

Adsorption Characteristics of Ammonium onto Rice Husk Biochar Pyrolysed at Different Temperatures

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Low nitrogen use efficiency of added fertilizers is a great concern as it is less than 50% in most agro-ecosystems. Biochar (BC) has a massive micro pore structure, high surface area and surface charge which improve the soil nutrient adsorption. Nonetheless the pyrolysis conditions and type of feedstock determine the physicochemical properties of BC. The present study was conducted to study the ammonium (NH₄⁺) adsorption of rice husk BC (RHB) produced at different pyrolysis temperatures (i.e., 300 °C, 500 °C and 600 °C) using a Down Draft Double Chamber (DDDC) pyrolyser (i.e., 500 °C) and a laboratory scale muffle furnace (i.e., 300 °C and 600 °C). Biochar were named as RHB_300, RHB_500, and RHB_600 and characterized. A batch sorption experiment was conducted to evaluate the NH₄⁺ sorption on BC and sorption isotherms were fitted (i.e., Langmuir and Freundlich). The fixed carbon percentage was increased with increasing pyrolysis temperature and highest was observed in RBH_600. Therefore, it can exist in soil over a long period of time as an NH₄⁺ adsorbent. The RHB_300 showed the highest NH₄⁺ sorption capacity at pH7. Langmuir isotherm model was best fitted with the NH₄⁺ sorption (R²=0.99) on RHB_300 and RHB_600, and RHB_500 was best fitted with Freundlich isotherm model (R²=0.97). The significantly higher ash content (i.e., 45%) in RHB_500 can be attributed to this deviation by increasing the BC surface heterogeneity. Among the tested BCs for soil application aimed at enhancing nitrogen use efficiency, the RBH_300 stands out as the best performer as it exhibited significant NH₄⁺ sorption capacity and high fixed carbon content.

Keywords: Rice husk, Black carbon, Nitrogen, Fertilizer use efficiency

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