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PERFORMANCE OF MEDIUM DURATION RICE AS INFLUENCED BY PLANT POPULATION AND FERTILIZER LEVELS

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Abstract: In a few trials conducted at the Regional Agricultural Research Station, Pattambi, Kerala to assess the performance of IR 42 - a low fertilizer responsive rice variety - under different plant population and fertilizer management situations, it was found that the variety has the built-in ability to tolerate low fertility and at the same time respond to higher fertilizer doses than the recommended dose of 90 kg N, 45 kg P_2O_5 and 45 kg K_2O/ha. The optimum plant population was found to be 33 hills/m . The highest net return and benefit cost ratio were associated with a plant population of 33 hills/m at full dose of fertilizer. But the return per rupee invested on fertilizer was more with 33 hills/m in the first crop season and with 25 hills/m in the second crop season at 50 per cent of the recommended dose of fertilizer.

INTRODUCTION

Rice production will have to be doubled to keep pace with the increasing population in India by 2000 AD. The high cost of fossil fuel dependent inputs is the major constraint in rice production. Hence the use of low fertilizer responsive varieties together with low-cost agronomic techniques to economize the use of chemical fertilizer is highly welcome. Most of the modern varieties of rice give high yields only when they are grown under ideal conditions of soil, water supply and nutrients and well protected from their natural enemies. They also possess the advantage of high fertilizer responsiveness (Ponnamperuma, 1979). But farmers cannot afford the cost of fertilizers required to express the full yield potential of these varieties. They need a variety which can exploit both soil and fertilizer nutrients efficiently and give fairly good yield with moderate amount of fertilizers. IR 42 is such a variety which combines high yield potential with the capacity to yield well at low nutrient levels (IRRI, 1978; Khush *el al.*, 1979; Ponnamperuma, 1979). Hence,a study was taken up by manipulating the low-cost input, plant population at varying fertilizer levels with a view to optimise production by minimising the use of the costly fertilizer.

MATERIALS AND METHODS

The trial was conducted for two first crop (April-May to September-October) and two second crop (September-October to December-January) seasons of 1982-83 and 1983-84 at the Regional Agricultural Research Station, Pattambi, Kerala. The trial consisted of four levels of fertilizer in the main plots and six plant populations in the sub-plots fitted in a split plot design with five replications. The fertilizer levels F_1, F_2, F_3 and F_4 were 0, 50, 75 and 100 per cent of the recommended dose (90 kg N, 45 kg P_2O_5 and 45 kg K_2O/ha) respectively. The plant population levels S_1, S_2, S_3, S_4, S_5 and S_6 were 25, 33, 50, 100, 44 and 66 hills/m corresponding to spacings of 20x20, 20x15, 20x10, 20x5, 15x15 and 15x10 cm.

The soil of the experimental site was sandy clay loam with a pH of 5.5, organic carbon 1.6%, total N 0.1%, available P_2O_5 21.2 kg/ha and exchangeable K_2O 242.8 kg/ha with a CEC of 14.2 me/100 g of soil.

Thirty day old seedlings of IR 42 were used for transplanting. Farm yard manure @ 5 t/ha was applied at the time of land preparation. Fertilizers were applied as per the package of practices recommendation of the Kerala Agricul-

tural University (KAU, 1981). Half the dose of N and K_2O and the full dose of P_2O_5 were applied as basal. The remaining N was given in two equal split doses, one at 20 days after planting. The second split dose of N along with half K_2O was applied at 40 days after planting.

RESULTS AND DISCUSSION

Grain yield

Grain and straw yields were significantly influenced by fertilizer levels and plant population (Table *2,* 3, 4 and 5). Full dose of fertilizer and plant population at 33 hills/m^2 gave highest grain as well as straw yield in both the seasons. The lowest yields of grain and straw were associated with the highest plant population i.e., 100 hills/m^2.

From the results a progressive increase in grain yield is observed with each higher level of fertilizer. The increase is higher during first crop than in the second crop season.

The yield increase in grain from zero to 100 per cent of the fertilizer was 33.0 and 24.3 per cent in first and second crop seasons, respectivlely. The grain yield increase from zero to 50 per cent of the recommended dose of fertilizer was as low as 14.5 per cent in the first crop and still lower i.e., 8.5 per cent in the second crop. Further, the reasonably good grain and straw yield at zero level 2.77 and 2.96 t/ha respectively in the first crop and 2.31 and 2.53 t/ha respectively in the second crop highlights the adaptability of the variety under low levels of fertility. This is very important from the view point of poor and marginal farmers as they cannot afford the high cost of fertilizer application. Under such situations, a variety like IR 42 which can give reasonalbly good yield without fertilizer application is most welcome. Further, the linear response as observed from the response curve shows that this variety can respond to even higher doses beyond the recommended level of 90 kg N, 45 kg P_2O_5 and 45 kg K_2O/ha. Thus it is evident that IR 42 has the built-in ability to exploit both low and high fertility situations.

It is observed that when the plant population is increased from 25 to 100 hills/m^2, the grain yield tends to increase up to 33 hills/m^2 and thereafter declines, at all the fertilizer levels. But at full dose of fertilizer, 25 hills/m^2 gave yield comparable with that of 33 hills/m^2 indicating that the former is sufficient at the highest level of fertility. Since yield response is more with 33 hills/m^2 at lower fertilizer levels, it is advantageous to adopt the above plant population as fertilizer input is costlier than seedlings.

From the economics of fertilizer aplication (Table 5) it can be seen that highest net return of Rs 6913 and Rs 3890 are obtained from the combination of full dose of fertilizer with a plant population of 33 hills/m^2 in the first crop and second crop seasons, respectively. The benefit cost ratio is also high (2.15 in the first crop and 1.65 in the second crop) in the above combination. The return per rupee invested on fertilizer is more (Rs 12.76) at 50 per cent of the fertilizer dose with a plant population of 33 hills/m^2 in the first crop as against 25 hills/m^2 in the second crop. This might be because of the fact that during the first crop the higher plant population together with longer duration of the crop gave more grain and straw yields and thereby higher gross return eventually increasing the return per rupee invested

Table 1. Grain yield (kg/ha) as influenced by fertilizer and plant population (Pooled data for I crop 1982 & 1983)

Fertilizer levels (% of recommended dose)	Plant population (hills/m²)						Mean
	S_1 (25)	S_2 (33)	S_3 (50)	S_4 (100)	S_5 (44)	S_6 (66)	
F_0 - 0	2817	2959	2844	2515	2886	2628	2775
F_1 - 50	3331	3657	3127	2718	3242	2991	3178
F_2 - 75	3730	3781	3489	2873	3539	3440	3475
F_3 - 100	4056	4249	3801	3121	3945	3931	3850
Mean	3484	3662	3315	2807	3403	3247	

	CD (0.05)	SEm
For F	125.2	40.6
For S	115.0	37.3
For S at the same F levels	230.0	
For F at the same or different S levels	244.5	

Table 2. Grain yield (kg/ha) as influenced by treatments (Pooled data for II crop 1982 & 1983)

Fertilizer levels (% of recommended dose)	Plant population (hills/m²)						Mean
	S_1 (25)	S_2 (33)	S_3 (50)	S_4 (100)	S_5 (44)	S_6 (66)	
F_0 - 0	2499	2354	2461	1990	2408	2185	2316
F_1 - 0	2472	2727	2654	2138	2510	2318	2515
F_2 - 75	2925	3039	2766	2245	2665	2410	2675
F_3 -100	3079	3205	2966	2509	2936	2582	2879
Mean	2811	2831	2712	2221	2630	2374	

	CD (0.05)	SEm
For F	44.3	, 31.6
For S	75.2	55.9
For S at the same level of F	150.4	
For F at the same or different levels of S	144.3	

Table 3. Straw yield (kg/ha) as influenced by fertilizer and plant population (Pooled data for I crop 1982 & 1983)

Fertilizer levels (% of recommended dose)	Plant population (hills/m^2)						Mean
	S_1 (25)	S_2 (33)	S_3 (50)	S_4 (100)	S_5 (44)	S_6 (66)	
F_0 - 0	2939	3090	3101	2745	3063	2827	2961
F_1 - 50	3575	3848	3323	2964	3388	3208	3384
F_2 - 75	3947	3952	3747	3079	3757	3604	3681
F_3 -100	4181	4396	3968	3313	4097	4086	4007
Mean	3661	3821	3535	3025	3576	3431	

	CD (0.05)	SEm
For F	107.0	34.7
For S	108.6	35.2
For S at same F levels	217.3	
For F at same or different s levels	225.4	

Table 4. Straw yield (kg/ha) as influenced by treatments (Pooled data for II crop 1982 & 1983)

Fertilizer levels (% of recommended dose)	Plant population (hills/m^2)						Mean
	S_1 (25)	S_2 (33)	S_3 (50)	S_4 (100)	S_5 (44)	S_6 (66)	
F_0 - 0	2631	2563	2623	2230	2693	2464	2534
F_1 - 50	3019	2957	2872	2451	2759	2624	2780
F_2 - 75	3159	3291	3006	2567	2919	2686	2938
F_3 -100	3316	3461	3271	2743	3234	2865	3148
Mean	3031	3068	2943	2498	2901	2660	

	CD (0.05)	SEm
For F	82.6	26.8
For S	76.3	24.7
For S at same F levels	152.6	
For F at same or different S levels	162.0	

Table 5. Economics of fertilizer application

	Treatments	Seasons	Net returns Rs/ha	Benefit cost ratio	Fertilizer response	Return per rupee invested on fertilizer
1.	F_0S_1	I Crop	3670	1.75	-	-
		II Crop	2726	1.56	-	-
2.	F_0S_2	I Crop	3858	1.75	-	-
		II Crop	2121	1.41	-	-
3.	F_0S_3	I Crop	3517	1.67	-	-
		II Crop	2280	1.43	-	-
4.	F_1S_1	I Crop	4936	1.93	5.71	11.43
		II Crop	3202	1.60	2.70	7.76
5.	F_1S_2	I Crop	5564	1.99	7.75	12.76
		II Crop	2813	1.50	4.14	6.95
6.	F_1S_3	I Crop	3858	1.67	3.15	7.16
		II Crop	2499	1.44	2.36	4.28
7.	F_2S_1	I Crop	5857	2.06	6.67	9.71
		II Crop	3459	1.62	3.15	6.15
8.	F_2S_2	I Crop	5719	1.90	6.09	9.51
		II Crop	3572	1.62	5.07	6.32
9.	F_2S_3	1 Crop	4809	1.81	4.79	6.17
		II Crop	2618	1.44	2.26	2.90
10.	F_3S_1	I Crop	6519	2.13	6.88	8.84
		II Crop	3700	1.64	3.22	5.25
11.	F_3S_2	I Crop	6913	2.16	7.11	8.93
		II Crop	3809	1.65	4.72	5.46
12.	F_3S_3	1 Crop	5466	1.90	5.32	5.28
		II Crop	3099	1.51	2.81	2.56

Price of grain Rs 3/kg Price of straw Rs 1/kg

on fertilizer. But during the second crop season the yield itself was low. Further, the additional cost involved in planting 33 hills as against 25 hills/m^2 has resulted in reducing the return per rupee invested on fertilizer in the combination of 50 per cent of the fertilizer dose with 33 hills/m^2 than with 25 hills/m^2.

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