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Combining Organic/Mineral Fertilisers as a Climate-Smart Integrated Soil Fertility Management Practice in Sub-Saharan Africa: Meta-Analysis

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Abstract

Low productivity and climate change require climate-smart agriculture (CSA) for sub-Saharan Africa (SSA), through (i) sustainably increasing crop productivity, (ii) enhancing the resilience of agricultural systems, and (iii) offsetting greenhouse gas emissions. We conducted a meta-analysis on experimental data to evaluate the contributions of combining organic and mineral nitrogen (N) applications to the three pillars of CSA for maize (*Zea mays*). Linear mixed effect modeling was carried out for; (i) grain productivity and agronomic efficiency of N (AE) inputs, (ii) inter-seasonal yield variability, and (iii) changes in soil organic carbon (SOC) content, while accounting for the quality of organic amendments and total N rates. Results showed that combined application of mineral and organic fertilisers leads to greater responses in productivity and AE as compared to sole applications when more than 100 kg N ha^{-1} is used with high-quality organic matter. For yield variability and SOC, no significant interactions were found when combining mineral and organic fertilisers. The variability of maize yields in soils amended with high-quality organic matter, except manure, was equal or smaller than for sole mineral fertiliser. Increases of SOC were only significant for organic inputs, and more pronounced for high-quality resources. For example, at a total N rate of 150 kg N ha^{-1} $season^{-1}$, combining mineral fertiliser with the highest quality organic resources (50:50) increased AE by 20 % and reduced SOC losses by 18 % over 7 growing seasons as compared to sole mineral fertiliser. We conclude that combining organic and mineral N fertilisers can have significant positive effects on productivity and AE, but only improves the other two CSA pillars yield variability and SOC depending on organic resource input and quality. The findings of our meta-analysis help to tailor a climate smart integrated soil fertility management in SSA.

Keywords: Climate-smart agriculture, linear mixed effect modelling, maize productivity, soil organic carbon, yield variability

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