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Conservation Agriculture Practices in Smallholder Farming of Western Kenya: Nutrient Cycling and Greenhouse Gas Fluxes

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Abstract

Conservation Agriculture (CA) encompasses a set of practices designed to improve crop yields and soil quality. In Kenya, CA is gaining acceptance not as an alternative, but rather necessity to increase food production by food insecure smallholder farmers. Limited understanding of short-term agroecosystem response during transition to CA can impede the process of adoption. The objective of this study was to explore short-term impacts of selected CA practices on soil nitrogen (N), greenhouse gas (GHG) fluxes, weed population dynamics and crop performance at two locations in western Kenya: low altitude with two annual cropping seasons (Bungoma) and high altitude with one annual cropping season (Trans-Nzoia). Three tillage practices (conventional, minimum and no-till) were combined with three cropping systems (continuous maize intercropped with common beans; maize intercropped with common beans relayed with *mucuna* cover crop after beans harvest; and maize, common beans and *mucuna* planted in strip cropping arrangement). Herbicides were used in no-till, shallow hand hoeing and herbicides were used in minimum till and deep hoeing with no herbicides was used in conventional till. In general, Bungoma demonstrated high GHG fluxes, soil N mineralisation but significantly lower yields compared with Trans-Nzoia. Transitioning to minimum-till or no-till-based CA practices at both locations and forgoing second-season cropping in Bungoma will reduce soil disturbance and C and N losses to mineralisation, GHG emissions and potential leaching. Even though evidence of early accrual of soil benefits associated with CA practices may take longer than the timeframe of this research, farmers noticed immediate reduction in weed competition, which is one of the leading causes of yield loss in Kenya. Weed density of grass and forb species declined significantly under minimum till and no-till in Trans-Nzoia and of grass species only in Bungoma. Transitioning to CA systems resulted in a decline of four out of five most dominant weed species. Corresponding costs of weed management were reduced by \$148.40 ha^{-1} in minimum till and \$149.60 ha^{-1} in no-till compared with conventional tillage.

Keywords: Bimodal precipitation, Bungoma, carbon dioxide, farmer adoption, methane, nitrous oxide, sub-Saharan Africa soil mineral nitrogen, Trans-Nzoia

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