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Sugarcane Trash Biochar: Effect of the Temperature in the Porosity

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Abstract : Biochar can be an alternative to use sugarcane trash. Biochar is a solid material obtained from pyrolysis, that is a biomass thermal degradation with low or no O_2 concentration. Pyrolysis transforms the carbon that is commonly found in other organic structures into a carbon with more stability that can resist microbial decomposition. Biochar has a versatility of uses such as soil fertility, carbon sequestration, energy generation, ecological restoration, and soil remediation. Biochar has a great ability to retain water and nutrients in the soil so that this material can improve the efficiency of irrigation and fertilization. The aim of this study was to characterize biochar produced from sugarcane trash in three different pyrolysis temperatures and determine the lowest temperature with the high yield and carbon content. Physical characterization of this biochar was performed to help the evaluation for the best production conditions. Sugarcane (Saccharum officinarum) trash was collected at Corredeira Farm, located in Ibaté, São Paulo State, Brazil. The farm has 800 hectares of planted area with an average yield of 87 $t \cdot ha^{-1}$. The sugarcane varieties planted on the farm are: RB 855453, RB 867515, RB 855536, SP 803280, SP 813250. Sugarcane trash was dried and crushed into 50 mm pieces. Crucibles and lids were used to settle the sugarcane trash samples. The higher amount of sugarcane trash was added to the crucible to avoid the O_2 concentration. Biochar production was performed in three different pyrolysis temperatures (200°C, 325°C, 450°C) in 2 hours residence time in the muffle furnace. Gravimetric yield of biochar was obtained. Proximate analysis of biochar was done using ASTM E-872 and ABNT NBR 8112. Volatile matter and ash content were calculated by direct weight loss and fixed carbon content calculated by difference. Porosity measurement was evaluated using an automatic gas adsorption device, Autosorb-1, with CO_2 described by Nakatani. Approximately 0.5 g of biochar in 2 mm particle sizes were used for each measurement. Vacuum outgassing was performed as a pre-treatment in different conditions for each biochar temperature. The pore size distribution of micropores was determined using Horváth-Kawazoe method. Biochar presented different colors for each treatment. Biochar - 200°C presented a higher number of pieces with 10mm or more and did not present the dark black color like other treatments after 2 h residence time in muffle furnace. Also, this treatment had the higher content of volatiles and the lower amount of fixed carbon. In porosity analysis, while the temperature treatments increase, the amount of pores also increase. The increase in temperature resulted in a biochar with a better quality. The pores in biochar can help in the soil aeration, adsorption, water retention.
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Keywords : proximate analysis, pyrolysis, soil amendment, sugarcane straw

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