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Response of High-yielding Varieties of Paddy to Fertility Levels and Sources of NPK

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ABSTRACT

A field experiment was conducted during the three years 1972-73 to 1974-75 at Gujarat Agricultural University, Anand campus, Anand to compare the performance of four varieties (Jaya, I.R.8, I.E.T.1039 and I.E.T.1991) of paddy with four different fertility levels (150 + 75 + 0; 210 + 105 + 0; 270 + 135 + 0 and 270 + 135 + 135 NPK in kg/ha) and two sources of N and P (DAP and SNPK) on yield and growth characters under sandy clay loam soil of Gujarat.

The three year results led to conclusion that significantly highest grain yield was obtained with the application of NPK @ 270 + 135 + 0 kg/ha though for high return per Rupee spent on fertilizer, application of NPK @ 150 + 75 + 0 kg/ha is recommended. Jaya proved to be the highest yielder. Both the sources were found to be equally effective. Interaction effects were not significant.

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INTRODUCTION

Rice is one of the most important food crops of our country. Dwarf rices differ from most of the tall varieties and are comparatively shorter in height and can withstand high fertility without lodging. Studies on fertilizer requirement of different dwarf varieties, therefore, have been made in many parts of the country. Yadav, Bajpai and Pathak (1976) obtained highest yield with $N_{80}+P_{40}+K_{40}$ kg/ha in Bundelkhand region of U.P. while Pathak, Krishna and Tiwari (1972) obtained high yields with the application of NPK @ 100+50+50 kg/ha. Khatua, Chaudhari, Panda and Misra (1976) recommended application of NPK @ 120+30+30 and 120+60+60 for the *kharif* and *rabi* season, respectively. Singh (1973) obtained a linear response to NPK application upto 120+60+60 kg/ha. Tiwari and Thakur (1976) obtained the highest yield with the application of 212 kg N with 100 kg P_2O_5/ha. Mahapatra and Padalia (1971) tried increasing doses from 0 to 210 kg/ha and obtained response upto 210 kg N/ha. Mahapatra (1969) found no significant difference among the sources of phosphorus except on strongly acid soils where superphosphate was not as good as others and on alkaline soils the rock phosphate was inferior. Singh and Dubey (1976) did not find any significant difference in grain and straw yield due to application of different sources of N and P tried.

The above studies indicated that these rices are highly responsive to heavy dose of fertilizers, yet little information is available on the highest net return per Rupee invested on fertilizers. The fertilizers are already in short supply and

costly, hence deserve to be used economically. It was, therefore, felt necessary to investigate the response of rice varieties to fertility levels alongwith their sources with special interest to find out net return per Rupee invested on fertilizers. For this, incremental cost benefit ratio (ICBR) was calculated over the lowest level of fertility. The present study was undertaken at Agronomy Farm of Gujarat Agricultural University, Anand campus.

MATERIALS AND METHODS

The experiment was undertaken in the Fertilizer Research Project, Gujarat Agricultural University, Anand campus, Anand during the three consecutive years 1972-73 to 1974-75 in the *kharif* season. It was conducted at the same site in all the years after *rabi* crop of wheat. Thirty-two treatment combinations of four fixed fertility levels (150+75+0; 210+105+0; 270+135+0 and 270+135+135 NPK in kg/ha), four varieties of paddy (Jaya, I.R.8; I.E.T.1991 and I.E.T. 1039) and two sources of N and P (DAP and SNPK) were tried in a split plot design with four replications. Varieties were taken in the main plot while fertility levels and sources in sub plots. The gross plot sizes 5·25×3·60 m and net plot size 4·25× 2·70 m were employed in this study. The soil under this experiment was sandy clay loam with pH 8·2. It had organic carbon, fine sand, silt and clay content of 1.06, 58·00. 12·30 and 26·50 per cent, respectively. The total nitrogen, available P_2O_5 and K_2O were 1963, 176 and 489 kg/ha, respectively. Transplanting of almost 30 days old two seedlings per hill with a spacing 15×15 cm was done in the 3rd week of July during all the years. Irrigation and necessary plant protection measures were taken as and when required during cropping seasons. The entire quantity of phosphorus in the form of DAP and SNPK as per treatment and 50 per cent of the total nitrogen that contained in DAP and SNPK and the rest in the form of urea and the entire quantity of potash for DAP and partially for SNPK were applied as basal dose. Remaining 50 per cent of the N was applied in two equal splits viz., 25 per cent at active tillering stage and 25 per cent at panicle initiation stage as urea.

RESULTS AND DISCUSSION

Relative Performance of Varieties:

Data in Table 1 and 2 show that varieties differed significantly in respect of grain yield as well as other growth and yield contributing characters during all the three years. Variety Jaya gave the maximum grain yield followed by I.R.8, I.E.T.1991 and I.E.T.1039 during all the three years as well as in the pooled results. Jaya was significantly superior to I.E.T.1991 and I.E.T.1039 during all the three years. Although the grain yield between Jaya and I.R.8 did not differ significantly during all the three years, yet all four varieties differed significantly in respect of grain yield in the test carried out for the pooled data of the three years. The four varieties viz., Jaya, I.R.8,

TABLE 1

Grain yield and straw yields of paddy (q/ha) as affected by different treatments.

Treatments	*Grain yield (q/ha)*				*Straw yield (q/ha)*			
	1972-73	*1973-74*	*1974-75*	*Pooled*	*1972-73*	*1973-74*	*1974-75*	*Pooled*
Varieties:								
I.R. 8	56·09	44·54	60·43	53·69	55·93	41·14	61·36	52·81
Jaya	60·78	46·56	60·57	55·97	59·65	42·55	62·26	54·82
I.E.T.1991	53·41	42·36	53·40	49·72	56·38	43·02	60·10	53·17
I.E.T.1039	50·05	40·16	49·08	46·43	56·61	39·12	56·98	50·90
C.D. 5%	4·87	3·08	3·52	2·05	N.S.	N.S.	N.S.	N.S.
Fertility levels: ($N + P + K$ *kg/ha*):								
150 + 75 + 0	51·46	40·63	53·98	48·69	52·92	38·72	55·96	49·20
210 + 105 + 0	54·31	43·23	54·99	50·84	56·51	41·18	59·31	52·33
270 + 135 + 0	57·62	45·04	58·44	53·70	60·19	42·57	61·87	54·88
270 + 135 + 135	56·95	44·73	56·06	52·58	58·94	43·36	63·56	55·29
C.D. 5%	2·26	1·53	1·94	1·11	1·74	1·40	2·01	1·20
Sources of N & P:								
DAP + Urea	54·76	43·88	55·59	51·41	56·24	41·43	59·76	52·48
SNPK + Urea	55·40	42·93	56·16	51·49	58·04	41·48	60·59	53·37
C.D. 5%	N.S.	N.S.	N.S.	N.S.	1.24	N.S.	N.S.	N.S.

I.E.T.1991 and I.E.T.1039 yielded on an average of three crop seasons 55·97, 53·69, 49·72 and 46·23 quintals grain per hectare, respectively. Jaya yielded on an average 4·25, 12·57 and 20·54 per cent more grain than that by I.R.8, I.E.T.1991 and I.E.T.1039, respectively. The reasons for the increased yield of Jaya appeared to be its ability to produce more number of grains per ear alongwith heavier test weight as compared to I.R.8 (Table 2). The varieties I.E.T.1991 and I.E.T. 1039 produced significantly the lowest yield of grain as compared to I.R.8 and Jaya. This might be due to significantly the lowest test weight inspite of their ability to produce more number of grains per ear. These results are in conformity with the findings of other workers too (Shastry, 1969; Barthakur and Gogoi, 1974; Tiwari and Thakur, 1976).

Differences in straw yield of the four varieties were not significant in any of the three years as well as in pooled analysis. Variety Jaya and I.E.T.1039 respectively gave the highest (54·82 q/ha) and the lowest (50·90 q/ha) straw yield. Variety I.E.T.1039 did not produce significantly the lowest straw yield though it was significantly shortest in plant height as compared to others. Straw yield was compensated by its ability to produce significantly the highest number of effective tiller/hill as compared to rest of the varieties during first two years of the experimentation.

Effect of Different Levels of Fertility:

The data incorporated in Table 2 clearly indicate that differences in yield of grain due to fertility levels were significant in the individual years as well as on pooling. In the first year, maximum

TABLE 2

Various plant characters of paddy as affected by different treatments.

Treatments	*Plant height (cm)*				*Number of effective tillers/hill*				*Number of grain/ear*				**1000-grain weight (gm)**			
	1792-73	*1973-74*	*1974-75*	*Mean*	*1972-73*	*1973-74*	*1974-75*	*Mean*	*1972-73*	*1973-74*	*1974-75*	*Mean*	*1972-73*	*1973-74*	*1974-75*	*Mean*
Varieties:																
I.R.8	69·9	82·2	82·0	78·0	6·1	4·3	6·7	5·7	85·3	96·5	104·3	95·4	27·7	29·5	27·1	28·1
Jaya	69·5	81·5	84·0	78·3	6·6	4·5	6·1	5·7	84·4	98·2	111·2	97·9	28·6	29·1	27·3	28·3
I.E.T. 1991	71·9	81·8	81·9	78·5	6·2	4·5	6·4	5·7	121·2	130·1	128·5	126·6	18·2	19·7	17·4	18·4
I.E.T. 1039	65·6	76·1	78·0	73·2	7·7	5·1	6·7	6·5	101·3	138·2	114·8	118·1	16·3	17·0	15·8	16·4
C.D. 5%	2·19	2·44	2·93	—	0·79	0·44	N.S.	—	12·90	5·53	7·26	—	0·86	0·23	0·48	—
Fertility Levels (N+P+K kg/ha):																
150 + 75 + 0	67·8	79·3	79·9	75·7	6·8	4·5	6·6	6·0	94·3	114·7	116·2	108·4	23·0	23·7	21·8	22·8
210+105+0	69·0	80·5	81·3	76·9	6·7	4·5	6·4	5·9	97·3	115·0	113·0	108·4	22·6	23·7	22·1	22·8
270 + 135 + 0	70·1	81·2	82·6	78·0	7·1	4·7	6·6	6·1	99·0	119·0	114·6	110·9	22·8	23·8	21·9	22·8
270 + 135 + 135	70·0	80·6	82·1	77·8	6·6	4·6	6·3	5·8	102·1	114·3	114·9	110·4	22·6	24·2	21·9	22·9
C.D. 5%	1·49	N.S.	0·90	—	0·41	N.S.	N.S.	—	N.S.	N.S.	N.S.	—	N.S.	N.S.	N.S.	—
Varieties:																
Sources N & P:																
DAP + Urea	69·1	80·6	81·1	76·9	6·5	4·5	6·3	5·8	98·9	115·5	113·9	109·4	22·6	23·9	21·9	22·8
SNPK + Urea	69·3	80·2	81·9	77·1	6·9	4·7	6·6	6·1	97·5	116·0	115·5	109·7	22·7	23·8	21·9	22·8
C.D. 5%	N.S.	N.S.	N.S.	—	0·29	N.S.	N.S.	—	N.S.	N.S.	N.S.	—	N.S.	N.S.	N.S.	—

grain yield (57·62 q/ha) was produced with the fertilizer treatment involving $N_{270}+P_{135}+K_0$ followed by $N_{270}+P_{135}+K_{135}$; $N_{210}+P_{105}+K_0$ and $N_{150}+P_{75}+K_0$ kg/ha. The same trend was maintained in subsequent years.

The pooled results also indicated that the differences in grain yield were significant. All the four fertility levels of NPK differed significantly from one another in respect of the said character. Application of NPK @ 270+135+0 produced the maximum grain yield (53·70 q/ha) followed by 270+135+135; 210+105+0 and 150+75+0 kg/ha. Application of potash had a depressing effect on grain yield in this study. Though the statistical analysis of the plant height, number of effective tillers per hill, number of grain per ear and test weight were not significant in most cases, yet the grain yield was influenced by them. The highest values of the above character were noticed in the case of increased fertility levels which gave ultimately increased yield.

The fertility levels exhibited pronounced effect on straw yield in all the individual years as well as in the pooled analysis of three years. Generally higher levels of fertility application proved superior in comparison to lower levels upto the fertility level of $N_{270}+P_{135}+K_0$ kg/ha. The fertility levels $N_{270}+P_{135}+K_0$ and $N_{270}+P_{135}+K_{135}$ were at par in respect of straw yield. The same trend was maintained in individual years as well as in pooled results. This might be due to increase in plant height with increasing levels of fertility upto $N_{270}+P_{135}+K_0$ (Table 2). The results are in accordance with the general findings of Mahapatra (1969), Pathak (1972) and Singh (1973) who reported that the yield of both grain and straw increased significantly as the level of fertility increased.

Effect of Sources:

Differential sources of N and P (DAP and SNPK) tried in this experiment did not exercise any marked influence on the yield of grain, straw and characters contributing towards them. Similarly non-significant differences in grain yield due to different complex fertilizers were reported by Mahapatra (1969) and Yogeswara Rao, Ranga Reddy, Shankar Reddy and Venkateswarlu (1973).

Effect of Interactions:

Of the various interactions between varieties, fertility levels and sources, none were found to be significant in any of the years.

Economics:

Fertilizer is a costly input. The level of fertilizer that gives the highest yield would not necessarily give maximum profit. The fertilizers are already in short supply and costly, hence deserve to be used economically in such a way that maximum return would be obtained per Rupee invested on fertilizers. On calculating net incremental cost benefit ratio (ICBR) over the control treatment ($N_{150}+P_{75}+K_0$ kg/ha), it was found that ICBR decreased with the increasing levels of fertility (Table 3). Thus the fertility

TABLE 3

Economics of paddy grain production as affected by different fertility levels (Pooled data)

Treatments kg/ha	*Grain yield in q/ha*	*Additional yield over lowest dose (q/ha)*	*Income due to additional (Rs./ha)*	*Additional cost of fertilizer application (Rs./ha)*	*Net ICBR.*
150+ 75+ 0,	48·69	—	—	—	—
210+105+ 0	50·84	2·15	258	423	1:0·64
270+135+ 0	53·70	5·01	601	845	1:0·41
270+135+135	52·58	3·89	467	1100	1:0·24

Rates: (1) Paddy grain—Rs. 120/q
(2) DAP—Rs. 2,184/t.
(3) Urea—Rs. 1,801/t.
(4) Muriate of potash—Rs. 936/t.

level @ $N_{150}+P_{75}+K_0$ kg/ha is recommended on the basis of ICBR.

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