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Effect of different levels of nitrogen and different spacing on performance of transplanted Basmati Rice (Oryza sativa L.)

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Abstract
An experiment was conducted to study the effect of different nitrogen levels (90,120 & 150 kg ha) combined with different spacing (15 x 15 cm, 20 x 20 cm & 30 x 30 cm). The experiment was conducted during the 2021& 2022 cropping season. Treatment S2N3, where 150 Kg Nha-1 20 x 20 cm row and maximum plant height for planting (79.07 cm), tillers m. -2 (594), panicle length (25.40cm), number of grains per panicle-1 (132.97), grain yield (5461.03 kg ha-1), straw yield (9662.03 kg ha-1) and sterility % age (5.7 %). All these parameters were statistically similar to S1N3 treatment (15 x 15 cm spacing with 150 Kg N ha-1) except panicle length. Statistically lowest values of all these parameters except panicle length, 1000 grain weight & sterility % were recorded under S1N1 (15cm spacing with 90 Kg N ha-1) and S3N1 (30 x 30 cm spacing with 120 Kg N ha-1) treatments. age There was no significant difference in harvesting index among all treatments.
Keywords: *Oryzasativa,spacing,Nitrogenlevels,paddyyield.*

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I. Introduction

Rice (Oryza sativa L.) is one of the most important cereal crops in the world and is a staple food in South-East Asia and more than half of the world's population depends on this crop (Tahir et al., 2007). India is the second largest producer of rice in the world after China. In 2021-2022, rice was grown in 43 .79 million litters ion out of a production of 116.42 million tonnes (FAOSTAT,2020). As the majority of soils are deficient in this nutrient, the crop requires large amounts of fertilizer especially nitrogen. Furthermore, different duration rice differs in applied nitrogen.

Nitrogen absorbed by rice during the vegetative growth stages contributed in growth during reproduction and grain-filling through translocation (Bufogle et al., 1997; Norman et al., 1992). Nitrogen is very essential for the growth and development of crops. It enhances biomass and seed yield subject to the efficient water supply. Lack of N results stunted growth, pale yellow colour, small grain size and poor vegetative as well as reproductive performance. Nitrogen is an essential component of amino acid and related protein of the plant structure. Growth of plants primarily depends on nitrogen availability in soil solution and its utilization by crop plants during growth and development. Dry matter production and its conversion to economic yield is a cumulative effect of various physiological processes occurring during the plant life cycle. An increase in yield of cereals with increasing rate of nitrogen has been reported earlier (Khan et al. 1994). However, it needs to be explored to determine the desired quantity of nitrogen fertilizer for boosting seed yield per unit area avoiding increase in the cost of production through optimizing the N supply of every newly evolved variety.

Light attenuation in row crops, such as rice, is influenced by canopy architecture, which has to be defined in terms of the size, shape orientation of shoot components and spacing. Cultural practices that improve the efficiency of light interception affect canopy architecture by modifying such components. (Booteand Loomis, 1991). Keepingin view the importance of N supply in relation to spacing, the present study was designed to find the response of N levels in relation to row spacing on dry matter (DM) production, kernel yield and sterility % age. Basmati is a hard stemmed, medium grain rice variety for its better productivity in this region.

II. Materials And Methods

This experiment was conducted to study the effect of different nitrogen levels combined with different spacing on the performance of rice variety Basmati. Three row spacings (15 x 15 cm, 20 x 20 cm, & 30 x 30 cm) and three nitrogen levels (90,120 & 150 kg ha- 1) were studied. The experiment was conducted during the 2021 and 2022 cropping season. The experiment was designed in split plot arrangements under a randomized

complete block design using three replications. The nursery was sown on 5th June and planted on 5th July. Plot size is 6m x 4m. The following treatments were studied during the experiment.
Factor A main plots (Spacing):
S1 = 15x 15cm
S2= 20 x 20 cm
S3 = 30 x 30 cm

Factor B sub plots (N levels):
N1 = 90 kg ha-1
N2 = 120 kg ha-1
N3 =150 kg ha-1

All farming practices were kept standard except for nitrogen levels and differentspacing. Nitrogen is divided into three parts, ie during exchange; 25 days and 45 days after planting. Recommended doses of phosphorus and potassium were used basally during transplantation.

The following observation were recorded during the course of study, Plant height (cm), Tillers m^{-2}, Panicle length (cm), No of grains $panicl^{-1}$, Thousand (1000) grain weight (g), Harvest Index, Sterility %age, Grain yield (kg ha^{-1}) and Straw yield (kg ha^{-1}). Data on fertile tillers m^{-2} were counted at the time of harvesting using a meter square placed randomly at 3 times in each sub plot in different locations. Height of 9 plants at random from each plot was recorded at maturity for the calculation of average plant height. Measurements were taken in cm from the soil surface to the tip of the panicle. Nine panicles at random were collected from each sub plot. Filled and unfilled grains were counted and sterility percentage was calculated. The panicles harvested from the selected plants were used for panicle length. The grains counted from selected plants at random were used for number of grains per panicle. One thousand grains were taken randomly from each sub plot and their weight (g) was recorded. For grain and straw yield (kg ha^{-1}) three samples of 10meter square area harvested at random from each sub plot were selected. Their grain and straw yield was weighed and converted into grain and straw yield (Kg per hectare). Data recorded were statistically analyzed through a computer software M stat C for RCBD with split plot arrangement and LSD test applied to signify the treatment differences (P <_0.05) (Steel et al.1997).

III. Results and Discussion

Plant height (cm): It is obvious from the results (Table- 1) that there were significant differences among various treatments under test. Maximum plant height (80 cm,79.07 cm and 78.83 cm) were produced by the treatments S_1N_3 (15 x 15 cm spacing &90 kg ha^{-1}), S_2N_3 (20 x 20 cm spacing & 150 kg ha^{-1}) and S_3N_3 (30 x 30 cm-150 kg ha^{-1}), respectively which was statistically at par with each other. The other treatments produced significantly lower plant height. It is evident from the results that plant height increases with the increasing level of N from 90- 150 Kg ha^{-1} irrespective of spacing. Singh and Sharma (1987) reported that application of 180 Kg N/ha resulted in higher plant height of rice. Meena *et al*. (2003) also reported similar results. The increase in plant height with increased N application irrespective of spacing might be primarily due to enhanced vegetative growth with more nitrogen supply to plant.

1000-Grain weight: The 1000-grain weight was affected significantly with row spacing and different nitrogen levels. Maximum 1000-grain weight (25.40 g) was obtained in case of treatment S_2N_3 (20 x 20 cm spacing with 150 kg N ha^{-1}). The other treatments produced significantly lower 1000-grain weight with increasing level of N upto150 Kg ha^{-1}. When there are more spacing there will be more air, light and inputs availability. Owing to this reason 1000 grain weight was maximums at 20 x 20 cm & 30 x 30 cm spacing as compared to 15 x 15 cm spacing. Similar finding havebeen reported by Bhowmickand Nayak (2000) and Rafey*et al.* (1989). Increase in grain weight at higher nitrogen rates might be primarily due to increase in chlorophyll content of leaves which led to higher photosynthetic rate and ultimately plenty of photosynthates available during grain development.

Table-1. YieldandyieldTraitsasaffectedbydifferentrow spacing and nitrogen levels

Treatments	PlantHeight(cm)	Tillersm^{-2}	Paniclelength(cm)	Noofgrainspanicle^{-1}	1000grainWeight(g)
S_1-N_1	69.43	527.00	23.03	119.43	70.93
S_1-N_2	75.60	560.98	22.67	127.87	67.87
S_1-N_3	80.00	601.00	23.10	131.13	66.93
S_2-N_1	71.40	540.10	22.87	120.30	72.23
S_2-N_2	77.33	552.90	23.90	126.73	71.17
S_2-N_3	79.07	594.30	25.40	132.97	69.23
S_3-N_1	70.80	541.47	23.60	117.27	68.60
S_3-N_2	75.17	555.00	23.90	123.20	69.13
S_3-N_3	78.83	588.17	23.73	129.57	67.73
LSDValue	1.410	18.23	0.7248	1.928	3.559

*Differences intreatmentmeanswith sameletterarestatisticallynon-significant.WhereasS1(15 x 15cm),S2 (20 x 20 cm)&S3(30 x 30 cm)arethreelevelsofrowspacing&N1(90kgha-1),N2(120kgha-1)&N3(150kgha-1) arethreelevelsofnitrogenapplied

Fertile tillers m-2: Spacing and nitrogen levels significantly affected number of tillers m-2. Maximum No. of tillers m-2 were produced in case of treatments S1N3 (601) S2N3 (594.30) and S3N3 (588.17) which were statistically at par with each other. The other treatments produced significantly lesser number of tillers m-2. The reason is that when there were more plant m-2, automatically tillers will be more per m-2 & this was increases with the increasing level of N as is evident from the results (Table-1). It is evident from the result that maximum level of N (150Kg ha-1) produced maximum tiller irrespective of spacing. These results are in line with those reported by Nawaz (2002) and Meena et al. (2003). Enhanced tillering by increased nitrogen application might be attributed to more nitrogen supply to plant at active tillering stage.

No. of grain panicle-1 : The data (Table-1) indicated that there was significant difference among treatments under test. Maximum number of grains panicle-1 was produced in case of treatment S2N3 (132.97) which were statistically at par with S1N3 (131.13). The other treatments produced significantly lesser number of grains panicle-1. Minimum No of grain panicle-1 (117.27) were produced under the treatment S3N1.

Table-2YieldandyieldTraitsasaffectedbydifferentrowspacing andnitrogen levels

TreatmentsHarvesting Index	Sterility %age	Grain Yield ($Kgha^{-1}$)	Straw Yield ($Kgha^{-1}$)
S_1-N_1	35.276.400	4461.27	8186.63
S_1-N_2	34.807.400	4866.37	9115.82
S_1-N_3	34.966.300	5274.93	9812.80
S_2-N_1	35.925.900	4688.87	8366.40
S_2-N_2	34.855.767	4976.47	9303.33
S_2-N_3	36.115.700	5461.03	9662.03
S-N	35.638.333	4354.60	7867.27
S_3-N_2	35.018.333	4727.07	8773.43
S_3-N_3	35.117.300	5163.20	9541.33
LSD Value	– 0.6260	251.7	652.0

Harvesting Index: Data in Table-2 revealed that this trait exhibited non-significant differences among spacing and nitrogen levels. However, maximum value (36.11)was achieved in the treatments S_2N_3. The reason wasthat when we planted rice plant at proper spacing, therewere more tillers per plant. When there were more plantsm^{-2}, automatically tillers will be more per m^2 and thisincreases with the increasing level of N as is evident fromtheresults(Table-2).

Sterility percentage: Data (Table-2) indicated significant differences among the treatments. Maximum sterility (8.333%) was recorded in the treatments S3N1 and S3N2. The least sterility (5.7%) was noted in the treatment S2N3. The reason of maximum sterility %age at wider spacing is that there were more tertiary tillers, which bear late flowering. Among them some were fertilized & majority was non fertilized due to lowering temperature and weak tiller.

Grain yield: The results (Table 2) indicated that paddy yield was significantly affected by row spacing and nitrogen levels.Maximum paddy yield (5461.03 kg ha-1)was obtained in case of treatment S2N3 (20 x 20 cm spacing with 150 kg N ha-1) followed by the treatment S1N3 (15 x 15 cm spacing with 150 kg N ha-1) which yielded 5274.93 kg ha-1and was at par with each other. All the other treatments produced significantly lower yield. The lowest paddy yield (4354.50 kg ha-1) was observed by the treatment S3N1 (30 x 30 cm spacing with 90 kg N ha-1). The reason is that at standard & closer spacing, there were more primary & secondary tillers than tertiary tillers as compared to rice planting at 30 x 30 cm spacing.

Straw Yield: It is obvious from the data (Table 2) that maximum straw yield (9662.03 kg ha-1) was achieved in case of treatment S2N3 (20 x 20 cm -156 kg N/ha) followed by the treatment S1 N3 (15 x 15 cm spacing with 150 kg N ha-1) which produced 9612.80 kg ha-1 and were at par with each other. The other treatments produced significantly lower straw yield. Similar finding have been reported by **Bhowmick and Nayak (2000).**Gunri, and Chaudhury (2004) who reported that closer spacing (15cm x 15 cm) proved better in straw yield of rice and nitrogen use efficiency and N uptake was better than the wider row spacing.

Conclusion: It can be concluded that the use of nitrogen fertilizers provides a great opportunity to obtain higher yield in rice. Good yield of Basmati can be achieved by applying 150 kg N ha-1 in row to row and plant spacing of 20 x 20 cm.

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