POLICY BRIEF

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POLICY BRIEF 2


Sulfur enhances maize yields

MAIZE YIELD RESPONSES TO FERTILIZERS IN GHANA

This policy brief describes the results of a study[1] that calculates fertilizer yield responses of maize in the rainfed production system of Ghana based on fertilizer application trials with the aim to provide site-specific fertilizer recommendations for desired crop yield responses.

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INTRODUCTION

Maize is an important cereal crop in Ghana grown on approximately 1.2 million hectares (ha), with an annual production of about 2.3 million metric tons (t). Annual per capita consumption of maize is estimated at about 62 kilograms (kg) as of 2016, and the country spent U.S. $22 million on its importation. Yields are low, falling far below the water-limited yield potentials at an estimated 60% yield gap. Low soil productivity due to poor and declining soil fertility is one of the major factors limiting crop yields. Nutrient loss of about 60 kg NPK ha^{-1} y^{-1} was reported for Ghana in the 1990s.

CHALLENGES

Fertilizer use in Ghana is low, estimated at about 22.6 kg N-P_2O_5-K_2O ha^{-1} in 2019, slightly above the sub-Saharan African average but well below the *Abuja Declaration* target of 50 kg ha^{-1} by 2015.

Current fertilizer recommendations are considered blanket, with little or no focus on secondary and micronutrients. There is growing evidence of micronutrients' importance and, therefore, the need to have balanced fertilization. Local soil conditions under which yield responses occur need to be understood to apply fertilizers as per soil chemical status and crop nutrient needs.

Experimental trial results of almost 1,700 data points were used to estimate maize yield responses to different fertilizer treatments across various agro-ecological zones (AEZs) of Ghana. The study locations are shown in Figure 1.

FINDINGS

- ✓ Treatment yields ranged from 0.14 to 10 t ha^{-1}. Overall, the highest yields at around 5–7 t ha^{-1} were obtained with a combination of 60-130 kg N ha^{-1}, 60 kg P_2O_5 ha^{-1}, and 20-60 kg K_2O ha^{-1}.

Contributing partners:

MOHAMMED VI POLYTECHNIC UNIVERSITY
ESAFE SCHOOL OF AGRICULTURE, FERTILIZERS AND ENVIRONMENTAL SCIENCES

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[1] *Bua, S., Elmejahad, K., MacCarthy, D., Adogoba, D.S., Kissiedu, I.N., Atakora, W.K., Fosu, M., Bindraban, P.S., 2020. Yield responses of maize to fertilizers in Ghana. IFDC FERARI Research Report No. 2.*

- ✓ Yield responses vary across the AEZs. Average yields were higher in Semi-Deciduous Forest (SDF) at 3.3 t ha^{-1} than in Guinea Savannah (GS), Sudan Savannah (SS), and Transition Savannah (TS) at 2.0, 2.5 and 3.1 t ha^{-1}, respectively.
- ✓ NPK treatment in combination with sulfur (S) tended to produce yields 0.7 t ha^{-1} higher, on average, than NPK alone.
- ✓ NPKS, with S rates varying from 8 to 154 kg S ha^{-1}, gave 1.5, 0.9, and 0.4 t ha^{-1} more in SS, GS, and SDF, respectively, compared to NPK (Figure 2).

Many studies on maize response have shown an increasingly higher response to S fertilization in similar environments in Western African countries. Kang & Osiname (1976)[2], for instance, reported a yield of 6.7 t ha^{-1} when 30 kg S ha^{-1} was added, compared to 5.9 t ha^{-1} without S. Friesen (1991)[3] reported up to 3.9 t ha^{-1} with 5-10 kg S ha^{-1} compared to 3.2 t ha^{-1} without S. Yield gains from S have also been reported in India. Rasheed et al. (2004)[4] obtained a yield of about 8.6 t ha^{-1} when 30 kg S ha^{-1} was applied, compared to 3.8 t ha^{-1} without S, and Khan et al. (2006)[5] reported a yield response of about 7.5 t ha^{-1} at 60 kg ha^{-1} S, and 5.0 t ha^{-1} without S. In Ghana, S applied at the rate of between 10 to 68 kg ha^{-1} was also found to increase yields in rice from 1.2 to 2.6 t ha^{-1}, on average over three years (Tsujimoto et al., 2017)[6].

These findings confirm the importance of S fertilization and, thus, the need for it to be considered for incorporation into fertilizer recommendations.

CONCLUSION AND RECOMMENDATIONS

Variable yield responses were observed both within and between AEZs, indicating the need for differentiated recommendations.

$N-P_2O_5-K_2O$ rates of 60-130 kg N, 60 kg P_2O_5, and 20-60 kg K_2O combined give the highest yield responses, disfavoring unbalanced combinations between N, P and K.

Given the growing evidence of high yield responses to S fertilization, the government should support research institutions and development partners to implement research geared toward establishing the right source, rate, time, and placement of S fertilizers for site-specific recommendations.

Fertilizer research programs should also integrate micronutrients (zinc, iron, manganese, boron, copper, and molybdenum) to ascertain the response and appropriate rates.

Figure 1. *Locations of Fertilization Yield Response Trials and the Range of Yield Levels Attained*

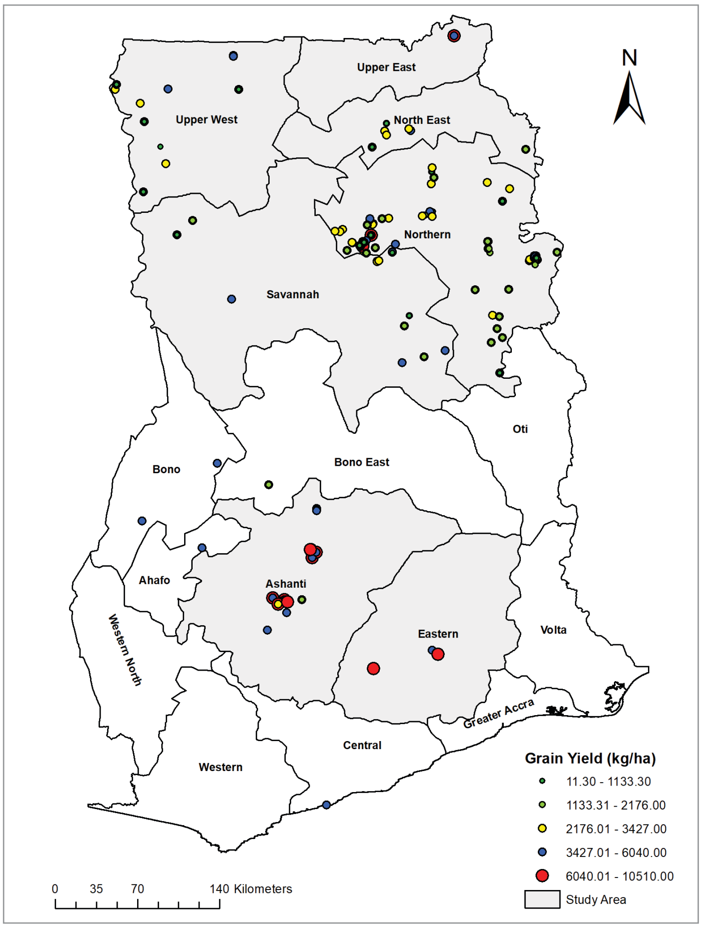
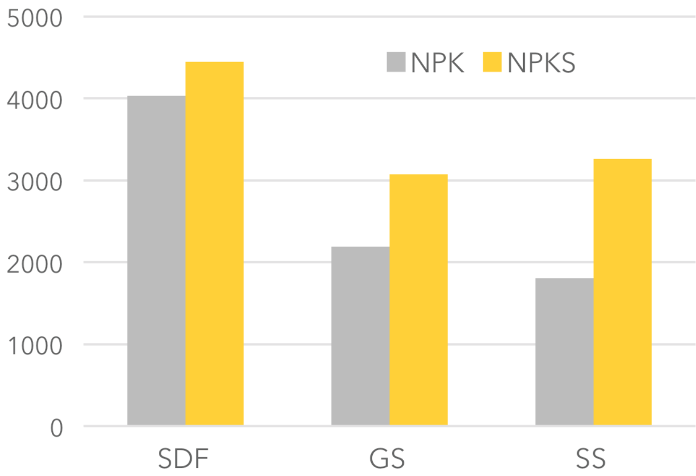


Figure 2. *Average Yield Responses (kg ha^{-1}) of NPK and NPKS in SDF, GS, and SS AEZs*



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