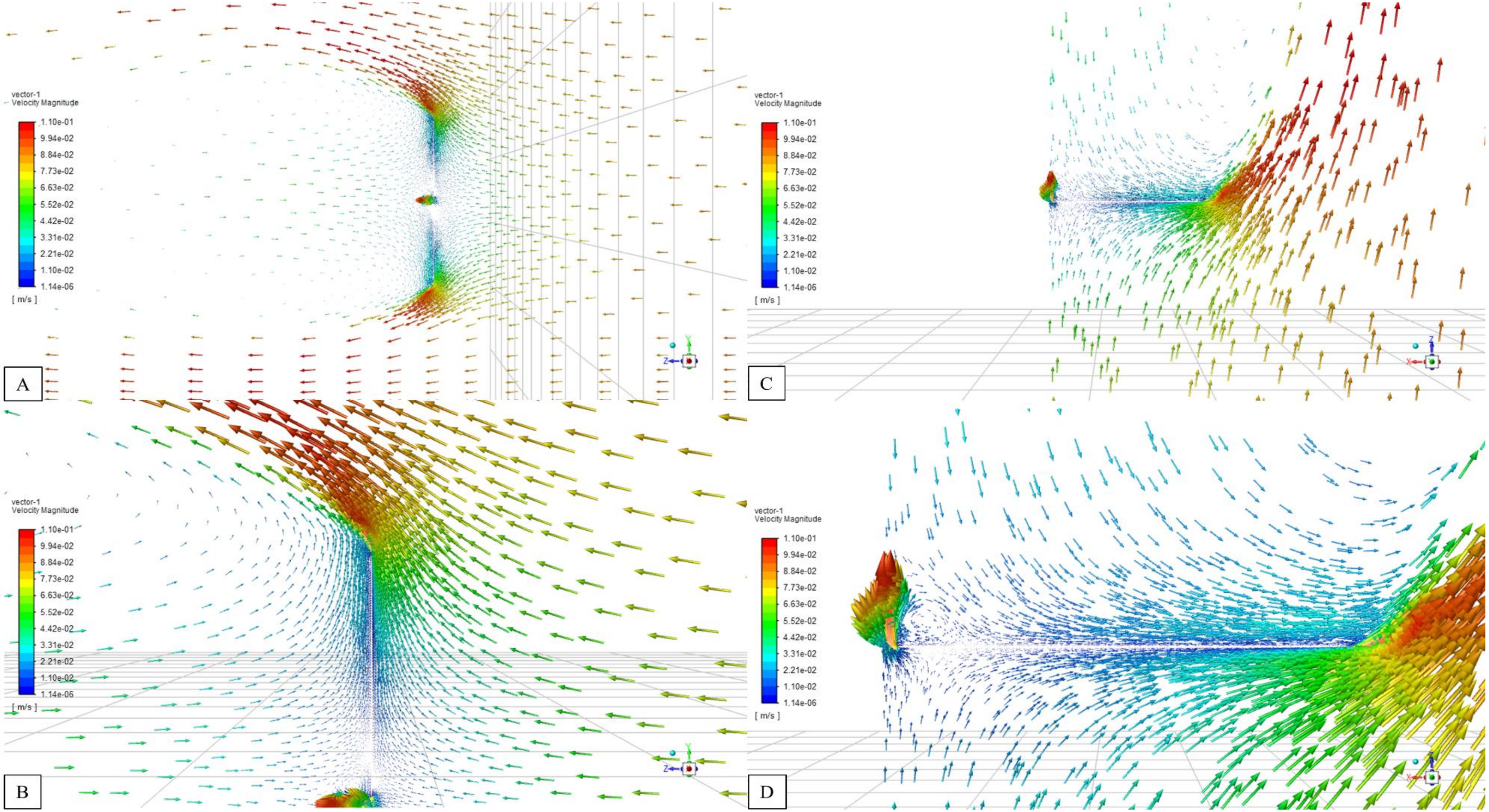


Figure 2. Flow of air modeled over the sticky trap panel. Lateral view of the panel (A); lateral view of the panel zoomed (B); above view of the panel (C); above view of the panel zoomed (D). Arrows indicate the wind direction and the smaller the arrow the lower the wind speed. Ansys SpaceClaim© 19.0; Ansys Fluent© 19.0.

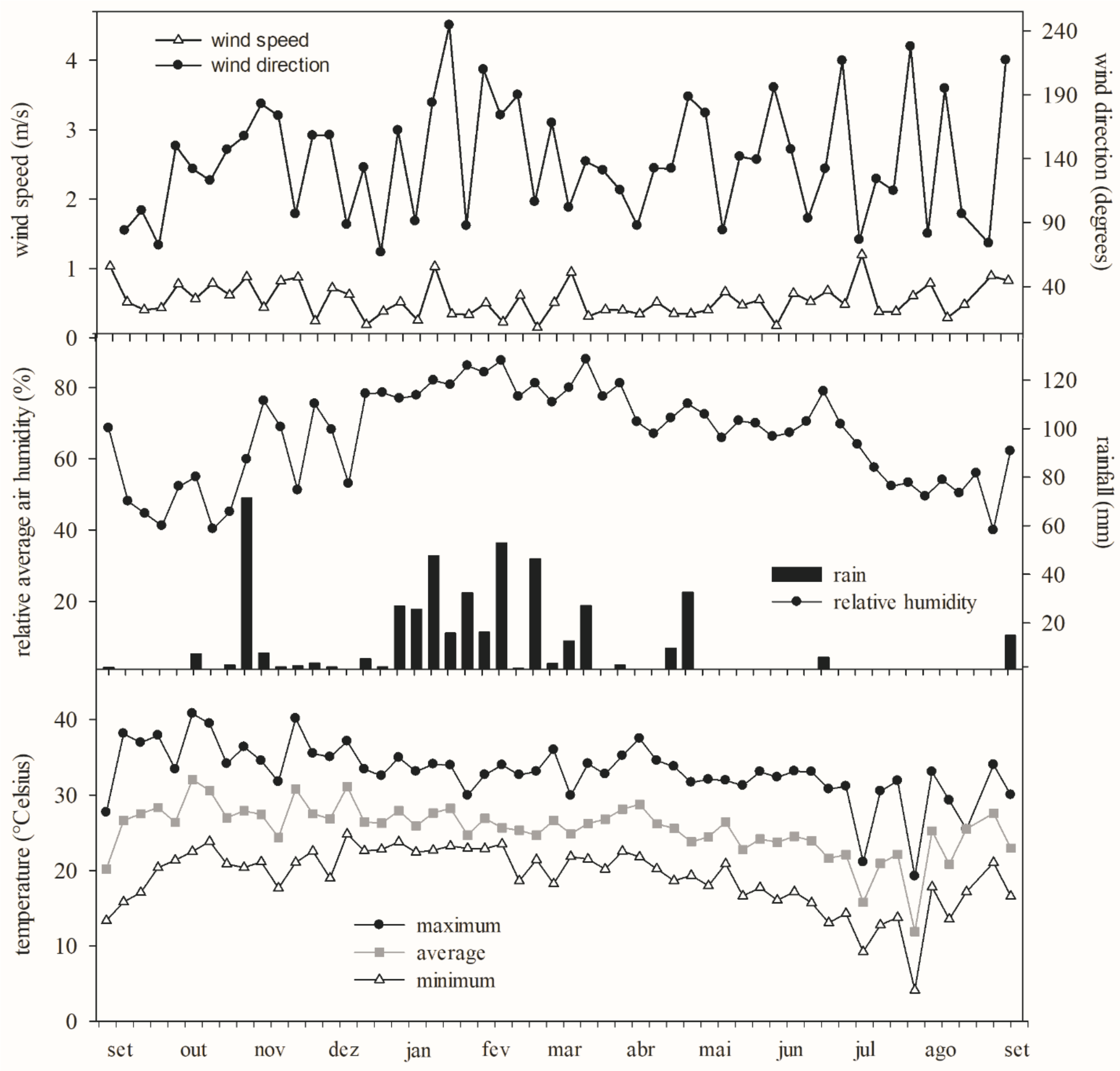


Figure 3. Temperature (maximum, average, minimum), total rainfall, average relative air humidity, and averages wind speed and direction. UNESP Farm, Selvíria, Mato Grosso do Sul, July 2020 to August 2021.

Table 1. Numbers of Scolytinae and Platypodinae species trapped per trap circle section (A through I), per side (N– northern, S– southern) and total (T) in ethanol-baited sticky flight intercept traps in a cerradão fragment. Universidade Estadual Paulista (UNESP/FEIS) Experimental Farm in Selvíria, Mato Grosso do Sul, Brazil, August 2020 to August 2021.

	circle									side		T
Species	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**N**	**S**	
Scolytinae												
Ambrosiodmus obliquus (LeConte, 1868)	-	-	-	-	-	-	-	-	1	1	-	1
Ambrosiodmus hagerdorni (Iglesias, 1914)	-	-	-	2	-	-	-	-	-	1	1	2
Ambrosiodmus opimus (Wood, 1974)	-	-	-	-	-	4	2	3	6	3	12	15
Ambrosiodmus sp.01	1	1	2		-	3	2	4	2	5	10	15
Araptus sp.01	-	1	-	1	2	2	2	4	2	7	7	14
Araptus sp.02	-	1	-	1	-	2	2	3	4	4	9	13
Araptus sp.03	-	-	1	2	1	4	3	4	-	8	7	15
Cnestus laticeps (Wood, 1977)	-	1	-	-	-	-	-	-	-	-	1	1
Coccotrypes carpophagus (Hornung, 1842)	1	-	-	-	-	-	-	-	1	1	1	2
Coptoborus tolimanus (Eggers, 1928)	-	-	2	-	1	3	2	11	11	12	18	30
Coptoborus villosulus (Blandford, 1898)	-	-	-	-	-	-	-	-	1	-	1	1
Cryptocarenus brevicolis Eggers, 1937	-	-	-	-	1	-	-	-	-	-	1	1
Cryptocarenus diadematus Eggers,1937	-	1	2	4	4	1	6	9	17	18	26	44
Cryptocarenus heveae (Hagedorn, 1912)	1	1	2	4	1	5	9	10	17	23	27	50
Cryptocarenus seriatus Eggers, 1933	-	-	-	1	1	1	-	8	2	5	8	13
Dryocoetoides cristatus (Fabricius, 1801)	-	-	-	-	-	-	1	-	-	-	1	1
Hylocurus retusipennis Blandford, 1898	-	-	4	2	2	4	2	8	24	28	18	46
Hypothenemus areccae (Hornung, 1842)	-	-	-	-	-	-	-	1	-	1	-	1
Hypothenemus brunneus (Hopkins, 1915)	-	-	5	1	2	-	-	2	9	10	9	19
Hypothenemus crudiae (Panzer, 1791)	-	-	-	-	-	-	-	1	-	1	-	1
Hypothenemus eruditus Westwood, 1936	1	2	5	4	10	10	4	7	9	29	23	52
Hypothenemus gossypii (Hopkins, 1915)	-	-	1	1	-	-	-	1	1	1	3	4
Hypothenemus javanus (Eggers, 1908)	-	2	2	4	8	2	3	11	14	28	18	46
Hypothenemus obscurus (Fabricius, 1801)	1	2	7	5	5	12	5	4	9	30	20	50
Hypothenemus plumeriae (Nordlinger, 1856)	-	-	-	1	-	-	-	-	1	2	-	2
Hypothenemus pubescens Hopkins, 1915	-	-	-	-	-	1	1	2	-	2	2	4
Hypot. subsulcatus Atkinson, Flechtmann, 2021	1	-	-	-	-	1	3	1	4	4	6	10
Hypothenemus suspectus Wood, 1974	-	-	2	1	1	-	-	1	1	3	3	6
Hypothene. wilsoni Atkinson, Flechtmann, 2021	-	-	2	1	3	2	3	3	5	12	7	19
Hylocurus sp.01	-	-	-	-	-	-	1	1	1	1	2	3
Hylocurus sp.02	-	-	-	-	-	1	-	-	1	-	2	2
Hylocurus sp.03	-	-	-	-	-	1	-	-	-	-	1	1
Phloeoborus rudis Erichson, 1915	-	-	-	-	-	-	1	1	-	2	-	2
Phloeotribus sp.01	-	-	-	-	-	1	-	-	-	-	1	1
Premnobius cavipennis Eichhoff, 1878	-	-	3	2	3	5	7	7	21	21	27	48
Pygmaeoborus cubensis Bright, 2019	1	-	-	-	-	-	-	-	-	-	1	1
Sampsonius dampfi Schedl, 1940	-	-	1	-	1	-	2	2	3	5	4	9
Scolytopsis puncticollis Blandford, 1896	-	-	-	-	-	-	1	-	-	1	-	1
Scolytopsis toba Wichmann, 1914	-	-	-	-	1	-	1	-	-	2	-	2
Taurodemus varulus (Wood, 1974)	-	-	-	-	-	1	-	-	-	-	1	1
Tricolus subincisuralis Schedl, 1939	-	-	-	-	-	-	1	-	-	-	1	1

Table 1. Continued.

Species	circle									side		T
	A	B	C	D	E	F	G	H	I	N	S	
Scolytinae												
Xyleborinus saxeseni (Ratzeburg, 1837)	-	1	-	1	2	-	1	1	4	4	6	10
Xyleborus affinis Eichhoff, 1868	2	5	12	19	25	35	44	48	62	101	151	252
Xyleborus bispinatus Eichhoff, 1868	-	-	-	-	-	1	-	1	-	1	1	2
Xyleborus bolivianus Eggers, 1943	-	-	-	-	2	-	-	-	1	-	3	3
Xyleborus ferrugineus (Fabricius, 1801)	9	43	51	101	121	154	189	257	359	504	780	1284
Xyleborus latipennis Schedl, 1976	-	-	-	-	-	-	1	-	1	-	2	2
Xyleborus spinulosus Blandford, 1898	-	1	-	1	1	3	4	2	5	9	8	17
Xyleborus volvulus (Fabricius, 1775)	2	4	6	7	13	8	10	17	21	39	49	88
Xyleborus sp.01	-	-	-	-	1	-	-	-	-	1	-	1
Xyleborus sp.02	-	-	-	-	1	-	-	-	-	1	-	1
Xylosandrus curtulus (Eichhoff, 1869)	-	-	1	1	1	1	2	-	-	4	2	6
Σ Scolytinae	20	66	111	166	212	268	315	435	621	931	1283	2214
Platypodinae												
Euplatypus parallelus (Fabricius, 1801)	-	2	1	4	7	7	11	21	22	24	51	75
Euplatypus segnis (Chapuis, 1865)	-	3	3	3	3	5	8	21	23	28	41	69
*Euplatypus segnis** (Chapuis, 1865)	-	-	-	-	-	1	-	-	-	1	-	1
Platypodinae sp.01	-	-	-	-	-	1	-	-	-	-	1	1
Teloplatypus ratzeburgi (Chapuis, 1865)	-	4	3	8	8	19	15	21	22	43	57	100
Teloplatypus sp.01	-	-	-	1	-	-	-	-	1	2	-	2
Σ Platypodinae	-	9	7	16	18	33	34	63	68	98	150	248

Table 2. Bostrichidae, Cerambycidae and Cleridae species trapped per trap circle section (A through I), per side (N– northern, S– southern) and total (T) in ethanol-baited sticky flight intercept traps in a cerradão fragment. Universidade Estadual Paulista (UNESP/FEIS) Experimental Farm, Selvíria, Mato Grosso do Sul, Brazil, August 2020 to August 2021.

	circle									side		T
species	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**N**	**S**	
Bostrichidae												
Bostrychopsis laminifer (Lesne, 1895)	-	-	-	-	-	-	-	-	1	-	1	1
Bostrychopsis uncinata (Germar, 1824)	-	-	-	-	-	1	-	2	-	3	-	3
Micrapate atra (Lesne, 1899)	-	-	1	3	-	-	1	4	5	8	6	14
Micrapate brasiliensis (Lesne, 1899)	-	1	-	1	1	5	7	2	6	13	10	23
Micrapate fusca (Lesne, 1899)	-	-	-	-	-	-	-	-	1	-	1	1
Micrapate germaini (Lesne, 1899)	-	-	1	-	-	1	2	2	2	4	4	8
Micrapate sp.01	-	-	-	-	1	-	-	-	1	2	-	2
Micrapate sp.n.	-	-	-	-	-	-	-	1	-	1	-	1
Xyloperthella picea (Olivier, 1790)	1	4	8	1	5	9	21	20	36	48	57	105
Σ Bostrichidae	1	5	10	5	7	16	31	31	52	79	79	158
Cerambycidae												
Adetus modestus Melzer, 1934	-	-	-	-	1	-	1	1	2	3	2	5
Aerenea brunnea Thomson, 1868	-	1	-	1	1	2	3	1	2	4	7	11
Anelaphus souzai (Zajciw, 1964)	-	-	-	-	-	-	-	-	1	-	1	1
Chevrolattela tripunctata (Chevrolat, 1962)	-	-	-	-	-	1	1	-	-	1	1	2
Compsa quadriguttata (White, 1855)	1	3	1	3	3	2	10	6	7	10	26	36
Compsibidion vanum (Thomson, 1867)	-	-	-	-	-	-	-	1	1	2	-	2
Ctenoplon x-littera (Thomson, 1865)	-	-	1	-	-	-	-	-	-	-	1	1
Desmiphora crocata Melzer, 1935	-	-	-	4	1	2	-	-	1	2	6	8
Deltosoma xerophila Di lorio, 1995	-	-	-	-	1	-	-	-	-	-	1	1
Estola nigrosignata Breuning, 1940	-	-	-	-	-	-	1	-	-	-	1	1
Gorybia castanea (Gounelle, 1909)	-	1	-	-	-	1	-	-	1	2	1	3
Lypsimena fuscata Haldeman, 1847	-	2	-	-	1	-	-	-	-	1	2	3
Mecometopus polygenus Thomson, 1861	-	1	-	-	-	1	2	-	-	2	2	4
Neoclytus pusillus Laporte & Gory, 1838	1	-	2	1	3	3	9	7	8	21	13	34
Oreodera aerumnosa Erichson, 1847	-	-	-	-	-	-	-	1	-	-	1	1
Oxymerus aculeatus Dupont, 1838	-	-	-	-	2	-	-	1	-	1	2	3
Oxymerus basalis (Dalman, 1823)	-	-	-	-	-	-	-	1	-	1	-	1
Piezocera araujosilvai Melzer, 1935	-	-	-	-	-	-	-	1	-	-	1	1
Pronoplon rubriceps (Gounelle, 1909)	-	1	-	-	-	-	-	-	-	-	1	1
Σ Cerambycidae	2	9	5	11	13	12	27	20	23	50	69	119
Cleridae												
Megaphloeus mucoreus (Klug, 1842)	-	4	5	12	18	22	19	30	34	84	60	144
Cleridae sp.01	-	1	-	-	1	-	2	2	3	1	8	9
Cleridae sp.02	-	-	-	-	1	-	-	-	-	-	1	1
Cleridae sp.03	-	-	-	-	-	-	-	-	1	-	1	1
Cleridae sp.04	-	-	-	-	1	-	2	-	2	2	3	5
Cleridae sp.05	-	-	-	1	-	-	1	-	-	1	1	2
Cleridae sp.06	-	-	-	-	-	-	-	-	2	-	2	2
Cleridae sp.07	-	1	1	-	-	-	-	1	1	1	3	4
Σ Cleridae	-	6	6	13	21	22	24	33	43	89	79	168

Table 3. Weekly numbers of Scolytinae, Platypodinae, Bostrichidae, Cerambycidae and Cleridae species (mean ± SE) trapped in ethanol-baited versus unbaited, and ethanol-baited perpendicular (perp.) versus parallel sticky flight intercept traps, inside a cerradão fragment in Selvíria, Mato Grosso do Sul, Brazil, August 2020 to August 2021.

	ethanol		**trap orientation**	
family/species	**absent**	**present**	**parallel**	**perp.**
Scolytinae				
Coptoborus tolimanus	0.00 ± 0.00 a	0.01 ± 0.00 a	0.01 ± 0.00 a	0.00 ± 0.00 a
Cryptocarenus diadematus	0.00 ± 0.00 b	0.01 ± 0.00 a	0.01 ± 0.00 a	0.02 ± 0.01 a
Cryptocarenus heveae	0.00 ± 0.00 b	0.01 ± 0.00 a	0.01 ± 0.00 a	0.01 ± 0.01 a
Hylocurus retusipennis	0.00 ± 0.00 b	0.01 ± 0.00 a	0.01 ± 0.00 a	0.03 ± 0.01 b
Hypothenemus eruditus	0.00 ± 0.00 b	0.01 ± 0.00 a	0.01 ± 0.00 a	0.01 ± 0.01 a
Hypothenemus javanus	0.00 ± 0.00 b	0.00 ± 0.00 a	0.01 ± 0.00 a	0.01 ± 0.00 a
Hypothenemus obscurus	0.00 ± 0.00 b	0.01 ± 0.00 a	0.01 ± 0.00 a	0.01 ± 0.00 a
Premnobius cavipennis	0.00 ± 0.00 b	0.01 ± 0.00 a	0.01 ± 0.00 a	0.01 ± 0.00 a
Xyleborus affinis	0.00 ± 0.00 b	0.06 ± 0.00 a	0.06 ± 0.01 a	0.02 ± 0.01 a
Xyleborus ferrugineus	0.09 ± 0.01 b	0.25 ± 0.01 a	0.27 ± 0.01 a	0.09 ± 0.01 a
Xyleborus volvulus	0.00 ± 0.00 b	0.02 ± 0.00 a	0.02 ± 0.00 a	0.00 ± 0.00 a
Σ Scolytinae	0.12 ± 0.01 b	0.43 ± 0.01 a	0.46 ± 0.01 a	0.27 ± 0.02 a
Platypodinae				
Euplatypus parallelus	0.00 ± 0.00 b	0.02 ± 0.00 a	0.02 ± 0.00 b	0.00 ± 0.00 a
Euplatypus segnis	0.00 ± 0.00 b	0.01 ± 0.00 a	0.01 ± 0.00 a	0.01 ± 0.00 a
T. ratzeburgi	0.00 ± 0.00 b	0.02 ± 0.00 a	0.02 ± 0.00 a	0.01 ± 0.00 a
Σ Platypodinae	0.00 ± 0.00 b	0.05 ± 0.00 a	0.06 ± 0.00 b	0.02 ± 0.01 a
Bostrichidae				
Micrapate brasiliensis	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a
Xyloperthella picea	0.00 ± 0.00 b	0.02 ± 0.00 a	0.02 ± 0.00 a	0.03 ± 0.01 a
Σ Bostrichidae	0.00 ± 0.00 b	0.03 ± 0.00 a	0.03 ± 0.00 a	0.05 ± 0.01 a
Cerambycidae				
Compsa quadriguttata	0.00 ± 0.00 b	0.01 ± 0.00 a	0.01 ± 0.00 a	0.00 ± 0.00 a
Neoclytus pusillus	0.00 ± 0.00 b	0.01 ± 0.00 a	0.01 ± 0.00 a	0.01 ± 0.00 a
Σ Cerambycidae	0.00 ± 0.00 b	0.03 ± 0.00 a	0.03 ± 0.00 a	0.02 ± 0.01 a
Cleridae				
M. mucoreus	0.00 ± 0.00 b	0.04 ± 0.01 a	0.03 ± 0.01 b	0.02 ± 0.01 a
Σ Cleridae	0.00 ± 0.00 b	0.04 ± 0.01 a	0.04 ± 0.01 b	0.02 ± 0.01 a

Means detransformed from $\sqrt{(x+0,5)}$, followed by the same letter per species and treatment do not differ ($p < 0.05$, Tukey test).

Table 4. Wind direction (degrees) (mean ± SE) in the cerradão fragment and pasture area for different time periods. UNESP Experimental Farm, Selvíria, Mato Grosso do Sul, Brazil, from July to August 2021.

	wind direction - area		
period	**fragment**	**pasture**	
morning	177.94 ± 7.65 a	103.70 ± 6.87 a	
afternoon	189.47 ± 7.72 a	105.63 ± 3.82 a	
	wind direction – period of the day		
place	**morning**	**afternoon**	**full day**
fragment	177.94 ± 7.65 a	189.47 ± 7.72 a	183.60 ± 5.43 a
pasture	103.70 ± 6.87 b	105.63 ± 3.82 b	104.65 ± 3.96 b

Means detransformed from √(x+0,5), followed by the same letter per column do not differ (p < 0.05, Tukey test).

Table 5. Wind speed (m/s) (mean ± SE) between cerradão fragment and pasture area, for different periods. UNESP Experimental Farm, Selvíria, Mato Grosso do Sul, Brazil, July to August 2021.

	wind speed – área		
period	**fragment**	**pasture**	
morning	0.09 ± 0.00 a	0.66 ± 0.06 a	
afternoon	0.09 ± 0.00 a	0.32 ± 0.05 b	
	wind speed – period of the day		
place	**morning**	**afternoon**	**full day**
fragment	0.09 ± 0.00 b	0.09 ± 0.00 b	0.09 ± 0.00 b
pasture	0.66 ± 0.06 a	0.32 ± 0.05 a	0.49 ± 0.04 a

Means detransformed from √(x+0,5) followed by the same letter per species do not differ (p < 0.05, Tukey test).

Table 6. Weekly numbers of Scolytinae, Platypodinae, Bostrichidae, Cerambycidae and Cleridae species (mean ± SE) trapped between in the northern (N) southern (S), eastern (E) and western (W) sides fo for ethanol-baited, unbaited, and parallel-oriented sticky flight intercept traps in a cerradão fragment in Selvíria, Mato Grosso do Sul, Brazil, August 2020 to August 2021.

family/species	**ethanol-baited**		**unbaited**		**parallel**	
Scolytinae	**N**	**S**	**N**	**S**	**E**	**W**
Coptoborus tolimanus	0.01 ± 0.00 a	0.01 ± 0.00 a	---	---	0.00 ± 0.00 a	0.00 ± 0.00 a
Cryptocarenus diadematus	0.01 ± 0.00 a	0.01 ± 0.00 a	---	---	0.01 ± 0.01 a	0.02 ± 0.01 a
Cryptocarenus heveae	0.01 ± 0.00 a	0.01 ± 0.00 a	---	---	0.02 ± 0.01 a	0.00 ± 0.00 a
Hylocurus retusipennis	0.01 ± 0.00 a	0.01 ± 0.00 a	---	---	0.04 ± 0.01 a	0.02 ± 0.01 a
Hypothenemus eruditus	0.01 ± 0.00 a	0.01 ± 0.00 a	0.00 ± 0.00 a	0.01 ± 0.01 a	0.02 ± 0.01 a	0.00 ± 0.00 a
Hypothenemus javanus	0.01 ± 0.00 a	0.01 ± 0.00 a	---	---	0.00 ± 0.00 a	0.01 ± 0.01 a
Hypothenemus obscurus	0.01 ± 0.00 a	0.01 ± 0.00 b	0.00 ± 0.00 a	0.01 ± 0.01 a	0.00 ± 0.00 b	0.02 ± 0.01 a
Premnobius cavipennis	0.01 ± 0.00 a	0.01 ± 0.00 a	0.01 ± 0.01 a	0.02 ± 0.01 a	0.01 ± 0.01 a	0.00 ± 0.00 a
Xyleborus affinis	0.04 ± 0.01 b	0.07 ± 0.01 a	0.04 ± 0.02 a	0.05 ± 0.02 a	0.02 ± 0.01 a	0.01 ± 0.01 a
Xyleborus ferrugineus	0.20 ± 0.01 b	0.33 ± 0.02 a	0.42 ± 0.08 a	0.29 ± 0.06 a	0.05 ± 0.02 b	0.13 ± 0.02 a
Xyleborus volvulus	0.01 ± 0.00 a	0.02 ± 0.00 a	0.09 ± 0.03 a	0.05 ± 0.02 a	---	---
Σ Scolytinae	0.38 ± 0.02 b	0.55 ± 0.02 a	0.57 ± 0.10 a	0.50 ± 0.10 a	0.23 ± 0.03 a	0.30 ± 0.03 a
Platypodinae						
Euplatypus parallelus	0.01 ± 0.00 b	0.02 ± 0.00 a	---	---	0.00 ± 0.00 a	0.00 ± 0.00 a
Euplatypus segnis	0.01 ± 0.00 a	0.02 ± 0.00 a	0.03 ± 0.02 a	0.04 ± 0.02 a	0.00 ± 0.00 a	0.01 ± 0.01 a
Teloplatypus ratzeburgi	0.02 ± 0.00 a	0.03 ± 0.00 a	0.01 ± 0.01 a	0.03 ± 0.01 a	0.00 ± 0.00 a	0.01 ± 0.01 a
Σ Platypodinae	0.05 ± 0.00 b	0.07 ± 0.01 a	0.03 ± 0.02 a	0.07 ± 0.02 a	0.00 ± 0.00 b	0.03 ± 0.01 a
Bostrichidae						
Micrapate brasiliensis	0.01 ± 0.00 a	0.00 ± 0.00 a	0.01 ± 0.01 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a
Xyloperthella picea	0.02 ± 0.00 a	0.02 ± 0.00 a	0.04 ± 0.02 a	0.03 ± 0.01 a	0.04 ± 0.01 a	0.02 ± 0.01 a
Σ Bostrichidae	0.03 ± 0.00 a	0.03 ± 0.00 a	0.05 ± 0.02 a	0.03 ± 0.02 a	0.05 ± 0.02 a	0.04 ± 0.01 a
Cerambycidae			---	---		
Compsa quadriguttata	0.00 ± 0.00 b	0.01 ± 0.00 a	0.01 ± 0.01 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.01 ± 0.01 a
Neoclytus pusillus	0.01 ± 0.00 a	0.01 ± 0.00 a	---	---	0.01 ± 0.01 a	0.01 ± 0.01 a
Σ Cerambycidae	0.02 ± 0.00 a	0.03 ± 0.00 a	0.01 ± 0.01 a	0.02 ± 0.01 a	0.01 ± 0.01 a	0.03 ± 0.01 a
Cleridae						
Megaphloeus mucoreus	0.04 ± 0.00 a	0.03 ± 0.00 b	---	---	0.02 ± 0.01 a	0.01 ± 0.01 a
Σ Cleridae	0.04 ± 0.00 a	0.04 ± 0.00 a	0.00 ± 0.00 a	0.01 ± 0.01 a	0.02 ± 0.01 a	0.01 ± 0.01 a

Means detransformed from √(x+0,5), followed by the same letter per species and treatment do not differ ($p < 0.05$, Tukey test).

Table 7. Weekly numbers of Scolytinae, Platypodinae, Bostrichidae, Cerambycidae and Cleridae species (mean ± SE) trapped among circles (A through I) in ethanol-baited E-W sticky flight intercept traps in a cerradão fragment in Selvíria, Mato Grosso do Sul, Brazil, August 2020 to Aug 2021.

family/species	A	B	C	D	E	F	G	H	I
Scolytinae									
Coptoborus tolimanus	0.00 ± 0.00 b	0.00 ± 0.00 b	0.00 ± 0.00 b	0.00 ± 0.00 b	0.00 ± 0.00 b	0.01 ± 0.00 ab	0.00 ± 0.00 b	0.02 ± 0.01 a	0.01 ± 0.01 ab
Cryptocarenus diadematus	0.00 ± 0.00 b	0.00 ± 0.00 b	0.00 ± 0.00 b	0.01 ± 0.00 b	0.01 ± 0.00 b	0.00 ± 0.00 b	0.01 ± 0.01 ab	0.02 ± 0.01 ab	0.03 ± 0.01 a
Cryptocarenus heveae	0.00 ± 0.00 b	0.00 ± 0.00 b	0.00 ± 0.00 b	0.01 ± 0.00 ab	0.00 ± 0.00 b	0.01 ± 0.00 ab	0.02 ± 0.01 ab	0.02 ± 0.01 ab	0.03 ± 0.01 a
Hylocurus retusipennis	0.00 ± 0.00 b	0.00 ± 0.00 b	0.01 ± 0.00 b	0.00 ± 0.00 b	0.00 ± 0.00 b	0.00 ± 0.00 b	0.00 ± 0.00 b	0.01 ± 0.00 b	0.04 ± 0.01 a
Hypothenemus eruditus	0.00 ± 0.00 a	0.00 ± 0.00 a	0.01 ± 0.01 a	0.01 ± 0.00 a	0.02 ± 0.01 a	0.02 ± 0.01 a	0.01 ± 0.00 a	0.01 ± 0.00 a	0.02 ± 0.01 a
Hypothenemus javanus	0.00 ± 0.00 b	0.00 ± 0.00 ab	0.00 ± 0.00 ab	0.01 ± 0.01 ab	0.02 ± 0.01 ab	0.00 ± 0.00 ab	0.01 ± 0.00 ab	0.02 ± 0.01 a	0.03 ± 0.01 a
Hypothenemus obscurus	0.00 ± 0.00 a	0.00 ± 0.00 a	0.02 ± 0.01 a	0.01 ± 0.00 a	0.01 ± 0.00 a	0.02 ± 0.01 a	0.01 ± 0.00 a	0.00 ± 0.00 a	0.02 ± 0.01 a
Premnobius cavipennis	0.00 ± 0.00 b	0.00 ± 0.00 b	0.00 ± 0.00 b	0.00 ± 0.00 b	0.01 ± 0.00 b	0.01 ± 0.00 b	0.01 ± 0.00 b	0.01 ± 0.01 b	0.04 ± 0.01 a
Xyleborus affinis	0.00 ± 0.00 d	0.01 ± 0.00 d	0.03 ± 0.01 cd	0.04 ± 0.01 bcd	0.05 ± 0.01 bcd	0.06 ± 0.01 abc	0.10 ± 0.02 ab	0.09 ± 0.01 ab	0.12 ± 0.02 a
Xyleborus ferrugineus	0.02 ± 0.01 f	0.09 ± 0.01 ef	0.10 ± 0.02 ef	0.20 ± 0.02 de	0.22 ± 0.03 d	0.28 ± 0.03 cd	0.36 ± 0.04 bc	0.47 ± 0.04 b	0.64 ± 0.06 a
Xyleborus volvulus	0.00 ± 0.00 b	0.01 ± 0.00 ab	0.00 ± 0.00 b	0.01 ± 0.01 ab	0.03 ± 0.01 ab	0.01 ± 0.01 ab	0.02 ± 0.01 ab	0.03 ± 0.01 ab	0.04 ± 0.01 a
Σ Scolytinae	0.04 ± 0.01 h	0.13 ± 0.02 gh	0.21 ± 0.02 fg	0.32 ± 0.03 ef	0.40 ± 0.03 de	0.48 ± 0.04 cd	0.60 ± 0.05 c	0.79 ± 0.05 b	1.10 ± 0.07 a
Platypodinae									
Euplatypus parallelus	0.00 ± 0.00 b	0.00 ± 0.00 b	0.00 ± 0.00 b	0.01 ± 0.00 b	0.02 ± 0.01 b	0.02 ± 0.01 b	0.02 ± 0.01 ab	0.05 ± 0.01 a	0.04 ± 0.01 a
Euplatypus segnis	0.00 ± 0.00 c	0.01 ± 0.00 c	0.01 ± 0.00 c	0.00 ± 0.00 c	0.00 ± 0.00 c	0.01 ± 0.00 c	0.02 ± 0.01 bc	0.04 ± 0.01 ab	0.04 ± 0.01 a
Teloplatypus ratzeburgi	0.00 ± 0.00 e	0.01 ± 0.00 de	0.01 ± 0.00 de	0.01 ± 0.01 bcde	0.02 ± 0.01 cde	0.04 ± 0.01 abc	0.03 ± 0.01 bcd	0.04 ± 0.01 a	0.04 ± 0.01 ab
Σ Platypodinae	0.00 ± 0.00 d	0.02 ± 0.01 cd	0.02 ± 0.01 d	0.02 ± 0.01 bcd	0.04 ± 0.01 bcd	0.07 ± 0.01 bc	0.07 ± 0.01 b	0.13 ± 0.02 a	0.13 ± 0.02 a
Bostrichidae									
Micrapate brasiliensis	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.01 ± 0.01 a	0.01 ± 0.01 a	0.00 ± 0.00 a	0.01 ± 0.00 a
Xyloperthella picea	0.00 ± 0.00 c	0.01 ± 0.00 bc	0.02 ± 0.01 bc	0.00 ± 0.00 c	0.01 ± 0.01 bc	0.01 ± 0.01 bc	0.03 ± 0.01 ab	0.03 ± 0.01 ab	0.06 ± 0.01 a
Σ Bostrichidae	0.00 ± 0.00 d	0.01 ± 0.01 d	0.02 ± 0.01 bcd	0.01 ± 0.01 d	0.01 ± 0.01 cd	0.03 ± 0.01 bcd	0.05 ± 0.01 b	0.05 ± 0.01 bc	0.09 ± 0.01 a
Cerambycidae									
Compsa quadriguttata	0.00 ± 0.00 b	0.01 ± 0.00 a	0.00 ± 0.00 b	0.00 ± 0.00 b	0.01 ± 0.00 a	0.00 ± 0.00 b	0.02 ± 0.01 a	0.01 ± 0.01 a	0.01 ± 0.01 a
Neoclytus pusillus	0.00 ± 0.00 b	0.00 ± 0.00 b	0.00 ± 0.00 b	0.00 ± 0.00 b	0.01 ± 0.00 a	0.01 ± 0.00 a	0.02 ± 0.01 a	0.01 ± 0.01 a	0.01 ± 0.01 a
Σ Cerambycidae	0.00 ± 0.00 d	0.02 ± 0.01 cd	0.00 ± 0.00 d	0.02 ± 0.01 cd	0.03 ± 0.01 cd	0.02 ± 0.01 bcd	0.06 ± 0.01 a	0.04 ± 0.01 bc	0.05 ± 0.01 ab
Cleridae									
Megaphloeus mucoreus	0.00 ± 0.00 d	0.01 ± 0.00 cd	0.01 ± 0.01 cd	0.03 ± 0.01 bcd	0.04 ± 0.01 abc	0.05 ± 0.01 abc	0.04 ± 0.01 abc	0.06 ± 0.01 ab	0.07 ± 0.01 a
Σ Cleridae	0.00 ± 0.00 d	0.01 ± 0.01 cd	0.01 ± 0.01 cd	0.03 ± 0.01 cd	0.05 ± 0.01 abc	0.05 ± 0.01 bc	0.05 ± 0.01 abc	0.07 ± 0.01 ab	0.09 ± 0.01 a

Means detransformed from $\sqrt{(x+0,5)}$, followed by the same letter per species do not differ ($p < 0.05$, Tukey test).

Table 8. Weekly numbers of Scolytinae, Platypodinae, Bostrichidae, Cerambycidae and Cleridae species (mean ± SE) trapped among circles (A through I) in the northern side in ethanol-baited E-W sticky flight intercept traps in a cerradão fragment in in Selvíria, Mato Grosso do Sul, Brazil, August 2020 to August 2021.

family/species	A	B	C	D	E	F	G	H	I
Scolytinae					northern side circles				
Coptoborus tolimanus	0.00 ± 0.00 a	0.00 ± 0.00 a	0.01 ± 0.01 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.01 ± 0.01 a	0.01 ± 0.01 a	0.01 ± 0.01 a	0.02 ± 0.01 a
Cryptocarenus diadematus	0.00 ± 0.00 b	0.00 ± 0.00 b	0.00 ± 0.00 b	0.00 ± 0.00 b	0.00 ± 0.00 b	0.00 ± 0.00 b	0.00 ± 0.00 b	0.03 ± 0.01 ab	0.05 ± 0.01 a
Cryptocarenus heveae	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.01 ± 0.01 a	0.00 ± 0.00 a	0.01 ± 0.01 a	0.02 ± 0.01 a	0.03 ± 0.01 a	0.03 ± 0.01 a
Hylocurus retusipennis	0.00 ± 0.00 b	0.00 ± 0.00 b	0.01 ± 0.01 ab	0.00 ± 0.00 b	0.00 ± 0.00 b	0.00 ± 0.00 b	0.00 ± 0.00 b	0.00 ± 0.00 b	0.03 ± 0.01 a
Hypothenemus eruditus	0.00 ± 0.00 a	0.01 ± 0.01 a	0.01 ± 0.01 a	0.01 ± 0.01 a	0.01 ± 0.01 a	0.02 ± 0.01 a	0.00 ± 0.00 a	0.01 ± 0.01 a	0.02 ± 0.01 a
Hypothenemus javanus	0.00 ± 0.00 b	0.00 ± 0.00 b	0.00 ± 0.00 b	0.00 ± 0.00 ab	0.01 ± 0.01 ab	0.00 ± 0.00 ab	0.00 ± 0.00 b	0.01 ± 0.01 ab	0.03 ± 0.02 a
Hypothenemus obscurus	0.00 ± 0.00 a	0.00 ± 0.00 a	0.01 ± 0.01 a	0.01 ± 0.01 a	0.01 ± 0.01 a	0.01 ± 0.01 a	0.01 ± 0.01 a	0.01 ± 0.01 a	0.00 ± 0.00 a
Premnobius cavipennis	0.00 ± 0.00 b	0.00 ± 0.00 b	0.00 ± 0.00 b	0.00 ± 0.00 b	0.01 ± 0.01 b	0.02 ± 0.01 b	0.00 ± 0.00 b	0.02 ± 0.01 b	0.05 ± 0.02 a
Xyleborus affinis	0.00 ± 0.00 d	0.01 ± 0.01 d	0.03 ± 0.01 cd	0.04 ± 0.01 bcd	0.08 ± 0.02 abcd	0.09 ± 0.02 abc	0.09 ± 0.02 abc	0.12 ± 0.02 ab	0.14 ± 0.03 a
Xyleborus ferrugineus	0.02 ± 0.01 d	0.12 ± 0.03 cd	0.13 ± 0.03 cd	0.22 ± 0.04 c	0.28 ± 0.04 bc	0.30 ± 0.05 bc	0.43 ± 0.05 b	0.61 ± 0.06 a	0.81 ± 0.09 a
Xyleborus volvulus	0.00 ± 0.00 a	0.00 ± 0.00 a	0.01 ± 0.01 a	0.01 ± 0.01 a	0.04 ± 0.01 a	0.02 ± 0.01 a	0.03 ± 0.01 a	0.03 ± 0.01 a	0.04 ± 0.01 a
Σ Scolytinae	0.05 ± 0.01 f	0.18 ± 0.03 ef	0.24 ± 0.03 ef	0.33 ± 0.05 dc	0.50 ± 0.05 cd	0.56 ± 0.06 c	0.63 ± 0.06 c	0.96 ± 0.07 b	1.36 ± 0.12 a
Platypodinae									
Euplatypus parallelus	0.00 ± 0.00 b	0.01 ± 0.01 b	0.00 ± 0.00 b	0.02 ± 0.01 ab	0.03 ± 0.01 ab	0.01 ± 0.01 ab	0.04 ± 0.01 ab	0.06 ± 0.02 a	0.06 ± 0.02 a
Euplatypus segnis	0.00 ± 0.00 b	0.01 ± 0.01 ab	0.01 ± 0.01 ab	0.00 ± 0.00 b	0.00 ± 0.00 b	0.01 ± 0.01 ab	0.02 ± 0.01 ab	0.04 ± 0.01 a	0.05 ± 0.01 a
Teloplatypus ratzeburgi	0.00 ± 0.00 b	0.01 ± 0.01 ab	0.01 ± 0.01 ab	0.02 ± 0.01 ab	0.02 ± 0.01 ab	0.03 ± 0.01 ab	0.03 ± 0.01 ab	0.05 ± 0.01 a	0.05 ± 0.02 a
Σ Platypodinae	0.00 ± 0.00 c	0.03 ± 0.01 bc	0.02 ± 0.01 bc	0.04 ± 0.01 bc	0.05 ± 0.01 bc	0.06 ± 0.02 bc	0.08 ± 0.02 ab	0.15 ± 0.03 a	0.16 ± 0.03 a
Bostrichidae									
Micrapate brasiliensis	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.01 ± 0.01 a	0.01 ± 0.01 a	0.00 ± 0.00 a	0.01 ± 0.01 a
Xyloperthella picea	0.00 ± 0.00 b	0.01 ± 0.01 b	0.03 ± 0.01 ab	0.00 ± 0.00 b	0.01 ± 0.01 b	0.01 ± 0.01 b	0.04 ± 0.01 ab	0.03 ± 0.01 ab	0.07 ± 0.02 a
Σ Bostrichidae	0.00 ± 0.00 c	0.01 ± 0.01 bc	0.03 ± 0.01 bc	0.00 ± 0.00 c	0.01 ± 0.01 bc	0.02 ± 0.01 bc	0.06 ± 0.02 ab	0.04 ± 0.01 bc	0.10 ± 0.02 a
Cerambycidae									
Compsa quadriguttata	0.00 ± 0.00 b	0.01 ± 0.01 b	0.00 ± 0.00 b	0.00 ± 0.00 b	0.01 ± 0.01 ab	0.01 ± 0.01 b	0.04 ± 0.01 a	0.01 ± 0.01 b	0.02 ± 0.01 ab
Neoclytus pusillus	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.02 ± 0.01 a	0.02 ± 0.01 a	0.01 ± 0.01 a
Σ Cerambycidae	0.00 ± 0.00 b	0.02 ± 0.01 b	0.00 ± 0.00 b	0.01 ± 0.01 b	0.03 ± 0.01 ab	0.04 ± 0.01 ab	0.08 ± 0.02 a	0.03 ± 0.01 ab	0.04 ± 0.01 ab
Cleridae									
Megaphloeus mucoreus	0.00 ± 0.00 b	0.01 ± 0.01 ab	0.01 ± 0.01 ab	0.03 ± 0.01 ab	0.03 ± 0.01 ab	0.04 ± 0.02 ab	0.03 ± 0.01 ab	0.05 ± 0.02 a	0.06 ± 0.02 a
Σ Cleridae	0.00 ± 0.00 c	0.00 ± 0.00 c	0.00 ± 0.00 c	0.00 ± 0.00 c	0.00 ± 0.00 c	0.00 ± 0.00 c	0.00 ± 0.00 c	0.00 ± 0.00 c	0.00 ± 0.00 c

Means detransformed from $\sqrt{(x+0,5)}$, followed by the same letter per species do not differ ($p < 0.05$, Tukey test).

Table 9. Weekly numbers of Scolytinae, Platypodinae, Bostrichidae, Cerambycidae and Cleridae species (mean ± SE) trapped in te circles (A through I) in the southern side of ethanol-baited E-W sticky flight intercept traps in a cerradão fragment in Selvíria/MS, Brazil, August 2020 to August 2021.

family/species	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**
Scolytinae					**southern side circles**				
Coptoborus tolimanus	0.00 ± 0.00 b	0.00 ± 0.00 b	0.00 ± 0.00 b	0.00 ± 0.00 b	0.00 ± 0.00 b	0.00 ± 0.00 b	0.00 ± 0.00 b	0.04 ± 0.01 a	0.00 ± 0.00 b
Cryptocarenus diadematus	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.01 ± 0.01 a	0.01 ± 0.01 a	0.00 ± 0.00 a	0.02 ± 0.01 a	0.01 ± 0.01 a	0.01 ± 0.01 a
Cryptocarenus heveae	0.00 ± 0.00 b	0.00 ± 0.00 ab	0.00 ± 0.00 ab	0.01 ± 0.01 ab	0.00 ± 0.00 b	0.01 ± 0.01 ab	0.01 ± 0.01 ab	0.01 ± 0.01 ab	0.03 ± 0.01 a
Hylocurus retusipennis	0.00 ± 0.00 b	0.00 ± 0.00 b	0.01 ± 0.01 b	0.00 ± 0.00 b	0.00 ± 0.00 b	0.00 ± 0.00 b	0.00 ± 0.00 b	0.01 ± 0.01 b	0.05 ± 0.02 a
Hypothenemus eruditus	0.00 ± 0.00 a	0.00 ± 0.00 a	0.01 ± 0.01 a	0.01 ± 0.01 a	0.02 ± 0.01 a	0.02 ± 0.01 a	0.01 ± 0.01 a	0.01 ± 0.01 a	0.02 ± 0.01 a
Hypothenemus javanus	0.00 ± 0.00 a	0.01 ± 0.01 a	0.01 ± 0.01 a	0.01 ± 0.01 a	0.02 ± 0.01 a	0.00 ± 0.00 a	0.01 ± 0.01 a	0.04 ± 0.01 a	0.02 ± 0.01 a
Hypothenemus obscurus	0.00 ± 0.00 a	0.00 ± 0.00 a	0.02 ± 0.01 a	0.01 ± 0.01 a	0.01 ± 0.01 a	0.03 ± 0.01 a	0.01 ± 0.01 a	0.00 ± 0.00 a	0.03 ± 0.01 a
Premnobius cavipennis	0.00 ± 0.00 a	0.00 ± 0.00 a	0.01 ± 0.01 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.02 ± 0.01 a	0.01 ± 0.01 a	0.03 ± 0.01 a
Xyleborus affinis	0.00 ± 0.00 d	0.00 ± 0.00 d	0.02 ± 0.01 bcd	0.05 ± 0.01 abcd	0.02 ± 0.01 cd	0.03 ± 0.01 bcd	0.10 ± 0.03 a	0.07 ± 0.02 abc	0.09 ± 0.03 ab
Xyleborus ferrugineus	0.01 ± 0.01 e	0.05 ± 0.02 de	0.06 ± 0.02 de	0.17 ± 0.03 bcd	0.16 ± 0.03 dc	0.26 ± 0.04 bc	0.29 ± 0.05 abc	0.32 ± 0.05 ab	0.46 ± 0.07 a
Xyleborus volvulus	0.00 ± 0.00 a	0.01 ± 0.01 a	0.00 ± 0.00 a	0.02 ± 0.01 a	0.02 ± 0.01 a	0.00 ± 0.00 a	0.02 ± 0.01 a	0.02 ± 0.01 a	0.03 ± 0.01 a
Σ Scolytinae	0.03 ± 0.01 e	0.09 ± 0.02 e	0.19 ± 0.03 de	0.31 ± 0.04 cd	0.30 ± 0.04 cd	0.40 ± 0.05 bc	0.58 ± 0.07 b	0.62 ± 0.07 ab	0.85 ± 0.09 ab
Platypodinae									
Euplatypus parallelus	0.00 ± 0.00 b	0.00 ± 0.00 b	0.00 ± 0.00 ab	0.00 ± 0.00 b	0.00 ± 0.00 ab	0.02 ± 0.01 ab	0.01 ± 0.01 ab	0.04 ± 0.01 a	0.03 ± 0.01 a
Euplatypus segnis	0.00 ± 0.00 b	0.00 ± 0.00 b	0.00 ± 0.00 b	0.00 ± 0.00 b	0.00 ± 0.00 b	0.00 ± 0.00 b	0.01 ± 0.01 ab	0.03 ± 0.01 ab	0.04 ± 0.01 ab
Teloplatypus ratzeburgi	0.00 ± 0.00 b	0.01 ± 0.01 ab	0.00 ± 0.00 ab	0.00 ± 0.00 ab	0.02 ± 0.01 ab	0.05 ± 0.01 a	0.03 ± 0.01 ab	0.04 ± 0.01 ab	0.03 ± 0.01 ab
Σ Platypodinae	0.00 ± 0.00 c	0.01 ± 0.01 bc	0.01 ± 0.01 bc	0.01 ± 0.01 bc	0.02 ± 0.01 bc	0.07 ± 0.02 ab	0.06 ± 0.02 abc	0.10 ± 0.02 a	0.11 ± 0.02 a
Bostrichidae									
Micrapate brasiliensis	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.01 ± 0.01 a	0.02 ± 0.01 a	0.00 ± 0.00 a	0.01 ± 0.01 a
Xyloperthella picea	0.00 ± 0.00 b	0.01 ± 0.01 b	0.00 ± 0.00 b	0.00 ± 0.00 b	0.01 ± 0.01 b	0.01 ± 0.01 b	0.02 ± 0.01 b	0.03 ± 0.01 ab	0.06 ± 0.02 a
Σ Bostrichidae	0.00 ± 0.00 c	0.01 ± 0.01 bc	0.00 ± 0.00 c	0.01 ± 0.01 bc	0.01 ± 0.01 bc	0.03 ± 0.01 abc	0.05 ± 0.01 abc	0.06 ± 0.02 ab	0.08 ± 0.02 a
Cerambycidae									
Compsa quadriguttata	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.01 ± 0.01 a	0.01 ± 0.01 a
Neoclytus pusillus	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.01 ± 0.01 a	0.01 ± 0.01 a	0.02 ± 0.01 a	0.01 ± 0.01 a	0.02 ± 0.01 a
Σ Cerambycidae	0.00 ± 0.00 b	0.01 ± 0.01 ab	0.00 ± 0.00 b	0.03 ± 0.01 ab	0.02 ± 0.01 ab	0.01 ± 0.01 ab	0.03 ± 0.01 ab	0.04 ± 0.01 ab	0.06 ± 0.01 a
Cleridae									
Megaphloeus mucoreus	0.00 ± 0.00 b	0.01 ± 0.01 b	0.01 ± 0.01 b	0.03 ± 0.01 ab	0.05 ± 0.01 ab	0.05 ± 0.02 ab	0.05 ± 0.02 ab	0.07 ± 0.02 a	0.08 ± 0.02 a
Σ Cleridae	0.00 ± 0.00 c	0.01 ± 0.01 bc	0.01 ± 0.01 bc	0.03 ± 0.01 abc	0.05 ± 0.02 abc	0.05 ± 0.02 abc	0.06 ± 0.02 ab	0.08 ± 0.02 a	0.08 ± 0.02 a

Means detransformed from √(x+0,5), followed by the same letter per species do not differ ($p < 0.05$, Tukey test).

Table 10. Weekly numbers of Scolytinae, Platypodinae and Cerambycidae species (mean ± SE) trapped in the circles (A through I) in the the E-W of an unbaited sticky intercept trap flight in a cerradão fragment in in Selvíria, Mato Grosso do Sul, Brazil, September 2020 to August 2021.

family/species	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**
Scolytinae									
Coptoborus tolimanus	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.02 ± 0.01 a
Cryptocarenus heveae	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.01 ± 0.01 a
Hypothenemus eruditus	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.01 ± 0.01 a	0.00 ± 0.00 a
Hypothenemus obscurus	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.01 ± 0.01 a	0.00 ± 0.00 a	0.01 ± 0.01 a	0.00 ± 0.00 a	0.01 ± 0.01 a	0.00 ± 0.00 a
Xyleborus affinis	0.00 ± 0.00 a	0.00 ± 0.00 a	0.01 ± 0.01 a	0.00 ± 0.00 a	0.01 ± 0.01 a	0.01 ± 0.01 a	0.01 ± 0.01 a	0.00 ± 0.00 a	0.00 ± 0.00 a
Xyleborus ferrugineus	0.00 ± 0.00 c	0.02 ± 0.01 bc	0.04 ± 0.02 abc	0.06 ± 0.02 abc	0.13 ± 0.04 abc	0.12 ± 0.03 abc	0.14 ± 0.04 ab	0.14 ± 0.04 ab	0.18 ± 0.05 a
Xyleborus volvulus	0.00 ± 0.00 a	0.00 ± 0.00 a	0.01 ± 0.01 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a
Σ Scolytinae	0.00 ± 0.00 b	0.03 ± 0.02 b	0.09 ± 0.03 ab	0.07 ± 0.03 ab	0.15 ± 0.04 ab	0.15 ± 0.04 ab	0.21 ± 0.05 a	0.18 ± 0.04 a	0.23 ± 0.05 a
Platypodinae									
Euplatypus segnis	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.01 ± 0.01 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a
Teloplatypus ratzeburgi	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.01 ± 0.01 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.01 ± 0.01 a	0.00 ± 0.00 a	0.00 ± 0.00 a
Σ Platypodinae	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.01 ± 0.01 a	0.01 ± 0.01 a	0.00 ± 0.00 a	0.01 ± 0.01 a	0.00 ± 0.00 a	0.00 ± 0.00 a
Cerambycidae									
Σ Cerambycidae	0.00 ± 0.00 a	0.00 ± 0.00 a	0.01 ± 0.01 a	0.00 ± 0.00 a	0.01 ± 0.01 a	0.01 ± 0.01 a	0.01 ± 0.01 a	0.00 ± 0.00 a	0.00 ± 0.00 a

Means detransformed from $\sqrt{(x+0,5)}$, followed by the same letter per species do not differ ($p < 0.05$, Tukey test).

Table 11. Weekly numbers of Scolytinae, Platypodinae and Cerambycidae species (mean ± SE) trapped among circles (A through I) in the southern and northern sides in an unbaited E-W sticky flight intercept trap in a cerradão fragment in Selvíria, Mato Grosso do Sul, Brazil, September 2020 to August 2021.

family/species	A	B	C	D	E	F	G	H	I
					northern side circles				
Scolytinae									
Coptoborus tolimanus	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.04 ± 0.03 a
Hypothenemus eruditus	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.02 ± 0.02 a	0.00 ± 0.00 a
Hypothenemus obscurus	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.02 ± 0.02 a	0.00 ± 0.00 a	0.02 ± 0.02 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a
Xyleborus affinis	0.00 ± 0.00 a	0.00 ± 0.00 a	0.02 ± 0.02 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.02 ± 0.02 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a
Xyleborus ferrugineus	0.00 ± 0.00 a	0.04 ± 0.03 a	0.04 ± 0.03 a	0.08 ± 0.04 a	0.08 ± 0.04 a	0.16 ± 0.06 a	0.15 ± 0.06 a	0.06 ± 0.03 a	0.12 ± 0.05 a
Σ Scolytinae	0.00 ± 0.00 a	0.06 ± 0.04 a	0.10 ± 0.05 a	0.10 ± 0.05 a	0.10 ± 0.04 a	0.22 ± 0.06 a	0.15 ± 0.06 a	0.14 ± 0.05 a	0.16 ± 0.06 a
Platypodinae									
Teloplatypus ratzeburgi	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.02 ± 0.02 a	0.00 ± 0.00 a	0.00 ± 0.00 a
Σ Platypodinae	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.02 ± 0.02 a	0.00 ± 0.00 a	0.00 ± 0.00 a
Cerambycidae									
Σ Cerambycidae	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.02 ± 0.02 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a
					southern side circles				
Scolytinae									
Hypothenemus obscurus	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.02 ± 0.02 a	0.00 ± 0.00 a
Xyleborus affinis	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.02 ± 0.02 a	0.00 ± 0.00 a	0.02 ± 0.02 a	0.00 ± 0.00 a	0.00 ± 0.00 a
Xyleborus ferrugineus	0.00 ± 0.00 b	0.00 ± 0.00 b	0.04 ± 0.03 ab	0.04 ± 0.03 ab	0.18 ± 0.07 ab	0.08 ± 0.04 ab	0.13 ± 0.06 ab	0.21 ± 0.06 a	0.24 ± 0.08 a
Xyleborus volvulus	0.00 ± 0.00 a	0.00 ± 0.00 a	0.02 ± 0.02 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a
Σ Scolytinae	0.00 ± 0.00 c	0.00 ± 0.00 c	0.08 ± 0.04 abc	0.04 ± 0.03 bc	0.20 ± 0.07 abc	0.08 ± 0.04 abc	0.26 ± 0.08 ab	0.23 ± 0.07 ab	0.30 ± 0.09 a
Platypodinae									
Euplatypus segnis	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.02 ± 0.02 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a
Teloplatypus ratzeburgi	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.02 ± 0.02 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a
Σ Platypodinae	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.02 ± 0.02 a	0.02 ± 0.02 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a
Cerambycidae									
Σ Cerambycidae	0.00 ± 0.00 a	0.00 ± 0.00 a	0.02 ± 0.02 a	0.00 ± 0.00 a	0.02 ± 0.02 a	0.00 ± 0.00 a	0.02 ± 0.02 a	0.00 ± 0.00 a	0.00 ± 0.00 a

Means detransformed from $\sqrt{(x+0,5)}$, followed by the same letter per species do not differ ($p < 0.05$, Tukey test).

Table 12. Weekly numbers of Scolytinae, Platypodinae, Bostrichidae, Cerambycidae and Cleridae species (mean ± SE) trapped in the circles (A through I) in an ethanol-baited N-S sticky intercept trap flight in a cerradão fragment in Selvíria, Mato Grosso do Sul, Brazil March to August 2021.

family/species	A	B	C	D	E	F	G	H	I
Scolytinae									
Coptoborus tolimanus	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.02 ± 0.02 a
Cryptocarenus diadematus	0.00 ± 0.00 a	0.00 ± 0.00 a	0.02 ± 0.02 a	0.02 ± 0.02 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.02 ± 0.02 a	0.02 ± 0.02 a	0.06 ± 0.03 a
Cryptocarenus heveae	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.02 ± 0.02 a	0.04 ± 0.03 a	0.00 ± 0.00 a	0.04 ± 0.03 a
Hylocurus retusipennis	0.00 ± 0.00 b	0.00 ± 0.00 b	0.00 ± 0.00 b	0.02 ± 0.02 ab	0.00 ± 0.00 b	0.06 ± 0.03 a	0.02 ± 0.02 ab	0.08 ± 0.04 a	0.08 ± 0.04 a
Hypothenemus eruditus	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.04 ± 0.03 a	0.02 ± 0.02 a	0.00 ± 0.00 a	0.04 ± 0.03 a	0.02 ± 0.02 a
Hypothenemus javanus	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.02 ± 0.02 a	0.02 ± 0.02 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.02 ± 0.02 a
Hypothenemus obscurus	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.02 ± 0.02 a	0.04 ± 0.03 a	0.00 ± 0.00 a	0.02 ± 0.02 a	0.00 ± 0.00 a
Premnobius cavipennis	0.00 ± 0.00 a	0.00 ± 0.00 a	0.02 ± 0.02 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.02 ± 0.02 a	0.00 ± 0.00 a	0.04 ± 0.03 a
Xyleborus affinis	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.02 ± 0.02 a	0.00 ± 0.00 a	0.06 ± 0.03 a	0.06 ± 0.04 a
Xyleborus ferrugineus	0.00 ± 0.00 b	0.02 ± 0.02 b	0.02 ± 0.02 b	0.06 ± 0.04 ab	0.10 ± 0.04 ab	0.06 ± 0.03 ab	0.12 ± 0.06 ab	0.21 ± 0.06 a	0.23 ± 0.07 a
Σ Scolytinae	0.02 ± 0.02 d	0.06 ± 0.04 cd	0.06 ± 0.04 cd	0.19 ± 0.06 cd	0.29 ± 0.07 bcd	0.22 ± 0.06 cd	0.31 ± 0.08 bc	0.51 ± 0.08 ab	0.67 ± 0.09 a
Platypodinae									
Euplatypus parallelus	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.02 ± 0.02 a
Euplatypus segnis	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.02 ± 0.02 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.02 ± 0.02 a	0.04 ± 0.03 a
Teloplatypus ratzeburgi	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.02 ± 0.02 a	0.02 ± 0.02 a	0.02 ± 0.02 a	0.00 ± 0.00 a
Σ Platypodinae	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.02 ± 0.02 a	0.00 ± 0.00 a	0.02 ± 0.02 a	0.02 ± 0.02 a	0.04 ± 0.03 a	0.06 ± 0.03 a
Bostrichidae									
Micrapate brasiliensis	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.02 ± 0.02 a	0.00 ± 0.00 a	0.02 ± 0.02 a
Xyloperthella picea	0.00 ± 0.00 c	0.00 ± 0.00 c	0.00 ± 0.00 c	0.00 ± 0.00 c	0.00 ± 0.00 c	0.06 ± 0.03 a	0.08 ± 0.04 a	0.04 ± 0.03 b	0.08 ± 0.04 a
Σ Bostrichidae	0.00 ± 0.00 b	0.00 ± 0.00 b	0.02 ± 0.02 ab	0.00 ± 0.00 b	0.02 ± 0.02 ab	0.06 ± 0.03 ab	0.1 ± 0.04 ab	0.09 ± 0.04 ab	0.13 ± 0.05 a
Cerambycidae									
Compsa quadriguttata	0.00 ± 0.00 a	0.00 ± 0.00 a	0.02 ± 0.02 a	0.02 ± 0.02 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a
Neoclytus pusillus	0.00 ± 0.00 a	0.00 ± 0.00 a	0.04 ± 0.03 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.02 ± 0.02 a	0.02 ± 0.02 a
Σ Cerambycidae	0.00 ± 0.00 a	0.02 ± 0.02 a	0.06 ± 0.04 a	0.02 ± 0.02 a	0.02 ± 0.02 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.02 ± 0.02 a	0.02 ± 0.02 a
Cleridae									
Megaphloeus mucoreus	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.04 ± 0.03 a	0.02 ± 0.02 a	0.04 ± 0.03 a	0.04 ± 0.03 a
Σ Cleridae	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.04 ± 0.03 a	0.02 ± 0.02 a	0.04 ± 0.03 a	0.04 ± 0.03 a

Means detransformed from $\sqrt{(x+0,5)}$, followed by the same letter per species do not differ ($p < 0.05$, Tukey test).

Table 13. Weekly numbers of Scolytinae, Platypodinae, Bostrichidae, Cerambycidae and Cleridae species (mean ± SE) trapped in the circles (A through I) based on intercept area (beetles/cm^2) in ethanol-baited E-W sticky flight intercept traps in a cerradão fragment in Selvíria, Mato Grosso do Sul, Brazil August 2020 to August 2021.

family/species	A	B	C	D	E	F	G	H	I
Scolytinae									
Coptoborus tolimanus	0.00 ± 0.00 b	0.00 ± 0.00 a	0.12 ± 0.08 ab	0.00 ± 0.00 b	0.03 ± 0.03 ab	0.08 ± 0.05 ab	0.04 ± 0.03 ab	0.20 ± 0.07 a	0.11 ± 0.05 ab
Cryptocarenus diadematus	0.00 ± 0.00 a	0.10 ± 0.10 a	0.06 ± 0.06 a	0.12 ± 0.07 a	0.13 ± 0.06 a	0.03 ± 0.03 a	0.11 ± 0.06 a	0.15 ± 0.05 a	0.22 ± 0.06 a
Cryptocarenus heveae	0.30 ± 0.30 a	0.10 ± 0.10 a	0.12 ± 0.08 a	0.16 ± 0.08 a	0.03 ± 0.03 a	0.10 ± 0.05 a	0.15 ± 0.06 a	0.19 ± 0.06 a	0.22 ± 0.06 a
Hylocurus retusipennis	0.00 ± 0.00 c	0.00 ± 0.00 c	0.23 ± 0.12 ab	0.04 ± 0.04 bc	0.06 ± 0.05 bc	0.03 ± 0.03 bc	0.02 ± 0.02 bc	0.07 ± 0.04 bc	0.31 ± 0.07 a
Hypothenemus eruditus	0.30 ± 0.30 a	0.20 ± 0.14 a	0.29 ± 0.13 a	0.16 ± 0.08 a	0.23 ± 0.09 a	0.21 ± 0.07 a	0.07 ± 0.04 a	0.07 ± 0.04 a	0.13 ± 0.04 a
Hypothenemus javanus	0.00 ± 0.00 a	0.20 ± 0.14 a	0.12 ± 0.08 a	0.12 ± 0.09 a	0.23 ± 0.10 a	0.05 ± 0.04 a	0.07 ± 0.04 a	0.20 ± 0.07 a	0.20 ± 0.07 a
Hypothenemus obscurus	0.30 ± 0.30 a	0.20 ± 0.14 a	0.41 ± 0.15 a	0.16 ± 0.08 a	0.13 ± 0.06 a	0.21 ± 0.08 a	0.11 ± 0.05 a	0.04 ± 0.03 a	0.14 ± 0.05 a
Premnobius cavipennis	0.00 ± 0.00 b	0.00 ± 0.00 b	0.12 ± 0.08 ab	0.08 ± 0.06 ab	0.10 ± 0.06 ab	0.10 ± 0.05 ab	0.11 ± 0.05 ab	0.11 ± 0.05 ab	0.30 ± 0.07 a
Xyleborus affinis	0.59 ± 0.42 a	0.39 ± 0.20 a	0.64 ± 0.19 a	0.78 ± 0.18 a	0.71 ± 0.17 a	0.71 ± 0.14 a	0.94 ± 0.16 a	0.80 ± 0.12 a	0.86 ± 0.14 a
Xyleborus ferrugineus	2.08 ± 0.78 b	3.73 ± 0.63 ab	2.52 ± 0.42 b	3.55 ± 0.43 ab	3.14 ± 0.36 ab	3.27 ± 0.37 ab	3.53 ± 0.34 ab	3.96 ± 0.34 ab	4.78 ± 0.44 a
Xyleborus volvulus	0.59 ± 0.42 a	0.39 ± 0.20 a	0.12 ± 0.08 a	0.25 ± 0.10 a	0.39 ± 0.11 a	0.13 ± 0.06 a	0.22 ± 0.07 a	0.22 ± 0.06 a	0.27 ± 0.07 a
Σ Scolytinae	5.06 ± 1.20 b	5.69 ± 0.75 ab	5.44 ± 0.60 b	5.85 ± 0.54 ab	5.64 ± 0.48 ab	5.59 ± 0.44 b	5.91 ± 0.45 ab	6.69 ± 0.43 ab	8.27 ± 0.56 a
Platypodinae									
Euplatypus parallelus	0.00 ± 0.00 b	0.20 ± 0.14 ab	0.06 ± 0.06 ab	0.16 ± 0.08 ab	0.23 ± 0.09 ab	0.18 ± 0.07 ab	0.24 ± 0.07 ab	0.39 ± 0.09 a	0.33 ± 0.07 ab
Euplatypus segnis	0.00 ± 0.00 b	0.29 ± 0.17 a	0.18 ± 0.10 a	0.04 ± 0.04 ab	0.03 ± 0.03 b	0.10 ± 0.05 ab	0.15 ± 0.06 ab	0.32 ± 0.08 a	0.31 ± 0.07 a
Teloplatypus ratzeburgi	0.00 ± 0.00 a	0.39 ± 0.20 a	0.18 ± 0.10 a	0.21 ± 0.09 a	0.26 ± 0.09 a	0.44 ± 0.11 a	0.31 ± 0.08 a	0.37 ± 0.08 a	0.33 ± 0.08 a
Σ Platypodinae	0.00 ± 0.00 c	0.88 ± 0.29 ab	0.41 ± 0.15 bc	0.45 ± 0.14 abc	0.52 ± 0.13 abc	0.78 ± 0.15 ab	0.70 ± 0.12 ab	1.08 ± 0.14 a	0.99 ± 0.13 ab
Bostrichidae									
Micrapate brasiliensis	0.00 ± 0.00 a	0.10 ± 0.10 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.03 ± 0.03 a	0.13 ± 0.06 a	0.13 ± 0.05 a	0.04 ± 0.03 a	0.08 ± 0.03 a
Xyloperthella picea	0.30 ± 0.30 a	0.39 ± 0.20 a	0.41 ± 0.15 a	0.04 ± 0.04 a	0.16 ± 0.07 a	0.13 ± 0.06 a	0.33 ± 0.09 a	0.28 ± 0.07 a	0.49 ± 0.10 a
Σ Bostrichidae	0.30 ± 0.30 a	0.49 ± 0.22 a	0.47 ± 0.16 a	0.16 ± 0.10 a	0.19 ± 0.08 a	0.31 ± 0.09 a	0.52 ± 0.11 a	0.41 ± 0.09 a	0.69 ± 0.11 a
Cerambycidae									
Compsa quadriguttata	0.30 ± 0.30 a	0.29 ± 0.17 a	0.00 ± 0.00 a	0.08 ± 0.06 a	0.10 ± 0.06 a	0.05 ± 0.04 a	0.22 ± 0.07 a	0.09 ± 0.05 a	0.11 ± 0.04 a
Neoclytus pusillus	0.30 ± 0.30 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.04 ± 0.04 a	0.10 ± 0.06 a	0.08 ± 0.05 a	0.20 ± 0.07 a	0.11 ± 0.05 a	0.11 ± 0.04 a
Σ Cerambycidae	0.59 ± 0.42 a	0.78 ± 0.28 a	0.06 ± 0.06 a	0.41 ± 0.14 a	0.36 ± 0.11 a	0.29 ± 0.09 a	0.55 ± 0.11 a	0.32 ± 0.08 a	0.34 ± 0.07 a
Cleridae									
Megaphloeus mucoreus	0.00 ± 0.00 a	0.39 ± 0.20 a	0.29 ± 0.13 a	0.49 ± 0.16 a	0.58 ± 0.13 a	0.52 ± 0.13 a	0.39 ± 0.09 a	0.52 ± 0.10 a	0.50 ± 0.09 a
Σ Cleridae	0.00 ± 0.00 b	0.59 0.24 ab	0.35 ± 0.14 ab	0.54 ± 0.17 ab	0.68 ± 0.15 a	0.52 ± 0.13 ab	0.48 ± 0.10 ab	0.58 ± 0.11 ab	0.64 ± 0.10 a

Means (x 10^3) detransformed from $\sqrt{(x+0,5)}$, followed by the same letter per species do not differ ($p < 0.05$, Tukey test

Table 14. Weekly numbers of Scolytinae, Platypodinae, Bostrichidae, Cerambycidae and Cleridae species (mean ± SE) trapped in the circles (A through I) in the southern side based on intercept area (beetles/cm²) in ethanol-baited E-W sticky flight intercept traps in a cerradão fragment in Selvíria, Mato Grosso do Sul, Brazil, August 2020 to August 2021.

family/species	A	B	C	D	E	F	G	H	I
Scolytinae					**southern side circles**				
Coptoborus tolimanus	0.00 ± 0.00 a	0.00 ± 0.00 a	0.23 ± 0.017 a	0.00 ± 0.00 a	0.06 ± 0.06 a	0.10 ± 0.07 a	0.09 ± 0.06 a	0.11 ± 0.06 a	0.19 ± 0.09 a
Cryptocarenus diadematus	0.00 ± 0.00 c	0.20 ± 0.20 c	0.00 ± 0.00 c	0.00 ± 0.00 c	0.06 ± 0.06 b	0.05 ± 0.05 b	0.04 ± 0.04 b	0.22 ± 0.09 a	0.34 ± 0.10 a
Cryptocarenus heveae	0.60 ± 0.60 a	0.00 ± 0.00 a	0.12 ± 0.12 a	0.17 ± 0.12 a	0.06 ± 0.06 a	0.10 ± 0.07 a	0.17 ± 0.09 a	0.26 ± 0.10 a	0.22 ± 0.08 a
Hylocurus retusipennis	0.00 ± 0.00 a	0.00 ± 0.00 a	0.23 ± 0.17 a	0.08 ± 0.08 a	0.06 ± 0.06 a	0.05 ± 0.05 a	0.00 ± 0.00 a	0.04 ± 0.04 a	0.25 ± 0.09 a
Hypothenemus eruditus	0.00 ± 0.00 a	0.39 ± 0.28 a	0.23 ± 0.17 a	0.17 ± 0.12 a	0.19 ± 0.11 a	0.21 ± 0.10 a	0.00 ± 0.00 a	0.07 ± 0.05 a	0.12 ± 0.06 a
Hypothenemus javanus	0.00 ± 0.00 c	0.00 ± 0.00 c	0.00 ± 0.00 c	0.08 ± 0.08 b	0.19 ± 0.11 ab	0.05 ± 0.05 b	0.00 ± 0.00 c	0.11 ± 0.08 ab	0.25 ± 0.11 a
Hypothenemus obscurus	0.00 ± 0.00 a	0.20 ± 0.20 a	0.23 ± 0.17 a	0.17 ± 0.12 a	0.13 ± 0.09 a	0.10 ± 0.07 a	0.09 ± 0.06 a	0.07 ± 0.05 a	0.03 ± 0.03 a
Premnobius cavipennis	0.00 ± 0.00 b	0.00 ± 0.00 b	0.00 ± 0.00 b	0.08 ± 0.08 b	0.13 ± 0.09 ab	0.21 ± 0.10 ab	0.00 ± 0.00 b	0.15 ± 0.07 ab	0.40 ± 0.12 a
Xyleborus affinis	0.60 ± 0.60 a	0.59 ± 0.34 a	0.70 ± 0.28 a	0.74 ± 0.24 a	1.17 ± 0.31 a	1.09 ± 0.25 a	0.90 ± 0.20 a	0.99 ± 0.20 a	1.02 ± 0.19 a
Xyleborus ferrugineus	2.98 ± 1.32 b	5.27 ± 1.07 ab	3.40 ± 0.70 ab	3.97 ± 0.68 ab	4.03 ± 0.58 ab	3.49 ± 0.60 ab	4.17 ± 0.51 ab	5.14 ± 0.51 ab	6.10 ± 0.70 a
Xyleborus volvulus	0.60 ± 0.60 a	0.20 ± 0.20 a	0.23 ± 0.17 a	0.17 ± 0.12 a	0.52 ± 0.18 a	0.21 ± 0.10 a	0.26 ± 0.12 a	0.26 ± 0.10 a	0.31 ± 0.11 a
Σ Scolytinae	5.96 ± 1.85 b	7.62 ± 1.24 ab	5.98 ± 0.86 b	6.03 ± 0.82 b	7.08 ± 0.76 ab	6.52 ± 0.70 ab	6.14 ± 0.58 ab	8.12 ± 0.61 ab	10.15 ± 0.88 a
Platypodinae									
Euplatypus parallelus	0.00 ± 0.00 a	0.39 ± 0.28 a	0.00 ± 0.00 a	0.33 ± 0.16 a	0.39 ± 0.16 a	0.16 ± 0.09 a	0.34 ± 0.12 a	0.48 ± 0.13 a	0.43 ± 0.11 a
Euplatypus segnis	0.00 ± 0.00 a	0.39 ± 0.28 a	0.23 ± 0.17 a	0.00 ± 0.00 a	0.06 ± 0.06 a	0.16 ± 0.09 a	0.17 ± 0.09 a	0.37 ± 0.11 a	0.34 ± 0.10 a
Teloplatypus ratzeburgi	0.00 ± 0.00 a	0.39 ± 0.28 a	0.23 ± 0.17 a	0.33 ± 0.16 a	0.26 ± 0.13 a	0.36 ± 0.14 a	0.30 ± 0.11 a	0.44 ± 0.12 a	0.40 ± 0.13 a
Σ Platypodinae	0.00 ± 0.00 b	1.17 ± 0.47 a	0.47 ± 0.23 ab	0.66 ± 0.23 ab	0.71 ± 0.21 ab	0.73 ± 0.20 ab	0.82 ± 0.18 ab	1.29 ± 0.21 a	1.18 ± 0.19 a
Bostrichidae									
Micrapate brasiliensis	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.06 ± 0.06 a	0.10 ± 0.07 a	0.09 ± 0.06 a	0.04 ± 0.04 a	0.09 ± 0.05 a
Xyloperthella picea	0.60 ± 0.60 a	0.39 ± 0.28 a	0.70 ± 0.28 a	0.08 ± 0.08 a	0.13 ± 0.09 a	0.16 ± 0.09 a	0.43 ± 0.15 a	0.29 ± 0.10 a	0.50 ± 0.13 a
Σ Bostrichidae	0.60 ± 0.60 a	0.39 ± 0.28 a	0.82 ± 0.31 a	0.08 ± 0.08 a	0.19 ± 0.11 a	0.26 ± 0.12 a	0.60 ± 0.18 a	0.33 ± 0.11 a	0.74 ± 0.15 a
Cerambycidae									
Compsa quadriguttata	0.60 ± 0.60 a	0.39 ± 0.28 a	0.00 ± 0.00 a	0.08 ± 0.08 a	0.19 ± 0.11 a	0.10 ± 0.07 a	0.43 ± 0.13 a	0.07 ± 0.05 a	0.12 ± 0.06 a
Neoclytus pusillus	0.00 ± 0.00 b	0.00 ± 0.00 b	0.00 ± 0.00 b	0.00 ± 0.00 b	0.00 ± 0.00 a	0.05 ± 0.05 ab	0.17 ± 0.09 a	0.15 ± 0.07 a	0.06 ± 0.04 ab
Σ Cerambycidae	0.60 ± 0.60 a	0.98 ± 0.43 a	0.12 ± 0.12 a	0.25 ± 0.14 a	0.45 ± 0.17 a	0.42 ± 0.16 a	0.77 ± 0.19 a	0.29 ± 0.10 a	0.28 ± 0.09 a
Cleridae									
Megaphloeus mucoreus	0.00 ± 0.00 a	0.39 ± 0.28 a	0.35 ± 0.20 a	0.50 ± 0.26 a	0.45 ± 0.17 a	0.42 ± 0.18 a	0.26 ± 0.10 a	0.44 ± 0.13 a	0.43 ± 0.11 a
Σ Cleridae	0.00 ± 0.00 a	0.78 ± 0.39 a	0.47 ± 0.23 a	0.50 ± 0.26 a	0.58 ± 0.19 a	0.42 ± 0.18 a	0.39 ± 0.13 a	0.51 ± 0.14 a	0.68 ± 0.14 a

Means (x 10^3) detransformed from $\sqrt{(x+0,5)}$, followed by the same letter per species do not differ ($p < 0.05$, Tukey test).

Table 15. Weekly numbers of Scolytinae, Platypodinae, Bostrichidae, Cerambycidae and Cleridae species (mean ± SE) trapped among circles (A through I) in the northern side based on intercept area (beetles/cm^2) in ethanol-baited E-W sticky flight intercept traps in a cerradão fragment in Selvíria, Mato Grosso do Sul, Brazil, August 2020 to August 2021.

family/species	A	B	C	D	E	F	G	H	I
Scolytinae					**northern side circles**				
Coptoborus tolimanus	0.00 ± 0.00 b	0.00 ± 0.00 b	0.00 ± 0.00 b	0.00 ± 0.00 b	0.00 ± 0.00 b	0.05 ± 0.05 b	0.00 ± 0.00 b	0.30 ± 0.12 a	0.03 ± 0.03 b
Cryptocarenus diadematus	0.00 ± 0.00 a	0.00 ± 0.00 a	0.12 ± 0.12 a	0.25 ± 0.14 a	0.19 ± 0.11 a	0.00 ± 0.00 a	0.18 ± 0.11 a	0.08 ± 0.05 a	0.10 ± 0.05 a
Cryptocarenus heveae	0.00 ± 0.00 a	0.20 ± 0.20 a	0.12 ± 0.12 a	0.16 ± 0.12 a	0.00 ± 0.00 a	0.10 ± 0.07 a	0.13 ± 0.08 a	0.11 ± 0.06 a	0.22 ± 0.08 a
Hylocurus retusipennis	0.00 ± 0.00 b	0.00 ± 0.00 b	0.23 ± 0.16 ab	0.00 ± 0.00 b	0.06 ± 0.06 ab	0.00 ± 0.00 b	0.04 ± 0.04 b	0.11 ± 0.06 ab	0.38 ± 0.12 a
Hypothenemus eruditus	0.59 ± 0.59 a	0.00 ± 0.00 a	0.35 ± 0.20 a	0.16 ± 0.12 a	0.26 ± 0.13 a	0.21 ± 0.10 a	0.13 ± 0.08 a	0.08 ± 0.05 a	0.13 ± 0.06 a
Hypothenemus javanus	0.00 ± 0.00 a	0.39 ± 0.28 a	0.23 ± 0.16 a	0.16 ± 0.16 a	0.26 ± 0.16 a	0.05 ± 0.05 a	0.13 ± 0.08 a	0.30 ± 0.12 a	0.16 ± 0.08 a
Hypothenemus obscurus	0.59 ± 0.59 a	0.20 ± 0.20 a	0.58 ± 0.26 a	0.16 ± 0.12 a	0.13 ± 0.09 a	0.31 ± 0.15 a	0.13 ± 0.08 a	0.00 ± 0.00 a	0.25 ± 0.09 a
Premnobius cavipennis	0.00 ± 0.00 a	0.00 ± 0.00 a	0.23 ± 0.16 a	0.08 ± 0.08 a	0.06 ± 0.06 a	0.00 ± 0.00 a	0.22 ± 0.10 a	0.08 ± 0.05 a	0.19 ± 0.09 a
Xyleborus affinis	0.59 ± 0.59 a	0.20 ± 0.20 a	0.58 ± 0.26 a	0.82 ± 0.25 a	0.26 ± 0.13 a	0.31 ± 0.13 a	0.98 ± 0.26 a	0.60 ± 0.15 a	0.70 ± 0.20 a
Xyleborus ferrugineus	1.19 ± 0.84 b	2.17 ± 0.64 ab	1.63 ± 0.45 ab	3.13 ± 0.52 ab	2.26 ± 0.43 ab	3.04 ± 0.44 ab	2.88 ± 0.46 ab	2.74 ± 0.42 ab	3.43 ± 0.52 a
Xyleborus volvulus	0.59 ± 0.59 a	0.59 ± 0.34 a	0.00 ± 0.00 a	0.33 ± 0.16 a	0.26 ± 0.13 a	0.05 ± 0.05 a	0.18 ± 0.09 a	0.19 ± 0.08 a	0.22 ± 0.09 a
Σ Scolytinae	4.15 ± 1.55 a	3.74 ± 0.82 a	4.90 ± 0.84 a	5.68 ± 0.71 a	4.20 ± 0.59 a	4.66 ± 0.53 a	5.67 ± 0.70 a	5.22 ± 0.59 a	6.35 ± 0.67 a
Platypodinae									
Euplatypus parallelus	0.00 ± 0.00 a	0.00 ± 0.00 a	0.12 ± 0.12 a	0.00 ± 0.00 a	0.06 ± 0.06 a	0.21 ± 0.10 a	0.13 ± 0.08 a	0.30 ± 0.12 a	0.22 ± 0.08 a
Euplatypus segnis	0.00 ± 0.00 a	0.20 ± 0.20 a	0.12 ± 0.12 a	0.08 ± 0.08 a	0.00 ± 0.00 a	0.05 ± 0.05 a	0.13 ± 0.08 a	0.26 ± 0.10 a	0.29 ± 0.10 a
Teloplatypus ratzeburgi	0.00 ± 0.00 a	0.39 ± 0.28 a	0.12 ± 0.12 a	0.08 ± 0.08 a	0.26 ± 0.13 a	0.52 ± 0.16 a	0.31 ± 0.12 a	0.30 ± 0.10 a	0.25 ± 0.10 a
Σ Platypodinae	0.00 ± 0.00 b	0.59 ± 0.34 ab	0.35 ± 0.20 ab	0.25 ± 0.14 ab	0.32 ± 0.14 ab	0.84 ± 0.23 a	0.58 ± 0.16 ab	0.86 ± 0.18 a	0.79 ± 0.17 ab
Bostrichidae									
Micrapate brasiliensis	0.00 ± 0.00 a	0.20 ± 0.20 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.16 ± 0.09 a	0.18 ± 0.09 a	0.04 ± 0.04 a	0.06 ± 0.04 a
Xyloperthella picea	0.00 ± 0.00 a	0.39 ± 0.28 a	0.12 ± 0.12 a	0.00 ± 0.00 a	0.19 ± 0.11 a	0.10 ± 0.07 a	0.22 ± 0.10 a	0.26 ± 0.10 a	0.48 ± 0.15 a
Σ Bostrichidae	0.00 ± 0.00 a	0.59 ± 0.34 a	0.12 ± 0.12 a	0.25 ± 0.18 a	0.19 ± 0.11 a	0.37 ± 0.14 a	0.44 ± 0.14 a	0.49 ± 0.13 a	0.63 ± 0.16 a
Cerambycidae									
Compsa quadriguttata	0.00 ± 0.00 a	0.20 ± 0.20 a	0.00 ± 0.00 a	0.08 ± 0.08 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.11 ± 0.08 a	0.10 ± 0.05 a
Neoclytus pusillus	0.59 ± 0.59 a	0.00 ± 0.00 a	0.00 ± 0.00 a	0.08 ± 0.08 a	0.19 ± 0.11 a	0.10 ± 0.07 a	0.22 ± 0.12 a	0.08 ± 0.05 a	0.16 ± 0.07 a
Σ Cerambycidae	0.59 ± 0.59 a	0.59 ± 0.34 a	0.00 ± 0.00 a	0.58 ± 0.24 a	0.26 ± 0.13 a	0.16 ± 0.09 a	0.31 ± 0.13 a	0.34 ± 0.12 a	0.41 ± 0.11 a
Cleridae									
Megaphloeus mucoreus	0.00 ± 0.00 a	0.39 ± 0.28 a	0.23 ± 0.16 a	0.49 ± 0.20 a	0.71 ± 0.21 a	0.63 ± 0.19 a	0.53 ± 0.15 a	0.60 ± 0.15 a	0.57 ± 0.13 a
Σ Cleridae	0.00 ± 0.00 b	0.59 0.24 ab	0.35 ± 0.14 ab	0.54 ± 0.17 ab	0.68 ± 0.15 a	0.52 ± 0.13 ab	0.48 ± 0.10 ab	0.58 ± 0.11 ab	0.64 ± 0.10 a

Means (x 10^3) detransformed from $\sqrt{(x+0,5)}$, followed by the same letter per species do not differ ($p < 0.05$, Tukey test).

Table 16. Weekly numbers of Scolytinae, Platypodinae, Bostrichidae, Cerambycidae and Cleridae species (mean ± SE) among grouped circles in ethanol-baited E-W sticky flight intercept traps in a cerradão fragment in Selvíria, Mato Grosso do Sul, Brazil August 2020 to August 2021.

family/species	circles A-E	circles F-G	circles H-I
Scolytinae			
Coptoborus tolimanus	0.00 ± 0.00 b	0.00 ± 0.00 b	0.02 ± 0.00 a
Cryptocarenus diadematus	0.00 ± 0.00 b	0.01 ± 0.00 b	0.02 ± 0.00 a
Cryptocarenus heveae	0.00 ± 0.00 b	0.01 ± 0.00 b	0.03 ± 0.01 a
Hylocurus retusipennis	0.00 ± 0.00 b	0.00 ± 0.00 b	0.03 ± 0.01 a
Hypothenemus eruditus	0.01 ± 0.00 a	0.01 ± 0.00 a	0.01 ± 0.00 a
Hypothenemus javanus	0.01 ± 0.00 b	0.01 ± 0.00 b	0.03 ± 0.01 a
Hypothenemus obscurus	0.01 ± 0.00 a	0.01 ± 0.00 a	0.01 ± 0.00 a
Premnobius cavipennis	0.00 ± 0.00 b	0.01 ± 0.00 b	0.03 ± 0.01 a
Xyleborus affinis	0.03 ± 0.00 c	0.08 ± 0.01 b	0.10 ± 0.01 a
Xyleborus ferrugineus	0.12 ± 0.01 c	0.32 ± 0.02 b	0.55 ± 0.04 a
Xyleborus volvulus	0.01 ± 0.00 b	0.02 ± 0.00 b	0.03 ± 0.01 a
Σ Scolytinae	0.22 ± 0.01 c	0.54 ± 0.03 b	0.95 ± 0.05 a
Platypodinae			
Euplatypus parallelus	0.01 ± 0.00 c	0.02 ± 0.00 b	0.04 ± 0.01 a
Euplatypus segnis	0.00 ± 0.00 b	0.01 ± 0.00 b	0.04 ± 0.01 a
Teloplatypus ratzeburgi	0.01 ± 0.00 b	0.03 ± 0.01 a	0.04 ± 0.01 a
Σ Platypodinae	0.02 ± 0.00 c	0.07 ± 0.01 b	0.13 ± 0.01 a
Bostrichidae			
Micrapate brasiliensis	0.00 ± 0.00 b	0.01 ± 0.00 a	0.01 ± 0.00 ab
Xyloperthella picea	0.01 ± 0.00 b	0.02 ± 0.01 b	0.05 ± 0.01 a
Σ Bostrichidae	0.01 ± 0.00 c	0.04 ± 0.01 b	0.07 ± 0.01 a
Cerambycidae			
Compsa quadriguttata	0.00 ± 0.00 b	0.01 ± 0.00 a	0.01 ± 0.00 a
Neoclytus pusillus	0.00 ± 0.00 b	0.01 ± 0.00 a	0.01 ± 0.00 a
Σ Cerambycidae	0.01 ± 0.00 b	0.04 ± 0.01 a	0.04 ± 0.01 a
Cleridae			
Megaphloeus mucoreus	0.02 ± 0.00 c	0.04 ± 0.01 b	0.06 ± 0.01 a
Σ Cleridae	0.02 ± 0.00 c	0.05 ± 0.01 b	0.08 ± 0.01 a

Means detransformed from $\sqrt{(x+0,5)}$, followed by the same letter per species do not differ ($p < 0.05$, Tukey test).

Table 17. Weekly numbers of Scolytinae, Platypodinae, Bostrichidae, Cerambycidae and Cleridae species (mean ± SE) in grouped circles in northern side in ethanol-baited E-W flight intercept traps in a cerradão fragment in Selvíria, Mato Grosso do Sul, Brazil, August 2020 to August 2021.

family/species	circles A-E	circles F-G	circles H-I
Scolytinae			
Coptoborus tolimanus	0.00± 0.00 b	0.00± 0.00 b	0.02 ± 0.01 a
Cryptocarenus diadematus	0.01 ± 0.00 a	0.01 ± 0.01 a	0.01 ± 0.00 a
Cryptocarenus heveae	0.00 ± 0.00 b	0.01 ± 0.01 ab	0.02 ± 0.01 a
Hylocurus retusipennis	0.00 ± 0.00 b	0.00 ± 0.00 b	0.03 ± 0.01 a
Hypothenemus eruditus	0.01 ± 0.00 a	0.02 ± 0.01 a	0.01 ± 0.01 a
Hypothenemus javanus	0.01 ± 0.00 b	0.01 ± 0.00 b	0.03 ± 0.01 a
Hypothenemus obscurus	0.01 ± 0.00 a	0.02 ± 0.01 a	0.02 ± 0.01 a
Premnobius cavipennis	0.00 ± 0.00 b	0.01 ± 0.01 ab	0.02 ± 0.01 a
Xyleborus affinis	0.02 ± 0.00 b	0.06 ± 0.01 a	0.08 ± 0.02 a
Xyleborus ferrugineus	0.09 ± 0.01 c	0.28 ± 0.03 b	0.39 ± 0.04 a
Xyleborus volvulus	0.01 ± 0.00 a	0.01 ± 0.01 a	0.03 ± 0.01 a
Σ Scolytinae	0.19 ± 0.01 c	0.49 ± 0.04 b	0.73 ± 0.06 a
Platypodinae			
Euplatypus parallelus	0.00 ± 0.00 b	0.02 ± 0.01 b	0.03 ± 0.01 a
Euplatypus segnis	0.00 ± 0.00 b	0.01 ± 0.00 b	0.03 ± 0.01 a
Teloplatypus ratzeburgi	0.01 ± 0.00 b	0.04 ± 0.01 a	0.03 ± 0.01 a
Σ Platypodinae	0.01 ± 0.00 c	0.07 ± 0.01 b	0.10 ± 0.02 a
Bostrichidae			
Micrapate brasiliensis	0.00 ± 0.00 b	0.02 ± 0.01 a	0.01 ± 0.00 ab
Xyloperthella picea	0.01 ± 0.00 b	0.02 ± 0.01 b	0.05 ± 0.01 a
Σ Bostrichidae	0.01 ± 0.00 c	0.04 ± 0.01 b	0.07 ± 0.01 a
Cerambycidae			
Compsa quadriguttata	0.00 ± 0.00 b	0.00 ± 0.00 b	0.01 ± 0.01 a
Neoclytus pusillus	0.00 ± 0.00 a	0.02 ± 0.01 a	0.02 ± 0.01 a
Σ Cerambycidae	0.01 ± 0.00 b	0.02 ± 0.01 b	0.05 ± 0.01 a
Cleridae			
Megaphloeus mucoreus	0.02 ± 0.00 b	0.05 ± 0.01 a	0.07 ± 0.01 a
Σ Cleridae	0.02 ± 0.00 b	0.06 ± 0.01 a	0.08 ± 0.01 a

Means detransformed from $\sqrt{(x+0,5)}$, followed by the same letter per species and treatment do not differ ($p < 0.05$, Tukey test).

Table 18. Weekly numbers of Scolytinae, Platypodinae, Bostrichidae, Cerambycidae and Cleridae species (mean ± SE) in grouped circles in southern side in ethanol-baited E-W flight intercept traps in a cerradão fragment in Selvíria, Mato Grosso do Sul, Brazil, August 2020 to August 2021.

family/species	circles A-E	circles F-G	circles H-I
Scolytinae			
Coptoborus tolimanus	0.00± 0.00 b	0.01± 0.00 ab	0.02± 0.00 a
Cryptocarenus diadematus	0.00 ± 0.00 b	0.00 ± 0.00 b	0.04 ± 0.01 a
Cryptocarenus heveae	0.00 ± 0.00 b	0.01 ± 0.01 b	0.03 ± 0.01 a
Hylocurus retusipennis	0.00 ± 0.00 b	0.00 ± 0.00 b	0.02 ± 0.01 a
Hypothenemus eruditus	0.01 ± 0.00 a	0.01 ± 0.00 a	0.01 ± 0.01 a
Hypothenemus javanus	0.00 ± 0.00 b	0.00 ± 0.00 b	0.02 ± 0.01 a
Hypothenemus obscurus	0.01 ± 0.00 a	0.01 ± 0.00 a	0.01 ± 0.00 a
Premnobius cavipennis	0.00 ± 0.00 b	0.01 ± 0.00 b	0.04 ± 0.01 a
Xyleborus affinis	0.03 ± 0.01 b	0.09 ± 0.01 a	0.13 ± 0.02 a
Xyleborus ferrugineus	0.16 ± 0.01 c	0.36 ± 0.04 b	0.71 ± 0.06 a
Xyleborus volvulus	0.01 ± 0.00 b	0.02 ± 0.01 ab	0.04 ± 0.01 a
Σ Scolytinae	0.26 ± 0.02 c	0.60 ± 0.04 b	1.16 ± 0.07 a
Platypodinae			
Euplatypus parallelus	0.01 ± 0.00 b	0.02 ± 0.01 b	0.06 ± 0.01 a
Euplatypus segnis	0.00 ± 0.00 b	0.02 ± 0.01 b	0.04 ± 0.01 a
Teloplatypus ratzeburgi	0.01 ± 0.00 b	0.03 ± 0.01 ab	0.05 ± 0.01 a
Σ Platypodinae	0.03 ± 0.00 c	0.07 ± 0.01 b	0.15 ± 0.02 a
Bostrichidae			
Micrapate brasiliensis	0.00 ± 0.00 a	0.01 ± 0.00 a	0.01 ± 0.00 a
Xyloperthella picea	0.01 ± 0.00 b	0.03 ± 0.01 b	0.05 ± 0.01 a
Σ Bostrichidae	0.01 ± 0.00 c	0.04 ± 0.01 b	0.07 ± 0.01 a
Cerambycidae			
Compsa quadriguttata	0.01 ± 0.00 b	0.03 ± 0.01 a	0.01 ± 0.01 ab
Neoclytus pusillus	0.00 ± 0.00 b	0.01 ± 0.00 a	0.01 ± 0.01 a
Σ Cerambycidae	0.02 ± 0.00 b	0.06 ± 0.01 a	0.04 ± 0.01 ab
Cleridae			
Megaphloeus mucoreus	0.02 ± 0.00 b	0.03 ± 0.01 b	0.05 ± 0.01 a
Σ Cleridae	0.02 ± 0.00 b	0.04 ± 0.01 b	0.08 ± 0.01 a

Means detransformed from $\sqrt{(x+0,5)}$, followed by the same letter per species and treatment do not differ ($p < 0.05$, Tukey test).

Table 19. Weekly numbers of Scolytinae, Platypodinae, Bostrichidae, Cerambycidae and Cleridae species (mean ± SE) in the circles in ethanol-baited N-S sticky flight intercept sticky traps in a cerradão fragment in Selvíria, Mato Grosso do Sul, Brazil, March to August 2021.

species	circles A-E	circles F-G	circles H-I
Scolytinae			
Coptoborus tolimanus	0.00 ± 0.00 a	0.00 ± 0.00 a	0.01 ± 0.01 a
Cryptocarenus diadematus	0.01 ± 0.01 a	0.01 ± 0.01 a	0.04 ± 0.02 a
Cryptocarenus heveae	0.00 ± 0.00 b	0.03 ± 0.02 a	0.02 ± 0.01 a
Hylocurus retusipennis	0.00 ± 0.00 b	0.04 ± 0.02 ab	0.08 ± 0.03 a
Hypothenemus eruditus	0.01 ± 0.01 a	0.01 ± 0.01 a	0.03 ± 0.02 a
Hypothenemus javanus	0.01 ± 0.01 a	0.00 ± 0.00 a	0.01 ± 0.01 a
Hypothenemus obscurus	0.00 ± 0.00 a	0.02 ± 0.01 a	0.01 ± 0.01 a
Premnobius cavipennis	0.00 ± 0.00 a	0.01 ± 0.01 a	0.02 ± 0.01 a
Xyleborus affinis	0.00 ± 0.00 b	0.01 ± 0.01 b	0.06 ± 0.03 a
Xyleborus ferrugineus	0.04 ± 0.01 b	0.09 ± 0.03 b	0.22 ± 0.04 a
Σ Scolytinae	0.13 ± 0.02 c	0.26 ± 0.05 b	0.59 ± 0.06 a
Platypodinae			
Euplatypus parallelus	0.00 ± 0.00 a	0.00 ± 0.00 a	0.01 ± 0.01 a
Euplatypus segnis	0.00 ± 0.00 a	0.00 ± 0.00 a	0.03 ± 0.02 a
Teloplatypus ratzeburgi	0.00 ± 0.00 a	0.02 ± 0.01 a	0.01 ± 0.01 a
Σ Platypodinae	0.00 ± 0.00 b	0.02 ± 0.01 ab	0.05 ± 0.02 a
Bostrichidae			
Micrapate brasiliensis	0.00 ± 0.00 a	0.01 ± 0.01 a	0.01 ± 0.01 a
Xyloperthella picea	0.00 ± 0.00 b	0.07 ± 0.03 a	0.06 ± 0.02 a
Σ Bostrichidae	0.01 ± 0.01 b	0.08 ± 0.03 a	0.11 ± 0.03 a
Cerambycidae			
Compsa quadriguttata	0.01 ± 0.01 a	0.00 ± 0.00 a	0.00 ± 0.00 a
Neoclytus pusillus	0.01 ± 0.01 a	0.00 ± 0.00 a	0.02 ± 0.01 a
Σ Cerambycidae	0.03 ± 0.01 a	0.00 ± 0.00 a	0.02 ± 0.01 a
Cleridae			
Megaphloeus mucoreus	0.00 ± 0.00 b	0.03 ± 0.02 ab	0.04 ± 0.02 a
Σ Cleridae	0.00 ± 0.00 b	0.03 ± 0.02 ab	0.04 ± 0.02 a

Means detransformed from $\sqrt{(x+0,5)}$, followed by the same letter per species do not differ ($p < 0.05$, Tukey test).

Table 20. Weekly numbers of Scolytinae, Platypodinae, Bostrichidae, Cerambycidae and Cleridae (mean ± SE) trapped above and below of the center of baited-ethanol E-W sticky flight intercept traps, in a cerrado fragment in Selvíria, Mato Grosso do Sul, Brazil, March to August 2021.

family/species	**above**	**below**
Scolytinae		
Coptoborus tolimanus	0.01 ± 0.00 a	0.01 ± 0,01 a
Cryptocarenus diadematus	0.03 ± 0.01 a	0.03 ± 0.01 a
Cryptocarenus heveae	0.04 ± 0.01 a	0.05 ± 0.01 a
Hylocurus retusipennis	0.05 ± 0.01 a	0.04 ± 0.01 a
Hypothenemus eruditus	0.03 ± 0.01 a	0.03 ± 0.01 a
Hypothenemus javanus	0.01 ± 0.00 a	0.01 ± 0.01 a
Hypothenemus obscurus	0.04 ± 0.01 a	0.03 ± 0.01 a
Premnobius cavipennis	0.01 ± 0.00 a	0.01 ± 0.01 a
Xyleborus affinis	0.08 ± 0.01 b	0.14 ± 0.02 a
Xyleborus ferrugineus	0.37 ± 0.03 a	0.35 ± 0.03 a
Xyleborus volvulus	0.01 ± 0.01 a	0.02 ± 0.01 a
Σ Scolytinae	0.82 ± 0.04 a	0.88 ± 0.04 a
Platypodinae		
Euplatypus parallelus	0.06 ± 0.01 a	0.05 ± 0.01 a
Euplatypus segnis	0.03 ± 0.01 a	0.02 ± 0.01 a
Teloplatypus ratzeburgi	0.04 ± 0.01 a	0.03 ± 0.01 a
Σ Platypodinae	0.13 ± 0.02 a	0.11 ± 0.02 a
Bostrichidae		
Micrapate brasiliensis	0.03 ± 0.01 a	0.02 ± 0.01 a
Xyloperthella picea	0.11 ± 0.02 a	0.08 ± 0.01 a
Σ Bostrichidae	0.18 ± 0.02 a	0.11 ± 0.02 b
Cerambycidae		
Compsa quadriguttata	0.02 ± 0.01 a	0.04 ± 0.01 a
Neoclytus pusillus	0.01 ± 0.01 a	0.02 ± 0.01 a
Σ Cerambycidae	0.05 ± 0.01 a	0.07 ± 0.01 a
Cleridae		
Megaphloeus mucoreus	0.16 ± 0.02 a	0.14 ± 0.02 a
Σ Cleridae	0.18 ± 0.02 a	0.15 ± 0.02 a

Means detransformed from √(x+0,5), followed by the same letter per species and treatment do not differ ($p < 0.05$, Tukey test).

Table 21. Weekly numbers of Scolytinae, Platypodinae, Bostrichidae, Cerambycidae and Cleridae (mean ± SE) trapped above and below of the center of baited-ethanol E-W sticky flight intercept traps, in northern and southern sides, in a cerrado fragment in Selvíria, Mato Grosso do Sul, Brazil, March to August 2021.

	northern side		**southern side**	
family/species	**above**	**below**	**above**	**below**
Scolytinae				
Coptoborus tolimanus	0.01 ± 0.00 a	0.01 ± 0.01 a	0.01 ± 0.01 a	0.02 ± 0.01 a
Cryptocarenus diadematus	0.03 ± 0.01 a	0.04 ± 0.02 a	0.04 ± 0.01 a	0.03 ± 0.01 a
Cryptocarenus heveae	0.04 ± 0.02 a	0.04 ± 0.02 a	0.04 ± 0.01 a	0.05 ± 0.02 a
Hylocurus retusipennis	0.06 ± 0.02 a	0.04 ± 0.02 a	0.03 ± 0.01 a	0.03 ± 0.01 a
Hypothenemus eruditus	0.04 ± 0.02 a	0.04 ± 0.02 a	0.02 ± 0.01 a	0.03 ± 0.01 a
Hypothenemus javanus	0.01 ± 0.01 a	0.01 ± 0.01 a	0.00 ± 0.00 a	0.01 ± 0.01 a
Hypothenemus obscurus	0.07 ± 0.02 a	0.05 ± 0.02 a	0.02 ± 0.01 a	0.02 ± 0.01 a
Premnobius cavipennis	0.01 ± 0.01 a	0.02 ± 0.01 a	0.01 ± 0.01 a	0.00 ± 0.00 a
Xyleborus affinis	0.06 ± 0.02 a	0.09 ± 0.02 a	0.10 ± 0.02 b	0.18 ± 0.03 a
Xyleborus ferrugineus	0.27 ± 0.04 a	0.29 ± 0.05 a	0.44 ± 0.04 a	0.39 ± 0.04 a
Xyleborus volvulus	0.01 ± 0.01 a	0.01 ± 0.01 a	0.01 ± 0.01 a	0.02 ± 0.01 a
Σ Scolytinae	0.75 ± 0.06 a	0.83 ± 0.06 a	0.86 ± 0.05 a	0.93 ± 0.05 a
Platypodinae				
Euplatypus parallelus	0.03 ± 0.01 a	0.02 ± 0.01 a	0.09 ± 0.02 a	0.07 ± 0.02 a
Euplatypus segnis	0.04 ± 0.02 a	0.02 ± 0.01 a	0.03 ± 0.01 a	0.02 ± 0.01 a
Teloplatypus ratzeburgi	0.03 ± 0.01 a	0.03 ± 0.01 a	0.05 ± 0.02 a	0.04 ± 0.01 a
Σ Platypodinae	0.10 ± 0.03 a	0.07 ± 0.02 a	0.16 ± 0.03 a	0.13 ± 0.03 a
Bostrichidae				
Micrapate brasiliensis	0.04 ± 0.02 a	0.01 ± 0.01 a	0.02 ± 0.01 a	0.02 ± 0.01 a
Xyloperthella picea	0.12 ± 0.03 a	0.09 ± 0.02 a	0.11 ± 0.02 a	0.07 ± 0.02 a
Σ Bostrichidae	0.21 ± 0.04 a	0.12 ± 0.03 b	0.16 ± 0.03 a	0.10 ± 0.02 a
Cerambycidae				
Compsa quadriguttata	0.01 ± 0.01 a	0.03 ± 0.01 a	0.03 ± 0.01 a	0.04 ± 0.01 a
Neoclytus pusillus	0.02 ± 0.01 a	0.02 ± 0.01 a	0.01 ± 0.01 a	0.01 ± 0.01 a
Σ Cerambycidae	0.04 ± 0.02 a	0.06 ± 0.02 a	0.06 ± 0.02 a	0.07 ± 0.02 a
Cleridae				
Megaphloeus mucoreus	0.22 ± 0.03 a	0.22 ± 0.04 a	0.13 ± 0.02 a	0.08 ± 0.02 a
Σ Cleridae	0.22 ± 0.03 a	0.24 ± 0.04 a	0.16 ± 0.03 a	0.09 ± 0.02 b

Means detransformed from $\sqrt{(x+0,5)}$, followed by the same letter per species and treatment do not differ ($p < 0.05$, Tukey test).

4. DISCUSSION

The results obtained confirm that the ethanol is a very good attractant for a large number of Scolytinae (especially ambrosia beetles), most Platypodinae and many Cerambycidae (Cavaletto et al., 2021; Miller et al., 2015; Flechtmann et al., 1995; Elliott et al., 1983; Montgomery & Wargo, 1982).

A large number of insect species, including the groups studied; use attractants as kairomone or pheromone, by flying upwind (Cardé, 2016; Nam & Choi, 2014; Barata & Araújo, 2008; Cardé & Knols, 2000; Fadamiro et al., 1996; Byers, 1988; Elkinton et al., 1987). The prevalent wind direction was westbound and not north-northwest**,** and the higher wind turbulence into the forest can be related to the wind penetrating and spliting into two or more directions when hiting a tree or a bush (Santana et al., 2021; Kruijt et al., 2000; Baynton et al., 1965) with a more fragmented pattern compared to the pasture without obstacles to the wind. In addition, the low wind speed inside the fragment seems to be characteristic of Neotropical forests (Santana et al., 2021; Crall et al. 2020; Kruijt et al., 2000, Baynton et al., 1965), but with lower values compared to temperate forests with a lower tree/understory density (Hoffman et al., 2015; Byers, 1988).

Higher numbers of *H. obscurus*, *X. ferrugineus* and total Platypodidae were trapped in western side of the baited W-S trap, coincidently the only side of all traps faced correctly downwind, whitout any species being more trapped in the eastern side (upwind), indicating they were flying upwind to locate the attractive source. However, the results with the E-W traps did not confirm that the upwind flight was the sole factor used for the beetles to find an attractant, what would be reasonable to assume that the trap perpendicular to the most frequent wind directions should trap more beetles than the parallel-positioned traps, which did not occur.

The species studied use the ethanol to locate the baited trap and the combination of low wind speeds with the lack of any clear prevailing wind direction may indicated that the trap design used in the experiment is not adequate to study beetle flight direction (upwind or downwind).

The wind splits towards where the outer circles are located and this perfectly matches the results of our experiment, which is outer circles trapped significantly more than the inner circles, that is, once the beetles get closer to the trap, the airflow could easily carry them to the edges of the panel, due its very small size and weight. The modeling suggests the ethanol, as soon as released from the dispenser, is being carried too by the airflow to the outer parts of the trap, in a phenomenon that was shown on both sides of the trap in the airflow modeling, certainly concentrating the ethanol plume in the edges of the panel, without the typical conical shape as it moves away from the release point (Cardé, 2020; Connor et al., 2018; Cardé, 2016; Celani et al., 2014; Willis et al., 1994). Coincidently, the area the ethanol plume probably concentrates most beetles caught. Hence, this "altered" plume shape might also help explaining why the results on the trap side with higher numbers of beetles collected were nt consistant.

The flight range of most of the species studied were within the trap's upper and lower limits of height above ground, 2.0 m and 0.5 m (Flechtmann et al., 1997). Because the wind splits radially the ethanol plume in all directions, we did not expect differences in the area above and below the trap's center. Indeed, the vast majority of the species catch was similar above and below the traps. The total Bostrichidae was higher above the center and *X. affinis* below this part agree with the literature with these species flying near the ground (Flechtmann et al. 1997; Roling & Kerby, 1975; Cachan, 1964) and Bostrichidae at 2.0 m heigh (Flechtmann et al. 1997).

The raining in the site was below average for this region (Alvares et al., 2013), and for similar experiment with (non-sticky) window traps in the same site from March 2017 to March 2018, with 1,892 mm. The abundance of Scolytinae/Platypodinae is positively correlated with rainfall (Safranyik et al., 1989; Flechtmann et al., 1995; Jones et al., 2019; Oliveira et al., 2021). A drop in the abundance of these beetles was reported in experiments with flight intercept traps in 2016/2017 and in 2020/2021 in the same study site (Flechtmann et al. unpub.). The drop in the beetle abundance was expected in the current 2020/2021 numbers compared to the compared to the 2017/2018 study. However, the average numbers in both window traps experiments were similar, and actually slightly higher in this experiment. This was supported by the fact that beetles hitting the panel in a standard window trap (whitout glue) might be blown away from the collecting unit (placed on the lower part of the trap) or from the trap without being trapped, while supposedly in our trap, the only fact that could explain it, is once the beetle hits the panel, it sticks to the glue, minimizing losses. In this case, a higher capture due to the glue under unfavorable weather conditions with lower beetle abundance compensates the losses in the standard window trap under normal weather conditions.

5. CONCLUSIONS

The sticky window traps were not adequate to verify if Scolytinae, Platypodinae, Bostrichidae and Cerambycidae fly upwind when trying to reach th attractant source, the kairomone ethanol. Modeling the wind after hitting the trap panel made clear that the beetles attracted to the ethanol barely reached ca. 60% (circles A-G) of the trap area, because both the beetles and ethanol was being carried to the periphery (circles H-I) of the trap. An even lower number of beetles would have been captured with the traps without glue application, as it is the case of the majority of the window traps. The wind would cause a smaller effect of “ethanol spread” and with a smaller plume as found with the wind modeling in this study with smaller flight intercept traps. The beetles would be better finding and correctly approach the trap, resulting in a higher trapping efficiency, if trap area were considered.

REFERENCES

Alvares, C.A., Stape, J.L., Sentelhas, P.C., Gonçalves, J.L.M., Sparovek, G. Köppen’s climate classification map for Brazil. Meteorologische Zeitschrift 22(6): 711-728, 2013.

Atkins, M.D. Laboratory studies on the behavior of the Douglas-fir beetle, *Dendroctonus pseudotsugae* Hopkins. The Canadian Entomologist 98(9): 953 – 991, 1966.

Atkinson, T.H., Foltz, L.J., Connor, M.D. Flight patterns of phloem- and wood-boring Coleoptera (Scolytidae, Platypodidae, Curculionidae, Buprestidae, Cerambycidae) in a North Florida slash pine plantation. Environmental Entomology 17(2): 259 – 265, 1988.

Barata, E.N., Araújo, J. Olfactory orientation responses of the eucalyptus woodborer, *Phoracantha semipunctata*, to host plant in a wind tunnel. Physiological Entomology 26(1): 26-37, 2001.

Bastos, E.S.A, Dorval, A., Peres Filho, O., Souza, M.D., Marques, E.N., Junior, J.G.S. Influence of ethanol concentration on Scolytinae (Coleoptera: Curculionidae) in a native forest in the municipality of Campo Verde – MT. Idesia 36(4): 1 – 9, 2018.

Baynton, W.H., Biggs, G., Hamilton, H.L., Sherr, P.E., Worth, J.B. Wind structure in and above a tropical forest. Journal of Applied Meteorology 4(6): 670 – 675, 1965.

Berti-Filho, E., Flechtmann, C.A.H. A model of ethanol trap to collect Scolytidae and Platypodidae (Insecta, Coleoptera). IPEF (34): 53 – 56, 1986.

Bouget, C., Brustel, A., Brin, A., Valladares, L. Evaluation of window flight traps for effectiveness at monitoring dead wood-associated beetles: the effect of ethanol lure under contrasting environmental conditions. Agricultural and Forest Entomology 11(2): 143 – 152, 2009.

Byers, J. A. Sex-specific responses to aggregation pheromone: Regulation of colonization density in the bark beetle *Ips paraconfusus*. Journal of Chemical Ecology 9(1): 129 – 142, 1983.

Byers, J. A. Upwind flight orientation to pheromone in western pine beetle tested with rotating windvane traps. Journal of Chemical Ecology 14(1): 189 – 198, 1988.

Byers, J. A. Chemical ecology of bark beetles. Experientia 45: 271 – 283, 1989.

Byers, J.A., Birgersson, G., Francke, W. Aggregation pheromones of bark beetles, P*ityogenes quadridens* and *P. bidentatus*, colonizing Scotch pine: olfactory avoidance of interspecific mating and competition. Chemoecology 23(4): 251 – 261, 2013.

Byers, J. A., Löfqvist, J. Flight initiation and survival in the bark beetle *Ips typographus* (Coleoptera: Scolytidae) during the spring dispersal. Holarctic Ecology 12(4): 432 – 440, 1989.

Cachan, P. Analyse statistique des pullulations Scolytoidea mycétophages en forêt sempervirente de Côte d'Ivoire macroclimat, microclimat, écologie et éthologie. Annales de la Faculté desSciences de l'Université de Dakar, série Sciences Animales 14(2): 8-65, 1964.

Cardé, R.T. Moth navigation along pheromone plumes. *In*: Allison, J.D., Cardé, R.T. Pheromone communication in moths: evolution, behavior and application, p. 173 – 189, 2016.

Cardé, R.T. Navigation along windborne plumes of pheromone and resource-linked odors. Annual Review of Entomology 66(1): 317 – 336, 2021.

Cardé, R.T., Knols, B.G.J. Effects of light levels and plume structure on the orientation maneuvers of male gypsy moths flying along pheromone plumes. Physiological Entomology 25(2): 141 – 150, 2000.

Cavaletto, G., Faccoli, M., Ranger, C.M., Rassati, D. Ambrosia beetle response to ethanol concentration and host tree species. Journal of Applied Entomology 145(8): 800 – 809, 2021.

Celani, A., Villermaux, E., Vergassola, M. Odor landscapes in turbulent environments. Physical Review X 4(4): 1 – 20, 2014.

Chen, H., Li, Z., Tang, M. Laboratory evaluation of flight activity of *Dendroctonus armandi* (Coleoptera: Curculionidae: Scolytinae). The Canadian Entomologist 142(4): 378 – 387, 2010.

Chapman, J.A., Kinghorn, J.M. Studies of flight and attack activity of the ambrosia beetle, *Trypodendron lineatum* (Oliv.), and other scolytids. The Canadian Entomologist 90(6): 362 – 372, 1958.

Chapman, J.A., Kinghorn, J.M. Window flight traps for Insects. The Canadian Entomologist 87(1): 46 – 47, 1955.

Connor, E.G., McHugh, M.K., Crimaldi, J.P. Quantification of airborne odor plumes using planar laser-induced fluorescence. Experiments in Fluids 59(9): 137, 2018.

Crall, J.D., Brokaw, J., Gagliardi, S.F., Mendenhall, C.D., Pierce, N.E., Combes, S.A. Wind drives temporal variation in pollinator visitation in a fragmented tropical forest. Biology Letters 16(4): 20200103, 2020.

Dorval, A., Peres Filho, O., Levantamento e flutuação populacional de coleópteros em vegetação do cerrado e da Baixada Cuiabana, MT. Ciência Florestal 11(2): 171 – 182. 2001.

Elkinton, J.S., Schal, C., Ono, T., Cardé, R.T. Pheromone puff trajectory and upwind flight of male gypsy moths in a forest. Physiological Entomology 12(4): 399 – 406. 1987.

Elliott, H.J., Madden, J.L., Bashford, R. The association of ethanol in attack behavior of the mountain pinhole borer *Platypus subgranosus* Schedl (Coleoptera: Curculionidae: Platypodinae). Journal of the Australian Entomological Society 22(4): 299-302, 1983.

Evenden, M.L., Whitehouse, C.M., Sykes, J. Factors influencing flight capacity of the mountain pine beetle (Coleoptera: Curculionidae: Scolytinae). Environmental Entomology 43(1): 187 – 196, 2014.

Fadamiro, H.Y., Wyatt, T.D., Hall, D.R. Behavioural response of *Prostephanus truncatus* (Horn) (Coleoptera: Bostrichidae) the individual components of its pheromone a flight tunnel: discrimination between two odour sources. Journal of Stored Products Research 32(2): 163 – 170, 1996.

Flechtmann, C.A.H. Scolytidae in pine plantations: overview and situation in Brazil. Série Técnica, Instituto de Pesquisas e Estudos Florestais 13(33): 49 – 56, 2000.

Flechtmann, C.A.H., Couto, H.T.Z., Gaspareto, C.L., Berti-Filho, E. Manual de Pragas Florestais: Scolytidae em reflorestamento com pinheiros tropicais. Instituto de Pesquisas e Estudos Florestais, Piracicaba, 201 p., 1995.

Flechtmann, C.A.H., Gaspareto, C.L., Teixeira, E.P. Altura de vôo de Bostrichidae (Coleoptera) em *Pinus caribaea* v. *hondurensis* em Agudos, SP. Revista do Instituto Florestal 9(1): 19 – 26, 1997.

Flechtmann, C.A.H., Ottati, A.L.T., Berisford, C.W. Comparison of four trap types for ambrosia beetles (Coleoptera, Scolytidae) in Brazilian eucalyptus stands. Journal of Economic Entomology 93(6): 1701 – 1707, 2001.

Hanula, J.L., Mayfield, A.E., Fraedrich, S.W., Rabaglia, R.J. Biology and host associations of redbay ambrosia beetle (Coleoptera: Curculionidae: Scolytinae), exotic vector of laurel wilt killing redbay trees in the southeastern United States. Journal of Economic Entomology 104(4): 1276 – 1286, 2008.

Hanula, J.L., Mayfield, A.E., Reid, L.S., Horn, S. Influence of trap distance from a source population and multiple traps on captures and attack densities of the redbay ambrosia beetle (Coleptera: Curculionidae: Scolytinae). Journal of Economic Entomology 109(3): 1196 – 1204, 2016.

Hanula, J.L., Ulyshen, M.D., Horn, S. Effect of trap type, trap position, time of year, and beetle density on captures of the redbay ambrosia beetle (Coleoptera: Curculionidae: Scolytinae). Journal of Economic Entomology 104(2): 501 – 508, 2011.

Hoffman, C.M., Linn, R., Parsons, R., Sieg, C., Winterkamp, J. Modeling spatial and temporal dynamics of wind flow and potential fire behavior following a mountain pine beetle outbreak in a lodgepole pine forest. Agricultural and Forest Meteorology 204: 79 – 93, 2015.

Hosking, G.P., Knight, F.B. Flight habits of some Scolytidae in the spruce-fir type of northern Maine. Annals of the Entomological Society of America 68(5): 917 – 921, 1975.

Hulcr, J., Beaver, R.A., Puranasakul, W., Dole, S.A., Sonthichai, S. A. Comparison of bark and ambrosia beetle communities in two forest types in northern Thailand (Coleoptera: Curculionidae: Scolytinae and Platypodinae). Environmental Entomology 37(6): 1461 – 1470, 2008.

Jones, K.L., Shegelski, V.A., Marculis, N.H., Wijerathna, A.N., Evenden, M.L. Factors influencing dispersal by flight in bark beetles (Coleoptera: Curculionidae: Scolytinae): from genes to landscapes. Canadian Journal of Forest Research 1(1): 1024 – 1041, 2019.

Kendra. P.E., Montogomery, W.S., Narvaez, T.I., Carrilo, D. Comparison of trap designs for detection of *Euwallacea* nr. *fornicatus* and other Scolytinae (Coleoptera: Curculionidae) that vector fungal pathogens of avocado trees in Florida. Journal of Economic Entomology 113(2): 980 – 987, 2020.

Klingeman, W.E., Bray, A.M., Oliver, J.B., Ranger, C.M., Palmquist, D.E. Trap style, bait, and height deployments in black walnut tree canopies help inform monitoring strategies for bark and ambrosia beetles (Coleoptera: Curculionidae: Scolytinae). Environmental Entomology 46(5): 1120 – 1129, 2017.

Kruijt, B., Malhi, Y., Lloyd, J., Nobre, A.D., Miranda, A.C., Pereira, M.G.P., Culf, A., Grace, J. Turbulence statistics above and within two Amazon rain forest canopies. Boundary-Layer Meteorology 94(2): 297 – 331, 2000.

Kuhns, E.H., Martini, X., Tribuiani, Y., Coy, M., Gibbard, C., Peña, J., Hulcr, J., Stelinski, L.L. Eucalyptol is an attractant of the redbay ambrosia beetle, *Xyleborus glabratus.* Journal of Chemical Ecology 40(4): 355 – 362, 2014.

McMullen, L.H., Atkins, M.D. On the flight and host selection of the Douglas-fir beetle, *Dendroctonus pseudotsugae* Hopk. (Coleoptera: Scolytidae). The Canadian Entomologist 94(12): 1309 – 1325, 1962.

Mesquita Filho, W. Determinação de horário de vôo e fatores que o influenciam em Sacarabaeidae coprófagos diurnos e noturnos em Selvíria/MS. Dissertation. Universidade

Estadual Paulista, Ilha Solteira, SP. 148 p., 2009. (não há publicações desta tese com dados meterorológicos)

Miller, D.R., Crowe, C.M., Mayo, P.D., Silk, P.J., Sweeney, J.D. Responses of Cerambycidae and other insects to traps baited with ethanol, 2-3-hexanediol, and 3,2-hydroxyketone lures in north-central Georgia. Forest Entomology 108(5): 2355 – 2365, 2015.

Montgomery, M.E., Wargo, P.M. Ethanol and other host-derived volatiles as attractants to beetles that bore into hardwoods. Journal of Chemical Ecology 9(2): 181 – 190, 1983.

Nam, Y., Choi, W.I. Diurnal flight pattern of *Platypus koryoensis* (Coleoptera: Platypodinae) in relation to abiotic factors in Korea. Journal of Asia-Pacific Entomology 17(3): 417 – 422, 2014.

Öhrn, P., Långström, B., Lindelöw, Å., Bjorklund, N. Seasonal flight patterns of *Ips typographus* in southern Sweden and thermal sums required for emergence. Agricultural and Forest Entomology 16(2): 147 – 157, 2014.

Oliveira, C.P.D., Oliveira, C.M.D., Specht, A., Frizzas, M.R. Seasonality and distribution of Coleoptera families (Arthropoda, Insecta) in the cerrado of central Brazil. Revista Brasileira de Entomologia 65(3): 20210025, 2021.

Owens, D., Seo, M., Montgomery, W.S., Rivera, M.J., Stelinski, L.L., Kendra, P.E. Dispersal behavior of *Euwallacea* nr. *fornicatus* (Coleoptera: Curculionidae: Scolytinae) in avocado groves and estimation of lure sampling range. Agricultural and Forest Entomology 21(2): 199 – 208, 2019.

Prochazka, J., Cizek, L., Schalaghamersky, J. Vertical stratification of Scolytinae beetles in temperate forests. Insect Conservation and Diversity 11(6): 534 – 544, 2018.

Ranger, C.M., Reding, M.E., Schultz, P.B., Oliver, J.B., Frank, S.D., Addesso, K.M., Chong, J.H., Sampson, B., Werle, C., Gill, S., Krause, C. Biology, ecology, and management of nonnative ambrosia beetles (Coleoptera: Curculionidae: Scolytinae) in ornamental plant nurseries. Journal of Integrated Pest Management 7(1): 9, 2016.

Reding, M.E., Schultz, P.B., Ranger, C.M., Oliver, J.B. Optimizing ethanol-baited traps for monitoring damaging ambrosia beetles (Coleoptera: Curculionidae: Scolytinae) in ornamental nurseries. Journal of Economic Entomology 104(6): 2017 – 2024, 2011.

Reding, M.E., Ranger, C.M., Oliver, J.B., Schultz, P.B. Monitoring attack and flight activity of *Xylosandrus* spp. (Coleoptera: Curculionidae: Scolytinae): The influence of temperature on activity. Journal of Economic Entomology 106(4): 1780 – 1787, 2013.

Roling, M.P., Kearby, W.H. Seasonal flight and vertical distribution of Scolytidae attracted to ethanol in an oak-hickory forest in Missouri. The Canadian Entomologist 107(12): 1315 – 1320, 1975.

Safranyik, L., Shore, T.L., Linton, D.A. Measuring trap efficiency for bark beetles (Col., Scolytidae). Journal of Applied Entomology 128(5): 337-341, 2004.

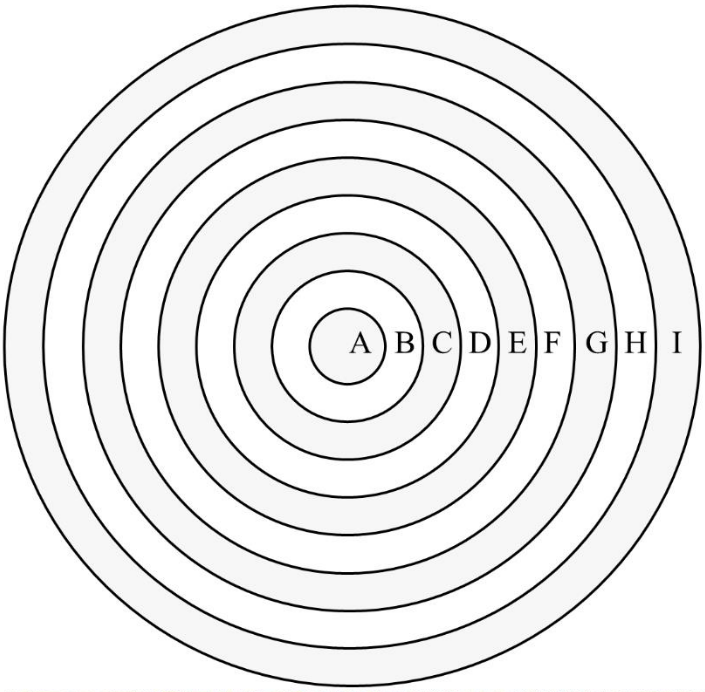
Santana, R.A.S., Dias-Júnior, C.Q., Vale, R.S., Tóta, J., Silva, R., Tapajós, R., Manzi, A.O., Beldini, T.P. Comparing the air turbulence above smooth and rough surfaces in the amazon region. Atmosphere 12(8): 1043, 2021.

VanDerLaan, N.R., Ginzel, M.D. The capacity of conophthorin to enhance the attraction of two *Xylosandrus* species (Coleoptera: Curculionidae: Scolytinae) to ethanol and the efficacy of verbenone as a deterrent. Agricultural and Forest Entomology 15(4): 391 – 397, 2013.

Willis, M.A., David, C.T., Murlis, J., Cardé, R.T. Effects of pheromone plume structure and visual stimuli on the pheromone-modulated upwind flight of male gypsy moths (*Lymantria dispar*) in a Forest (Lepidoptera: Lymantriidae). Journal of Insect Behavior 7(3): 385 – 409, 1994.

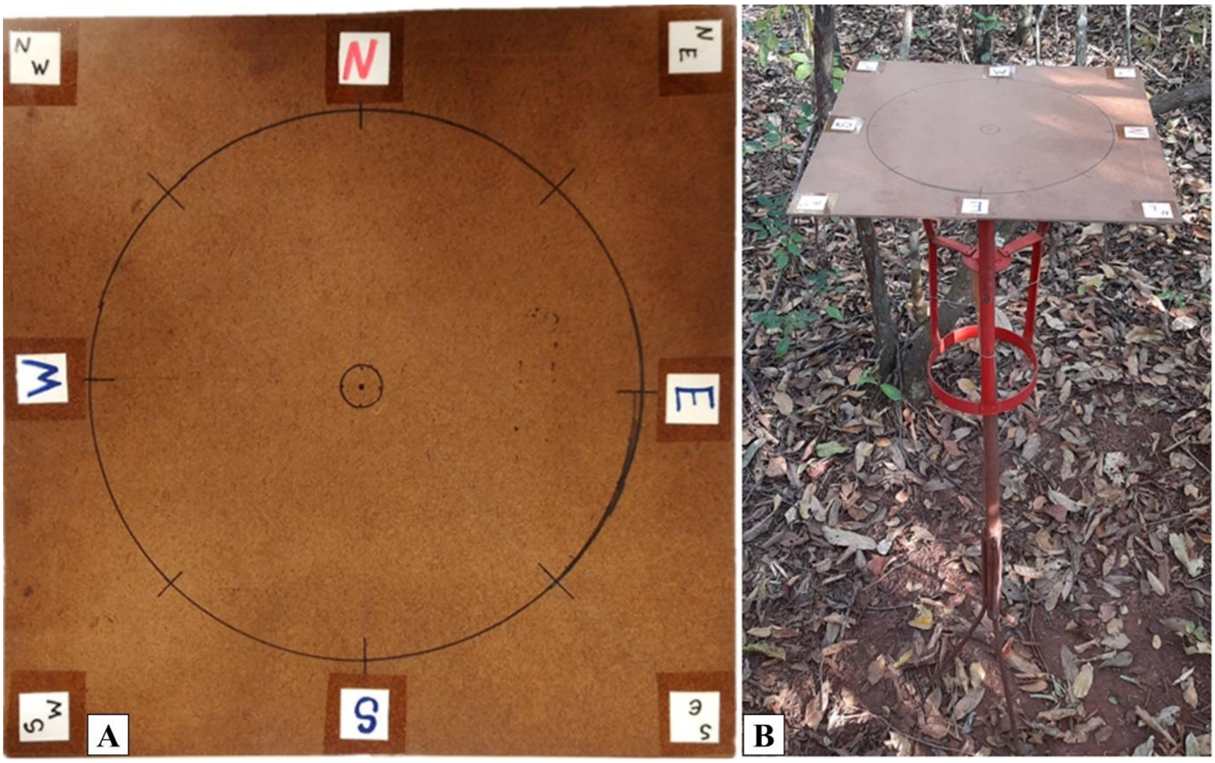
Wood, S.L. A Reclassification of the genera of Scolytidae (Coleoptera). Great Basin Naturalist Memoirs 10(2): 1 – 130, 1986.

APPENDIX: Supplementary Figures 1 and 2.



letter	radius (cm)	area (cm^2)
A	5	78
B	10	236
C	15	393
D	20	550
E	25	706
F	30	864
G	35	1021
H	40	1178
I	45	1335

Supplementary Figure 1. Sticky flight intercept trap. Corresponding circles (A) and respective intercept areas (cm^2); trap inside the cerradão fragment (B, C) at Universidade Estadual Paulista (UNESP/FEIS) Experimental Farm in Selvíria, state of Mato Grosso do Sul, Brazil



Suplementary Figure 2. Anemometer built to determine wind speed and wind direction inside the study area. Masonite board with circle and cardinal points (A), anemometer (B) installed in the study area. Cerradão fragment, at Universidade Estadual Paulista (UNESP/FEIS) Experimental Farm in Selvíria, state of Mato Grosso do Sul, Brazil.