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Effects of biochar and waste water irrigation on soil biological properties in urban agriculture in N-Ghana

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Urban agriculture (UA) in West African countries substantially contributes to urban economy and food supply for the urban population. It is often characterized by high nutrient inputs compared to agriculture in rural areas and the use of mostly untreated waste water for irrigation. Biochar has been proposed to increase crop yield and improve soil properties. In this study we assessed microbial respiration, microbial biomass carbon and enzyme activities of soil from a field experiment in UA in northern Ghana treated with fertilizer and/or biochar under clean and waste water irrigation. Our results show a strong increase of SOC by biochar application by up to 141%. Hot water extractable carbon (HWC) was increased by biochar by about 11 to 26% and microbial biomass carbon (MBC) by 34%. Waste water irrigation increased HWC significantly by 4%. Basal respiration was significantly increased in mineral fertilized soil by up to 46% and decreased by 12-45% under waste water irrigation. Overall, the metabolic quotient (qCO_2) indicated less stress for the microbial community and increased carbon use efficiency with biochar application and waste water irrigation. Furthermore, waste water irrigation increased total enzyme activities and biochar treated soils exhibit a more diverse C-cycling community and a higher activity of aminopeptidases. Therefore, biochar and waste water showed positive effects on biological soil properties and contributed to soil fertility. Our results also suggest beneficial effects of biochar on non-biochar SOC stocks in the long term.