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Spatial distribution of acidity components and oxidizable carbon fractions in a silvopastoral system

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Abstract

The silvopastoral system (SPS) stands out as an agroecological production system that has improved the soil's chemical quality. However, these chemical properties may have distinct changes with greater or lesser distances from the tree row tracks of the silvopastoral system. The objective of this study was to investigate the effects of the distance of the soil sampling points from the eucalyptus tree rows in a 2-year silvopastoral system on acidity components and oxidizable organic carbon fractions of the soil, as well as to compare these chemical properties with the conventional pasture system and native Cerrado vegetation. In the silvopastoral system (SPS), the soil samples were collected at 2.5, 5.0, 7.5, and 10 m of transverse distance from the eucalyptus tree row tracks. Soil samples collected in a conventional pasture area (CP) and a native Cerrado vegetation area (NV) were used as reference treatments. Soil samples were collected at depths from 0.0–0.10, 0.10–0.20, and 0.20–0.30 m. The acidity components (pH, Al^{3+} and H + Al) and oxidizable organic C fractions (F_1: labile fraction; F_2: moderately labile fraction; and F_3: poorly labile fraction) were determined. The results showed that the lowest soil acidity level was observed at 2.5 and 10.0 m distances from the eucalyptus tree rows. However, the spatial distribution of soil sampling points to the eucalyptus tree rows in a 2-year silvopastoral system did not change the oxidizable fractions of the soil organic carbon. The 2-year silvopastoral system and native Cerrado vegetation area had the highest concentrations of organic carbon in the labile (F_1) and poorly labile (F_3) fractions in the soil profile compared to the conventional pasture system. A 2-year silvopastoral system in a low fertility tropical soil from the Brazilian Cerrado has not yet been able to improve the soil's chemical quality; therefore, further research should be carried out to investigate the medium and long-term effects of the silvopastoral system on the acidity components and oxidizable organic carbon fractions of the soil.

Keywords: soil organic matter compartments; organic C; mitigating greenhouse gas emissions; agroecological practices.
Abbreviation: SPS_silvopastoral system, CP_conventional pasture, NV_native Cerrado vegetation, GHG_greenhouse gas. pH_active acidity.

Introduction

The silvopastoral system (SPS) is considered a conservation production system and has been used in Brazil to fight the increasing degradation of pasture areas. Silvopastoral systems constitute a set of strategies to enhance productivity while reducing input costs and increasing environmental sustainability, enhancing organic carbon sequestration, and building the production system's resilience to cope with the impacts of climate change (Solorio et al., 2017).

The SPS is a land use management system combining trees and/or woody perennial plants, pasture, and livestock, benefiting from ecological and economic interactions between its parts due to production diversification (Torres et al., 2017; Marques-Filho et al., 2017). Therefore, the adoption of SPS can improve the chemical, physical and biological properties of the soil compared to conventional livestock production systems (Loss et al., 2014). Interaction between the different components of SPS can increase soil organic matter content and reduce greenhouse gas (GHG) emissions by improving above- and belowground biomass (Torres et al., 2017). In addition, food production and carbon sequestration by tree planting in these systems can help to reduce deforestation in tropical countries (Zomer et al., 2016; Solorio et al., 2017).

The quality of the agricultural production system can be measured through some chemical indicators of the soil, such as acidity components and oxidizable carbon fractions (Awale et al., 2017; Batista et al., 2018; Bongiorno et al., 2019; Rocha-Junior et al., 2020). The relationships between active acidity (pH), exchangeable acidity (Al^{3+}), and potential acidity ($H^+ + Al^{3+}$) have been used to understand the complex chemical reactions of the soil. They are considered an excellent indicator in the evaluation of the effective cation exchange capacity (ECEC) and potential cation exchange capacity (CEC) at pH 7.0 (Mantovanelli et al., 2016). On the other hand, the quantification of the oxidizable fractions of organic carbon allows the evaluation of the dynamics of soil organic matter and the identification of the most efficient agricultural production systems for maintaining and/or improving soil quality (Rosset et al., 2016; Batista et al., 2018).

The use of acidity components and oxidizable carbon fractions can assess the impact of silvopastoral system management on soil quality compared to other land use systems and/or native vegetation. Indeed, the oxidizable carbon fraction (i.e., labile carbon fraction) and the soil acidity components have been identified as excellent indicators in assessing soil quality (Awale et al., 2017; Bongiorno et al., 2019; Rocha-Junior et al., 2020). However, the ideal location of soil sampling points in the silvopastoral system has been a limiting factor for assessing soil quality in this production system. This is because the labile organic matter in soil mainly originates from the decomposition of plant and faunal biomass, root exudates, and decreased microbial biomass (Bolan et al., 2011). In the silvopastoral system, tree rows in the middle of the forage species have made it difficult to choose the proper location of soil sampling points.

Acidity components and organic matter in the soil can have distinct changes with greater or lesser distances from the tree rows of the silvopastoral system. Faria et al. (2009) reported a reduction in exchangeable acidity and an increase in soil pH with increasing distance from eucalyptus tree rows in the silvopastoral system. However, Marques-Filho et al. (2017) showed no effect of the distance from the location of the soil sampling points to the eucalyptus tree rows on the organic matter content and soil pH. Therefore, identifying the distance separating the soil sampling points from the tree rows is extremely important, especially when comparing the soil quality of the silvopastoral system with other land use management systems.

This research was conducted to investigate the effects of the distance of the soil sampling points concerning the eucalyptus tree rows of the silvopastoral system on acidity components and oxidizable carbon fractions of the soil, and to compare these chemical properties of the soil with the conventional pasture system and native vegetation.

Results and Discussion

Effects of soil sampling distance and depth in silvopastoral systems on soil acidity components

The soil pH value in the 0.0–0.10 m layer was higher in the conventional pasture system (PC) and silvopastoral system at distances of 2.5 m (SPS-2.5) and 10.0 m (SPS-10) from the eucalyptus tree triple rows (Table 1). The lower soil pH value observed in the silvopastoral system at distances of 5 m (SPS-5) and 7.5 m (SPS-7.5) m from the eucalyptus triple rows was similar to the pH value of the Cerrado native vegetation area (NV) (Table 1). In the 0.10–0.20 m and 0.20–0.30 m layers, the soil pH value was higher in the silvopastoral system at distances of 2.5 m (SPS-2.5) and 10.0 m (SPS-10) from the eucalyptus triple rows when compared to the other treatments (Table 1).

Faria et al. (2009) evaluated the soil's chemical properties from eucalyptus tree rows in a silvopastoral system. They showed that the soil pH value increased significantly with the greater distance from the eucalyptus row tracks. These results have been attributed to rainfall promoting the washing of organic compounds and minerals from tree leaves and trunks into the soil. These substances can cause greater soil acidity near the tree rows in the silvopastoral system. However, this change in soil acidity provided by trees planted in intercropping with forage grasses in the silvopastoral system was not evident in this study since the soil pH value was higher at 2.5 m and 10 m from the eucalyptus tree rows. In a study conducted in a 6-year silvopastoral system composed of a consortium of palisade grass (*Urochloa brizantha* cv. Marandu) and eucalyptus trees, Marques-Filho et al. (2017) reported no change in the soil pH value in samples collected up to a distance of 10 m from the eucalyptus tree rows. Therefore, based on our results and the contradictory results observed in the literature, other studies should be conducted to investigate the impact of tree row tracks in the silvopastoral system on acidity and other soil chemical properties.

The soil pH value ranged from 4.0 to 4.6, regardless of the soil layer (Table 1), and these values are classified as low (pH in $CaCl_2 \leq 4.4$) and medium (pH from 4.5 to 4.8) according to pH classes for Cerrado soils (Sousa and Lobato 2004). Therefore, these results suggest that both the silvopastoral system and the conventional pasture system have not contributed in the short term to the decrease in active soil acidity. The silvopastoral system used in this study was implemented 2-years ago, and the stabilization of this agroecological production system, in general, occurs only after 8-years of implementation. Therefore, further studies should be carried out in long-term silvopastoral systems to assess their effect on soil acidity components compared to conventional pasture systems and native vegetation.

In the three soil layers, the potential acidity (H+Al) was significantly higher in the native vegetation area (NV), followed by the silvopastoral system with soil samples collected at 5 m (SPS-5) and 7.5 m (SPS-7.5) from the eucalyptus tree rows, and lower in the conventional pasture area (CP) and silvopastoral system with samples collected 2.5 m (SPS-2.5) and 10 m (SPS-10) of distance from the eucalyptus tree rows (Table 1).

The higher H+Al content in the soil under native vegetation can be attributed to the high degree of soil weathering, absence of acidity correction practices, and the low level of natural soil fertility. Carvalho et al. (2015) also reported high

Table 1. Mean values of active acidity (pH), potential acidity (H+Al) and exchangeable acidity (Al^{3+}) at 0.0–0.10; 0.10–0.20 and 0.20–0.30 m depths of the soil in samples collected at different distances from eucalyptus tree rows of the silvopastoral system (SPS) and in areas of conventional pasture (CP) and native Cerrado vegetation (NV).

Treatments†	Soil acidity components††		
	pH (unit)	H+Al ($cmol_c\ dm^{-3}$)	Al^{3+} ($cmol_c\ dm^{-3}$)
	0.0–0.10 m		
SPS-2.5	4.65 a	4.65 c	0.30 b
SPS-5	4.27 b	5.18 b	0.48 a
SPS-7.5	4.20 b	5.60 b	0.50 a
SPS-10	4.54 a	4.46 c	0.28 b
CP	4.57 a	3.99 c	0.25 b
NV	4.39 b	7.29 a	0.28 b
F value	3.51*	16.14**	6.71**
CV (%)	4.32	11.24	24.81
	0.10–0.20 m		
SPS-2.5	4.42 a	4.86 c	0.40 b
SPS-5	4.19 b	5.40 b	0.40 b
SPS-7.5	4.09 b	5.87 b	0.58 a
SPS-10	4.48 a	4.66 c	0.28 b
CP	4.22 b	4.39 c	0.40 b
NV	4.29 b	10.01 a	0.55 a
F value	4.51**	49.77**	2.93*
CV (%)	3.16	3.91	30.04
	0.20–0.30 m		
SPS-2.5	4.57 a	4.43 c	0.28 b
SPS-5	4.16 b	5.48 b	0.48 a
SPS-7.5	4.07 b	5.93 b	0.63 a
SPS-10	4.45 a	4.68 c	0.38 b
CP	4.16 b	4.47 c	0.45 a
NV	4.23 b	9.76 a	0.55 a
F value	5.14**	22.26**	4.11*
CV (%)	4.01	5.85	26.72

† SPS-2.5: Silvopastoral system with soil samples collected 2.5 m from triple row tracks of eucalyptus trees. SPS-5: Silvopastoral system with soil samples collected 5.0 m from triple row tracks of eucalyptus trees. SPS-7.5: Silvopastoral system with soil samples collected 7.5 m from triple row tracks of eucalyptus trees. SPS-10: Silvopastoral system with soil samples collected 10.0 m from triple row tracks of eucalyptus trees. CP: conventional pasture. NV: native Cerrado vegetation., †† pH in 0.01 mol L^{-1} $CaCl_2$, soil:solution ratio (1:2.5). H+Al extracted by 0.5 mol L^{-1} $Ca(CH_3COO)_2.H_2O$ solution at pH 7.0. Al^{3+} extracted by 1 mol L^{-1} KCl solution. , Means followed by distinct letters in the column show significant differences (Scott–Knott test, $P \leq 0.05$). * and **: statistical significance at 5% and 1%, respectively, by F test. CV: coefficient of variation.

Table 2. Mean values of oxidizable organic C fractions at 0.0–0.10, 0.10–0.20 and 0.20–0.30 m depths of the soil in samples collected at different distances from eucalyptus tree rows of the silvopastoral system (SPS) and in areas of conventional pasture (CP) and native Cerrado vegetation (NV).

Treatments†	Oxidizable organic carbon fractions†† ($g\ kg^{-1}$)		
	Labile fraction (F_1)	Moderately labile fraction (F_2)	Poorly labile fraction (F_3)
	0.0–0.10 m		
SPS-2.5	4.21 a	1.87 b	3.64
SPS-5	3.46 a	2.56 b	2.78
SPS-7.5	3.75 a	2.29 b	3.48
SPS-10	4.03 a	2.67 b	3.03
CP	1.50 b	2.95 b	3.52
NV	4.36 a	8.86 a	4.57
F value	10.12**	3.32*	0.46^{NS}
CV (%)	18.69	27.22	51.86
	0.10–0.20 m		
SPS-2.5	3.51 b	1.74	4.03 b
SPS-5	4.11 b	1.39	4.13 b
SPS-7.5	3.83 b	2.40	3.90 b
SPS-10	3.09 b	2.15	3.27 b
CP	2.70 b	2.80	1.26 c
NV	5.34 a	1.75	8.59 a

F value	3.69*	0.95^{NS}	10.37**
CV %	26.28	51.35	35.54
	0.20–0.30 m		
SPS-2.5	3.66 a	1.82 b	4.05 a
SPS-5	3.75 a	1.25 b	4.69 a
SPS-7.5	3.07 a	1.23 b	4.44 a
SPS-10	4.13 a	1.70 b	4.07 a
CP	1.87 b	2.00 b	1.21 b
NV	5.62 a	4.26 a	6.21 a
F value	2.97*	6.67**	6.28**
CV (%)	38.85	42.79	31.60

† SPS-2.5: Silvopastoral system with soil samples collected 2.5 m from triple row tracks of eucalyptus trees. SPS-5: Silvopastoral system with soil samples collected 5.0 m from triple row tracks of eucalyptus trees. SPS-7.5: Silvopastoral system with soil samples collected 7.5 m from triple row tracks of eucalyptus trees. SPS-10: Silvopastoral system with soil samples collected 10.0 m from triple row tracks of eucalyptus trees. CP: conventional pasture. NV: native Cerrado vegetation.
†† F_1: labile fraction represents the organic C oxidized by $K_2Cr_2O_7$ in an acidic media of 6 mol L^{-1} H_2SO_4. F_2: moderately labile fraction obtained by the difference in organic C oxidized by $K_2Cr_2O_7$ in acidic media of 9 and 6 mol L^{-1} H_2SO_4. F_3: poorly labile fraction obtained by the difference in organic C oxidized by $K_2Cr_2O_7$ in acidic media of 12 and 9 mol L^{-1} H_2SO_4.
Means followed by distinct letters in the column show significant differences (Scott–Knott test, $P \leq 0.05$). ^{NS}: not significant. * and **: statistical significance at 5% and 1%, respectively, by F test. CV: coefficient of variation.

levels of potential soil acidity and low levels of exchangeable cations in a typical Quartzipsamment (Entisol) under native Cerrado vegetation, which was due to the low natural fertility of this soil. In a Rhodic Hapludox (Oxisol) under native forest, Theodoro et al. (2003) argued that due to the low natural fertility of these soils, there is a predominance of H^+ and Al^{3+} ions, which results in the intensification of the exchangeable base cation leaching from the soil with the high precipitation indices in tropical conditions.

The potential soil acidity in the conventional pasture area and silvopastoral system at distances of 2.5 and 10 m from the eucalyptus tree rows was less than 5 $cmol_c$ dm^{-3}. These values are considered potential acidity medium levels (Sousa and Lobato, 2004). Potential acidity is inversely related to active soil acidity (pH). Therefore, the treatments that have the lowest potential acidity are the treatments that also have the highest pH values, especially in the 0.0–0.10 m layer (Table 1). When the soil pH value is less than 5.5, there is a higher concentration of H^+ ions, which are retained in the soil colloids. Under these conditions, the H^+ ions obtained by covalence bind to negative soil colloids and aluminum compounds, which makes the potential nonexchangeable acidity even greater. Indeed, Frazão et al. (2008) showed that soils with high potential acidity also have low levels of exchangeable basic cations and, consequently, high levels of H^+ and Al^{3+} ions retained in the soil colloids.

The exchangeable aluminum (Al^{3+}) content in the 0.0–0.10 m layer was higher in the silvopastoral system at distances of 5 m (SPS-5) and 7.5 m (SPS-7.5) from the eucalyptus tree rows than in the other treatments (Table 1). In the 0.10–0.20 m layer, a higher Al^{3+} content was observed in the native vegetation area (NV) and the silvopastoral system at distances of 7.5 m (SPS-7.5) from the eucalyptus triple rows, while in the 0.20–0.30 m layer, the Al^{3+} content was significantly higher in the area of native vegetation (NV), conventional pasture (CP) and silvopastoral system at distances of 5 m (SPS-5) and 7.5 m (SPS-7.5) from the eucalyptus tree rows (Table 1).

In general, the higher exchangeable Al^{3+} content is related to these treatments' lower soil pH value. Soil exchangeable acidity (Al^{3+}) increases with the decrease of the soil pH value. In acidic soils, there is a gradual increase in the solubilization of the soil aluminum complexes (Faria et al., 2009). Freire et al. (2007) also reported that high Al^{3+} levels could occur in soils with low pH values since aluminum complexes release H^+ ions into the soil solution when hydrolyzed and thus contribute to increased soil acidity.

The high Al^{3+} content observed in the soil under native Cerrado vegetation may be due to the lack of soil acid correction practices and the low natural soil fertility (Oliveira et al., 2017). Similar results were shown by Carneiro et al. (2009), which showed that the exchangeable (Al^{3+}) and potential (H+Al) acidity of both sandy and clayey soils were higher in the native Cerrado vegetation area than in other land use systems.

Effects of soil sampling distance and depth in silvopastoral systems on soil oxidizable carbon fractions

Oxidizable organic C fractions were significantly affected by production systems in most soil layers sampled (Table 2). In the 0.0–0.10 and 0.20–0.30 m layers, the labile organic C fraction (F_1) was significantly lower in the conventional pasture area (CP) than in the silvopastoral system and native vegetation. Among the oxidizable soil organic carbon fractions, the labile fraction is considered the most sensitive to changes resulting from different land use and management (Barreto et al., 2011).

Therefore, our results suggest that the conventional pasture system is inefficient in improving stock and maintaining soil organic matter stability. This is because the reduction in the labile C fraction indicates that there was minor addition of crop residues to the soil in this agricultural production system, as reported by Melo et al. (2016). On the other hand, the higher concentration of the labile C fraction observed in the silvopastoral system and native vegetation area is indicative of the greater addition of organic residues in these systems (Oliveira et al., 2018). Martins et al. (2015) argued that in native forest areas, the litter layer formed on the soil surface by the constant input of plant residues is responsible for most of the fraction of labile organic carbon in the soil.

In the 0.0–0.10 and 0.20–0.30 m layers, the moderately labile C fraction (F_2) was significantly higher in the native Cerrado vegetation area (NV) than in the conventional pasture and silvopastoral systems (Table 2). Land use systems did not alter the moderately labile C fraction in the 0.10–0.20 m layer. The higher concentration of the moderately labile C fraction in the Cerrado native vegetation area is associated with the high input of plant residues on the soil surface, which results in a greater accumulation of the light fraction of soil organic matter (Souza et al., 2014).

The light C fraction is a short-term reservoir of plant nutrients and the primary fraction for soil organic matter formation and serves as a readily decomposable substrate for soil microorganisms (Neff et al., 2002). Its size is a balance between residue inputs and decomposition (Song et al., 2012).

In the 0.10–0.20 and 0.20–0.30 m layers, the poorly labile C fraction (F_3) was significantly lower in the conventional pasture area (CP) than in the silvopastoral system and native Cerrado vegetation (Table 2). Land use systems did not alter the moderately labile C fraction in the 0.0–0.10 m layer. The lower concentration of the poorly labile C fraction in the conventional pasture system may be due to the lower plant species diversity in this production system. According to Dias et al. (2018), the poorly labile carbon fraction is associated with the presence of organic compounds with greater chemical stability, which depends on the carbon/nitrogen ratio and chemical composition of crop residues deposited in the soil. Therefore, such inference can explain the lower concentration of poorly labile organic C in some land use systems, especially in the conventional pasture system when compared to the area of native vegetation. On the other hand, the higher concentration of poorly labile organic C in the native vegetation area, especially in the 0.10–0.20 m layer, indicates the ability of this environment to maintain organic C storage in more stable fractions of soil organic matter, as reported by Melo et al. (2016). Furthermore, the age of native species may be related to the high level of litter recalcitrance in native vegetation areas (Barreto et al., 2014).

Materials and Methods

Description of the study site

The study was conducted in the experimental area of Ouro Branco Farm, Bandeirantes, Mato Grosso do Sul, Brazil. The municipality is located at 19°55′04″ S and 54°22′06″ W, with an undulating relief and average altitude of 638 m. The regional climate, according to the Köppen classification, is Aw (tropical climate with hot summers and a tendency toward high rainfall levels and dry winters, with a dry season between May and September), with a mean annual rainfall of 1,275 mm and a mean annual temperature of 23.1 °C. The soil was classified as classified as Neossolo Quartzarênico Órtico latossólico - RQo (Santos et al., 2018) or simply Quartzipsamment (USDA 2014), with 84-86% sand and 10-11% clay.

Experimental design, treatments, and trial management

The treatments were represented by soil sampling in the silvopastoral system (SPS), with the soil samples being collected at 2.5, 5.0, 7.5, and 10 m of transverse distance from the eucalyptus tree rows. Soil samples collected in a conventional pasture area (CP) and a native Cerrado vegetation area (NV) were used as reference treatments.

The SPS used in this study was installed in September 2015 in a production area of 120 hectares. Seedlings of *Eucalyptus urograndis* hybrid (*Eucalyptus grandis* × *Eucalyptus urophylla*) (clone I-144) were planted in triple row tracks in the east/west direction, using a spacing of 2.0 m between plants and 1.5 m between plant rows. The triple row tracks of eucalyptus trees were separated by 20.0 m. Eucalyptus plants were planted in consortium with palisade grass cv. BRS Marandu [*Urochloa brizantha* (Hochst. ex A. Rich.) R.D. Webster (Syn. *Brachiaria brizantha* (Hochst. ex A. Rich.) Stapf)]. Subsequently, Nellore heifers, weighing approximately 300 kg and aged around 26 months, were subjected to extensive grazing with mineral supplements and unrestricted water (at will).

The conventional pasture area had 120 hectares and was planted with the same forage species (i.e., palisade grass cv. BRS Marandu) and was also subjected to intensive grazing by 26-month-old Nellore heifers, with approximately 300 kg of live weight. In this conventional pasture area, there was no presence of tree plants. Neither the silvopastoral system (SPS) nor the conventional pasture (CP) received the application of soil acidity correctives. The area of native vegetation (NV) has tree species typical of the Cerrado region and has no anthropogenic interference.

Soil sampling

For soil sampling, the total area of the silvopastoral system, pasture, and native vegetation was divided into four blocks (subareas), which corresponded to the four replications. In September 2017, after two years of SPS implementation, soil samples were collected at depths from 0.0–0.10, 0.10–0.20, and 0.20–0.30 m using a hole auger at twenty different points per block. Soil samples from each depth were oven-dried at 55 °C for 48 h, ground to pass through a 2.0 mm mesh screen, and then submitted to determine the acidity components and the oxidizable organic C fractions of the soil.

Measurement of soil acidity components

The soil acidity components, i.e., active acidity (pH), exchangeable acidity (Al^{3+}), and potential acidity (H + Al), were determined according to the methodology described by Teixeira et al. (2017). The soil pH in 0.01 mol L^{-1} $CaCl_2$ solution was determined potentiometrically in a 1:2.5 ratio (soil:solution) using a combined calomel reference glass electrode and pH meter. Exchangeable Al was extracted by 1.0 mol L^{-1} KCl solution and determined by titration with 0.025 mol L^{-1} NaOH. Soil potential acidity was extracted by 0.5 mol L^{-1} $Ca(CH_3COO)_2.H_2O$ solution at pH 7.0 and determined by titration with 0.025 mol L^{-1} NaOH.

Measurement of soil oxidizable organic carbon fractions

Oxidizable fractions of soil organic carbon were determined according to the methodology described by Chan et al. (2001) and modifications proposed by Barreto et al. (2011). Three oxidizable C fractions were determined by comparing the organic C concentrations extracted with increasing oxidation degree: F_1 (labile C fraction), F_2 (moderately labile C fraction), and F_3 (poorly labile C fraction). The F_1 fraction represented the organic C oxidized by $K_2Cr_2O_7$ in an acidic media of 6 mol L^{-1} H_2SO_4. The F_2 fraction was obtained from the difference in organic C oxidized by $K_2Cr_2O_7$ in acidic media of 9 and 6 mol L^{-1} H_2SO_4. F_3 was obtained by the difference between organic C oxidized by $K_2Cr_2O_7$ in acidic media of 12 and 9 mol L^{-1} H_2SO_4.

Statistical analysis

The experiment was analyzed using a randomized block design with six treatments and four replications. Normality of the data was previously tested by the Lilliefors test at the 5% level, and then the data were analyzed by analysis of variance (F test, $p \leq 0.05$). The effects of production system soil sampling distance on acidity components and oxidizable

C fractions were grouped by the Scott–Knott test at the 0.05 level of confidence. All analyses were performed using Assistat® software version 7.7 for Windows (Silva and Azevedo 2016).

Conclusions

The spatial distribution of soil sampling points in a silvopastoral system can change the values of soil acidity components, and the lowest level of soil acidity was observed at 2.5 and 10.0 m distances from the eucalyptus tree rows.

The oxidizable fractions of the soil organic carbon were not modified by the distance of the soil sampling points concerning the eucalyptus tree rows in a 2-year silvopastoral system.

The 2-year silvopastoral system and native Cerrado vegetation area have the highest concentrations of organic carbon in the labile (F_1) and poorly labile (F_3) fractions in the soil profile compared to the conventional pasture system.

The 2-year silvopastoral system in a soil of low natural fertility from the Brazilian Cerrado was not yet able to improve the soil chemical quality; therefore, further studies should be conducted to investigate the effects of the long-term silvopastoral system on the acidity components and oxidizable organic carbon fractions of the soil.

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