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Performance and yield stability of maize under a long-term experiment in the sub-humid tropics

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Abstract

Zea mays L. is an important staple cereal crop to the food security and livelihoods of people worldwide. We evaluated the effects of organic and conventional farming systems on maize growth and temporal yield stability under different external input levels in a long-term experiment (18-years and on-going) at two sites (Chuka and Kandara) in Central Kenya. The experiment was based on a three-year crop rotation cycle. Maize sole-crop was cultivated during the long rains' (LR) seasons at the start of each crop-rotation cycle. We implemented the following four farming systems: organic high (Org-High), conventional high (Conv-High), organic low (Org-Low), and conventional low (Conv-Low) in a randomised complete block design. Fortnight scouting reports were utilised to manage pests and diseases in the experimental sites. The sites experienced rainfall variation over the years and within seasons. We observed declining total rainfall amounts during the maize sole-cropping (LR) seasons. Crop growth parameters; height, stem diameter, and grain yield were higher in high input systems, but grain yield stability was not. At the beginning of the experiment, grain yields of conventional systems were higher compared to the organic systems, whose yield levels gradually increased over time, reaching the yield levels of conventional systems. At Chuka, Org-High generally had higher grain yields except in LR07 and LR22, while at Kandara, the Org-High system had the highest yields during the LR13, LR16, and LR22 seasons. With regard to grain yield stability, the site (Chuka) with better soil fertility, the Conv-High system had the least residual variance (0.28 Mg ha^{-2}), followed by Org-Low, Conv-Low, and Org-High showing the highest residual variance (0.67 Mg ha^{-2}). Contrary, in the site (Kandara) with low soil fertility, Org-Low had the lowest residual variance in grain yield (0.16 Mg ha^{-2}), followed by Conv-Low and Org-High, while Conv-High (4.15 Mg ha^{-2}) had the highest residual variance. We observed that applying higher nutrient input levels did not necessarily lead to yield stability. Our findings suggest promoting long-term implementation of organic farming practices, especially in regions with degraded soils, for improved yield and resilience.

Keywords: Agroecology, crop rotation, farming system, nutrient replenishment, soil fertility, yield trend

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