

Edaphic invertebrate macrofauna associated with cassava crop in different soil coverages

Nathalia de França Guimarães^{1*}, Auro Akio Otsubo², Rodrigo Arroyo Garcia², Anderson de Souza Gallo¹, Emerson Machado de Carvalho³, Rogério Ferreira da Silva⁴

¹Federal Rural University of Rio de Janeiro, Institute of agronomy, Soil Department, Seropédica, RJ, Brazil

²Embrapa Western Agriculture, Dourados, MS, Brazil

³Federal University of Southern Bahia, campus "Jorge Amado", Itabuna, BA, Brazil

⁴State University of Mato Grosso do Sul, Unity of Glória de Dourados, Glória de Dourados, MS, Brazil

*Corresponding author: n.fguimaraes@hotmail.com

Abstract

This study aimed to identify and assess the edaphic invertebrate macrofauna associated with cassava crop in succession to different soil coverages. The experimental design was randomized blocks as 6 x 3 factorial design with four replications. The first factor was soil cover cultivated from December 2014 to April 2015 (fallow, pearl millet, forage sorghum, *Crotalaria ochroleuca*, *Urochloa ruziziensis* and Corn+*Urochloa ruziziensis*). The second factor was sampling periods (March/2015, October/2015 and June/2016). We sampled four blocks of 0.25 x 0.25 x 0.20 m in each system, following the TSBF (Tropical Soil Biology and Fertility) collection method. The taxonomic composition and abundance of organisms, richness of groups and the diversity indexes of Shannon, Pielou equitability and Simpson dominance were evaluated. There was no interaction between the factors (soil cover x season) for the variables studied. There was difference in the dominance of organisms according to the soil cover (isolated), being the highest index (0.44) obtained by previous cultivation of forage sorghum. The abundance of organisms, group richness and diversity index were influenced by sampling period, demonstrating the influence of seasonality on the invertebrate macrofauna community of the soil.

Keywords: Soil organisms, cover crops, *Manihot esculenta* Crantz, soil quality, no-till farming.

Introduction

Brazil is one of the world leaders in cassava production. According to the Brazilian Institute of Geography and Statistics (IBGE, 2017), Brazilian production of this root will reach over 20 million tons in 2017, being Mato Grosso do Sul one of the largest producers. This is due to the fact that in this region, the edaphoclimatic characteristics are favorable to the production (Silva et al., 2008). In addition, the country is a pioneer in soil conservation with the no-tillage system, a practice that has been keeping agricultural productivity high for several crops (Devidé et al., 2017), including cassava leading to increase of root production and starch content (Amabile et al., 1994; Oliveira et al., 2001).

The use of cover plants, combined with the no-tillage system promotes several benefits to the soil system, as these plants contribute to nutrient cycling, water storage and increase in organic matter (Santos et al., 2008). They also maintain a lower soil temperature in the top layer. The cover plants also improve several parameters related to the physical attributes of the soil (Silva et al., 2008), such as the structure and resistance to penetration through "biopores" derived from decomposition of aggressive root system of previous crops.

From the point of view of biological attributes, several studies indicate that the use of cover crops causes numerous changes in soil quality (Cordeiro et al., 2004; Silva et al., 2007; Crotty et al., 2015; Dudás et al., 2016). According to Baretta et al., (2003), the soil fauna can be benefited by the increase in the quality and quantity of vegetal residues, changing its composition and diversity in different degrees of intensity through changes in habitat, food supply, creation of microenvironments and intraspecific and interspecific competition (Marques et al., 2014; Terry et al., 2015).

The soil invertebrate macrofauna is composed of animals with a body diameter between 2 mm to 20 mm and they can belong to almost all orders (Lavelle and Spain, 2001; Correia and Oliveira, 2005). These organisms play a key role in the functioning of the ecosystem, as they occupy several trophic levels within the soil food chain (Silva et al., 2007). They can influence soil processes through two main pathways: directly, through the physical modification of the litterfall and the soil environment, and indirectly, through interactions with the microbial community (González et al., 2001). They regulate populations through selective predation of fungi and bacteria, stimulation, digestion and dissemination of ingested microorganisms and the

fragmentation of debris (Brown, 1995; Cragg and Bardgett, 2001). Besides, they are used as indicators of soil quality as they are sensitive and react quickly to changes induced by anthropogenic activities and environmental disturbances (Rousseau et al., 2012; Guimarães et al., 2016).

Thus, this work aims to evaluate the edaphic invertebrate macrofauna associated with cassava culture in succession to different soil coverings.

Results and Discussion

Dry mass of cover plants

There was a difference in aerial part of dry mass (APDM) of the cover plants. The dry mass of the sorghum treatment was higher than the degraded meadow cover (M), millet, crotalaria and intercropped corn, not only differing from the single brachiaria (Figure 1). This result corroborates with Carvalho et al. (2013), who identified sorghum having highest production of green and dry matter with high production of phytomass for soil protection.

All treatments accumulated dry mass above 6 t ha⁻¹ (Figure 1). According to Alvarenga et al. (2001), this amount of APDM on the surface is sufficient to obtain good soil coverage, ensuring the beneficial effects regarding the maintenance and/or improvement of the soil's biological characteristics. According to Cordeiro et al. (2004), the good amount of vegetal residues on the soil can promote new habitats and food availability, changing the diversity of the edaphic fauna community.

Relative frequency of the soil macrofauna organisms

The composition of the soil macrofauna community in three sampling periods showed that collected organisms belonged to the following six taxonomic groups: Oligochaeta (Annelida), Isoptera, Heteroptera, Coleoptera and Formicidae (Arthropoda: Insecta) and others (Table 2).

In the first evaluation (March/2015) of the systems under cover (treatments) of millet, sorghum and corn + *Urochloa* revealed a higher presence of the Oligochaeta, with 79%, 42% and 58% of the individuals collected, respectively. The Formicidae group showed low predominance in all treatments, as it reached 10% of the total macrofauna individuals in no soil cover.

The Isoptera group was the one with the highest profile in the 1st sampling. In crotalaria and *Urochloa* treatments, the group represented 87% and 68% of the quantified individuals, respectively. In addition, it was the second most prevalent in fallow and Corn + *Urochloa*. This result may be associated with the fact that the experiment was implemented over an occupied area with pasture in the process of degradation. In fact, isoptera is an order formed by individuals known as termites. According to Aquino et al. (2008), the high presence of these organisms can be a sign of the degradation process in pastures, where they occur in high numbers. According to Cunha and Morais (2010), the formation of pastures facilitates the proliferation of termite mounds because of the homogeneity of the environment and the absence of competitors.

In October 2015 (2nd sampling), there was a sharp decline in the presence of organisms in the Isoptera group, with a predominance in Crotalaria only (Table 2). In the sorghum

and corn + *Urochloa* systems, the group was not even captured. This occurrence may be related to the management of cover crops, showing improvement in soil quality over time. The straw accumulated by the plants provided a favorable environment for the communities of the edaphic macrofauna (Silva et al., 2007), mainly for providing food and shelter to the weather. Therefore, it seems to have conditions for the establishment of the other groups of macrofauna.

We found a dominance of Heteroptera and Formicidae in fallow, which altogether accounted 75% of the total individuals of the invertebrate macrofauna. The Heteroptera group was also the most present in millet (50% of individuals), followed by Isoptera and Coleoptera, with 33% and 16%, respectively. In Sorghum, the Coleoptera group was prevailed, accounting for 80% of the total of organisms. The Formicidae group stood out in the *Urochloa* and Maize + *Urochloa* systems, representing 68% and 89% of individuals, respectively.

In the third sampling period, the Formicidae group was more frequent in five of the soil cover systems (treatments), except for the millet, in which Isoptera predominated (64%) (Table 2). The behavior of the Formicidae group is highlighted, which in the first evaluation had low frequency, increasing its population over time, except in corn + *Urochloa cv. ruziziensis*. This result can be attributed to the improvement of soil properties due to cover crops (Silva et al., 2007). The high presence of individuals in this group is commonly associated with changes in soil management, especially during its reconditioning (Anderson et al., 2002). In addition, June was the driest (25 mm) among the seasons evaluated (Table 1). According to Santos et al. (2012), the frequency of ants is higher, when there is a reduction in precipitation and an increase in air temperature.

Functional groups

The groups of macroinvertebrates were classified into five functional groups: saprophagous-Oligochaeta and Blattodea; predator-Chilopoda, Araneae, Dermoptera and Hymenoptera (excluding Formicidae); saprophage-predator - Isoptera, Coleoptera and Formicidae; phytophagous-Orthoptera and Heteroptera; and others: Diptera (Figure 2).

In the first season, saprophages and saprophage-predators were the most significantly groups present in most soil coverings, except in fallow (spontaneous vegetation), which had the highest density of phytophages (48%) (Fig 2A). Saprophages were more representative in the Millet, Corn + *Urochloa* and Sorghum systems, with 74%, 58% and 42%, respectively, a result attributed to the large number of individuals of the Oligochaeta class captured in these systems (Table 2). The saprophagous-predator group was the most representative in Crotalaria and *Urochloa*, with 93% and 70% of the organism density. Abundant populations of organisms in this group indicate a normal flow of energy within communities (Neutel et al. 2002), which is the normal functioning of the soil (Rousseau et al., 2012). Sorghum showed a more uniform distribution of macrofauna individuals due to functional groups.

In the second season, in sorghum (93.3%), crotalaria (100%) *Urochloa* (77.3%) and corn + *Urochloa* (96%) coverings, there was a greater expression of saprophagous-predator macroinvertebrates (Figure 2B). These coverings

accumulated the highest dry matter (Figure 1), suggesting that the abundance of individuals in this group responds to the increase in plant biomass in the soil (Sayer et al. 2010; Rousseau et al. 2012). In *Crotalaria*, 100% of organisms belong to this group, suggesting a food preference for the plants of this family, which may be related to their low C/N ratio (Silva et al., 2007). At fallow, saprophage-predators showed similar behavior to phytophages, with 50% of the organisms for each group. Spontaneous vegetation environments can be important sources of shelter and food for soil predators and their presence contributes to the control of phytophagous populations (Marasas et al., 2010). In the third sampling period, the saprophage-predators showed high representativeness in all soil coverings (Figure 3C), a result related to the high dominance of the groups Formicidae, Isoptera and Coleoptera (Table 2), all of them saprophages-predators. Therefore, it is possible to affirm that the plant material of cover plants favors individuals in this functional group in a more advanced degree of decomposition over time, who feed on dead organic matter. At the same time, they regulate populations of organisms from other groups, as they also play a role as predators in agroecosystems, explaining the group's high dominance in all soil coverings tested in the third sampling.

Abundance, richness of groups and ecological indexes

There was no significant interaction ($p > 0.05$) between the two studied factors (soil cover x season) for the variables abundance of organisms (AO), richness of groups (RG), diversity indices (DI), equitability (E) and dominance (Do) (Table 3).

When analyzing the levels apart, we found that only the 'Do' showed a significant difference ($p < 0.01$) due to the soil cover. Sorghum showed the highest value to 'Do' compared to fallow and Millet, without statistically differing from the other ground covers (*Crotalaria*, *Urochloa* and Corn + *Urochloa*) (Table 3). Simpson's index was expressed whether there is dominance by one or a few species and varies from 0 to 1, the closer to 1 the greater the dominance of a given group. Therefore, the highest Simpson's index is related to the dominance of some groups in this system, mainly Oligochaeta, which was one of the most expressive in March (first sampling season). The Coleoptera was most representative in October (second season sampling), reaching 80% of the composition of edaphic macroinvertebrates and Formicidae, which was one of the most dominant in June (third sampling season) (Table 2). This is due to the fact that sorghum was the covering with the highest accumulation of dry matter (Figure 1). The occurrence of a certain group of edaphic fauna is mainly due to the beneficial effects of vegetable residues kept on the soil surface, providing a more favorable environment for the survival of certain groups (Moço et al., 2005), as it provides food, humidity, favorable temperature, and protection from the weather (Guimarães et al., 2016).

Analysis of sampling times showed significant differences ($p < 0.01$) for the variables AO, WG and DI (Table 3). For three variables, the first and third seasons (March/2015 and June/2016) were statistically superior to the second sample. This result demonstrates the influence of seasonality in the structure of the edaphic community, where differences

found between the months, times or periods analyzed mainly associated with precipitation (Machado et al., 2015) and temperature, which can influence the pattern of distribution and diversity of many groups (Almeida et al., 2015).

Several authors reported edaphic invertebrates with greater abundance of organisms, richness of groups and diversity index in periods of greater precipitation (Moço et al., 2005; Silva et al., 2007; Almeida et al., 2015; Guimarães et al., 2016). This factor allied to biotic factors of the environment such as vegetation cover, which can contribute to the formation of different microsites (Moço et al., 2005; Almeida et al., 2015), favoring the establishment of several groups of soil invertebrate macrofauna.

In the present study, despite low rainfall in the sampling times of March (96 mm) and June (25 mm) (Table 1), the months leading up to these showed high rainfall (February and May), with 264 mm and 228 mm, respectively. This occurrence may have influenced the highest values for abundance of organisms, group richness and Shannon's diversity index (Table 3), making the capacity of the vegetation cover of the studied plants to maintain soil moisture more evident (Santos et al., 2008).

Cluster analysis

The cluster analysis is a technique whose objective is to group management systems based on common characteristics (Guimarães et al., 2016). The cluster analysis showed the formation of two large distinct groups in relation to the edaphic macroinvertebrate community (Figure 3). These two groups did not show any similarity to each other, since their connection distance was 100%.

The first group includes the fallow, *Crotalaria* and *Urochloa* systems with 70% similarity. This grouping was probably occurred due to the similarity between the three systems in terms of the abundance of macrofauna organisms (Table 2), since they were the most abundant. Within group 1, the formation of two levels is perceived (Figure 3). Considering the levels, there was 34% dissimilarity between the *Urochloa* treatment and those of the fallow and *Crotalaria* systems. The formation of the level with the Fallow and *Crotalaria* is possibly associated with the similarity in the average values for the variables abundance of organisms and equitability index (Table 2).

The second group comprised of Millet, Sorgho and Corn + *Urochloa* systems, which showed a similarity of 54%. Within this group, the formation of two independent and distant levels was observed. On one level, Corn + *Urochloa* were isolated with a 46% difference from Millet and Sorghum. This isolation probably was occurred due to the reduction in the abundance of macrofauna organisms in the system, being the only one that presented less than 200 m⁻² organisms (Table 2). However, the Millet and Sorghum systems formed a second level, with 78% similarity between them, corroborating Silva et al. (2007), who evaluated effect of cassava cultivation in different soil cover systems on the density and diversity of the macrofauna community. They found similarity between sorghum and millet reaching up to 98%. This result allows us to infer that these two grasses have a similar effect on the soil invertebrate macrofauna.

Table 1. Precipitation (P), temperature (T) and relative humidity (RH) during the months of the experiment, Naviraí, MS, 2017. Source: Cooperativa Agrícola Sulmatogrossense (Copasul).

Months	P (mm)		T (°C)		RH (%)	
	Total	DA ⁶	Max.	Min.	Max.	Min.
Dec/2014 ¹	208	6.9	33.4	22.3	84.5	42.9
Jan/2015	138.0	4.4	35.2	22.8	83.8	39.9
Feb/2015	264.0	9.4	33.8	22.0	85.2	58.6
Mar/2015 ²	96.0	3.0	33.7	21.3	85.1	49.3
Apr/2015	279.7	9.3	31.4	20.1	86.6	50.9
May/2015 ³	259.0	8.3	27.0	16.9	86.3	60.5
Jun/2015	56.5	1.8	27.6	16.2	83.4	53.4
Jul/2015	290.4	9.3	28.4	15.3	84.6	67.7
Aug/2015	43.0	1.3	32.6	18.5	75.8	45.5
Sep/2015	342.0	11.4	31.6	19.5	79.2	50.2
Oct/2015 ⁴	216.5	6.9	32.0	22.8	83.7	51.9
Apr/2016	95.0	3.1	33.8	21.3	77.4	43.9
May/2016	228.5	7.3	24.7	15.6	83.1	69.4
Jun/2016 ⁵	25.0	0.8	24.3	12.6	88.7	80.9

¹Sowing of cover and maize species; ²First assessment of macrofauna; ³Cassava planting; ⁴Second assessment of macrofauna; ⁵Third assessment of macrofauna. ⁶DA = Daily average.

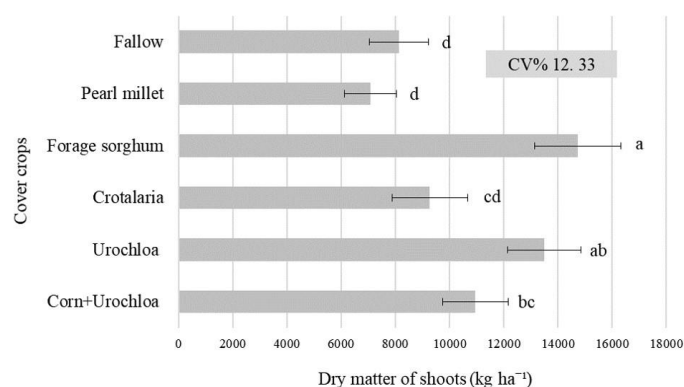


Fig 1. Dry mass of cover plants (kg ha⁻¹) and standard deviation, Naviraí, MS, 2017. Fallow (F); Millet (Mi); Forage Sorghum (FS); *Crotalaria ochroleuca* (CR); *Urochloa cv. Ruziziensis* and corn + *Urochloa cv. ruziziensis* (C + UR). CV% = Coefficient of variation.

Table 2. Relative frequency (%) of soil macrofauna organisms in different soil coverings and fallow, in three evaluation periods. Naviraí, MS, 2017.

Treat. *	Formicidae %	Isoptera	Coleoptera	Oligochaeta	Heteroptera	Others**
March/2015						
F	6	26	2	15	48	3
MI	4	6	5	79	2	4
FS	6	3	8	42	25	16
CR	2	87	4	2	5	0
UR	3	68	1	2	26	0
C+UR	3	14	11	58	11	3
October/2015						
F	25	12.5	12.5	0	50	0
MI	0	33.3	16.7	0	50	0
FS	13.3	0	80	0	0	6.7
CR	0	75	25	0	0	0
UR	68.2	6.9	9.1	11.3	0	4.5
C+UR	89.7	0	0	0	0	10.3
June/2016						
F	64	4	23	1	1	7
MI	21	64	6	2	4	3
FS	46	30	20	-	2	2
CR	67	6	12	-	6	9
UR	75	19	5	-	-	1
C+UR	45	28	15	-	9	3

*Treat - Treatments: Fallow (F); Millet (MI); Forage sorghum (FS); *Crotalaria ochroleuca* (CR); *Urochloa cv. ruziziensis*; Corn + *Urochloa cv. ruziziensis* (C + UR); ** Others - Araneae, Diptera, Hymenoptera (excluding Formicidae), Orthoptera, Chilopoda, Blattodea and Dermaptera.

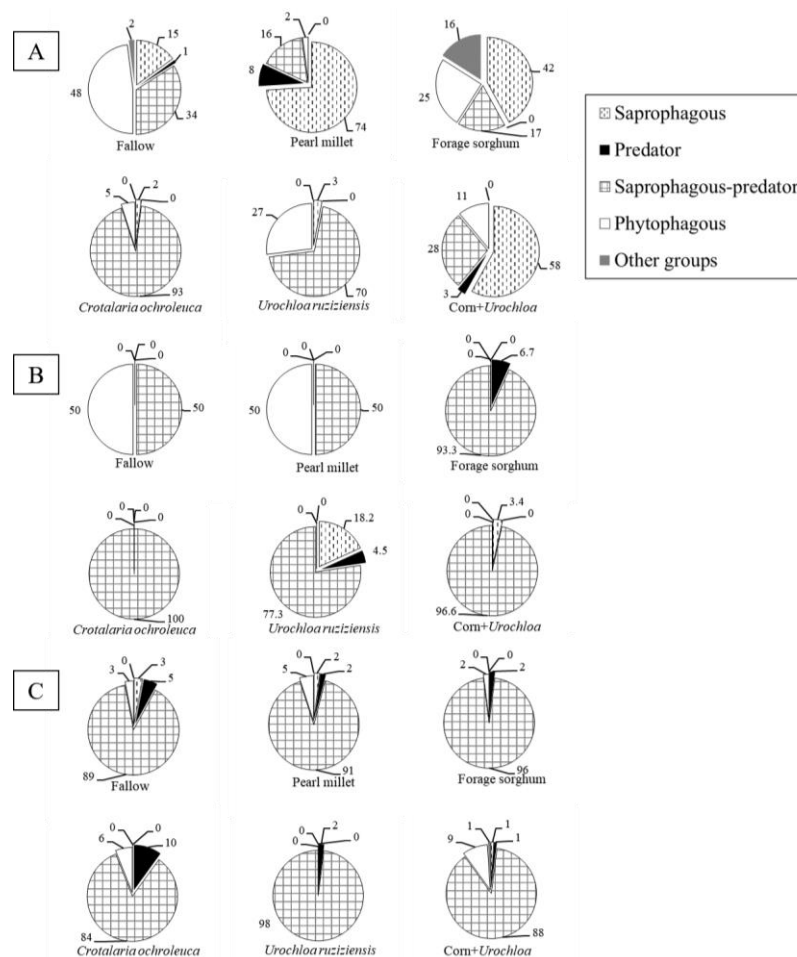


Fig 2. Relative density (%) of the functional groups of the soil macrofauna organisms in different soil coverings and fallow, in the first (A), second (B) and third (C) evaluation period. Naviraí, MS, 2017. Saprothages (Oligochaeta and Blattodea); predator [Chilopoda, Araneae, Dermoptera and Hymenoptera (excluding Formicidae)]; Saprothages-predator (Isoptera, Coleoptera and Formicidae); phytophagous (Orthoptera and Heteroptera) and another (Diptera).

Table 3. Abundance of organisms - number of individuals m^{-2} (AO), Wealth of groups - number of groups (WG), Shannon diversity index (DI), Pielou equitability index (EI), Simpson's dominance index (Do) in different soil coverings and fallow, in three evaluation periods/seasons. Naviraí, MS, 2017.

	AO ¹	WG	DI	EI	Do ²
	Number of individuals m^{-2}	Number of groups	-----Index-----		
Systems					
F	426.41 a	3.58 a	0.39 a	0.76 a	0.06 b**
MI	352.00 a	3.16 a	0.33 a	0.72 a	0.11 b
FS	277.75 a	2.66 a	0.29 a	0.69 a	0.44 a
CR	460.33 a	2.75 a	0.29 a	0.74 a	0.20 ab
UR	531.44 a	2.66 a	0.27 a	0.71 a	0.26 ab
C+UR	198.41 a	2.91 a	0.35 a	0.67 a	0.35 ab
Seasons					
Mar./2015	501.87 a**	3.20 a**	0.35 a**	0.73 a	0.30 a
Oct./2015	77.80 b	2.00 b	0.23 b	0.67 a	0.16 a
Jun./2016	543.50 a	3.66 a	0.38 a	0.74 a	0.25 a
Interaction					
Sist x Season	1.74 ^{ns}	0.58 ^{ns}	0.74 ^{ns}	1.97 ^{ns}	0.72 ^{ns}
CV%	15.20	33.52	35.59	34.61	58.38

Average with the same letters in the columns do not differ according to the Tukey's test. Fallow (F); Millet (MI); Forage sorghum (FS); *Crotalaria ochroleuca* (CR); *Urochloa cv. ruziziensis*; Corn + *Urochloa cv. ruziziensis* (M + UR). **significant at the 1% probability level ($p < 0.01$). ^{ns} not significant ($p > 0.05$). ¹ Data transformed using the expression $x = \log(x)$. ² Data transformed using the expression $x = vx$. System x Seasons - Systems x Seasons.

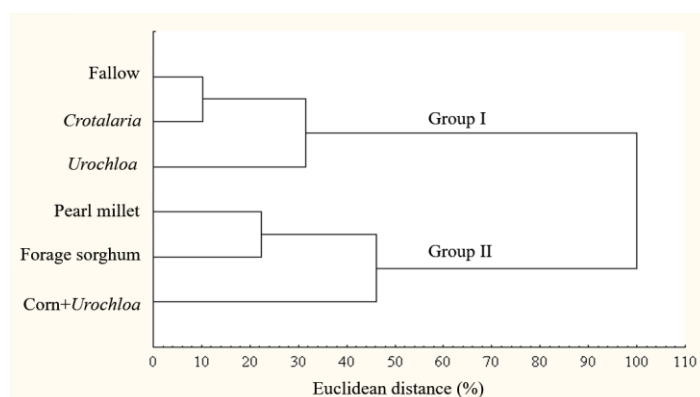


Fig 3. Dendrogram of dissimilarity of the edaphic macroinvertebrate community, based on Euclidean distance, under different ground cover and fallow (average of the three assessment periods), Navirai, MS, 2017. fallow; millet; forage sorghum; *Crotalaria ochroleuca*; *Urochloa cv. ruziziensis*; corn + *Urochloa cv. ruziziensis*.

Materials and Methods

Site location and characterization

The experiment was implemented in the municipality of Navirai, state of MS (23°03'54"11"; altitude of 364 m), in the experimental area of Cooperativa Agrícola Sulmatogrossense (Copasul), on an area occupied with pasture in the process of degradation. The soil is classified as medium-textured dystrophic red latosol, whose chemical characteristics in the 0.0-0.20 m layer were: pH (in CaCl₂) = 4.9; P = 4 mg dm⁻³; K=0.11 cmol_c dm⁻³; Ca = 0.16 cmol_c dm⁻³; Mg= 0.6 cmol_c dm⁻³; H + Al: 2.6 cmol_c dm⁻³ and, soil organic matter = 21 g kg⁻¹. According to Köppen and Geiger (1928), the region's climate is classified as Am (humid or sub-humid tropical climate). The annual average temperature and rainfall in Navirai is 22.4°C and 1517 mm, respectively. The climatic data during the conduction of the experiment are summarized in Table 1.

Experimental design

The experimental design used was randomized blocks in a double factorial scheme (6 x 3), with four replications. The first factor was constituted by soil cover. The second factor was the sampling period (March/2015, October/2015 and June/2016). The experiment was implemented in a strip scheme to enable the operation of machinery. Each experimental plot measured 8.00 x 10.50 m, totaling 84 m² per experimental unit.

Field establishment and treatments

In October 2014, a corrective was applied to the experimental plots, except for the conventional system, which was kept as fallow (F). The applied dose of corrective was calculated aiming to increase base saturation to 60%. The application manually performed in a cover, using dolomitic filler limestone. Subsequently, the corrective was incorporated and the soil was prepared with plowing and two harrows, obtaining a good condition for mechanized sowing.

Sowing of cover and corn species was carried out in December 2014, with basic fertilization of 300 kg ha⁻¹ of the formula 08-28-16 for all treatments, detailed below:

Millet (MI): spacing of 0.45 m, sowing depth of 3 cm and use of 8 kg ha⁻¹ of seeds of the BRS 1501 variety;

Forage sorghum (FS): spacing of 0.45 m between rows, sowing depth of 3 cm, with a quantity of seeds of 10 kg ha⁻¹. The cultivar IAC - Santa Elisa was used;

***Crotalaria ochroleuca* (Cr):** spacing between rows of 0.45m and sowing depth of 3 cm, using 8 kg ha⁻¹ of seeds;

***Urochloa ruziziensis* (brachiaria) (Ur):** spacing between rows of 0.45m and sowing depth of 2 cm, using 4 kg ha⁻¹ of pure viable seeds;

Corn + *Urochloa ruziziensis* (Co + Ur): For the corn + brachiaria consortium, the corn hybrid DKB 390 was used. The corn was sown with spacing between rows of 0.90 m, with the forage implanted between the rows (interim row method). For corn, the sowing density of 5 plants m⁻² was used. For the forage, the population of 10 plants m⁻² was adopted. In addition to the basic fertilization, 50 kg ha⁻¹ of nitrogen and potassium were applied via protected urea and potassium chloride, respectively, when the plants were in the four-leaf stage developed in all treatments.

The mechanical handling of all cover species was carried out with a rotary shredder, about 130 days after sowing. To determine the dry phytomass produced by cover crops and corn, three subsamples of 1.8 m were collected. It made up a sample composed of the plants contained in 5.4 m², except for the *Urochloa ruziziensis* treatment, for which three were samples of 0.68 m sub-collected, making up a 2.04 m² subsample. The degraded fallow pasture also had the production of phytomass before the planting of cassava. These aliquots were dehydrated in a forced aeration oven at 60°C, for 72 hours, with subsequent weighing. Subsequently, the data obtained were converted to kg ha⁻¹.

The cassava cultivar 'Baianinha' was planted in May 2015, on the straw of the ground cover under evaluation. The conventional system treatment associated with degraded pasture (P), which was planted after mechanical soil preparation. Planting was done mechanically with a two-row planter. Sowing was done in simple rows, with spacing and 1.00 m between rows and 0.70 m between plants, with a population of 14,286 plants ha⁻¹. Each plot consisted of eight planting lines with 15 plants in each line. The sample collection area for analysis was the plants of the three central lines, except for the plants at the end of the line. The planting depth was 0.10 m. Fertilization of planting, was formulated as 04-20-20 + Zn at a dose of 160 kg ha⁻¹.

Parameters evaluated

The evaluations of the edaphic invertebrate macrofauna were carried out in three periods. The first in March 2015, 100 days after the sowing of cover plants. The second in October 2015, 165 days after the cassava planting and the third in June 2016, 13 months after the cassava implantation. In each system, four blocks of 0.25 m x 0.25 m x 0.20 m were sampled randomly, following the TSBF - Tropical Soil Biology and Fertility collection method (Anderson and Ingram, 1993). 72 soil samples were manually selected and the organisms found (> 10 mm long and/or > 2 mm body diameter) extracted and stored in a 70% ethanol solution. In the laboratory, the organisms were identified and counted. The fauna components were identified at the level of class, order or family.

The characterization of the macrofauna community was carried out based on the taxonomic composition (%); abundance (number of trap individuals⁻¹); wealth (number of groups); Shannon's diversity index, obtained by the relation: $H' = -\sum p_i \ln p_i$, where: $p_i = n_i/N$; n_i = abundance of each group and N = total number of groups (Shannon and Weaver, 1949); Pielou's equitability index ($e = H/\log S$, where H = Shannon's index and S = total number of groups in the community) (Pielou, 1977) and Simpson's dominance index ($S = \sum (n_i/N)^2$, where: n_i = number of individuals in the group i and N = sum of the density of all groups). In addition, the classes, orders or family found were brought together into functional groups according to the main eating habits they develop in the environment (Moço et al., 2005).

Statistical analysis

The data obtained were submitted to normality and homogeneity tests of variance and were transformed to meet the assumptions of ANOVA, when necessary. Then, they were subjected to analysis of variance and the means compared by the Tukey test, at 5% significance, except for the frequency and relative density of soil organisms. In addition, the data on abundance, wealth, diversity, equitability and dominance (average of the three evaluation periods) were submitted to multivariate cluster analysis, adopting the method of the most distant neighbor (complete linkage), to describe the dissimilarity between the systems. The data were grouped using the *Joining* method, using Euclidean distances (Statistica, 1997).

Conclusions

The use of cover crops in the pre-cultivation of cassava in the no-tillage system provided favorable conditions for the populations of the soil invertebrate macrofauna, with greater emphasis on the groups Isoptera and Formicidae.

The use of cover crops stimulated the activity of macrofauna individuals belonging to the predatory and saprophagous-predator functional groups, increasing their populations over time. Forage sorghum influenced Simpson's higher dominance index in relation to other soil coverings, regardless of the evaluation period. However, the other ecological index variables were not affected by the coverage. The abundance of organisms, richness of groups and diversity index were influenced by the sampling periods,

showing the influence of the seasonality of the precipitation in the soil invertebrate macrofauna community.

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