

Low Cost Technologies for Enhancing N and P Availability and Maize (*Zea mays* L.) Performance on Acid Soils

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Abstract: Soil degradation especially soil acidity and low fertility are the major constraints hampering maize production in Molo district, Kenya. The challenge therefore is to develop sustainable soil management strategies for enhancing maize production and concomitantly food security. A three-year field experiment were conducted on smallholder farms (SHF) of Molo to test the effectiveness of applying low cost technologies (LCT): lime, farm yard manure (FYM), minjingu rock phosphate (MRP), biological nitrogen fixation (BNF) and cowpea (CP) residue and crotalaria (CR) green manure, in enhancing nutrient availability and maize performance on acid soils. The performance of maize in three cropping systems; (a) pure maize (M) in rotation with CP with or without application of LCT ($M_{(lime, MRP)} - CP$, M-CP), (b) maize intercropped with CP in rotation with CR with application of LCT ($M/CP_{(lime, MRP)}-CR$ and $M/CP_{(lime, MRP, FYM)}-CR$) and (c) maize in rotation with fallow (F) with or without application of diamonium phosphate fertilizer (DAP) ($M_{DAP}-F$, M-F) as control, was evaluated during the long rain seasons (LRS) of 2004, 2005 and 2006. CP and CR were planted in the short rains season (SRS) of 2004 and 2006. The soil pH was significantly increased two months after liming and had appreciably increased by the end of the trial period to levels conducive to maize growth in the $M/CP_{(lime, MRP)}-CR$ and $M/CP_{(lime, MRP, FYM)}-CR$ and $M_{(lime, MRP)} - CP$ cropping systems. The cropping systems $M/CP_{(lime, MRP)}-CR$ and $M/CP_{(lime, MRP, FYM)}-CR$ showed superior performance in N_2 fixation and soil available N and P due to the application of LCT. Crotalaria fixed significantly higher amounts of N_2 (127-158 kg ha⁻¹) than cowpea (37-56 kg ha⁻¹) in both years. Similarly, soil available N and P increased progressively with the planting seasons, except for the control, with P showing minor fluctuations. Maize grain yields were correspondingly higher under the imposed LCT and was notably higher in the $M/CP_{(lime, MRP, FYM)}-CR$ and $M/CP_{(lime, MRP)}-CR$ cropping systems. The utilization of the short rain season fallow by planting CR and CP and incorporating its residue and green manure, respectively during land preparation for the following maize/cowpea intercrop alongside application of LCT is thus a feasible strategy to manage soil acidity and boost maize performance on the SHF of Molo District, Kenya.

Key words: Cropping system • Lime • Minjingu rock phosphate • Farm yard manure • Legumes • Smallholder farms

INTRODUCTION

Maize (*Zea mays* L.) is a major staple food that is, to a large extent synonymous with food security, practically grown by every smallholder farmer in Kenya [1]. Its production in the smallholder farms (SHF) of Molo district is constrained by soil degradation especially soil acidity and low fertility [2] thus threatening food

security. The active pH (H₂O) of the soils in Molo is below 5 [3, 4] and thus unsuitable for maize growth. Maximum maize yields are obtained in the pH range of 5.6 to 7.5 [5; <http://maizedoctor.cimmyt.org/index.php>].

In acid mineral soils, a variety of individual chemical constraints and interactions between them limit plant growth [6]. For instance, P adsorption and inhibition of nitrification process are responsible for the the