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Effect of nitrogen levels on growth and yield of basmati rice varieties

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Abstract
A field experiment was conducted during kharif season (2020) at Crop Research Farm, Department of Agronomy, SHUATS, Allahabad (U.P.). The soil of experimental plot was sandy loam in texture, nearly natural in soil reaction (pH 7.1), low in organic carbon (0.28%), available N (225 kg/ha), available P (19.50 kg/ha) and available9 K (213.7 kg/ha). The Treatments consisted of 3 levels of Nitrogen N_1 (90 kg/ha), N_2 (100 kg/ha), N_3 (110 kg/ha) and 3 different varieties (Basmati 1121), (Basmati 1718) and (Pusa basmati-1). The experiment was laid out in Randomized Block Design with 9 treatments and replicated thrice. The results revealed that the application of Nitrogen 110 kg/ha + basmati 1121 recorded maximum plant height (73.00 cm), Number of tillers/hill (15.20), plant dry weight (22.14 g/hill), panicle length (31.93 cm), number of panicle per meter (565.90), number of panicle per hill (9.80), number of filled grains per panicle (141.90), number of grains per panicle (197.20), test weight (29.30), grain yield (2.56 t/ha), straw yield (4.78 t/ha) and harvest index was found to be non-significant. Maximum Gross retunes (125722 INR/ha), Net retunes (59522.10 INR/ha) and B:C ratio (1.76) where also recorded with the treatment with the application of Nitrogen 110 kg/ha + basmati 1121.

Keywords: Nitrogen, growth, yield, basmati 1121, basmati 1718 and Pusa basmati-1

1. Introduction
Rice (Oryza sativa L.) is principal food crop of South India and South Eastern countries and supports nearly one half of the world population. It, being the staple food for more than two third of the Indian population, holds the key for food security and plays a pivotal role in national economy. Basmati occupies a prime position in Indian culture, not only for its superior organoleptic qualities, but also as an auspicious food. India had an immense wealth of aromatic rice, much of which has been lost during the last three decades in the aftermath of the Green Revolution, where emphasis was on yield rather than quality. Basmati (bas means aroma, Mati means queen) is popular not only throughout Asia but also in Europe and the United States. Basmati rice is traditionally associated with Himalayan foothills with India and Pakistan producing 70 and 30 per cent respectively, of the total Basmati rice of the world (Bligh 2000) [2]. Upon cooking/ cooked Basmati rice is characterized by extra-long, super-fine, slender grains with chalky endosperm and a shape comparable with a Turkish dagger; pleasant and exquisite aroma, sweet taste, dry and soft texture, delicate curvature; medium to low gelatinization temperature and one and a half to two-fold length-wise elongation, with least breadth-wise expansion and tenderness (Siddiq *et al*. 1997) [8]. Basmati rice responds differently to N application as compared to non-basmati rice. Most of the basmati rice cultivars are susceptible to disease and insect-pest attack, and more prone to lodging. Therefore, nitrogen requirement of basmati rice is quite low and excessive use of N adversely affects the crop yield. To achieve high yield and to improve quality, N is a major factor considered in all types of environment. Low N may not lead to realization of maximum yield potential and high N may lead to lodging, increased incidence of insect pest attack and lower quality. One major consequence of inadequate N is reduced leaf area, thereby, limiting light interception, photosynthesis and finally biomass growth, grain yield and water productivity (Sinclair 1990). In last decade, IARI New Delhi has developed and released basmati type varieties such as Pusa Basmati 1121. These varieties have also been released and recommended by PAU Ludhiana for Punjab state as Pusa Basmati 1121. These varieties have quite high yield as compared to tadeonal basmati varieties. It is quite obvious to achieve full yield potential of these varieties, nitrogen requirement may be greater than traditional basmati varieties. Therefore, it is necessary to know the optimum rate of N application, as well as its influence on components of yield and growth parameters of high yielding basmati varieties. Keeping these

facts/observations in view, present experiment entitled Influence of nitrogen application on the yield and yield parameters of different cultivars of basmati rice was conducted.

Materials and Methods

The experiment was conducted during *Rabi* season of 2020-2021. The experiment was conducted in Randomized Block Design consisting of nine treatment combinations with three replications and was laid out with the different treatments allocated randomly in each replication. The soil of the experimental field was sandy loam in texture, slightly alkaline reaction (pH 7.1) with low level of organic carbon (0.28%), available N (225 Kg/ha), P (19.50 kg/ha) and higher level of K (92.00 kg/ha). The treatment combinations are T_1 -Nitrogen 90 kg/ha + basmati 1121, T_2 - Nitrogen 90 kg/ha + basmati 1718, T_3 - Nitrogen 90 kg/ha + pusa basmati-1, T_4 - Nitrogen 100 kg/ha + basmati 1121, T_5 - Nitrogen 100 kg/ha + basmati 1718, T_6 - Nitrogen 100 kg/ha + pusa basmati -1, T_7 - Nitrogen 100 kg/ha + basmati 1121, T_8 - Nitrogen 110 kg/ha + basmati 1718, T_9 - Nitrogen 110 kg/ha + pusa basmati-1. The observations were recorded on different growth parameters at harvest. The experimental data analysed statistically by applying the technique of analysis of variance (ANOVA) prescribed for the design to test the significance of overall difference among treatments by the F test and conclusion were drawn at 5% probability level. Economics of treatments was also worked out (Gomez and Gomez, 1984).

Results and Discussions

Data pertaining to growth parameters which is plant height (cm), number of tillers/plant, dry weight (g/plant) was recorded and tabulated in Table 1. The significantly maximum plant height was recorded with application of Nitrogen 110 kg/ha + Basmati 1121 (73.00 cm) which was significantly superior over all other treatments and statistically at par with treatment of Nitrogen 110 kg/ha + basmati 1718 (69.30) variety, while in case of number of tillers/hill (15.20) was recorded with application of Nitrogen 110 Kg/ha + basmati 1121 variety which is superior all over the treatments except Nitrogen 110 kg/ha + basmati 1718 (14.41) which was statically at par with application of Nitrogen 110 Kg/ha + basmati 1121 variety. Data related to plant dry weight was significantly increase by application of Nitrogen 110 kg/ha + basmati 1121 (22.14) which was significantly superior over all other treatments except with treatment of application of Nitrogen 110 kg/ha + basmati 1718 (21.35) which were statistically at par with treatment of application of Nitrogen 110 kg/ha + basmati 1121. Similar results were reported by Kumar and Mahajan (2014) [6].

Table 1: Growth attributes of Basmati rice varieties influenced by different nitrogen levels

Treatments	Plant height (cm) At Harvest	No. of tiller/hill At Harvest	Plant dry weight (g/hill) At Harvest
Nitrogen 90 kg/ha + Basmati 1121	59.80	12.30	18.78
Nitrogen 90 kg/ha + Basmati 1718	56.00	11.70	18.00
Nitrogen 90 kg/ha + Pusa Basmati-1	51.70	11.30	17.41
Nitrogen 100 kg/ha + Basmati 1121	66.20	13.90	20.10
Nitrogen 100 kg/ha + Basmati 1718	67.30	14.20	20.27
Nitrogen 90 kg/ha + Pusa Basmati-1	62.80	12.50	19.24
Nitrogen 110 kg/ha + Basmati 1121	73.00	15.20	22.14
Nitrogen 110 kg/ha + Basmati 1718	69.30	14.40	21.35
Nitrogen 110 kg/ha + PusaBasmati-1	65.20	13.50	19.77
SEm (±)	1.43	0.26	0.28
CD (P=0.05)	4.29	0.79	0.83

Yield Attributes

Panicle per meter, Panicle length, Number of grains per panicle, Number of filled grains per panicle and Test weight

The yield attributes of basmati rice was significantly influenced by rate of N application and varieties (Table 3). At Harvest, maximum number of panicle per meter with treatment with application of Nitrogen 110 kg/ha + basmati 1121 was recorded maximum number of panicle/m^2 (565.9) which was significantly superior over all other treatments except with the treatment of application of Nitrogen 110 kg/ha + basmati 1718 (538.7) which was statistically at par with the treatment with application of Nitrogen 110 kg/ha + basmati 1121 variety. The treatment with application of Nitrogen 110 kg/ha + basmati 1121 was recorded maximum panicle length (31.93 cm) was recorded significantly superior over all other treatments except with application of Nitrogen 110 kg/ha + basmati 1718 (31.31) which was statistically at par with the treatment with application of Nitrogen 110 kg/ha + basmati 1121 variety. The number of grains/panicle (197.2) was recorded significantly maximum with application of Nitrogen 110 kg/ha + basmati 1121 was recorded significantly superior over all other treatments except with application of Nitrogen 110 kg/ha + basmati 1171 which where statistically at par with the treatment with application of Nitrogen 110 kg/ha + basmati 1121. The number of filled grains/panicle 141.9) was recorded significantly maximum with application of Nitrogen 110 kg/ha + basmati 1121 was recorded significantly superior over all other treatments except with application of Nitrogen 110 kg/ha + basmati 1718 (129.6) which where statistically at par with the treatment with application of Nitrogen 110 kg/ha + basmati 1121. Treatment with application of Nitrogen 110 kg/ha + basmati 1121 was recorded maximum test weight (29.30 g) which was significantly superior over all other treatments except with the treatment of application of Nitrogen 110 kg/ ha +basmati 1718 (28.50 g) which were statistically at par with treatment with application of Nitrogen 110 kg/ha + basmati 1121.

Table 2: Yield attributes of Basmati rice varieties influenced by different nitrogen levels

Treatments	Panicle/m^2	Panicle length (cm)	Grains/Panicle (No.)	Filled Grains/Panicle (No.)	Test Weight (g)
Nitrogen 90 kg/ha + Basmati 1121	453.8	29.93	100.50	77.10	27.0
Nitrogen 90 kg/ha + Basmati 1718	427.9	29.47	92.80	74.50	26.7
Nitrogen 90 kg/ha + Pusa Basmati-1	385.0	29.00	88.50	70.10	26.0
Nitrogen 100 kg/ha + Basmati 1121	500.3	30.20	126.40	103.30	27.7
Nitrogen 100 kg/ha + Basmati 1718	515.2	30.80	166.30	122.30	28.0
Nitrogen 90 kg/ha + Pusa Basmati-1	480.0	30.00	103.50	83.90	27.0
Nitrogen 110 kg/ha + Basmati 1121	565.9	31.93	197.20	141.90	29.30
Nitrogen 110 kg/ha + Basmati 1718	538.7	31.31	176.10	129.60	28.50
Nitrogen 110 kg/ha + PusaBasmati-1	492.8	30.20	115.00	91.10	27.0
SEm (±)	14.53	0.22	9.11	6.30	0.27
CD (P=0.05)	43.55	0.66	27.30	18.88	0.81

Table 3: Yield of Basmati rice varieties influenced by different nitrogen levels

Treatments	Grain yield (t/ha)	Straw yield (t/ha)	Harvest index (%)
Nitrogen 90 kg/ha + Basmati 1121	2.28	4.25	34.3
Nitrogen 90 kg/ha + Basmati 1718	2.45	4.19	34.8
Nitrogen 90 kg/ha + Pusa Basmati-1	2.15	4.12	33.7
Nitrogen 100 kg/ha + Basmati 1121	2.47	4.55	34.6
Nitrogen 100 kg/ha + Basmati 1718	2.33	4.42	35.2
Nitrogen 90 kg/ha + Pusa Basmati-1	2.32	4.26	35.1
Nitrogen 110 kg/ha + Basmati 1121	2.56	4.78	35.3
Nitrogen 110 kg/ha + Basmati 1718	2.27	4.60	34.8
Nitrogen 110 kg/ha + PusaBasmati-1	2.17	4.35	34.9
SEm (±)	0.04	0.09	0.49
CD (P=0.05)	0.12	0.28	----

Yield

The grain yield of basmati rice was significantly influenced by rate of N application and varieties (Table 3). The treatments with the application of Nitrogen 110 kg/ha + basmati 1121, grain yield of rice is (2.56 t/ha) which was significantly superior all over treatments except with the treatment of application of Nitrogen 100 kg/ha + basmati 1121 (2.47 t/ha) and Nitrogen 90 kg/ha + basmati 1718 which was statistically at par with the treatment of application of Nitrogen 110 kg/ha + basmati 1121 variety. Treatment with application of Nitrogen 110 kg/ha + basmati 1121 was recorded maximum stover yield (4.78 t/ha) which was significantly superior over all other treatments and treatment with application of Nitrogen 100 kg/ha + basmati 1121 (4.55 t/ha) is statistically at par with the treatment with application of Nitrogen 110 kg/ha + basmati 1121. The highest harvest index was observed with application of Nitrogen 110 kg/ha + basmati 1121 (35.3) and minimum in treatment with application of nitrogen 90 kg/ha + pusa basmati -1. Similar results were observed by Gunri *et al*. (2004) [5].

Conclusion

On the basis of one season experimentation application Nitrogen 110 kg/ha + basmati 1121 was found more productive (2.56 t/ha) as well as economic (59522.10 INR/ha).

The conclusions drawn are based on one season data only which requires further confirmation for recommendation.

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