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Increased fulvic acid concentration explains aggregate-associated carbon and nitrogen accumulation in a biochar-amended tropical soil

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Abstract

Humic substances contribute largely to C and N sequestration by enhancing the accumulation of aggregate-associated C and N. However, the response of humic substances and aggregate-associated C and N to biochar application is less studied in the tropical ecosystem. A field experiment was conducted to investigate the effects of corn cob biochar on aggregate stability and humic substances, and how these humic substances impact on aggregate-associated C and N in a tropical ecosystem. The treatments included control/no biochar (CT), 15-ton biochar ha^{-1} (BC-15), 30-ton biochar ha^{-1} (BC-30), and 30-ton corn cob biochar ha^{-1} + phosphate fertiliser (BC-30 + P). The BC-30 and BC-30+P plots significantly increased the concentrations of the humic substances (humic and fulvic acids) compared to the CT. There was a significant increase in the mean weight diameter by 153 and 288 % in the BC-30 and BC-30+P treated soils was recorded. The BC-30 treatment resulted in a significant increase in the structural coefficient by 215 and 274 %, respectively, in the BC-30 and BC-30+P treatments relative to the CT. Significant increases in the aggregate-associated C and N accumulation were observed in the macro aggregates of the biochar-treated soils. The most important soil property that greatly contributed to the accumulation of aggregate-associated C and N was the fulvic acid – C, and, therefore, it could be used as an indicator to detect early accumulation of C and N in larger aggregates of soils of the humid tropics. Though the applied biochar increased the aliphatic and aromatic C compounds, it is the aliphatic C compound (fulvic acid) that largely and most significantly influenced early C and N accumulation within the macro aggregates in the shortest time.

Keywords: C and N stoichiometry, degree of polymerisation, geometric mean weight diameter, humic acid, humic substances, structural coefficient

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