BOREON ADSORPTION IN OXISOLS FROM MINAS GERAIS, BRAZIL

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INTRODUCTION

- Boron (B) deficiency is the most widespread micronutrient problem in eucalyptus plantations in Brazil, particularly for Cerrado ecosystems. Boron fertilization is used to overcome deficiencies in these areas. Upon the addition of B, it is distributed between the solid and solution soil phases depending upon B's affinity for the different soil constituents. The goal of this work was to evaluate the role of clay, organic matter and pH in B adsorption using samples from five common Oxisols occurring in Minas Gerais, Brazil.

MATERIAL AND METHODS

- Surface and subsurface samples of five Oxisols from Minas Gerais-Brazil (Table 1).
- Organic carbon was removed using two methods: H_2O_2 (Kunze & Dixon, 1986) and NaOCl (Kaiser & Guggenberger, 2003; Mikutta et al., 2005) oxidation.
- After organic carbon removal, samples were shaken with 5 mmol/L $CaCl_2$ solution, and then centrifuged at 2000 rpm for 15 minutes. The supernatant was removed and discarded; the treatment was repeated four times. Ca-saturated soil samples were dried at 40ºC and passed through a 2 mm sieve. Organic carbon was measured before and after the organic carbon removal.
- $CaCO_3$ was added to increase the pH in half of the samples with and without organic carbon removal and maintained at field capacity for 21 d. Soils were dried at 40ºC and passed through a 2 mm sieve.
- To determine the quantity of adsorbed B, 4 g of dried soil was shaken for 24 h, in polyethylene tubes, with 20 mL of 5 mmol L^{-1} $CaCl_2$ containing 2 or 8 mg L^{-1} of B.
- The equilibrated suspensions were centrifuged for 15 min at 2000 rpm, filtered, and B was measured colorimetrically in the supernatants. Soil B adsorption was determined by subtracting B in soil solution from B added (blanks).
- Stepwise multiple linear regression (forward addition of variables) was used to determine the relationship among variables.

RESULTS AND DISCUSSION

- Between 40 % and 80 % of organic carbon was removed from the soil (Table 1).
- B adsorption was higher in high clay Oxisols than in coarser soils (Figure 1a-1d). The percentage of adsorbed B varied from 1 to 40%, increasing with clay content.
- High pH promoted increased B sorption, with the most pronounced effect occurring at higher levels of added B (Figure 1a-1d).
- Boron adsorption remained constant, or increased, with the removal of organic carbon.
- Within a level of applied B, B sorption was mainly explained by pH and clay content (Figure 1e-1f).

CONCLUSION

- The mineral phase (clay) and soil pH are more important in explaining B adsorption in these soils than is the organic phase, and should be considered when designing B fertilization practices. The interaction between pH and clay will determine the amount of B sorbed to soils (Figure 2).

Table 1- Soil characteristics

Soil[1/]	CEC[2/]	Clay	B	OC removal	OC	CaCO3	
						no	yes
	$cmol_c\ dm^{-3}$	$kg\ kg^{-1}$	mg/kg	-	$dag\ kg^{-1}$	-------pH[3/]-------	
1	3.31	0.180	0.121	without	0.87	4.90	6.58
				H_2O_2	0.52	4.68	7.47
				NaOCl	0.34	4.39	4.70
2	8.17	0.520	0.366	without	1.79	4.32	6.68
				H_2O_2	0.73	4.31	5.30
				NaOCl	0.81	4.28	5.13
3	10.58	0.420	0.142	without	2.37	4.35	6.04
				H_2O_2	0.85	4.41	5.37
				NaOCl	0.65	4.53	5.08
4	7.04	0.740	0.118	without	1.60	4.80	6.78
				H_2O_2	0.75	4.69	5.57
				NaOCl	0.79	4.61	4.80
5	10.20	0.780	0.398	without	3.22	5.18	6.02
				H_2O_2	0.65	4.81	6.25
				NaOCl	1.29	3.50	6.09

[1/] 1)Tres Marias; 2)Visconde do Rio Branco;3) TG surface (0-20 cm); 4)TG subsurface (20-40 cm); 5)Sete Lagoas; [2/] CEC: Cation exchange capacity, based on CaOAc pH 7.0 solution; [3/]pH in water

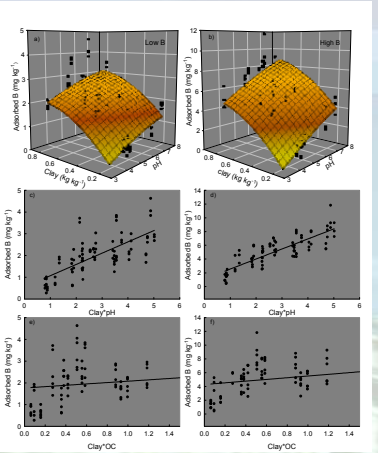

Figure 1. B sorption as a function of pH, clay and OC (above). The significant terms in the equation for both high and low B addition were the interaction terms clay*pH and OC*pH (below).

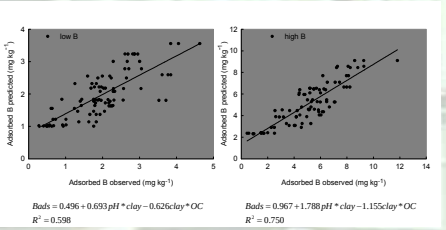

Figure 2. Calculated regressions models for B sorption along with the relationship of predicted versus observed B sorption. B adsorption in soils from Brazil, considering interaction pH, clay and OC.

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