Physical fractionation of organic matter and management impacts of Tropical soils

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Introduction

The increase of soil organic matter (SOM) improves the Cation exchange capacity (CEC) of tropical weathered soils. Moreover, the soil acidity amelioration is required to achieve high yields in these soils. The application of lime may increase SOM with time by improving cation chemical bonds with soil colloids. Soil C fraction may also be affected by different cropping systems.

Objective

The main objective of this work were to evaluate the C and soil physical changes under practices as tillage and acidity remediation.

Materials and Methods

The experiment was carried out in an oxisol in Botucatu, São Paulo, Brazil in two fields (no till and conventional systems).

Treatments: (lime and silicate rates calculated to raise soil base saturation to 70%)
Control, lime, silicate, gypsum+lime and gypsum+silicate. The initial soil pH was 3.7

Soil samples:
Taken at depths of 0-10, 10-20, 20-40 cm one year after treatment applications

Analysis:
-Soil C fractionation - Cambardella e Elliot (1992)
(total organic carbon, particulate organic carbon and mineral associated with carbon)
- Cation exchange capacity (CEC)
- Soil porosity

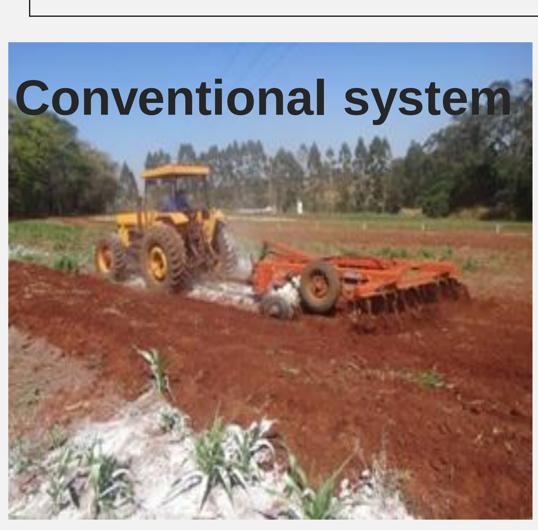
Table 2: Particulate organic carbon (POC), mineral-associated organic carbon (CAM), total organic carbon (TOC) and labile carbon (LC) from 0 to 40 cm depth as affected by soil acidity amelioration under no till (NT) and conventional tillage(CS). November, 2013.

	POC		MAC		TOC		LC	
Treatments	**NT**	**CS**	**NT**	**CS**	**NT**	**CS**	**NT**	**CS**
		---------------------------------g kg^{-1} ----------------------------------						
				0-10 cm				
Control	5,3 abc	3,0 a	20,4 a	17,4 a	25,7 abc	20,4 a	0,26 ab	0,17 a
Lime	4,3 c	3,5 a	19,6 a	16,4 a	24,0 c	19,9 a	0,22 b	0,21 a
Silicate	**6,1 a**	2,5 a	20,0 a	17,7 a	**26,1 ab**	20,2 a	**0,31 a**	0,14 a
Gypsum+Lime	5,7 ab	2,7 a	20,8 a	18,2 a	**26,5 a**	20,1 a	0,27 ab	0,16 a
Gypsum+Silicate	4,7 bc	2,7 a	19,9 a	17,6 a	24,6 bc	20,3 a	0,23 b	0,15 a
Mean	**5,22 A**	2,88 B	**20,14** A	17,46 B	**25,38 A**	20,18 B	0,26 A	0,17 B
				10-20 cm				
Control	1,8 ab	2,2 a	20,9 a	16,0 b	22,7 a	18,2 b	0,08 b	0,14 a
Lime	1,2 b	2,1 a	19,7 a	16,8 b	20,9 a	19,0 ab	0,06 b	0,13 a
Silicate	1,6 a	2,3 a	20,6 a	15,8 b	22,1 a	18,1 b	0,07 b	0,15 a
Gypsum+Lime	**1,9 ab**	1,9 a	20,2 a	**18,5 a**	22,1 a	**20,2 a**	**0,09 ab**	0,10 a
Gypsum+Silicate	**2,6 a**	2,2 a	19,4 a	16,8 b	22,0 a	**19,0 ab**	**0,13 a**	0,13 a
Mean	1,82 A	2,14 A	**20,16 A**	16,78 B	**21,96 A**	18,9 B	0,09 A	0,13 A
				20-40 cm				
Control	1,6 a	0,8 c	15,5 a	13,4 ab	17,2 a	14,1 a	**0,11 a**	0,05 c
Lime	1,5 a	1,4 b	15,3 a	12,5 b	16,9 a	14,0 a	**0,10 a**	0,11 bc
Silicate	1,4 a	**2,0 a**	16,0 a	11,3 b	17,4 a	13,4 a	0,09 ab	**0,18 a**
Gypsum+Lime	1,4 a	1,0 bc	15,8 a	**15,0 a**	17,2 a	14,7 a	0,09 ab	0,07 cd
Gypsum+Silicate	0,9 a	1,6 ab	16,4 a	13,2 ab	17,4 a	14,8 a	0,05 b	0,12 b
Mean	1,36 A	1,36 A	15,8 A	13,08 A	**17,22 A**	14,2 B	0,09 B	**0,11 A**

Treatment means within a row and column followed by the same letter are not significantly different at the 0.05 level by LSD (P<0.05). Lowercase letters compare soil acidity amelioration and capital letters compare the systems.

Particulate organic carbon (POC) reduced with the lime treatment in both system. The same happened with LC.

The treatments didn't affect the MAC in NT. So in CS the lime used "protected" the soil C.



Treatment applied 10/05/2012

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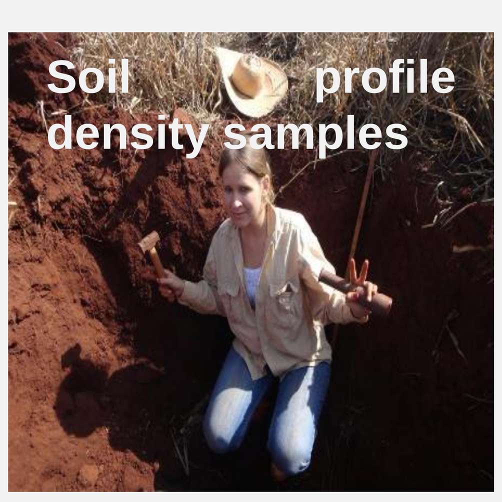

Soil samples11/05/2013

Soil tillage 11/01/2013

Results

Table 1: Macroporosity (%), microporosity (%) and total porosity from 0 to 40 cm depth as affected by soil acidity amelioration under no till (NT) and conventional tillage(CS). November, 2013.

	0_10 cm		10_20 cm		20_40 cm	
Treatments	**NT**	**CS**	**NT**	**CS**	**NT**	**CS**
			Macroporosity (%)			
Control	11,1 a	19,6 bc	13,7 a	16,0 a	16,3 ab	8,6 a
Lime	13,3 a	**26,6 ab**	15,1 a	10,6 a	19,1 a	9,1 a
Silicate	11,5 a	15,7 c	8,3 a	10,6 a	12,3 bc	7,1 a
Gypsum+Lime	14,2 a	**34,7 a**	7,3 a	12,1 a	10,6 c	7,5 a
Gypsum+Silicate	17,2 a	21,3 bc	10,8 Aa	12,4 a	10,7 c	7,0 a
Mean	13,4 B	**23,6 A**	11,0 A	12,3 A	13,8 A	7,9 B
			Microporosity (%)			
Control	29,7 a	20,7 a	28,4 b	24,8 a	27,8 b	26,3 aA
Lime	**32,4 a**	22,4 a	**43,7 a**	**26,0 a**	**29,7 b**	30,7 aA
Silicate	29,6 a	23,7 a	31,0 b	23,5 a	28,5 b	30,4 aA
Gypsum+Lime	**29,3 a**	19,7 a	**41,4 a**	**25,5 a**	**40,6 a**	26,8 aA
Gypsum+Silicate	27,9 a	20,4 a	33,0 b	25,4 a	30,1 b	31,0 aA
Mean	**29,8 A**	21,4 B	**35,5 A**	25,1 B	31,3 A	29,1 A
			Total porosity (%)			
Control	40,8 a	40,3 a	42,2 b	40,8 a	44,2 bc	34,9 a
Lime	45,7 a	49,0 a	**58,8 a**	36,6 a	**48,8 ab**	39,8 a
Silicate	41,2 a	43,0 a	39,2 c	34,1 a	42,4 bc	37,5 a
Gypsum+Lime	43,5 a	**54,3 a**	**48,7 b**	37,6 a	**51,2 a**	34,3 a
Gypsum+Silicate	45,1 a	41,7 a	43,8 b	37,8 a	40,8 c	38,1 a
Mean	43,3 A	45,7 A	**46,6** A	37,4 B	**45,5** A	36,9 B

Treatment means within a row and column followed by the same letter are not significantly different at the 0.05 level by LSD (P<0.05). Lowercase letters compare soil acidity amelioration and capital letters compare the systems.

The lime applied incresed macroporosity % on CS and total porosity and microporosity % in NT.

The means showed the gypsum may increse the TOC on soil even as NT system

The organic matter increased the CEC as the gypsum+silicate applied.

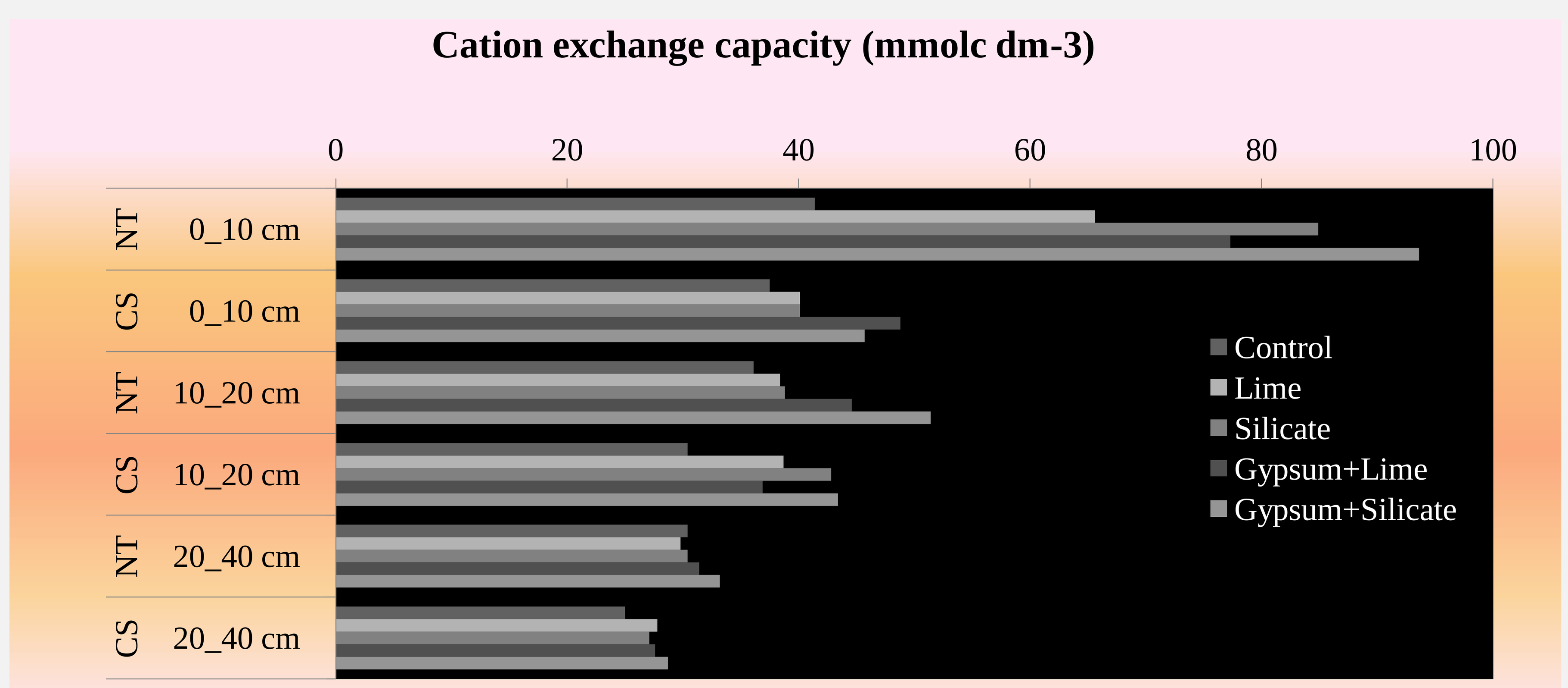

Figure 1: Cation exchange capacity (CEC) from 0 to 40 cm depth as affected by soil acidity amelioration under no till (NT) and conventional tillage (CS). November, 2013.

Conclusion

- The results suggested that C-loss depends on soil management system.

- The lime applied with or without gypsum exchange soil physical properties.

- Organic matter increased the CEC and total porosity.

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