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Potential of selected soil and water conservation practices to reduce greenhouse gas intensity in sub-humid agro-ecozones of Kenya

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Abstract

Food insecurity and global warming are major challenges for agricultural production. Soil and water conservation practices (SWCPs) can improve crop yields through hydrothermal regulation and are widely applied as a common practice among smallholder farmers. However, their impacts on net global warming potential (GWP) and greenhouse gas intensity (GHGI) are not well understood. We implemented mulching and tied ridges with the following treatments: mulch-conventional (MCONV), mulch-integrated (MINT), mulch-organic (MORG), tied ridge-conventional (TRCONV), tied ridge-integrated (TRINT), tied ridge-organic (TRORG), and the control in randomised incomplete block design to evaluate the effects of SWCPs on GWP and GHGI. We employed static, vented chamber techniques for greenhouse gas sampling. We used mixed linear model fitted with lmer function during data analysis. Net GWP ($p < 0.001$) and GHGI ($p < 0.001$) significantly varied by treatment. We observed high CH_4 uptake under TRORG (-247 %, $p = 0.02$) compared to the control. There were significantly higher CO_2 and N_2O emissions under MORG and TRORG compared to control. We observed increased CO_2 emissions by +54 % and +65 %, and N_2O emissions by +217 % and +238 % under MORG and TRORG respectively compared to control ($p < 0.05$). Compared to the control, net GWP was higher under MINT (+118 %) and TRINT (+115 %), while it was significantly lower under TRORG (−32 %). We observed high GHGI sinks under TRORG (−86 %), and MRORG (−74 %). Although CO_2 and N_2O emissions increased under organic-based treatments, enhanced CH_4 uptake and yield effects resulted in reduced net GWP and strong GHGI sinks, particularly under TRORG. These findings suggest that integrating tied ridges with organic inputs increases GHGI sinks without compromising crop yields.

Keywords: Climate- smart agriculture, greenhouse gas intensity, greenhouse gas mitigation, sub-Saharan Africa

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