Tropentag, September 20-22, 2023, hybrid conference

"Competing pathways for equitable food systems transformation: Trade-offs and synergies"

Biochar co-compost improves growth and yield of amaranth and cowpea in highly weathered sub-Saharan soils

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Abstract

Soil fertility decline is a major constraint to crop production in sub-Sahara Africa (SSA). In Ghana, the highly weathered soils are continuously cropped without any external fertiliser addition. This study was done to examine the quality of biochar co-compost produced from corn cob and rice husk biochar together with easily accessible feedstocks like domestic bio-waste, poultry litter, and rice straw, and to assess the direct and residual effects of the compost produced on soil physicochemical properties, nutrient uptake, and growth and yield parameters of amaranth and cowpea in an amaranth-cowpea cropping rotation. The study, which involved nine treatments, was conducted in pots filled with low nutrient, Haplic acrisol, Ferric acrisol and Plinthic acrisol, collected from the coastal savannah zone, semi-deciduous forest zone and guinea savannah zone of Ghana, respectively, and arranged in a randomised complete block design (RCBD). The treatments in the study included a no amendment control (Co), inorganic NPK fertiliser (IF), rice husk biochar (RHB), corn cob biochar (CCB), compost without biochar (Com), biochar co-compost containing 5 % RHB (5CoRHB), biochar co-compost containing 10 % RHB (10CoRHB), biochar co-compost containing 5 % CCB (5CoCCB) and biochar co-compost containing 10 % CCB (10CoCCB). The result showed that soil pH, electrical conductivity (EC), total nitrogen (TN), total carbon (TC), carbon to nitrogen ration (CN ratio), and available P were significantly increased in the biochar, compost, and biochar co-compost treatments compared to the un-amended control. Biochar co-compost increased soil pH by 0.8 – 1.6 units, TN by 8.4 – 46.3 %, and available P by 1278 – 5300 %, compared to the control. Soil pH in the biochar co-compost amended soils positively correlated with EC, TN, available P, and the exchangeable cations. Biochar co-compost increased biomass yields of amaranth and cowpea above 100 % in all the soil types. In both plants, N, P and K uptakes in the biochar co-composts increased with increased biochar addition (10 % biochar > 5 % biochar). We conclude that biochar co-compost application has the potential to improve soil physicochemical properties and increase crop yields by reducing nutrient losses through slower N mineralisation and higher release of P and K for plant uptake.

Keywords: Biochar, biochar co-compost, compost, growth, soil properties, yield

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