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EFFECT OF SPACING, NUMBER OF SEEDLINGS PER HILL AND NITROGEN ON GROWTH AND YIELD OF ANNAPURNA RICE (*Oryza sativa* L.)

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Spacing, number of seedlings per hill and nitrogen are some of the important agronomic factors which are known to influence grain yield in rice. In the case of short duration and shy tillering varieties as well as in soils of low fertility, closer spacing and larger number of seedlings per hill have been found to increase grain yields due to greater plant population per unit area (Ghose, 1956). Individual plant yield declines with less space, but yields per hectare increase provided that the plant population is not increased beyond the optimum limit (Hedaythullah *et al*, 1947, Matsuo, 1964, Sahu and Lenka, 1966). Similarly when spacing is increased beyond the opti nun limit, the yields decrease significantly (Khan and Shafi, 1956). Plant population has a direct bearing on fertiliser needs as it determines the number of plants that take nutrients from the soil. It is therefore important to determine spacing, number of seedlings per hill and level of nitrogen for each variety and for each agroclimatic region for projecting the maximum yield potential of that variety. The present paper deals with the results of an experiment conducted with the above objective in view at the Central Rice Research Station, Pattambi representing the middle lateritic region of Kerala.

Materials and Methods

The field experiments were conducted during the first (June to September) and second (September to December) crop seasons of 1969 and 1970 in the double crop wet lands where a green manure crop (Daincha) was raised in the preceeding summer season The soil was lateritic loam with 0 89 percent organic carbon, and 68 and 140 kg of available P205 and K_2O respectively per hectare. The pH of the soil was 5.4. The experiment was laid out in split plot design with 3 replications. The gross **plot** size was 3.6 X 3.3 m. The main plot treatments were the combinations of 3 spacings (15 X 10 cm, 15 x 15 cm and 15 X 20 cm) and 3 seedling rates (1, 2 and 3 seedlings per hill). The sub plot treatments included 4 levels of nitrogen (0, 40, 80 and 120 kg N per ha), Nitrogen was applied in two instalments, 2/3 as basal dressing before planting and 1/3 at the time of panicle initiation. P_2O_5 and K_2O were applied as basal

The results revealed that a closer spacing of 15 x 10 cm was the optimum for the test variety. The number of seedlings planted per hill had no significant influence either on plant characters or on grain yield in the majority of the seasons. However, planting 3 seedlings per hill in the first crop season and 2 seedlings per hill in the second crop season appeared to be advantageous. Nitrogen significantly influenced plant height, effective tillers per hill, ear weight and grain yield. The grain yield response due to N was positive and significant upto 80 kg level. The nature of response curve was quadratic and the optimum dose of N corresponding to the maximum yield of paddy was 94,4 kg per ha. The economic optimum level with the prevailing market conditions was 76.6 kg N per ha.

Transplanting 2 to 3 seedlings per hill at a spacing of 15 X 10 cm with 76.6 kg N per hectare proved to be the best agronomic practice for Annapurna.

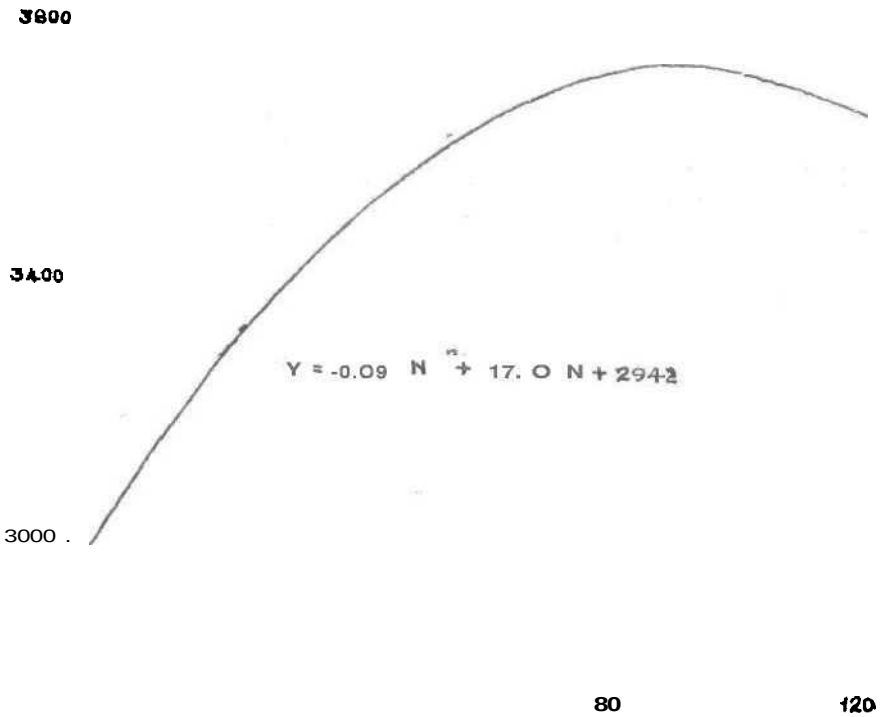

Fig. 1. Response of Annapurna rice to N levels (grain yield)

a result of raising a green manure crop (Daincha) in the preceding summer season. During the remaining three seasons the grain yield increased with levels of N but failed to show statistical significance beyond 80 kg N per ha. In the pooled analysis also the grain yield increased significantly with graded doses of N from 0 to 80 kg and at 120 kg level the yield declined. Thus the significant reduction in grain yield at 120 kg N level obtained in the first crop season of 1969 has reflected in the pooled mean. The pronounced influence of ear weight on grain yield was evident only at 40 kg N level. The statistically not significant increase in grain yield beyond 80 kg N level during the last three seasons of the trial could be ascribed to the proportionately low rate of increase in the number of effective tillers per hill and a significant reduction in ear weight.

The interactions between spacing and number of seedlings per hill and between nitrogen level and number of seedlings per hill were not significant in any of the 4 seasons. The interaction between spacing and N level was significant in 2 out of the four seasons. I however failed to show significance in the pooled analysis Average grain yield corresponding to different spacings and N levels (Table 3) reveals that the maximum yield of 3858 kg grain per ha. was recorded at a spacing of 15 X 10 cm with 80 kg N per ha. Hills spiced at 20 X 15 cm without N produced the lowest yield of 2792 kg per ha, In all the spacings tried the response for N was evident. The reduction in grain yeild due to wider spacing (20 X 15 cm) over closer spacing (10 X 15) cm at 0, 40, 80 and 120 kg N levels was 381, 403, 201 and 289 kg respectively per ha. This evidently shows the comparative advantage of closer spacing (15 X 10 cm) over the widest spacing (20 X 15 cm) under all the levels of N tried. At higher levels of N, the grain yield increased with number of seedlings per hill and the maximum yield was obtained at 80 kg N per ha. However, the differences between 2 and 3 seedlings were not much.

The response to N levels as indicated by second order polynomial equation ($Y = ax^2 + bx + c$) drawn out for grain yield is presented in the accompanying Figure 1. The optimum dose of N corresponding to the maximum yield of paddy expected is 94.4 kg per ha, The level of nitrogen giving the maximum profit works out to be 76.6 kg per ha. at a price of Rs. 2.25 per kg of nitrogen and at Rs. 0.70 per kg of paddy.

Summary

Investigations on the effect of spacing, number of seedlings per hill and application of N at different levels, on the growth and yield of Annapurna rice were carried out at the Central Rice Research Station Pattambi for four consecutive seasons from the first crop season of 1969'

Table 2

Effect of spacing, number of seedlings per hill and levels of nitrogen on grain yield (kg/ha)

Treatments	1969		1970		Mean
	1st crop	2nd crop	1st crop	2nd crop	
Spacing (cm) 10 X 15	4305	4283	2908	3029	3631
15 x 15	4216	4057	2882	2831	3434
20 x 15	4128	3868	2781	2723	3313
F	NS	Sig.	Sig.	Sig.	Sig.
CD (0.05)	-	169	114	135	212
Number of seedlings per hill					
1	4134	3737	2562	2616	3325
2	4178	4189	2686	2998	3513
3	4338	4033	2823	2970	3541
F	NS	NS	NS	Sig.	NS
CD (0.05)	-	-	-	135	-
Levels of nitrogen (kg/ha)					
0	4087	3265	2082	2377	2943
40	4403	3963	2671	2862	3475
80	4412	4450	2950	3101	3728
120	3963	4600	3058	3106	3682
F	Sig.	Sig.	Sig.	Sig.	Sig.
CD (0.05)	180	306	139	79	194

NS, Not significant.
Sig, Significant.

Table 3

Mean grain yield (kg/ha) of paddy at different levels of nitrogen as affected by spacing and number of seedlings per hill

	Spacing (cm)			Number of seedlings per hill		
	10 x 15	15 x 15	20 x 15	1	2	3
Nitrogen levels (kg/ha)						
0	3173	2893	2792	2843	3009	3002
40	3691	3445	3288	3371	3517	3535
80	3858	3670	3657	3548	3786	3857
120	3803	3727	3514	3534	3737	3770
F (Interaction)		NS			NS	

NS:- Not significant.

Table 1

Effect of spacing, number of seedlings per hill and levels of nitrogen on plant characters

Treatments	Mean height (cm)					Mean number of effective tillers per hill					Mean ear weight (g)				
	1969		1970		Mean	1969		1970		Mean	1969		1970		Mean
	1st crop	2nd crop	1st crop	2nd crop		1st crop	2nd crop	1st crop	2nd crop		1st crop	2nd crop	1st crop	2nd crop	
Spacing (cm)															
10 × 15	74.4	65.5	73.9	67.1	70.2	6.1	5.8	4.9	6.8	5.9	2.34	2.16	2.05	1.97	2.13
15 × 15	75.1	67.3	74.6	66.8	70.9	8.0	7.5	5.8	8.2	7.4	2.13	2.18	1.92	1.82	2.01
20 × 15	75.0	67.1	74.8	67.3	71.0	9.7	9.2	7.0	9.9	8.9	1.92	1.89	1.86	1.81	1.87
F	NS	NS	NS	NS	NS	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
CD (0.05)						0.84	1.65	0.57	0.45	0.91	0.07	0.11	0.05	0.07	0.08
Number of seedling per hill															
1	74.0	67.0	74.8	66.9	70.7	7.6	7.3	5.8	7.5	7.1	2.14	2.11	1.94	1.85	2.01
2	75.2	66.9	74.4	67.3	70.9	8.0	7.7	5.9	8.9	7.6	2.08	2.13	1.95	1.84	2.00
3	75.3	65.9	74.3	67.0	70.6	8.3	7 5	6.1	8.5	7.6	2.17	1.99	1.95	1.82	1.98
F	NS	NS	NS	NS	NS	NS	NS	NS	Sig.	NS	NS	NS	NS	NS	NS
CD (0.05)									0.45						
Levels of nitrogen (kg/ha)															
0	73.1	64.1	72.4	64.7	68.6	6.9	6.1	4.4	6.9	6.1	1.97	1.71	1.69	1.59	1.74
40	75.8	66.8	74.9	67.1	71.1	7.4	7.1	5.7	8.3	7.1	2.25	2.14	1.95	1.90	2.06
80	76.6	67.7	76.0	68.6	72.2	8.5	8.6	6.4	8.7	8.0	2.28	2.30	2.08	2.02	2.18
120	75.2	67.7	75.7	68.1	71.4	8.9	8.9	7.0	9.3	8.5	2.02	2.18	2.08	1.91	2.04
F	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
CD (0.05)	1.29	1.72	0.91	1.35	1.42	0.38	0.38	0.36	0.64	0.46	0.03	0.03	0.02	0.02	0.02

NS; Not significant
Sig; significant

dressing at the rate of 50 kg each per hectare as super phosphate and muriate of potash respectively. The test variety Annapurna (90 to 100 days) is a dwarf *indica* rice evolved from a cross between Ptb. 10 and Taichung (Native) 1 in the year 1966.

Results and Discussion

Effect of spacing on plant height at maturity was not significant. But it exerted significant influence on the number of productive tillers per hill and mean ear weight (Table 1). With wider spacing there was an increase in the number of effective tillers per hill accompained by a decrease in ear weight. With closer spacing there was a reduction in the number of effective tillers per hill. Higher plant population per unit area on account of closer spacing possibly caused competition among the plants for light and nutrients, resulting in the reduction in tillering. With wider spacing the competition among the tillers within a hill would have resulted in the reduction of mean ear weight.

The grain yield was found to go down as the spacing became wider. Highest grain yield was obtained under closer spacing viz. 15 X 10 cm in all the four seasons (Table 2). This can be attributed to the increased number of panicles per unit area and higher panicle weight obtained under closer spacing. Mandal and Mahapatra (1968), Matsuo (1964), Ramiah (,, Rosher (1959) and Vachhani *et al* (1961) have reported good yield responses due to closer spacing in early maturing shy tillering varieties.

Number of seedlings per hill did not influence the plant characters and grain yield significantly except for the number of effective tillers per hill and grain yield in the second crop season of 1970. However the trend in grain yield was in favour of 3 seedlings per hill in the first crop season and 2 seedlings per hill in the second crop season.

Nitrogen exerted significant influence on plant height, number of effective tillers per hill, ear weight (Table 1) and grain yield (Table 2) in all the four seasons. A positive response in plant height and ear weight with increasing levels of N was noticed only up to 80 kg N per ha. Beyond that level a significant reduction in the mean ear weight was recorded. Effective tillers per hill increased progressively with level of N in all the seasons The data clearly show that the nitrogen levels are more important for grain yields than the adopted spacings (Table 2). In the first crop season of 1969 the grain yield response due to 40 kg N was significantly superior to no nitrogen, The effects due to 40 and 80 kg N levels were on par and at 120 kg. N level a drastic reduction in grain yield was noticed. This lack of response to applied N beyond 40 kg level in this season was due to the high initial fertility of the soil as

REFERENCES

Ghose, R.L. M. 1937. Rice Research these 45 years. Special Rice number *Indian Fmg.* *5:* 5 (1956)

Hedaythullah, S., Roy, K. P., Sen, S. 1947. A study on the effect of cultural factors in transplanted paddy on the behaviour of some plant characters influencing the yield. *Indian J. agric. Sci.* **17**: 69-80

Khan, S., Shafi, M. 1956. Effect of spacing and varying the number of secdings per hill on the yield of paddy in the Punjab (Pak) *Pak j.* Sci. Res. 8: 28-35

Matsuo, T. 1964, Varietal response to nitrogen and spacing. Proceedings of a symposium at the International Rice Research Institute. pp. 437-448

Mandal, B. B.. Mahapatra, K 1968. Effect of date of planting, spacing and level of N on the yield of rice. *The Andhra agric. J.* XV: 93-98

Ramiah, K. Rice in Madras. 1937. A popular handbook. Government press, Madras. 31-32

Rosher, P. H. 1959. The spacing of swamp rice in Trinidad. *Empire Joun Exptal Agric.* 27

Sahu, B. N., Lenka, D. 1966. Cultural cum manurial trials on paddy-studies on the effect of date of planting, spacing, rates of planting and levels of nitrogen and phosphate on the yield of paddy. *Indian J. Agron.* **11**: 127-37

Vachhani, M. V., Upadhyaya, S. R., Rao, M. V. 1961 Influence of spicing on plant characters and yield *of* transplanted rice. Rice News *Tell.* 9: 15-16

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