

IMPACT OF FIRES IN DIFFERENT MANAGEMENT SYSTEMS ON THE AREIA BRANCA FARM IN THE MUNICIPAL OF POMBAL- PB - BRAZIL

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ABSTRACT - The burning of pasture and crop residues in the period prior to the rains in the semi-arid region is a practice usually applied by farmers to facilitate cleaning of the area and renew pasture. This study aimed to evaluate the effect of fire in chemical and biological soil properties in different areas in the hinterland of Paraíba. The treatments consisted in the use of fire and grazing in an area of growing with and no use of fire in grassland and preserved savanna area that served as a witness. Samples were collected bimonthly from September 2008 to July/2009. Samples were collected at depth of 0-20 cm in each area, for analysis of chemical indicators. To determine the biological indicators were installed traps "Provid" which consisted in the use of plastic bottles for collection of soil macrofauna, the soil samples without problems to determine the mesofauna were extracted using the type extractors modified Berlese-Tullgren (OLIVEIRA 1999). Composed of rectangular boards, each containing structure, 25W lamps divided in two upper compartments contains rings with the samples and the lamps, while in the lower compartment are funnels and bottles of glass with a solution of ethyl alcohol 80% to the collection of organisms. The largest number of individuals of the mesofauna was collected in the areas of native grassland and savanna preserved without burning. As for the macrofauna, the capture of the organisms was higher in the area of native pasture without burning. The pH values were analyzed were near the neutrality, mainly suffering major reductions in CCQ. In burned areas (PNQ and CCQ) showed increased levels of P and K after burning and then there was a reduction in the levels.

Keywords: use of fire, soil organisms, quality indicators

IMPACTOS DO USO DAS QUEIMADAS EM DIFERENTES SISTEMAS DE MANEJO EM AREIA BRANCA MUNICÍPIO DE POMBAL – PB BRASIL

RESUMO - A queima da pastagem e dos resíduos vegetais no período que antecede às chuvas na região semi-árida é uma prática usualmente aplicada pelos agricultores para facilitar a limpeza da área e renovar a pastagem. O presente trabalho objetivou avaliar o efeito do fogo nas características químicas e biológicas do solo em diferentes áreas no sertão paraibano. Os tratamentos consistiram no uso do fogo em pastagem e em área de cultivo de milho e não uso do fogo em pastagem e em área de caatinga preservada que serviu como testemunha. As amostragens foram realizadas bimestralmente, de setembro/2008 a julho/2009. Foram coletadas amostras de solo na profundidade de 0-20 cm, em cada área, para análises de indicadores químicos. Para a determinação dos indicadores biológicos foram instaladas armadilhas do tipo "Provid" que consistiram no uso de garrafas pet, para a coleta da macrofauna do solo, as amostras indeformadas para determinação da mesofauna foram extraídas utilizando extratores do tipo Berlese-Tullgren modificado (OLIVEIRA, 1999). Composto por tábuas retangulares, contendo cada estrutura, lâmpadas de 25W, dividida em dois compartimento superior contém os anéis com as amostras e as lâmpadas, enquanto no compartimento inferior estão os funis e os frascos de vidro com a solução de álcool etílico a 80% para o recolhimento dos organismos. O maior número de indivíduos da mesofauna foi coletado nas áreas de caatinga preservada e pastagem nativa sem queima. Já para a macrofauna, a captura dos organismos foi superior na área de pastagem nativa sem queima. Os valores de pH analisados foi próximo à neutralidade, sofrendo reduções maiores principalmente na CCQ. Nas áreas queimadas (PNQ e CCQ) verificou-se aumento nos teores de P e K após a queima e em seguida ocorreu redução nos teores.

Palavras-chave: uso do fogo, organismos do solo, indicadores de qualidade

INTRODUCTION

The burning, a practice commonly used to clear the ground in the savanna, remove all ground cover and therefore a source of food by limiting the number of ecological niches and leading to further reduction of food resources (ARAÚJO FILHO & BARBOSA, 2000). In this context intensifying the effects on soil fauna for that being deprived of their food and shelter (NUNES et al., 2006).

One of the advantages of burning was in the pasture soil incorporation of nutrients in dry matter, thus contributing to the improvement of fertility (ZANINE & DINIZ, 2006). According to Jacques (2003), the argument that burning completely renews the grasslands, providing a diet of higher nutritional value for animals, but have no scientific support.

Corona-Garcia et al. (2004) state that fire at high temperatures (380-460 ° C) dramatically increases the water repellency of the hydraulic conductivity at the aggregate size distribution and porosity of the soil.

After burning there is an increase in the heating surface, by increased absorption of solar radiation, a fact not only caused by the loss of vegetation, but also the color which is on earth.

The soil cover of savanna, often forming a thick layer of leaves with various extracts of fresh material (CARVALHO, 2003), especially in the dry period, whereas woody species that make up this ecosystem type are deciduous and lose their leaves in early dry season (ANDRADE LIMA, 1981). These food resources that accumulate as also the microhabitat structure generated under these conditions, allow the colonization of various species of soil fauna with different survival strategies (CORREIA and ANDRADE, 1999).

The diversity of soil fauna has been considered a key aspect to maintaining the structure and fertility of tropical soils (LAVELLE et al. In 1994, BROWN et al., 2003), with apparently more rapid response than other soil properties serving therefore, as biological indicators sensitive to ecological changes in agroecosystems (BARETTA et al., 2003).

Decomposition of plant material in soil, nutrient cycling and indirect regulation of biological processes in soil, establishing interactions at different levels with microorganisms, which are fundamental for the maintenance of soil fertility and productivity of the ecosystem.

The main factors controlling the processes of transformation of soil organic matter (SOM) is the quantity and quality of the material, physical and chemical environment and decomposer organisms. Among the organisms, bacteria and fungi have high values of biomass and respiratory metabolism and a major player in the process of decomposition of soil organic matter (TOLEDO, 2003; LEJON et al., 2005).

Therefore, in areas native firing promotes the mineralization of the biomass and the transfer of nutrients to the soil surface in the form of ash consisting of oxides

of calcium, potassium, magnesium and other minerals. As a consequence, there is an immediate increase in production of forage, but it decreases in later years, especially when the burning is held annually and in the same area. However, an issue to be carefully considered regarding the use of fire, both in the native vegetation of the semi-arid pasture as is the fact that these severely degraded vegetation types cannot return to its original state even when abandoned for decades.

The present study aimed to evaluate the impacts of burning on the chemical and biological soil in areas with different management in semi-arid region of Paraíba.

The use of fire in the environment

The fire in some ecosystems can cause destruction and create severe damage and irreparable losses in terms of conservation, ecological and economic. Fire affects the biotic and abiotic components of the environment and its effects on them still generate much controversy (KOPROSKI, 2005).

According Svejcar (1989) the main determinants of changes in nutritional value are due to the burning action of fire on the dominant species, changes in diet after firing, the action of fire on vegetation structure and especially the reduction of material breakdown. So the burning seems to be a widespread practice, because of its low cost and ease of adoption.

Some advantages would burn grazing embodiment in the soil of nutrients in dry matter, thus contributing to the improvement of fertility (ZANINE and DINIZ, 2006).

For Spera et al. (2000), the action of the fire causes a lot of changes in physical, chemical and biological in the soil. Many authors refer to the use of fire as a method of soil management wrong, attributing possible actions degrading and soil sterility. Fire as a modifier of ecosystems has been highlighted in recent years, mainly because it is considered one of the causes of the increased concentration of carbon dioxide in the atmosphere.

The fire can vary in intensity, frequency or periodic, duration, location, form and extent. Its effects may differ between species affected during the seasons, nature of the combustible material, soil composition and conformation. Moreover, the fire differs in natural environments, the environments used or modified by man (CHANDLER et al., 1983).

According to Trindade Junior et al. (2004), farmers consider the traditional annual burning as a practical method for cleaning the field of plant remains, combating weeds, reducing the incidence of pests and diseases, and especially cost savings. However, the negative consequences that result from the burning need for further research to quantify its effects, especially with regard to the removal of soil organisms, burning of organic matter, nutrient volatilization, release of CO₂ into the atmosphere, reduced infiltration and soil water

retention, increased susceptibility to soil erosion, reduced soil productivity and imbalance in the environment.

Discard the remainder of forage from one year to the other, promotes a supposed improvement in the quality of forage due to the regrowth. Opposed to this fact, under natural field studies have shown that burning reduces forage quality and also the amount of nutrients in their Phytomass (HERINGER, 2000).

According to Jacques (2003), the argument that burning completely renews the grasslands, providing a diet of higher nutritional value for animals, but have no scientific support.

According to Neary et al. (1999), the impacts of fire on the sustainability of the soil are due to structural and functional changes in local ecosystems. According to these authors, the change in nutrient uptake, increased surface temperature of the soil and the changing rate of evaporation is the main influences that the change or removal of vegetation can bring edaphic systems.

The most widespread arguments against the use of fire in rural areas are the same effects on the ecosystem components, especially soil and atmospheric air. When the combustion process is complete the elements released by the fire are only water, carbon dioxide and heat. However, in practice, is never complete combustion and thereby there is also the release of residual fuel (carbon particles), carbon monoxide and other products which pollutants such as hydrocarbons and nitrogen oxides. The effects of fire on the ecosystem are directly related to the intensity (SOARES, 1995).

Influence of fire on soil chemical properties

There are arguments for and against the use of fire. Among the main effects of fire can be noted that, from a nutritional standpoint, it causes a great loss of nitrogen and organic matter, and this plays an important role in maintaining the fertility of tropical soils. The fire also causes the redistribution of nutrients among compartments of the forest ecosystem, accelerating the availability, may change the nutrient cycle through the effect on the deposition of "litter" and litter decomposition. Causes further changes in the rates of the various elements mineralization. (POGGIANI et al., 1983).

Second (SGHACHT et al., 1996) in the short term, raising the soil temperature induces an increase in the rate of waste decomposition and mineralization rate of organic matter (OM).

The burning of vegetation, instead of incorporation into the ground, provides the offset to the atmosphere essential to plant growth: nitrogen, phosphorus and potassium, causing also the air pollution and affecting the ozone layer Primavesi second (1999).

Studying the effect of fire on areas for reform of eucalyptus, MALUF (1991) found significant losses of some nutrients reaching the atmosphere, in kg ha⁻¹, 269.6 N, 5.6 P, 11.6 S, 16.9 K, 94.6 Ca and 26 Mg of S.

One of the most significant effects of fire is controlled on the ecosystem the mineralization of organic matter accumulated since the mineraliser is a rapid fire thereof. The mineralization constitutes the link between the organic and inorganic worlds, being so important to life like photosynthesis, which links the organic and inorganic worlds. The impoverishment of the soil through the fire can however occur primarily in two situations. First, fires in high intensity burning, volatilized or scattered almost all organic matter and most of the nutrients. Second, by successive firings gradually reduce the capital of nutrients from the soil without allowing its restoration. Numerous studies in the literature showing that some reporting increases of more than 100% in total N, P, K, Ca and Mg mineralized after the passage of fire. As plants absorb nutrients only mineralized, it is natural for them to grow more rapidly in burned areas (SOARES, 1995).

Nitrogen, carbon, sulfur, phosphorus and potassium are released from burning vegetation and litter. The non-volatized material is deposited on the soil surface, or removed as particulate matter in the smoke and ash. In ecosystems of open vegetation (savannas), shortly after the fires may occur increasing the pH and concentration of P, Ca, Mg and K in the surface layers of soil or significant variation in levels of other elements (PIETIKAINEN & FRITZE, 1995; FERNANDEZ et al., 1997). These increases are attributed to the effect of ash fertilizer, which even can lead to increased or acceleration of the primary production in certain ecosystems.

The degree of disorder in the OM determines a series of qualitative and quantitative transformation in its nature and composition, which according to Almendros et al. (1984), are attributed to three main processes: a) destruction by mineralization and carbonization of the organic constituents, b) change in its chemical nature of the different humic fractions and c) the contribution of various forms of amorphous organic carbon to the soil, in the form of pyrolytic products and remnants of burned vegetation.

The effect of fire on the content of soil organic matter is variable, depending on the degree of soil moisture, time and temperature of the burning and the time when it is performed. In pasture, the action of fire is relatively fast and the impact on organic matter content is not significant when considering only one burning. However firing in successive years in the same area can modify the contents of soil organic matter. Nitrogen can be lost through volatilization depending on the temperature (NASCIMENTO JÚNIOR et al., 1999).

The increase in soil temperature with the use of fire can cause oxidation of organic matter, concentrating the levels of P bound to Al, Fe and Ca and decreasing P concentrations of organic compounds and reduce the concentration of Ca, K and Mg in soil solution by leaching (FASSBENDER and BORNEMISZA, 1987).

The O.M. can be destroyed by distillation at temperatures ranging from 200-300 ° C, carbonized 300-

400 ° C and consumed above 450 ° C (NEARY et al., 1999). According to Santos et al. (1992), losses of soil and organic matter in grassland fires are greater the shorter the interval between firings, the terrain slope and soil type.

According Pardini et al. (2004), there is a drastic change in soil properties, erosion and nutrient losses after the use of fire in all soil types.

Influence of fire on soil biological attributes

As the soil microbiota is primarily responsible for the decomposition of organic compounds, the nutrient cycling and energy flow by soil microbial biomass and its activity has been identified as the characteristics most sensitive to changes in soil quality caused by use changes and management practices, such as those promoted by the application of organic waste (DEBOSZ et al., 2002).

The diversity of soil fauna has been considered a key aspect to maintaining the structure and fertility of tropical soils (LAVELLE et al. In 1994, BROWN et al., 2003), with apparently more rapid response than other soil properties serving therefore, as biological indicators sensitive to ecological changes in agroecosystems (BARETTA et al., 2003).

The main effects of the use of fire are related to biological and chemical alterations, such as reduction or alteration of the microbial population, temporary increase in nutrient availability, changes in pH, increasing the carbon source and organic matter oxidation (SANTOS et al., 1992).

The indiscriminate action of the fire decreases the amount of organic material, energy source of microorganisms, thus culminating in a decline in population of mesofauna and consequently the loss of productive capacity of the soil (ASSAD, 1996).

Antunes (1993), in his work about the effect of fire on soil microbiota of Atlantic Forest, found reduction in colony number and diversity of fungi in the soil affected by fire and a significant increase in soil pH. Moreover, maintaining the waste on the road surface tends to increase temporarily the micro and, consequently, causes higher fixation of some nutrients essential to the life cycle of the organisms.

The inert form of carbon (C) burning (carbon) will remain on the ground free from the action of microbial activity, a mean; will not be effectively used as an energy source, and consequently the formation of organic matter (ALBRECHT et al., 1995).

Therefore, in native areas firing promotes remineralisation of biomass and the transfer of nutrients to the soil surface in the form of ash consisting of oxides of calcium, potassium, magnesium and other minerals. As a consequence, there is an immediate increase in production of forage, but it decreases in later years, especially when the burning is held annually and in the same area. However, an issue to be carefully considered regarding the use of fire, both in the native vegetation of the semi-arid pasture as is the fact that these severely degraded vegetation types cannot return to its original state even when abandoned for decades.

MATERIALS AND METHODS

The study area is located on White Sand Farm, about 6 km from the town of Pombal-PB (06 ° 30'00" S and 37 ° 35 '48" W). The climate is characterized as Bsh the Köppen classification, with average annual rainfall of 431.8 mm. The classes of soils in the municipality according to Embrapa (2006) are mostly ALFISOLS, in association with the ENTISOLS and ULTISOLS.

The experimental design was in randomized blocks with split subdivided on time in a factorial 4 x 6 x 3 (four areas, six months and three repetitions). The areas studied were: A1 - preserved savanna (PS), A2 - native pasture burning (NPB), A3 - without burning native pasture (PNWB) and A4-burned conventional cultivation (CCB), whose annual crop corn was explored.

Four plots were demarcated of 100m² (10 x 10 m), being two plots located in an area of native pasture, where one was burned and the other left without burning, and the third was installed in an area of savanna, considered in this study as control and the fourth installment installed in an area of cultivation conventional corn was also burned (Figure 1).





Figura 1. Experimental plots: pasture burned (A), pasture without burning (B), area of cultivation of corn burned (C) and area of savanna (D).

Burning in the pastures and corn cultivation was performed at the beginning of the dry period (September 2008). In all experimental areas were evaluated bimonthly in order to evaluate the magnitude of changes in the physical, chemical and biological as management systems adopted them

For the analysis of chemical indicators of soil quality soil samples were collected at 0-20 cm in the plots. In plots burned soil samples were collected before and after firing in order to compare the results, and observe the occurrence of changes in these attributes sampling was random, collecting single samples from each plot, to remove a composite sample. After air-dried, samples were sieved and sent to the Soils Laboratory of the Technical School of Sousa, Sousa (PB) for the performance of analytical procedures, according to the methodology of Embrapa (1997).

Among the biological markers was evaluated bimonthly density and diversity of organisms in macrofauna and mesofauna in the selected areas.

In each experimental area were installed three traps "Provid" (Antoniolli et al., 2006) to capture the organisms of macrofauna in each area were installed three traps Provid, designed by Antoniolli et al. (2006). This trap consists of PET bottles with a capacity of two liters, containing four openings in the form of windows with dimensions of 4 x 6 cm in height of 20 cm from the base. The bottles were buried in the ground so that the edges of the openings to stay at the soil surface and spaced from each other (Figure 2) Each trap remained in the field for a period of three days, inside containing 200 ml of alcohol 70% more 3-5 drops of 2% formalin.

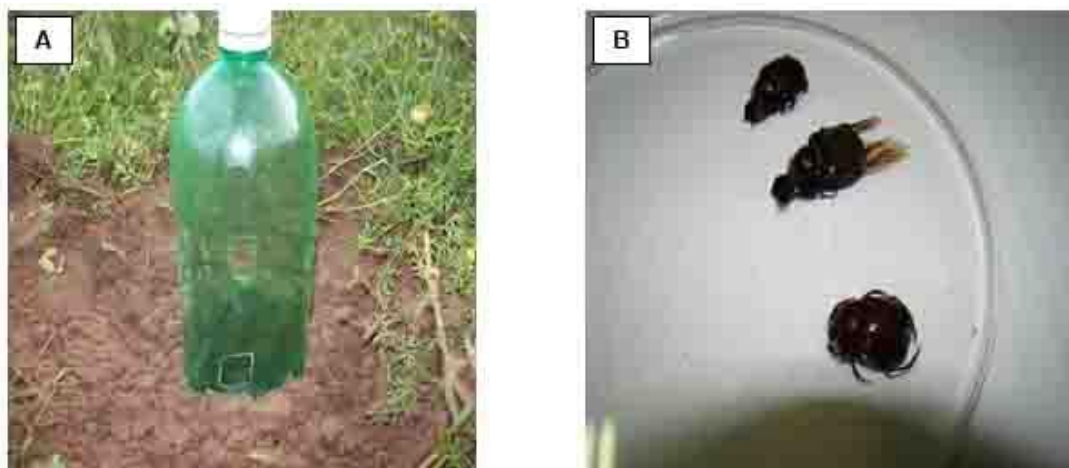


Figure 2. Trap type Provid collection of macrofauna (A) and identification of organisms in the laboratory (B)

After the collecting of the traps was made the identification and counting of organisms in the laboratory. Using Petri dishes under a binocular microscope, the sample specimens macrofauna were quantified and

identified at large groups in general orders according to the descriptions provided by Thiplehorn & Johnson (2005).

Artigo Científico

From the data obtained were calculated on the total abundance, richness (number of groups identified) and the Shannon diversity index and Pielou evenness for comparison of communities in each collection area. The Shannon index considers the wealth of species and their relative abundance, defined by: $H = -\log \sum p_i * p_i$, where $p_i = n_i / N$, n_i = abundance of each group and N = total abundance. The Pielou index is an index of uniformity, which refers to the pattern of distribution of individuals

between groups, being given by the expression: $e = H / \log S$, where H = Shannon index and S = number of species or groups.

To determine the mesofauna, samples of soil and ground litter were collected with the use of metal rings (diameter = 4.8 cm and height = 5.2 cm). In the bimonthly samples were taken three samples in each selected area, totaling 12 samples / month of collection (Figure 3).



Figure 3. Metal ring used to collect undisturbed soil samples for determination of soil mesofauna

After collected, the samples were placed in plastic bags, properly identified and transported in coolers to the dependencies of the Laboratory of Soil / UFCG / campus of Pombal, where

After the transfer of the samples, the battery extractor was sealed with the veil, to prevent the entry of other insects that are attracted by the lights (Figure 4)



Figure 4. Extract used in Berlese-Tullgren extraction of soil mesofauna.

The samples were stored into the extractor for 96 hours exposed to light and heat, the temperature where the top ring has reached about 42 ° C. With the high temperature, the organisms migrating to the deeper layers and fall into the glass vials containing the solution of ethyl alcohol 80%. The contents of the vials from the extracts were examined individually in a Petri dish with the aid of a binocular lens. The identification and quantification of mesofauna, as well as the comparison of communities in areas followed the same methodology adopted for soil macrofauna.

The collection of soil for moisture content determination was performed concomitantly with the samples of soil fauna. In determining the water content in the soil were collected on aluminum cans of known weight, soil samples to 15.0 cm. Once collected, the cans were taken to the laboratory where the weighing is carried then placed in an oven at 105 ° C for 24 hours. Later they were placed in desiccators to cool down, and then weighed. The water content in soil is determined by the methodology described by Tedesco et al. (1995).

The results of the study variables were subjected to analysis of variance and means compared by Tukey test

at 5% probability using the statistical program ASSISTAT beta version 2008.

RESULTS AND DISCUSSION

The monthly averages of water content in the soil for the study period between September 2008 and July 2009 are shown in Figure 5. It was observed that water content in the soil throughout the experimental period was significantly higher in the months of March, May and July/2009, a period of occurrence of the highest rainfall in the region which contributes to increase the water content in soil. The evaluation of water content in soil is essential for the maintenance of resilience in the microhabitat of edaphic organisms. According Souto et al. (2002), which evaluated the mesofauna and microbial activity in semi-arid region of Paraíba, the increase in soil water supply can reduce or contribute to a reduction in the supply of O₂ in the soil, reflecting the population of existing organism. Thus, it is of fundamental importance to the continuous monitoring of weather and soil water content in the evaluation studies of edafic organisms.

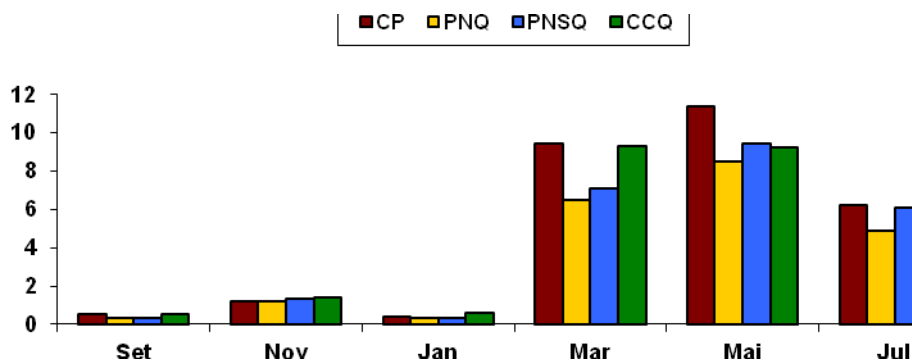


Figure 5. Soil Moisture (%) in the experimental areas during the sampling period (September to November/2008 and January to July/2009).

Assessing levels of soil moisture at four experimental sites along the sampling times (Figure 5) showed that the highest averages were found in the area of advanced CP, while the lower water contents obtained in the form PNQ. This fact is explained by greater vegetation found in the PC area, where the litter provides better conservation of soil moisture. In the area PNQ removal of vegetation by crop management (use of fire) left the bare ground, absorbing the sun's radiant energy promoting, consequently, the water evaporation from the soil, reducing the percentage of moisture.

It was collected in the four experimental areas a total of 460 organisms of mesofauna divided into seven groups, except in the area PNSQ, identified eight groups. The ecological indices (Table 1), the value of the Shannon varied between the areas. It was found that in all areas of

the lowest values of the Shannon index (H) were recorded in the Hymenoptera group, indicating that this group was dominant over others, thus reflecting on the Pielou evenness index (e), or that is, species diversity is associated with a relationship between number of species (species richness) and the distribution of the number of individuals among species (evenness) (WALKER, 1989). The groups Hymenoptera, Diptera, Acarina, Colembola, Diplura and Hemiptera were present in all studied areas, with high proportions for the first four. Nunes et al. (2009) also reported the presence of more Hymenopteros (Formicidae) where according to these authors this group is predominant in the savanna prevalent in periods of low water. It was found that the groups had Colembola and Acarina and their populations reduced in burned areas

(PNQ and CCQ) when compared with the area of native vegetation (CP).

Table 1. Densities and rates of soil mesofauna collected in different areas during the experimental period (September 2008 to July/2009)

| Faunistic Group | CP | | | PNQ | | | PNSQ | | | CCQ | | |
|-----------------|-------|-------------|-------------|-------|-------------|-------------|-------|-------------|-------------|-------|-------------|-------------|
| | N.I.* | H | J | N.I. | H | J | N.I. | H | J | N.I. | H | J |
| Diptera | 0,363 | | | 0,255 | | | 0,173 | | | 0,290 | | |
| Hymenoptera | 0,308 | | | 0,364 | | | 0,332 | | | 0,336 | | |
| Acarina | 0,340 | | | 0,327 | | | 0,275 | | | 0,283 | | |
| Colembola | 0,323 | | | 0,228 | | | 0,336 | | | 0,275 | | |
| Odonata | 0,037 | | | - | | | - | | | - | | |
| Diplura | 0,158 | | | 0,213 | | | 0,242 | | | 0,087 | | |
| Hemiptera | 0,037 | | | 0,159 | | | 0,251 | | | 0,221 | | |
| Embiidina | - | | | - | | | 0,037 | | | - | | |
| Coleoptera | - | | | 0,049 | | | - | | | 0,221 | | |
| TOTAL | | 1,57 | 0,75 | | 1,60 | 0,76 | | 1,64 | 0,79 | | 1,71 | 0,82 |

* N. Individuals number.

The effects of fire on soil on edafic mesofauna were higher in the PNQ (Table 1) where observed and reduction in the number of organisms in relation to other areas. In relation to wealth (no groups) to simulate the CP PNQ was supposedly an area that is in balance. Similar results were obtained by Nunes et al. (2006) and Nunes et al. (2009) which according to these authors the presence of ash in burned areas improves soil fertility, contributed in some way to generate a more favorable environment for the establishment of invertebrate edafic fauna. However, this fact requires a more detailed investigation.

Considering the whole sample period it was found that the effect of fire on the population of mesofauna was more pronounced in the driest periods in

the region (in September, November/2008 and January/2009) with a reduction in the number of organisms collected. With the onset of rains in the region increases occurred in the soil water content (Figure 5) and increase in herbaceous PNQ in providing greater supply of food and smaller microclimatic variation. According to Oliveira et al. (2006), herbaceous environments consisting of grazing influence the edaphic communities that are less abundant and diverse. Nunes et al. (2009) point out that the available food resources, as well as microhabitat structure has generated greater soil moisture, allowed the colonization of various species of soil fauna with different strategies for survival in the cropping systems in question.

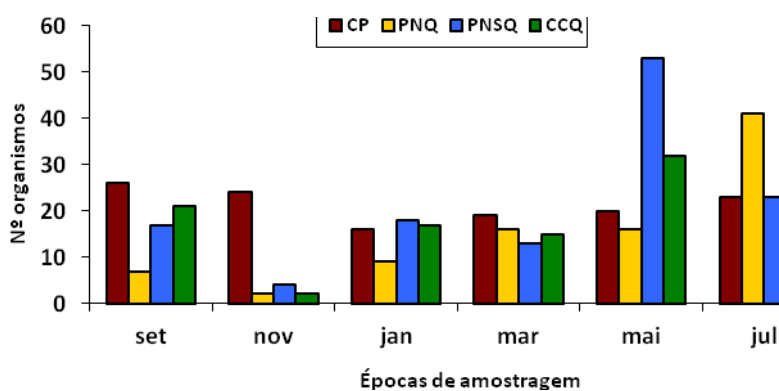


Figure 6. Total mesofauna organisms collected in the experimental areas at different sampling dates (September-November/2008 and January-March-May-July/2009).

With respect to macrofauna was collected a total of 2,051 organisms during the experimental period. Of the total of organisms was observed that 60.1% belonged to the Hymenoptera, Coleoptera group to 17.7% and 15.5% to the group Diptera which are the most representative in all areas studied. This superiority in the density of individuals in the Hymenoptera was also verified by Correia et al. (2009) to quantify the macrofauna at three in the harsh environments of Paraiba.

Table 2 shows that the groups Hymenoptera, Coleoptera, Diptera, Hemiptera and Aracnida were captured in all areas studied. Groups and Hymenoptera and Coleoptera recorded the lowest values in the Shannon index, except in the groups that had PNSQ Hymenoptera and Diptera with lower values. This indicates that these groups were the most abundant in those areas, contributing to the reduction represented by the evenness index of Pielou (e).

The Shannon diversity index is one of the most commonly used and shown to be extremely suitable for use in soil ecology, since it assigns higher values to rare species in the community (TOLEDO, 2003).

In the PQ reductions occurred in all groups, and this can be attributed to the burning place which provided

the removal of vegetation along with individuals from some groups of macrofauna living there.

The density of the Hymenoptera group was higher in CP with more pronounced reductions in the areas PNQ and CCQ. Similar results were reported by Brown et al. (2001) found that reductions in populations of ants, in areas of cultivation and pasture, in relation to native vegetation. The factor that may have contributed negatively to the population of the areas Hymenópteros PNQ and CCQ was the use of fire for waste disposal, because PSQ in the number of organisms was practically equal to the CP. Importantly, the area had already been submitted PNQ to burning the previous year and the effects on the macrofauna was more evident with several groups representing less than 2% of the total catch. Thus, the crop residue is of great importance in maintaining the resiliency in microhabitats. Silva et al (2007) point out that the presence of permanent cover on the soil contributes to the increased availability of energy associated with the existence of new habitats favorable to the colonization of invertebrate organisms, which can benefit the ecological sustainability of production systems.

Table 2. Densities and rates of soil macrofauna collected in different areas during the experimental period (September 2008 to July/2009)

| Faunistic Group | CP | | | PNQ | | | PNSQ | | | CCQ | | |
|---------------------|-------|-------------|---|-------|-------------|---|-------|--------------|--------------|-------|--------------|--------------|
| | N.I.* | H | J | N.I. | H | J | N.I. | H | J | N.I. | H | J |
| Diptera | 0,273 | | | 0,226 | | | 0,339 | | | 0,261 | | |
| Hymenoptera | 0,315 | | | 0,271 | | | 0,324 | | | 0,294 | | |
| Aracnida | 0,068 | | | 0,044 | | | 0,077 | | | 0,066 | | |
| Odonata | 0,019 | | | - | | | 0,056 | | | 0,034 | | |
| Diplura | 0,026 | | | 0,061 | | | 0,062 | | | - | | |
| Hemiptera | 0,063 | | | 0,131 | | | 0,039 | | | 0,115 | | |
| Embiidina | - | | | - | | | - | | | - | | |
| Coleoptera | 0,331 | | | 0,297 | | | 0,045 | | | 0,312 | | |
| Orthoptera | 0,083 | | | - | | | 0,010 | | | - | | |
| Chilopoda | - | | | 0,014 | | | - | | | - | | |
| Mantodea | - | | | 0,014 | | | - | | | 0,024 | | |
| Larva de Coleoptero | - | | | - | | | - | | | - | | |
| TOTAL | | 1,18 | | | 1,06 | | | 0,955 | 0,459 | | 1,109 | 0,533 |

* N. Individuals number.

In relation to the evaluation times of macrofauna (Figure 7) shows that the largest number of individuals was collected in the months of PNSQ November/2008 and January-July/2009. However, in the month of May/2009 in CP occurred in the highest density of macrofauna surpassing all times and the other areas studied. The macrofauna community dynamics, according to Odum

(1988) follows the same trend of variation in the systems managed by reducing or increasing according to the evaluation time. This oscillation in the density and richness of edafic macrofauna seems to relate to the variation of temperature and humidity systems. Because of the close association with the processes that occur in the compartment litter-soil and its high sensitivity to biotic

and abiotic factors, the diversity of soil macrofauna community reflects the pattern of ecosystem functioning.

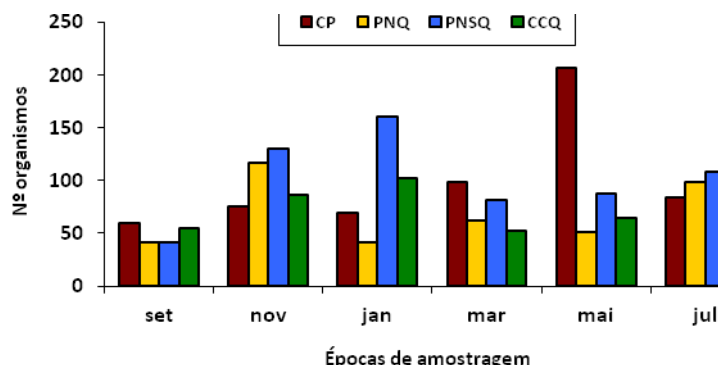


Figure 7. Total macrofauna organisms collected in the experimental areas at different sampling dates (September-November/2008 and January-March-May-July/2009).

Table 3 can be seen the results of some chemical parameters of the soil analyzed. In general, there was little variation in the levels of chemicals evaluated. The results

of chemical analysis are shown in Table 1. The soil CCQ showed good chemical characteristics with base saturation greater than 50%, which gives them a eutrophic character.

Table 3. Chemical characteristics of soils in experimental areas at a depth of 0-20 cm, at different times of sampling. CP = Savanna Preserved; PNQ = Native Pasture Burn; PNSQ = Native Pasture without burning; QCC = Conventional Farming Burned.

| AREA | pH | P mg dm ⁻³ | K | Na | Ca | Mg | Al | H+Al | SB | CT C | V % | MO g kg ⁻¹ | PST % |
|----------------------------------------------------|-----|--------------------------|------|------|-----|-----|-----|------|------|---------|--------|--------------------------|----------|
| | | | | | | | | | | | | | |
| First sample (September/2008 – Before the burning) | | | | | | | | | | | | | |
| CP | 7,0 | 16 | 0,20 | 0,05 | 0,3 | 0,3 | 0,0 | 1,3 | 0,85 | 2,15 | 40 | 1,78 | 2 |
| PNQ | 6,8 | 27 | 0,27 | 0,04 | 0,4 | 0,1 | 0,0 | 0,16 | 0,81 | 0,97 | 84 | 4,79 | 4 |
| PNSQ | 6,6 | 69 | 0,17 | 0,03 | 0,6 | 0,2 | 0,0 | 1,32 | 1,0 | 2,32 | 43 | 3,50 | 1 |
| CCQ | 8,0 | 309 | 0,61 | 0,07 | 1,1 | 0,3 | 0,0 | 0,0 | 2,08 | 2,08 | 100 | 13,83 | 3 |
| Second Sample (November/2008) | | | | | | | | | | | | | |
| CP | 7,0 | 16 | 0,20 | 0,05 | 0,3 | 0,3 | 0,0 | 1,3 | 0,85 | 2,15 | 40 | 1,78 | 2 |
| PNQ | 6,5 | 28 | 0,32 | 0,03 | 0,4 | 0,1 | 0,0 | 1,65 | 0,85 | 2,50 | 34 | 2,21 | 1 |
| PNSQ | 6,1 | 43 | 0,22 | 0,03 | 0,6 | 0,2 | 0,0 | 2,64 | 1,05 | 3,69 | 28 | 7,59 | <1 |
| CCQ | 7,9 | 335 | 1,24 | 0,08 | 1,3 | 0,3 | 0,0 | 0,0 | 2,92 | 2,92 | 100 | 9,96 | 3 |
| Thirdly Sample (January/2009) | | | | | | | | | | | | | |
| CP | 6,8 | 12 | 0,22 | 0,05 | 0,4 | 0,4 | 0,0 | 1,14 | 1,07 | 2,55 | 42 | 1,57 | 2 |
| PNQ | 6,8 | 24 | 0,57 | 0,03 | 0,5 | 0,2 | 0,0 | 1,32 | 1,30 | 2,62 | 50 | 4,37 | 1 |
| PNSQ | 6,6 | 37 | 0,18 | 0,04 | 0,7 | 0,2 | 0,0 | 1,81 | 0,94 | 2,75 | 34 | 5,66 | 1 |
| CCQ | 7,5 | 191 | 0,54 | 0,05 | 1,1 | 0,2 | 0,0 | 0,0 | 1,89 | 1,89 | 100 | 11,03 | 3 |

P, K, Na: Extrator Mehlich 1; Al, Ca, Mg: Extrator KCL 1M; SB=Ca⁺²+Mg⁺²+K⁺+Na⁺; H + Al: Extrator Acetato de Cálcio 0,5 M, pH 7,0; CTC=SB+H⁺+Al⁺³; M.O.: Digestão Úmida Walkley-Black; PST= Percentagem de Sódio Trocável

The pH values analyzed in all areas and sampling time was close to neutrality, suffering major reductions mainly in CCQ. In burned areas (PNQ and CCQ) showed increased levels of P and K after burning and then there was a reduction in the levels. Similar results were

obtained by Pomianoski et al. (2006) to assess the effect of fire in chemical and biological soil properties in the Bracatinga Agroforestry System in Colombo, PR.

Virtually no change in Ca and Mg in the different areas studied. The organic material was reduced in its

content particularly in the areas that were maintained with the use of fire.

CONCLUSIONS

- The density of macrofauna and mesofauna of the soil appeared as a biomarker sensitive to changes in management between the different systems of land use evaluated;
- The group Hymenoptera was the most numerous in all areas studied for both mesofauna and macrofauna for;
- Burning stimulates changes in edafic populations, especially in the pasture;
- The burning of waste in the pasture and conventional tillage with corn initially increases the concentration of some nutrients, especially phosphorus and potassium concentrations did not return to the original;
- The months of greater soil water regimes favored the increase of the community of soil mesofauna and macrofauna in the study area;
- Soil management by means of fires contributed to the reduction of the diversity of fauna culminating with the elimination of some groups

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