EFFECTS OF AGING ON BIOCHAR STABILITY AND SOIL AMENDMENT PROPERTIES

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Previous literature offers great evidence about biochar functionalities for crop productivity and soil remediation. However, the role of biochar in climate change mitigation depends on biochar stability, and its soil amendment features are likely to change over time. When incorporated into the soil, biochar undergoes various degradation processes, such as fragmentation, dissolution and oxidation caused by physical, chemical, and biological factors. These natural aging mechanisms have been poorly explored and they cannot be neglected as alterations in biochar and soil dynamics might affect the desired outcomes. Moreover, understanding biochar-amended soil aging in the field is rather complex as waiting for decades/centuries of observation is impractical, especially when sustainable solutions are urgently needed. One proposed way to address this issue is to induce accelerated biochar aging in the laboratory by using controlled strategies that mimic natural features in a much shorter time (days/weeks). For instance, wet-dry cycles can simulate physical and chemical changes caused by rainfall events and temperature variation, while chemical oxidation helps comprehend biochar abiotic oxidation mechanisms in the soil (Wang et al., 2020). Thus, this study aims to investigate the effects of aging on three biochars, focusing on their long-term capacity to store carbon and ability to retain water and nutrient in the soil. Two sewage sludge biochars derived from different locations (Brazil and United Kingdom) and a sugarcane biochar, pyrolysed at two different temperatures each, will be aged using two accelerated aging methods: wet-dry cycles and chemical oxidation with H_2O_2 (hydrogen peroxide). Analysis of biochar functional properties by means of standard methods, and the decomposition rate of biochar will be assessed to examine their real potential to sequestrate carbon. Also, the water-holding capacity of fresh and aged biochar-amended sandy soil will be analysed. Therefore, the physicochemical changes of aged biochars and the consequences associated with them will be explored. For example, we will discuss how the modifications of surface functionality, specific surface area and porosity might impact biochar adsorption properties in the soil. The results regarding the modification of biochar elemental composition and the degree of carbon degradation will be drivers for deliberating biochar aromaticity and hydrophilicity in the long term. The water retention experiment will provide comparative evidence of how aging affects biochar-amended soil hydrology. Besides, the selection of sewage sludge and sugarcane as biomasses for biochar production is decisive for the comparison of waste and plant-based biochars, as well as for the valorisation and recycling of waste materials. We expect that different degrees of oxidation and fragmentation for each biochar will result in diverse water-holding capacities and, despite the probable stability variances between the samples, we believe that the carbon storage in the soil will be consistent in the long term, with meaningful prospects for decreasing GHG emissions. Finally, we consider this study is significantly relevant to the “Bio-Char III: Production, Characterization and Applications” conference, mainly regarding the “Biochar and Climate Change” theme, because its findings will reveal a truthful perspective of the biochars’ carbon sequestration and soil ameliorant/fertiliser attributes. Consequently, it will contribute to the formulation of integrated biochar management strategies within a long-standing mindset.

Reference

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