Original Research Article

Influence of Use and Management of the Soil in the Attributes Chemicals of an Ultisol

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ABSTRACT

The use of vegetation cover to protect the soil and increase the soil organic matter content available to plants is a good alternative to minimize problems with the loss of soil quality. In this sense, the objective of this study was to evaluate the chemical properties in order to monitor soil quality in different types of management. The experimental design was completely randomized with three treatments: Area of natural vegetation; Area of perennial crop cultivation and degraded pasture area; with five repetitions. Chemical soil properties were evaluated: phosphorus, potassium, magnesium and calcium contents by extraction with ion exchanger resin. The content of organic matter was determined by the colorimetric method and the pH, in calcium chloride, as well as the acidity potential the pH 7.0. Were calculated the sums of bases, cation exchange capacity and base saturation. In the soil depths: 0.00-0.10; 0.10-0.20 and 0.20-0.40m. Data were analyzed statistically using the Tukey test at 5% for comparison of means. In the treatment without human intervention, there was an accumulation of exchangeable bases, organic matter and phosphorus, as well as reducing potential acidity. The results show that management interferes with the chemical quality of the soil.

Keywords: organic matter*, soil acidity, phosphorus.*

1. INTRODUCTION

The sustainable use of natural resources, especially soil and water, has been constituted a topic increasingly relevant, due the increase of anthropogenic activities. Consequently, increases the concern with the quality and sustainable use of these resources (Araújo et al., 2007).

The introduction of agricultural systems to replace the forests causes an imbalance in the ecosystem in which the removal of the original vegetation and the deployment of crops, combined with inadequate management practices, lead to the disruption of the balance between the soil and the environment, modifying this way, its chemical, physical and biological properties, limiting their agricultural use (Richart, et al., 2005).

The quality of these attributes provides suitable conditions for the growth and development of plants and the maintenance of the diversity of organisms that inhabit the soil (Doran & Parkin, 1994). The assessment of soil quality in a way simple and reliable is one of the current research challenges. According to these authors, it can be measured by quantifying of some attributes, i.e., physical, chemical and biological properties that enable the monitoring of changes in the medium and long term, referring the quality of the soil. Soil quality must be monitored to detect changes that may be mediated at a certain time and can be done on the farm or on a larger scale, such as watershed, region and others.

According to Araujo et al.,(2007), management practices and soil conservation and water must be planned and executed attempting to maintain or even improve their attributes, in order to increase the soil's ability to sustain a competitive biological productivity. The conventional management systems, especially with intensive soil disturbance through plowing and harrowing, which has favored the intensification of the processes of erosion and soil compaction and that, in medium and long term, may lead to physical, chemical and biological degradation of the soil (Leite et al., 2003; Araújo et al., 2004). In these conditions, the absorption of nutrients available to the root system is hampered and the amount of oxygen in the rhizosphere can become limiting in several metabolic processes (Beulter & Centurion, 2004).

Islam & Weil (2000) proposed the use of data of physical, chemical and biological characteristics of soil collected in an area of undisturbed natural forest, as a reference for assembling a general index of soil quality. According to Brookes (1995), the relationship between the physical, chemical and biological properties of the soil vary in time and space. And these changes can be beneficial or harmful to production systems. Proper management promotes gain soil quality and crop productivity. Consequently, the variation of these attributes, determined by management and soil use, and its evaluation are important for better management aiming at sustainability of the system (Carneiro et al., 2009).

Works performed by Souza & Alves (2003) in dystrophic Oxisol, show that soil management systems with less or no soil disturbance led to significant accumulation of organic matter, phosphorus, potassium, magnesium and calcium and decrease of exchangeable aluminum and potential acidity. Already crops with soil disturbance, the effects were the opposite.

Studies conducted in Oxisol, in the region northern of the state of Pará, found that sum of bases and cation exchange capacity (CEC) were the most sensitive variables to changes in management (primary forest, explored forest, grassland, scrub, juquira (Brazilian vegetation typical) and planting), and the pH and potential acidity and soil pH were influenced by the replacement of forest by pasture (Ferreira et al., 2011).

With that, the aim of this work was to evaluate the chemical quality of the soil of an Ultisol under different uses and management.

2. MATERIAL AND METHODS

The experiment was conducted at the experimental area of farm Teaching and Research at the University Camilo Castelo Branco - UNICASTELO, of Fernandópolis city, São Paulo (SP) (Santa Rita farm), located between coordinates 20°16'50" south latitude and 50°17'43" west longitude and 20°18'05" south latitude and 50°16'26 "west longitude (Figure 1).

The climate of the region, according to the Koppen classification, is humid subtropical, Aw, with winter (dry and mild) and summer (hot and rainy) (Rolim et al., 2007). According to the Embrapa (2007) region is characterized by a period of 6 months of the year with water deficit and average temperature of 23.5° C or 74,3º F (Table 1).

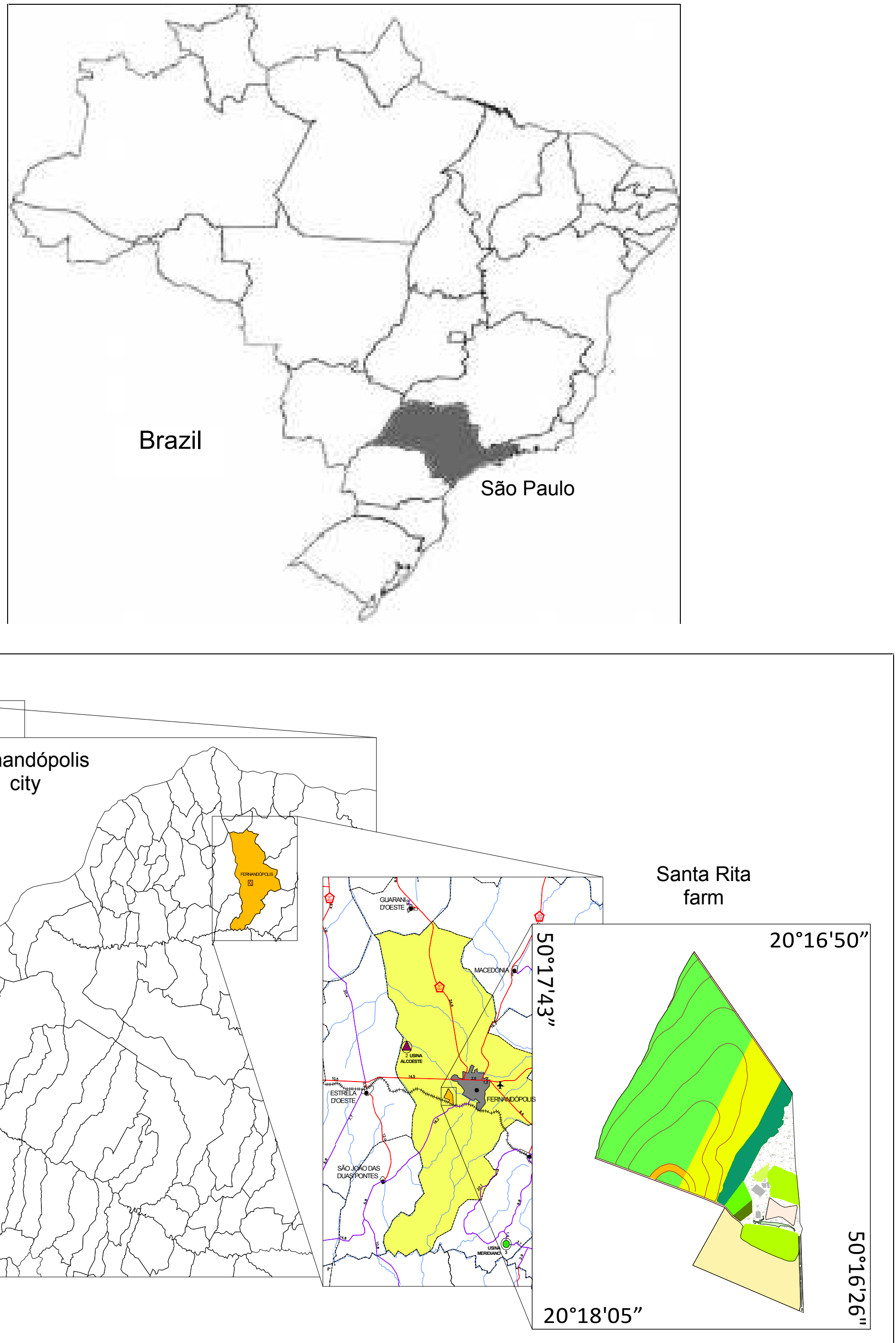


Figure 1: Location of the Santa Rita farm, Fernandópolis city, SP, Brazil

Table 1: Water balance of the Fernandópolis city, SP.

Month	AT (°C)	AT (ºF)	P (mm)	PE (mm)	WS (mm)	AE (mm)	DE (mm)	EXC (mm)
January	25.2	77.4	242	130	100	130	0	84
February	25.3	77.5	193	120	100	120	0	73
March	25.0	77.0	131	124	100	124	0	7
April	23.4	74.1	65	94	74	91	4	0
May	21,2	70.2	47	70	59	62	8	0
June	20.2	68.4	37	57	48	48	9	0
July	20.1	68.2	13	58	31	30	27	0
August	22.3	72.1	20	80	17	34	46	0
September	24.1	75.4	35	101	9	43	58	0
October	24.8	76.6	126	119	16	119	0	0
November	24.8	76.6	120	120	16	120	0	0
December	25.0	77.0	187	131	72	131	0	0
Totals	-		1.216	1.205	642	1.053	152	163
Average	23,5	74.2	-	-	-	-	-	-

NOTE: AT (average temperature); P (precipitation); PE (potential evapotranspiration); WS (water storage in the soil); AE (actual evapotranspiration); DE (disability); EXC (excess).

According to Soil Survey Staff (1999) soils of Santa Rita farm consist of Ultisol. The experimental design will be completely randomized, with three treatments and five repetitions, totaling 25 experimental plots. The treatments are:

- Natural vegetation area (Figure 2);
- Area of cultivation of perennial crops (implanted 15 years ago, spacing 1 x 2 m, area without management of manuring) (Figure 2) and
- Degraded pasture area (3 ha) (Figure 2).

For each treatment will be used soil samples in duplicates for better data reliability.

Chemical soil properties were evaluated according to the methodology described by Raij & Quaggio (1983) and the contents of phosphorus, potassium, magnesium and calcium by extraction with an ion exchange resin were evaluated. The organic matter (OM) was determined by the colorimetric method and the pH, in calcium chloride, as well as the potential acidity (hydrogen + aluminum) at pH 7.0. Were calculated sums of bases (SB = Ca + Mg + K), cation exchange capacity (CEC = SB + (H + AL)) and base saturation (V% = (100 x SB) / CEC). The samples were collected with the aid of exchange of mug, in three soil depths: 0.00-0.10; 0.10-0.20 and 0.20-0.40 m (Figure 3).

Natural vegetation.

Perennial crop - Eucalyptus.

Degraded pasture.

Figure 2: View of the experimental area

For data analysis, was performed the analysis of variance (F test) and applied the Tukey test (5%), for comparison of means, using SISVAR program (Ferreira, 2008).

Soil collected

Trench to collect soil

Figure 3: Composite sample of soil was used for the determination of soil fertility and collecting.

3. RESULTS AND DISCUSSION

The results for the chemical properties of the soil are presented in Table 2 and Figure 4. For all properties and soil depths studied, the F test was significant at 5% of probability. To soil organic matter, the highest contents found were to treatment native vegetation in any soil depth. The same behavior was observed for phosphorus, calcium, potassium and magnesium (Figure 4). This higher content of nutrients that are beneficial and essential for plant development was recorded in the treatment where there was no human intervention. In grasslands and eucalyptus treatments there was a gradual reduction, this due to greater soil disturbance and lower vegetation cover.

According to Souza & Alves (2003) who observed similar behavior that found in this work, claim that management systems with little or no soil disturbance, tends to accumulate exchangeable cations, phosphorus and organic matter. Was also observed the same behavior in research conducted by Ferreira et al (2011). This accumulation of exchangeable bases in the soil surface depth agrees with a lower potential acidity found in treatments native vegetation and grassland. Regarding the treatment eucalyptus there is a greater potential acidity and lower content of exchangeable bases, phosphorus and soil organic matter. Identical behavior was verified by Souza & Alves (2003) and Ferreira et al. (2011).

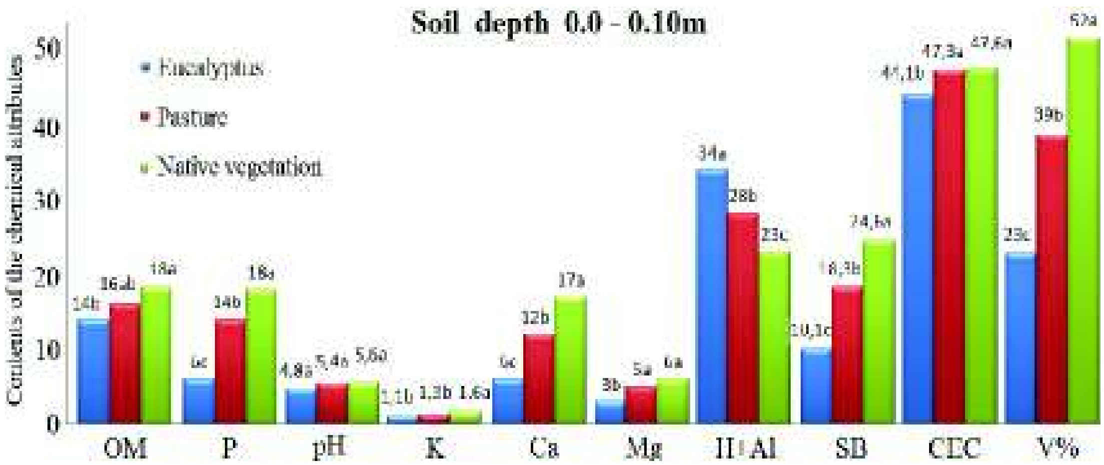
Regarding the sum of bases, cation exchange capacity and base saturation, values found in this research, are considered low compared to the values considered average by Raij et al. (1996). But even with values below of the optimal considered, was portrayed very well the difference between the treatments. The optimal saturation bases should be around 70% for most of the crops. The pH was an index with little variation among the treatments studied, this is due to no soil correction of cultivated areas and the native vegetation be slightly acidic (inherent soil characteristic). Bonini (2012) verified in Oxisol corrected higher pH than the native vegetation.

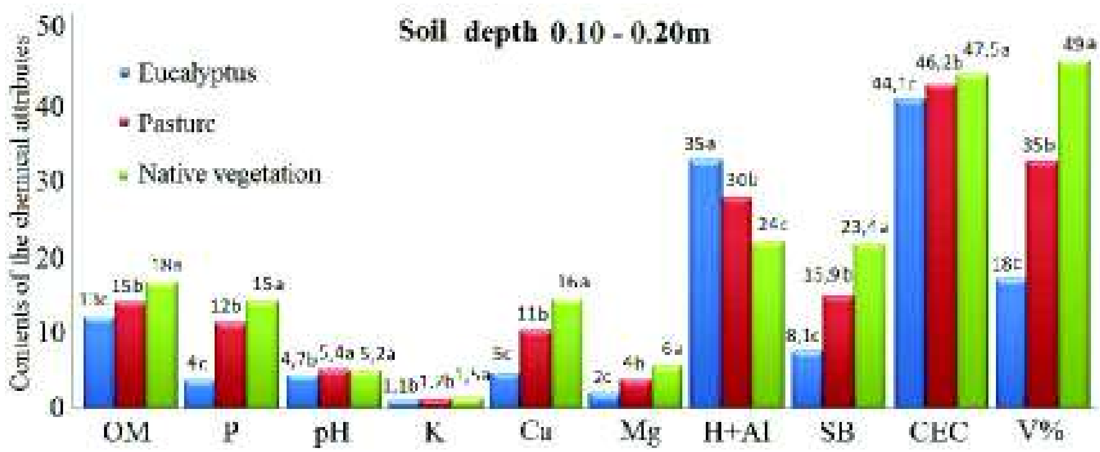
Table 2: F Test, SDM - significant difference minimum 5%, VC- variation coefficient (%) and average values for the soil properties studied, in different uses and management of the soil, in depths of 0.00-0.10; 0:10 to 0:20 and 0.20- 0.40m. 2013.

Treatments	OM	P	pH	K	Ca	Mg	H+Al	SB	CEC	V%
	g dm^{-3}	mg dm^{-3}	-			mmolc dm^{-3}				%
					0.00-0.10m					
F	5.471*	384.00*	218.81^{ns}	16.28*	78.00*	12.92*	111.76*	668.38*	165.22*	585.3*
SDM – 5%	3.943	1.352	31.912	0.270	2.704	1.843	2.257	1.222	0.654	0.817
VC(%)	11.30	4.92	15.71	9.35	10.69	18.21	3.66	3.19	0.65	1.00
					0.10-0.20m					
F	57.00*	134.08*	13.00*	15.97*	166.50*	72.00*	164.58*	732.43*	225.44*	24.21*
SDM – 5%	1.445	2.184	0.433	0.237	1.770	1.022	1.946	1.224	0.495	1.371
VC(%)	4.35	9.67	3.92	8.69	7.78	11.79	3.03	3.57	0.50	1.84

					0.20-0.40m					
F	7.63*	66.07*	14.182 *	35.48 *	25.11*	11.19 *	18.00*	35.29*	9.288	98.14 *
SDM – 5%	2.397	2.314	0.479	0.194	1.198	2.068	1.616	1.467	1.976	1.777
VC(%)	7.54	13.34	4.45	7.92	5.82	26.31	2.40	4.64	2.01	2.58

** Significant at 5%, ns no significant.*





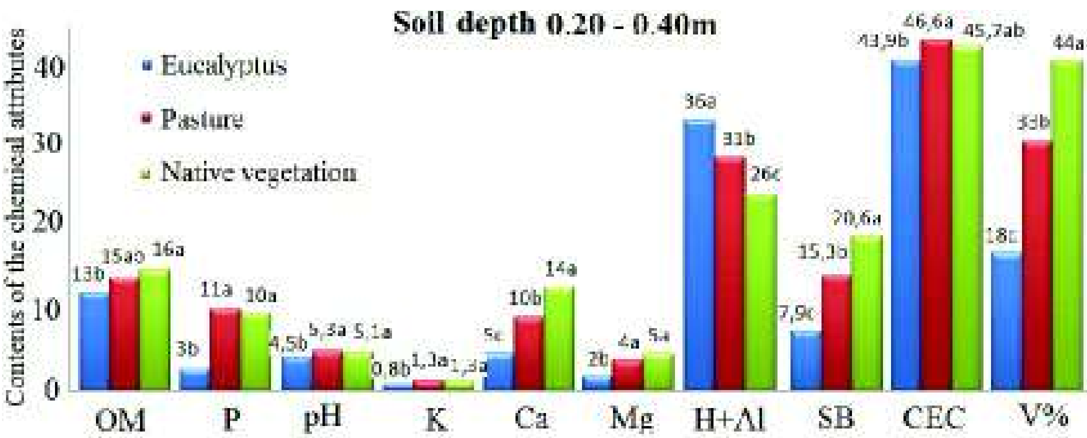


Figure 4: graphs the average values for the chemical properties of soil studied, in different uses and managements of the soil, in depths of 0.00-0.10; 0.10-0.20 and 0.20-0.40m. 2013.

Same letter do not differ significantly for the Tukey test (5%).

4. CONCLUSION

The chemical properties of the soil were good indicators of soil quality, except for the pH index. Treatment with higher accumulation of organic matter, phosphorus, exchangeable cations was the native vegetation. The worst treatment was eucalyptus. The analyzes performed indicate that the management interfere with the chemical quality of the soil.

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