

Impact of reduced tillage and crop residue management on soil properties and crop yields in a long-term trial in western Kenya

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Abstract

Sustainable farming practices are required to address the persistent problems of land degradation and declining crop productivity in sub-Saharan Africa (SSA). Approaches such as reducing tillage and retaining crop residues as mulch are potential entry points for smallholder farmers to move towards sustainability. In this study, we assessed the impact of reduced tillage (RT) versus conventional tillage (CT), each combined with crop residue reapplication, on soil quality indicators and crop yields under an eight-year trial in western Kenya. Our results indicate that RT combined with crop residue reapplication enhanced physical soil quality through increased macro-aggregate (>2000 μm) proportions and mean weight diameter (MWD). Similarly, lower respiratory quotient ($q\text{CO}_2$) values indicate that soil microbes under RT have better substrate use efficiency compared with those under CT. Nevertheless, soil organic carbon (SOC), potentially mineralizable C (PMC), microbial biomass C (MBC) and mineral nitrogen contents were all higher under CT with crop residue incorporated into the soil. Maize grain yield and above-ground biomass were also higher under CT. Thus, despite RT showing potential to improve soil physical properties, CT performed better. A step-wise approach is proposed towards the practice of conservation agriculture under resource constrained smallholder farming conditions, starting with increased biomass production to provide crop residue for soil cover, then followed by reduced tillage approaches.

SR15074 Accepted 20 November 2015

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