Indian Journal of Agronomy **45** (2) : 304–308 (June 2000)

Effect of row spacing and nitrogen level on growth, yield and seed quality of scented rice (*Oryza sativa*) under transplanted conditions

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Received : August 1999

ABSTRACT

A field experiment was conducted during the rainy season of 1994 and 1995 at Karnal, Haryana, to study the effect of row spacing and nitrogen levels on growth, seed yield and seed quality of 'Pusa Basmati 1' scented rice (*Oryza sativa* L.). Row spacing did not influence yield attributes, seed and straw yields. Significant linear increase in seed yield was recorded up to 80 kg N/ha and thereafter a marginal reduction in seed yield was observed at 120 kg N/ha. However, straw yield increased up to the highest level of N. Seed quality in terms of germination was neither affected by row spacing nor by N levels. The response of seed yield to N levels was quadratic. The maximum response was observed at 40 kg N/ha and thereafter it decreased with the increase in N level. The optimum economic dose of N was worked out to be 98.5 kg/ha with additional profit of Rs 8,075/ha.

Key words : Spacing, Nitrogen, Seed yield, Germination, Economics

The future of the Indian foreign-exchange earning may largely be secured through export of scented rice varieties (Dwivedi, 1997). Rice variety 'Pusa Basmati 1' has been widely cultivated in Haryana and is being exported to Gulf countries. Good-quality seed is the basic input for the production of any crop. For getting higher yield and quality of seed maintenance of adequate plant density and nitrogen fertilizer are the most important agronomic factors.

Since information on these agronomic aspects of the seed crop of 'Pusa Basmati 1' rice is meagre, an attempt was made to access their effect on seed yield and its quality.

MATERIALS AND METHODS

The field experiment was conducted during the rainy (*kharif*) season of 1994 and 1995 at the Seed Production Farm of Regional Station, Indian Agricultural Research Institute, Karnal. The soil of the experimental area was clay loam in texture, having pH 7.9, organic carbon 0.45%,

electrical conductivity 0.31 m mhos/cm and 130, 29 and 310 kg/ha available N, P and K respectively. The treatments comprised 3 row spacings (15 cm ×15 cm, and 20 cm × 5 cm and 30 cm × 15 cm and 4 nitrogen levels (0, 40,80 and 120 kg/ha).

The experiment was laid out in split-plot design, keeping the row spacings in the main plot and the nitrogen levels in subplots, using 4 replications. Seedlings of 35 days old 'Pusa Basmati 1' rice were transplanted keeping 1 seedling/hill on 7 and 9 July in 1994 and 1995 under puddled conditions. Phosphorus, potash and zinc sulphate @ 40 and 30 kg and 25 kg/ha were applied at the last puddling operation. Nitrogen as per treatment was top-dressed at 15 and 30 days after transplanting. Roguing was done to bring the seed plot to seed-certification standards.

RESULTS AND DISCUSSION

Yield-arrtibuting characters and seed yield

Row spacing : The yield-attributing characters like plant height, seed weight/ panicle, length of panicle and 1,000-seed weight could not reach the level of significance due to different spacings. Wider spacing of 20 cm × 15 cm and 30 cm × 15 cm, recorded significantly higher number of paincles/plant than the narrower spacing of 15 cm × 15 cm, which may be due to more space and nutrients available for the individual plant. The seed and straw yields were not significantly different due to different spacings. The results confirm the findings of Shah *et al.* (1991) in transplanted rice under late-sown condition and of Balasubramaiam and Palaniappan (1991) in lowland rice.

Nitrogen : Increasing levels of N from 0 to 80 kg/ha significantly increased the plant height and seed weight/panicle (Table 1). Application of N @ 80 or 120 kg/ha improved all the yield-attributing characters compared with the control. Incremental doses of N increased the number of panicles/plant and recorded maximum panicles/plant at 120 kg N/ha in 1994 and 1995 respectively. Seed weight/panicle increased significantly up to 80 kg N/ha and declined at the highest dose. Dwivedi (1997) and Behra (1998) also reported significant increase in plant height, number of panicles/plant and seed weight/panicle due to nitrogen. Pancle length and 1,000-seed weight remained unaffected due to N. Our findings confirm the results of Murty *et al.* (1992), who reported no variation in seed weight between the levels, indicating neglible influnece of N on seed-filling in medium-duration rice.

Nitrogen had marked effect on seed yield. Seed yield increased significantly with increase in N up to 80 kg/ha in both the years and further increase in N reduced the yield marginally (Table 2). Significantly higher yield at 80 kg/ha was obtained, might be owing to better N uptake leading to greater dry-matter production and its translocation to the sink (Dalal and Dixit, 1987). Increased panicles/ plant and seed weight/panicle were mainly responsible for the increased yield at this level of N. The straw yield also significantly increased with increasing level of N during both the years. Vigorous growth (plant height) with increase in N level resulted higher straw yield. Similar

Table 1. Effect of row spacing and nitrogen level on growth and yield attributes of rice

Treatment	Plant height (cm)		Panicles/ plant		Seed weight/ panicle (g)		Panicle length (cm)		1,000-seed weight (g)	
	1994	1995	1994	1995	1994	1995	1994	1995	1994	1995
Row spacing (cm×cm)										
15 × 15	82.6	89.7	9.8	11.8	3.38	3.37	28.27	30.53	22.10	21.92
20 × 15	84.6	89.9	13.3	15.1	3.60	3.40	28.25	30.68	22.08	21.90
30 × 15	86.6	91.7	14.1	16.3	3.43	3.48	28.67	30.95	22.25	21.72
CD (P = 0.05)	NS	NS	2.72	2.24	NS	NS	NS	NS	NS	NS
N (kg/ha)										
0	73.8	82.2	10.0	11.4	318	3.17	28.10	30.04	22.15	21.92
40	81.5	89.9	11.5	13.1	3.39	3.31	28.35	30.90	22.19	21.70
80	87.4	93.7	13.8	16.5	3.74	3.70	28.96	31.2	22.31	22.01
120	88.3	94.2	14.3	16.8	3.57	3.48	28.65	30.90	22.28	21.93
CD (P = 0.05)	2.69	1.96	1.95	2.0	0.32	0.28	NS	NS	NS	NS

findings were reported by Thakur (1989).

Germination

The differences in germination due to different spacings and nitrogen levels of resultant seed was not statistically significant (Table 2). Saibabu *et al.* (1984) also reported that N levels failed to exert significant influence on seed germination. The seedling length of the germinated seed (data not reported) was also not affected by spacing and N levels which may be due to non-significant difference in 1,000-seed weight.

Economics of nitrogen fertilization

Relationship between the seed yield and the nitrogen levels was quadratic. The optimum economic dose of N for seed crop of 'Pusa Basmati 1' was 95.8 kg/ha. At this

Table 2. Seed yield and quality as affected by row spacing and nitrogen level

Treatment	Seed yield (q/ha)		Straw yield (q/ha)		Germination (%)	
	1994	1995	1994	1995	1994	1995
Row spacing (cm×cm)						
15 × 15	32.58	35.45	54.88	60.34	87.9	89.2
20 × 15	34.06	36.18	55.10	59.79	88.6	89.6
30 × 15	34.3	36.87	56.88	60.87	88.1	90.0
CD (P = 0.05)	NS	NS	NS	NS	NS	NS
N (kg/ha)						
0	29.80	31.83	45.73	53.70	88.3	89.5
40	32.2	34.10	49.81	56.38	88.0	90.1
80	37.4	40.50	59.00	63.47	88.6	90.4
120	35.2	38.25	62.40	67.77	88.3	90.0
CD (P = 0.05)	4.04	4.45	6.34	9.61	NS	NS

Table 3. Economics of nitrogen fertilization on the basis of optimum yield (average data of 2 years)

Treatment (N kg/ha)	Optimum yield* (q/ha)	Difference in yield over control (q/ha)	Value of increased yield (Rs/ha)	Cost of N fertilizer	Response of rice (seed/kg N)	Additional return over control (Rs/ha)
0	31.00					
40	35.59	4.59	5,508	288	11.48	5,220
80	37.97	6.97	8,364	576	8.71	7,788
120	38.13	7.13	8,556	864	5.94	7,692
Optimum dose						
98.5	38.32	7.32	8,784	709	7.43	8,075

*Optimum yield was calculated from the quadratic equation : $3100.1 + 14.26\ N - .0693\ N^2$; Cost of seed, Rs 12/kg; cost of N, Rs 7.20/kg

level, the yield of rice was 7.32 q more than that of the control. The mean response of seed yield to N was highest at 40 kg N/ha and it reduced with the increase in the level of N (Table 3). However, maximum additional profit (Rs 8,075/ha) was recorded at the optimum level of N. Behra (1998) also obtained quadratic response to N and reported 107.9 kg/ha the optimum economic dose of N for grain crop of 'Pusa Basmati 1'.

Though seed certification standard with regard to germination (80%) can be met at any nitrogen level, to achieve the maximum yield the crop should be fertilized with 98.5 kg N/ha to get maximum economic returns under Karnal conditions.

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