Tropentag, September 14-16, 2022, hybrid conference

"Can agroecological farming feed the world?
Farmers' and academia's views"

Biochar improved gravelly soil water and fertiliser use efficiency and the yield of pearl millet (*Pennisetum glaucum*)

Sebastian Ayinbisa Yanore[1], Samuel Kwasi Godfried Adiku[1], Dilys Sefakor Maccarthy[2], Daniel Etsey Dodor[1], John Bright Amoah Nyasapoh[1]

[1] *University of Ghana, Dept. of Soil Science, Ghana*
[2] *University of Ghana, Soil and Irrigation Research Centre, Ghana*

Abstract

The effect of biochar on water and fertiliser use and the response of pearl millet(*Pennisetum glaucum*) grown on a gravelly soil (> 15 % v/v) of Northern Ghana was investigated in a greenhouse. Gravelly soil with varying soil gravel contents (SGC) of 0 %, 10 %, 30 %, 40 % and 60 % were constructed with Polyvinyl chloride columns (internal diameter = 16 cm and height= 40 cm). Rice husk biochar (pyrolyzed at 360°C) was applied at 25 ton ha^{-1} in three application modes: no biochar (BCN_m), top 10 cm mix (BCT_m) and fully mixed (BCF_m). These columns were randomly arranged in the greenhouse, pearl millet seeded and fertilised at 100 kg N ha^{-1}, 40 kg P ha^{-1} and 40 kg K ha^{-1}. Rainfall was simulated following normal rainfall patterns for the soil sampling area, derived from 42-year rainfall data. Runoff (R) and drainage (D) were determined following each simulated rainfall event, whiles the soil moisture content (θ) was determined as the difference in moisture before and after irrigation. The actual evapotranspiration (ET_a) was calculated using the water balance equation. Plant growth data collected were plant height, number of tillers, leaves and chlorophyll content. The water use efficiency (WUE) was determined as the ratio of grain yield to the ET_a. The partial factor productivity (PFP) was determined as the ratio of the plant shoot and grain weight to the N applied. The results showed that biochar significantly increased the θ and reduced (R + D) by 35 and 32% for BCT_m and BCF_m compared to BCN_m, respectively. Biochar reduced ($p < 0.05$) nutrient loss in soils containing 40 % SGCs. The plant growth parameters responded positively to the biochar amended soil and consequently reduced the negative effects of SGC on plant development. The WUE and PFP in the gravelly soils increased with biochar addition even at 60 % SGC compared to the BCN_m. Biochar application (BCT_m and BCF_m) resulted in increased θ, grain yield WUE and PFP than the BCN_m. In conclusion, biochar improved θ by filling the macropores created by soil gravels, increased soil CEC and P status, thus, increased yield, the highest effect measured at BCF_m.

Keywords: Biochar, nutrient loss, soil gravel content, water balance components, water use efficiency

Contact Address: Sebastian Ayinbisa Yanore, University of Ghana, Dept. of Soil Science, Oppsite Akuafo Main Hall, GA-455-580 Accra, Ghana, e-mail: syanore___ayinbisa@st.ug.edu.gh