

Investigation of appropriate fertilizer doses for potato production using different planting spacing in major growing areas of Malawi

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Abstract

Potato total yield and tuber size largely depend on the variety planted and on crop management including soil fertility. In Malawi there is lack of appropriate recommendation for use of available fertilizers in the market and as a consequence, farmers do not get the maximum benefit from use of fertilizer. The objective of the study was to determine the optimum level of NPK fertilizer for potato production in major growing areas of Malawi. Three trials were conducted in Tsangano, Bembeke and Njuli-Farm using the potato varieties Holland, Violet and Lady Rosetta respectively. Results showed an increase in tuber yield from 0 kg of fertilizer/ha to 600 kg/ha. Between 600kg/ha and 800kg/ha, there were no significant differences in total tuber yield in the three sites, suggesting that at those sites, further fertilizer application above 600kg/ha is not economically justified. It was recommended that the trial be conducted at multiple sites in potato growing areas before final recommendations on the optimum level of the NPK fertilizer.

Introduction

Potato yields of about 5 to 15 tons/ha being obtained by farmers in Malawi are relatively low (Demo et al., 2007). Moreover tubers are generally of sub-standard sizes that are not desired by consumers and processors. Potato total yield and tuber size largely depend on the variety planted and on crop management including soil fertility. Preliminary trials conducted in Dedza and in Mozambique revealed that total tuber yield can be increased by over 3 folds with use of NPK fertilizers. Application of fertilizer on potato crops is generally profitable when optimum doses are used. Most farmers use fertilizer for potato production in Malawi. However, there is lack of appropriate recommendation for use of available fertilizers in the market and as a consequence; farmers do not get the maximum benefit from use of fertilizer. Existing recommendation prescribes the use of a mixture of NPK23:21:0 and potassium sulphate (K_2SO_4) before planting. Potassium sulphate is not usually available in the market and farmers end up applying only NPK23:21:0 that does not contain potassium which is one of the important nutrients for the crop. It is therefore very necessary to investigate optimum doses (for potato production) of the commonly available NPK fertilizers for potato production.

Objective

The objective is to determine the optimum dose of NPK fertilizer for potato production in major growing areas of Malawi.

Materials and Methods

Three trials were conducted in Tsangano, Bembeke and Njuli-Farm using the potato varieties Holland, Violet and Lady Rosetta respectively. Five different levels (0 kg/ha, 200 kg/ha, 400 kg/ha, 600 kg/ha and 800 kg/ha) of the regularly available NPK fertilizer 8:18:15 +6S were tested. The Randomized Complete Block Design with 3 replications was used. The NPK fertilizer was applied at planting time in each of the trials. The trial at Tsangano and Bembeke were conducted during the dry season between July and November 2007. Water supply to the dry

season trials was by furrow irrigation with two watering per week. The trial at Njuli was planted during the rainy season at the end of January 2008. Data analysis was done using SAS statistical software. ANOVA was computed and the Duncan Multiple Range Test was used to separate treatment means.

Results and Discussion

Effect of NPK fertilizer levels on potato tuber yield of the local cultivar Holland at Tsangano in Ntcheu District of Malawi

Fig.1 shows the total tuber yield recorded per experimental unit with increasing doses of fertilizer applied at planting time ranging from 0 kg per ha (smallest bag of potato in Fig.1) to 800 kg/ha (the biggest bag with potato in Fig. 1). Statistical analysis revealed significant increases in total tuber yield with increase in level of fertilizer (Table 1). Total tuber yield ranged from 4.7 tonnes/ha with no fertilizer applied at planting to 19.3 tonnes/ha with 800 kg NPK/ha. The highest yield increase between two consecutive fertilizer levels was recorded between 0 kg/ha and 200kg/ha (increase of 7.0 tonnes/ha). The use of fertilizers even at small doses is therefore profitable in potato production under the conditions of this trial. Table 1 also shows that maximum total tuber yield was not attained with the range of fertilizer levels/ha tested in this trial. There was however no significant difference between 400kg/ha and 600kg/ha in terms of total tuber yield.



Fig. 1: Effect of NPK fertilizer on Potato Yield in Tsangano-Ntcheu, 2007

Other variables reported in Table 1 include % plants harvested, mean number of tubers per plant, and mean tuber weight. It should be noted that tubers harvested were generally of small sizes. This may be explained by the poor potential of the planted cultivar (Holland) to produce large tubers probably due to degeneration of seed tubers planted that originated from one of the best crop in a farmer field in the testing zone.

Effect of NPK fertilizer levels on potato tuber yield of the local cultivar Violet at Bembeke in Dedza District of Malawi

This trial was conducted at Bembeke Extension Planting Area using the local cultivar Violet obtained from a farmer. The same fertilizer type and levels used in Tsangano were applied (0 kg/ha, 200 kg/ha, 400 kg/ha, 600 kg/ha and 800 kg/ha). Planting was done in July and harvesting in November 2007.

Results in Table 2 revealed that the total tuber yield generally increased significantly with increase in fertilizer dose tested. The lowest total tuber yield of 9.4 tonnes/ha was recorded with when no fertilizer was applied while the highest yield of 25.7 tonnes/ha was obtained with 800 kg of NPK 8: 18: 15 +6S applied per ha. Again, the highest yield increment between two consecutive fertilizer doses was recorded between 0kg NPK/ha and 200 kg NPK/ha. This highest increment was 9.2 tonnes/ha which is over nine times greater than the yield required to recover cost of fertilizer applied, using the fertilizer cost and potato selling price reported above in the Tsangano trial. It should be noted that no significant yield increase was recorded between the fertilizer dose 200kg/ha and 400 kg/ha and between 600 kg/ha and 800 kg/ha.

Yields in Tsangano were higher than those of Bembeke; this could be due to variety difference and to difference in native soil fertility.

Effect of NPK fertilizer levels on potato tuber yield of the variety Lady Rosetta at Njuli-Estate

At Njuli-Estate, total tuber yields varied from 22.8 tonnes/ha with no NPK fertilizer application to 31.4 tonnes/ha with 800 kg of NPK /ha. The yield of commercial size tubers (≥ 40 mm diameter) ranged from 17.6 tonnes/ha without NPK fertilizer to 26.2 tonnes/ha with 800 kg of NPK/ha (Table 3). Significant differences were recorded in commercial yields with 600 kg NPK fertilizer out yielding the control treatment (0 kg NPK/ha) by 37.5% (Table 3). It should be noted that even without NPK fertilizer application, a total tuber yield of 22.8 tonnes/ha was recorded. This can be explained by the high level of native soil fertility at the trial site. This site had not been cropped and was kept under fallow for several years. The number of tubers harvested per plant and the mean weight of individual tuber are presented in Table 3.

Table 1: Evaluation of different levels of NPK 8:18:15+6S fertilizer on tuber yield and yield parameters of the potato variety Holland during the winter season (July-November 2007) at Tsangano in Ntcheu District of Malawi

Fertiliser levels (kg/ha)	% plants harvested	Total tuber yield (tons/ha)	Mean No. of tubers per plant	Mean weight of individual tuber (g)
0	96.3 b	4.7 d	7.2 c	17.0 c
200	99.5 a	11.7 c	10.6 b	27.0 b
400	99.5 a	15.2 b	13.6 a	26.8 b
600	97.8 ab	15.7 b	12.3 ab	31.3 a
800	99.0 a	19.3 a	14.1 a	33.0 a
CV(%)	1.62	10.66	13.50	9.22

Means with the same letter are not significantly different at 5% level of significance

Table 2: Evaluation of different levels of NPK 8:18:15+6S fertilizer on tuber yield and yield parameters of the potato variety Violet during the winter season (July-November 2007) at Bembeke in Dedza District

Fertiliser levels (kg/ha)	% plants harvested	Total tuber yield (tons/ha)	Mean No. of tubers per plant	Mean weight of individual tuber (g)
0	100a	9.4 c	5.0 b	45.8 b
200	100a	18.6 b	7.3 b	63.3 b
400	100a	16.2 b	7.4 b	53.5 b
600	100a	23.7 a	6.7 b	92.8 a
800	100a	25.7 a	10.2 a	60.3 b
CV(%)	0.00	17.52	20.19	23.08

Means with the same letter are not significantly different at 5% level of significance

Table 3: Evaluation of different levels of NPK 8:18:15+6S fertilizer on tuber yield and yield parameters of the potato Lady Rosetta during the summer season (end January-May 2007) at Njuli-Estate

Fertiliser levels (kg/ha)	% plants harvested	Total tuber yield (tons/ha)	Commercial Tuber yield (tones/ha)	Mean total No. of tubers per plant	Mean weight (g) per tuber	Mean No. commercial tuber per plant	Mean weight (g) of com. tuber
0	99.0 a	22.8 a	17.6 c	11.4 a	48.3 a	6.6 b	65.0 b
200	96.7 a	25.8 a	20.8 abc	12.8 a	50.7 a	7.4 ab	69.3 b
400	99.0 a	24.8 a	20.3 bc	10.8 a	55.7 a	5.7 b	85.7 ab
600	99.0 a	28.7 a	24.2 ab	11.3 a	61.7 a	6.3 ab	95.7 a
800	96.7 a	31.4 a	26.2 a	14.6 a	53.3 a	8.4 a	78.0 ab
CV (%)	2.88	16.07	13.19	17.29	12.58	18.34	14.37

Means with the same letter are not significantly different at 5% level of significance

NS = Not significant at 5% level of probability

Conclusion and Recommendations

From these preliminary two trials, three recommendations can be drawn. (i) Application of NPK 8:18:15+ 6S fertilizer at planting is economically justified up to a dose of 600 kg/ha. (ii) If funds to purchase fertilizer are limited, at least 200 kg of NPK fertilizer or even less should be applied since highest return per unit cost on fertilizer is obtained between 0 and 200kg NPK per ha. (iii) Further investigations should be conducted in different sites in order to determine consistency of results obtained and to determine with precision optimum doses of fertilizers to be applied. (iv) Soil tests should be carried out to determine native soil fertility in different project sites and to improve trial design and interpretation of results.