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Research Application Summary

# Upscaling the use of efficient and affordable soil fertility replenishment practices for small holder farmers of western Kenya

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## Abstract

The study assessed the agronomic effectiveness of fertilizer use recommendations in western Kenya on maize yields. The treatments included: FURP – 75kg N/ha CAN and 26kgP/ha DAP; 2) FURP – 75kg N/ha CAN and 26kgP/ha DAP plus lime (2t/ha); 3) FURP – 75kg N/ha CAN and 26kgP/ha Minjingu phosphate rock; and 4) Rutuba bio Agricultural organic manure at 125kg/ha and DAP at 13 kg P /ha. Inclusion of agricultural lime and manure in combination with mineral fertilizers significantly increased yields in this rather acidic environment.

Key words: Acidic soils, fertilizer use, western Kenya

## Résumé

L'étude a évalué l'efficacité agronomique de l'utilisation d'engrais, sur recommandations, dans l'ouest du Kenya sur les rendements de maïs. Les traitements comprenaient: FURP - 75 kg N / ha CAN et 26kgP/ha DAP; 2) FURP - 75 kg N / ha CAN et 26kgP/ha DAP addition de chaux (2t/ha); 3) FURP - 75 kg N / ha CAN et 26kgP / ha Minjingu phosphate et 4) Rutuba, engrais organiques bio agricole de 125kg/ha et DAP à 13 kg P / ha. L'inclusion de la chaux agricole et du fumier en combinaison avec des engrais minéraux a augmenté les rendements de manière significative dans cet environnement plutôt acide.

Mots clés: Sols acides, l'utilisation d'engrais, l'ouest du Kenya

## Background

Land degradation and nutrient depletion especially nitrogen (N) and phosphorus (P) are considered to be major threats to food security in sub Saharan Africa, Kenya included. Almost 75% of the Kenyan soils have N and P deficiency. Poverty and lack of access to food is therefore of great concern. Employing strategies that empower farmers economically and promoting sustainable agricultural intensification using efficient, effective

and affordable agricultural technologies would be an effective way of breaking this poverty cycle. Various recommendation including fertilizer rates, timing and placement have been made, but farmers are sometimes not yet aware of these technologies. This study assessed the agronomic effectiveness of the fertilizer use recommendation project (FURP) technology using different fertilizer combinations on maize yield under farmer management in three agroecological zones of Kenya.

**Literature Summary**

The constraint of food insecurity due to declining soil fertility is well documented. Efforts to restore soil fertility have been enormous over the past century in Kenya and include providing inorganic fertilizer recommendations (e.g. the Fertilizer Use Recommendation Project – FURP) and use of combination of organic and inorganic fertilizers, for improved crop yields, measures to improve soil acidity through application of lime, farmyard manure and rock phosphates (Ndung'u *et al.,* 2006; Okalebo *et al.,* 2006; Kihanda *et al.,* 2006). These materials are often applied to manage the widespread N and P deficiencies in the highly leached and P fixing soils of the Kenyan highlands.

Despite the many publication on fertilizer application, farmers are still not applying optimal fertilizers. There is thus the need to compare these technologies side by side with participatory contribution of small scale farmers.

**Study Description**

The study was conducted in three districts of Kenya: Siaya (Sega), Trans Nzoia (Matunda) and Uasin Gishu (Kapsaret). Siaya district represent a very populous area in Kenya with small farms (<2ha) and very low P application rates while Trans Nzoia and Uasin Gishu, though representing the wheat and maize granaries of the country respectively, has about 40% of the farmers being small scale farmers (Wanyama *et al.,* 2005). A total of 100 farms were used as demonstration sites in the three districts, with each farmer representing a replicate in each district. The tested technologies included: 1) FURP – 75kg N/ha CAN and 26kgP/ha DAP; 2) FURP – 75kg N/ha CAN and 26kgP/ha DAP plus lime (2t/ha); 3) FURP – 75kg N/ha CAN and 26kgP/ha Minjingu phosphate rock; and 4) Rutuba bio Agricultural organic manure at 125kg/ha and DAP at 13 kg P / ha. In each demonstration farm, a control was delineated in each treatment for better view of the treatment effects. Potassium was also applied at 60 kg $K_2O$ $ha^{-1}$. Composite soil samples (0-15cm) were collected before planting and soil pH, available P, Organic C and total N were analyzed (Okalebo *et al.,* 2002).

## Research Application

The initial soil characterization before fertilizer and lime applications are shown in Table 1. The pH of surface (0 – 15cm) soils ranged from 4.67 to 5.45 in Uasin Gishu District, while the range was 5.16 to 5.77 in TransNzoia district. Sega District had the lowest pH values. This shows stronger acidity of soils from the Sega and Uasin Gishu soils compared to Trans Nzoia soils. Responses are therefore expected upon application of Minjingu and lime on these soils. In Uasin Gishu District, addition of either DAP and Lime, Minjingu PR or Rutuba and ½ rate of DAP gave significantly higher grain yields ($p<0.05$) than either no input or DAP alone. Although the soil chemical analysis data showed no need for P application, because of the higher than critical values of available P levels (Table 1), significant increases in maize grain yields can be attained by correcting the soil pH through liming, addition of Minjingu PR or organic Manure. In Trans Nzoia District, the soil had pH of higher than 5.5; hence addition of Minjingu PR had no significant influence on maize yields. However, DAP alone or in combination with lime or Rutuba commercial manure gave significantly higher yields above the control (Fig. 2). Although Uasin Gishu and Trans Nzoia have yield potentials of > 9t/ha (Nekesa, 2007), lower yields were realized in this work despite the high levels of available P in these sites. However, significant yield increases were noted in both Trans Nzoia and Uasin Gishu after addition of lime or Rutuba organic manure in combination with DAP, implying the need to correct the soil pH for optimal yields.

**Table 1. Initial soil characteristics of the study sites.**

| Districts | Soil properties | | | |
|---|---|---|---|---|
| | Soil pH (1:2.5 soil:$H_2O$ ) | Olsen P (mg P/kg) | Organic C (%) | Total N (%) |
| Siaya | 5.04± 0.06 | 0.71± 0.09 | 6.08± 0.78 | 0.08± 0.01 |
| Uasin Gishu | 5.09 ±0.08 | 16.16± 0.98 | nd | nd |
| Trans Nzoia | 5.65 ±0.07 | 18.64± 2.43 | nd | nd |

## Recommendation

Its recommended that liming agents such as agricultural lime or manure should be applied in combination with the conventional DAP to improve the soil fertility.

## Acknowledgement

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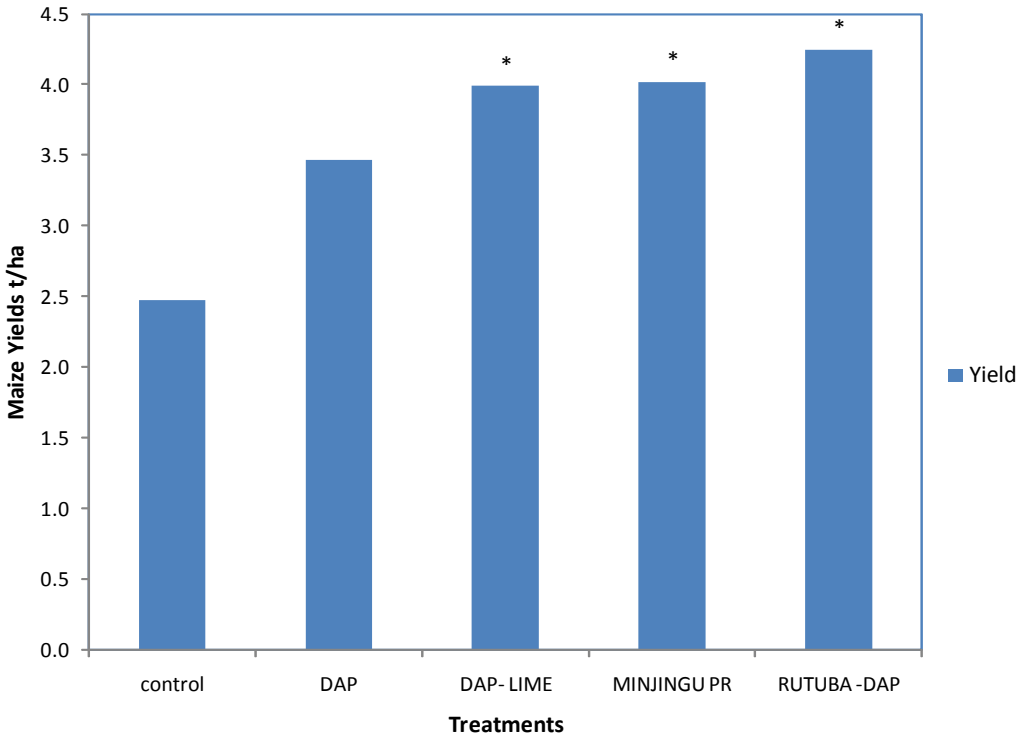


**Figure 1. Effect of different phosphate fertilizers under FURP recommendation on maize grain yields (t ha$^{-1}$) in Uasin Gishu District, Kenya.**

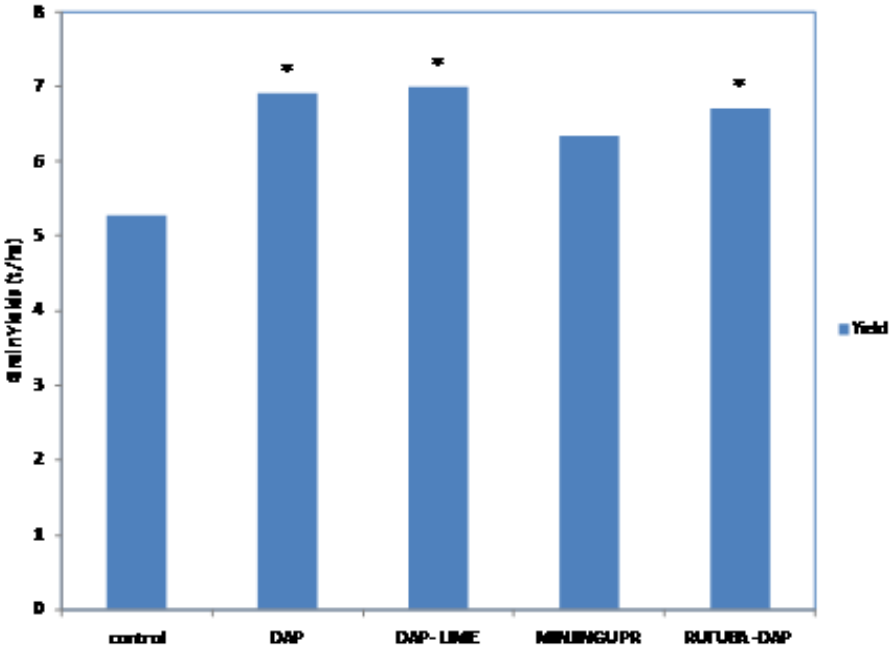


**Figure 2. Effect of different phosphate fertilizers under FURP recommendation on maize grain yields (t ha$^{-1}$) in Trans Nzoia District, Kenya.**

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