BIOCHAR AS A SOIL CONDITIONER IN AGRICULTURAL SYSTEMS IN THE CERRADO

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This research work was carried out at the Capivara Farm of Embrapa Arroz e Feijão in Santo Antônio de Goiás, GO and at the Estrela do Sul Farm in the municipality of Nova Xavantina, MT. We tested the effects of incorporating biochar into the soil of upland rice and soybean production systems in the Cerrado. Here we refer to biochar as any type of material produced from carbonized vegetable waste in *pyrolysis. Pyrolysis* is seen as a promising approach to lowering the levels of CO2 in the atmosphere, as it is a fast and controlled way of transforming biomass that is re-deposited on agricultural soils at a slower decomposition rate than organic matter in the soil (LEHMANN, 2007). Biochar characteristics such as recalcitrance, aromaticity and high specific surface make this material desirable as a soil conditioner, which can contribute to the lasting improvement of the chemical, physical-hydraulic and biological characteristics of the soil. This contribution can result over time through optimizing using fertilizers and attenuating or reversing soil degradation processes. In this sense, it is necessary to study the long-term effect of biochar on production systems. The biochar used in these studies was obtained from charcoal residue from eucalyptus planted forests produced by slow pyrolysis, at a temperature between 450-550 ° C, in the absence of oxygen. Vegetable charcoal residues are smaller than 8 mm. The biochar was ground to pass through a 2 mm sieve and incorporated only once in the 0-20 cm layer of Red Clay Oxisol (57% clay, 33% sand) in 2009, of sandy Plintosol (17% clay, 76% sand) in 2008, and of red yellow latosol frank sandy clay (31% clay, 67% sand) in 2006. In general, the total C content of the biochar varied between 50 and 77%, total N between 0.3 and 0.7%, pH (H_2O) between 7.6 and 7.9, K available between 780 and 3300 mg/kg, P available between 72 and 1000 mg/kg. The biochar is porous, rich in micropores ≤ 10 μm (Figure). The effect on soil properties and grain productivity was evaluated during the harvests, up to 5 years after the application of the biochar. In the Latosol and Plintosol we tested the doses of 8, 16 and 32 ton/ha of biochar. In the sandy clayey Oxisol we tested doses of 2, 4, 8 and 16 ton/ha. For all experiments, we included a reference, soil without biochar. The research was funded by Embrapa with support from CNPq, the Goiás Research Foundation, Federal University of Goiás, Mato Grosso State University and Wageningen University.

RESULTS

The organic OC in the Latosol increased at a rate of 0.25% for each ton of biochar applied 1.5 years after biochar application. In Plintosol the rate was 0.07% immediately and 1 year after application of the biochar. In the sandy clay Oxisol, the rate was 0.52% from 4 years after application of biochar. Crop rotation, present in integrated systems cultivated with soybean and brachiaria in the Latosol sandy clay and with upland rice followed by irrigated beans and millet in the Latosol, led to an increase in organic C in the soil over time. The soil C may have been physically protected in the biochar micropores and immobilized by microorganisms. In addition, the weathering of the biochar over time induces the activation and formation of phenolic and carboxylic groups adsorbed on the clay particles. On the contrary, on sandy soil in monoculture with upland rice, the effect of biochar on organic C increase was short-lived. However, the increase in total porosity with the application of biochar increased the water available to the plants by up to 4 mm in the 5-10 cm layer in the sandy soil. In sandy soil, upland rice productivity increased with the dose of biochar, especially in drier crops. An overview of the results of the studies conducted is shown in the table.

NEXT STEPS AND RECOMENDATIONS

Biochar can be used as a strategy to increase water available to plants in sandy soils, to contribute to the increase of organic C in clayey soils in the long term and to increase the pH of acidic soils. Improving soil quality positively affects crop productivity.

Biochar does not significantly increase the N_2O emission of nitrogen fertilizer applied to the soil

DATA PUBLISHED IN:

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Continued in Annex

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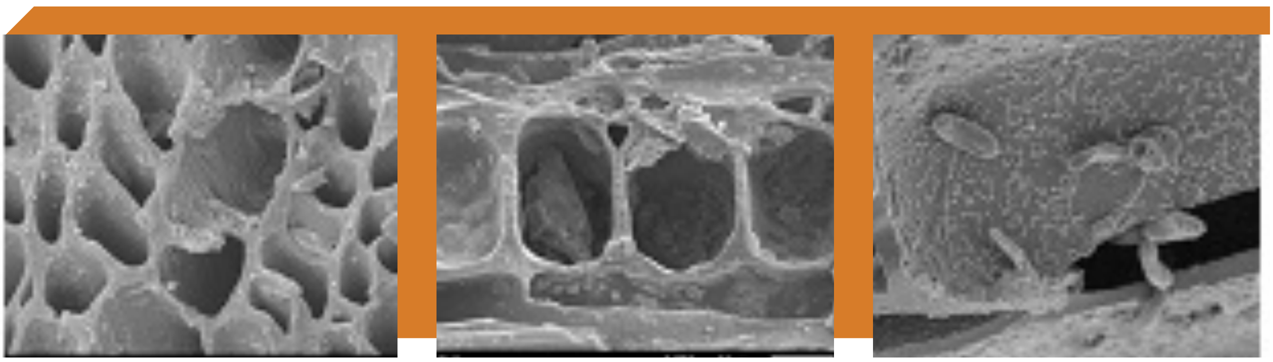
Table 1: Effects of usingbiochar as a soil conditioner on soil properties and grain yield during agricultural crops in a sandy and clayey soil in the Cerrado

	---------------Plintosol--------		---------------Latosol---------	
	Primeiras safras	Últimas safras	Primeiras safras	Últimas safras
Water holding capacity in the soil	?	↑	?	↓
Soil organic matter	↑	x	x	↑
Soil acidity	↓	↓	↓	↓
Grain productivity x x	↑	x	x	↓
N_2O emission	↑	x	x	x

↑ = INCREASED; ↓ = REDUCED; x == NO EFFECT; ? = NOT INVESTIGATED.

Source: Authors.

Figure 1: Electron microscopy image of micropore details of three types of charcoal biochar applied to clayey, sandy and sandy clayey soils



Source: Authors.