

The effect of biochar soil-carbon stabilization in a highly SOM-depleted soil

Maia, CMBF^{a*}; Sohi, SP^b

^aEmbrapa Forestry, Estrada da Ribeira, km 111, CP 319, 83441-000, Colombo, PR, Brazil;

^bUniversity of Edinburgh, Address, United Kingdom

*E-mail: claudia.maia@cnpf.embrapa.br

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Introduction

Biochar may be an important strategy to store stable carbon in soils, but the impact on the dynamics of other carbon entering soil has not been established. Important issues are still open about how biochar modified the soil organic matter stability and recalcitrance. This study aimed to follow the inputs and dynamics of organic C added into an amended soil profile by maize, and ¹³C/¹²C isotopic ratio monitored monthly during a cropping cycle. The hypothesis was that the presence of biochar would accelerate the accumulation of plant-derived organic matter in soil initially low in carbon. Plots of 3.5m x 6m size were established in five randomized block design with four treatments: biochar and maize; biochar fallow (no maize); unamended fallow; and unamended maize. Charcoal fines from Brazil were used as biochar and a soil highly depleted in organic matter due to long term bare fallow management (Woburn Experimental Farm, Rothamsted Research, UK). The fines were applied at 30 Mg per ha (dry mass), equivalent of 20.5 Mg C per ha and 153 Kg N per ha incorporated to 15 cm. Soil samples were taken monthly from 0 to 25 cm depth from April to October 2009.

Results and Discussions

After 141 days total soil C with biochar was in average 2.7 times higher (10.4 mg C/g) than plots without biochar. There was no difference in soil ammonium concentration in all plots, but fallow plots with and without biochar displayed higher nitrate than plots with maize. No differences were found at pH, CaCO₃, total N and inorganic C. Plots with biochar had biomass average (33.66 t ha⁻¹) 17% higher than plots unamended (28.76 t ha⁻¹). As for the isotopic ratio in the whole soil sample at 0 to 25 cm (Figure 1), plots unamended maize showed the higher Delta ¹³C average (-26.57‰) during

the maize cycle. Plots with biochar and maize show δ ¹³C average of -28.38‰ and plots amended fallow of -28.01‰. Plots unamended fallow show a intermediary value (-27.47‰). At the subsoil, from 25 to 50 cm, the differences between δ ¹³C averages were smaller but again the highest value was found at plots unamended maize (-27.87‰) and lowest value at plots amended fallow (-28.31‰). Plots unamended fallow show δ ¹³C average of -27.91‰.

These results indicate that biochar presence could be distinguished from MO from C4 plants. Data from δ ¹³C of organic fractions are been processed to ascertain the origins of the additional carbon in amended plots.

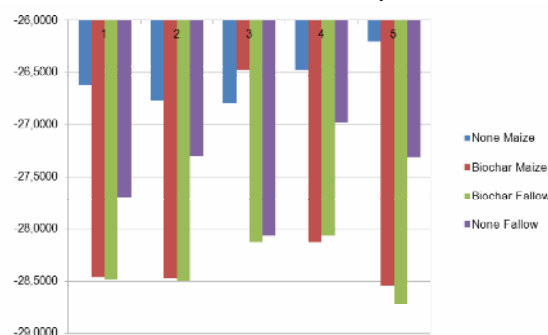


Figure 1. Isotopic ratio variation (δ C¹³) in soil at 0 to 25 cm depth during the first maize cycle (2009).

Conclusions

In Brazil, up to 1 Mt of charcoal fines arises as a by-product of charcoal production from sustainable plantation forest. This material appears to impacts on the dynamics of carbon cycling in the soil, and this may be used or manipulated for commercial agronomic gain, as well as carbon sequestration.

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