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The effect of charcoal amendment on soil physical properties related to water retention in the Brazilian savanna (Cerrado)

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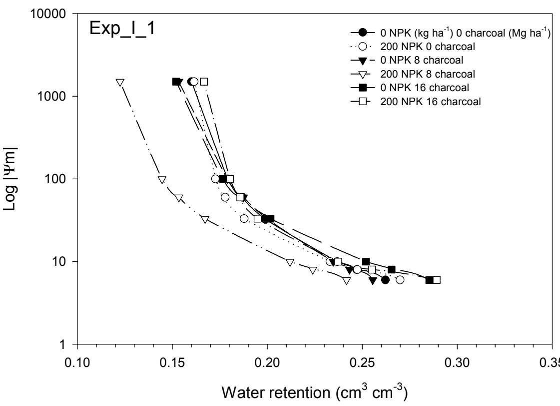
Introduction

Charcoal amendments to soil had been proposed as alternative to paralell climate change mitigation (C sequestration) and soil quality improvement by increasing soil organic matter levels and nutrient availability. The objective of this work was to evaluate the effect of different doses of fine of charcoal in combination with mineral fertilizer on the physical properties of soils related to water retention.

Were evaluated the effects of different doses of fine of charcoal (0,2,4,8,16,32 Mg ha^{-1}) in combination with mineral fertilizer (NPK, 0,100,200,300,400 kg ha^{-1}). Three experiments were conducted in the Brazilian savanna (Cerrado) in 3 different soil types (sandy Haplic Ferralsol (EXP I) under soybeans, sandy Dystric Cambisol (EXP II) and clayey Rhodic Ferralsol (EXP III)) under upland rice. Charcoal was incorporated to the soil in 2006, 2008 e 2009, respectively. EXP I was evaluated in the 1st and 3rd year after aplication and EXPs II and III in the 1st year after application of charcoal. The undisturbed soil samples were collected in 0-10 cm of depth, and the soil retention curves were built using van Genuchten's parameters[1] with SWRC software[2].

Results and Discussions

In the sandy soils charcoal, in general, increased water retention, agreeing with Sohi[3]. However, in EXP I (Fig. 1), in the 1st year, when charcoal was combined with NPK, especially the 8 and 16 Mg ha^{-1} doses, water retention was decreased compared to no combination. In EXP II (sandy Cambisol) (Fig. 2) the 32 Mg ha^{-1} charcoal dose in combination with 200 kg ha^{-1} NPK had highest water retention. In EXP III (clayey Ferralsol) (Fig. 3) the highest water retention was observed at 16 Mg ha^{-1}. Charcoal increased significantly the microporosity in EXP I but did not have effect on this parameter in the other experiments (Fig. 4). This was due higher sandy quantity on soil, wich has originally higher macroporosity than microporosity.



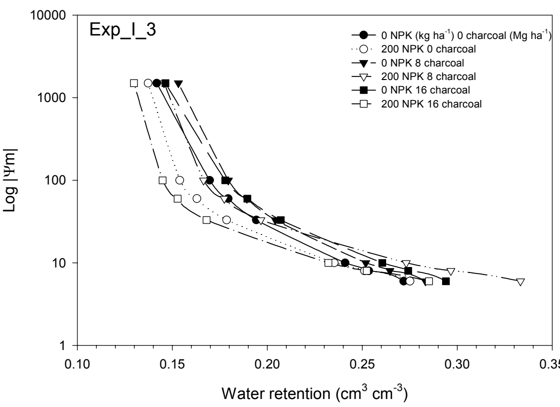


Figure 1. Effects of charcoal and chemical fertilizer on soil water retention curves in the 1st (Exp_I_1) and 3rd (Exp_I_3) year after application. Nova Xavantina, MT, 2010.

In EXP III (Fig. 3) charcoal modified macroporosity in a positive manner (Fig. 5). Besides the above described results charcoal did not show effect on other examined parameters like available water, total porosity, soil density, gravitational water, S index based on variance analysis, may be, because charcoal undergoes changes through time and these avaliations was done just after 1 and 3 years, and the charcoal had no time to have these modifications.

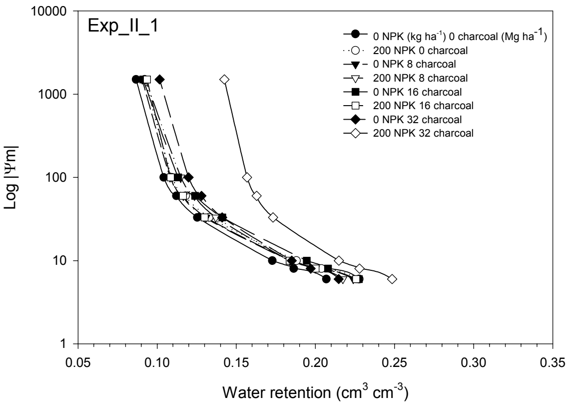


Figure 2. Effects of charcoal and chemical fertilizer on soil water retention curves in the 1st year after application. Nova Xavantina, MT, 2010.

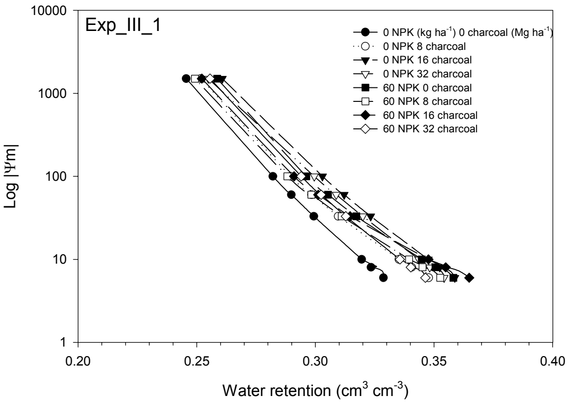


Figure 3. Effects of charcoal and chemical fertilizer on soil water retention curves in the 1st year after application. Santo Antônio de Goiás, GO, 2010.

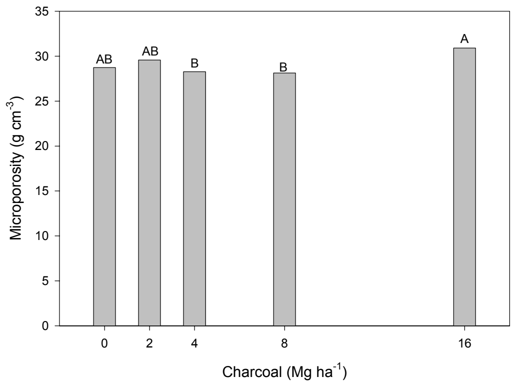


Figure 4. Effects of charcoal amendment on soil microporosity. Nova Xavantina, MT, 2010.

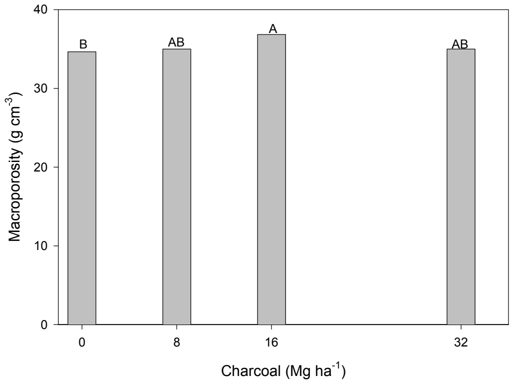


Figure 5. Effects of charcoal amendment on soil macroporosity. Santo Antônio de Goiás, GO, 2010.

Conclusions

Observing the water retention curves, differences between soils with and without charcoal amendment can be seen that, with time, may evolve in a manner that differences might be detected, in favor of charcoal addition.

Acknowledgements

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