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Influence of Conservation Tillage on Soil Microbial Diversity, Structure and Crop Yields in Sub-Humid and Semi-Arid Environments in Kenya

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Abstract

Conservation tillage is one of the ways to maximise benefits derived from farming mainly through enhanced soil biological and physical conditions as well as better utilisation of rain water. In a study conducted over 5 to 10 cropping seasons in two agro-ecological zones in Kenya (three sites), the effect of conservation tillage practices on soil microbial diversity, soil structure, water conservation and crop yield were investigated. The on-farm experiments were laid out as split-split plot design involving different cropping systems and crop residue management strategies superimposed on the tillage practices. Clearly, higher soil macro-aggregation was observed in reduced tillage (by up to 18 %) and tied-ridges compared to conventional tillage system. Similarly, application of crop residue had positive effects on soil aggregation indices (increase by 13 %) in clay soil within sub-humid zone while combination of crop residue and manure was better than sole application of manure (by 4 %) in a sandy semi-arid zone. Among the cropping systems, aggregation indices declined in the order: intercropping > continuous maize > rotation. Conservation tillage practices showed higher diversity of bacterial and fungal populations compared to conventionally tilled plots. In the dryland zone, regardless of tillage system, application of 1 t ha⁻¹ of maize stover and manure each, was the best practice. In the humid zone, although reduced tillage had lower yields than conventional tillage its performance was enhanced when combined with ripping or sub-soiling. Thus from the study, conservation tillage was superior in improving soil microbial diversity and soil structure but low agronomic performance must be overcome through ripping and sub-soiling.

Keywords: Conservation tillage, crop residue, manure, microbial diversity, soil aggregation