Tropentag, September 10-12, 2025, hybrid conference

"Reconcile land system changes
with planetary health"

Effectiveness of co-composted biochar on soil acidity and maize growth in acidic soil of Bangladesh

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Abstract

Biochar has attracted enormous interest in enhancing agricultural productivity in acidic soils but its high cost limits widespread adoption. Thus, new amendments such as co-composted biochar (COMBI) are gaining the spotlight, however, the effect of COMBI on plant growth, nutrient uptake, and the mechanism for ameliorating soil acidity remains unclear. This study aimed to investigate the efficacy of COMBI compared to locally available amendments in improving soil properties, nutrient uptake, and maize growth in acidic soil. A pot study was established in a net house with six treatments: control, compost, ash, biochar, poultry litter, and COMBI, applied at 10 % (w/w) in triplicate, and replicated in the field experiment. The results showed that the application of amendments increased soil pH and decreased exchangeable acidity. COMBI showed a significant ameliorating effect on soil acidity, increasing soil pH by 1.53 units compared to the control. The effect of COMBI on soil cation exchange capacity and base cations was significantly larger compared to the control and other treatments ($p < 0.05$). Also, the application of amendments enhanced the uptake of N, P, K, Ca, and Mg by maize and thus promoted maize plant height, shoot, root, and total dry weight in the pot study. On the nutrient uptake potential of maize, COMBI showed the most significant effect compared to all other treatments. This was translated into a significant increase in total dry biomass (186 %) after 40 days of maize growth for COMBI ($p < 0.05$), followed by biochar (89 %), poultry litter (50 %), compost (47 %), and ash (41 %). Similar to the pot study, the application of amendments enhanced nutrient uptake and maize growth in the field, and the application of COMBI significantly increased shoot dry weight by 54 % after 60 days of maize growth ($p < 0.05$), followed by biochar (38 %), compost (21 %), poultry litter (15 %), and ash (6 %). Correlation analyses revealed strong positive relationships between improved soil properties such as pH, organic matter and cation exchange capacity, and plant growth parameters, particularly nutrient uptake. Therefore, COMBI is a promising alternative for acid soil amelioration and crop growth promotion.

Keywords: Acidification, composted biochar, exchangeable acidity, plant nutrients, soil health, soil pH

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