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Research Application Summary

Determining appropriate mode and rate of applying lime to improve maize production in acid soils of north Kakamega and Siaya districts, Kenya

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Abstract

Increasing soil acidity is a major cause of low soil fertility in western Kenya where about 57,670 hectares is acidic. While liming can increase soil pH, the most appropriate method of application needs to be determined. This study aimed at determining the best method of applying lime by comparing three methods, Broadcasting, Banding and Spot, using four lime rates (0, 2, 4 and 6 t ha^{-1}) in North Kakamega and Siaya districts and using maize as a test crop. One time application of lime using the three methods was done during planting with 26 kg ha^{-1} phosphorus and 75 kg ha^{-1} nitrogen applied as blanket. Data were collected on percentage seed emergence, crop height, tissue chemical composition and grain yield. The results indicated low germination percentage with 6 t ha^{-1} of lime applied via spot (85.2-94.8%) as compared to control (91.8-98.1%). The heights taken 67 days after sowing were 43% higher than control for 6 t ha^{-1} banded lime plots in North Kakamega district and 38.07% higher than control for 4 t ha^{-1} broadcast lime in Siaya district.

Key words: Lime application methods, maize, soil acidity, western Kenya

Résumé

L'acidité croissante du sol est une cause importante de la basse fertilité du sol au Kenya occidental où environ 57.670 hectares de terre sont acides. Tandis que le chaulage peut augmenter le pH du sol, la méthode d'application la plus appropriée doit être déterminée. Cette étude a visé à déterminer la meilleure façon d'appliquer la chaux en comparant trois méthodes : la semis à la volée, sur des planches de semis et des spots, en utilisant quatre taux de chaux (0, 2, 4 et 6 t ha^{-1}) dans les districts du nord de Kakamega et de Siaya et en utilisant le maïs comme la culture d'essai. Une seule application de chaux employant les trois méthodes a été faite pendant la plantation avec 26 kg ha^{-1} de phosphore et 75 kg ha^{-1} d'azote appliqués comme couverture. Des données ont été rassemblées sur le pourcentage d'apparition de graine, la taille de culture, la composition chimique du tissu et le rendement en grain. Les résultats ont indiqué le

faible pourcentage de germination avec 6 t ha^{-1} de chaux appliqués a travers des spots (85.2 à 94.8%) par rapport à la référence (91.8 à 98.1%). Les tailles prises 67 jours après l'ensemencement étaient 43% plus hautes que la référence pour 6 t ha^{-1} de parcelles de chaux réunies dans le district du nord de Kakamega et 38.07% plus hautes que la référence pour 4 t ha^{-1} de chaux d'émission dans le district de Siaya.

Mots clés: Méthodes d'application de la chaux, maïs, acidité du sol, Kenya occidental

Background

Soil acidity is one of the major cause of low maize yields in Kenya (Nekesa, 2007). Since maize is the main staple food in the Kenyan diet, with an annual per capita consumption of 98 kilograms (ACDI/ VOCA, 2007), there is need to produce enough for domestic consumption and surplus for sale.

In Western Kenya, it is estimated that about 57,670 ha of land are acidic with pH <5.5 (Kanyanjua *et al*., 2002). This is caused by leaching of basic elements overtime (Ca, Mg and K), continuous cropping, atmospheric pollution and application of N fertilizers containing ammonia. As a result, the average subsistence maize, beans and cowpea yields in the region hardly exceed 1t/ha (Nekesa, 1999; Ayaga, 2005; Okalebo *et al.*, 2009) as compared to 5-6 t/ha from research stations.

Research in these regions by Kenya Agricultural Research Institute (KARI) Kakamega and Moi University has demonstrated the potential of using lime plus organic matter, inorganic fertilizers and rock P to address the problem of soil acidity and enhance soil fertility. Despite this, use of lime is still low because of cost and lack of effective minimum rate of application, lack of awareness of its importance and mode of application by small holder farmers, and weak extension services. Therefore this research aimed at establishing an affective minimum lime rate and mode of application in Siaya and Kakamega North districts in Western Kenya.

Literature Summary

Liming is practiced by growers to counteract soil acidity (Plaster, 2003), by raising the pH enough thus making aluminium, iron and manganese less soluble and so prevent them from being toxic to plants (Cook *et al.*, 1987). Best results have been obtained from liming when there is close contact between the grains of lime and soil (Plaster, 2003). Broadcasting has been

the most desirable method of lime application since all soil particles comes in contact with lime particles (Cook *et al.*, 1987; Troeh and Thompson, 1993; ACDI/ VOCA-Kenya, 2007). However, in presence of too much wind it becomes impossible to achieve a uniform application of finely ground lime (Troeh and Thompson, 1993). On the other hand row (band) application of lime at the time of seeding legumes has been tried experimentally and with good results. The method is, however, difficult to manage because the farmer should also apply fertilizer. Thus to apply both materials, it is necessary to go over the land twice (Cook *et al.*, 1987). This method (row application) has therefore been largely used where it is desirable to keep the soil quite acid for a single lime-loving crop in rotation.

Study Description

On-farm experiment is being conducted in four sites, two located in Siaya district and the other two at Kabras in Kakamega North district, both in Western Kenya. The experimental design is a 3 x 4 factorial arranged in a Randomized Complete Block (involving three levels of lime application, Broadcasting, Band and Spot; and four levels of lime, 0, 2, 4 and 6 t/ha) with four replicates. This gives 12 treatment combinations (M_1L_0, M_1L_1, M_1L_2, M_1L_3, M_2L_0, M_2L_1, M_2L_2, M_2L_3, M_3L_0, M_3L_1, M_3L_2 and M_3L_3), where M is the method and L is the lime rate. In total there are 48 experimental units per site.

The test crop is maize (variety H 513) planted in both districts. In the trial done so far lime was applied at planting time with phosphorus and nitrogen applied as a blanket except for control plots. Initial chemical and physical soil characterization was done and successive sampling done monthly till harvesting to monitor soil changes due to treatments. Analysis for soil pH, available P, total N, exchangeable Ca, Mg and K, and Al will be done following laboratory procedures described by Okalebo *et al.* (2002). Germination percentage and crop heights have been assessed. Analysis of variance (ANOVA) was used to determine if there were significant differences between treatments using General Statistic package.

Research Application

The results obtained so far indicated low germination percentage with 6 t ha^{-1} of lime applied via spot (85.22-94.75%) as compared to control (91.76-98.08%). The height taken 67 days after sowing was 43% taller than control for the 6 t ha^{-1} banded lime plots in North Kakamega district and 38.07% taller than control for 4 t ha^{-1} broadcast lime in Siaya district. The study is on-going and will involve assessing grain yields.

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