CAPÍTULO 7

Influence Of Poultry Lifler Application On Soil Fauna Dynamics In Common Bean (Phaseolus vulgaris L.) Cultivation

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Abstract: The poultry industry generates large amounts of organic residues that can be used as fertilizer. However, the application of poultry litter to the soil may alter the structure and composition of soil fauna communities. This study aimed to determine the contribution of poultry litter application to the mesofauna and macrofauna of the soil under common bean cultivation. The experimental design was a randomized block design (RBD) arranged in a 2 × 5 + 1 factorial scheme, consisting of two sampling seasons (spring and summer), five poultry litter doses (control – no fertilization; 620; 1240; 1860; and 2480 kg ha^{-1}), plus a mineral fertilizer treatment, with eight replications. Soil fauna samples were collected using PROVID traps. The density of organisms, the number of soil fauna groups, the frequency of functional groups, and biodiversity indices were evaluated. A significant reduction in the population of organisms belonging to the orders Hymenoptera and Collembola was observed with increasing poultry litter doses. However, poultry litter application did not significantly affect evenness, Shannon, or Simpson diversity indices.

Keywords: soil fauna; poultry litter; functional groups.

INTRODUCTION

Brazil is a major producer of poultry under confinement systems (Silva et al., 2011). The expansion of the poultry sector, accompanied by the large-scale production of poultry litter, has created the need for appropriate disposal and utilization of these residues in agricultural activities (Menezes et al., 2003). Due to their high nutrient content and availability on rural properties at relatively low cost, poultry litter can be used as a fertilizer source for commercial crops (Costa et al., 2009). In this context, the application of poultry litter in common bean (Phaseolus vulgaris L.) cultivation may be considered an alternative nutrient source, contributing to greater sustainability within the production system. Common bean is an important agricultural crop in Brazil, with approximately 2.91 million hectares cultivated and a production of 3.022 million tons (CONAB, 2020).

In general, the use of organic fertilization as a nutrient source promotes biological balance in the soil, thereby contributing to the sustainability of agricultural activities (Medeiros & Wanderley, 2003). The addition of organic residues from animal production systems, such as poultry litter, can influence soil biology by providing food resources to soil organisms through the incorporation of organic matter (Baretta et al., 2003). Soil fauna, in turn, is considered an indicator of soil quality and plays a crucial role in the decomposition of organic residues, soil structuring, and nutrient cycling (Osler & Sommerkorn, 2007; Dupont et al., 2009). Furthermore, soil fauna contributes to stimulating microbial activity, fragmenting plant residues (Yang & Chen, 2009), redistributing organic matter throughout the soil profile through the mixing of mineral and organic particles, creating biopores, and promoting soil aggregation (Oliveira et al., 2012; Siddiky et al., 2012).

However, it is important to emphasize that the effects of organic residue addition on soil fauna are variable and may be beneficial when applied in adequate amounts, or detrimental when used in excessive quantities (Almeida et al., 2017). Therefore, in order for poultry litter application in common bean cultivation to enhance crop productivity and promote sustainability, it is essential to conduct studies addressing residue management practices and their effects on soil fauna.

In this context, the present study aimed to evaluate the effects of different doses of poultry litter as organic fertilization on the mesofauna and macrofauna of soil cultivated with common bean.

MATERIAL AND METHODS

The experiment was conducted in an experimental field area of the Federal University of Santa Maria, Frederico Westphalen Campus (RS), Brazil, located at 27°23′45.75″ S latitude and 53°25′45.92″ W longitude, at an altitude of 566 m. The soil of the experimental area was classified as a Red Oxisol (EMBRAPA, 2006), with gently undulating relief. According to the Köppen classification, the regional climate is Cfa (humid subtropical), with a mean annual temperature of 18 °C and an average annual precipitation of 1,800 mm.

Soil analysis, performed according to the methodology described by Embrapa (1997), showed the following physical and chemical characteristics: 62% clay; pH (H_2O) of 5.8; 5.3 mg dm^{-3} of available P (Mehlich-1); 288 mg dm^{-3} of K; 7.6 cmolc dm^{-3} of Ca^{2+}; 4.8 cmolc dm^{-3} of Mg^{2+}; and 3.5% organic matter.

The poultry litter (PL) used in the experiment originated from seven broiler production cycles and was composted for 120 days prior to application. The chemical composition of the poultry litter, determined according to Tedesco et al. (1995), is presented in Table 1.

	pH	MO	N	P_2O_5	K_2O	Ca	Mg
Poultry litters				%			
	7,1	68,47	4,8	4,03	4,76	6,37	1,13

Table 1. Chemical composition of poultry litter used as fertilizer in common bean cultivation.

The experimental design consisted of a randomized block design arranged in a factorial scheme (2 × 5 + 1), comprising two soil fauna sampling periods (spring and summer), five poultry litter doses (0 – no fertilization; 620; 1,240; 1,860; and 2,480 kg ha^{-1} of poultry litter), plus mineral fertilization (MF) applied at a rate of 100 kg ha^{-1} using the 14–37–12 formulation, corresponding to an expected yield of 2.5 t ha^{-1}, according to the recommendations of ROLAS (2004). Four replications were used for each treatment.

The experiment was established in 2010 in an area managed under a no-tillage system, with common bean cultivated during the summer and crop rotation in the winter. For five consecutive years, the experimental area was maintained under this management system and had received five poultry litter applications for fertilization of the common bean crop prior to the execution of this study. Each experimental plot had an area of 20 m^2 (4 × 5 m), corresponding to ten crop rows of 5 m each. The crop was manually sown with 50 cm spacing between rows and 7 cm between plants, resulting in a plant population of approximately 285,000 plants ha^{-1}.

Sowing was carried out 10 days after desiccation of the winter crop using glyphosate at a rate of 1,440 g a.i. ha^{-1}. Poultry litter was manually applied in the planting rows at the same time as sowing. Weed control after bean seedling emergence was performed manually.

Soil fauna sampling was conducted using PROVID-type traps (Antoniolli et al., 2006), which capture mesofauna and macrofauna organisms with high mobility in the soil. The traps contained 250 mL of 70% ethanol for preservation of the captured organisms and remained in the field for seven days. The first sampling was carried out in 2015 before bean sowing, when the soil surface was covered with decomposing ryegrass residues. The second sampling was conducted after completion of the bean crop cycle, when crop residues were present as litter on the soil surface, at 90 days after sowing (DAS). For this purpose, bean plants from each plot were harvested, individually threshed, and the residues were uniformly redistributed within their respective treatments.

The collected organisms were identified at the order level using binocular stereomicroscopes with 60× magnification (Buzzi, 2008). Subsequently, the number of individuals (NI) in each order was counted, and the number of orders was determined according to the functional classification of soil organisms proposed by Lavelle (1996). Based on these data, the Margalef richness index, Pielou evenness index, Simpson dominance index, and Shannon diversity index were calculated (Odum, 1988).

The results were subjected to an F-test to evaluate the significance of interactions. The quantitative factor (poultry litter doses) was unfolded within the qualitative factor (sampling season). When the interaction was not significant, simple effects were analyzed. Means of the qualitative factor were compared using Tukey's test, while the quantitative factor was analyzed through regression analysis at the 5% significance level. In addition, the means of the quantitative treatments were compared with those of mineral fertilization using Dunnett's test. All statistical analyses were performed using SAS software (SAS Institute, 1999).

RESULTS AND DISCUSSION

The results revealed the occurrence of soil fauna individuals distributed across seven taxonomic orders: Acarina, Araneae, Coleoptera, Collembola, Diptera, Hymenoptera, and Orthoptera (Table 1). The analysis indicated a significant interaction between the factors sampling season and poultry litter (PL) doses for the orders Acarina, Araneae, Coleoptera, Collembola, Hymenoptera, and Orthoptera.

Significant effects were also observed for all functional groups, as well as for the abundance indices, Simpson dominance, Shannon diversity, and Pielou evenness. Furthermore, the mineral fertilization treatment differed significantly from poultry litter doses according to Dunnett's test (Table 1).

				Orders			
Teste f	Acar	Aran	Colp	Coll	Dipt	Hym	Ort
Season (S)	40,33*	17,52*	75,00*	4621,68*	18,75*	4621,69*	581,02*
Doses (D)	435,68*	0,93*	37,48*	516,77*	0,43	932,07*	39,72*
S x D	664,28*	0,77*	23,85*	415,23*	0,20	590,03*	49,82*
Dunnett	4,64**	1,08**	1,04**	5,58**	1,37	3,96**	1,12**
CV (%)	7,84	50,92	26,07	6,18	57,68	9,41	15,67

			Funcional Groups		
	Micr	Soc	Pred	Fit	Out
Season (S)	5078,28*	2498,19*	2788,79*	539,44*	22,76*
Doses (D)	148,58*	111,88*	106,76*	63,58*	311,13*
S x D	234,21*	90,58*	120,77*	74,74*	301,18*
Dunnett	3,96**	3,01**	3,27**	1,07**	2,83**
CV (%)	4,80	7,95	7,17	15,22	5,79

			Diversity indices		
	Abun	Marg	Piel	Shan	Simp
Season (S)	936,33*	0,94*	0,24*	0,02*	0,04*
Doses (D)	3084,35*	0,02	0,005*	0,004*	0,004*
S x D	2567,28*	0,02	0,006*	0,005*	0,003*
Dunnett	10,87**	0,09	0,03**	0,02**	0,02**
CV (%)	4,50	9,57	4,05	2,41	3,32

Acar = Acarina; Aran = Araneae; Colp = Coleoptera; Coll = Collembola; Dipt = Diptera; Hym = Hymenoptera; Ort = Orthoptera; Micr = Microphages; Soc = Social insects; Pred = Predators; Fit = Phytophages; Out = Other groups. Abun = Abundance; Marg = Margalef index; Piel = Pielou evenness; Shan = Shannon diversity index; Simp = Simpson dominance index.

* Significant at $p < 0.05$ by the F test.

** Significant by Dunnett's test ($p < 0.05$) comparing mineral fertilization with poultry litter doses.

Table 1. F-test for the factors season, dose, and season × dose for taxonomic orders and functional groups, and Dunnett's test for diversity indices.

Before the establishment of the common bean crop, no variation was observed in the number of individuals belonging to the orders Hymenoptera (Figure 1E), Collembola (Figure 1D), Acarina (Figure 1A), and Orthoptera (Figure 1F) among the plots receiving different poultry litter (PL) doses. This result is related to the sampling period, which was conducted shortly before the establishment of the bean crop. At 90 days after sowing (DAS), the orders Hymenoptera (Figure 1E), Coleoptera (Figure 1C), and Collembola (Figure 1D) showed a quadratic response with a minimum point. The order Acarina (Figure 1A) was the only group that exhibited a quadratic adjustment with a maximum point. In contrast, the orders Orthoptera (Figure 1E) and Araneae (Figure 1F) were not affected by the PL doses.

Poultry litter doses induced a quadratic response for the order Acarina, with a calculated maximum point at 333.33 kg ha^{-1}, remaining significantly higher up to the dose of 1,240 kg ha^{-1} (Figure 1A). Tessaro et al. (2011) reported a reduction in mite populations 42 days after the application of liquid dairy slurry. In the present experiment, the number of individuals was lower in the second sampling at doses of 1,860 and 2,480 kg ha^{-1} of PL, suggesting that mite populations may have been stimulated only at the lower poultry litter doses applied.

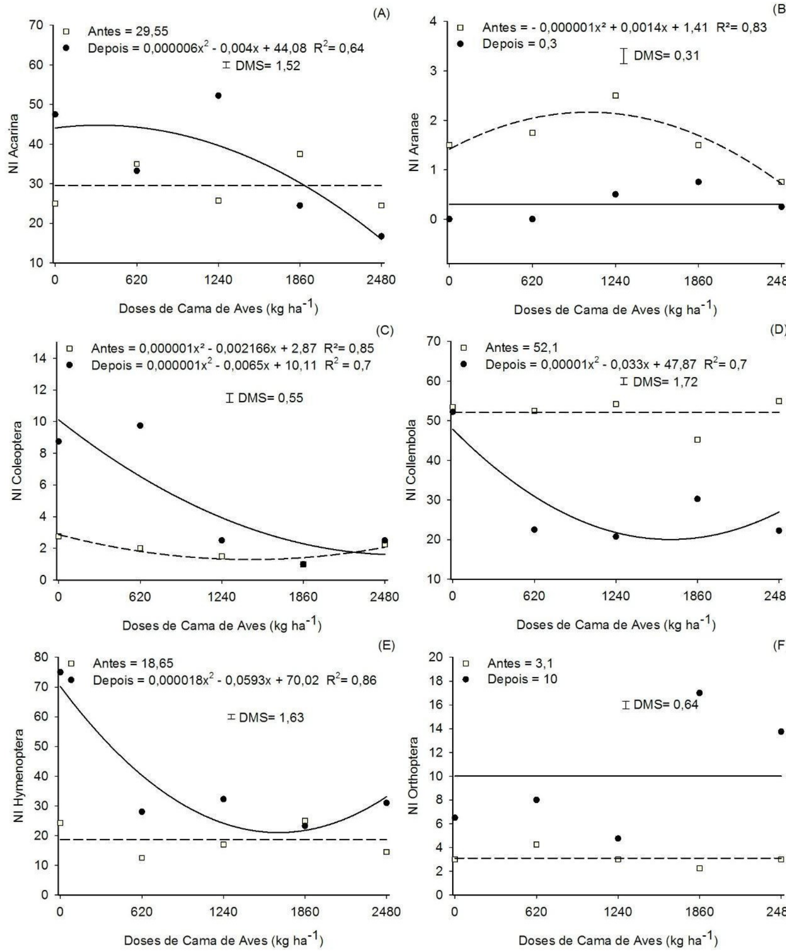

Figure 1. Number of individuals (NI) of the orders Acarina (A), Araneae (B), Coleoptera (C), Collembola (D), Hymenoptera (E), and Orthoptera (F) in Phaseolus vulgaris cultivation evaluated at two sampling periods—before bean sowing and at 90 days after sowing (DAS)—under poultry litter doses of 0, 620, 1,240, 1,860, and 2,480 kg ha^{-1}.

The maximum point for the order Araneae occurred at 700 kg ha^{-1} of poultry litter (PL) before the bean cropping cycle, being significantly higher at all tested doses (Figure 1B). Alves et al. (2008) reported a reduction in the number of individuals of the order Araneae with the application of 12 Mg ha^{-1} (200 m^3 of liquid dairy slurry) compared with organomineral fertilization. This reduction may be associated with a decrease in food availability—arthropods from other orders—since spiders are predatory organisms.

The order Coleoptera showed a quadratic response in both sampling periods, with minimum points at 1,083 and 3,250 kg ha^{-1} at 0 and 90 DAS, respectively. A significant difference between sampling periods was observed at the doses of zero and 620 kg ha^{-1} of PL, with 0 DAS presenting a lower number of individuals compared to 90 DAS (Figure 1C). According to Bernardi et al. (2010), the abundance of individuals of the order Coleoptera in Rio Grande do Sul is strongly influenced by external factors such as temperature. Therefore, climatic conditions may have influenced the abundance of Coleoptera as much as the treatments tested.

The minimum point for the order Collembola was 1,650 kg ha^{-1} of PL at 90 DAS. Data obtained before bean sowing (0 DAS) showed a significant adjustment, with the number of individuals being statistically higher at 0 DAS at the doses of 620, 1,240, 1,860, and 2,480 kg ha^{-1} (Figure 1D). Similar results were reported by Silva et al. (2013c), who observed higher populations of individuals of the order Collembola during the early developmental stages of cover crops grown in intercropping systems or monoculture. In the present study, crop residues from the preceding crop may have favored a higher population of collembolans.

The addition of PL resulted in a reduction in the number of individuals of the order Hymenoptera at 90 DAS, with a minimum point at 1,647.2 kg ha^{-1} (Figure 1E). A higher number of individuals and significant differences compared with 0 DAS were observed at the doses of zero, 620, 1,240, and 2,480 kg ha^{-1} of PL (Figure 1E). Bean cultivation may have been a determining factor in these results, since leguminous plants tend to favor the occurrence of ants (Santos et al., 2008). Moreover, a high frequency of Hymenoptera is common, as ants exhibit high mobility in the soil environment (Parr et al., 2007).

The significant interaction between the factors evaluated in the functional groups indicates differences between sampling periods and PL doses (Table 1). The microphage group did not show a significant response to the organic fertilization doses; however, there was a significant difference in the proportion of organisms between sampling periods, with higher values in the first sampling period (Figure 2A). This result may be related to low soil moisture associated with high temperatures at the end of the bean crop cycle. According to Rovedder et al. (2004), these conditions can lead to physiological order Collembola. Nevertheless, collembolans also represent an important food source for predatory organisms (Steffen et al., 2007), and in the present study the group of predatory organisms increased significantly in the second sampling (Figure 2C), which likely contributed to the reduction in the relative frequency of microphages. drying and restrict the number of annual generations and individuals of the order Collembola. Nevertheless, collembolans also represent an important food source for predatory organisms (Steffen et al., 2007), and in the present study the group of predatory organisms increased significantly in the second sampling (Figure 2C), which likely contributed to the reduction in the relative frequency of microphages

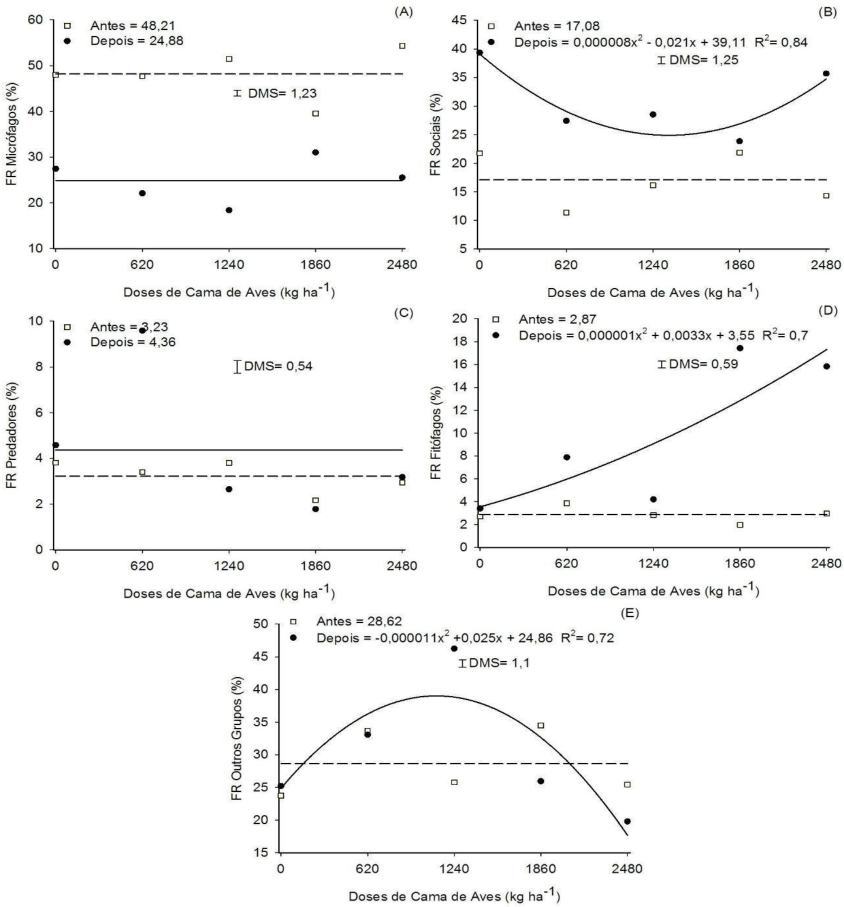

Figure 2. Relative frequency of functional groups: Microphages (A), Social insects (B), Predators (C), Phytophages (D), and Other groups (E), evaluated at two sampling periods—before bean sowing and at 90 days after sowing (DAS)—under poultry litter doses of 0, 620, 1,240, 1,860, and 2,480 kg ha^{-1}.

Social insects showed a minimum point at 1,312.5 kg ha^{-1} of poultry litter (PL) at 90 DAS, with a significant difference between sampling periods and a higher relative frequency at 90 DAS at the doses of zero, 620, 1,240, and 2,480 kg ha^{-1} (Figure 2B). This group—represented mainly by ants—plays an important role in soil aeration capacity, water infiltration, and incorporation of organic matter (Silva et al., 2012a), highlighting its importance for soil quality.

The Other groups category showed differences between sampling periods at the doses of 1,240, 1,860, and 2,480 kg ha^{-1}, with a maximum point at 1,136.34 kg ha^{-1} at 90 DAS (Figure 2E). Organisms within this group do not have a well-defined ecological function (Costa, 2002), as they are represented by individuals from several species that do not belong to the other functional groups.

The abundance of organisms showed a minimum point at 1,958.33 kg ha^{-1} at 90 DAS, with the doses of zero and 1,240 kg ha^{-1} presenting higher values at 90 DAS, whereas the doses of 620, 1,860, and 2,480 kg ha^{-1} showed higher values at 0 DAS (Figure 3A). The marked superiority of the zero dose at 90 DAS reflects the effect of plant residue cover, since at 0 DAS the litter layer consisted of ryegrass residues and at 90 DAS of bean residues. Leguminous plants tend to favor a higher relative density of soil organisms compared with grasses (Santos et al., 2008). Poultry litter doses reduced organism abundance, which can be explained by the significant reduction in the number of individuals (NI) of the orders Acarina, Collembola, and Hymenoptera, which together accounted for more than 80% of the total individuals (Table 2).

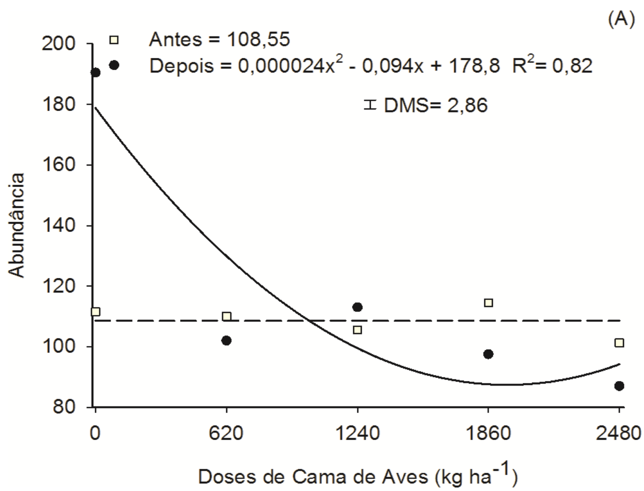

Figure 3. Abundance of soil fauna individuals in Phaseolus vulgaris cultivation before and after the application of poultry litter doses corresponding to 0, 1, 2, 3, and 4 times the recommended rate of organic fertilization.

Regression analyses were not significant (P < 0.05) for Margalef richness, Simpson dominance, Shannon diversity, and Pielou evenness. Therefore, these indices were analyzed using Tukey's test (P < 0.05), and the results are presented in Table 2.

Although the data for individuals at the order level showed significant regression adjustments (Figure 1), the comparison of means for these variables is presented here to facilitate the reader's interpretation of the remaining results.

Treataments/ orde rs	Hym	Coleo	Dipt	Coll	Acar	Orth	Aran
	Before bean sowing (0 DAS)						
Control	24.25 Ab*	2.75 ABb	1.5 Aa	53.5 ABa	25 Db	3 ABb	1.5 ABa
Mineral	18.75 Bb	1.5 BCa	1.75 Aa	56.5 Aa	30.75 BCa	4.25 Ab	1.25 ABa
Mineral + Org	16.75 BCb	3.5 Aa	2.25 Aa	47.75 BCa	26.25 CDa	4.25 Ab	1.5 ABa
620 kg ha^{-1} Org	12.5 Cb	2 ABCb	2 Aa	52.5 ABa	35 ABa	4.25 Ab	1.75 ABa
1240 kg ha^{-1} Org	17 BCb	1.5 BCb	1.5 Aa	54.25 Aa	25.75 CDb	3 ABb	2.5 Aa
1860 kg ha^{-1} Org	25 Aa	1 Ca	2 Aa	45.25 Ca	37.5 Aa	2.25 Bb	1.5 ABa
2480 kg ha^{-1} Org	14.5 BCb	2.25 ABCa	1.25 Aa	55 Aa	24.5 Da	3 ABb	0.75 Ba
CV (%)	11.4	34.14	35.82	5.22	7.97	22.95	35.52
	After bean harvest (90 DAS)						
Control	75 Aa	8.75 Aa	0.5 Ab	52.25 Aa	47.5 Aa	6.5 DEa	0 Ab
Mineral	40.25 Ba	1.5 Ba	0.25 Ab	51.25 Aa	15.25 Db	11.5 Ca	0.5 Aa
Mineral + Org	76.5 Aa	1.75 Bb	0.25 Ab	21.75 Cb	20.25 CDb	14.5 ABa	0.25 Ab
620 kg ha^{-1} Org	28 CDa	9.75 Aa	0.5 Ab	22.5 Cb	33.25 Ba	8 Da	0 Ab
1240 kg ha^{-1} Org	32.25 Ca	2.5 Ba	0 Ab	20.75 Cb	52.25 Aa	4.75 Ea	0.5 Ab
1860 kg ha^{-1} Org	23.25 Da	1 Ba	0.75 Ab	30.25 Bb	24.5 Cb	17 Aa	0.75 Aa
2480 kg ha^{-1} Org	31 Ca	2.5 Ba	0.5 Aa	22.25 Cb	16.75 Da	13.75 BCa	0.25 Aa
CV (%)	6.75	24.15	127.27	8.45	7.56	11.46	139.96

Treatments/indices	Margalef	Simpson	Shannon	Pielou
	Before bean sowing (0 DAS)			
Control	1.27 Aa	0.33 BCa	0.57 ABa	0.68 ABb
Mineral	1.26 Aa	0.34 Ba	0.55 BCa	0.66 BCb
Mineral + Org	1.29 Aa	0.31 Cb	0.60 Aa	0.71 Aa
620 kg ha-1 Org	1.27 Aa	0.34 Ba	0.56 BCb	0.66 BCb
1240 kg ha-1 Org	1.28 Aa	0.35 ABa	0.56 BCa	0.66 BCb
1860 kg ha-1 Org	1.26 Aa	0.31 Ca	0.57 BCb	0.67 BCb
2480 kg ha-1 Org	1.24 Aa	0.37 Aa	0.53 Cb	0.63 Cb
CV (%)	3.31	3.61	2.74	2.73
	After bean harvest (90 DAS)			
Control	0.86 Ab	0.29 Cb	0.58 Ba	0.79 ABCa
Mineral	0.94 Ab	0.32 BCb	0.56 Ba	0.76 BCa
Mineral + Org	0.92 Ab	0.38 Aa	0.53 Cb	0.72 Ca
620 kg ha-1 Org	0.97 Ab	0.25 Db	0.65 Aa	0.88 Aa
1240 kg ha-1 Org	0.95 Ab	0.33 Ba	0.55 BCa	0.74 BCa
1860 kg ha-1 Org	1.15 Aa	0.25 Db	0.64 Aa	0.81 ABCa
2480 kg ha-1 Org	1.06 Aa	0.26 Db	0.63 Aa	0.84 ABa
CV (%)	15.37	3.72	2.62	5.32

*Means followed by the same uppercase letter within columns do not differ among treatments, and means followed by the same lowercase letter within columns do not differ between sampling periods, according to Tukey's test (P < 0.05). Abbreviations: Hym = hymenoptera; Coleo = coleoptera; Dipt = diptera; Coll = collembola; Acar = acarina; Orth = orthoptera e Aran = aranae.

Table 2. Tukey test (P < 0.05) for the number of individuals at the order level and for the Margalef richness, Simpson dominance, Shannon diversity, and Pielou evenness indices at two soil fauna sampling periods in common bean cultivation.

Pielou's evenness was higher at 90 DAS in all treatments, except for the mineral + organic treatment (Table 2). The increase in this index during the second sampling period (90 DAS) occurred because the order Collembola was less abundant at this time.

Simpson's dominance index was higher before bean sowing (0 DAS) in most treatments (Table 2). The number of collembolans decreased at 90 DAS and contributed to the reduction in the values of this index. This result suggests that ryegrass residues maintained as soil cover prior to bean establishment may have favored a greater occurrence of individuals of the order Collembola in this experiment.

Shannon diversity was higher at 90 DAS in the control, mineral fertilization, and in the poultry litter doses of 620, 1,860, and 2,480 kg ha^{-1} (Table 2). The increase in this index at 90 DAS is associated with the reduction in the number of individuals of the dominant order, Collembola, which accounted for the highest number of individuals at 0 DAS. The negative impact of mineral fertilization compared with organic fertilization on soil fauna has already been reported in the literature (Alves et al., 2008; Sileshi & Mafongoya, 2006), and this effect appears to be related to the direct addition of organic matter—an important food source for soil macrofauna—provided by organic fertilizers.

Dunnett's test revealed that, individually, all poultry litter doses at 90 DAS significantly reduced the abundance of the orders Hymenoptera and Collembola when compared with mineral fertilization (Table 3). This result differs from those reported by Quadros et al. (2009), who observed a higher number of individuals from both orders under organic fertilization compared with mineral fertilization in bean cultivation. According to Alves et al. (2008), the addition of organomineral fertilizers may exert beneficial effects on soil fauna due to their more balanced nutrient composition.

	Orders						
Treatments	Acar	Aran	Colp	Coll	Dipt	Hym	Ort
	Before bean sowing (0 DAS)						
Min	30.75	1.25	1.5	56.5	1.75	18.75	4.25
0 kg ha^{-1}	25*	1.5	2.75	53.5	1.5	24.25*	3
620 kg ha^{-1}	35	1.75	2	52.5	52.5	12.5*	4.25
1240 kg ha^{-1}	25.75*	2.5*	1.5	54.25	54.25	17	3
1860 kg ha^{-1}	37.5*	1.5	1	45.25*	45.25	25*	2.25*
2480 kg ha^{-1}	24.5*	0.75	2.25	55	55	14.5*	3
CV	7,9	35,03	35,21	5,02	38,73	11,54	22,93
	After bean harvest (90 DAS)						
Min	15,25	0,50	1,50	51,25	0,25	40,25	11,50
0 kg ha^{-1}	47,50*	0,00	8,75*	52,25	0,50	75,00*	6,50*
620 kg ha^{-1}	33,25*	0,00	9,75*	22,50*	0,50	28,00*	8,00*
1240 kg ha$^{-111111}$	52,25*	0,50	2,50	20,75*	0,00	32,25*	4,75*
1860 kg ha^{-1}	24,50*	0,75	1,00	30,25*	0,75	23,25*	17,00*
2480 kg ha^{-1}	16,75	0,25	2,50	22,25*	0,50	31,00*	13,75

CV (%)	7,41	130,38	23,2	7,50	128,99	7,94	12,67

Abbreviations: Acar = acarina; Aran = aranae; Colp = coleóptera; Coll = Collembola; Dipt = díptera; Hym = Hymenoptera; Ort = orthoptera.

Significant difference according to Dunnett's test at 5% probability, comparing poultry litter doses with mineral fertilization.

Table 3. Dunnett test for the number of individuals before (0 DAS) and after (90 DAS) the application of each poultry litter dose compared with mineral fertilization.

For the orders Diptera and Araneae, Dunnett's test did not reveal significant differences for any poultry litter (PL) dose compared with mineral fertilization during the second sampling period (90 DAS). The highest numbers of individuals of the order Coleoptera were observed at the doses of 0 and 620 kg ha^{-1} (Table 3). It has already been reported in the literature that organic fertilization favors the occurrence of coleopterans compared with mineral fertilization (Alves et al., 2008). However, in the present study it was evident that higher doses of organic fertilization did not favor the occurrence of individuals of this order. In contrast, the order Orthoptera differed from mineral fertilization only at the dose of 1,860 kg ha^{-1} of poultry litter.

For the order Acarina, a significantly higher number of individuals was observed under poultry litter doses compared with mineral fertilization (Table 2). Quadros et al. (2009), working with different crops, found no differences among organic, integrated, and mineral production systems regarding mite populations. According to Vargas et al. (1997), it is difficult to determine which factor controls mite populations, since this group occupies a wide range of environments and several associated factors may influence the number of individuals in a given location.

CONCLUSION

The application of poultry litter in common bean cultivation positively influenced soil fauna. However, this effect was more evident at lower application rates.

Although organic fertilization with poultry litter showed beneficial effects on soil macrofauna, further studies evaluating intermediate application rates between those tested in this experiment are still necessary. Such studies would allow more precise recommendations for the use of organic fertilization in bean cultivation, particularly with respect to maintaining and enhancing soil macrofauna populations and promoting soil biological quality.

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