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Kousik Nandi
Department of Agronomy, Uttar Banga Krishi Viswavidyalaya. Pundibari, Cooch Behar, West Bengal, India

Subhendu Bandyopadhyay
Department of Agronomy, Uttar Banga Krishi Viswavidyalaya. Pundibari, Cooch Behar, West Bengal, India

Shreyosi Roy
Department of Agronomy, Uttar Banga Krishi Viswavidyalaya. Pundibari, Cooch Behar, West Bengal, India

Himadri Sekhar Mallik
Department of Agronomy, Uttar Banga Krishi Viswavidyalaya. Pundibari, Cooch Behar, West Bengal, India

Abhijit Nandi
Department of Plant Pathology, Uttar Banga Krishi Viswavidyalaya. Pundibari, Cooch Behar, West Bengal, India

Corresponding Author:
Kousik Nandi
Department of Agronomy, Uttar Banga Krishi Viswavidyalaya. Pundibari, Cooch Behar, West Bengal, India

Influence of sowing dates, organic nutrient sources, and varietal performance on yield and yield attributes of rice (*Oryza sativa* L.) in Eastern India

Kousik Nandi, Subhendu Bandyopadhyay, Shreyosi Roy, Himadri Sekhar Mallik and Abhijit Nandi

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Abstract
A field experiment was conducted during the kharif seasons of 2019 and 2020 at the University Research Farm, Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, to assess the influence of sowing dates, organic nutrient sources, and varieties on rice productivity. The trial was laid out in a split-plot design with three replications, comprising five sowing dates (D1–D5), two organic nutrient sources [F1: farmyard manure (FYM), F2: vermicompost], and two varieties (V1: Tulipanji, V2=Kalonunia). Significant differences were observed in panicle length, panicle number m^{-2}, filled grains $panicle^{-1}$, test weight, grain yield, and straw yield. Among sowing dates, D3 produced the maximum grain yield (2.71 and 2.54 t ha^{-1} in 2019 and 2020, respectively), recording ~18% higher productivity compared to D5. Vermicompost (F2) increased grain yield by about 13% over FYM (F1). Variety V1 consistently outperformed V2, producing 14–18% higher grain yield. The study emphasizes that timely sowing (D3), vermicompost application, and cultivation of variety V1 together can substantially enhance rice productivity under the agro-climatic conditions of eastern India.

Keywords: Rice, sowing date, fertilizer level, variety, yield attributes, harvest index

Introduction
Rice (*Oryza sativa* L.) is the staple food for more than half of the global population, with Asia contributing nearly 90% of its production and consumption (FAO, 2023) [3]. In India, it covers about 44 million hectares and plays a key role in food security (ICAR, 2022) [4]. Its productivity is strongly influenced by sowing time, nutrient management, and varietal adaptability. Timely sowing ensures favourable climatic conditions during critical growth stages, enhancing tillering, panicle initiation, and grain filling (Singh *et al*., 2018; Prasad *et al*., 2020) [7, 5]. Organic nutrient sources such as farmyard manure (FYM) and vermicompost improve soil fertility and yield sustainability, with vermicompost often proving superior due to its gradual nutrient release and stimulation of microbial activity (Sharma *et al*., 2019; Ali *et al*., 2021) [6, 1]. Varietal response also plays a crucial role, as yield performance depends on traits like tillering ability, spikelet fertility, and adaptability to management practices (Dutta *et al*., 2022) [2]. Although many studies have examined sowing dates, nutrient management, or varietal performance separately, research integrating these factors is limited. Hence, this study was undertaken during kharif 2019 and 2020 to evaluate the combined effects of sowing dates, organic nutrient sources, and varieties on rice productivity under eastern Indian conditions.

Materials and Methods
Experimental Site
The field experiments were conducted during kharif 2019 and 2020 at the University Research Farm, Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar (26°19′ N, 89°23′ E, 43 m amsl). The soil was sandy loam, slightly acidic, and moderate in fertility. The climate is humid subtropical with ~950 mm annual rainfall, mostly received during July–August.
The experiment was laid out in a split-plot design with three replications. Treatments consisted

of five sowing dates (D1–D5), two organic nutrient sources [F1: farmyard manure (FYM), F2: vermicompost], and two varieties ((V1:Tulipanji, V2=Kalonunia). Recommended agronomic practices were uniformly followed.

Data were recorded on panicle length, panicles m^{-2}, filled grains $panicle^{-1}$, test weight, grain yield, straw yield, and harvest index (HI). Grain and straw yields were expressed on a hectare basis at 14% moisture. HI was calculated as:

Statistical Analysis

The data were analysed using analysis of variance (ANOVA) appropriate for split-plot design (Gomez and Gomez, 1984). Critical difference (CD) at 5% level of probability was used to separate treatment means.

Results and Discussion

Effect of Sowing Dates

Sowing dates significantly influenced most yield attributes and yield (Table 1). The longest panicles were recorded in D3 (27.79 cm in 2019 and 26.52 cm in 2020), while the shortest were in D5. Panicle number m^{-2} was also maximum in D3 (273.36 and 267.46), followed by D4, and minimum in D5. Filled grains $panicle^{-1}$ were highest in D3 (110.63 and 103.71) and lowest in D5 (92.83 and 87.46), reflecting better spikelet fertility under timely sowing. Test weight was not significantly affected, though a slight increase was observed in D3.

Grain yield followed a similar trend, with D3 producing the highest yield (2.71 and 2.54 t ha^{-1}), ~18% more than D5. Straw yield was maximum in D1 (5.98 and 5.65 t ha^{-1}). Harvest index remained unaffected across dates, ranging between 30–34%. The superiority of D3 can be attributed to favourable climatic conditions during tillering and grain filling, which enhanced both vegetative and reproductive growth. These findings are in agreement with Singh *et al*. (2018) [9], Sarker *et al*. (2019) [8], and Prasad *et al*. (2020) [11], who also reported yield advantages of timely sowing in rice.

Effect of organic sources

Application of vermicompost (F2) resulted in superior growth parameters compared to FYM (F1). Plant height was higher under F2 (26.09 and 25.20 cm) than F1 (25.13 and 24.09 cm), and the number of panicles per m² was also greater (264.09 and 256.08 for F2 vs. 253.89 and 239.02 for F1). Filled grains per panicle and test weight were enhanced under vermicompost (104.79–99.02 grains; 13.56–13.42 g) compared to FYM (98.77–93.02 grains; 13.29–13.03 g). Grain yield (2.50–2.39 t ha^{-1}) and straw yield (5.60–5.38 t ha^{-1}) were higher under F2 than F1 (2.41–2.29 t ha^{-1} and 4.95–4.98 t ha^{-1}, respectively). However, harvest index was slightly higher under FYM (32.78–31.42%) than vermicompost (30.81–30.60%). The improvement under vermicompost can be attributed to enhanced nutrient availability, microbial activity, and growth-promoting substances, whereas FYM favoured slightly better partitioning of biomass to grain. These observations agree with Verma *et al*. (2024) [12] and Iqbal *et al*. (2024) [13], who reported improved growth and yield in rice with vermicompost application due to better nutrient efficiency and soil microbial activity.

Effect of Varieties

The performance of different rice varieties significantly influenced growth, yield, and yield components (Table 1). Tulipanji (V1) consistently outperformed Kalonunia (V2) across both seasons. Plant height was higher in Tulipanji (26.57 and 25.45 cm) than in Kalonunia (24.66 and 23.84 cm), and panicle number per m² was also greater (277.72 and 266.11 for V1 vs. 240.26 and 229.00 for V2). Filled grains per panicle and test weight followed a similar trend, with Tulipanji recording 104.42–99.80 grains and 14.05–14.12 g, compared to Kalonunia (99.14–92.23 grains; 12.81–12.32 g).

Grain yield was notably higher in Tulipanji (2.81–2.71 t ha^{-1}) than in Kalonunia (2.09–1.97 t ha^{-1}), and straw yield also followed the same pattern (5.63–5.72 t ha^{-1} for Tulipanji vs. 4.93–4.64 t ha^{-1} for Kalonunia). The harvest index was greater in Tulipanji (33.50–32.21%) compared to Kalonunia (30.21–29.92%), indicating more efficient partitioning of biomass into grain.

The superiority of Tulipanji can be attributed to its enhanced genetic potential for vegetative growth, panicle formation, and spikelet fertility, which translated into higher grain and straw yield. These results are in agreement with Singh *et al*. (2018) [7] and Sarker *et al*. (2019) [10], who reported that varietal differences significantly affect yield attributes and overall productivity in rice.

The correlation study revealed that grain yield was strongly and positively associated with most yield-attributing traits. A highly significant correlation was observed between grain yield and number of filled grains ($r = 0.97$), followed by panicle length ($r = 0.96$) and straw yield ($r = 0.95$). Test weight also exhibited a moderately strong positive relationship with grain yield ($r = 0.85$). These results suggest that improvement in panicle architecture, sink capacity, and biomass accumulation are the major determinants of higher yield.

Panicle length showed a strong positive correlation with number of filled grains ($r = 0.98$) and panicle number per unit area ($r = 0.96$), confirming that longer panicles tend to bear more grains and thereby contribute to yield enhancement. Similarly, straw yield was positively correlated with both panicle length ($r = 0.93$) and number of filled grains ($r = 0.92$), indicating that greater vegetative growth supports a higher reproductive output.

In contrast, harvest index (HI) displayed weak to negative correlations with most yield-contributing traits. The most notable negative association was recorded with straw yield ($r = –0.46$), which implies that genotypes producing excessive biomass tend to partition a smaller proportion of assimilates into grain yield. Negative associations of HI with panicle length ($r = –0.24$), grain yield ($r = –0.18$), and number of filled grains ($r = –0.14$) further highlight the trade-off between biomass accumulation and efficient assimilate partitioning.

The heatmap provided a visual confirmation of these relationships. Deep red clusters were evident among grain yield, panicle length, filled grains, and straw yield, reaffirming their strong positive associations. On the other hand, blue shades against HI, especially with straw yield, indicated its antagonistic relationship with biomass production. Thus, the heatmap complements the correlation matrix by providing a clear visual pattern of how traits group together and influence yield.

Table 1: Effect of sowing dates on yield attributes and yield of rice (2019 and 2020).

	Panicle Length (cm)		Panicle m-2		No of filled grain		Test wt (g)		Grain yield t ha -1		Straw yield t ha -1		HI	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
D_1	24.83	24.00	251.24	236.05	97.88	93.54	13.43	12.93	2.35	2.24	5.98	5.65	28.12	28.51
D_2	25.06	24.39	256.16	247.73	102.30	95.58	13.23	13.29	2.41	2.38	5.44	5.32	30.48	30.68
D_3	27.79	26.52	273.36	267.46	110.63	103.71	13.74	13.86	2.71	2.54	5.25	5.19	34.51	32.78
D_4	26.74	25.88	267.47	262.21	105.29	99.79	13.59	13.66	2.50	2.39	5.03	4.90	33.32	32.59
D_5	23.65	22.43	246.73	224.31	92.83	87.46	13.16	12.36	2.28	2.15	4.69	4.83	32.85	30.74
S.Em (±)	0.54	0.38	3.77	7.49	3.07	2.79	0.52	0.36	0.04	0.06	0.24	0.08	1.06	0.42
CD (P=0.05)	1.75	1.23	12.31	24.43	10.02	9.11	NS	NS	0.13	0.19	0.78	0.25	3.47	1.38
CV (%)	7.27	5.29	5.05	10.48	10.45	10.08	13.37	9.34	5.55	8.47	15.68	5.05	11.58	4.73

Table 2: Effect of fertilizer regimes on yield attributes and yield of rice (2019 and 2020)

	Panicle Length (cm)		Panicle m-2		No of filled grain		Test wt (g)		Grain yield t ha -1		Straw yield t ha -1		HI	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
F_1	25.13	24.09	253.89	239.02	98.77	93.02	13.29	13.03	2.41	2.29	4.95	4.98	32.78	31.42
F_2	26.09	25.20	264.09	256.08	104.79	99.02	13.56	13.42	2.50	2.39	5.60	5.38	30.81	30.60
S.Em (±)	0.28	0.28	2.71	3.20	1.54	1.43	0.24	0.20	0.02	0.03	0.09	0.09	0.52	0.52
CD (P=0.05)	0.88	0.87	8.53	10.09	4.85	4.49	0.75	0.63	0.07	0.10	0.30	0.29	1.65	1.65
CV (%)	5.96	6.17	5.73	7.08	8.28	8.14	9.66	8.34	5.27	7.73	9.76	9.73	8.99	9.24

Table 3: Effect of varieties on yield attributes and yield of rice (2019 and 2020).

	Panicle Length (cm)		Panicle m-2		No of filled grain		Test wt (g)		Grain yield t ha -1		Straw yield t ha -1		HI	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
V1	26.57	25.45	277.72	266.11	104.42	99.80	14.05	14.12	2.81	2.71	5.63	5.72	33.49	32.17
V2	24.66	23.84	240.26	229.00	99.14	92.23	12.81	12.32	2.09	1.97	4.93	4.64	30.11	29.85
S.Em (±)	0.31	0.25	2.46	4.79	2.04	1.48	0.23	0.19	0.02	0.03	0.07	0.05	0.37	0.24
CD (P=0.05)	NS	0.73	7.26	14.12	6.01	4.37	NS	NS	0.06	0.07	0.21	0.15	1.11	0.70
CV (%)	6.64	5.53	5.20	10.59	10.97	8.44	9.19	7.81	5.73	5.90	7.23	5.28	6.45	4.21

Trait	Panicle Length	Panicle m²	No. of filled grain	Test wt	Grain yield	Straw yield	HI
Panicle Length	1.00						
Panicle m²	0.96	1.00					
No. filled grain	0.98	0.95	1.00				
Test wt	0.96	0.95	0.85	1.00			
Grain yield	0.97	0.93	0.97	0.85	1.00		
Straw yield	0.93	0.85	0.92	0.77	0.95	1.00	
HI	-0.24	-0.05	-0.14	-0.04	-0.18	-0.46	1.00

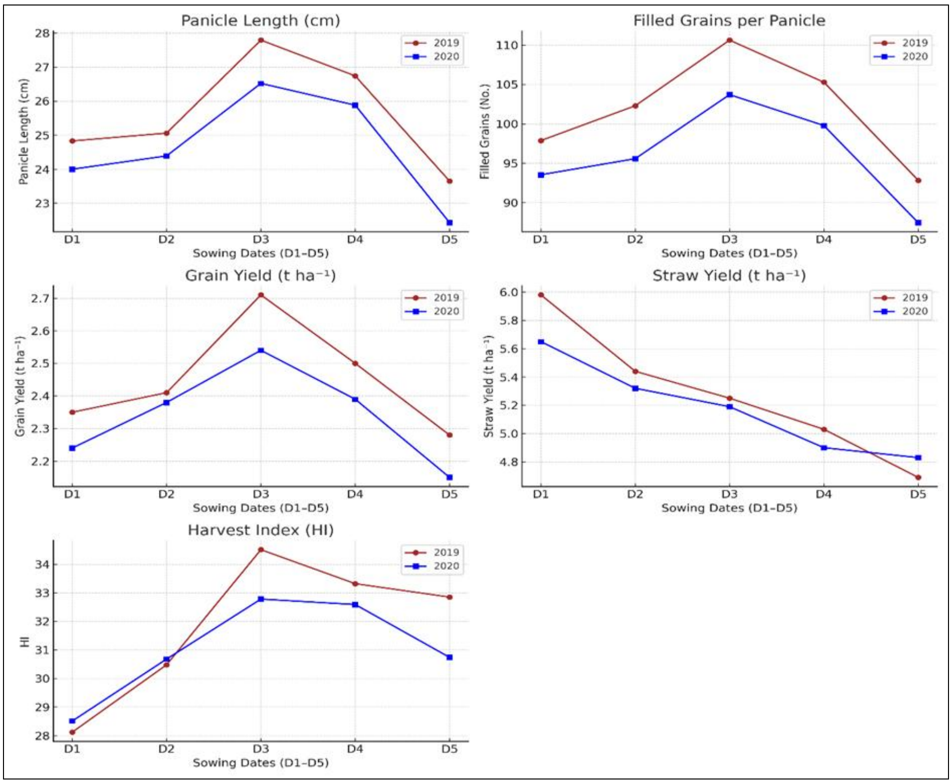

Fig 1: Effect of sowing dates on panicle length, filled grains, grain yield, and straw yield of rice during 2019 and 2020.

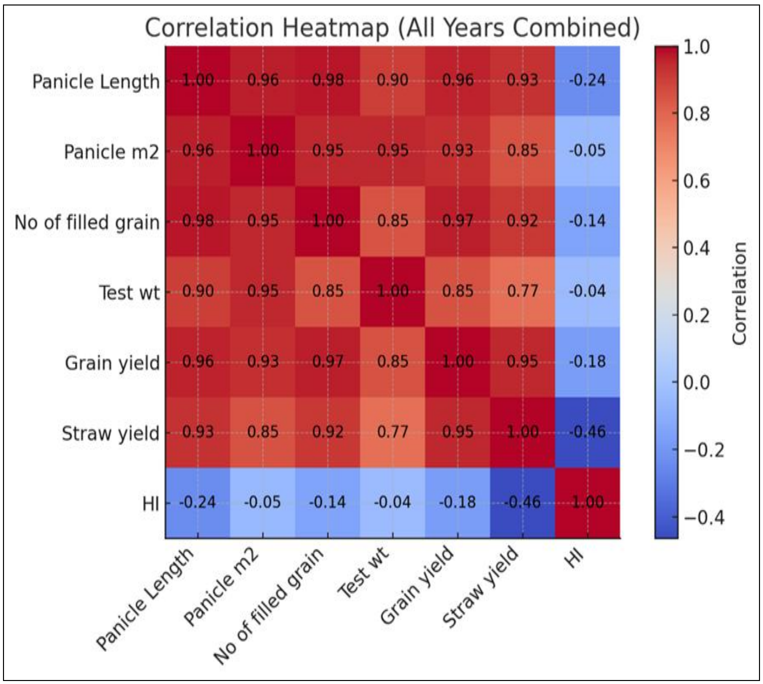

Fig 2: Heatmap of correlation coefficients among yield-contributing characters of rice genotypes

Conclusion

The study demonstrated that sowing dates, organic nutrient sources, and rice varieties significantly influenced growth, yield, and yield components. Timely sowing (D3) produced the longest panicles, highest panicle number, filled grains, and grain and straw yields, highlighting the importance of synchronizing crop development with favorable climatic conditions. Among organic nutrient sources, vermicompost (F2) outperformed FYM (F1) in terms of plant height, panicle number, filled grains, test weight, and overall yield, although FYM slightly improved harvest index. Regarding varietal performance, Tulipanji (V1) exhibited superior growth, yield attributes, and productivity compared to Kalonunia (V2).

Overall, integrating optimal sowing dates (D3) with vermicompost application and cultivation of high-yielding varieties like Tulipanji can maximize rice productivity and contribute to sustainable crop production.

Overall, the combined interpretation suggests that grain yield in rice is primarily governed by panicle length, number of filled grains, and straw yield, while harvest index plays a relatively minor or negative role. These findings indicate that selection strategies should focus on enhancing sink capacity and total biomass production rather than relying solely on harvest index.

References

1. Ali M, Singh S, Kumar R. Effect of organic manures on growth and productivity of rice. J Agron Crop Sci. 2021;207(2):145-152.
2. Dutta C, Nath DJ, Phyllei D. Aromatic rice and factors affecting aroma in rice. Int J Environ Climate Change. 2022;12(11):1773-1779.
3. FAO. Rice Market Monitor. Rome: Food and Agriculture Organization of the United Nations; 2023.
4. ICAR. Annual Report 2021–22. New Delhi: Indian Council of Agricultural Research; 2022.
5. Prasad R, Kumar A, Singh S. Effect of sowing dates on phenology and yield of rice. Oryza. 2020;57(1):23-28.
6. Sharma P, Singh A, Verma R. Role of organic nutrient sources in sustainable rice production. Indian J Agron. 2019;64(3):356-362.
7. Singh SK, Verma R, Jaiswal P. Influence of sowing dates on growth and yield attributes of rice. Oryza. 2018;55(3):350-355.
8. Sarker MA, Rahman MH, Islam MS. Effect of transplanting time on yield performance of rice. Bangladesh Agron J. 2019;22(1):15-22.
9. Singh R, Kumar P, Sharma S. Effect of sowing date on the growth characteristics and yield of growth-constrained direct-seeding rice. Plants. 2018;12(9):1899.
10. Sarker MAR, Hossain M, Rahman MM. Elastic sowing dates with low seeding rate for grain yield maintenance in mechanized large-scale double-cropped rice production. Sci Rep. 2019;10:23456.
11. Prasad PVV, Singh S, Zhang Y. Optimization of sowing dates for enhanced rice yield: Insights from field experiments in the middle and lower reaches of the Yangtze River, China. BMC Plant Biol. 2020;20:123.
12. Verma A, Sharma R, Singh K. Effect of organic fertilizers on growth and yield of rice. Int J Environ Sci Technol. 2024;12(11):1773-1779.
13. Iqbal M, Khan A, Ali S. Impact of vermicompost on soil fertility and rice yield. J Soil Sci Plant Nutr. 2024.