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Changes in the abundance and diversity of soil arthropods in the cultivation of fruit crops[1]

Alterações na abundância e diversidade dos artrópodes de solo em cultivos de fruteiras

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ABSTRACT - The aim of this study was to evaluate the influence of fruit-crop management (mango, guava and coconut) on the composition and distribution of soil arthropods (mesofauna and macrofauna) during seasonal periods in the Curu Valley region of the State of Ceará, Brazil. The study was carried out during the following periods: rainy/dry (July/August 2013), dry (October/ November 2013), dry/rainy (January/February 2014) and rainy (April/May 2014). Pitfall traps were used to capture the arthropods. After sorting, the Shannon-Wiener diversity index and the Pielou evenness index were calculated. Diversity values were compared in pairs using Student's t-test ($\alpha = 0.05$) in the SAS v 9.0 software (2002). The similarity of the areas and groups was evaluated by multivariate analysis employing the techniques of principal component (PCA) and factor (FA) analysis in the Statistica® software (2014). The abundance and diversity of soil arthropods in the cultivation of fruit trees vary according to the type of management and to the seasonal period in the region. The Acari, Collembola and Formicidae groups were the most abundant in each area and during the four periods of the study. The area cultivated with coconut shows better soil conditions for maintaining the arthropod community in the soil.

Key words: Soil management. Semi-arid. Edaphic fauna.

RESUMO - O objetivo desse estudo foi avaliar a influência do manejo em cultivos de fruteiras (Mangueiras, goiabeiras e de coqueiros) na composição e distribuição dos artrópodes de solo (mesofauna e macrofauna) nos períodos sazonais da região do Vale do Curu, Ceará. O estudo foi realizado nos períodos chuvoso/seco (julho/agosto 2013), seco (outubro/novembro 2013), seco/chuvoso (janeiro/fevereiro 2014) e chuvoso (abril/maio 2014). Na captura dos artrópodes foram utilizadas armadilhas "*pitfall*". Após a triagem, foram calculados os índices de diversidade de Shannon-Wiener e de uniformidade de Pielou. Os valores de diversidade foram comparados, dois a dois, através do teste t-studant (α = 0,05) com o Software SAS versão 9.0 (2002). A similaridade das áreas e de grupos foi avaliada com análise multivariada empregando técnica de componentes principais (ACP) e de análises de fatores (AF) com o Software Statistica® (2014). A abundância e a diversidade dos artrópodes de solo em cultivo de fruteiras, variam em função dos manejos e com o período sazonal da região. Os grupos Acari, Collembola e Formicidae foram os mais abundantes nas áreas e nos quatro períodos do estudo. A área cultivada com coqueiros apresenta melhores condições edáficas para a manutenção da comunidade dos artrópodes de solo.

Palavras-chave: Manejo do solo. Semiárido. Fauna edáfica.

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INTRODUCTION

The soil is a dynamic system; this property also results from the joint biological activity of edaphic organisms in processes that involve energy flow, and the relevant stages of the biogeochemical cycles of ecosystems (BARRETT *et al*., 2011; ESTRADE *et al*., 2010). The action of man, with a view to agricultural exploitation, modifies the intensity of these processes by virtue of practices that exclusively aim to maximise plant production (LAVELLE, 2009).

The importance of soil organisms to ecosystems can be seen by the numerous functions they perform in the soil (MOÇO *et al*., 2005), such as the fragmentation and movement of organic residue, the deposition of material in the litter (BARETTA; BROWN; CARDOSO, 2010), the incorporation of organic matter with the mineral fraction (OLIVEIRA; RESCK; FRIZZAS, 2006; SILVA *et al*., 2013), the mobilisation of nutrients (TOYOTA *et al*., 2013) and the regulation of the microbial population by predation and/or the dispersion of propagules into the environment (ROY *et al*., 2011). Edaphic fauna is therefore an active part of the agricultural environment, sensitive to the interference caused by soil and crop management (BARETTA *et al*., 2008).

For the effects of management practices on the populations, functions and interactions of soil organisms, Hole *et al*. (2005) state that although there is a wide range of response among the different species, most groups display greater abundance or biomass under conservation systems than under conventional-tillage systems, as the former cause less disturbance to their habitats, preserving the structures that serve as shelter.

In general, larger organisms appear to be more affected by crop operations than smaller organisms, being more sensitive to changes in the local microclimate due to ruptures in the physical structure of the soil, which expose the organisms to unfavourable conditions of light, temperature and moisture, and makes them vulnerable to attacks from predators (BARETTA *et al*., 2011). According to Smith *et al*. (2009) and Baretta *et al*. (2011), changes in the physical environment and the food supply affect different groups of organisms of the most varied life forms, including rhizophages, saprophages, predators and parasitoids, and in some cases can completely destroy the structure of primary communities, leaving them empty for an indefinite period.

Studies have been undertaken in the search for information on the biodiversity of soils, seeking to understand how they relate and how they are affected by the various interventions carried out in the ecosystem (AQUINO *et al*., 2008; ASPUND; BOKHORST; WARDLE, 2013; BARETTA *et al*., 2008; 2011; LAVELLE *et al*., 2014; MOÇO *et al*., 2010). Diversity and richness have been the most-used parameters, especially when analysing the phylum Arthropoda, or more precisely the class Insecta, due to its high diversity and reproductive capacity (over a short time), and because its communities are only slightly influenced by anthropogenic environmental changes (BARETTA *et al*., 2007).

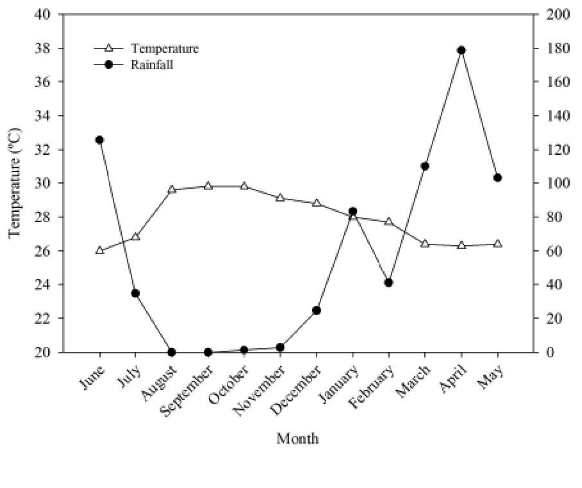
However, this knowledge is still in the early stages, especially for the Brazilian semi-arid region, becoming even more critical as anthropogenic environmental changes become more pronounced (OLIVEIRA; SOUTO, 2011). In this context, the aim of this study was to evaluate the influence of fruit-crop management (mango, guava and coconut) on the composition and distribution of soil arthropods (mesofauna and macrofauna) during four seasonal periods in the Curu Valley region of the State of Ceará, Brazil.

MATERIAL AND METHODS

The study was carried out on the Curu Valley Experimental Farm (FEVC-UFC) (3º48' S, 39º20' W, at an altitude of 47 m) belonging to the Universidade Federal do Ceará (UFC), located in the town of Pentecoste, Ceará. According to the Köppen classification, the climate in the region is of type BSwh', semi-arid with irregular rainfall and a mean of 801 $mm.yr^{-1}$, with a critical period of water deficiency from June to January (AGUIAR *et al*., 2004) (Figure 1). The predominant soil on the farm is a Fluvic Neossol.

Four areas of the farm were chosen for the study, three of which were managed with fruit crops (mango,

Figure 1 - Mean values for temperature and total rainfall volume from June 2013 to May 2014 on the Curu Valley Experimental Farm, Ceará



guava and coconut), and one with native vegetation (Caatinga) to serve as the control. The area of native vegetation (NV) has a phytophysiognomy marked by the presence of shrub and arboreal Caatinga (Dry Tropical Forest) with a predominance of woody species.

The area cultivated with mango is an orchard planted ten years ago, occupying a three-hectare area of the farm. The plants used were of the ‘Tommy Atkins’ variety, spaced 10 x 10 m apart, under continuous crop management, which includes: mechanical clearing (control of spontaneous grasses) three times a year; crowning and covering the soil with crushed material from clearing and pruning; pruning shortly after the fruiting period; mineral fertilisation with NPK [Urea (NH_2CONH_2), single superphosphate ($CaH(PO_4).2H_2O$) and Potassium Chloride (KCl)]; and when necessary: liming, depending on soil analysis; the application of pesticides for the control of pests and diseases, especially the control of fruit flies; and localised irrigation.

The area cultivated with guava is an orchard that was also planted ten years ago, and occupies a two-hectare area of the farm. The plants are of the ‘Paluma’ variety, at a spacing of 5 x 5 m, under a continuous management of pruning after the fruiting period; mineral fertilisation with NPK [Urea (NH_2 $CONH_2$), single superphosphate (CaH $(PO_4).2H_2O$) and Potassium Chloride (KCl)]; liming, according to the soil analysis; and the use of pesticides for the control of pests and diseases, especially fruit flies. In this area, clean cultivation is carried out; there is no ground cover, and all plant material (pruning and clearing) as well as fruit on the ground is collected and removed from the orchard.

The area of coconut palms is also an orchard planted ten years ago, occupying a three-hectare area of the farm. The plants are of the ‘Dwarf’ variety and are under continuous crop management, including: mechanical clearing (control of spontaneous grasses) every two months; the application of fertiliser in the form of cattle manure incorporated into the soil; periodic pruning for the removal of senescent leaves and inflorescences; crowning around the plants; ground cover, using the material removed from the plants; pest-control (acaricide); and constant irrigation by means of sprinklers.

Characterisation of the soil in the study areas was carried out for two seasonal periods (rainy and dry). The analysis was carried out on homogenised composite samples from six single samples (Table 1).

In each area (native vegetation, mango, guava and coconut), 12 traps were installed 10 m apart, covering a sampling area of 2000 m^2 (40 m x 50 m). Any possible effect from the border (the transition between the areas) on the communities of soil arthropods was suppressed by using a spacing of 20 m between the first row of traps and the adjacent area. The statistical design was completely randomised with 12 replications, with each trap representing one replication. Four collections were made during the following periods: rainy/dry transition (July/August 2013), dry (October/November 2013), dry/rainy (January/February 2014) and rainy (April/May 2014).

The traps were made from polyethylene terephthalate (PET) bottles containing two units of different sizes. The first unit, 15 cm in height and 10 cm in diameter (capture area), was buried leaving the border level with the ground, and the second unit, with a height of 10 cm and a diameter of 8 cm, (placed inside the larger container) was used as a collector, two-thirds full of solution (water, detergent and NaCl) for the capture and death of the invertebrates. The top part of the larger bottles was used as a funnel, and fitted into the collector.

Table 1 - Soil chemical characteristics, analysed for two periods at a depth of 0-15 cm in the areas of native vegetation (NV), and Cultivated with Mango (CM), Guava (CG) and Coconut (CC), in the Curu Valley region, Ceará

Period	Area	pH	EC	CEC	V	PST	P	TOM	TOC	N
		H_2O	$Ds.m^{-1}$	$Cmol_c.kg^{-1}$	--------- % ---------		$(mg.Kg^{-1})$	------------- $(g.Kg^{-1})$ -------------		
Rainy	NV	5.5	0.40	8.8	70	1	5	18.10	10.50	0.97
	CM	6.1	0.34	10.3	78	1	9	25.55	14.82	1.34
	CG	7.0	0.61	20.2	94	3	48	31.24	18.12	1.79
	CC	7.5	0.56	10	100	2	60	19.45	11.28	1.10
Dry	NV	5.2	0.41	11	56	1	7	24.20	14.00	1.51
	CM	6.5	0.52	9.6	77	2	9	24.90	14.50	1.32
	CG	6.5	1.18	23.4	88	3	50	46.50	27.00	2.85
	CC	7.1	0.78	8.4	88	4	39	28.50	16.60	1.67

After collection, all the material was taken to the Acarology and Entomology Laboratory at the Department of Plant Science of UFC. The contents were washed in running water and then preserved in 70% alcohol for sorting. The material was sorted using a Petri dish and stereoscope (magnifying glass) and classified at the large-group level (Order, Family and/or Morphospecies). Identification of the taxa was based on specialised literature (FUJIHARA *et al*., 2011), and when necessary, samples were sent to specialists in taxonomy.

The DIVES software (Species Diversity v 3.0) was used to estimate the Shannon-Wiener diversity index and the Pielou evenness index.

The Shannon diversity index (*H'*) was calculated with equation 1.

$$H' = -\sum pi.\log pi \qquad (1)$$

where: $pi = ni/N$, where ni = the density of each group and $N = \Sigma$ of the density of all the groups.

The Pielou evenness index (*e*) was defined using equation 2.

$$e = H'/\log S \qquad (2)$$

where: H' = Shannon index and S = Number of species or groups.

Diversity values were compared in pairs, using Student's t-test ($\alpha = 0.05$) in the SAS v 9.0 Software (2002). The similarity between areas and between groups was evaluated by multivariate analysis, employing the techniques of principal component (PCA) and factor (FA) analysis. As this was non-parametric data, the original values were standardised, obtaining mean values of 0 and a standard deviation equal to 1. For this, the Statistica® software (2014) was used.

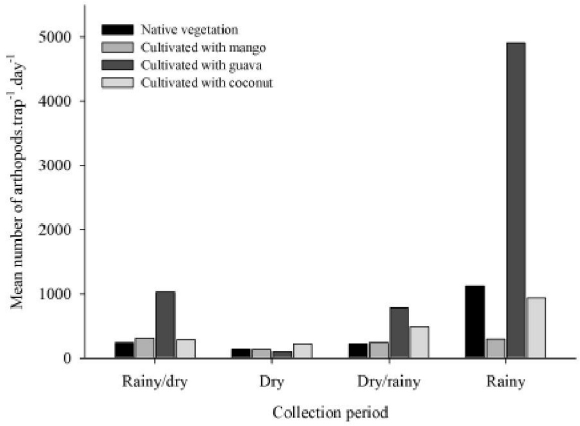
In the correlation matrix of the variables with the components, a significance level of 5% probability was considered when selecting variables presented as significant, that exhibited a high correlation with the main component in which they were found. In the factor analysis (FA), factors with an eigenvalue greater than 1.0 were extracted by principal component, and the factorial axes rotated using the normalised varimax method. For this study, a value of 0.7 was established for significant factorial loadings.

RESULTS AND DISCUSSION

In each collection period, organisms of different groups of the phylum Arthropoda were collected and classified as constant: Coleoptera, Diptera, Hemiptera, Hymenoptera and Orthoptera (Class Insecta); Acari, Araneae, Pseudcorpiones and Scorpiones (Class Arachnida) and Class Collembola. However, Thysanoptera, Lepidoptera, Dermaptera, Isoptera and Blattodea (Class Insecta); Class Diplopoda and the order Isopoda (Crustacea) were captured at a low relative frequency. In total, 139,931 individuals were collected, divided into 19 groups, 4 classes and 16 orders.

The highest number of individuals was collected during the wet period (greater rainfall), and the lowest during the dry period, while during the transition periods from wet to dry and vice versa, intermediate values were seen. The cultivated area that showed the smallest discrepancy in the results, with similar values for each period of the study, was the area cultivated with mango (Figure 2).

Figure 2 - Mean number of arthropods.trap^{-1}.day^{-1} collected in areas of fruit cultivation and native vegetation during four seasonal periods in the Curu Valley, Ceará



It was found that the Acari, Collembola and Formicidae groups had the highest percentage of individuals, and alternated in predominance in each system and during the four sampling periods (Table 2).

In the area cultivated with mango it was found that the Formicidae group had the highest percentage of individuals during the rainy/dry and dry periods, while during the dry/rainy and rainy periods, the highest percentage was Collembola. In the area cultivated with guava, the greatest percentage of individuals was of the Collembola group during the rainy/dry, dry/rainy and rainy periods, while during the dry period, the Formicidae group was the most abundant. In the area cultivated with coconut, the highest collected percentages were from the Formicidae group during the dry period, Collembola

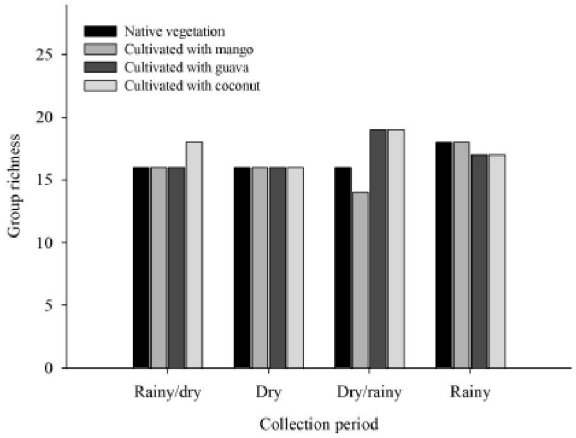
Table 2 - Percentage of soil arthropods collected in the areas under study during four collection periods in the Curu Valley, Ceará

Group	Percentage of arthropods (%)			
	Rainy/Dry	Dry	Dry/Rainy	Rainy
	Cultivated with mango (CM)			
Collembolas	11	3.2	55	61
Formicidae	53	91	18	13
Acari	13	1.5	4.2	12
Diptera	6.4	0.8	10	6.4
Hymenoptera	3.9	0.7	1.5	1.1
Aranae	4.5	0.1	0.6	0.3
Others	8.2	2.7	10.7	7.2
	Cultivated with guava (CG)			
Collembolas	82	4.8	68	94
Formicidae	4.7	72	10	1.2
Acari	2.6	8.3	12	1.6
Diptera	3.7	3.6	3.6	0.3
Hymenoptera	3.1	1.4	0.6	1.4
Aranae	0.7	3.7	1.1	0.2
Others	3.2	6.2	4.7	1.3
	Cultivated with coconut (CC)			
Collembolas	26	25	61	24
Formicidae	26	57	16	7.0
Acari	23	2.3	10	63
Diptera	8.0	8.8	4.9	1.8
Aranae	3.5	3.2	1.9	1.1
Coleoptera	2.6	0.4	1.	1.0
Others	10.9	3.3	5.2	2.1
	Native vegetation (NV)			
Collembolas	20	8.7	31	84
Formicidae	8.2	48.0	39	3.7
Acari	52	2.1	15	4.7
Diptera	8.6	0.6	4.9	3.9
Hemiptera	1.3	37.0	0.8	0.3
Coleoptera	2.6	0.1	0.4	1.5
Others	7.3	3.5	8.9	1.9

during the rainy/dry period and Acari during the rainy period. Under native vegetation, the highest percentages were from the Collembola group during the rainy/dry and rainy periods, Formicidae and Hemiptera during the dry period and Formicidae during the dry/rainy period. The other groups were collected at a low relative frequency in all areas.

During the seasonal collection periods, group richness was similar for each area (Figure 3). During the dry/rainy transition period, the area cultivated with coconut displayed the greatest group richness, while richness for the other areas was similar. During the dry period, group richness was the same in all areas. During the dry/rainy period, the greatest richness was seen in the areas of guava

Figure 3 - Richness of soil arthropods collected in areas of fruit cultivation and native vegetation during four seasonal periods in the Curu Valley, Ceará



and coconut, and the lowest, in the area of mango. During the rainy period, the greatest richness was seen in the areas of native vegetation and mango cultivation, while the areas of guava and coconut displayed similar values.

Significant differences (t >0.10, DF = 1; *p* >0.0001) were seen in soil arthropod diversity for the comparisons between areas and between collection periods, with the greatest diversity estimated for the area cultivated with coconut, and the lowest in the area of guava (Table 3).

During the rainy/dry period, the greatest diversity was seen in the area cultivated with coconut, and the lowest in the area of guava, while the area cultivated with mango showed no difference in relation to the native vegetation. During the dry period, the areas cultivated with coconut and guava did not differ from the native vegetation, while the area cultivated with mango displayed less diversity. During the dry/rainy period, the lowest diversity was seen in the area cultivated with guava, while the areas of mango and coconut showed greater diversity, but did not differ from the native vegetation. During the rainy period, the area cultivated with guava had the lowest diversity, showing no difference from the native vegetation, while the areas cultivated with mango and coconut displayed greater diversity than the native vegetation, but did not differ from each other. The same differences are seen for evenness.

The higher percentage of individuals found during the rainy season in the area cultivated with guava contributed to a reduction in the diversity index during this period (Table 2), since the greater the density of the fauna, the greater the chance of one group predominating, as was the case with the Collembola group, which accounted for 94% of the total. This also influenced evenness, considering that this is associated with the number of species (richness) and the distribution of individuals.

As previously mentioned, the area cultivated with mango, with the exception of the dry period, presented very

Table 3 - Values of the diversity index and evenness index for each area under evaluation and during the four collection periods, in the Curu Valley, Ceará

Variable	Collection			
	Rainy/dry	Dry	Dry/rainy	Rainy
	Native vegetation (NV)			
Shannon Index	0.61 ± 0.002 Ba	0.43 ± 0.006 Ab	0.59 ± 0.006 Aa	0.31 ± 0.005 Bc
Pielou Index	0.64	0.53	0.62	0.32
	Cultivated with mango (CM)			
Shannon Index	0.61 ± 0.004 Ba	0.23 ± 0.006 Bb	0.59 ± 0.006 Aa	0.55 ± 0.006 Aa
Pielou Index	0.59	0.26	0.66	0.66
	Cultivated with Guava (CG)			
Shannon Index	0.39 ± 0.006 Ca	0.38 ± 0.006 Aa	0.46 ± 0.006 Ba	0.14 ± 0.004 Bb
Pielou Index	0.36	0.46	0.46	0.15
	Cultivated with Coconut (CC)			
Shannon Index	0.74 ± 0.003 Aa	0.49 ± 0.006 Ab	0.58 ± 0.006 Ab	0.45 ± 0.005 Ab
Pielou Index	0.69	0.56	0.59	0.50

Mean values by the same uppercase letter in a column do not differ by Student’s t-test; Mean values followed by the same lowercase letter on a line do not differ by Student’s t-test close percentages for individuals, with small variations in the diversity index (H') and evenness index (e). In the area of coconut, minimal mobilisation of the soil, and the crop residue remaining on the surface, resulted in greater diversity of the fauna in comparison to the other cropping systems.

According to Baretta *et al*. (2007), under such conditions, the available food resources as well as the structure of the generated microhabitat, which maintains greater soil moisture, enabled the colonisation of several species of soil fauna with different survival strategies. Studies conducted in São Paulo by Alves, Baretta and Cardoso (2006) demonstrated that the lack of preparation and the abundance of ground cover under a no-tillage system, with longer implementation time, resulted in greater diversity of the edaphic fauna.

Values for the diversity index and for the evenness index in the area of native vegetation during the rainy period (Table 3), are different from other studies of edaphic fauna that were carried out in soils of the Caatinga biome (Dry Tropical Forest), which demonstrated high values for richness, diversity and evenness during wet periods (NUNES, ARAÚJO FILHO; MENEZES, 2009; SOUTO *et al*., 2008).

The dissimilarities between areas in the composition and distribution of soil arthropods, which demonstrate the effect of the alterations that occurred due to management practices and soil use, were confirmed by the correlations between the variables and factors obtained in the principal component and factor analysis.

From the correlations between the variables, five factors were obtained that showed a significant correlation (p<0.05) with the original variables, where it can be seen which factors belong to the variables and how much of each component is explained by each variable (Table 4).

The variables with the greatest contribution in the first factor were Collembola, Hymenoptera, Diversity and Evenness, while in the second factor these were Hymenoptera, Araneae, Orthoptera and Others. In the third factor, Acari, Araneae and Richness made the greatest contribution. In the fourth factor were Formicidae, Diptera and Coleoptera, with Diptera and Hemiptera in the fifth factor.

The variability of the data (soil arthropods and faunal indices) was evaluated for 100% of the information contained in the samples. Principal component analysis was carried out for the first two factors, since they were the most representative in the data analysis, with eigenvalues that respectively explained 29.91 and 22.58% of the variability, explaining 52.49% of the total variance of the analysed variables (Figure 3).

The variables grouped on the right side of the graph are influenced by rainfall (Prec) and to a lesser extent by total organic matter. The variables most influenced by moisture were Coleoptera, Ortoptera, Araneae, Diptera, Others, Wealth and Acari, while the remainder were influenced by the total organic matter.

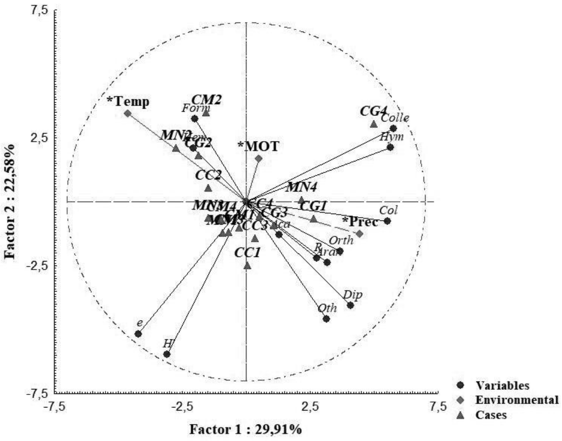
All the variables on the left side of the graph are influenced by temperature, especially the Formicidae

Table 4 - Correlations between the original variables (Arthropods and Indices) and the factors

Variable	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Collembola	0.86*	0.27	0.18	0.19	0.07
Formicidae	0.11	-0.22	-0.08	-0.89*	-0.14
Acari	-0.02	-0.18	0.79*	0.11	0.04
Diptera	0.00	0.41	0.09	0.51*	-0.66*
Coleoptera	0.48	0.05	0.38	0.57*	-0.44
Hymenoptera	0.76*	0.57*	0.11	0.04	0.15
Hemiptera	0.02	-0.16	-0.12	0.18	0.81*
Araneae	0.03	0.51*	0.74*	-0.28	-0.09
Orthoptera	0.15	0.77*	-0.12	0.12	-0.15
Others	-0.17	0.79*	0.11	0.25	-0.25
Diversity	-0.93*	0.27	0.13	0.10	0.01
Evenness	-0.95*	0.07	0.04	0.14	0.13
Richness	0.04	0.04	0.58*	0.22	-0.29

*Significant correlations P <0.05; Others = Sum of arthropod groups collected in small quantities

Figure 4 - Correlation circle between the original variables (soil arthropods and indices) and the factors of the principal component analysis for the areas cultivated with fruit trees and native vegetation in the Curu Valley, Ceará. Coll = Collembla; Aca = Acari; Form = Formicidae; Hym = Hymenoptera; Ara = Araneae; He = Hemiptera; Dip = Diptera; Colle = Coleoptera; Orth = Orthoptera; Oth = Arthropods collected at a lower frequency; H' = Shannon index; *e* = Pielou index; TOM = Total organic matter; Prec = Precipitation; Temp = Temperature; NV1 = Native vegetation (rainy/dry); CM1 = Cultivated with Mango (rainy/dry); CG1 = Cultivated with Guava (rainy/dry); CC1 = Cultivated with Coconut (rainy/dry); NV2 = Native vegetation (dry); CM2 = Mango (dry); CG2 = Guava (dry); CC2 = coconut (dry); NV3 = Native vegetation (dry/rainy); CM3 = Mango (dry/rainy); CG3 = Guava (dry/rainy); CC3 = Coconut (dry/rainy); NV4 = Native vegetation (rainy); CM4 = Mango (rainy); CG4 = Guava (rainy) and CC4 = Coconut (rainy)



and Hemiptera groups. The variables Collembola and Hymenoptera showed a good correlation with each other and with the principal components, which means that these organisms were collected in larger quantities in the CG4 and MN4 areas (rainy), and made similar contributions to forming the factors.

In biological terms, positive correlations may mean a direct relationship between groups, but should be analysed in greater detail in future studies. It is important to note that Collembola and Hymenoptera are influenced by rainfall, since for both groups a larger population is expected during this period (VASCONCELLOS *et al*., 2010). The CG4 area (rainy) was the most distant, due to displaying high dominance (Collembola) and lower values for the diversity index and evenness index, whose variables were plotted on opposite sides of the graph.

The samples collected in each area during the dry period fell into a single quadrant and displayed relative approximation, with the variables Formicidae and Hemiptera standing out, displaying a good correlation with each other and with the factors. These results confirm the influence of the environmental factors (temperature, moisture and organic matter) on the arthropod community in the soil, and that other (undetermined) factors may also contribute to a higher percentage of these organisms during this period.

The areas in their respective collection periods (MN1, MN3, CM1, CM3 and CM4) displayed high similarity, whose variables (H', *e*) exhibited high correlation with each other and with the principal components. These results are quite logical, since the diversity index reflects the relationship between the number of individuals and their distribution in the groups (evenness).

Similar to above, the areas CC1, CC3, CC4, CG1 and CG3 in their respective collection periods displayed a relative similarity to one another, with a higher percentage of individuals, despite making different contributions to forming the principal components. It can be seen that in these areas and during their respective collection periods, the populations of edaphic organisms are in a similar situation, and are highly influenced by the rainfall.

These results support the assertion that soil arthropods are influenced by the different cropping systems, with the changes occurring in the soil causing systemic responses in their community, estimates of which are an important tool in evaluating managements and system.

The finding that soil arthropods are influenced by environmental conditions has been confirmed by several studies (AQUINO *et al*., 2008; BARETTA *et al*., 2011; FERNANDES *et al*., 2011; LUDWIG *et al*., 2012; MAUNSELL *et al*., 2013; MOÇO *et al*., 2005, 2010), few however have demonstrated this influence for the conditions of the Brazilian semi-arid region (Dry Tropical Forest) (VASCONCELLOS *et al*., 2010).

Further studies, using other collection methods, are necessary to determine more accurately the distribution patterns and species diversity of soil arthropods in this environment.

CONCLUSIONS

1. The abundance and diversity of soil arthropods in the cultivation of fruit crops vary depending on the crop and the seasonal period in the region;
2. The Acari, Collembola and Formicidae groups were the most abundant in each area and during the four periods of the study;

3. The area cultivated with coconut displays better edaphic conditions for maintaining the arthropod community in the soil.

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