

EFFECT OF POTASSIUM ON GROWTH, YIELD AND NUTRIENT UPTAKE OF TWO EXOTIC RICE VARIETIES *

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The high yielding varieties of rice generally make heavy demands on the soil (or major plant nutrients). But relatively little attention has been paid so far in India to the potassium requirements of rice. While reviewing the results of potash experiments conducted in India, Vaidyanathan (1933) and Pawar *et al* (1960) reported negative response of paddy to this nutrient. Tseng and Wang (1958) and Dubey and Das (1961) also recorded depression in yield in cereals with higher levels of potash application. The results of experiments conducted in Kerala are erratic (unpublished records, G. R. R. S., Pattambi). The present studies were undertaken with a view to study objectively the influence of potassium on the growth, yield and nutrient uptake of two rice varieties viz., Tainan 3 and Taichung Native 1.

Material and Methods

The plants were grown in cement concrete pans of 100 x 100 x 15 cm. The pans were filled with river sand collected from Thiruvallam (Trivandrum Dist) river bed to a depth of 10 cm. Paddy seeds were dibbled at a spacing of 20 cm on either way and after 10 days, 25 hills alone were retained in each pan with 2 seedlings per hill. Basal dressing for all the treatments was applied on the day previous to sowing and the pans were irrigated so as to maintain adequate moisture in the growth medium for germination of seeds.

Eight treatments with 2 varieties (Tainan 3 and Taichung Native 1) and 4 levels of potassium in the form of muriate of potash (0, 40.80 and 120 kg/ha) were arranged in a

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randomised block design with 3 replications. Nitrogen as ammonium sulphate and phosphoric acid as super phosphate were applied at 100 and 80 kg/ha respectively in all the pans and "Spartin" at the rate of 25 gram per pan to supply micronutrients. The different fertilisers were applied according to the following schedule:-

Basal dose	N 10	P 20	K 0	N 10	P 20	K 10	N 10	P 20	K 10	N 10	P 20	K 10
On 15th day of sowing	N 30	P 30	K 0	N 30	P 30	K 20	N 30	P 30	K 30	N 30	P 30	K 30
On 30th day of sowing	N 30	P 20	K 0	N 30	P 20	K 10	N 30	P 20	K 10	N 30	P 20	K 30
On 45th day of sowing	N 20	P 10	K 0	N 20	P 10	K 0	N 20	P 10	K 10	N 20	P 10	K 20
On 60th day of sowing	N 10	P 0	K 0	N 10	P 0	K 0	N 10	P 0	K 10	N 10	P 0	K 30

The effects of the different treatments were assessed in terms of plant height, tillering, yield and panicle characters like length of panicle, weight of panicle, 1000 grain weight and chaff percentage.

Analyses of the growth medium (sand), grain and straw were made using the standard methods (Piper 1950 and Jackson 1962). The data were statistically analysed.

Results and Discussion

The growth medium consisted of 94 percent coarse and fine sand fractions, 1 percent silt and 3.5 percent clay. Chemically it had pH of 6.2, sesquioxide contents of 0.67 percent, acid insolubles of 97.55 percent, nitrogen, P_2O_5 and K_2O , 0.06, 0.008 and 0.0060 percent respectively and calcium and magnesium oxides together 0.113 percent.

Data relating to plant height and tiller numbers recorded on different occasions are presented in Table 1.

Table 1

Mean height in cm and number of tillers of rice under different fertiliser treatments

Variety	Treatments	On 15 th day		On 45 th day		At harvest	
		Height	Till ers	Height:	Tilleers	Height	Tilleers
Tainan 3	K ₀	17.5	2.0	52.2	16.6	79.7	11.3
	K ₄₀	18.9	2.0	56.3	16.2	81.2	10.7
	K ₈₀	19.5	2.0	57.4	16.9	82.2	11.3
	K ₁₂₀	21.7	2.0	58.7	16.8	83.9	11.3
Taichung (N) 1	K ₀	24.2	4.8	45.7	21.0	65.8	14.6
	K ₄₀	26.7	6.0	48.4	20.9	65.3	15.3
	K ₈₀	25.6	5.0	48.2	21.5	65.5	14.6
	K ₁₂₀	25.9	5.5	47.0	20.9	65.5	14.9

It may be seen that plants of Taichung N 1 were taller than Tainan 3 in the early stages of growth. But during the later stages Tainan 3 plants grew faster and attained greater heights. Taichung N 1 showed much higher tiller number than Tainan 3 at all stages of growth. In both the varieties, potash at all levels had little influence on plant height and tiller number.

Data regarding grain, straw and panicles are given in **Table 2**.

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Table 2

Yield and panicle characters of rice plants under different fertiliser treatments

Variety and Potash doses in kg/ha	Grain kg/ha	Straw kg/ha	Panicle			Chaff (%)	
			Length (cm)	Weight (gm)	1000 grain weight (gm)		
Tainan 3	K ₀	2700	4650	20.2	1.62	22.01	16.5
	K ₄₀	2430	4900	20.3	2.03	23.36	21.5
	K ₈₀	2890	5250	20.6	2.18	22.47	23.7
	K ₁₂₀	2890	5750	20.5	1.89	23.95	25.7
Taichung N 1	K ₀	3000	4230	19.9	1.62	20.59	13.8
	K ₄₀	2860	4400	20.2	1.34	23.02	16.5
	K ₈₀	2740	4550	20.0	1.43	21.17	20.5
	K ₁₂₀	2900	4750	19.4	1.53	23.64	23.2

The difference in grain yield between the two strains was not statistically significant. Potash is seen to have no influence on yield even at higher levels. In Taichung N 1 there was a downward trend in grain yield with increasing levels of potash.

The straw yield in both the strains showed linear increases with increasing levels of potash,

There was little difference in panicle length between the two varieties and the different levels of potash had no influence on this character. Tainan 3 being a "panicle weight type" recorded higher panicle weight than Taichung N 1 which is a "panicle number type" confirming the observation of Tanaka *et al* (1964). The difference in 1000 grain weight between the two strains was marked. Being a "panicle weight type" Tainan 3 recorded a higher mean value. Both the strains showed significant positive response to different levels of potash. This may be attributed to the key role of potash in grain formation and producing plumpy grains. Cuthbertson (1960) reported similar results in water culture studies. Tainan 3 and Taichung N 1 showed significant linear increase in the percentage of chaff with increasing doses of potash. This is contrary to the widely held belief that potash tends to reduce the amount of chaff in cereals. Table 3 represents the nutrient uptake in grain and straw.

Table 3

Mean nutrient uptake in rice grain and straw under different fertiliser treatments

Varieties	Potash doses (kg/ha)	Grain			Straw		
		Nutrient		uptake	Nutrient		uptake
		N	P ₂ O ₅	K ₂ O	N	P ₂ O ₅	K ₂ O
	g/plot	g/plot	g/plot	g/plot	g/plot	g/plot	
Tainan 3	K ₀	2.13	2.08	4.67	1.24	0.68	6.18
	K ₄₀	1.99	1.65	3.78	1.14	0.88	6.09
	K ₈₀	2.80	2.19	5.52	1.97	1.13	8.12
	K ₁₂₀	2.83	2.14	5.66	0.95	0.81	8.58
Taichung N 1	K ₀	2.58	2.40	3.27	1.32	0.72	6.42
	K ₄₀	2.69	2.15	3.55	1.32	0.80	7.95
	K ₈₀	3.18	2.14	3.69	2.52	0.82	7.86
	K ₁₂₀	2.44	2.06	4.29	1.33	0.73	8.67

Note- Nutrient uptake was computed from values nutrient contents

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The grains of Taichung N 1 were richer in nitrogen but poorer in potash than those of Tainan 3. There was but little difference between the varieties in phosphorus contents. As for the straw, Taichung N 1 recorded higher values than Tainan 3 for both nitrogen and potash but a lower value for phosphorus. The total mean uptake of nitrogen by Tainan 3 during the entire growth period was 37.7 kg/ha as compared to 43.4 kg/ha by Taichung N 1. The absorption of phosphorus by the two strains was almost equal, the mean values for Tainan 3 and Taichung N 1 being 29.0 kg/ha and 29.6 kg/ha respectively. The total uptake of potash by both the varieties was very high. Tainan 3 assimilated 121.5 kg/ha and Taichung N 1 114.2 kg/ha. It is evident that both these varieties were capable of removing large amounts of this nutrient, the greater part of it accumulating in the straw. The high uptake of potash was not, however, manifested in higher grain yields. This was presumably due to the imbalance of major nutrients brought about by luxury consumption of potash.

The uptake of major nutrients was influenced considerably by the level of applied potash. The assimilation of nitrogen and phosphorus in general was maximum for 80 kg K_2O /ha of potash. Absorption of potash generally increased with increasing doses of this nutrient. However, for optimum uptake of all the three major nutrients the application of potash at 80 kg K_2O /ha appeared to be most favourable.

It was noteworthy that in the present studies none of the plants at 0 kg K_2O /ha exhibited any of the typical potash deficiency symptoms. It was likely that traces of potash present in the growth medium as well as in the tap water used for irrigation were adequate to meet the minimum requirements of the crop.

Summary

In a pot culture experiment designed to assess the effect of potassium on Tainan 3 and Taichung N 1, it was found that this nutrient had little effect on growth characters of rice plants, Taichung N 1 showed a negative response of grain yield to incremental doses of potash and there was significant linear increase of straw yield and chaff percentage in both the varieties. Potash applied at 80 kg K_2O /ha was the most favourable dose for optimum absorption of nitrogen, phosphorus and potash.

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