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Influence of NPK on the Growth, Yield and Composition of Rice Varieties Differing in Inherent Yield Potentials

BY

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ABSTRACT

Three varieties (tall *indica* TKM 6, *Japonica indica* ADT 27 and dwarf *indica* Co. 33) differing in inherent yield potentials were taken and the influence of NPK on the growth, yield and nutrient aspects were assessed. The optimum doses of N were 39 kg per acre for TKM 6, 106 kg for ADT 27 and 157 kg for Co 33. For maximising production and increasing the cultivators' monetary profit, Co 33 was found superior to the other two chosen varieties.

INTRODUCTION

There is no precise recommendation of P_2O_5 and K_2O doses to supplement N so as to bring about the best combination for the benefit of rice cultivator. So, an attempt was made to assess the optimum NPK requirements and nitrogen response using varieties differing in inherent yield potential. This study also envisaged the working out the economics of fertiliser application, nutrient content at maximum tillering stage and protein content of grain.

MATERIALS AND METHODS

The trials were laid in Central Farm wet lands during 1969-70 *kharif* season. The soil was of black clay loam, medium in available nitrogen and potassium and low in available phosphoric acid. The lay out was in $3^3 \times 6$ factorial confounded, in nine plot blocks, with varieties, phosphoric acid and potassium confounded, each plot split into six sub plots to receive six levels of nitrogen (Table 1).

Seedlings of 30 days old were planted adopting a spacing of 20 cm between rows and 10 cm along the row at two seedlings per hole, in plots of 10.2 sq. m per treatment. P_2O_5 and K_2O were applied as basal dressing in the form of superphosphate and muriate of potash respectively. Nitrogen was applied in the form of ammonium sulphate in two equal doses one half at the time of planting and the other half 30 days after planting.

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Table 1. Details of treatments

Varieties	Levels of P_2O_5	Levels of K_2O	Levels of N
V_0 Tall *indica* TKM 6	P_0 0 kg/h	K_0 0 kg/ha	N_0 0 kg/ha
V_1 *Japonica* - *indica* ADT 27	P_1 40 ,,	K_1 40 ,,	N_1 40 ,,
V_2 Dwarf *indida* - Karuna Co. 33	P_2 80 ,,	K_2 80 ,,	N_2 80 ,,
			N_3 120 ,,
			N_4 160 ,,
			N_5 200 ,,

RESULTS AND DISCUSSION

(i) Crop growth and yield components: Plant height, tiller production, number of grains per panicle and weight of grains were the characters much influenced and appeared to be essentially a function of variety and nitrogen levels (Beachell and Jennings, 1964). The height of TKM 6 varied from 118.5 cm. to 141 cm under 0 to 200 kg N whereas the range of height in ADT 27 and CO. 33 was 94 to 121 cm and 59 to 78 cm respectively. TKM 6 lodged at flowering stage beyond 80 kg N.

Tiller number per hill progressively increased with N levels in CO 33 (7 to 13 tillers from 0 to 200 kg N) and was closely followed by ADT 27 (7 to 12 tillers). But TKM 6 was quite inferior (8 to 10 tillers). The findings that application of N improved tillering capacity in the order of dwarf *indica*, *japonica* and tall *indica* are in agreement with the findings of earlier workers (Srinivasalu and Pawar 1965; Tanaka *et al.*, 1964)

Number of grains per panicle exhibited an increasing trend with the increase in N levels, conformity, with the findings of Lusanandana *et al.*,(1963). But the rate of increase was significant

Fig. 1.

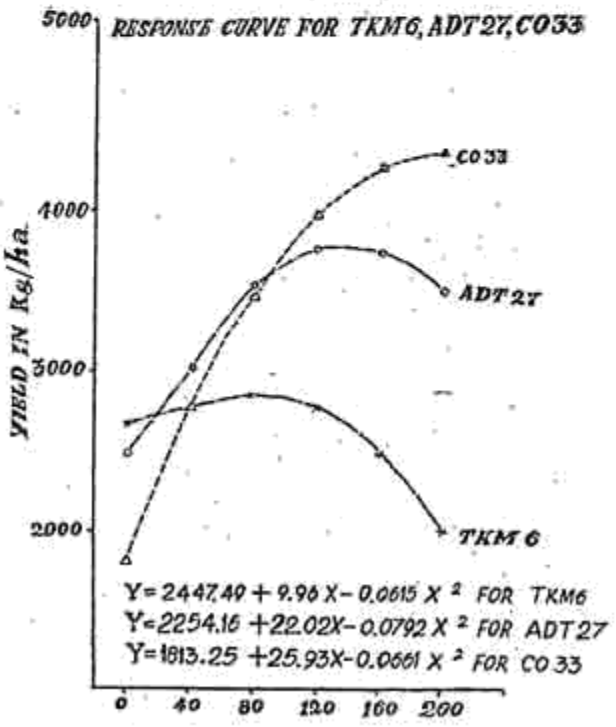

TABLE 2. Effect of N levels on productive tillers and yield

	TKM 6 [V_0]		ADT. 27 [V_1]		Co 33 [V_2]	
	(a)	(b)	(a)	(b)	(a)	(b)
N_0	8.6/88	17.6/0.46	7.9/107	15.6/0.49	7.8/99	16.7/0.69
N_1	9.1/107	17.6/0.42	9.2/119	15.8/0.47	9.8/108	16.9/0.86
N_2	9.8/113	17.2/0.34	10.1/134	15.6/0.43	10.7/ 115	17.0/0.83
N_3	10.1/117	16.9/0.27	11.2/149	15.5/0.40	11.1/128	17.0/0.80
N_4	10.3/122	16.5/0.22	11.3/141	15.4/0.37	12.2/133	17.0/0.76
N_5	10.3/120	15.8/0.17	12.2/145	15.2/0.32	13 4/139	16.9/0.68

a) Productive tillers per hill/number of grains per panicle.

SE — 0.55/6 3; CD — 1.22/14.8.

b) Weight of 1000 grains in g/grain straw ratio.

SE — 0.17/0.04, CD — 0.38/0.09.

only upto 120 kg N. Both ADT 27 and CO 33 were equally superior to TKM 6, range in number of grains being 107 to 149, 99 to 139 and 88 to 122 respectively (Table 2).

The 1000 - grain weight reached the maximum at 40 kg N in TKM 6 and ADT. 27 and 120 kg N in CO 33, weight being 17.6 g, 15.8 g and 17.03 gm respectively. Tanaka *et al.* (1964)observed that the weight of1000 grains showed an increase only upto 20 ppm in both *japonica* and *indica* varieties and beyond that level there was a tendency for the grain weight to decrease particularly in low response varieties.

CO 33 gave the highest grain to rtsaw ratio (0.77) and it was significantly superior to ADT 27 which registered only 0.41. TKM 6 recorded the lowest value of 0 31. Nitrogen influenced the grain to straw ratio at all levels and the ratio was more in 40 kg/ha in CO 33. It was also seen that this ratio was significantly lower at higher levels of nitrogen thereby showing decrease in grain straw ratio due to nitrogen fertilisation and the decrease was more in TKM. 6 (Table 2).

Tanaka *et al.* (1964) reported that grain straw ratio generally decreased with increase in applied N especially in tall *indica* varieties.

TABLE 3. Yield in Kg/ha

	V_0		V_1		V_2	
	Grain	Straw	Grain	Straw	Grain	Straw
N_0	2351	5153	2268	4760	1727	2547
N_1	2881	6907	3043	6569	2902	3463
N_2	2967	8913	3378	7996	3458	4201
N_3	2593	9782	3824	9520	3927	5093
N_4	2413	10889	3820	10603	4196	5736
N_5	2054	12138	3447	11186	4416	6616
SE	95 2	564.1				
CD	205.9	1249.5				

Phosphoric acid and potassium and the different interactions did not seem to have any marked effect on the height, tillers, number of grains, 1000-grain weight and grain straw ratio.

Interaction was observed in $P_2O_5 \times N$ on plaint height and grain/straw ratio and also in $K_2O \times N$ on number of grains.

(ii) **Yield:** TKM 6 recorded the highest grain yield under 80 kg N/ha, but the difference between 40 kg and 80 kg was not a marked one. Strain ADT 27 gave the highest yield under 120 kg N/ha beyond which the yielding ability got reduced. In the case of CO 33, the yield was found to increase significantly from level to level, the highest yield being under the highest dose (200 kg N/ha) tried. It was also seen that upto 40 kg/ha there was no appreciable difference among the varieties. At 80 and 120 kg N/ha, CO. 33 and ADT 27 yielded on par and they were significantly superior to TKM 6. When the level of N. was increased to 160 and 200 kg/ha, strain CO 33 out yielded the other two varieties. (Table 3).

Chavan *et al.* (1957) Tanaka *et al.* (1958) and Relwani (1959) clearly indicated that for *indica* varieties 30 to 40kg N/ha and for *Japonica* varieties 80 to 90 kg N/ha were economic doses. In TKM6, the difference in yield among the various levels of P_2O_5 was not a marked one though P_1 (40 kg/ha) gave the highest yield. In ADT. 27, P_1 was significantly superior to P_0 and P_2

TABLE 4. Percentage of nutrient content

	V_0	V_1	V_2	SE	CD
N content in plant	3.05	2 8	3.3	0 06	0.22
P	0.28	0.27	0.31	0 01	0.03
K	1 85	1 53	1.73	0.08	0.26
Protein content in rice	10.43	11.07	11.07	0.14	0.48

registering 12.4 per cent increased yield over P_0. Strain CO 33 gave more yield under P_2 (80 kg/ha) registering 12 per cent increased yield over P_0 but the difference between P_2 and P_1 was not appreciable. Regarding the response to K_2O, TKM 6 and ADT 27 gave the highest yield under K_1 (40 kg K_2O/ha) while CO. 33 under K_2 (80 kg/ha). But there was no significant difference between K_1 and K_0 in TKM 6 and K_2 and K_1 in ADT 27 and Co 33.

(iii) **Yield of straw**: TKM 6 recorded the highest straw yield followed by ADT 27, both of them being significanty superior to strain CO 33. Straw yield was found to increase significantly with every additional dose of N. Between TKM 6 and ADT 27 there was no appreciable difference (Table 3). Tanaka *et al.* (1964) observed increased yield in straw with increase in N level Weight of chaff increased significantly with every additional dose of N. This is in accordance with the findings of Tanaka *et al.* (1964) The percentage of chaff ranged from 7 to 16.9 in TKM 6, 6.5 to 9.1 in ADT 27 and 5.6 to 7.5 in CO 33.

(iv) **Response curves and economics:** Response curves to N showed quadratic nature and it is presented in Fig. 1. There was an increased yield of 13 kg, for every kg of N added, up to 40 kg N in TKM 6. In ADT 27, the increased yield for every kg of N was 19 kg, 14 kg, 13 kg and 10 kg at 40.80, 120 and 160 kg N respectively. CO 33 recorded 29, 22, 18, 15 and 13 kg of increased yield per kg of N at 40, 80, 120, 160 and 200 kg N/ha. The optimum dose of N worked out to be 39 kg, 106 kg and 157 kg for TKM 6, ADT 27 and CO 33 respectively.

The highest net profit was obtained from 40 N + 40 P + O K in TKM.6, 120 N + 40 P + O K in ADT. 27 and 200 N + 40 P + 40 K in CO 33, amount being Rs. 430 in TKM 6, Rs. 832 in ADT 27 and Rs. 1131 in CO 33 over no fertilizer treatment.

(v) **Nutrient aspect:** CO 33 was high in N and P percentage, and TKM. 6 in K content (Table 4). This is in agreement with Dastur and Malkani (1933) who had reported that *indica*

varieties registered more N content than *japonica* type. Increased application of neither P_2O_5 nor K_2O had any influence on the nitrogen content in plants. This is in conformity with the findings of Perur and Narayana (1961) who found very little effect on nitrogen content due to the application of P_2O_5 and K_2O. Application of P_2O_5 did not influence the K content in plants either alone or in combination with K_2O or nitrogen. Protein content in rice was high in both CO 33 and ADT 27 (11.07 per cent) in contrast to TKM 6 (10.43 per cent). Both individually and in combination, N and P_2O_5 application increased protein content.

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