ABSTRACT

Continuous and indiscriminate use of chemical fertilizers in staple cereal crops such as rice and maize deteriorate the quality of soils. Recycled nutrient-rich agro-residues, such as legume stover, as biochar and compost, can improve soil quality and maintain crop yield in drylands. We prepared and tested biochar as well as compost from legume stovers for their physico-chemical properties, effects on crop yield, soil carbon, microbial properties, and residual nutrient effects in dryland soils. Both show similar total–N content, although there are noticeable differences in macro, secondary, and micronutrients. The surface area and C: N ratio is significantly higher in the case of biochar (i.e., 4.47 m^2g^{-1}; 37.68) than in compost (i.e., 0.87m^2g^{-1}; 10.5). We analysed nine different treatments, including chemical fertilizers (as blanket and soil test-based recommendations: STB), sole organic (biochar and compost) and their combinations (with 75% and 50% STB) as integrated applications (INM) under field experiment with maize-chickpea and pot experiment with rice-chickpea cropping systems. In maize chickpea sequence, reducing mineral fertilizer doses through INM can be extended up to 50% with improved system equivalent yield. Nevertheless, after two years of the field experiment, the biochar treatments show higher (24–30%) organic carbon stock in the top layer of soil than the respective compost treatments. Furthermore, the biochar-based INM approach showed the maximum residual effect in chickpea crops under both cropping sequences. The system equivalent yield in field crops showed the best results (8 Mg ha^{-1}) for 50% need-based fertilizer and 50% biochar as INM. The rice-chickpea system also tended to better crop yield in balanced mineral fertilization (50% STB) and biochar (50% nutrient equivalence) than other fertilization methods. The findings show that drylands facing widespread land degradation in terms of nutrient imbalances and low C levels will benefit from an integrated approach of need-based fertilizer with biochar application. INM using biochar in the maize-chickpea and rice-chickpea system kept the crop yield intact while sequestering soil carbon in resource poor dryland soils. Therefore, this might be a long-term strategy or solution for semi-arid tropical drylands for sustainable agriculture and global food security.

Keywords: Biochar, Compost, Integrated nutrient management (INM), Maize-chickpea, Rice-Chickpea.