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Maize Productivity and Response to Fertiliser Use as Affected by Soil Fertility Variability, Manure Application and Cropping System in Africa

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Abstract

To counter growing food insecurity in sub-Saharan Africa (SSA), there are renewed efforts to support farmers to intensify crop production mainly by increasing the use of fertilisers and improved crop varieties. However, the impact of these efforts will be very limited, unless the fundamental issues of providing the crops with balanced and adequate nutrients are addressed, and fertiliser recommendations are fine-tuned to account for highly variable soil fertility conditions. We conducted multi-location nutrient omission trials in sites with high potential for maize production intensification (> 800 mm annual rainfall) in East and southern Africa to determine (i) nutrient-induced yield gaps; and (ii) nutrient requirements for balanced fertilisation of maize under variable soil fertility conditions. Nutrient were applied at rates to achieve a yield target yield of 7 t ha^{-1} . Fields were demarcated into three categories of soil fertility (low, medium and high) based on soil organic matter contents. Experimental results revealed that N deficiency accounted for the largest yield gaps $1\text{--}4 \text{ t ha}^{-1}$ across all categories of soil fertility. On the high fertility fields, 90 % of the maximum attainable yields were achieved with application of N+P. In medium fertility fields, additional nutrients (K, Mg Ca, S, Zn and B) were required to significantly increase maize yields above the N+P treatment. On the degraded soils, baseline yields were very low, and were increased to less than 2 t ha^{-1} by applying N+P and to less than 3 t ha^{-1} by applying all macro and micronutrients. In the degraded soils, replenishing organic matter through strategic fertiliser application with incorporation of crop residues may provide an option to increase attainable yields over time. Use of compost and animal manures, may also play a role, but available quantities are limited and the quality is often poor. To support sustainable intensification of maize production in SSA, we have developed the nutrient expert decision support tool to build capacity among extension systems and smallholder farmers for the practical identification of soil fertility variability and local adaptation of site-specific fertiliser management practices.

Keywords: Maize, yield gap