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Integrated soil fertility management with biochar cocompost and inorganic fertiliser has potential to increase soil quality; nitrogen use efficiency and maize yields in africa

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Abstract

Maize yields in most African countries are lower than their potential levels due to low soil fertility and poor agronomic practices. Farm waste can be recycled into useful soil amendments as alternatives or supplements to the expensive, and rarely available inorganic fertilisers in a circular economy approach. This study examined soil quality, nitrogen use efficiency and maize yields responses in soils amended with rice husk biochar cocomposted, and poultry manure and rice husk, and poultry manure and rice straw compost over a 3-year period. The amendments were applied based on their initial nitrogen content to supply 100 kg N ha⁻¹, with or without inorganic NPK fertiliser at 100 kg N ha⁻¹, 60 kg P₂O₅, and -60 kg K₂O ha⁻¹, respectively in a highly weathered, coastal savannah Haplic once a year under rainfed, conditions Standard laboratory methods were used to determine soil quality (pH, CEC, soil total N, organic matter, bulk density, porosity, and basal respiration) before and 3 years after amendment additions. Agronomic Efficiency, Grain Harvest Index, and maize Nitrogen Use Efficiency, and their relationships maize aboveground biomass and grain yields were also estimated. The average maize yields were 1661 kg ha⁻¹, 2223 kg ha⁻¹, and 4299 kg ha⁻¹ for the control (farmers practice), sole compost application and the biochar cocompost amended soils, respectively. Maize N Use efficiency increased significantly from 46 % in the control soil to 52 % and 58 % respectively in the sole organic input additions, and up to 63 % in the combined inorganic and organic N input treatments relative to the unamended control. Biochar cocompost and compost only additions reduced soil bulk density, and increased soil carbon content and soil total nitrogen over the 4-year period. Statistical analyses of the data revealed that improved soil quality positively correlated with nitrogen use efficiency, and maize grain yields. The study demonstrated that biochar cocompost application, particularly, with inorganic NPK fertiliser can improve maize yields to improve food security in Africa.

Keywords: Biochar, cocompost, maize yield, nutrient use efficiency , soil quality