

Influence of Nitrogen and Potash on Cassava

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INTRODUCTION

Cassava (*Manihot esculenta* crantz.) responds well to fertilizer application. Remarkable yield response to addition of nitrogen, phosphorus and potassium has been observed (3). The response of fresh tuber yield of cassava to nitrogen and potash is reported to be more pronounced (2,4,11,16.) In general potash is considered to be the most important nutrient for tuber crops as it is involved in the production and translocation of starch (10,13). However it has been shown that, in root crops, potash may have negative effects too, e.g. dioscorea (7,12), sweet potato (6) and cassava (9).

The amounts of nutrients removed by cassava as shown by Altmannsberger (1), Amarasiri (2) and Velly (15) also stresses the importance of nitrogen and potassium to cassava. (Table 1).

The national average yield of 8.5 tonnes of fresh tubers per hectare (14) could be considered very low, taking into account the yield potential of the popular cassava varieties available in Sri Lanka. (Table 2). It was therefore envisaged to study the optimum requirement of nitrogen and potash in the Dry Zone, where there is a potential for expansion of cassava cultivation.

These studies were conducted at the Agricultural Research Station, Tinnevely (Jaffna) and Agricultural Research Station, Alutharama (Mahiyangana). These two sites were selected due to their differences in soil and climatic conditions (Table 3).

MATERIALS AND METHODS

A randomized complete block design as a 4x3 factorial with an additional treatment having three replicates was used in both locations.

Nitrogen levels used were 0, 45, 90 and 135 kg. N per hectare supplied as sulphate of ammonia (21%N) given in three equal split applications, as basal dressing, one month after planting and three months after planting.

Potassium application was done at the rate of 0, 45 and 90 kg. K₂O per hectare, supplied as Muriate of potash (50% K₂O). This was applied in two equal splits, as basal and at three months after planting.

Phosphorus was incorporated as a blanket application at the rate of 45 kg. P_2O_5 per hectare which was furnished by concentrated superphosphate (43% P_2O_5).

The additional treatment consisting of 45 kg/ha. N, 45 kg/ha. K_2O only (without P) was also included in the experiment.

Cuttings 22 to 25 cm. long, extracted from mature sticks of the cultivar MU 22, was used as planting material. The cuttings were planted upright with two-thirds of the cuttings buried in the soil. The cuttings were spaced at a distance of 90 cm. by 90 cm. A plot consisted of 25 plants making a plot size of 4.5x4.5 m. The nett plot for yield assessment consisted of 9 plants after leaving a one-plant border.

Basal fertilizer was applied the day before planting and subsequent top dressings as described earlier were done after weeding.

The crop was planted in September 1972, and was grown purely under rain-fed conditions. Harvesting was done nine months after planting.

Soil samples were taken at the commencement of the experiment prior to fertilizer application and were analysed for nitrogen, potassium, phosphorus and organic matter (Table 4).

RESULTS AND DISCUSSION

Considerable variation was observed in fresh tuber yields in the two locations (Table 5). The general mean yield at Alutharama was 61.69 tonnes per hectare and at Tinnevely was 30.58 tonnes of fresh tubers per hectare-Alutharama recording almost 100% more than at Tinnevely. The crop at Tinnevely was subject to a period of nearly 6 months drought, while at Alutharama the rainfall distribution was such that no serious moisture stress was experienced during the period of the experiments for more than 50 days at a stretch.

Statistical analysis of fresh tuber yield showed that the treatment combinations were significant at 5% level in both the locations. However the response due to various treatments did not show the same trend at the two locations. At Alutharama the highest yield of 80.87 tonnes per hectare of fresh tubers was obtained with the fertilizer treatment N_1PK_1 supplying 45 kg/ha of all the three components N, P_2O_5 and K_2O . At Tinnevely, the highest yield was obtained at the fertilizer combination of N_3PK_2 supplying 135 kg/ha N, 45 kg/ha. P_2O_5 and 90 kg/ha. K_2O . Cassava tuber yield corresponding to this fertilizer treatment was 36.61 kg/ha. At Alutharama the lowest yield of 56.50 kg/ha was obtained at a fertilizer level of 45 kg/ha. N, 45 kg/ha. P_2O_5 and 90 kg/ha. K_2O whereas at Tinnevely the lowest yield of 23.63 kg/ha. was obtained corresponding to the fertilizer treatment 0 kg/ha. N 45

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kg/ha. P_2O_5 and 90 kg/ha. K_2O . The treatment differences as regards to fresh tuber yield at both the locations as calculated by the Duncan's Multiple Range Test are shown in Table 5. The response of fresh tuber yield as influenced by individual nutrients is described below.

Nitrogen

Levels of nitrogen showed significant differences at both locations. positive linear response was obtained for nitrogen application at both locations. This is in agreement with the results obtained by Chew (4). The response functions of fresh tuber yield to nitrogen are:—

$$\begin{array}{ll} \text{Alutharama} & \dots\dots\dots Y = 55.2538 + 4.6054X \\ \text{Tinnevelly} & \dots\dots\dots Y = 25.8468 + 2.0407X \end{array}$$

In deriving the regression equations coded values of 1,2,3 and 4 were used for X corresponding to 0, 45 90 and 135 kg/ha. N. The regression graphs for the two locations are shown in Figure 1.

At Alutharama the response to nitrogen levels was significant at 1% level and it is shown that the response to doses of 45, 90 and 135 kg/ha. N was 7.0 4.46 and 12.85 tonnes fresh tubers per hectare respectively over the zero nitrogen level. At Tinnevelly a 5% response was observed to nitrogen treatments and the respective increase in yield due to application of 45, 90 and 135 kg/ha. N over the no nitrogen control was found to be 2.71 1.96 and 5.75. tonnes per hectare of fresh cassava tubers (Table 6).

At Alutharama the application of 135 kg/ha. N gave the highest response which was found to be 13.85 tonnes per hectare more than the zero nitrogen control and this response was highly significant. At Tinnevelly the superiority of 135 kg/ha. N over the on nitrogen control was 5.75 tonnes of fresh tubers per hectare and this superiority reached 5% significance level.

The importance of nitrogenous fertilizers to cassava has been pointed out by several workers (5, 8, 11, 12) and a response upto 168.5 kg/ha. N has been observed (4). The linearity in response to nitrogen application and the amount of nitrogen removed by cassava as shown by Table 1 indicate that the tuber yield could be further increased with additional amounts of nitrogen at both locations. However economics must decide any increase in the dose of fertilizers.

Potassium

The response to application of potash did not reach significant levels in any of the locations (Table 6). Application of 45 kg/ha. K_2O was found to be slightly superior to zero potash control at both locations. In both locations, however, the mean effect of increasing the level of potash from 45 kg/ha. K_2O to

90 kg/ha. K_2O was associated with a slight non-significant reduction in fresh tuber yield (Table 6). Significant negative response to potash over and above a certain limit has been cited by Kumar, Mandal and Magoon (9) and Prevot Olganier (13). The phenomenon of yield depression to excess potash has also been reported on several other root and tuber crops, such as sweet potato (6) and dioscorea (7, 12). Further experimentation is necessary to ascertain the negative effects of potash on cassava in Sri Lanka.

At Alutharama, incorporation of 45 kg/ha. P_2O_5 to a mixture of similar quantities N and K_2O furnished a 17.47 kg/ha. increase in yield over the fertilizer treatment containing 45 kg/ha. N and 45 kg/ha. K_2O without additional P_2O_5 . This response was found to be significant at 5% level. At Tinnevely no such significant response was observed. This may be possibly due to the lower P_2O_5 content in Alutharama soils and a higher soil P_2O_5 level at Tinnevely (Table 4).

Significant (5%) NxK interaction was observed at Alutharama and not at Tinnevely (Table 7). The only significant interaction however at Alutharama was at K_0 level, N_3 , (135 kg/ha. N) being superior to N_3 (zero N).

Perusal of Table 5 shows a distinct superiority of tuber yield at Alutharama to all the fertilizer treatments which could be due to the following reasons:

1. Higher soil nitrogen content at Alutharama (Table 4) which is also substantiated by the linear response to nitrogen application upto 135 kg/ha. N.
2. High potash content in the soils at Tinnevely which would have contributed to a depression in fresh tuber yields.
3. The drought which prevailed at Tinnevely may be another factor for the lower yields at that location.

SUMMARY

An experiment was conducted to study the effect of application of nitrogenous and potassic fertilizers on fresh tuber yield of cassava in the Dry Zone. The response due to various combinations of nitrogen and potash behaved in a differential manner at the two locations. A positive linear response to addition of nitrogen upto 135 kg/ha. was observed both at Alutharama and Tinnevely. There was no significant yield response due to addition of potash. However a negative effect was observed due to the addition of 90 kg/ha. K_2O at both locations. At Alutharama supplying 45 kg/ha. P_2O_5 in combination with similar amounts of N and K_2O resulted in a significantly higher yield over the treatment which received similar quantities of N and K_2O without P_2O_5 . This treatment gave almost a 100% superiority in fresh tuber yields.

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REFERENCES

1. Altmannsberger, K (1932) Extracted from Green Manuscript, Hannover, Germany. 4. 10. 51.
2. Amarasiri, S. L. (1975) Agricultural Research Station, Maha Illuppallama. Personal Communication.
3. Chadha, T. R. (1958) Fertilizer Experiment on Tapioca in the Kerala State. Indian Soc. of Soil Sc. 6 (1): 53-63
4. Chew, W. Y. (1970) Varieties and NPK Fertilizer for Tapioca on Peat. Malaysian Agric. J. 47 (4) 483-491.
5. DA. Silva J. R. and Ferreira, E. S., (1968) Response of Cassava to Increasing Doses of N.P. and K. *Bragantia* 27 (2): 357-364.
6. Ho, A. C. T. (1969) Potash gives Sweet Potato a Big Lift. *Better Crops with Plant Food*. 1:8-11.
7. Irving, H. (1956) Fertilizer Experiments With Yams in Eastern Nigeria. 1949-51. *Trop. Agr. (Trinidad)* 33(1):67
8. Krochmal, A and Samuels, C. (1969) The Influence of NPK Levels on Growth and Tuber Development of Cassava in Tanks. *Proc. Int. Symp. on Tropical Root Crops. Trinidad. 1 Sec. 2, 97-102.*
9. Kumar, B. N., Mandal, R. C., and Magoon, M. L. (1970) Influence of Potash on Cassava.
Ind. J. of Agronomy, XVI: 82-84.
10. Malvolta, E. Graner, E. A. Coury, T., Sobr. M. O. C. and Pacheco, J. A. C. (1952) Studies on Mineral Nutrition on Cassava (*Manihot utilissima* Pohl.). *Plant, Phys.* 30 (1): 81-82.
11. Mandal, R. C., Singh, K. D., and Magoon, M. L. (1971) Relative Efficacy of Different Sources, Levels and Split Applications of Nitrogen. *Ind. J. of Agronomy.* 16 (14): 449-452.
12. Obi, J. (1959) The Standard D. N. P. K. Experiments Reg. Res. Sta. Samaru Min. Agr. N. Reg. Nigeria.
Tech. Rep. No. 8.
13. Prevot, P. and Olganier, M. (1958) Potassium Fertilization in Tropical and Sub Tropical Regions. *Potassium Symp. Berne.* 277-318.
14. Statistics. Extension Division, Department of Agriculture. Sri Lanka. (1975).
15. Velly, J. Contributions to the Determination of Soil Maintenance, Fertilization and Extraction of Minerals by Main Crops. Madagascar (Tananarive) No. 282: 872-890. English Translation.
16. Vijayan, M. R., and Aiyer, R. S. (1969) Effect of Nitrogen and Phosphorus on the Yield and Quality of Cassava.
Agric. Res. J of Kerala 7 (2): 84-90.

Table 1: Estimated Nutrient Removal in Kg/ha by Cassava Tubers (different workers)

<i>Nutrient</i>	<i>Altmannsberger</i>	<i>Amarasiri</i>	<i>Velly</i>
<i>N</i>	80	62	73
<i>P₂O₅</i>	20	12	28
<i>K₂O</i>	120	375	54

Table 2: Yield Potentials of Popular Cultivars of Cassava in Sri Lanka

<i>Variety</i>	<i>Local Name</i>	<i>Age (Months)</i>	<i>Yield (kg/ha)</i>
MU 10	Kolumbumaravalli	05-06	18-22
KU 71	Moneragala White	05-06	18-22
Mu 22	Peradeni Manyokka	09-10	40-45
Mu 44	Sudu Manyokka	08-09	40-45

Table 3: Soil and Agro-Ecological Factors at Tinnevelly and Alutharama

<i>Station</i>	<i>Elevation</i>	<i>Rainfall</i>	<i>Soil Type</i>	<i>Topography</i>
Tinnevelly	3 m	1270-1900 mm.	Calcic Red Yellow Latosols	Level Terrian
Alutharama	243 m	1900-2540 mm.	Reddish Brown Earths	Undulating.

Table 4: Soil Analysis Data

<i>Nutrients</i>	<i>Alutharama</i>	<i>Tinnevelly</i>
<i>N</i>	0.163 %	0.106 %
<i>P₂ O₅</i>	112.0 Kg. ha ⁻¹	358.0 kg. ha ⁻¹
<i>K₂ O</i>	0.416 Ex. Kme. 100 ⁻¹ g soils	0.524 Ex. K me. 100 ⁻¹ g soil
<i>O.M.</i>	0.803 %	2.394 %

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Table 5: Average Yield of Fresh Tubers (Tonnes Per Hectare)

No.	Fertilizer Treatment	Location	
		Alutharama	Tinnevelly
1.	N_0PK_0	57.64	29.88
2.	N_1PK_0	66.96	27.21
3.	N_2PK_0	64.97	28.16
4.	N_3PK_0	79.99	33.75
5.	N_0PK_1	61.54	30.81
6.	N_1PK_1	80.87	32.94
7.	N_2PK_1	65.46	29.70
8.	N_3PK_1	70.75	36.61
9.	K_0PK_2	57.33	23.63
10.	N_1KP_2	56.50	32.28
11.	N_2PK_2	66.16	32.35
12.	N_3PK_2	74.05	34.84
13.	$N_1P_0K_1$	63.40	29.12
General Mean		61.69	30.58
C.V.		11.79%	12.37%

Significant Differences According to DMR Test.

Alutharama: 10 9 1 5 13 3 7 11 2 8 12 4 6

Tinnevelly: 9 2 3 13 7 1 4 5 10 11 6 12 8

**Table 6: Effect of Nitrogen and Potash on Fresh Tuber Yield (Tonnes per Hectare)
At Alutharama and Tinnevelly**

Nutrient (kg. ha-1)	Alutharama	Tinnevelly
0 N	61.07	28.11
45 N	68.11	30.81
90 N	65.53	30.07
135 N	74.92	33.86
L.S.D. (p=5%)	7.69	3.18
(p=1%)	10.43	—
0 K ₂ 0	67.39	28.83
45 K ₂ 0	68.66	32.51
90 K ₂ 0	63.51	30.78
L.S.D.	Not Significant	

TABLE 7
Nitrogen and Potash Interaction on Fresh Tuber Yield (Tonnes per Hectare).

	Alutharama				Tinnevely				
	K ₀	K ₁	K ₂	Mean	K ₀	K ₁	K ₂	Mean	
N ₀	...	57.64	61.54	57.33	58.84	29.88	30.81	23.63	28.11
N ₁	...	66.96	80.87	56.50	68.11	27.21	32.94	32.28	30.81
N ₂	...	64.97	65.46	66.16	65.53	28.16	29.70	32.35	30.07
N ₄	...	79.99	70.75	74.05	74.93	30.08	36.61	34.84	33.84
L.S.D. (N x K) (p=5%)	18.86								
***	Not significant								

NITROGEN

N₀, N₁, N₂ and N₃ corresponding to zero, 45, 90 and 135 nitrogen (kg. ha⁻¹)

POTASH

K₀, K₁ and K₂ corresponding to zero, 45, and 90 K₂O (kg. ha⁻¹).

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Figure - 1

