CHAPTER 121

Soil microbiological parameters in an intercropped production system under management organic

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Josimar da Silva Chaves
teacher of University Federal in Roraima (UFRR/EAGRO)
Email: josimar.chaves@ufrr.br

Sandoval Menezes de Matos
Graduated in Mathematics (UERR); Master in Agroecology (UERR); Electrical Technician at the Institute Federal in Education, Science and Technology in Roraima.
E-mail:sandoval.matos@ifrr.edu.br

Romildo Nicolau Alves
Institute Federal in Education, Science and Technology in Roraima
E-mail:romildo.alves@ifrr.edu.br

Hipólito Ribas Pereira
Institute Federal in Education, Science and Technology in Roraima
E-mail:hipolito.pereira@ifrr.edu.br

Juliano Jonas Sábio de Melo
Institute Federal in Education, Science and Technology in Roraima
E-mail: julianosabio@ifrr.edu.br

André Ferreira Silva
Institute Federal in Education, Science and Technology in Roraima
E-mail: andre.silva@ifrr.edu.br

Edileusa de Jesus dos Santos
Institute Federal in Education, Science and Technology in Roraima
E-mail:edileusa.santos@ifrr.edu.br

Robson Pereira Silva
University State in Roraima, Brazil
Email:robsonrj77@hotmail.com

Cristiane Pereira de Oliveira
Institute Federal in Education, Science and Technology in Roraima
Email: cristiane.oliveira@ifrr.edu.br

Gabriel Carvalho Gomes
Institute Federal in Education, Science and Technology in Roraima
Email: gabriel.gomes@ifrr.edu.br

ABSTRACT
The different soil management systems, such as no-tillage and conventional planting, as well as crop rotation and succession, promote changes in the soil, altering factors such as the availability of water, oxygen and substrate, directly affecting the soil microbiota. The objective was to evaluate the effects of the management of intercropping systems with the presence of the legume gliricidia, without gliricidia and native vegetation on soil microbiological attributes. An experiment was carried out under field conditions, in an area of organic management of land use, cultivated with legume gliricidia, fruit trees and forest essence. The design used was in randomized blocks, in which ten soil samples were collected in triplicate at two depths (0-10 and 10-20 cm). The samples were homogenized and sieved in sieves, placed in properly identified plastic bags and subsequent analysis of the microbial attributes (microbial biomass carbon-Cmic, microbial biomass nitrogen-Nmic, metabolic quotient-qCO2 and basal respiration (RBS). that the cultivation systems caused significant alterations in the microbiological attributes of the soil when compared with the native vegetation. of the native vegetation, while the values of Cmic, RBS and qCO2 did not differentiate.These results confirm that the intercropping systems with the presence of gliricidia was equal to the native forest, in providing favorable conditions for the mineralization of organic matter by the soil microbiota.

Keywords: Sun management, Vegetables, Microbiota.

1 INTRODUCTION

Soil is a living and dynamic natural resource that enables and sustains the production of food and fiber, regulating the global balance of the ecosystem, which is closely linked to the particularities and processes that occur in the atmosphere, hydrosphere, lithosphere and biosphere (Silva & Mendonça, 2007), fundamental for agricultural production. Among all the resources natural resources, the soil is a non-renewable resource on a human scale and has been suffering in recent years several degrading processes, making it necessary to adhere to agricultural practices, such as prevention for degradation not to affect new areas and that Keep capacity productive of same (Cavalcante et al., 2012).

Soil quality is defined as its ability to sustain and maintain biological productivity within the ecosystem, maintaining environmental quality and promoting the health of the plants and animals encompassed therein, and it can be evaluated using physical, chemical and biological indicators (Leal et al., 2021). Soil quality is a property of sustainability of cultures, also influencing the health of plants, animals and consequently in human beings (Melo et al., 2017). Soil is a naturally diverse habitat, with highly complex biological communities in which are different forms of microorganisms, both eukaryotes and prokaryotes, that interact in an environment dynamic and in state of balance (Carrer Filho, 2002).

The living microbial components of the soil are also called microbial biomass and bacteria and fungi account for about 90% of soil microbial activity (Andreola & Fernandes, 2007). The soil has an immense diversity of the microbiota, being the main activities of the organisms the decomposition of the OM, production of humus, nutrient and energy cycling (including atmospheric nitrogen fixation), production of complex compounds that contribute to soil aggregation, decomposition of xenobiotics and biological control of pests and diseases (Moreira & Siqueira, 2006). The population of microorganisms in the soil is a component of paramount importance in the transformations of matter organic of ground, then Those use Those materials as source in energy and nutrients for The formation and Ocellular development, thus causing temporary immobilization of carbon, nitrogen, calcium, magnesia phosphor, sulfur and micronutrients, you which after The death From microorganisms, will be made available for at plants.

Soil organic matter represents the main source of energy for microorganisms and nutrients for plants. plants, and their changes can indicate the degree of preservation or imbalance of natural ecosystems. In this context, the sensitivity of chemical indicators may not be sufficient to indicate changes that have occurred with the material organic of ground, for the replacement gives forest per activities agrosilvopastoral, having The need in select indicators, as you biological, what be sensitive The small changes at the system soil-plant, with that you microorganisms can be used as sensitive indicators of soil quality. Some of the main indicators soil quality microbiological factors are the biodiversity of microorganisms, the microbial biomass (BMS) the respiration basal it's the metabolic quotient (Araújo & Monteiro, 2007).

However, in isolation, the microbial biomass (BMS) little reflects changes in soil quality, despite to be an indicator of anthropic interventions (Brookes, 1995). However, BMS associated with organic matter content can be used as indices to compare soil quality under different managements. Although, BMS's answer is faster, if compared to the content of organic matter (Jenkinson & Ladd, 1981). These authors suggest that the changes in BMS content long-term predict soil organic matter content. The microorganisms decompose organic matter, release nutrients in forms available to plants, and degrade toxic substances (Kennedy & Doran, 2002).

Green manures perform important actions in the soil such as: protection from the impact of rains and also against moisture loss; disruption of densified and compacted layers over time; increase in the content of mattersoil organic; increase in the capacity of infiltration and retention of water in the soil; Decreased Al and Mn toxicity due to complexification and pH elevation; promoting the rescue and recycling of easily leached nutrients, extraction and mobilization of nutrients from deeper soil and subsoil layers, such as Ca, Mg, K, P and micronutrients; extraction of phosphor fixed; fixation of No atmospheric in manner symbiotic by legumes; inhibition gives germination and of plant growth invasive, whether by effects allelopathic, whether by the simple competition per light (Silva et al., 2020)

Thus, green manure has several beneficial functions for the soil, with an increase in biological diversity in the soil. production unit provides changes in the dynamics of invasive species, in the population dynamics of insects, pests, predators and pollinators. In addition to influence the qualities physical, chemicals and biological soil (Espíndola et al. al., 2004).

At practice gives fertilizing green he can if use so much grasses as legumes, at the ent you waste in legumes can contribute to the reduction of acidity of soil and the C/N ratio in soil organic matter and residues of grasses has a higher lignin content, favoring the structuring and stability of aggregates, making them less susceptible to compaction (Andrade et al., 2009). However, for green manure, legumes have been used more often due to their atmospheric N2 fixation potential through the symbiotic association of bacteria of the genus *Rhizobium* and *Bradyrhizobium*, which, in addition, has a deep root system, capable of exploiting nutrients from the deepest layers of the soil. You effects chemicals at the ground provided for the fertilizing green depend in factors as: species used, O management aimed at biomass, planting time, cutting of green manure, the time the residues remain in the soil and the interaction between Those factors (Alcântara et al., 2000).

Souza et al. (2020), evaluating biological fixation and nitrogen transfer by *Gliricidia sepium* in an orchard organic intercropping of orange and banana found that the amount of N made available through green manuring supplied in 55% of the nutritional requirement of crops (oranges and bananas). This amount of N supplied by gliricidia pruning was enough to supply the N demand of the orange plants, in the formation phase, with that the same author reports that The use of Fabaceae that have a high potential for biological fixation of nitrogen (NFB) and of production of biomass, as green manures in orchards, in addition to providing savings on fertilizers, contributes to the ecological management of the orchard. Thus, the objective was to evaluate the effects of the management of intercropping systems with the presence of the legume gliricidia, without gliricidia and vegetation native about attributes microbiological of ground, per quite gives analysis gives biomass microbial, breathing basal and nitrogen from microbial biomass, managed in organic form.

2 METHODOLOGY

This is an exploratory research of a quantitative nature (Pereira et al., 2018). The experiment was developed at Instituto Federal Roraima - *Campus* Novo Paraíso, located in the municipality of Caracaraí, Roraima, under the coordinates 1°15'7.86 N and 60°29'14.18 W. The weather type is tropical rainy, with annual rainfall totals relatively high, arriving The two 000 mm second The classification in Koppen. With temperatures averages in 26.8

°C The soil of the study area is classified as Argisol Dystrophic Red Latosol (Embrapa, 2013), with the physical and chemical properties described in Table 1. Chemical and microbiological analyzes of the soil were carried out in the laboratory of soils and plants of federal Institute from Roraima - New *Campus* Paradise.

Table 1. Chemical characterization and physical gives layer in 0–20 cm from soil gives system area in consortium.

Área	pH	PK	Ca + Mg	Al	(H+Al)	SB	CTCpH7	t	V	MOS	Granulometria Argila	Silte	Areia
	H2O	mg/dm³	mmolc/dm³						-------%-------		g/kg		
CGL	6,13	39,0	1.0	4,45	0.05	4,22	5,50	9,72	5.55	56,6	2,1	170	10	820
SGL	6,00	19,0	0.05	2,15	0.05	5,14	2,20	7,34	2.25	30,0	1.0	-	-	-
VNM	4.57	13,0	0,06	1,23	1,30	8,45	1,28	9,73	2,58	13	1,3	-	-	-

(CGL) system in cultivation consortium with gliricidia; (SGL) system in cultivation consortium without gliricidia; (VNM) vegetation native – Woods;
(P) Phosphorus available (Mehlich -1) (K) Potassium available. (Ca) Exchangeable calcium. (Mg) Exchangeable magnesium. (Al) Exchangeable acidity. (H+Al) Potential acidity. (SB) Sum of bases. (CTC) Cation Exchange Capacity at pH7.0. (t) Effective Cation Exchange Capacity. (V) Base Saturation. (m) Saturation per Aluminum. (MOS) Matter organic of Ground. Source: Authors.

The treatments consisted of three areas with different management and use (area in intercropping with gliricidia (*Gliricidia sepium* (Jacq.) Steud.) + fruit (orange (*Citrus sinensis* L. Osbeck), banana (*Musa* spp.) (CGL); area with intercropping of orange and forest essence (ipê - *Handroanthus heptaphyllus*) without gliricidia (CSG) and the area of native vegetation (forest) (VNM) used as a reference. Each 1600m² area was divided into five plots, of which each one he was subdivided in two subplots, in the which were collected samples in ground at rhizosphere of plants, in the depths of 0 – 10 and 10 -20 cm. The design used is a completely randomized block design with a factorial arrangement. (3x2), with three soil management and land use systems (legumes + fruit trees, fruit trees + forest essence and vegetation native - forest) and two soil collection depths. Thirty soil samples were collected in the three study areas in the depths in 0.0 – 10cm and 10 – 20 cm, with three repetitions in your respective depths totalizing 90 samples. The samples were packed in sterile plastic bags, properly identified, and stored in a cold chamber at 4ºC (Sarathchandra, 1978).

In the samples in ground in laboratory were done O process in squeegee in sieve in mesh two mm in opening, where all animal and plant residues were removed. For the analysis of basal respiration determination (RBS), it was determined according to Jenkinson and Powlson (1976), using 20 g of each soil sample were incubated for 168 hours at room temperature in 0.5 liter hermetically sealed flasks and the CO

$_2$ captured in 100 mL flasks containing 10 mL of a KOH solution (0.3M). After incubation, 3 mL of $BaCl_2$ was added (20%) and the excess of KOH was determined by titration with HCl solution (0.1 mol L^{-1}. For the extraction of carbon and nitrogen from the biomass (Cmic and Nmic) 60 mL of a 0.5 M solution of K_2SO_4 were added to the soil samples that were subjected to agitation (40 min; 150 rpm), followed by decanting for 30 minutes. Then, the samples were filtered through filter paper for separation. from the extract to posteriorly determination of Cmic and number

Determination of Microbial Biomass Carbon (Cmic) was carried out by the fumigation-extraction method, according to Vance, et al., (1987), using the correction factor (kC) of 0.33 recommended by Sparling and West (1988), in order to express the fraction of Cmic recovered after the fumigation-extraction process. Determination of Nitrogen from Biomass microbial (Nmic) was performed by the fumigation-extraction method with the extractor soil ratio of 1:2.5 (Tate et al., 1988), with the addition of chloroform directly to the sample, keeping them in a dark place for 24 hours, continuing extraction and quantification of microbial nitrogen by steam distillation (Kjeldanhl), followed by volumetry of acid-base neutralization using acid sulfuric acid (H_2SO_4) as titrant.

The data of the variables obtained in each time of soil sampling, distinctly, were submitted to analysis of variance and the results of the means of each treatment were statistically analyzed using the SISVAR program, version 4.3 (Ferreira, 2014). You effects From treatments will be compared fur test of tukey The 5% in probability.

3 RESULTS AND DISCUSSION

Higher values of microbial biomass carbon (C_{mic}) were observed in soil samples of vegetation native (forest) at a depth of 0-10 cm (Table 2), with significant differences between intercropping systems with presence of gliricidia (CGL) and without gliricidia (SGL). However, at a depth of 10-20cm higher values were observed in the consortium system with the presence of gliricidia. These results corroborate those obtained by Silva et al. (2021), which cites a 356% increase in microbial biomass carbon (C_{mic}) in intercropping areas of fruit trees with gliricidia in in relation to intercropped areas without the presence of gliricidia, at a depth of 0-10 cm. Silva et al. (2021), mentions that most microbiological activity in the surface layer of the soil is due to the higher content of organic matter present on the surface from soil. Leal et al. (2021), evaluating the effect of management systems and land use on the population of microorganisms in the soil, in areas of intercropping of fruit trees with and without gliricidia, observed a greater number of colony-forming units (UFC g solo $^{-1}$), in system with consortium with gliricidia.

Other factor what justifies that increment It is O management applied in this area with at pruning of plants in gliricidia being the biomass placed in the rhizosphere region of fruit plants. According to Paula (2015), the decomposition of waste from leguminous plants, can be a source of carbon and nutrients for the soil biota and later for the plants, highlighting the importance gives synchronization in between The release in nutrients by plants in consortium and your demand by cultures main. Nutrients are released by the decomposition of waste, through pruning. Souza et al. (2020), working in a consortium of fruit trees with gliricidia, emphasize that the repeated deposition of gliricidia twigs and leaves in crowning of the fruit trees, increased O contents in organic matter of ground and consequently the microbiota, being able to extract nutrients in layers deep of ground, leaving them to reach for O growth of cultures through gives cyclingof nutrients.

Results many different to the in Carbon gives biomass microbial (C_{mic}), were observed for O Nitrogen gives microbial biomass (N_{mic}) (Table 2). A significant difference was observed between the soil management systems, being in the depth of 0-10 cm, the highest values in the consortium with the presence of the leguminous gliricidia (CGL) and in the area with native vegetation - forest (VNM) respectively. At a depth of 10-20 cm, higher values were observed in the systems in management from soil CGL and SGL respectively, obtaining a significant difference each other.

Table 2. Values of soil microbiological attributes, in different management systems.

attributes microbiological	System in management of ground	Depths (cm)	
		0-10	10-20
Microbial Biomass Carbon - Cmic (mg Cmic kg $^{-1}$ soil)	CGL SGL VNM	989.6 B 277.7 Ç 1074.7 A	507.1 A 404.2 B 442.7 B
Microbial biomass nitrogen - Nmic (mg Nmic kg $^{-1}$ soil)	CGL SGL VNM	347.3 A 99.7 Ç 236.4 B	314.1 A 159.5 B 35.3 Ç
Basal Soil Respiration - RBS (mg C-CO_2 kg-1 soil h $^{-1}$)	CGL SGL VNM	1.86 B 1.04 C 3.75 A	1.08 B 0.52 C 1.37 A
Metabolic quotient - qCO2 (mg C-CO2 g-1 Cmic h $^{-1}$)	CGL SGL VNM	1.46 B 1.67 B 2.77 A	0.75 B 0.73 B 0.95 A

CGL : System consortium with gliricidia; **SGL** : system without consortium with gliricidia; **VNM** : Area in Woods.
Values at same column, comparing systems in management of ground, in a row gives same letter uppercase, no differ in between yes (Tukey$p<0.05$). Analysis carried out at the Laboratory in soils and IFRR plant, Caracaraí-RR, 2021.
Source: authors.

The biomass attributes C_{mic} and N_{mic} serve as indicators of soil quality (Ferreira; Wendland; Didonet, 2011); however, the use of these parameters alone is not so appropriate to determine the real metabolic state of the microorganisms of ground (Bowles et al., 2014), with that, does if required to take in consideration other attributes that express the microbiological quality of the soil. In this sense, the quantification of other parameters such as Basal respiration of the soil (RBS) and the metabolic quotient (qCO_2) contributes with pertinent information about the soil microbiota activity and the dynamic of microorganisms (Anderson; Domsch, 1990).

Regarding RBS, a significant difference was observed in all types of soil management, with the lowest value observed under SGL at both depths. A higher value was observed for the area of native vegetation (forest) and the system CGL at both depths. Thus, the greatest release of CO_2, expressed by RBS, in forest soil may be in occupation gives constant incorporation in matter organic O what promotes O increase gives biomass, resulting in larger release of CO_2 (Kuzyakov, 2010). Thus, the higher content of C_{mic} is positively related to the release of CO_2 (Adachi et al., 2006).

When observing the values of qCO_2, a high value was observed for the forest followed by the CGL at a depth of 0- 10, and the forest followed by the SGL system at a depth of 10-20, this value indicates that the $CO_{2 \text{ release rate}}$ per unit in C_{mic} It is smaller under ground with the handling CGL on depth in 0-10, and at depth in 10-20 cm, the system in SGL

Gupta and Singh (1980) defined the process of $CO_{2 \text{ release}}$ as the sum total of all the metabolic functions of the body. soil, in which CO_2 is produced, this is the result of 3 processes called microbial respiration, root respiration and faunal respiration is a non-biological process, chemical oxidation which can be directly influenced by high temperature.

According to Cunha et al. (2011), higher CO2 release is generally associated with higher biological activity, which, in turn, is directly related to the amount of labile C in the soil, which explains the higher values in the topsoil layer that was observed in all management systems and in the forest (Souto et al., 2009). However, according toCunha et al. (2011), the interpretation of the results of biological activity must be done with discretion, as high values of breathing nor ever indicate conditions desirable, being able The I enjoy deadline to mean release in nutrients for at plantsand, in the long term, loss of organic C from the soil to the atmosphere (Parkin et al., 1996). Therefore, high values of C-CO2 can indicate so much situations in disturb how high level of productivity of system (Islam & Weil, 2000).

Thus, in a management system there are several biotic and abiotic interactions that can interfere with the parameters soil microbiologicals. Based on the results observed for the attributes of microbial biomass, it can be infer that, compared to SGL, CGL promotes less disturbance of soil microbial biomass, providing greater $C_{\text{mic values}}$ and N_{mic}, but higher values of qCO_2 can be caused by high temperatures and high humidity causing greater activity microbial and The oxidation of organic matter by having greater release CO_2.

In general, the soil microbial biomass attributes were affected by the soil management system, being that the forest presented values of C_{mic}, N_{mic}, RBS and qCO_2 higher than those observed under CGL and SGL. The highest values observed for the parameters evaluated in the forest soil are related to the higher content of organic matter present, in comparison to solo under CGL and SGL, one time what school subjects organic promotes results beneficial to properties edaphic (Cardozo et al., 2008) and microbiological of ground (Elfstrand; et al., 2007; Elfstrand; et al., 2007).

Thus, the soil management treatment under CGL was the closest and even surpassed in some parameters the area of native vegetation (forest), thus suggesting that the agricultural activity conducted under this type of management is any less impactful under O Score by sight From indicators microbiological.

4 CONCLUSION

It concludes that the cropping systems caused alterations in the microbiological attributes of the soil in comparison withnatural environment (forest). The presence of the legume gliricidia, associated with the management of plant pruning, was decisive for the elevate you parameters microbiological analyzed of ground.

The intercropping systems with the presence of the leguminous gliricidia (CGL), provided nitrogen values of the microbial biomass (N_{mic}) higher than the values observed in a forest environment, thus being an efficient system in use and cycling of that nutrient.

Works involving the study of soil microbiota in intercropped agricultural systems in the Amazon should be developed, for better use of available resources in rural properties in this region, given the scarcity of resources financial by farmers relatives. perspectives as other plants agricultural and legumes native are parameters that can to be analyzed and come to add this study.

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REFERENCES

Adachi, M., et al. (2006). Differences in soil respiration between different tropical ecosystems. *Applied Soil Ecology*. 34(2/3), 258-65

Anderson, J. D., & Ingram, J.S.I. (1996). *Tropical soil biology and fertility: a handbook of methods*. (2nd ed.): CAB International, 171p.

Anderson, T. H., & Domsch, K. H. (1990). Application of ecophysiological quotients (qCO2 and qD) on microbial biomasses from soils of different cropping histories. *Soil Biology and Biochemistry*. 22(2), 251-5.

Andrade, S. R., stone, F. L., & Silveira, M. P. (2009). cultures in Roof and Quality Physical in a Latosol in a System in Planting Direct. *Magazine Brazilian in Engineering Agricultural and Environmental* . 13(4), 411- 418.

Andreola, F., & Fernandes, S. THE. P. (2007). *microbiota of ground and quality environmental* . Institute Agronomic Campinas, sp, 21-37 .

Araújo, R., Goedert, WJ, & Coelho, MPC (2007). Soil quality under different uses and native Cerrado. *Brazilian Journal of Soil Science* , 31:1099-1108.

Borges, AL, Silva, S. de O., Caldas, RC, & Ledo, CAS (2006). Leaf nutrient contents in banana genotypes. *Brazilian Magazine of fruit growing* , v.28, p.314-318.

Brookes, DC (1995). The use of microbial parameters in monitoring soil pollution by heavy metals. *Biology and Fertility of Soils* , Berlin, v. 19, p. 269-279, Cardozo, S. v., et al. (2008). Description in properties edaphic in areas under management organic and Natural at region mountain of state of River in January. *Seminar: Sciences agrarian* , 29(3), 517-530,

Cavalcante, S. v., Santos, VR, Santos-Neto, AL, Santos, MAL, Santos, C. G., & Costa, LC Biomass and nutrient extraction by plants of roof (2012). *Magazine Brazilian in Engineering Agricultural and Environmental* . 16(5), 521-528.

load Son, R. (2002). *Actinomycetes as agents in biocontrol in illnesses and as promoters in growth of tomato* . 78 f. Dissertation (Master's degree) - University Federal in Vicious, Viçosa-MG.

Cochran, W G (1965). *techniques in sampling* . Background in Culture, 555p.

Cunha, EQ, Stone, LF, Ferreira, EPB, Didonet, AD, Moreira, JAA, & Leandro, WM (2011) – Soil preparation systems and cover crops at production organic in bean and corn. II – attributes biological of ground. *Magazine Brazilian in Science of only* , 35(2), 603-611. http://dx.doi.org/10.1590/S0100-06832011000200029

Dias., et al. (2007). Transfer of N fixed by leguminous trees to Survenola grass grown in intercropping. *Rural Science* , Santa Maria, 37(2), 352-356.

Elfstrand, S., Båth, B., & Mårtensson, A. (2007). Influence of various forms of green manure amendment on soil microbial community composition, enzyme activity and nutrient levels in leek. *applied Soil Ecology* , 36(1), 610-621.

Espíndola, JAA, Almeida, LD, & Guerra, MGJ (2004). *Strategy for using legumes for green manure in a production unit agroecological* . Seropedic: Embrapa Agrobiology, 24 P. (Embrapa Agrobiology. documents, 174).

Espindola, JAA, Guerra, JGM, Perin, A., Teixeira, MG, Almeida, DL, Urquiaga, S., Busquet, RNB (2006). Banana trees intercropped with legumes herbaceous perennials used as toppings cheers. *Search Brazilian Agriculture* , v.41, p.415-420.

Ferreira, D. F. (2014). Sisvar: The computer statistical statistical analysis SYSTEM *Science Agrotechnology* - UFLA 35(6). 1039.

Ferreira, E. P. B., Wendland, A., & Didonet, A. D. (2011). Microbial biomass and enzyme activity of a Cerrado Oxisol under agroecological production system. *Bragantia*, 70(4), 1-9.

Finckh, M. R., & Tamm, L. (2015). *Organic management and airborne diseases*. In: Finckh, M. R.; Van Bruggen, A. H. C.; Tamm, L. *Plant diseases and their management in organic agriculture*. (1ª ed.) APS Press.

Gupta, S. R., & Singh, J. S. (1981). Soil respiration in tropical Grass Land. *Soil Biol. Biochem*. Vol. 13, pp 261-268,

Hara AF, & Oliveira AL (2019). Symbiotic effectiveness of rhizobia isolates in cowpea (*Vigna unguiculata* L.walp) in acid and alic latosol in the Amazon. *Brazil J of Develop* ., Curitiba, 5(12), 28310-28324, dec. 2019 ISSN 2525-8761.

Islam, K. R., & Weil, R. R. (2000) – Land use effects on soil quality in a tropical forest ecosystem of Bangladesh. *Agriculture Ecosystems & Environment*, 79(1), 9-16. https://doi.org/10.1016/S0167-8809(99)00145-0

Jenkinson, D. S., & Ladd, J. N. (1981). Microbial biomass in soil: measurement and turnover. In: Paul, E. A., Ladd, J. N. (Org.) *Soil biochemistry.* New York: Marcel Dekker, p. 415-471.

Jenkinson, D. S., & Powlson, D. S. (1976). The effects of biocidal treatments on metabolism in soil: a method for measuring soil biomass. *Soil Biology and Biochemistry*, 8(3), 209-213.

Kennedy, A., & Doran, J. (2002). Sustainable agriculture: role of microorganisms In: BITTON, G. (Org.). *Encyclopedia of environmental microbiology*. New York: John Wiley & Sons, p. 3116-3126.

Loyal, M. L. THE., et al. (2021). It is made From systems in management and of use of ground at population in microorganisms of ground. *research, society and development* , 10(9), e21910917966. http://dx.doi.org/10.33448/rsd-v10i9.17966 .

Kuzyakov, Y. (2010). Priming effects: Interactions between living and dead organic matter. *Soil Biology and Biochemistry,* 42(9), 1363-1371. Rodrigues, M. G. V., et al. (2010). Amostragem foliar da bananeira 'prata-anã'. *Rev. Bras. Frutic*., Jaboticabal - SP, 32(1), 321-325.

Mafra, THE. L., Miklos, THE. THE. W., Vocurca, H. L., Harkaly, THE. H., & Mendoza, AND. (1998). Production in phytomass and attributes chemicals of ground under cultivation in alleys and under vegetation native in thick. *R. Bras. ci. only* , 22:43-48.

Melo, V. F., Silva, D. T., Evald, A., & Rocha, P. R. R. (2017). Chemical and biological quality of the soil in different systems of use in the savanna environment. *Revista Agro@mbiente on-line*. 11(2): 101-10.

Osterroht, M.(2002). Growth of pasture: fundamentals for O management in pastures. *agroecology today* , Botucatu, 2(13), 21-22 .

Paula, P. D., et al. (2015). Decomposition of pruning of legumes arboreal *gliricidia sepium* and acacia very distressing in a system agroforestry. *Science forest* . Santa Maria. 25, 791-800.

Parkin, T. B., Doran, J. W., & Francop-Vizcaino, E. (1996) – Field and laboratory tests of soil respiration. In: Doran, J.W. & Jones, A. (Eds) – Method for assessing soil quality. Madison, *Soil Science Society of America*, p. 231-245.

Paulino, GM, Alves, BJR, Barroso, DG, Urquiaga, S., & Espindola, JAA (2009). Biological fixation and nitrogen transfer by legumes in orchard organic in hose and soursop. *Search agriculture Brazilian* . 44: 1598-607.

Paulino, GM, Alves, BJR, Barroso, DG, Urquiaga, S., & Espindola, JAA (2011). Performance of gliricidia in alley cultivation in an organic orchard in hoses and soursop. *Magazine tree* , 781-789.

Pereira THE. S., et al. (2018). Methodology gives search scientific. [*free e-book*]. Santa Maria/RS. Ed. UAB/NTE/UFSM

Queiroz, L. R. (2006). *legumes as source in nitrogen for The culture of corn.* Thesis (Doctorate degree in Production Vegetable) – fields From Goytacazes-RJ, University State of North Fluminense - UENF, 72f .

Santana, AC, Chaves, J.S, & Rodriguez, CA (2017). Microbial biomass in different soil management systems in southern Roraima state. *Magazine Brazilian in Sciences gives amazon* , p.1-67.

Silva, C. F., et al. (2021). Soil attributes as indicators of the stabilization process of erosion in gullies at different formation stages in the South east region of Brazil. *Revista Ambiente & Água* [online]. 2021, 16(4). https://doi.org/10.4136/ambi-agua.2632.

Silva, H. S., et al. (2021). Activity microbial at the ground in system in production consortium. *research, society and development* , v. 10, n.14, e534101422366. http://dx.doi.org/10.33448/rsd-v10i14.22366

Simon, S. *Manual in Fruticulture* .: agronomic Ceres, 2014. 530p.

Siqueira, J O., Moreira, F. M. S., Grisi, B. M., Hungary, M., & Araujo R. S. (1994). *microorganisms and Law Suit biological of ground: Perspective environmental.*
Company Brazilian in Search agriculture, center National in Search in Rice and Bean, center National in Search in Soy. EMBRAPA p.142.

Souto, P. Ç., bake, I. THE., Souto, J S., & Oliveira, VM (2009) - kinetics gives breathing edaphic in two environments distinct at the semi-arid gives Paraíba, Brazil. *Magazine Caatinga* , 22(3), 52-58.

Souza, S. L., Keys, S. J., alves, No. R., Rodrigues, G T., Paradise, THE. S. B., saints, No. J P., bushes, M. S., & Soares, B. R. Fixation biological and transfer of nitrogen by *Gliricidia sepium* in an organic orchard of orange and banana (2020). *Brazilian Applied Science Review.* 4(5), 2916-2925p. 10.34115/basrv4n5-013.

Sparling, G. P., & West, A. W. (1988). A direct extraction method to estimate soil microbial C: calibration in situ using microbial respiration and 14C labelled cells. *Soil Biology and Biochemistry*, 20(3), 337-343.

Tate, K. R., Ross, D. J., & Feltham, C. W. (1988). A direct extraction method to estimate soil microbial C: Effects of experimental variables and some different calibration procedures. *Soil Biol. Biochem.*, 20:329-335.

Thomas, R. L., Sheard, R. W., & Moyer, J. R. 1967. Comparison of conventional and automated procedures for nitrogen, phosphorus, and potassium analysis of plant material using a single digestion. *Agron. J.* 59:240-243.

Vance, E. D., Brookes, P. C., & Jenkinson, D. S. An extraction method for measuring soil microbial biomass C. *Soil Biology and Biochemistry*. 19: 703-707, 1987.