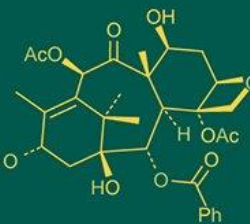
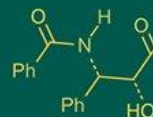
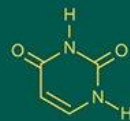


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Rahul Yadav

M.Sc. Scholar, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Uttar Pradesh, India

Vikram Singh

Professor, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Uttar Pradesh, India

Amit Kumar

Ph.D. Scholar, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Uttar Pradesh, India

Amit Raj

Ph.D. Scholar, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Uttar Pradesh, India

Corresponding Author:**Rahul Yadav**

M.Sc. Scholar, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Uttar Pradesh, India

Response of rice (*Oryza sativa*) varieties on varying nitrogen level

Rahul Yadav, Vikram Singh, Amit Kumar and Amit Raj

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Abstract

A field experiment was conducted at Crop Research Farm, Department of Agronomy, Naini Agriculture Institute, Sam Higginbottom Institute of Agriculture, Technology and Sciences, Prayagraj, UP, during the *Kharif* season of 2025. The experiment was laid out in Randomized Block Design with 10 treatments and were three replications which there were three Rice varieties viz., (*Pusa Basmati1121*, *Pusa Basmati1718* *Pusa Basmati1509*) and three levels of Nitrogen (80, 90, 100 kg N/ha) and were replicated thrice. Among the various treatment combinations with the application of Nitrogen 100 kg/ha recorded significantly higher plant height (102.44 cm) in *Pusa Basmati1121*, dry weight (83.21 g/hill) in *Pusa Basmati1509*, and grain yield (5.120 t/ha) and straw yield (13.23 t/ha) in *Pusa Basmati1718*. However, number of tillers per hill (26.73), number of effective tillers/hill (19.6), number of seed per panicle (92.17) and harvest index (38.78%) were recorded in *Pusa Basmati1718* variety with application of Nitrogen 100 kg/ha. Maximum test weight (31.84 g) was recorded in *Pusa Basmati 1718* with application of Nitrogen 100 kg/ha. Maximum gross returns (14,2836.67INR/ha), net returns (10,2046.67 INR/ha) and benefit cost ratio (2.50) were also recorded in *Pusa Basmati 1718* with application of Nitrogen 100 kg/ha.

Keywords: Pusa Basmati1121, Pusa Basmati1718, Nitrogen, Pusa Basmati1509, Yield

Introduction

Rice (*Oryza sativa* L.) is one of the most important cereal crops of the world and serves as the staple food for more than half of the global population. Presently, more than 90 per cent of the world's rice is produced and consumed in Asia. In India, rice is cultivated on about 48 million hectares with a production of about 149 million tonnes during 2024-25 (MoA&FW, 2025). The increasing population and changing food habits are expected to enhance the demand for rice in the coming years, thereby posing a challenge for sustainable rice production under shrinking natural resources (FAO, 2024).

In India, Basmati rice is primarily grown in the Indo-Gangetic region of north-western region comprising the seven states Punjab, Haryana, Himachal Pradesh, Uttarakhand, Jammu and Kathua districts of Jammu and Kashmir, and 27 districts of western Uttar Pradesh. This region has been earmarked as the Geographical Indication (GI) for Basmati rice and the GI status has been conferred to Basmati rice in 2016 (GI No. 145 of the Geographical Indication Registry, Government of India, vide certificate No. 238 dated 15.02.2016). India is the largest cultivator and exporter of Basmati rice, followed by Pakistan. Basmati rice from the Indian subcontinent is highly prized in the international market for its unique grain, cooking and eating quality

PB 1121 is a semi-dwarf rice variety with a plant height ranging from 110 to 120 cm. The allele for reduced plant height was derived from Taichung Native 1. It has a seed to seed maturity of 140-145 days in the Basmati growing regions of India. *PB 1121* has a yield potential of up to 5.5 tons per hectare. It can produce 18-20 tillers per plant at a spacing of 20 cm × 15 cm and around 350-400 panicles/m². It possesses well exerted long panicles, ranging from 26 to 28 cm. The number of filled grains per panicle ranges from 105 to 110 and the 1000-grain weight of the fully mature grains is 27.0-28.0 g (at 14% moisture). Since Basmati grains are extra-long and slender in appearance, they are prone to breakage during machine harvesting. Therefore, manual threshing in Basmati rice is preferred as it results in reduced broken grains, high head rice recovery and better price realization for farmers as compared to a machine harvested crop. *PB 1121* has easy Threshability, which is

advantageous for manual threshing by the farmers (Uday *et al.*, 2021) ^[17].

Pusa Basmati 1509, introduced in 2013, is an early-maturing variety with a shorter growth duration of 115 days, allowing farmers to save on irrigation and reduce the turnaround time between crops. It exhibits a semi-dwarf stature, reducing lodging risks, and achieves an average yield of 5 t/ha. Its early maturity and high yield make it a preferred choice among farmers in Basmati-growing regions (Singh *et al.* 2014) ^[15]

In terms of yield, *Pusa Basmati 1718* has a high production potential, usually producing about 45-55 quintals per hectare under good management practices. Compared with traditional basmati varieties, it offers a better balance between yield and grain quality. The grains are extra-long and slender, and after cooking they elongate significantly while remaining soft and fluffy (Yadav P *et al.*, 2021) ^[19].

Pusa Basmati 1718 is an improved basmati rice variety developed for higher yield, better grain quality, and resistance to major diseases. It was developed by the Indian Agricultural Research Institute (IARI), New Delhi, one of India's leading agricultural research institutions. This variety was released to provide farmers with a better alternative to older basmati varieties while maintaining the traditional aroma and grain quality that basmati rice is famous for good coking.

Pusa Basmati 1718 belongs to the basmati group of rice, which is widely known for its extra-long slender grains, pleasant aroma, and excellent cooking quality. It was developed as an improved version of the well-known *Pusa Basmati 1121*, which is one of the most popular basmati varieties grown in India. Although *Pusa Basmati 1121* had excellent grain quality, it was susceptible to certain diseases, especially bacterial leaf blight. To overcome this problem, scientists introduced disease resistance while maintaining the same grain characteristics and yield potential, resulting in the development of *Pusa Basmati 1718*.

Pusa Basmati 1718 is a semi-dwarf plant type, usually reaching a height of about 95-105 cm. The semi-dwarf nature of the plant helps reduce lodging, which means the crop is less likely to fall down due to strong winds or heavy rainfall. This makes the crop more stable and easier to harvest. The variety has a medium-long growth duration, generally taking about 135-140 days from sowing to maturity under normal growing conditions.

One of the most important features of *Pusa Basmati 1718* is its resistance to bacterial leaf blight (BLB), a serious disease that can significantly reduce rice yield. Because of this resistance, farmers can reduce crop losses and sometimes even lower their dependence on chemical pesticides. This characteristic makes the variety more sustainable and economical.

Materials and Methods

The experiment was carried out during *Kharif* season of 2025 at Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, SHUATS, Prayagraj, UP. to check the Response of Rice (*Oryza sativa*) Varieties on varying Nitrogen level L. grown under The experimental field's soil had a sandy loam texture, with a pH of 7.1, a low organic carbon content (0.391%), available nitrogen (178.48 kg/ha), available phosphorus (27.2 kg/ha), and available potassium (219.4 kg/ha). The study was designed using a Randomized Block Design featuring ten treatments and

three replications. The treatment combinations are as follows:

The Rice seedlings were transplanted at 26 days after germination in net plot area of 3m x 3m. Fertilizer was applied by broadcasting method to meet the recommended dosage of 90- 60 -60 N-P-K kg/ha.

The experiment was laid out in Randomized Block Design (RBD) with three replications and ten treatments. The experimental material consisted of three rice varieties namely *Pusa Basmati 1121*, *Pusa Basmati 1718* and *Pusa Basmati 1509*. Different nitrogen levels. Nitrogen 80 kg/ha, 90 kg/ha and 100 kg/ha, were applied through urea as per treatment combinations.

The experimental field was prepared by proper ploughing, puddling and leveling before transplanting. Healthy and uniform seedlings of rice were transplanted in puddled field at recommended spacing following standard agronomic practices. Nitrogen was applied in split doses at basal stage, active tillering stage and panicle initiation stage. Recommended doses of phosphorus and potassium were applied uniformly to all the plots as basal application through DAP and MOP respectively

The observation on growth parameters i.e. Plant height(cm), Number of tillers/hills, Plant dry weight (g), were recorded whereas yield attributing parameters i.e. Number of productive tillers/hill, Number of Seed/panicle, Test Weight(g), Grain yield (t/ha), Stover yield (t/ha) and Harvest Index (%). from the net plot area these observation were recorded. The seed and stover yield were taken for the net plot of 1m² and using this formula (economic yield /Biological yield) x 100 then calculate for 1 ha harvest index is calculated. The recorded data were analysed statically by ANOVA technique, and the significance of treatment differences was tested using the Critical Difference (CD) at a 5% probability level.

Result and Discussion

3.1 Growth parameters

Plant Height (cm)

At 100 DAT, significantly higher plant height (102.44 cm) was recorded with the application nitrogen 100 kg/ha *Pusa Basmati1121* variety whereas the application of nitrogen to *Pusa Basmati1121* variety at 90 kg N/ha (96.94 cm) and *Pusa Basmati1509* variety at 100 kg N/ha (92.74 cm) were found to be statistically at par with highest.

Significant response in plant height was recorded among varieties with different levels of nitrogen, whereas highest was recorded in *Pusa Basmati1121* variety which might be due to the varietal genetic make-up. The fact that due to the supply of nitrogen favours greater absorption of nutrients resulting in rapid expansion of foliage, better accumulation of photosynthates and eventually resulting in increased growth structure (Amrutha *et al.* (2016) ^[4]. Many studies states that supply of nitrogen upto a certain amount only rapidly effects the height in rice.

Number of Tillers/Hill

At 100 DAT, significantly higher number of tillers/hill (26.73) were recorded with the application of 100 kg N/ha to *Pusa Basmati1718* variety, whereas the application of 100 kg N/ha to *Pusa Basmati1509* variety (25.86) and 100 kg N/ha to *Pusa Basmati1121* variety (23.93) was found to be statistically at par with the highest

These results might be due to the differential response of tillering in the genotype could be attributed to its genetic potentiality. Reported that tillering rate was highly influenced by many environmental factors such as nutrient availability, soil water status, competition with weeds and diseases. A higher nitrogen supply might have favoured the conversion of carbohydrates to protein. In fact, nitrogen encouraged the plant foliage and boosted plant growth, also responsible for branching or tillering, leaf production (Arya *et al.*, 2019) ^[6]. Similar results were reported by Dangi *et al.* (2017) ^[8], Samant *et al.* (2015) ^[14] and Reddy *et al.* (2022) ^[13].

Plant Dry Weight (g/hill)

At 100 DAT, significantly higher dry weight (83.21 g) was recorded with the application of 100 kg N/ha in *Pusa Basmati1509* variety, 90kg/ha (77.06 g) whereas in *Pusa*

Basmati1718 variety with application of 100 kg N/ha (81.84 g) and in *Pusa Basmati1121* variety with 100 kg N/ha (82.13 g), 90kg/ha (75.74 g) were found to be statistically at par with the highest.

The significant increase in plant dry weight in different stages of growth of all the varieties due to the fact of nitrogen results increase in higher number of tillers, photosynthetic area, which leads to accumulation of dry matter. Jadon *et al.* (2015) ^[9] reported that increased rate of nitrogen improved overall growth of the crop in term of dry matter production per plant by virtue of its impact on morphological and photosynthetic components along with accumulation of nutrient. Samant *et al.* (2015) ^[14] reported that variation in the genetical variability among the varieties against growth characters as well as due to changing in the agro climatic conditions.

Table 1: Response of rice variety on varying nitrogen level on crop growth

S. No.	Treatment combinations	AT 100 DAT		
		Plant Height (cm)	Tillers/hill	Dry weight (g)
1.	<i>Pusa Basmati 1121</i> + Nitrogen 80 kg/ha	86.86	19.86	75.42
2.	<i>Pusa Basmati 1121</i> + Nitrogen 90 kg/ha	96.94	22.73	75.74
3.	<i>Pusa Basmati 1121</i> + Nitrogen 100 kg/ha	102.44	23.93	82.13
4.	<i>Pusa Basmati 1718</i> + Nitrogen 80 kg/ha	82.05	20.6	67.64
5.	<i>Pusa Basmati 1718</i> + Nitrogen 90 kg/ha	83.24	22.66	73.61
6.	<i>Pusa Basmati 1718</i> + Nitrogen 100 kg/ha	92.35	26.73	81.84
7.	<i>Pusa Basmati 1509</i> + Nitrogen 80 kg/ha	80.10	20.6	73.01
8.	<i>Pusa Basmati 1509</i> + Nitrogen 90 kg/ha	87.25	22.2	77.06
9.	<i>Pusa Basmati 1509</i> + Nitrogen 100 kg/ha	92.74	25.86	83.21
10.	Control (N-P-K 90-60-60 kg/ha)	81.45	21.93	73.60
	F-Test	S	S	S
	S. Em (±)	3.34	0.93	2.61
	C.D. (p=0.05)	9.92	2.83	7.76

3.2 Yield parameters

Number of effective tillers/hill

Significantly highest number of productive tillers/hill (19.06) were recorded with the application of 100 kg N/ha in *Pusa Basmati1718* variety and it was found to be statistically at par with application of 90 kg N/ha in treatment number10 control (19.2) and *Pusa Basmati1121* variety with application of 100 kg N/ha (18.2).

The higher number of effective tillers at increased nitrogen levels may be due to better vegetative growth and enhanced nutrient availability. Nitrogen promotes tiller formation and

plant growth, resulting in more productive tillers. Similar results were also reported by Singh *et al.* (2017) ^[16] in rice.

Number of Seeds/panicle

Significantly highest number of seeds/panicle (92.17) were recorded in *Pusa Basmati1718* variety with application of 100 kg N/ha, whereas in *Pusa Basmati1509* variety with 100 kg N/ha (89.93) and *Pusa Basmati1121* variety with 100 kg N/ha (87.34) were found to be statistically at par with the highest. Similar findings were also reported by Singh *et al.* (2017) ^[16] and Arya *et al.* (2019) ^[6] in rice.

Table 2: Response of rice variety on varying nitrogen levels on yield attributes and yield

S. No.	Treatments	Effective tillers/plant	No of Seeds / penical	Grain yield (t/ha)	Stover yield (t/ha)	Harvest Index (%)
1.	<i>Pusa Basmati 1121</i> + Nitrogen 80 kg/h	15.8	81.23	2.833	8.80	32.15
2.	<i>Pusa Basmati 1121</i> + Nitrogen 90 kg/h	17.2	82.23	3.133	8.99	34.89
3.	<i>Pusa Basmati 1121</i> + Nitrogen 100 kg/h	18.2	87.34	4.590	12.21	37.59
4.	<i>Pusa Basmati 1718</i> + Nitrogen 80 kg/h	14.06	81.57	3.933	12.13	32.23
5.	<i>Pusa Basmati 1718</i> + Nitrogen 90 kg/h	17.8	84.40	3.473	10.6	32.76
6.	<i>Pusa Basmati 1718</i> + Nitrogen 100 kg/h	19.06	92.17	5.120	13.23	38.78
7.	<i>Pusa Basmati 1509</i> + Nitrogen 80 kg/h	16.4	77.50	3.333	10.22	32.58
8.	<i>Pusa Basmati 1509</i> + Nitrogen 90 kg/h	17.6	84.73	3.533	11.12	31.77
9.	<i>Pusa Basmati 1509</i> + Nitrogen 100 kg/h	18.2	89.93	4.327	12.32	35.12
10.	N-P-K 90-60-60 kg/ha (control)	19.2	83.03	2.717	8.96	30.32
	F-test	S	S	S	S	S
	SEm(±)	1.00	2.50	0.24	0.22	0.75
	CD (P=0.05)	2.97	7.42	0.72	2.12	1.46

Test weight

Test weight was significantly recorded higher in Pusa Basmati1121 variety with 100 kg N/ha (32.44), whereas in Pusa Basmati1718 variety with 100 kg N/ha (31.84), and Pusa Basmati1509 variety with 100 kg N/ha (31.79).

The higher test weight under 100 kg N/ha may be due to better nitrogen availability, which improved grain filling and resulted in heavier grains. Similar findings were reported by Kumar *et al.* (2019)^[10] and Patel *et al.* (2020)^[12] in rice.

Straw yield (t/ha)

Straw yield was significantly higher in Pusa Basmati 1718 variety with the application of 100 kg N/ha (13.23 t/ha). However, Pusa Basmati 1509 receiving 100 kg N/ha (12.32 t/ha) and Pusa Basmati 1121 with 100 kg N/ha (12.21 t/ha) were found to be statistically at par with the highest treatment. The higher straw yield recorded under increased nitrogen levels may be attributed to enhanced vegetative growth, increased tiller production, greater plant height and higher dry matter accumulation. Nitrogen plays a vital role in chlorophyll formation and photosynthetic activity, which ultimately promotes biomass production and straw yield. The superior performance of Pusa Basmati 1718 may be due to its better genetic potential for vegetative growth and efficient utilization of applied nitrogen. Similar results were also reported by Kumar *et al.* (2019)^[10], Singh *et al.* (2021) and Patel *et al.* (2020)^[12], who observed a significant increase in straw yield of rice with higher nitrogen application levels.

Grain yield (t/ha)

Grain yield was significantly highest in Pusa Basmati1718 variety with application of nitrogen 100 kg/ha (5.120 t/ha), whereas with application of 100 kg N/ha in Pusa Basmati1121 variety (4.590 t/ha) and Pusa Basmati1509 variety (4.327 t/ha) were found to be statistically at par with highest.

Harvest Index

Significantly higher harvest index (38.78%) was recorded in Pusa Basmati1718 variety with application of nitrogen 100 kg/ha, whereas Pusa Basmati1121 variety with application of 100 kg N/ha (37.59%) and Pusa Basmati1509 variety with application of nitrogen 100 kg/ha (35.12%) was found to be statistically at par with treatment number 6.

Significant increase in yield attributes like productive tillers/hill, number of effective tillers/plant, test weight was observed which might be due to the fact that genetic character and adaptation of the variety to the environment and climatic conditions that determine the tillering nature in among the rice varieties. Plant receiving proper quantity of applied nitrogen showed effect on productive tillers/hill due to proper growth and development Uday, *et. al* (2021)^[17].

Conclusion

Based on the study it can be concluded that rice variety Pusa Basmati 1718 with application of Nitrogen 100 kg/ha (Treatment6) is recommended under Eastern Uttar Pradesh Agro-Climatic conditions for higher yields and economic returns.

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Competing Interests

Authors have declared that no competing interests exist.

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