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A N I N T E R N A T I O N A L J O U R N A L

Study of Acari and Collembola Populations in Four Cultivation Systems in Dourados - MS

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ABSTRACT

The impact four cultivation systems on the soil fauna was studied, using Oribatida and Gamasida acarids as bioindicators and collembolan. The research was carried out in experimental fields, located in EMBRAPA - CPAO in Dourados, Centerwest of Brazil from July 1997 to December 1999. The constant pasture system presented smaller impact on the soil fauna followed by agricultural cattle rotation and a direct plantation system. In the conventional plantation series, the populational density of the mesofauna organisms was low, especially collembolan families.

Key words: Edafica mesofauna, direct plantation, soil prepare systems, cultures rotation

INTRODUCTION

Before the evidence of the unsustainable traditional systems for preparing the soil, it becomes necessary in Dourados-MS to establish intensive systems of cattle and agricultural production with rotation between culture and breeding. Among the factors that can influence the maintainance of the systems, is also included the abundant and diversified soil artropofauna. This has an important role, being inportant knowledge of acari and collembolan population, to know the ideal time for chemical products application so that the handling of these organisms can be made in an appropriate way which doesn´t modify the natural balance established in the ecosystem.

The population size and the activity of the soil biota members can be modified by cultural practices (Primavesi, 1990). Agricultural practices as monoculture, show a tendency to reduce the species diversity (Brady, 1989). Muzilli et al., (1983) and by Derpsch et al., (1991) reported positive effect of the culture rotation in increasing the posterior yields. The animals control in rotative grassland is another practice that can provide improvements in the native conditions of the soil, enriching it in organic matter and suppressing the aluminum effects (Tomasini et al., 1987). The edafica mesofauna has important roles, such as a catalyzer in the microbial activity for the organic matter decomposition (Dunger, 1983, Bruno et al., 1995, Bzuneck and Santos, 1988, Sautter, 1994), soil moistening process (Dunger, 1956), mechanical disaggregation of the decomposing vegetable material, and formation and maintenance of the structure of the soil (Sautter et al., 1996).

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Oribatida acari and collembolan are more numerous soil arthropods and when better distributed, they influence directly the soil fertility, stimulating the microbial activity, the mushrooms inhibition and bacteria which cause diseases (Butcher and Snider, 1971). Acari and Collembola contribute to the soil formation (Thompson and Edwards, 1974; Primavesi, 1990), and can also carry the organic matter, in advanced decayed condition, to deeper levels of the soil and vice-versa (Hole, 1981; Sautter, 1994). They can contribute to the soil structure producing a fertile atmosphere and increasing considerably the soil porosity (Berg and Pawluk, 1984). They can also accelerate the nutrients mineralization (Seasted and Crossley, 1980; Seasted, 1984) as well as increase up to six times the speed of the vegetable residues decomposition (Behan et al., 1978). The objective of the present research was to analyze the impact of the plantation type on the edafica mesofauna using acari and collembolan as bioindicators.

MATERIAL AND METHODS

This work was carried out in experimental fields, located in EMBRAPA - CPAO (Empresa de Pesquisa Agropecuária-Centro de Pesquisa Agropecuária do Oeste) in Dourados-MS. (22º 14' S and 54º 49' West, 452m altitude). The soil artropofauna was sampled monthly at the beginning of July 1997 to December 1999. The modified Berlese funnel was used in a strip of 0-5 cm of depth and with a soil volume of 252 cm^3. For this study, four systems were selected. System 1-conventional (conv), with oat / soybean / oat / soybean rotation; system 2- direct plantation. 3-cattle/agriculture rotation with oat / brachiaria / brachiaria / brachiaria (Pasture1) and brachiaria / soybean / oat / soybean (Pasture2); system 4 - continuous pasture (Pcont). The culture series in the direct plantation system is described in Table 1. The soil samples were taken using only the central strip of the area and accomplished in zig-zag, leaving a space of 5m hedge on all sides of the area. The number of samplings was ten funnels by system. The samples were conditioned in plastic sacks to minimize the losses by humidity, and soon after installed in exhibitor tables, whose light source and heat were 25w lamps, staying for seven days in the laboratory of UNIGRAN. The organisms were picked up in plastic pots, which contained a 70% alcoholic solution. After the exhibition period, identification, scoring and separation of the organisms were proceeded with aid of a stereoscope microscope. The statistics analysis for each species of arthropods was carried with a double interation (cultivation system and year) with ten repetitions for each treatment. The original data were transformed to $\sqrt{x + 0,5}$ and the averages were compared with Tukey test at the level 5% of probability.

Table 1 - Culture series implanted in the summer and winter. Dourados, MS.1997/1999.

	1997	1998		1999	
Series	Winter	Summer	Winter	Summer	Winter
DirA	TURNIP	MILHO	OAT	SOYBEAN	WHEAT
DirB	WHEAT	SOYBEAN	TURNIP	MILHO	OAT
DirC	OAT	SOYBEAN	WHEAT	SOYBEAN	TURNIP

RESULTS AND DISCUSSION

The global data of means, variation coefficient and "F" test for each groups of arthropods in four cultivation systems from 1997 to 1999 are documented in Table 2. Oribatida and Gamasida acari and collembolan families, Entomobryidae, Sminthuridae and Poduridae were identified. The general mean number of organism of the edafica mesofauna in different cultivation systems is shown in Fig. 1.

It was found that the largest number of individuals was obtained in the continuous pasture, followed by pasture 1 and 2, and by direct plantation (A, B, C). The above mentioned systems presented larger organisms population of mesofauna when compared with the conventional plantation (Fig. 2b), indicating therefore, that the cultures rotation in direct plantation, associated to the handling of animals, was a practical that

increased the biological attributes of the soil and possibly the grains yield.

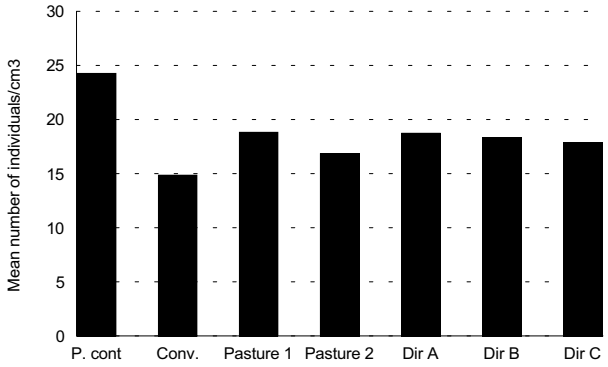

Figure 1 - General mean number of Acari and Collembola captured in four cultivation systems. Dourados-MS, 1997/1999.

According to was Perdue and Crossley Jr., (1989), the plantation system decisive in the structure maintenance and in the most favorable habitat to the soil fauna that were usually harmed by the contional prepared operations (Fiapar, 1981). This superiority occurred probably due to the vegetable residues deposited in the soil surface, creating a favorable microhabitat for the development of these arthropods, and it was also verified by Bzuneck and Santos (1991).

A smaller number of Oribatida and Gamasida acari was observed (besides collembolan) in conventional plantation system (Fig. 2b). The absence in this system of vegetable residues in soil surface, the movement and turning of the earth, didn't offer conditions for the development of acari and collembolan. Bzuneck and Santos (1991) and Blumberg and Crossley (1983) also reported a populational reduction of the organisms of the edafica mesofauna in this cultivation system. Certain animals, like acari and collembolan didn't have enough pigmented protection to support direct sunbeams, decreasing consequently those individuals' population (Primavesi, 1990).

Table 2 - Global data of means, variation coefficient and "F" test for each groups of arthropods in four cultivation system from 1997 to 1999. Dourados-MS.

Arthropods	**Year**		
Oribatida	**97**	**98**	**99**
Mean	1.3939	1.9522	2.4115
Cv	26.055	30.082	31.374
F	11.13*	11.64*	5.84*
	P ≤ 0.05	P ≤ 0.05	P ≤ 0.05
Gamasida			
Mean	1.4502	1.4888	1.3163
Cv	29.843	36.119	39.596
F	6.59*	7.25*	7.74*
	P ≤ 0.05	P ≤ 0.05	P ≤ 0.05
Entomobryidae			
Mean	1.3982	1.0997	0.86416
Cv	29.615	34.462	34.004
F	7.43*	5.22*	6.05*
	P ≤ 0.05	P ≤ 0.05	P ≤ 0.05
Sminthuridae			
Mean	0.9311	0.87153	0.72265
Cv	28.980	29.215	13.705
F	6.11*	6.66*	1.94*
	P ≤ 0.05	P ≤ 0.05	P ≤ 0.05
Poduridae			
Mean	1.0654	0.82826	0.73354
Cv	28.182	28.118	20.32
F	4.91*	2.77*	1.51n.s
	P ≤ 0.05	P ≤ 0.05	P ≤ 0.05

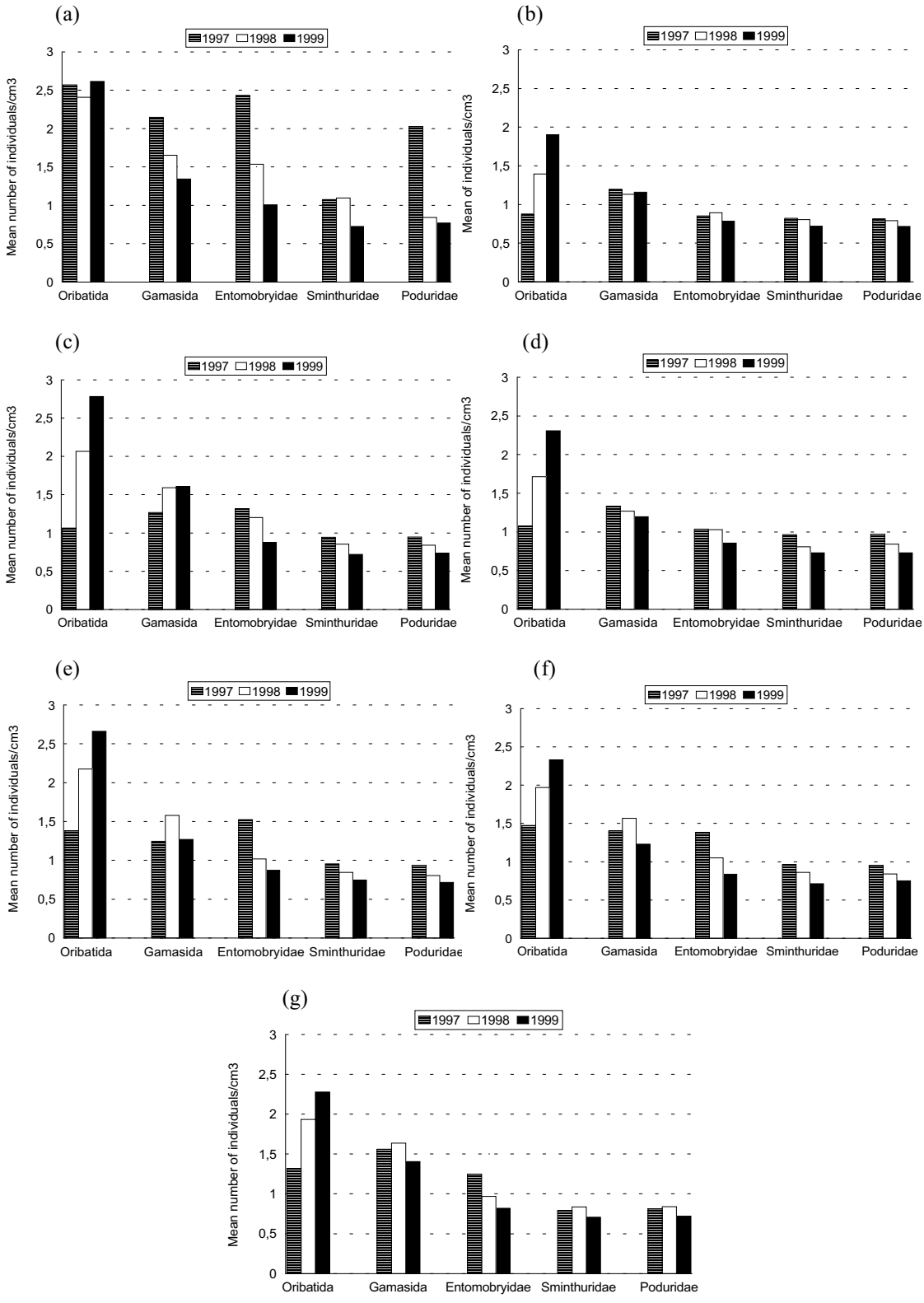

Figure 2 - Mean number of individuals obtained in cultivation systems: continuous pasture (a), conventional (b), pasture 1 (c), pasture2 (d), dir A (e), dir B (f), dir C (g). Dourados - MS, 1999.

The increase of Oribatida medium number was observed in the continuous pasture system (Fig. 2a, 3a). The Oribatida number increased significantly, through Tukey test at 5% of probability, in the direct plantation (A), pasture 1 and 2. However a significant difference was observed between pasture 1 and pasture 2 (Fig. 3a) from 1998 to 1999, through Tukey test at 5% of probability, probably due to the use of chemical products in the soybean and oat dessication area.

According to Tousignant and Coderre (1992) and Sautter and Santos (1994) in general, Oribatida acari seemed to demonstrate a preference for rich habitats in organic matter, besides they may be the first settlers of disturbed areas. During 1997, Gamasidas occurred in abundance in continuous pasture system, when compared with the other ones (Fig. 3b). However, a populational reduction was observed from 1998 to 1999 (Fig. 2a). It was important to notice the origin of the vegetable residues for the development of certain edaficas species. In 1997 in the direct plantation system (C) a larger and significant population of Gamasidas was observed (Fig. 2g), while oat culture was installed, when compared with turnip culture (A) (Fig. 2e). In pasture 1 and 2 in 1997, no significant difference, was observed in Gamasidas number. However, it was observed that during 1998 and 1999 the Gamasida population was larger in pasture 1, following the same behavior of the Oribatida acari (Fig. 2c, 3b). Although there was not significant difference among the rotations in the direct plantation systems A, B and C, it was observed that the largest number of individuals was obtained in system C (Fig. 2g), probably because in the series which the dead covering was constituted of leguminous residues, there occurred a favorable development of these acari. The dead covering of leguminous presented low carbon/nitrogen (C/N), relationship increasing the number of individuals as it was noticed by Bzuneck and Santos (1991). In direct plantations A and B, the cultures with high relationship, such corn, wheat and oat, occurred many times during the succession and they were not chosen by Gamasida. This fact was also noticed by Bzuneck and Santos (1991).

The collembolan, which belonged to the Entomobryidae family occurred in high numbers in continuous pasture system, but a fall was observed in individuals number from 1998 to 1999 (Fig. 2a). The conventional prepared system presented a small number of individuals during the whole study period. No significant difference, was observed among the direct plantation systems (Fig. 3c). The Collembola populations increased with the increment in organic matter content. Since they were typically epiedaficas forms, (due to high availability of organic matter in the soil surface), they occurred in abundance (Sautter et al., 1996).

The Sminthuridae family occurred in high abundance in the continuous pasture system as well as the other species in study, preferably from 1997 to 1998, but in 1999 observed no significant difference was observed, in relation to the other treatments (Fig. 2a and 3d). During 1997, the direct plantation system (C), didn't differ significantly from the conventional system. In 1999, the direct plantation system (A) presented a larger number of individuals, although it didn't differ from the other treatments (Fig. 3d). The Poduridae family occurred in smaller populational index; however, its population was more expressive in the continuous pasture system in 1997 (Fig. 2a, 3e).

During 1999, an accentuated fall of all the species was observed (except of Oribatida; Fig. 2a). The Sminthuridae and Poduridae families were found in small number, almost disappearing (Fig. 3 d, e). Probably, the environmental factors were responsible for the decrease of the species. During 1999, it there were periods of continuous droughts, which probably harmed the appropriate development of the mesofauna organisms.

Continuous pasture system was the favorite one for the arthropods population studied and the conventional system presented a low medium number of organisms (Fig. 3 a,b,c,d,e). It indicated that the residues left by the cattle and straw were important in these individuals' maintenance. According to Tomasini et al., (1987), the handling of animals in rotative pasture could provide improvements in the native conditions of the soil, enriching it with organic matter. However, it was observed that the cattle and agricultural rotation area (pasture 2), didn't present an expressive increase when compared with the continuous pasture, direct plantation A, B and C and pasture 1, transcending only the conventional system. Researches are necessary to determine the abiotic factor that interfered negatively in the organisms population.

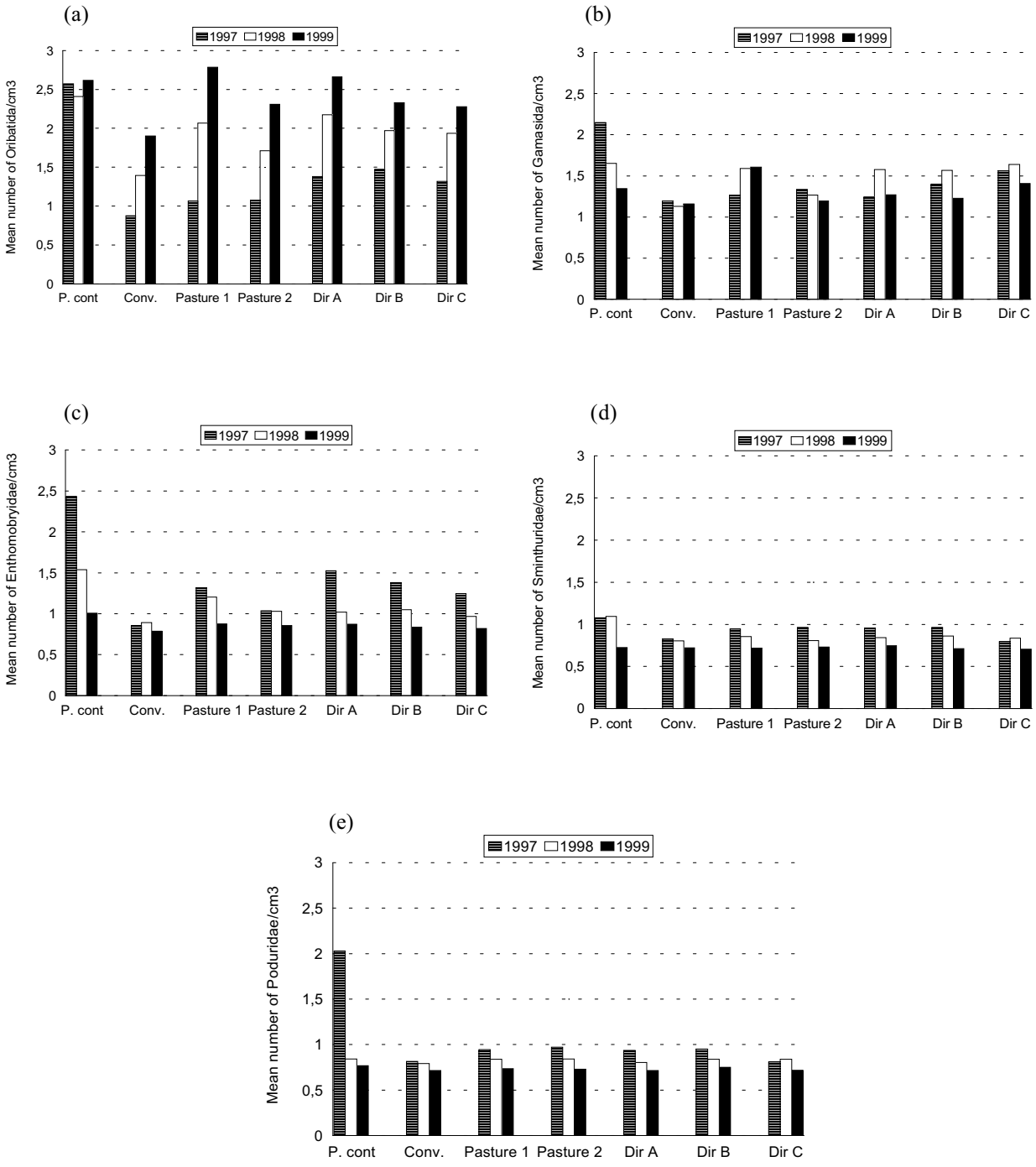

Figure 3 - Mean number of acari Oribatida (a), Gamasida (b) and collembola Entomobryidae (c), Sminthuridae (d) e Poduridae (e), in four cultivation systems. Dourados - MS, 1999.

Probably the micro-climate formed in the direct plantation system, cattle/agriculture rotation and continuous pasture has been favorable to the humidity storage in the soil, and consequently the individuals' abundance.

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RESUMO

O impacto de quatro sistemas de cultivo sobre a fauna de solo foram estudados, utilizando-se como bioindicadores os acari Oribatida e Gamasida e os Collembola. A pesquisa foi conduzida em campos experimentais, localizados na EMBRAPA - CPAO no município de Dourados, MS, no período de julho de 1997 à dezembro de 1999. O sistema de pastagem contínua apresentou menor impacto sobre a fauna de solo seguido da rotação agricultura pecuária e do sistema de plantio direto. Nas sucessões do plantio convencional, a densidade populacional dos organismos da mesofauna foi baixa, em especial as famílias de colembolos.

REFERENCES

Behan, V. A.; Stuart, B. B. and Mckevan, D. K. (1978), Effects of nitrogen fertilizes, as urea, on acarina and other arthropods in Quebec black spruce humus. *Pedobiologia*, **18**, 249-263.

Berg, N. W. and Pawluk, S. (1984), Soil mesofaunal studies under different vegetative regimes in north central Alberta. *Can. J. Soil Sci*., **64**, 209-223.

Blumberg, A. Y. and Crossley Jr., D. A. (1983), Comparasion of soil surface arthropod populations in conventional tillage, no-tillage and old field systems. *Agro-Ecosystems*, **8**, 247-53.

Brady, N. C. (1989), *Natureza e propriedades dos solos*. 7. ed. Rio de Janeiro : Freitas Bastos. 878 pp.

Bruno, E. C. G.; Marques, O. A.; Saldivar, L. M.; Zeni, K; Santos, H. R. and Fernandes, W. D. (1995), Composição da artropofauna de solo em três ambientes na região de Dourados-MS. In- *V Reunião Sul-Brasileira de Insetos de solo*. (EMBRAPA-CPAO). pp.92.

Butcher, J. W. and Snider, R. J. (1971), Bioecology of edaphic Collembola and Acarina. *Ann. Rev. Entomology*, **16**, 249-288.

Bzuneck, H. L. and Santos, H. R. (1988), *Efeitos de dois sistemas de preparo do solo e sucessões de cultura, na população de ácaros e collembola*. (Tese de Mestrado). Curitiba : SCA/UFPR. 130 pp.

Bzuneck, H. L. and Santos, H. R. (1991), Efeitos de dois sistemas de preparo do solo e sucessões de cultura, na população de ácaros Galumnidae (Cryptostigmata). *Revista Ciência Agrária*, **11**, 1-2.

Derpsch, R.; Roth, C. H.; Sidiras, N. and Kopke, U. (1991), *Controle de erosão no Paraná, Brasil: Sistemas de Cobertura do solo, pantio direto e preparo conservacionista do solo*. GTZ/IAPAR. 272 pp.

Dunger, W. (1983), *Tiere im boden*. Die Newe-Brehm buecherei. 327. Wittemberg-Lutherstadt: A. Ziemsen Verlag. 287 pp.

Dunger, W. (1956), Untersuchungen uber die Laubstreuzersetzung durch Collembolen. *Zool. Jb. Abt. Systematik*., **94,** 75-98.

FIAPAR (1981), *Plantio Direto do Estado do Paraná.* Londrina : FIAPAR. (Circular; 23). 244 pp.

Hole, F. D. (1981), Effects of animals on soil. *Geoderma*, **25,** 75-112.

Muzilli, O.; Vieira, M. J.; Almeida, F. L. S.; Nazareno, N. R. X.; Carvalho, A. O. R.; Laurenti, A. E. and Llanilo, R. F. (1983), Comportamento e possibilidades da cultura do milho em plantio direto no estado do Paraná. *Pesq. Agropec. Bras*., **18**, 41-47.

Perdue, J. C. and Crossley Jr., D. A. (1989), Seasonal abundance of soil mites (Acari) in experimental agroecosystems: effects of drought in no-tillage and conventional tellage. *Soil and Tillage Res*., **15**, 117-124.

Primavesi, A. (1990), *Manejo ecológico do solo:* Agricultura em regiões tropicais. 9. ed. São Paulo : Nobel.

Sautter, K. D. and Santos, H. R. (1994), Avaliação da estrutura da população da mesofauna edáfica, em diferentes regimes de reabilitação de um solo degradado pela mineração do xisto. *Agrárias*, **13**, 31-34.

Sautter, K. D. (1994), *Comparação da população de Collembola (Insecta) e Oribatei (Acari: Cryptostigmata) entre plantio direto e três níveis de fertilidade, plantio convencional e um ecossistema natural (campo).* (Dissertação de Mestrado), Curitiba: UFPR. 98 pp.

Sautter, K. D.; Kobiyama, M. and Ushiwata, C. T. (1996), Influência do lodo de esgoto doméstico e lodo deágua sobre a mesofauna edáfica. *Arq. Biol. Tecnol*., **39** : (4), 745-750.

Seasted, T. R. and Crossley,D. A. (1980), Effects of microarthropods on the seasonal dynamics of nutrients in forests littes. *Soil Biology Biochem.*, **12**, 337-342.

Seasted, T. R. (1984), The role of microarthropods in decomposition and mineralization processes. *Ann. Rev. Entomol.*, **29**, 25-46.

Thompson, A. R. and Edwards, C. A. (1974), Effects of pesticides on nontarget invertebrates in freshwater and soil. In- Guenzi, W. D. (ed.)*Pesticides in soil and water*. Madison : Soil Science Society of America. pp. 341-375.

Tomasini, R. G. A.; Velloso, J. A. R.; Amantino, J. K. and Ambrosi, I. (1987),*Campo bruto melhorado: grãos, solo e vida.* Passo Fundo, EMBRAPA, CNPT, (Documentos, 6/87). 22 pp.

Tousignant, S and Coderre, D. (1992), Niche partitioning by soil mites in a recent hard wood plantation in Southern Quebec, Canada. *Pedobiologia*, **36**, 287-294.

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