Research Application Summary

Effects of NP fertilisers and manure application on maize-bean yields, and soil nitrogen mineralisation in Machakos County, Eastern Kenya

Ogucha, N.[1], Mochoge, B.E.[1] & Kibunja, C.[2]
[1]Department of Agricultural Resource Management, Kenyatta University, P. O. Box 43844 – 00100, Nairobi, Kenya
[2]KARI, National Agricultural Research Laboratories, Kenya
Corresponding author: bmochoge1947@hotmail.com

Abstract

The inherent poor fertility of soils in Kenya constitute a major constrain to sustainable smallholders agriculture and more especially in arid and semi-arid parts of the country. The solution herein lies in the efficient use of nutrients and good management of soil moisture content. This study investigates the effects of manure and fertiliser application on maize-bean intercrop yields, fertiliser use efficiency, nitrogen mineralisation potentials and predicts the long-term soil fertility sustainability. The experiments are being conducted in the laboratory and in the field. Soils will be sampled from a layer of 0-60cm soil profile (0-20, 20-40, 40-6 cm soil depth) for soil physic-chemical and biological properties analysis. Soil sampling will be done at the start and end of each season for two seasons. Maize and beans will be planted as an intercrop in plots measuring 4.5x 4.5 m with a of spacing of 75 x 60 cm for maize and 20 cm for beans which will be planted between maize rows. NP fertilisers will be applied at three levels (0, 50 and 75 kg/ha), and manure at three levels (0, 5 and 10 ton/ha). P fertiliser and manure will be applied at planting while N fertiliser will be top-dressed four weeks after planting. Maize and bean grains will be dried after harvest and weighed at 12.5 % moisture content. Data will be subjected to analysis of variance using the general linear model of the SAS software. Treatment differences will be examined using Tukey-Kramer significant difference (HSD) test. Regression and correlation analyses between various variables will be done to show different interactions. Expected outputs of this study include improved crop yields, proper management of inputs, improved nutrient use efficiency and nitrogen mineralisation potential of the Katumani luvisols documented.

Key words: NP fertilisers, manure application, maize-bean intercropping, soil nitrogen mineralisation potential

Résumé

La faible fertilité inhérente des sols au Kenya constitue une importante contrainte à l'agriculture durable des petits

exploitants et plus particulièrement dans les régions arides et semi-arides du pays. La solution réside ici dans l'utilisation efficace des nutriments et une bonne gestion de la teneur en humidité du sol. Cette étude examine les effets de l'application du fumier et des engrais sur les rendements des cultures intercalaires du maïs-haricot, l'efficacité d'utilisation des engrais, les potentiels de minéralisation de l'azote et elle prédit la viabilité de la fertilité des sols à long terme. Les expériences sont menées en laboratoire et sur le terrain. Les sols seront échantillonnés à partir d'une couche de profil du sol de 0-60cm (0-20, 20-40, 40-60 cm de profondeur) pour l'analyse des propriétés physico-chimiques et biologiques des sols. L'échantillonnage des sols sera effectué au début et à la fin de chaque saison pendant deux saisons. Le maïs et les haricots seront plantés en culture intercalaire dans les parcelles mesurant 4,5 x 4,5 m avec un espacement de 75 x 60 cm pour le maïs et de 20 cm pour les haricots qui seront plantés entre les rangs de maïs. Les engrais NP seront appliqués à trois niveaux (0, 50 et 75 kg / ha) et le fumier à trois niveaux (0, 5 et 10 tonnes / ha). L'engrais P et le fumier seront appliqués lors de la plantation tandis que l'engrais azoté N sera déposé quatre semaines après la plantation. Les grains de maïs et de haricots seront séchés après la récolte et pesés à la teneur en humidité de 12,5%. Les données seront soumises à une analyse de la variance en utilisant le modèle linéaire général du logiciel SAS. Les différences de traitement seront examinées à l'aide du test de différence significative de Tukey-Kramer (HSD). Les analyses de régression et de corrélation entre les différentes variables seront faites pour montrer les différentes interactions. Les résultats attendus de cette étude comprennent l'amélioration des rendements des cultures, la bonne gestion des intrants, l'amélioration de l'efficacité d'utilisation des nutriments et du potentiel de minéralisation de l'azote des Katumaniluvisols.

Mots clés: Engrais NP, application du fumier, culture intercalaire maïs-haricot, potentiel de minéralisation des sols en azote

Background

The food security situation is very critical in sub-Saharan Africa (SSA) including Kenya due to very rapid increase in population growth, and decline in soil fertility and fragmentation of the arable land for settlements giving rise to small land parcels that are not profitable. The problems of low land productivity (Ogola *et al*., 2011) mainly caused by low and declining soil fertility, and low fertiliser inputs pose a great challenge to the sustainable

smallholder crop production in SSA (Myers *et al*., 2001). To achieve the Millennium Development Goals and the NEPAD'S Initiatives on "Food for All", and the planned Kenyan 2030 vision of transforming Kenya to self reliance in food production, efforts must be made to enhance food production in Kenya in tandem with increased population growth. Although only 20-30% of Kenya has potential for arable farming, leaving about 70-80% in the arid and semi arid lands (ASALs), Kenya has still the potential to produce enough food to feed her population if resources such as water and fertiliser inputs are properly managed. A key characteristic of these ASALs is low and unreliable rainfalls, which leads to low land productivity and frequent crop failures even in fertile soils (Mulagoli and Karuri, 2001). Solutions to these problems continue to be investigated in order to enhance food production. As a partial solution to the problems, water resource management in addition to other agricultural practices such as growing drought resistance crops have been undertaken in such regions. Use of both organic and mineral fertilisers is often limited and this has resulted in a gradual depletion of soil nutrients in Kenya (Smaling *et al*., 1997). In 1990, the average fertiliser use in Kenya was only 9.4 kg ha^{-1}, compared with 81 kg ha^{-1} in other developing countries especially those in Asian continent in the 1990's (Ogola *et al*., 2002b). Current information indicates that Kenya has increased fertiliser usage to 30 kg/ha and is projected to increase to 50 kg/ha by 2015 (Mwangi, 2011). The aim of the present study is to determine nutrient management and its effect on maize-bean yields through integrated use of mineral fertilisers and manures in Machakos County, Eastern part of Kenya.

Study Description

The field experiment is being carried out at Katumani, Machakos County in the semi-arid Eastern Kenya. This study is investigating the effects of manure and fertiliser application on maize-beans yields, fertiliser use efficiency, determining soil nitrogen mineralisation potentials will predict the long-term soil fertility sustainability. The experiments are being conducted in the laboratory and in the field. Soils will be sampled from a layer of 0-60cm soil profile (0-20, 20-40, 40-6 cm soil depth) for physico-chemical and biological analyses. The soil sampling is to take place at the start and end of each season for two seasons. Maize (var.Sc Duma 43) and common beans will be intercropped in plots measuring 4.5x 4.5 m with a of spacing of 75 x 60 cm for maize and 20 cm for beans which will be planted between maize rows. NP fertilisers will be applied at three levels (0, 50 and 75 kg/ha), and manure also at three levels (0, 5 and 10 ton/

ha). P fertiliser and manure will be applied at planting while N fertiliser will be top-dressed four weeks after planting. Maize and bean grains will be dried after harvest and weighed at 12.5 % moisture content. The trial will be a factorial, arranged in a complete randomised block design with three replicates. Data will be subjected to analysis of variance using the general linear model of the SAS software. Treatment differences will be examined using Tukey-Kramer significant difference (HSD) test. Regression and correlation analyses between various variables will be done discern any relationships. Expected outputs of this study include improved crop yields, proper management of inputs, improved nutrient use efficiency and nitrogen mineralisation potential of the Katumani luvisols..

Research Application

This study will provide information on N dynamics in soils from ASALs, effect of NP and manure on maize yields and soil microbial biomass in these poor soils. Further, information gathered from this research will be useful in enhancing the use of organic materials and inorganic fertilisers among farmers who have little disposable income to purchase inorganic fertilisers. Also, through the study, recommendations will be made for proper management of inputs such as fertilisers in terms of placement and application timing.

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