

Article title	Can Secondary and Micronutrients Really Increase Maize Productivity? a Case Study in the Savanna Agroecological Zones of Northern Ghana
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Abstract	<p>Over the past decades, fertilizer recommendation for maize production in savanna agroecological zones of northern Ghana has been NPK-based. However in recent times there is a strong push for the inclusion of secondary- and micro-nutrients in the fertilizer recommendations. During the 2018 and 2019 growing seasons, we conducted nutrient omission trials in 12 locations within the Sudan savanna and Guinea savanna agroecological zones of northern Ghana to quantify maize yield gaps resulting from omission of secondary and micronutrients from NPK-only fertilization for maize production. In the 2018 and 2019 growing seasons, applying only NPK fertilizer resulted in average yields of 3.22 and 3.89 t ha<sup>-1</sup>, respectively, in the Guinea savanna agroecological zone and 2.0 and 2.65 t ha<sup>-1</sup>, respectively, in the Sudan savanna agroecological zone. During the two growing seasons, application of sulfur (S), zinc (Zn), and boron (B) in addition to the NPK fertilizers (“balanced” fertilization) resulted in an average of 60% and 64% yield increases over those of the NPK-only treatment in the Sudan savanna and Guinea savanna agroecological zones, respectively. Compared to balanced fertilization, omission of S, Zn, and B reduced grain yield by an average of ~34%, ~28%, and ~14%, respectively, in the Guinea savanna agroecological zone and 27%, 29% and 15%, respectively, in the Sudan savanna agroecological zone. The combined data suggest that, even though secondary and micronutrients are needed in small quantities by plants relative to N, P, and K, they have an enormous effect on crop productivity. Therefore, to ensure sustainably increased maize productivity in the savanna agroecological zones of northern Ghana, fertilizer recommendations should not be restricted to only NPK fertilizers; limiting secondary and micronutrients must be accounted for in a holistic and balanced fertilizer recommendation.</p>
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