



International Journal of Research in Agronomy

E-ISSN: 2618-0618
P-ISSN: 2618-060X
© Agronomy
NAAS Rating (2026): 5.20
www.agronomyjournals.com
2026; 9(6): 1174-1177
Received: 11-04-2026
Accepted: 15-05-2026

Vineet Singh
M.Sc. Scholar, Department of
Agronomy, Prof. Rajendra Singh (Rajju
bhैया) University, Prayagraj, Uttar
Pradesh, India

Lalit Kumar Sanodiya
Assistant Professor, Department of
Agronomy, Prof. Rajendra Singh (Rajju
bhैया) University, Prayagraj, Uttar
Pradesh, India

Vikas Singh
M.Sc. Scholar, Department of
Agronomy, Prof. Rajendra Singh (Rajju
bhैया) University, Prayagraj, Uttar
Pradesh, India

Saurabh Singh
M.Sc. Scholar, Department of
Agronomy, Prof. Rajendra Singh (Rajju
bhैया) University, Prayagraj, Uttar
Pradesh, India

Abhishek Tiwari
M.Sc. Scholar, Department of
Agriculture, Prof. Rajendra Singh
(Rajju bhैया) University, Prayagraj,
Uttar Pradesh, India

Ayush Pandey
M.Sc. Scholar, Department of
Agriculture, Prof. Rajendra Singh
(Rajju bhैया) University, Prayagraj,
Uttar Pradesh, India

Aman Kumar Pandey
M.Sc. Scholar, Department of
Agriculture, Prof. Rajendra Singh
(Rajju bhैया) University, Prayagraj,
Uttar Pradesh, India

Aman Yadav
M.Sc. Scholar, Department of
Agronomy, Prof. Rajendra Singh (Rajju
bhैया) University, Prayagraj, Uttar
Pradesh, India

Abhishek Pratap Singh
M.Sc. Scholar, Department of
Agronomy, Prof. Rajendra Singh (Rajju
bhैया) University, Prayagraj, Uttar
Pradesh, India

Corresponding Author:
Vineet Singh
M.Sc. Scholar, Department of
Agronomy, Prof. Rajendra Singh (Rajju
bhैया) University, Prayagraj, Uttar
Pradesh, India

Effect of nitrogen levels and growth regulators on growth and yield of black rice (*Oryza sativa* L.) in the Prayagraj region

Vineet Singh, Lalit Kumar Sanodiya, Vikas Singh, Saurabh Singh, Abhishek Tiwari, Ayush Pandey, Aman Kumar Pandey, Aman Yadav and Abhishek Pratap Singh

DOI: <https://www.doi.org/10.33545/2618060X.2026.v9.i6o.5846>

Abstract

The present study on the Effect of Nitrogen Levels and Growth Regulators on Growth and Yield of Black Rice (*Oryza sativa* L.) revealed that the combined application of 120 kg N ha⁻¹ and Seaweed Sap (G) 5% (T₅) significantly improved plant growth, yield attributes, grain yield, and economic returns compared to other treatments. This treatment produced the highest grain yield (4891 kg ha⁻¹), net return (₹61,467 ha⁻¹), and benefit-cost ratio (2.77). The findings indicate that balanced nitrogen fertilization along with seaweed-based bio-stimulants enhances nutrient use efficiency, crop productivity, and profitability. Therefore, the application of 120 kg N ha⁻¹ + Seaweed Sap (G) 5% can be recommended as an effective and economical nutrient management practice for black rice cultivation under the subtropical conditions of eastern Uttar Pradesh.

Keywords: Black rice, *Oryza sativa* L., nitrogen levels, growth regulators, seaweed sap

1. Introduction

Rice (*Oryza sativa* L.) is one of the most important cultivated cereal crops of the world, it is the major food source of nearly half of the world population. Among the rice cultivars, black rice is a variant rice species (*Oryza sativa* L.) gaining demand in today's world. With the increasing health consciousness among the people for nutrient rich grain quality, black rice got evolved as a promising cultivar in the recent year. Black rice has more antioxidants than any other rice variety. It is considered to have multiple benefits in human health due to the presence of different antioxidants (Sutharut and Sudarat 2012) [2]. Crop geometry is an important factor for optimizing the spacing between plants for efficient utilization of the natural resources like light, water, nutrient and space (Haque *et al.*, 2015) [3]. The optimum planting geometry under varied fertility regimes needs to be worked out to exploit the genetic potential of a genotype. Nitrogen fertilization is important for modern rice varieties in order to exploit their maximum yield potential (Mrudhula *et al.*, 2021) [4]. High yielding modern rice varieties show a greater response in relation to applied nitrogen, while they differ in nitrogen demand depending on their genotype and agronomic traits under different climatic condition. In order to exploit the optimum plant population with respect to optimised doses of N in black rice need to be standardized. Recent advancements in the fields of crop physiology, plant biochemistry, and nutrient management have continuously highlighted the profound importance of developing site-specific and crop-specific nitrogen management strategies. Proper, scientifically validated nitrogen application schedules improve not only the total grain yield but also drastically enhance essential efficiency metrics, including agronomic nitrogen use efficiency, physiological efficiency, apparent recovery efficiency, and partial factor productivity of the applied inputs (Chaudhary *et al.*, 2008) [1]. Fundamental empirical studies have demonstrated that balanced nitrogen fertilization acts as a master switch that enhances overall photosynthetic capacity, upregulates carbohydrate metabolism, accelerates protein synthesis, coordinates optimal grain filling, and promotes expansive root development, thereby improving overall crop performance and resilience (Kumar

et al., 2019) [6]. However, rely solely on chemical fertilizers is often insufficient to achieve the fine-tuned control over plant architecture and physiological efficiency needed to maximize the performance of traditional landraces like black rice, necessitating the exploration of complementary agronomic tools.

2. Materials and Methods

The materials, methodology and techniques adopted during the course of investigation entitled, "Effect of Nitrogen Levels and Growth Regulators on Growth and Yield of Black Rice (*Oryza sativa* L.) in the Prayagraj Region" with a brief description regarding site of experiment, soil properties, sampling techniques, climatic conditions during crop growing period, cropping history, calendar history, calendar operations and statistical analysis are described in this chapter under the following headings.

2.1 Location of experimental site

The materials, methodology and techniques adopted during the course of investigation entitled, "Effect of Nitrogen Levels and Growth Regulators on Growth and Yield of Black Rice (*Oryza sativa* L.) in the Prayagraj Region" was *Kharif* 2025 at Crop Research Farm, Department of Agronomy, PRSU, Prayagraj, UP, which is located at 25.28° N latitude, 81.54° E longitude and 98

m altitude above the mean sea level. This area situated on the Allahabad Mirzapur Road, about 12 km away from Prayagraj city. All the facilities required for crop cultivation were met out from the department.

2.2 Climate and weather condition

Prayagraj belongs to sub-tropical and semi-arid climatic condition, with both extremes of temperature, i.e., winter and summer. It receives southwest monsoon rains which commence in the month of July and withdraws by the end of September. The meteorological data recorded during the growing period of experiment including the weekly average of maximum and minimum temperature, relative humidity and rainfall recorded at the Argo-Meteorological Observatory Unit, School of Forestry and Environment Sciences, Sam Higginbottom University of Agriculture Technology & Sciences. Prayagraj during the cropping period is illustrated graphically in fig 1.

2.2.1 Weather during experimental period

Weekly meteorological data on weather condition during crop growth period of the experimentation have been depicted in table 1.

Table 1: Mean weekly weather parameters and total rainfall during the cropping season (*Kharif* 2025)

Month	Week	Temperature (°C)		Relative Humidity (%)		Rain fall (mm)
		Max	Min	Max	Min	
July 2025	1st	31.40	21.61	71	35	0.5
	2nd	32.34	20.38	76	41	0.00
Aug 2025	1st	28.25	17.66	82	46	0.56
	2nd	29.71	18.55	88	51	1.56
	3rd	24.31	16.69	83	39	0.00
	4th	27.51	13.54	81	34	2.56
Sept 2025	1st	29.39	12.72	81	35	0.0
	2nd	26.41	15.22	84	39	1.2
	3rd	21.02	9.53	83	37	0.00
	4th	26.31	9.34	86	38	0.00
Oct 2026	1st	26.53	16.43	89	55	0.57
	2nd	27.94	15.51	91	60	0.26
	3rd	24.51	13.33	86	46	00
	4th	24.34	11.49	85	47	00

Source: Meteorological observatory, Collage of Forestry, SHUATS, PRAYAGRAJ.

3. Results and Discussion

The present investigation entitled "Effect of Nitrogen Levels and Growth Regulators on Growth and Yield of Black Rice (*Oryza sativa* L.) in the Prayagraj Region" was carried out at the Research Farm of Prof. Rajendra Singh (Rajju Bhaiya) University in Prayagraj, Uttar Pradesh, during *Kharif* 2025-2026. Ten treatment combinations with three nitrogen levels (100, 120, and 140 kg N ha⁻¹) combined with various seaweed-based growth regulators (Seaweed Sap (K), Seaweed Sap (G), and Sagarika at 5% concentration) and a control that represented farmer practices comprised the experiment. The study's findings unequivocally showed that growth regulators and nitrogen levels had a significant impact on black rice's growth, yield characteristics, productivity, and financial returns. T₉ (140 kg N ha⁻¹ + Sagarika 5%) consistently performed better than the other treatment combinations in nearly every metric examined.

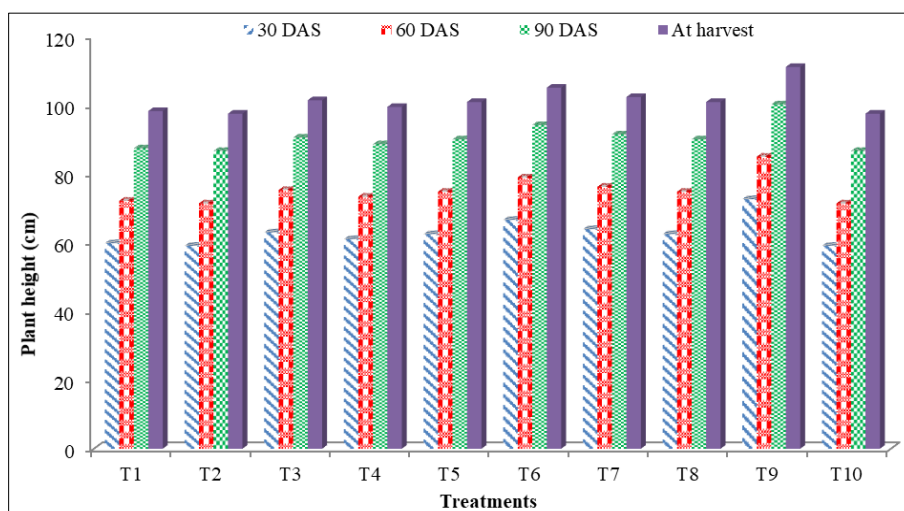
Plant height increased with crop growth under all treatments. Significant differences among treatments were observed from 60 DAT onwards. The highest plant height at 60 DAT, 90 DAT, and

harvest was recorded in T₉ (140 kg N ha⁻¹ + Sagarika 5%), followed by T₆ (120 kg N ha⁻¹ + Sagarika 5%). The increased plant height may be attributed to the combined effect of higher nitrogen availability and Sagarika, which enhanced nutrient uptake, photosynthesis, cell division, and vegetative growth. The presence of natural growth-promoting substances in Sagarika further contributed to better plant Vigor and overall growth performance at table 2.

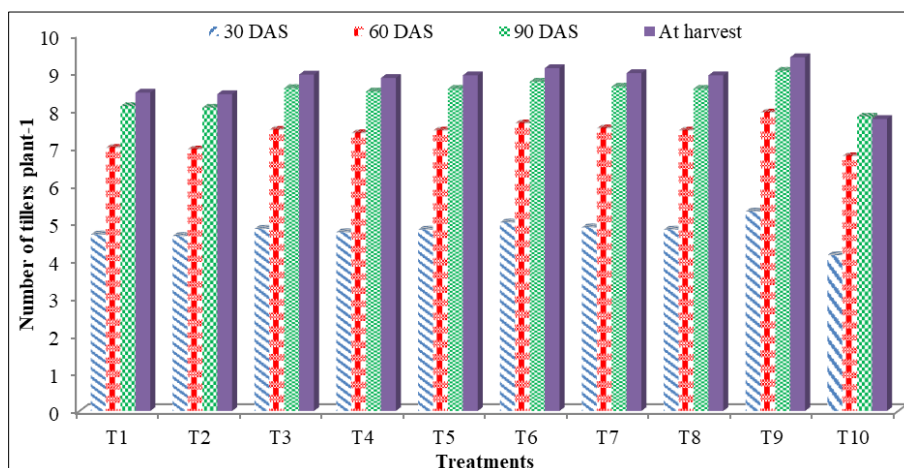
The number of tillers per plant varied significantly among treatments at all growth stages. Treatment T₉ (140 kg N ha⁻¹ + Sagarika 5%) recorded the highest number of tillers throughout the crop growth period, followed by T₆ (120 kg N ha⁻¹ + Sagarika 5%). At harvest, T₉ produced the maximum tillers (9.40 tillers plant⁻¹), while the control recorded the lowest value (7.76 tillers plant⁻¹). The increased tillering under T₉ may be due to improved nitrogen availability and the growth-promoting hormones present in Sagarika, which enhanced nutrient uptake, meristematic activity, and overall plant growth at table 3.

Table 2: Effect of Nitrogen Levels and Growth Regulators on Plant height (cm) of Black rice at different DAT

Treatments	30 DAT	60 DAT	90 DAT	At harvest
T ₁ : Nitrogen 100 kg/ha + Seaweed Sap (K) 5%	59.85	72.21	87.46	98.35
T ₂ : Nitrogen 100 kg/ha + Seaweed Sap (G) 5%	59.08	71.44	86.69	97.58
T ₃ : Nitrogen 100 kg/ha + Sagarika 5%	62.99	75.35	90.60	101.49
T ₄ : Nitrogen 120 kg/ha + Seaweed Sap (K) 5%	61.04	73.40	88.65	99.54
T ₅ : Nitrogen 120 kg/ha + Seaweed Sap (G) 5%	62.48	74.84	90.09	100.98
T ₆ : Nitrogen 120 kg/ha + Sagarika 5%	66.65	79.01	94.26	105.15
T ₇ : Nitrogen 140 kg/ha + Seaweed Sap (K) 5%	63.93	76.29	91.54	102.43
T ₈ : Nitrogen 140 kg/ha + Seaweed Sap (G) 5%	62.48	74.84	90.09	100.98
T ₉ : Nitrogen 140 kg/ha + Sagarika 5%	72.68	85.04	100.29	111.18
T ₁₀ : Control (Farmer Practices)	59.08	71.44	86.69	97.58
F- test	S	S	S	S
SE.m ($\pm$)	1.413	1.357	1.485	1.680
C. D. (P = 0.05)	3.998	3.839	4.201	4.753

**Table 3:** Effect of Nitrogen Levels and Growth Regulators on No. of tillers per plant of Black rice at different DAT

Treatments	30 DAT	60 DAT	90 DAT	At harvest
T ₁ : Nitrogen 100 kg/ha + Seaweed Sap (K) 5%	4.69	6.99	8.10	8.46
T ₂ : Nitrogen 100 kg/ha + Seaweed Sap (G) 5%	4.65	6.95	8.06	8.42
T ₃ : Nitrogen 100 kg/ha + Sagarika 5%	4.84	7.47	8.58	8.94
T ₄ : Nitrogen 120 kg/ha + Seaweed Sap (K) 5%	4.75	7.38	8.49	8.85
T ₅ : Nitrogen 120 kg/ha + Seaweed Sap (G) 5%	4.82	7.45	8.56	8.92
T ₆ : Nitrogen 120 kg/ha + Sagarika 5%	5.01	7.64	8.75	9.11
T ₇ : Nitrogen 140 kg/ha + Seaweed Sap (K) 5%	4.88	7.51	8.62	8.98
T ₈ : Nitrogen 140 kg/ha + Seaweed Sap (G) 5%	4.82	7.45	8.56	8.92
T ₉ : Nitrogen 140 kg/ha + Sagarika 5%	5.30	7.93	9.04	9.40
T ₁₀ : Control (Farmer Practices)	4.14	6.77	7.82	7.76
F- test	S	S	S	S
SE.m ($\pm$)	0.095	0.132	0.186	0.262
C. D. (P = 0.05)	0.269	0.373	0.527	0.742



Different treatments had a considerable impact on straw and grain yields. T₉ (140 kg N ha⁻¹ + Sagarika 5%) provided the highest grain yield (4.95 t ha⁻¹) and straw yield (12.22 t ha⁻¹), followed by T₆, while the control treatment yielded the lowest. greater tillering, more panicles, greater grain filling, and improved nutrient use brought about by the combined effects of nitrogen

and Sagarika may all contribute to the higher yield under T₉. Treatment differences were non-significant, despite the harvest index ranging from 28.81% to 31.17%, suggesting that the percentage of biomass allotted to grain and straw remained mostly constant across treatments at Table 4.

Table 4: Yield and yield attributes of Black rice under different treatments

Treatments	Grain yield (t/ha)	Stover yield (t/ha)	Biological yield (t/ha)	Harvest index (%)
T ₁	3.61	8.2	11.80	30.54
T ₂	3.52	7.93	11.44	30.72
T ₃	4.26	10.15	14.40	29.54
T ₄	4.4	10.57	14.96	29.37
T ₅	4.47	10.78	15.24	29.29
T ₆	4.67	11.38	16.04	29.08
T ₇	4.54	10.99	15.52	29.21
T ₈	4.47	10.78	15.24	29.29
T ₉	4.95	12.22	17.16	28.81
T ₁₀	3.31	7.3	10.60	31.17

References

1. Chaudhary SK, Jha S, Kumar R. Effect of nitrogen levels on yield of rice. *Indian Journal of Agronomy*. 2008;53(3):210–215.
2. Sutharut J, Sudarat J. Total anthocyanin content and antioxidant activity of germinated colored rice. *International Food Research Journal*. 2012;19(1):215–222.
3. Haque ME, Bell RW, Islam MA, Rahman MA. Minimum tillage unpuddled transplanting: an alternative crop establishment strategy for rice in conservation agriculture cropping systems. *Field Crops Research*. 2016;185:31–39.
4. Mrudhula KA, Suneetha Y, Krishna Veni B. Effect of nitrogen levels on growth, yield, nitrogen uptake and economics of rice variety BPT 2782-Bhavathi. *International Journal of Chemical Studies*. 2021;9(1):2496–2499.
5. Chaudhry V, Rehman A, Mishra A, Chauhan PS, Nautiyal CS. Changes in bacterial community structure of agricultural land due to long-term organic and chemical amendments. *Microbial Ecology*. 2012;64(2):450–460.
6. Kumar R, Singh Y, Kumar A. Influence of nitrogen on rice productivity. *Crop Research*. 2005;30(2):202–206.