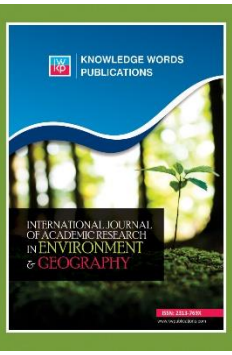

INTERNATIONAL JOURNAL OF ACADEMIC RESEARCH IN ENVIRONMENT & GEOGRAPHY

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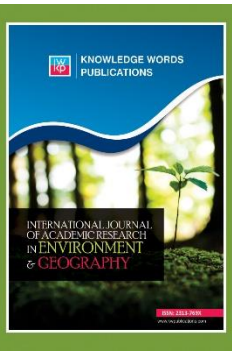
To Link this Article: http://dx.doi.org/10.46886/IJAREG/v4-i1/3737 DOI: 10.46886/IJAREG/v4-i1/3737

Received: *06 Feb 2017,* ***Revised:*** *28 Mar 2017,* ***Accepted:*** *11 April 2017*

Published Online: 26 May 2017

In-Text Citation: (Ngomat & Mworia, 2017)

To Cite this Article: Ngomat, M. S., & Mworia, M. (2017). Evaluation of the Effects of Potassium Fertilizer on Potato Growth and Yield in Saboti Sub County, Trans Nzoia County, Kenya. *International Journal of Acdemic Research in Enviornment & Geography*, *4*(1), 48–57.



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Evaluation of the Effects of Potassium Fertilizer on Potato Growth and Yield in Saboti Sub County, Trans Nzoia County, Kenya

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Abstract

Irish potatoes are an important field crop grown for food. Successful Irish potato production is often hindered by lack of fertilizer application and poor choice of Potato planting varieties and hence low yield. The purpose of the study was to assess potato growth and yield response to application of potassium chlorid(muriate of potash) in Milimani Location, Saboti Sub-county,Trans Nzoia county. A randomized complete block design experiment with three replicates was conducted. Growth and yield data collected was subjected to Analysis of Variance (ANOVA) and means separated by Duncan Multiple Range Test (DMRT) at $p<0.05$ Significance level using SAS software. It was found out that there was significant difference in yield and yield attributes. However there were no significant differences in mean yield between the two sites of production. Fertilizer rates differed significantly. It was recommended that the fertilizer industry should change fertilizer formulation; establish fertilizer blending plants and the ministry of agriculture to establish a fertilizer advisory service for farmers to boost harvest and incomes and that the fertilizer rate of 250kg/ha be applied and Sherekea variety be variety of choice for Milimani Location, Saboti Sub-county, Trans Nzoia County.

Keywords: Irish, Potatoes, Fertilizer, Variety, Potassium Chloride, Rate.

Introduction

Potato is one of the most consumed produce in Kenya, second to maize. Potato is grown in Kenya by approximately 500,000 small scale farmers on 120,000 hectares with yield of 7.7 tons/ha (Janssens, 2013). The rise in potato production is as a result of an increase in total area under cultivation. Productivity has fallen by 17.4% between 2010 and 2013 (FAOSTAT 2014). Despite increased acreage in production of potatoes, statistics indicate that yield per acre is reducing and this implies that certain variables are responsible causes. According to Rytel et al. (2013), the quality of potato tubers and their chemical composition are influenced by genetics, soil fertility, weather conditions and chemical treatments that are applied. Therefore,

additional K-containing sources are necessary to supply to provide optimal plant growth performance and yield (Zorb et al., 2014). Rhue et al., (1986) reported that maintaining optimal K nutrition is of a big importance for development of potato plants. Potassium influences synthesis, location, transformation and storage of carbohydrates, tuber quality and processing characteristics as well as plant resistance to stress and diseases (Ebert, 2009). According to Janssens (2013), production of potatoes in Kenya is characterized by a couple of constrains. The first initial constraint is that production is bimodal. It is produced twice a year following rainfall pattern of Kenya. Other constraints include diseases like Late Blight and Brown Rot, Lack of crop rotation where farmers cultivate potatoes in the same piece of land over and over again, poor storage facilities and lack of enough capital for capital intensive production which increases production levels.

Research Questions

1. To assess the relationship between potassium chloride application rate to the growth of potatoes.
2. To evaluate the relationship between potassium chloride application rate to the weight of different sizes of the three potato varieties.
3. To compare the relationship between potassium chloride application rates to the yield of three potato varieties.

Research Objectives

1. There is no significant relationship in the application of potassium chloride rates and the growth parameters of potato varieties
2. There is no significant difference in the application of potassium chloride application rates to the weight and size of three Irish potato varieties.
3. Application of potassium chloride fertilizer does not significantly affect the yields of three potato varieties

Literature Review

Potassium in the Soil and Availability to Plants

Potassium application has been neglected by majority of farmers in our country resulting in continual depletion of soil K (Ladha et al., 2003 and Lai et al, 2007) Indian soils are generally high in total K but only a small fraction of it is present in available form because of dynamic equilibriums between exchangeable, non exchangeable and fixed K With high crop intensity and high K removal, the soils are becoming deficient in K. Frequent K deficiencies have been observed in crops in this region (Panaullah et al, 2006). Regmi et al. (2002) suggested that because of inadequate K application, soil K imbalance in agricultural ecosystem and stagnation of yield will become more pronounced with time. The major constraint to potato production in the cool highlands of Kenya is the rapid decline in soil fertility occasioned by continuous cultivation without adequate replenishment of mined nutrients (Kiiya et al., 2006). The situation is exacerbated by the inherently high soil acidity with pH values of 4 to 5 being common (Recke, 1997; Kiiya et al., 2006). Due to small land sizes, farmers continuously plant crops on the same land, practicing intensive cropping systems that mainly involve double and relay cropping of different crops without a fallow period (Kaguongo et al, 2008). Fertilizer is

mostly applied below the recommended rate of (90 kgN/ha + 230 P2O5/ha) (Kaguongo et al., 2008).

Potassium Chloride Application Rates to the Weight and Size of Three Irish Potatoes

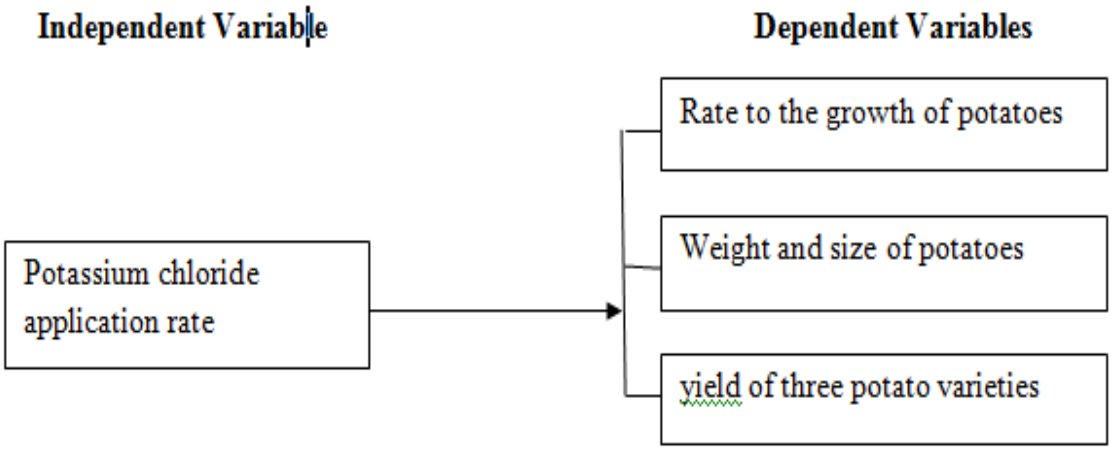
Potatoes remove very large amounts of K in the harvested tubers (200 to 400 Ib/A), but K is taken up by the plant in the cationic K+ form, regardless of the fertilizer material applied to the soil. Potassium deficiencies reduce the yield, size, and quality of the potato crop. A lack of adequate K can be associated with low specific gravity in potatoes. During peak periods, potatoes can take up 14 Ib K/A each day. Excessively high K can result in its accumulation in tubers, where it -may increase the water content and decrease the specific gravity. Potassium fertilizer is commonly broadcast across the field prior to planting. Band placement of a small fraction of K fertilizer in the beds or during row mark out will also efficiently supply K to the plants.Since potatoes have a very high K requirement, it is important that an adequate supply be maintained in the root zone at all times. Many important yield and quality parameters of the tuber are negatively affected if the K supply runs short, especially during tuber bulking. The harvested tubers may contain over 90% of the total K taken up by the plant. Pre -plant applications are the most effective way to supply K. Avoid high rates of banded K in close proximity to the seed piece. A combination of broadcast and band Reference placement may be more appropriate if K application rates are high. Broadcast application of K shortly after plant emergence is also common.

Effect Potassium Source on Potato Tuber Quality

Potato plants absorb large quantities of potassium throughout the growing season and are known as a potassium preferring crop (Kelling et al. 2002; Blagoeva et. al., 2004). By exploring commercial potato fields, Dow et al. (1978) established that potassium was allocated from fields to potato tubers in the range from 203 to 397 Ib K/acre which was directly proportional to tuber yields. Therefore, relatively high levels of potassium fertilization are usually recommended to achieve optimal potato yield. Positive influence of increasing potassium rates on potato yield was established by Imas and Bansal (1999); Kelling et al. (2002) and Al-Moshileh et al. (2005). Studies have shown that increasing rates of K resulted in increased tuber formation as the maximum yield was achieved at K400 and K600 when fertilized with K_2SO_4 and KC1 respectively. results were obtained by Kelling et. al. (2002) who found no significant and distinct influence of K source on potato yield. In contrast to positive influence of potassium fertilization rate on potato tuber yield, the effect of the source of potassium was not found significant by Stanley and Jewell (1989) as well. However Qin et. al. (2008) did not observe yield differences due to the source of potassium. Dry matter content is an essential quality parameter for potato processing. High dry matter content improves the quality of potatoes designated for human nutrition (Wibowo et. al., 2014). It corresponds to high chips yield and low oil absorption during frying. Furthermore, reduced dry matter content in tubers makes them more susceptible to mechanical damage (Ishpekov et. al. 2000). The observed effect was more pronounced, in treatments with KC1 where the decrease of dry matter content reached 15% at the highest K level (K600) when compared to the control. Similar observation was reported by Bansal and Trehan (2011) who established enhanced

reduction of dry mater content in tubers when fertilized with KCI. The effect of KCI on starch content in potato tubers was even more extreme.

Conceptual Framework



Methodology of Research

Research Design

The study used was a randomized complete block design (RCBD), Number of replications were three. Total number of plots per site was 36 with two sites which gave a total number of plots – 72 .Plot sizes 2m x 2m= ($4m^2$).Total field area – 30m x 8 m – 240 m^2. Alleyway of - 1m left between blocks.

Data Collection Instruments and Sampling Techniques

Data was collected by observing and measuring different experimental units. Among were: the number of stems per plant, Stand count, Plant height, Number of leaves per plant, Aggregate and grade wise tuber yield and Leaf Area Index (LAI)

Data Analysis

The data from the measured variables was subject to analysis of variance (ANOVA) to determine whether there was a significant difference between the variable means. The means were separated by Lsd at ($P \leq 0.05$) significance level using SAS programme version 9.1

Results of the Study

Fertilizer rate and variety on growth and yield of Irish potatoes

Fertilizer rate and variety on Leaf Area Index of Irish potatoes

In terms of leaf area index (L.A.I) there was a significant difference between different fertilizer rates. 0 kg/ha produced plants with smaller L.A.I. The L.A.I increased with the increase in fertilize rate. Varieties Sherekea and markies were better in terms of L.A.I as compared to Kenya Mpya in both Meru and Milimani sites**.(fig2)**

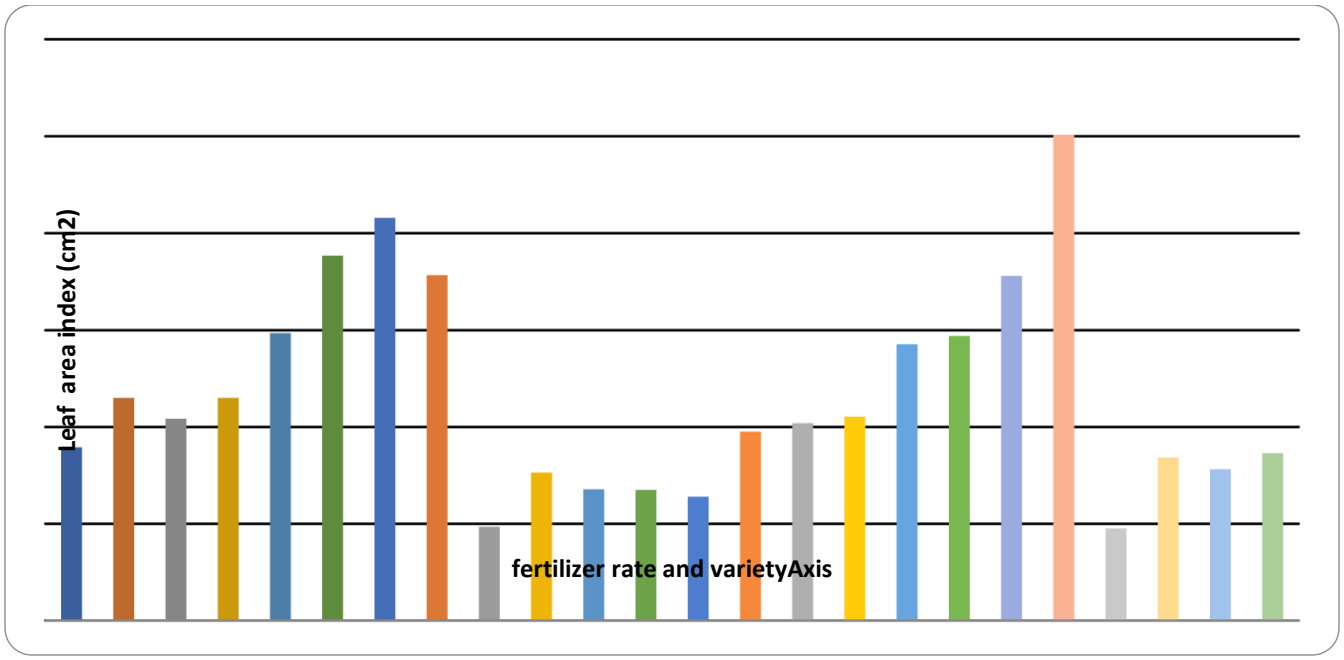


Figure 1: Fertilizer rate and variety on Leaf Area Index of Irish potatoes

Fertilizer rate and variety on weight of small size of Irish potatoes

There was a significant difference P<0.03) difference between small and cocktail sized potatoes. Generally the size increased with increase in fertilizer rate with 150kg/ha to giving the heaviest potatoes and then started to decreased at 250kg/ha. Varieties Sherekea and markies produced the heaviest potatoes while Kenya Mpya produced the lightest (Fig 7c, and7 d)

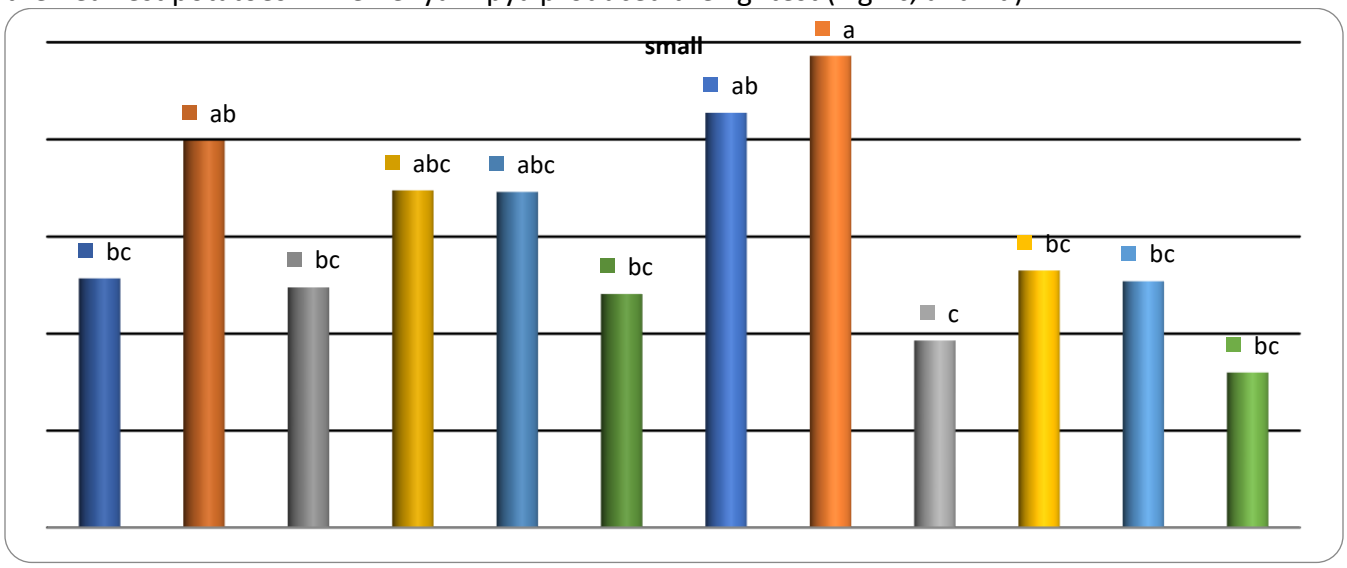


Figure 7c: Fertilizer rate and variety on weight of small size of Irish potatoes

Fertilizer rate and variety on yield of Irish potatoes

Yield showed that there was a significant difference (P<0.05) between fertilizer level and variety. The yield increased with increase in fertilizer rate. Generally 150kg/ha produced the

highest yield. Sherekea did better by producing an average of 8tons/ ha. Both Meru and Milimani were not significantly different (P<0.05) in terms of yield. Fig 6.

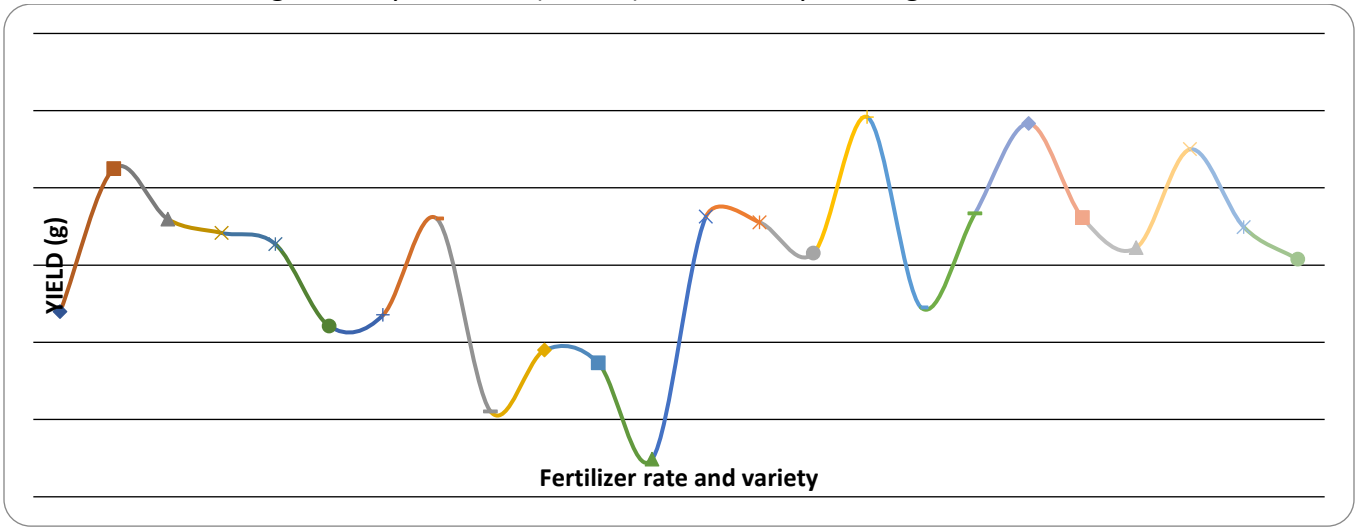


Figure 2: Fertilizer rate and variety on yield of Irish potatoes

Conclusions and Discussions

It was concluded from the study that, Potassium chloride application improves the growth of Irish potatoes. There were indeed significant differences in varietal tuber yield with the application of potassium chloride, with variety Sherekea producing the highest yield of 10% advantage over markies and Kenya Mpya varieties respectively. Application of potassium chloride influenced the weight in different sizes as it increased the proportion of large tubers relative to small ones. Application rate of potassium chloride at 250kg/ha for Milimani location gave optimum production level of potatoes. The fertilizer used as a side dressing/ top dressing.

Recommendations

From the study findings it was recommended that, application of a compound fertilizer rich in K is recommended for increased yield in production of potatoes relative to fertilizer with less or none of this nutrient like DAP. It was recommended fertilizer formulation specific to meet potato production requirements for each specified agro-zones. Establishment of fertilizer blending plants and fertilizer advisory service for farmers to boost potato production and incomes. The fertilizer rate of 250kg/ha and variety Sherekea is recommended for Milimani Location Saboti Sub-county.

Suggestion for Further Research

Research context was limited to Saboti in Trans Nzoia west Sub County, therefore the future research can be extended to different sectors of sub counties and counties.

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