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# BIOCHAR USE OF ASSESSMENT ON SOIL MOISTURE

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## ABSTRACT

This study aimed to evaluate the effect of the application of biochar in soil physical properties. The experiment was arranged in a randomized block design with 6 treatments: 1- without biochar (control); 2- biochar coconut; 3- sludge biochar; 4- biochar coconut + sludge (1:1); 5- sludge biochar + raw sludge (1:1); 6- biochar + coconut raw sludge (1:1). The amount of biochar was applied 30 t.ha$^{-1}$, with 4 repetitions, and a total of 24 plots. The plots consisted of crop lines with areas of 1.05 m$^2$ each. The deployment area was plowed and fenced to a depth of approximately 0.20 m. Biochar is produced in a furnace adapted based on the model developed by IBI (International Initiative biochar) and used as biomass residue of coconut production (dried coconut shells). The coconut shells were put in the oven internal chamber to the pyrolysis process. The plots consisted to sites with areas of 16 m$^2$ each, which was grown okra. Soil moisture was monitored using tensiometers installed at depths of 10 cm and spread in the experimental area. The parameter evaluated were soil moisture. The results showed that the moisture had little variation among the treatments.

**Keywords:** Soil physical quality; water availability; soil management

# AVALIAÇÃO DO USO DE BIOCARVÃO NA UMIDADE DO SOLO

## RESUMO

O presente trabalho teve como objetivo avaliar o efeito da aplicação de biocarvão nas propriedades físicas do solo. O experimento foi disposto em blocos casualizados, com 6 tratamentos: 1- sem biocarvão (testemunha); 2- biocarvão de coco; 3- biocarvão de lodo; 4- biocarvão coco + lodo (1:1); 5- biocarvão de lodo + lodo cru (1:1); 6- biocarvão de coco + lodo cru (1:1). A dose de biocarvão aplicada foi 30 t/ha, com 4 repetições, e um total de 24 parcelas. As parcelas consistiram de linhas de cultivos com áreas de 1,05 m$^2$ cada. A área de implantação foi arada e gradeada a uma profundidade de aproximadamente 0,20 m. O biocarvão foi produzido em um forno adaptado com base no modelo desenvolvido pela IBI (Iniciativa

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Internacional de Biocarvão) e utilizado como biomassa vegetal o resíduo da produção de coco (cascas de coco seco). As cascas de coco foram acondicionadas na câmara interna do forno para o processo de pirólise. A umidade do solo foi monitorada com o uso de tensiômetros instalados na profundidade de 10 cm e espalhados na área experimental. O parâmetro avaliado foi a umidade do solo e os resultados mostraram que a umidade do solo apresentou pouca variação entre os tratamentos.

**Palavras-chave:** Qualidade física do solo; disponibilidade de água; manejo de solo

## INTRODUCTION

Food safety and the scarcity of water resources have been causing concern and has aroused the scientific community to changes in current soil use management systems and the development of more sustainable technologies in agriculture. In the last 50 years, the world population doubled, reaching more than 6 billion people. According to the Uuited Nations Population Division (2008), in 2050 there will be 9.2 billion people inhabiting the world and depending on products from agriculture, which is the soil as the basis of the production system.

According to Guimarães et al. (2013) in studies at the Federal University of Sergipe pointed depletion of soil organic matter (SOM) of agricultural areas as a major obstacle to the development and productivity of crops in the state. In addition to the climatic conditions favorable to rapid decomposition of organic residues, this problem also results from factors such as low plant biomass production and use of tillage techniques that stimulate the loss of organic matter (OM), a key component in the construction and maintenance of soil structure.

The potential use of biochar in the soil, both to carbon sequestration evaluation to the effects on soil quality and productivity of crops has been the subject of many studies in different countries. However, most studies are done with biochar produced from wood, and using other crop residues such as corn straw and rice husks. Most studies have also been developed in protected conditions in a greenhouse.

This study aimed to evaluate the effect of biochar application produced by slow pyrolysis process from dried coconut peeling and sewage sludge in the soil water retention capacity under field conditions.

## METHODOLOGY

The study was conducted in the experimental field of the Federal University of Sergipe, located in São Cristóvão-SE. The climate according to Thornthwaite is sub-humid areas with water deficit in the summer, the rainy season occurs between April and August, the average temperature in the region is 24.85 °C and average annual rainfall of 1,576.30 mm.

The soil is classified as Red Ultisol according to EMBRAPA (2007). sandy loam texture with the following physicochemical characteristics: pH = 4.64; P = 1.82 mg.dm-3; K = 25.40 mg.dm-3; $Ca^{2+}$ ; $Mg^{2+}$ = 1.37 mmolc.dm-3; $Al^{3+}$ = 0.45 mmolc.dm-3; V = 76.13%; CTC = 1.88 cmol.dm-3; MO = 11.06 g.dm-3; sand, silt and clay 71.57%, 13.43% and 15%, respectively; bulk density of 1.398 g.cm-3.

Biochar was produced in an adapted furnace using a model developed by IBI (International Initiative biochar) (http://www.biochar-international.org/technology), the TLUD (Top Lid Updraft).

As biomass was used residue of coconut production (dried coconut peeling) collected direct from a rural producer and sewage sludge collected in sewage treatment plant. Coconut residues were previously air-dried in a greenhouse and the sludge was exposed to air for a day to reduce the moisture content.

The coconut shells and sewage sludge conditioned in the inner chamber of the furnace TLUD were transformed into biochar in a pyrolysis process which lasts about 40 minutes and temperatures ranging from 350-450 °C in the inner compartment and around 650-700 °C in the outer compartment.

The experiment was arranged in a randomized block design with 6 treatments: 1- without biochar (control); 2- biochar coconut; 3- sludge biochar; 4- biochar coconut + sludge (1:1); 5- sludge biochar + raw sludge (1:1); 6- biochar + coconut raw sludge (1:1). The amount of biochar was applied 30 t.ha-1, with 4 repetitions, and a total of 24 plots. The plots consisted of crop lines with areas of 1.05 m2 each. The deployment area was plowed and fenced to a depth of approximately 0.20 m.

The biochar was applied and incorporated into the soil manually thirty days before sowing at a depth of 0.05 m in the soil. The sowing occured in 5 of May of 2016 and put 3 seeds per hole, with plant spacing of 0.30 m (seeds used cultivar Santa Cruz). Thinning was performed 13 days after sowing and the irrigation method used was trickle irrigation system.

Soil moisture was monitored using tensiometers installed at a depth of 0.10 m and spread in each treatment of the experimental area. Readings were taken by digital tensiometer, being held in the afternoon, before irrigation.

Also undisturbed samples were collected to take the water retention. The applied potential following: -1, -4, -6, -10 kPa using suction table, and the potential -33, -100, -500 and -1500 kPa applied through porous plates pressures within chamber pressure as Klute (1986). The samples were then dried in an oven at a temperature of 105-110 °C. The adjustment of the water retention curves in soil was in accordance with the equation of van Genuchten (1980) using the program version CURVARET 2:16 and plotted as a function of the suction applied.

## RESULTS AND DISCUSSION

According to data obtained it can be seen that for all treatments was points where the soil was saturated, that is, above the field capacity (CC), as a result of the rainfall which occurred during the trial period (Figure 1). There was little variation from the water tension in the soil and treatments. Since the treatments containing coconut biochar were those who were closer to the field capacity.

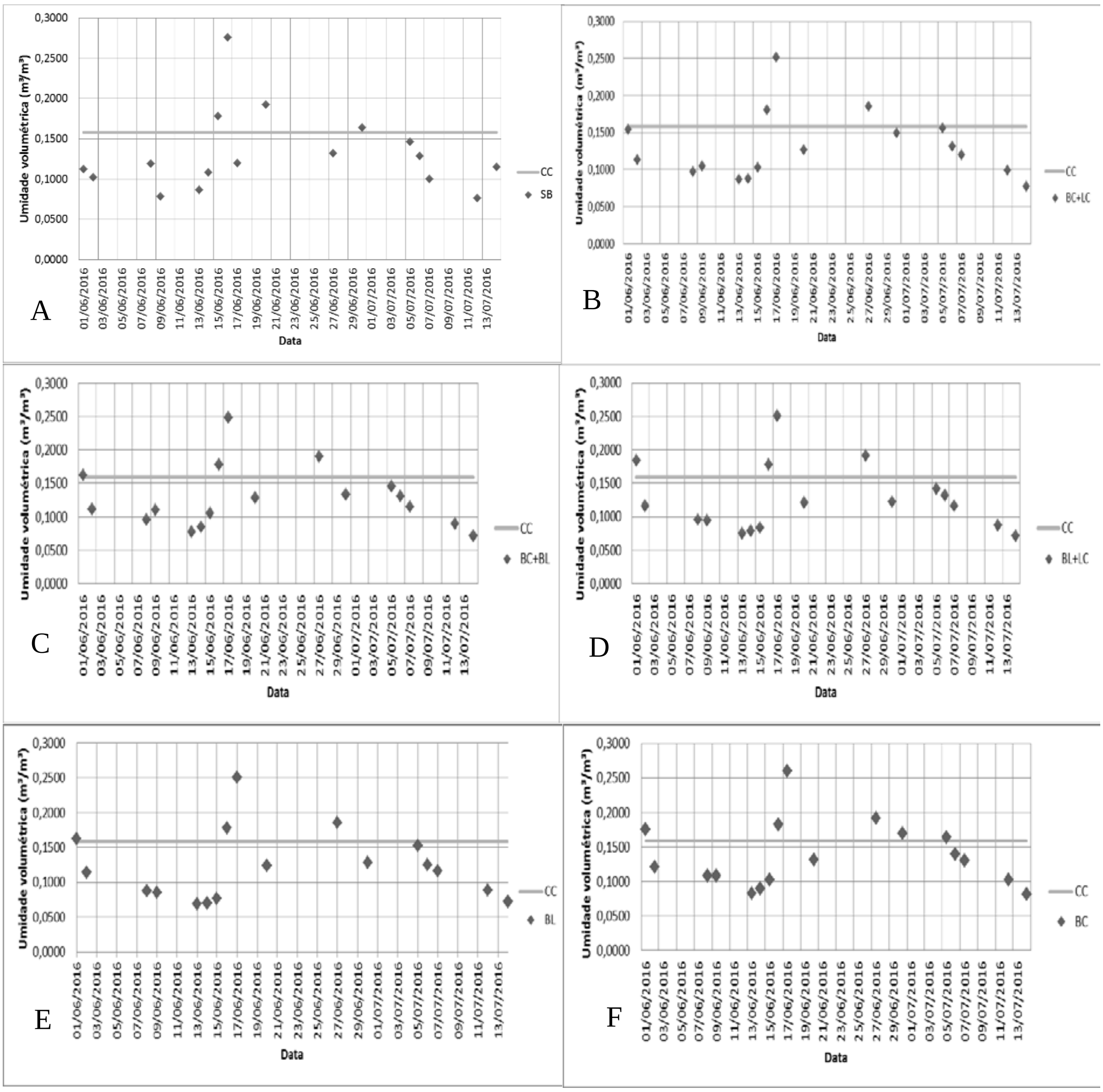


**Figure 1: Soil moisture in the treatments:** without biochar (A); biochar coconut + raw sludge (B); biochar coconut + biochar sludge (C); biochar sludge + raw sludge (D); biochar sludge (E) and biochar coconut (F).

Anderson et al (2011) investigated temporal changes in soil microbial ecology and physicochemical parameters in the presence and absence of biochar observed that rhizosphere soil had up to 5.7% less moisture by weight than the bulk soil. When compared to the Biomax® sintered glass (SG) controls, soils with biochar (BC) retained 0.9–3.5% more moisture by weight.

The few variation among treatments occured due to the preciptation during the experiment period. This climate situation is common in winter season, especially in coast zone. According to Karhu et al (2011) that investigated the hypothesis that biochar addition would increase soil water holding capacity, but the results showed there were no statistically significant differences in soil water content between biochar and control plots (for air temperature during the measurement period). Heavy rain events increased soil water content similarly in both treatments.

Some authors such as Novak et al. (2009), Dumroese et al. (2011) and Lei & Zhang (2013), noted that there was a significant influence on water retention in the soil when it was treated with biochar. According to Alburquerque et al. (2014), when the bio-carbon is added to the soil, there is a tendency to increase the field capacity of the soil, mainly when applied at high doses, resulting in increased plant growth and water saving. Chan et al. (2008), studying the application rates of the biochar, found that soil field capacity increases when biochar is added, but this effect improves when the biochar is incorporated in large doses, obtaining significant changes when the doses are 50 And 100 t ha-1.

## CONCLUSION

The results allowed conclud that there was little variation from the water tension in the soil and treatments and that the biochar has a great potential to be used in soils and maintain soil moisture, especially in Sergipe that has a semiarid zone were agricultura lis praticed.

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