Influence of organic and mineral fertilizers on edafic fauna in Luvisol cultivated with sesame

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Abstract - The aim of this study was to evaluate the abundance and diversity of soil macrofauna under the influence of organic fertilization with goat manure compared to NPK fertilization in a Luvisol soil with two sesame cultivars. The design utilized was in random blocks with the treatment groups: T1: goat manure as organic source in BRS 196 cultivar (CNPA G4), T2: goat manure as organic source in BRS Seda cultivar, T3: mineral fertilizer with NPK in BRS 196 cultivar (CNPA G4), T4: mineral fertilizer with NPK in BRS Seda cultivar, T5: No fertilization in BRS 196 cultivar (CNPA G4) and T6: No fertilization in BRS Seda cultivar, with these fertilizers based on soil analysis, totaling 24 experimental units. In assessing the ecological, it was measured the total number of individuals (abundance) and wealth of faunal groups and communities comparisons were made using the Shannon biodiversity indices (H and equitability of Pielou (e). The treatment groups with organic fertilization were more abundant and rich as well as the faunistic group Hymenoptera had the highest abundance and lower diversity and uniformity, independently of the treatment groups studied and the samplings collected. The treatment groups studied did not influence the diversity and uniformity of edafic macrofauna.

Keywords: macrofauna, biological indices, *Sesamum Indicum* L.

Influencia de fertilizantes orgánicos y minerales en la fauna edáfica de un Luvisol cultivado en sésamo

Resumen - El objetivo de este trabajo fue evaluar la abundancia y diversidad de la macrofauna del suelo bajo la influencia de la fertilización orgánica del estiércol caprino en comparación con la fertilización NPK en un Luvissolo con dos cultivares de sésamo. El diseño experimental fue un diseño de bloques al azar con los siguientes tratamientos: T1: estiércol caprino como fuente orgánica en el cultivo BRS 196 (CNPA G4), T2: estiércol caprino como fuente orgánica en el cultivo BRS Seda, T3: fertilización mineral con NPK en el cultivo BRS 196 (CNPA G4), T4: Fertilización mineral con NPK en cultivar BRS Seda, T5: Sin fertilización en cultivo BRS 196 (CNPA G4) y T6: Sin fertilización en cultivo BRS Seda, con estos fertilizaciones basados en análisis de suelo, totalizando 24 unidades experimentales. En la evaluación del comportamiento ecológico, se midió el número total de individuos (abundancia) y la riqueza de los grupos de fauna y se hicieron comparaciones de las comunidades utilizando los índices de biodiversidad de Shannon (H) y de equidad de Pielou (e). Los tratamientos con fertilización orgánica fueron más abundantes y ricos, así como el grupo de fauna Hymenoptera obtuvo la mayor abundancia y la menor diversidad y uniformidad, independientemente de los tratamientos estudiados y los muestreos llevados a cabo. Los tratamientos estudiados no influyeron en la diversidad y uniformidad de la macrofauna edáfica.

Palabras clave: macrofauna, índices biológicos, *Sesamum Indicum* L.

Influência de fertilizantes orgânicos e minerais na fauna edáfica de um Luvissolo com cultivo de gergelim

Resumo - O objetivo deste trabalho foi avaliar a abundância e diversidade da macrofauna do solo sob influência da adubação orgânica com esterco caprino em comparação com a adubação NPK em um Luvissolo com duas cultivares de gergelim. O delineamento utilizado foi em blocos casualizados, com os tratamentos: T1: Esterco caprino como fonte orgânica no cultivar BRS 196 (CNPA G4), T2: Esterco caprino como fonte orgânica no cultivar BRS Seda, T3: Adubação mineral com NPK no cultivar BRS 196 (CNPA G4), T4: Adubação mineral com NPK no cultivar BRS Seda, T5: Sem adubação no cultivar BRS 196 (CNPA G4) e T6: Sem adubação no cultivar BRS Seda, com estas adubações fundamentadas na análise do solo, totalizando 24 unidades experimentais. Na avaliação do comportamento ecológico, mensurou-se o número total de indivíduos (abundância) e riqueza de grupos faunísticos e foram feitas comparações das comunidades utilizando-se os índices de biodiversidade de Shannon (H) e de equitabilidade de Pielou (e). Os tratamentos com adubação orgânica mostraram-se mais abundantes e ricos, assim como, o grupo faunístico Hymenoptera obteve a maior abundância e as menores diversidade e uniformidade, independentemente dos tratamentos estudados e das amostragens realizadas. Os tratamentos estudados não influenciaram na diversidade e uniformidade da macrofauna edáfica.

Palavras-chave: macrofauna, índices biológicos, *Sesamum Indicum* L.

Introduction

According to Faostat (2013) sesame (*Sesamum indicum L.*) is explored in several countries and is considered one of the oldest oilseeds of humanity under cultivation. Worldwide production is estimated at 4,092,236 tons in an area of approximately 6,628,276 million hectares with an average yield of 617.4 kg ha^{-1}. Brazil produces 5,000 tons of grain per year in an area of 8,000 ha, the average yield is about 625 kg ha^{-1}.

The macrofauna consists of a complexity of organisms that differ in size, metabolism, activity and mobility (Pasini and Benito 2004), with a length greater than 2 mm (Swift et al. 1979).

According to Bayer and Mielniczuk (1999), macrofauna plays an essential role in fragmentation and incorporation of residues in the soil, thus creating favorable conditions for decomposition action of microorganisms. However, the benefits of edafic fauna are little known in Brazilian soils (Alves et al. 2006). According to Giracca et al. (2010) the population of these organisms can be influenced by cultivation, fertilization and liming system. The use of different vegetation cover and cultural practices appears to act directly on the population of soil fauna. This effect is often related to the remaining organic residues on the soil surface.

The addition of organic residues in cultivation systems is a factor that can influence soil biota, mainly by providing food for the organisms and changes in temperature and land cover (Correia and Pinheiro. 1999; Baretta et al 2003). The soil macrofauna plays an important role in ecosystem processes in relation to nutrient cycling and soil structure as it is responsible for the fragmentation of the organic residues, mixture of mineral and organic particles, redistribution of organic matter, in addition to producing "fecal pellets" (Hendrix et al. 1990; Baretta et al. 2007).

The purpose of this study was to evaluate the abundance, diversity and uniformity of soil macrofauna under the influence of organic fertilization with goat manure compared to NPK fertilization in a Luvisol with two sesame cultivars.

Material and methods

Experimental location

The experiment was conducted in 2013 in Alagoinha-PB, under field conditions at the Experimental Station of the State Enterprise for Agricultural Research of Paraiba (Empresa Estadual de Pesquisa Agropecuária da Paraíba (EMEPA), approximately 1.24 miles away from the city.

The experiment, in particular, is located in Alagoinha, in the mesoregion the Agreste of Paraíba microregion of Guarabira, with position delimited by the geographic coordinates 06º 58' 08" S and 35º 33' 09,8" W, with an average altitude of 539.70ft, and the PB 075, from Guarabira to Alagoa Grande, the main access road to the experiment.

Climatic characterization and soil type

The regional climate according to Koppen's classification is As' type, which is characterized by being hot and humid, with average temperatures around 25°C (Climatempo 2013). Alagoinha - PB had an annual average rainfall of 1,170 mm in the last ten years, with rainfall concentrating on the autumn-winter seasons (Aesa 2013).

The soil where the experiment was performed was collected and described by Santos (1998) and classified according to Embrapa (1997) as Eutrophic red-yellow Podzol Ta,, currently reclassified according to Embrapa (2013) as Chromic Palic Abruptic Luvisol, of sandy loam texture, with chemical characteristics determined in the Laboratory of Soil Science and Plant Nutrition of the CNPA / EMBRAPA, Campina Grande, PB and physical attributes determined in the Laboratory of Chemistry and Soil Fertility of CCA / UFPB, Areia, in composed sample obtained in the layer of 0-20 cm.

Obtaining organic input

The goat manure was obtained from the Center for Agricultural Sciences, Federal University of Paraíba. The analysis of this material was performed at the Laboratory of Soil Science and Plant Nutrition CNPA / EMBRAPA in 2013.

Soil preparation and conduction of experiment

Soil preparation was done through a trimmer with subsequent harrowing, then it was delimited for the blocks formation with its respective terms, therefore, we used pickets and strings in determining them.

The seeding met the requirements contained in Ordinance 246/2012, regarding the Agricultural Zoning of Climatic Risk for sesame cultivation in the state of Paraíba, crop year 2012/2013 (Mapa 2012). After demarcating the area, furrow opening was performed at a depth of 10.0 cm for fertilizer application in accordance with previous draw of plots, and then covered with a thin layer of soil, for distribution of seeds at the maximum depth of 2.0 cm with manual seeder.

Nitrogen fertilization, due to the low organic matter content, according to the characterization of soil chemical properties was set at 80 kg ha^{-1} of N (ammonium sulfate), subdivided twice, being 1/3 at planting and the remainder at flowering (35-45 days from seedling emergence), placed on the side and covered with soil; relative

to phosphorus, due to its low level (8.7 mg dm^{-3}), and the low mobility of this soil, was used 80 kg ha^{-1} at seeding, as Cavalcanti et al. (2008). Also according to the same authors, in relation to potassium, despite the high content of this element shown in the chemical analysis of the soil (0.28 cmolc dm^{-3}) was necessary to apply 20 kg ha^{-1} of this nutrient in coverage placed adjacent and covered with soil, at the same time of nitrogen fertilization. From the value established for nitrogen fertilizer (80 kg ha^{-1}) was calculated as equivalent with respect to organic source studied, taking into account the percentage of N contained in the object of study material so as to provide the same amount of N (96.48 kg of goat dung) to meet the need of the experiment equivalency.

During the experiment hand weedings were performed with the help of hoes, to keep the culture free from competition with weeds and applied herbicide recommended for wide and / or narrow leaves.

Obtaining seeds

The seeds of BRS196 and BRS Seda cultivars used in the experiment were provided by the CNPA / EMBRAPA, adapted to soil and climatic conditions of the region, with high productive potential, more than 1500 kg ha^{-1}, when grown under grown under rainfed conditions and more than 2500 kg ha^{-1} under ideal conditions of soil, water and crop management.

Experimental design

The design used was randomized block with factorial arrangement (2 x 1) + 4, with four repetitions on two sesame cultivars (BRS 196 (CNPA G4) and BRS Seda), an animal organic source (goat dung) and four additional treatments (control treatment), and a treatment with and without NPK fertilization with these, based on soil analysis, totaling 24 experimental units. Each plot was 28.8 m^2 (8.0 m x 3.6 m), useful area of 9.6 m^2 (8.0 m x 1.2 m), spaced at 0.6 m between rows and 0.1 m between plants, totaling 480 plants per plot. Therefore, treatments obey the following distribution: T1: goat manure as organic source in BRS 196 cultivar (CNPA G4), T2: goat manure as organic source in BRS Seda cultivar, T3: mineral fertilizer with NPK in BRS 196 cultivar (CNPA G4), T4: mineral fertilizer with NPK in BRS Seda cultivar, T5: No fertilization in BRS 196 cultivar (CNPA G4) and T6: No fertilization in BRS Seda cultivar.

Evaluation of edafic macrofauna

For the evaluation of soil macrofauna adapted PROVID traps (Antoniolli et al., 2006), consisting of PET bottle with a capacity of two liters containing four openings as windows with dimensions of 2 cm x 2 cm were installed, located at 20 cm from the bottle base, this being buried with the openings at ground level so as to allow the entrance of the macrofauna individuals (Figure 1).

The sampling of edafic macrofauna was carried out during the development of sesame cultivars under the influence of these organic and mineral fertilizers. The first implementation of the traps was performed 15 days after seedling emergence (DAS), being used 3 PET bottles distributed in the central interrow of each parcel as follows: the first at 1.5 meters from the start, the second located in the center, and the third at 1.5 meters from the end of interrow totaling 72 traps throughout the experimental area.

Traps were installed, for a period of four days containing inside 130 ml of a neutral detergent solution at the concentration of 15% and 3 drops of formaldehyde.

After collection, individuals captured in the traps were washed and kept in 70% alcohol until the counting and identification of organisms at the level of order. The procedures for traps implementation and collection of soil macrofauna were performed five times in an interval of 20 days rrom previous collection.

In assessing the ecological behavior of soil macrofauna, the total number of individuals (abundance) and wealth of faunistic groups were measured and comparisons of communities using the Shannon biodiversity indices (H) and and equitability of Pielou (e) were performed (Odum 1993).

The Shannon diversity index (H) is defined by:

$H = -\Sigma\ pi.\ log\ pi$

Where:

$pi = Ni / N$;

ni = number of individuals in each group;

N = total number of individuals.

This index takes values ranging from 0 to 5, and the decline of their values is the result of a higher dominance over other groups (Begon et al. 1996).

The uniformity index of Pielou (e) is an equitability index, which is defined by:

$e = H/S$

Where:

H = Shannon index;

S = number of species or groups.

Figure 1. Trap type PROVID adapted to capture the soil macrofauna (Gondim 2010).

Results and discussion

Abundance and richness of edafic macrofauna

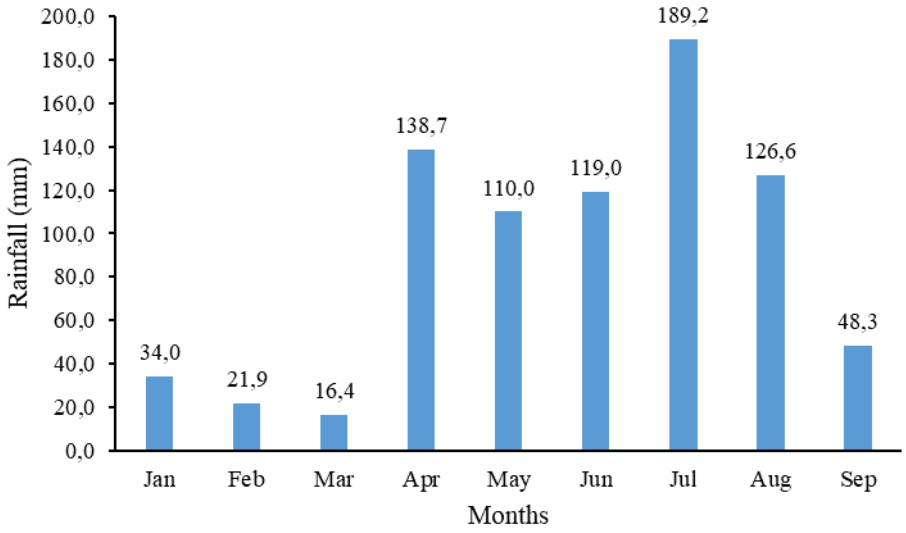
In Table 1 we can observe the distribution of individuals collected by sampling performed.

Table 1. Distribution of individuals in the five samples.

Samples					
1st Sampling (05/06/2013)	2nd Sampling (29/06/2013)	3rd Sampling (23/07/2013)	4th Sampling (16/08/2013)	5th Sampling (09/09/2013)	Average of Samples
Namber of Individuals					
4.124	1.547	1.381	1.485	2.152	2.138

During the study period a total of 10,689 individuals belonging to edafic macrofauna were collected presenting their distribution among the five samplings carried: first: 4124, second: 1547, third: 1,381, fourth, and fifth sampling 1485: 2,152 individuals, as can be seen in Table 1. This highest abundance occurred in the first sampling may be justified by the precipitation occurred in April and May as can be seen in Figure 2, where even before the arrival of them, the amount of rain was greatly reduced, providing with the arrival of the rainy season ideal conditions of temperature and humidity for reproduction of soil organisms and the consequent increase of its population. Gondim (2010) noted that, regardless of the applied doses of bovine bio-fertilizer and irrigation with non-saline water, there was a greater abundance of individuals in the rainy season compared to the dry season.

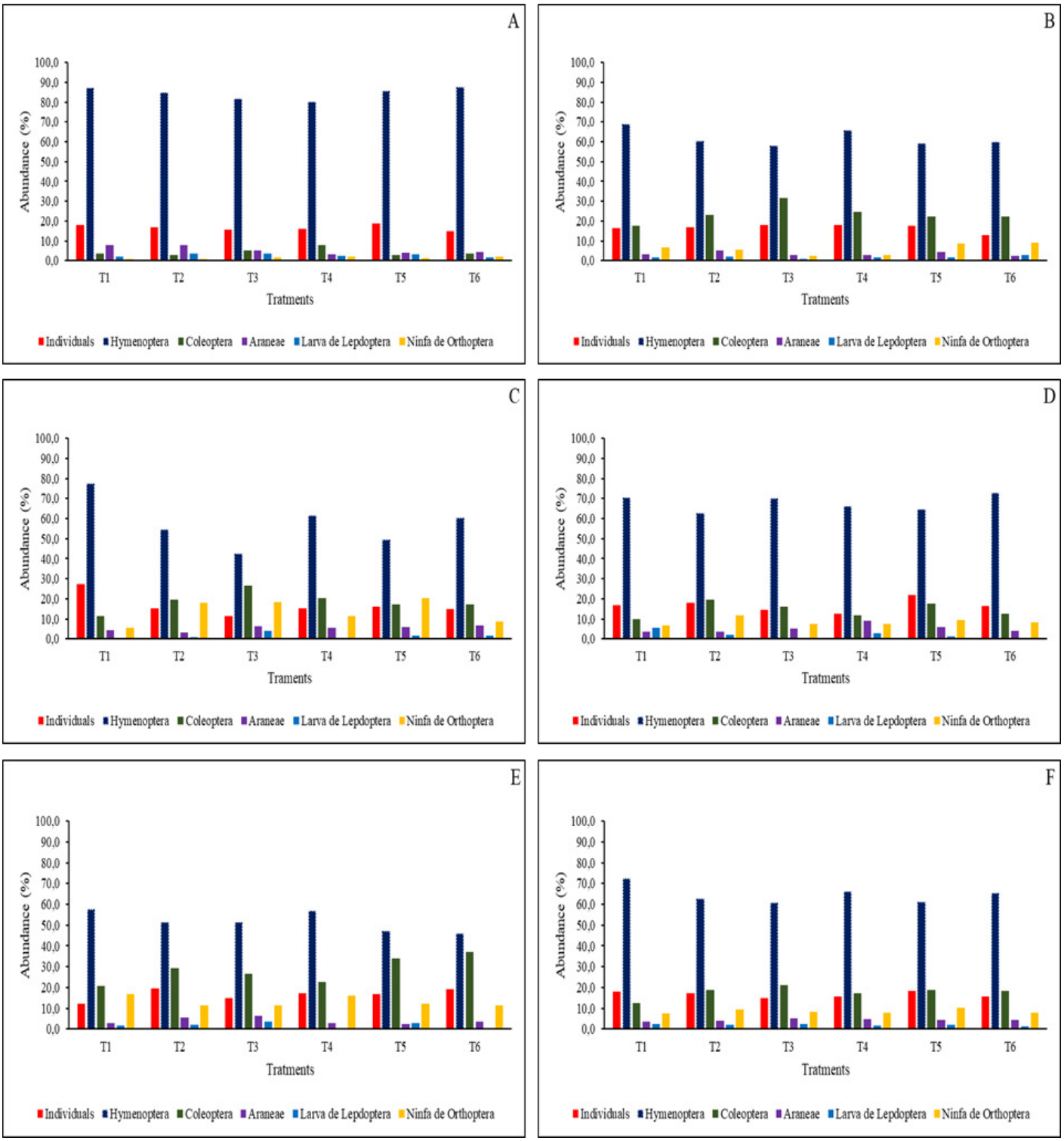
Figure 2. Rainfall in Alagoinha – PB in the period studied, 2013 (Aesa, 2013).



From the second to the penultimate sampling a balance between the number of individuals, which can be considered normal after the population explosion that has occurred previously due to the factors already exposed. In the fifth and last sampling this balance was broken with a considerable increase in the number of individuals collected, despite the precipitation have shown steady decline (Figure 2). Araújo (2010) observed that with the end of the rainy season, after the leaves fall from the tree and shrub layer, taxonomic groups of soil macrofauna tend to increase due to a larger distribution of food.

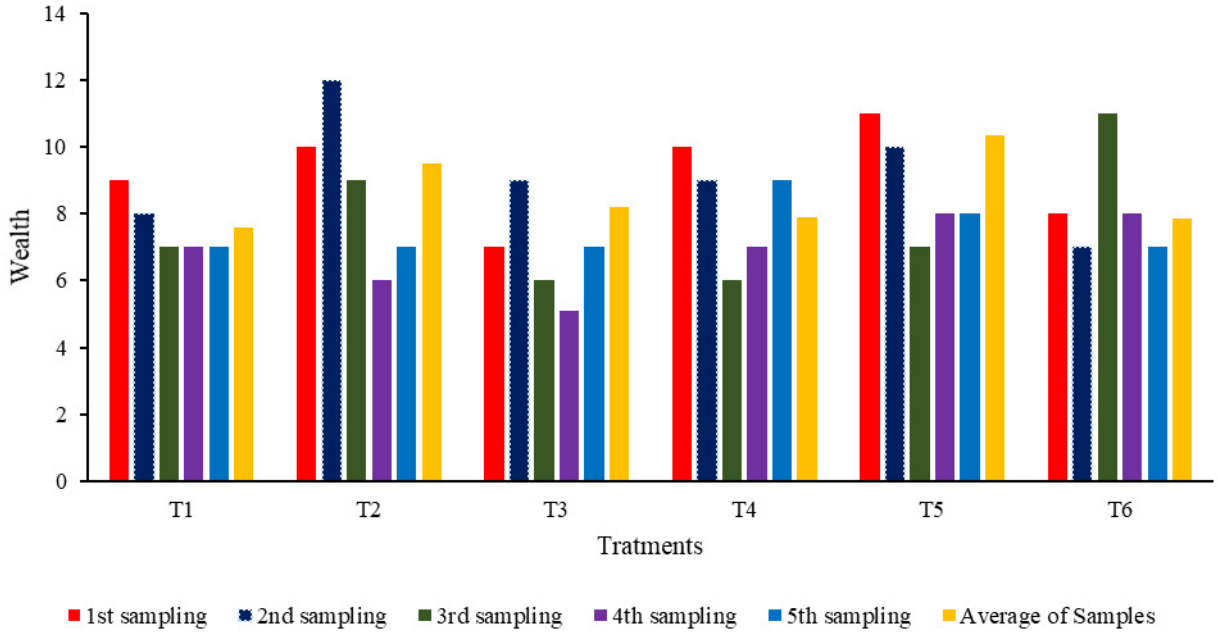
In Figure 3 we can observe the variation in the abundance of individuals of the main faunistic groups due to the treatment applied to each sample. On the other hand, in Figure 4 we can observe the richness of faunistic groups due to the treatment applied to each sample.

Figure 3. Variation of the individuals abundance of the main faunistic groups depending on the treatment applied in the 1st (A), 2nd (B), 3rd (C), 4th (D), 5th (E) sampling and the main faunistic groups depending on the treatment applied in all samplings (F).



Regarding the distribution of individuals by treatment applied, it is noticed in Figures 3 that prevailed a balance in this distribution with percentage changes mostly small and although these are not significant, the treatments where there was an organic fertilizer with goat manure (T1 and T2) had an abundance and wealth of faunistic groups (Figure 4) higher than those who received mineral fertilizer (T3 and T4) and who did not receive any fertilizer (T5 and T6) in all samplings carried. Possibly the organic fertilizer with goat manure has become an additional food source to organisms in the edafic macrofauna in the treatments contemplated with this fertilizer, making the population of these organisms increase.

Figure 4. Richness of faunistic groups depending on the treatment applied in all samplings.



Concerning the distribution of faunistic groups by treatment applied and by sampling performed we observed in Figures 3 which independently of them, has occurred the predominance of the Hymenoptera group, which was followed in abundance by Coleoptera group. The greater abundance of this group occurred in the first sampling where its percentage exceeded 80%, following the large population collected in it and lowering considerably (around 20%) with the growth of populations of other groups especially Coleoptera. This higher frequency of Hymenoptera and Coleoptera groups can be explained by the fact that members of these groups possess greater mobility favored by its anatomy and physiology.

The superiority in the number or density of individuals of the Hymenoptera group was also verified by Correia et al. (2009) when quantify the edafic macrofauna in three environments of the Agreste by Fernandes et al. (2009) evaluating the impacts of the use of fire in semiarid soils of Paraíba and by Gondim (2010) evaluating the effect of bovine biofertilizer on edafic macrofauna.

Other faunistic groups found (Pulmonata, Blattaria, Scolopendromopha, Spirostreptida, Scorpiones, Pulpa of Coleoptera, Larva of Coleoptera, Orthoptera, Isoptera, Ixodida, Hemyptera and Mantodea) presented a number of individuals very reduced during the samplings. Souto (2006) reports that the faunistic groups that appear in smaller numbers, are probably restricted to more favorable environments, but nevertheless are of great importance in organic matter decomposition process.

Diversity and uniformity of edafic macrofauna

In Tables 2, 3, 4, 5, 6 and 7 it is observed index values of Shannon diversity and Pielou uniformity of the main animal groups by treatment applied in each sampling performed. In Table 8 we observe the values of Shannon diversity indices and Pielou uniformity of each treatment applied by sampling performed.

According to Tables 2, 3, 4, 5, 6 and 7 Hymenoptera faunistic group showed the lowest Shannon diversity indices in relation to other groups regardless of the applied treatment and sampling performed, showing that this group is the most dominant and less uniform as the Pielou index is directly proportional to the Shannon index. According to Begon et al. (1996) this reflects a larger population of individuals of a particular group or groups over others, thereby promoting reduced Shannon diversity.

Table 2. Values of the Shannon diversity index (H) and uniformity of Pielou (e) of the main faunistic groups of edafic macrofauna in sample per treatment applied.

Treatments	Faunal Groups											
	Hymenoptera		Coleoptera		Araneae		Lepdoptera Larva		Orthoptera Nymph		Others[1]	
	1st Sampling (05/06/2013)											
	H	e	H	e	H	e	H	e	H	e	H	e
T_1[2]	0,06	0,01	1,38	0,14	1,44	0,14	1,67	0,17	2,03	0,20	2,60	0,26
T_2[3]	0,07	0,01	1,52	0,14	1,54	0,14	1,46	0,13	2,14	0,19	2,37	0,22
T_3[4]	0,09	0,01	1,28	0,14	1,30	0,14	1,43	0,16	1,81	0,20	1,97	0,22
T_4[5]	0,09	0,01	1,09	0,11	1,50	0,11	1,59	0,16	1,70	0,17	2,36	0,24
T_5[6]	0,07	0,01	1,53	0,22	1,38	0,22	1,51	0,22	1,89	0,27	2,55	0,36
T_6[7]	0,06	0,01	1,42	0,18	1,37	0,17	1,74	0,22	1,71	0,21	2,68	0,34

[1] Others: average of faunistic groups with lower abundance. [2] T_1: Manure goat as organic source in BRS 196 cultivar (CNPA G4). [3] T_2: goat manure as organic source in BRS Seda cultivar. [4] T_3: Mineral fertilization with NPK in BRS 196 cultivar (CNPA G4). [5] T_4: Mineral fertilization with NPK in BRS Seda cultivar. [6] T_5: No fertilization in BRS 196 cultivar (CNPA G4). [7] T_6: No fertilization in BRS Seda cultivar.

Table 3. Values of the Shannon diversity index (H) and uniformity of Pielou (e) of the main faunistic groups of edafic macrofauna in sample per treatment applied.

Treatments	Faunal Groups											
	Hymenoptera		Coleoptera		Araneae		Lepdoptera Larva		Orthoptera Nymph		Others[1]	
	2nd Sampling (29/06/2013)											
	H	e	H	e	H	e	H	e	H	e	H	e
T_1[2]	0,23	0,02	0,50	0,04	1,54	0,13	2,15	0,18	1,60	0,13	2,07	0,17
T_2[3]	0,18	0,02	0,61	0,06	1,54	0,15	1,74	0,17	1,54	0,15	2,29	0,23
T_3[4]	0,16	0,02	0,76	0,08	1,51	0,17	1,81	0,20	1,18	0,13	2,15	0,24
T_4[5]	0,22	0,02	0,64	0,07	1,30	0,14	1,71	0,19	1,27	0,14	2,24	0,25
T_5[6]	0,23	0,03	0,65	0,08	1,36	0,17	1,74	0,22	1,05	0,13	2,25	0,28
T_6[7]	0,22	0,03	0,65	0,09	1,61	0,23	1,53	0,22	1,05	0,15	1,92	0,27

[1] Others: average of faunistic groups with lower abundance. [2] T_1: Manure goat as organic source in BRS 196 cultivar (CNPA G4). [3] T_2: goat manure as organic source in BRS Seda cultivar. [4] T_3: Mineral fertilization with NPK in BRS 196 cultivar (CNPA G4). [5] T_4: Mineral fertilization with NPK in BRS Seda cultivar. [6] T_5: No fertilization in BRS 196 cultivar (CNPA G4). [7] T_6: No fertilization in BRS Seda cultivar.

Table 4. Values of the Shannon diversity index (H) and uniformity of Pielou (e) of the main faunistic groups of edafic macrofauna in sample per treatment applied.

Treatments	Faunal Groups											
	Hymenoptera		Coleoptera		Araneae		Lepdoptera Larva		Orthoptera Nymph		Others[1]	
	3rd Sampling (23/07/2013)											
	H	e	H	e	H	e	H	e	H	e	H	e
T_1[2]	0,11	0,01	0,95	0,09	1,37	0,12	2,27	0,21	1,25	0,11	2,42	0,22
T_2[3]	0,21	0,02	0,69	0,18	1,25	0,14	2,33	0,26	0,95	0,11	2,03	0,23
T_3[4]	0,30	0,04	0,77	0,11	1,23	0,18	1,74	0,25	0,69	0,10	1,83	0,26
T_4[5]	0,37	0,05	0,58	0,08	1,20	0,17	1,42	0,20	0,74	0,11	1,60	0,23
T_5[6]	0,26	0,04	0,71	0,12	1,48	0,25	2,02	0,34	0,74	0,12	2,13	0,36
T_6[7]	0,22	0,04	0,77	0,13	1,16	0,19	1,83	0,31	1,05	0,18	2,14	0,36

[1] Others: average of faunistic groups with lower abundance. [2] T_1: Manure goat as organic source in BRS 196 cultivar (CNPA G4). [3] T_2: goat manure as organic source in BRS Seda cultivar. [4] T_3: Mineral fertilization with NPK in BRS 196 cultivar (CNPA G4). [5] T_4: Mineral fertilization with NPK in BRS Seda cultivar. [6] T_5: No fertilization in BRS 196 cultivar (CNPA G4). [7] T_6: No fertilization in BRS Seda cultivar.

Table 5. Values of the Shannon diversity index (H) and uniformity of Pielou (e) of the main faunistic groups of edafic macrofauna in sample per treatment applied.

Treatments	Faunal Groups											
	Hymenoptera		Coleoptera		Araneae		Lepdoptera Larva		Orthoptera Nymph		Others[1]	
	4th Sampling (16/08/2013)											
	H	e	H	e	H	e	H	e	H	e	H	e
T_1[2]	0,15	0,02	0,79	0,10	1,30	0,16	0,00	0,00	1,13	0,14	0,00	0,00
T_2[3]	0,15	0,02	1,01	0,13	1,44	0,18	1,25	0,16	1,16	0,15	1,94	0,24
T_3[4]	0,19	0,03	0,75	0,11	1,23	0,18	1,91	0,27	1,03	0,15	2,41	0,34
T_4[5]	0,14	0,02	0,91	0,13	1,38	0,20	2,38	0,34	1,08	0,15	2,18	0,31
T_5[6]	0,20	0,04	0,71	0,14	1,42	0,28	1,73	0,35	0,93	0,19	2,42	0,48
T_6[7]	0,18	0,03	0,93	0,16	1,05	0,18	1,58	0,26	1,13	0,19	1,77	0,30

[1] Others: average of faunistic groups with lower abundance. [2] T_1: Manure goat as organic source in BRS 196 cultivar (CNPA G4). [3] T_2: goat manure as organic source in BRS Seda cultivar. [4] T_3: Mineral fertilization with NPK in BRS 196 cultivar (CNPA G4). [5] T_4: Mineral fertilization with NPK in BRS Seda cultivar. [6] T_5: No fertilization in BRS 196 cultivar (CNPA G4). [7] T_6: No fertilization in BRS Seda cultivar.

Table 6. Values of the Shannon diversity index (H) and uniformity of Pielou (e) of the main faunistic groups of edafic macrofauna in sample per treatment applied.

Treatments	Faunal Groups											
	Hymenoptera		Coleoptera		Araneae		Lepdoptera Larva		Orthoptera Nymph		Others[1]	
	5th Sampling (09/09/2013)											
	H	e	H	e	H	e	H	e	H	e	H	e
T_1[2]	0,33	0,04	0,47	0,05	1,61	0,18	1,52	0,17	0,92	0,10	2,36	0,26
T_2[3]	0,29	0,04	0,53	0,07	1,26	0,16	1,72	0,22	0,94	0,12	2,62	0,33
T_3[4]	0,34	0,05	0,43	0,06	1,44	0,21	2,32	0,33	0,94	0,13	2,12	0,30
T_4[5]	0,24	0,03	0,65	0,09	1,53	0,22	2,27	0,32	0,80	0,11	2,57	0,37
T_5[6]	0,29	0,04	0,58	0,08	1,20	0,17	1,46	0,21	0,95	0,14	2,35	0,34
T_6[7]	0,24	0,03	0,68	0,10	1,58	0,23	1,82	0,26	0,78	0,11	2,42	0,35

[1] Others: average of faunistic groups with lower abundance. [2] T_1: Manure goat as organic source in BRS 196 cultivar (CNPA G4). [3] T_2: goat manure as organic source in BRS Seda cultivar. [4] T_3: Mineral fertilization with NPK in BRS 196 cultivar (CNPA G4). [5] T_4: Mineral fertilization with NPK in BRS Seda cultivar. [6] T_5: No fertilization in BRS 196 cultivar (CNPA G4). [7] T_6: No fertilization in BRS Seda cultivar.

Table 7. Values of the Shannon diversity index (H) and uniformity of Pielou (e) of the main faunistic groups of edafic macrofauna in sample per treatment applied.

Treatments	Faunal Groups											
	Hymenoptera		Coleoptera		Araneae		Lepdoptera Larva		Orthoptera Nymph		Others[1]	
	Average of Samples											
	H	e	H	e	H	e	H	e	H	e	H	e
T_1[2]	0,18	0,02	0,82	0,08	1,45	0,15	1,52	0,15	1,39	0,14	1,89	0,18
T_2[3]	0,18	0,02	0,87	0,12	1,41	0,15	1,70	0,19	1,35	0,14	2,25	0,25
T_3[4]	0,22	0,03	0,80	0,10	1,34	0,18	1,84	0,24	1,13	0,14	2,10	0,27
T_4[5]	0,21	0,03	0,77	0,10	1,38	0,17	1,87	0,24	1,12	0,14	2,19	0,28
T_5[6]	0,21	0,03	0,84	0,13	1,37	0,22	1,69	0,27	1,11	0,17	2,34	0,36
T_6[7]	0,18	0,03	0,89	0,13	1,35	0,20	1,70	0,25	1,14	0,17	2,19	0,32

[1] Others: average of faunistic groups with lower abundance. [2] T_1: Manure goat as organic source in BRS 196 cultivar (CNPA G4). [3] T_2: goat manure as organic source in BRS Seda cultivar. [4] T_3: Mineral fertilization with NPK in BRS 196 cultivar (CNPA G4). [5] T_4: Mineral fertilization with NPK in BRS Seda cultivar. [6] T_5: No fertilization in BRS 196 cultivar (CNPA G4). [7] T_6: No fertilization in BRS Seda cultivar.

Table 8. Values of the Shannon diversity index (H) and uniformity of Pielou (e) of the treatments in all five samples.

Treatments	Samples											
	1st Sampling (05/06/2013)		2nd Sampling (29/06/2013)		3rd Sampling (23/07/2013)		4th Sampling (16/08/2013)		5th Sampling (09/09/2013)		Average of Samples	
	H	e	H	e	H	e	H	e	H	e	H	e
T_1 [2]	1,53	0,17	1,35	0,15	1,40	0,20	0,56	0,11	1,20	0,15	1,21	0,16
T_2 [3]	1,52	0,15	1,32	0,15	1,24	0,21	1,16	0,17	1,23	0,18	1,29	0,17
T_3 [4]	1,31	0,19	1,26	0,16	1,09	0,16	1,25	0,16	1,27	0,18	1,24	0,17
T_4 [5]	1,39	0,14	1,23	0,10	0,99	0,17	1,35	0,17	1,34	0,15	1,26	0,15
T_5 [6]	1,49	0,14	1,21	0,12	1,22	0,14	1,24	0,21	1,14	0,16	1,26	0,15
T_6 [7]	1,50	0,19	1,16	0,17	1,20	0,11	1,11	0,17	1,25	0,18	1,24	0,16

[2] T_1: Manure goat as organic source in BRS 196 cultivar (CNPA G4). [3] T_2: goat manure as organic source in BRS Seda cultivar. [4] T_3: Mineral fertilization with NPK in BRS 196 cultivar (CNPA G4). [5] T_4: Mineral fertilization with NPK in BRS Seda cultivar. [6] T_5: No fertilization in BRS 196 cultivar (CNPA G4). [7] T_6: No fertilization in BRS Seda cultivar.

Is still observed in Tables 2, 3, 4, 5, 6 and 7 an increase in Shannon diversity index and respectively the Pielou indices of uniformity of Hymenoptera group from the first to the other samples, this much due to the greater abundance of this group in this sampling and the resulting decline since the Shannon diversity is inversely proportional to abundance. An opposite behavior occurred with Coleoptera the second most representative group where Shannon indices showed a decrease with the increase of its population.

In Table 8 it is observed that the differences between the indices of diversity and uniformity occurred between treatments applied were small and inconsistent.

Conclusions

- In the samples and treatments studied, the Hymenoptera group showed the highest abundance of individual and the lower diversity and uniformity;
- The organisms of edafic macrofauna collected in the experimental area obeyed the following order: Hymenoptera> Coleoptera> Orthoptera nymph > Araneae> Lepidoptera larva;
- As sesame plants grew there was a decrease in the number of organisms of Hymenoptera group;
- Given the high number of organisms of the edafic macrofauna in the experimental area, it is recommended the cultivation of another plant to protect the main crop (sesame).

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