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Effect of sowing period and nitrogen management on growth attributes of direct seeded rice (*Oryza sativa* L.) under Eastern Uttar Pradesh

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Abstract

A field experiment was conducted at Agricultural Research Farm, Banaras Hindu University, Varanasi, India, to evaluate the effect of sowing period and nitrogen management on number of leaves and leaf area index of direct seeded rice, during two consecutive *Kharif* seasons (2023 and 2024). The experiment was conducted in Factorial Randomized Block Design (FRBD) comprising fifteen treatment combinations, involving three levels of Factor I (sowing period: S₁-1st fortnight of June, S₂- 2nd fortnight of June, S₃- 1st fortnight of July) and five levels of Factor II (nitrogen management: N₀- control, N₁- 100% N through urea (50% N at basal + 25% N at tillering (G₂₁) + 25% N at stem elongation (G₃₀), N₂- 90% N through urea (25% N at basal + 50% N at tillering (G₂₁) + 25% N at stem elongation (G₃₀) + 10% N through vermicompost, N₃- 80% N through urea (25% N at basal + 25% N at tillering (G₂₁) + 50% N at stem elongation (G₃₀) + 20% N through vermicompost, N₄- 70% N through urea (50% N at basal + 50% N at flowering (G₅₀) + 30% N through vermicompost). The number of leaves and leaf area index was measured at 30, 60 and 90 DAS. The result indicates that sowing period and nitrogen management significantly enhances these parameters at 60 and 90 DAS. Among the treatments, S₁ (1st fortnight of June) and N₂ (90% N through urea (25% N at basal + 50% N at tillering (G₂₁) + 25% N at stem elongation (G₃₀) + 10% N through vermicompost) recorded significantly higher value of these parameters. It can be concluded that sowing direct seeded rice during 1st fortnight of June and application of 90% nitrogen through urea {25% N at basal + 50% N at tillering (G₂₁) + 25% N at stem elongation (G₃₀)} + 10% N through vermicompost resulted in significant improvement in number of leaves and LAI of rice

Keywords: Direct seeded rice, leaf area index, nitrogen management, sowing period

Introduction

Globally, rice is considered as one of the most important staple food crop. More than two billion people depend on rice for 60–70% of their energy requirement in Asia (Ahmed *et al.*, 2020a) ^[1]. It is a rich source of carbohydrates and also contains 6-7% protein in white rice and 7-9% in brown rice, 2-2.5% fat, 0.8% cellulose, and 5-9% ash, which makes it a vital component of human nutrition. Rice has more than 160 million hectares of cultivated area and approximately 720 million tons of annual production globally. India ranks first in terms of rice-growing area and second in production after China worldwide. In India, it is cultivated in around 47.83 million hectares, with an annual production of 137.82 million tons and 2882 kg ha⁻¹ average productivity during 2023–24 (Ministry of Agriculture & Farmers Welfare, Government of India 2024-25). In India, it is grown across a wide range of agroclimatic regions, and states such as Uttar Pradesh, West Bengal, and Punjab are major producers of rice.

The performance of direct seeded rice is heavily affected by sowing time. Timely sown crops gets favorable environmental conditions during critical growth stages, which helps to maximize the crop productivity (Vange and Obi, 2006, Bashir *et al.*, 2010) ^[11, 3]. However, these conditions depend on various factors like region, location, and genotypes (Bashir *et al.*, 2010) ^[3]. The production of rice is also affected by time of nitrogen application. In rice, it is applied mainly through broadcasting, and it has very low nitrogen use efficiency. This efficiency can be enhanced by applying nitrogen in split doses. In recent years, there has been increasing emphasis on

integrated nutrient management. It relies on the combined application of organic and inorganic sources of nutrients. Among various organic sources, vermicompost can be an efficient option to enhance both soil and plant health. It is made from a process known as vermicomposting. The soils of Eastern Uttar Pradesh are deficit on available nitrogen content and sowing in these climatic conditions are highly affected by rainfall and temperature. So, this study was performed to identify the suitable sowing time and nitrogen management options for enhancing growth attributes of direct seeded rice in Eastern Uttar Pradesh.

Materials and Methods

The present study was conducted during two consecutive *Kharif*

seasons (2023 and 2024) at Agricultural Research Farm (Banaras Hindu University, Varanasi, India) to evaluate the effect of sowing period and nitrogen management on growth of direct seeded rice under climatic conditions of Eastern Uttar Pradesh. The experimental site was located at latitude of 25°18' N and longitude of 83°03' E longitude with 75.70 m MSL altitude. The field experiment was conducted using a Factorial Randomized Block Design (FRBD) comprising fifteen treatment combinations, involving three levels of Factor I (sowing period) and five levels of Factor II (nitrogen management) during *Kharif* 2023 and 2024. The details of the treatments and symbols used are presented in Table 1.

Table 1: Treatment details

S.	Treatments	Symbols
Factor I: Sowing period		
1	1 st fortnight of June	S ₁
2	2 nd fortnight of June	S ₂
3	1 st fortnight of July	S ₃
Factor II: Nitrogen management (Based on BBCH scale)		
4	Control	N ₀
5	100% N through urea (50% N at basal + 25% N at tillering (G ₂₁) + 25% N at stem elongation (G ₃₀))	N ₁
6	90% N through urea (25% N at basal + 50% N at tillering (G ₂₁) + 25% N at stem elongation (G ₃₀) + 10% N through vermicompost	N ₂
7	80% N through urea (25% N at basal + 25% N at tillering (G ₂₁) + 50% N at stem elongation (G ₃₀) + 20% N through vermicompost	N ₃
8	70% N through urea (50% N at basal + 50% N at flowering (G ₅₀) + 30% N through vermicompost	N ₄

Note: 1) Recommended dose of fertilizer of 150-60-60-05 kg N-P₂O₅-K₂O-ZnSO₄ ha⁻¹

All the recommended dose of phosphorus, potassium and zinc was applied as basal dose. All the required dose of vermicompost was applied at the time of sowing and urea was applied as per the treatments. The experimental soil was slightly alkaline in nature with 6.43 pH, low in available nitrogen, organic matter and zinc and medium in available P₂O₅ and K₂O. The variety MTU 7029 was selected for the experiment. The first sowing was performed on 06 June 2023 and other was performed as per the treatments in first year. In second year, first sowing was done on 08 June 2024 and other are performed on 2nd fortnight of June and 1st fortnight of July. The number of leaves per hill of selected plant was counted at 30, 60 and 90 DAS. Leaf area index was measured at same days as number of leaves. Radford (1967) [8] suggested the formula for LAI as given here under:

Leaf area index (LAI) =	Total leaf area (cm ²)
	Unit land area (cm ²)

The variation of data was analyzed by the technique as described by Gomez and Gomez (1984) [4]. The significance of differences among treatment means was tested using the Least Significant Difference (LSD) test at the 5 per cent level of probability (P = 0.05).

Results and Discussion

The data presented in the Table 2 suggested that the number of leaves was significantly influenced by sowing periods at all stages of crop growth, except at 30 DAS. Among the sowing periods, S₁ (1st fortnight of June) recorded significantly highest leaves at 60 and 90 DAS, which was statistically at par with S₂ at these stages, during both the years of experiment. The nitrogen treatments also had significant effects on number of leaves except at 30 DAS. Among the nitrogen management treatments, N₂ [90% N through urea {25% N at basal + 50% N at tillering (G₂₁) + 25% N at stem elongation (G₃₀)} + 10% N through vermicompost] had statistically higher number of leaves at 60 DAS at 90 DAS, and

was found to be statistically comparable with N₁ and N₃ at these stages, during both years. Table 4.3 indicates that leaf area index (LAI) was significantly influenced by sowing period at all growth stages except at 30 DAS. LAI increased progressively with crop growth and reached its peak at 90 DAS. Among the treatments, S₁ (1st fortnight of June) recorded significantly superior LAI at 60 and 90 DAS, compare to other sowing period in both years. Nitrogen management also causes significant impact on LAI at all stages, except at 30 DAS. The nitrogen treatment N₂ [90% N through urea {25% N at basal + 50% N at tillering (G₂₁) + 25% N at stem elongation (G₃₀)} + 10% N through vermicompost] recorded significantly higher value at 60 and 90 DAS and found statistically comparable with N₁ and N₃ at the respective stages, during both years. The interaction between sowing period and nitrogen management treatments on the number of leaves and LAI was non-significant at all growth stages during both years. The highest value of these parameters under S₁ (1st Fortnight of June) can be favored to early sowing, which provides a longer vegetative period along with more favorable temperature and radiation conditions. This enhances heat unit accumulation and promotes higher LAI and leaf production (Mir *et al.*, 2024, Ren *et al.*, 2023) [7, 9]. The sowing period S₃ (1st Fortnight of July) resulted in the lowest values for all growth parameters. This decline can be mainly linked to delay sowing. S₃ is often affected by rainfall immediately after planting, which causes less seed germination and encourages weed growth at critical growth stages. It shortens the vegetative phase and limits plant establishment, leading to reduced dry matter accumulation, especially at early stages of growth (Zhang *et al.*, 2023, Mir *et al.*, 2024) [12, 7]. Among the treatments, N₂ [90% N through urea {25% N as basal + 50% N at tillering (G₂₁) + 25% N at stem elongation (G₃₀)} + 10% N through vermicompost] had highest value of these attributes. This may be attributed to the adequate splitting and timely supply of nitrogen at critical growth stage, which enhanced photosynthetic activity, cell division, vegetative

growth, and biomass accumulation. The integrated use of inorganic nitrogen and vermicompost also improved nutrient availability and soil health, resulting in better growth and development of crop. Similar findings have also been reported by Huang *et al.* (2025) ^[5], Somniyam *et al.* (2025) ^[10], Ma *et al.* (2023) ^[6] where timely splitting and combined application of organic and inorganic sources of nutrient can enhance plant growth attributes.

Table 2: Effect of sowing period and nitrogen management on number of leaves of rice

Treatment	Number of leaves per hill					
	30 DAS		60 DAS		90 DAS	
	2023	2024	2023	2024	2023	2024
Sowing Period (S)						
S ₁	4.56	4.69	12.23	13.33	13.6	14.33
S ₂	4.44	4.53	11.77	12.69	12.4	12.8
S ₃	4.13	4.22	9.27	9.53	10.13	10.6
SEm ±	0.16	0.19	0.22	0.29	0.49	0.57
CD (P=0.05)	NS	NS	0.63	0.81	1.42	1.77
Nitrogen Management (N)						
N ₀	4.09	4.15	6.44	6.78	7.11	7.56
N ₁	4.62	4.76	11.78	12.12	12.78	13.89
N ₂	4.4	4.48	13.56	14.22	14.33	15.11
N ₃	4.35	4.41	12.59	12.33	13.11	14.11
N ₄	4.45	4.63	10.22	11.33	11.22	12.22
SEm ±	0.19	0.17	0.86	0.84	0.75	0.79
CD (P=0.05)	NS	NS	2.55	2.41	2.45	2.52
Interaction	NS	NS	NS	NS	NS	NS

Table 3: Effect of sowing period and nitrogen management on leaf area index of rice

Treatment	Leaf area index (LAI)					
	30 DAS		60 DAS		90 DAS	
	2023	2024	2023	2024	2023	2024
Sowing Period (S)						
S ₁	1.24	1.27	2.21	2.24	2.74	2.78
S ₂	1.19	1.20	2.08	2.12	2.56	2.58
S ₃	1.15	1.17	2.02	2.03	2.42	2.35
SEm ±	0.04	0.04	0.04	0.03	0.05	0.06
CD (P=0.05)	NS	NS	0.11	0.10	0.14	0.17
Nitrogen Management (N)						
N ₀	1.08	1.09	1.76	1.74	1.93	1.95
N ₁	1.24	1.28	2.25	2.30	2.53	2.61
N ₂	1.21	1.23	2.40	2.42	3.01	3.03
N ₃	1.19	1.21	2.14	2.16	2.91	2.93
N ₄	1.23	1.25	1.98	2.04	2.42	2.36
SEm ±	0.05	0.05	0.06	0.05	0.06	0.07
CD (P=0.05)	NS	NS	0.17	0.15	0.18	0.2
Interaction	NS	NS	NS	NS	NS	NS

Conclusion

Based on the findings of the two-year investigation, it can be concluded that sowing direct seeded rice during 1st fortnight of June and application of 90% nitrogen through urea {25% N at basal + 50% N at tillering (G₂₁) + 25% N at stem elongation (G₃₀)} + 10% N through vermicompost resulted in significant improvement in number of leaves and LAI of rice. Therefore, it can be recommended that direct seeded rice (MTU 7029) should be sown during 1st fortnight of June with the application of 135 kg ha⁻¹ nitrogen through urea {25% N at basal + 50% N at tillering (G₂₁) + 25% N at stem elongation (G₃₀)} + 15 kg ha⁻¹ N through vermicompost for enhancing growth attributes under the agro-climatic conditions of the Varanasi region of Eastern Uttar Pradesh.

References

- Ahmed M, Ahmad S, Raza MA, Kumar U, Ansar M, Shah GA, *et al.* Models calibration and evaluation. In: Ahmed M, editor. Systems modeling. Singapore: Springer; 2020. p. 151–178.
- Department of Agriculture and Farmers Welfare, Ministry of Agriculture and Farmers Welfare, Government of India. Annual report 2024–25. New Delhi: Ministry of Agriculture and Farmers Welfare; 2025. https://www.agriwelfare.gov.in/Documents/HomeWhatsNew/AR_Eng_2024_25
- Bashir M, Akbar N, Iqbal A, Zaman H. Effect of different sowing dates on yield and yield components of direct seeded coarse rice (*Oryza sativa* L.). Pakistan Journal of Agricultural Sciences. 2010;47:361–365.
- Gomez KA, Gomez AA. Statistical procedures for agricultural research. 2nd Ed. New York: John Wiley and Sons; 1984.
- Huang M, Shu A, Xie J, Cao F, Chen J, Wang W, *et al.* Nitrogen management for improving grain yield and quality in high-quality hybrid rice. Journal of Soil Science and Plant Nutrition. 2025;25(1):1480–1492.
- Ma S, Wang G, Su S, Lu J, Ren T, Cong R, *et al.* Effects of optimized nitrogen fertilizer management on the yield, nitrogen uptake, and ammonia volatilization of direct-seeded rice. Journal of the Science of Food and Agriculture. 2023;103(9):4553–4561.
- Mir MS, Singh P, Kanth RH, Shah ZA, Dar EA, Bhat JA, *et al.* Influence of sowing dates and weed management practices on weed dynamics, productivity and profitability of direct seeded rice. Scientific Reports. 2024;14(1):18877.
- Radford DJ. Growth analysis formulae: Their use and abuse. Crop Science. 1967;7:171–175.
- Ren N, Lu J, Zhu S, Shen C, Du B, Chen K. Improving the allocation of light-temperature resources and increasing yield of rice through early sowing and increasing nitrogen. Agronomy. 2023;13(12):2989.
- Somniyam V, Rangseesakorn K, Krongtadech D, Somniyam P. Effects of vermicompost on growth and yield of Japonica rice (*Koshihikari* var.) in Thailand. International Journal of Agricultural Technology. 2025;21(5):2021–2032.
- Vange T, Obi IU. Effect of planting date on some agronomic traits and grain yield of upland rice varieties. Sustainable Development on Agricultural Environment. 2006;2(1):1–9.
- Zhang R, Zhou N, Ashen R, Zhou L, Feng T, Zhang K, *et al.* Effect of sowing date on the growth characteristics and yield of growth-constrained direct-seeding rice. Plants. 2023;12:2989.