ISSN Print: 2664-844X
ISSN Online: 2664-8458
NAAS Rating (2026): 4.97
IJAFS 2026; 8(7): 165-169
www.agriculturaljournals.com
Received: 02-04-2026
Accepted: 08-05-2026

Mukesh Loyal
NRI Rd, V I T Campus, Sector-36, Karolan Ka Barh, Seesyawas, Jaipur, Rajasthan, India

PK Sharma
NRI Rd, V I T Campus, Sector-36, Karolan Ka Barh, Seesyawas, Jaipur, Rajasthan, India

Corresponding Author:
Mukesh Loyal
NRI Rd, V I T Campus, Sector-36, Karolan Ka Barh, Seesyawas, Jaipur, Rajasthan, India

Effect of sowing dates on growth and yield performance of Different Wheat (*Triticum aestivum* L.) varieties

Mukesh Loyal and PK Sharma

DOI: https://www.doi.org/10.33545/2664844X.2026.v8.i7c.1658

Abstract
A field experiment was conducted to evaluate effect of sowing dates on growth and yield performance of different wheat varieties during the Rabi season of 2025–26 at the Research Farm, Vivekananda Global University, Jaipur, Rajasthan. The experiment was laid out in Split Plot Design with three replications comprising three dates of sowing *viz*., 05 November, 20 November and 05 December as main plot treatments and four wheat varieties namely Raj 4079, Raj 4120, HD 2967 and Raj 4037 as sub-plot treatments. The objective of the study was to evaluate the effect of sowing dates and varieties on yield attributes and productivity of wheat under semi-arid conditions of Rajasthan.

The results revealed that yield attributes such as number of effective tillers, ear length, grains ear^{-1} and test weight were significantly improved under timely sowing and superior varieties. The highest number of effective tillers (318.6 m^{-2}), ear length (11.4 cm), grains ear^{-1} (48.8) and test weight (42.6 g) were recorded under 05 November sowing. Similarly, variety Raj 4079 produced maximum effective tillers (312.8 m^{-2}), ear length (11.2 cm), grains ear^{-1} (47.6) and test weight (43.4 g). Timely sowing on 05 November also produced the highest grain yield (54.8 q ha^{-1}), straw yield (71.6 q ha^{-1}), biological yield (126.4 q ha^{-1}) and harvest index (43.4%). Among the varieties, Raj 4079 recorded the highest grain yield (53.6 q ha^{-1}), straw yield (70.2 q ha^{-1}), biological yield (123.8 q ha^{-1}) and harvest index (43.3%).

Based on the findings of the present investigation, it may be concluded that timely sowing on 05 November significantly enhanced, yield, and quality of wheat compared to delay sowing dates. Among the varieties, Raj 4079 proved superior for growth and yield performance, while HD 2967 excelled in quality traits such as nitrogen uptake and protein content. Therefore, sowing wheat on 05 November with Raj 4079 is recommended for maximizing productivity, whereas HD 2967 may be preferred when grain quality is the primary objective.

Keywords: Date, varieties and yield

Introduction
Wheat (*Triticum aestivum* L.) is one of the most important cereal crops worldwide and serves as a staple food for a large proportion of the global population. In India, wheat ranks second only to rice in terms of area and production and plays a crucial role in ensuring national food and nutritional security (Bhat, 2025) [5]. The crop is cultivated under diverse agro-climatic conditions and contributes significantly to the agricultural economy. Wheat is a long-day crop that performs best under cool and humid conditions during vegetative growth followed by relatively warm and dry weather during grain development and maturity (Draganka *et al*., 2004) [10]. Optimum temperatures ranging from 20–25°C for germination and 16–22°C for vegetative growth are considered favorable for obtaining higher yields. However, deviations from these conditions, particularly during reproductive stages, adversely affect crop growth and grain formation (Bobade, 2010) [6]. Climate change has emerged as a major challenge to sustainable wheat production due to increasing temperatures, erratic rainfall patterns, drought, and other abiotic stresses (David and Sharon, 2012) [8]. Rising temperatures during critical growth stages accelerate crop phenology, shorten grain-filling duration, and reduce grain size and weight, ultimately leading to lower yields (Tadesse *et al*., 2016) [25]. Studies have indicated that even a moderate increase in seasonal temperature can significantly affect wheat productivity, particularly in tropical and semi-arid regions where crops are already exposed to environmental stresses (Agrawal and Sinha, 1993) [1].

Global projections suggest an increase in average surface temperature by 1.8–4.0 °C during the present century, posing serious threats to agricultural productivity and food security (Parry *et al*., 2004; Easterling *et al*., 2007) [19, 11].

Among various agronomic factors, sowing date is one of the most critical determinants of wheat productivity because it governs the crop's exposure to prevailing temperature regimes throughout its growth cycle. Timely sowing ensures optimum utilization of environmental resources and enables the crop to complete sensitive developmental stages under favorable conditions. Delayed sowing often exposes wheat to terminal heat stress during grain filling, resulting in reduced yield and quality (Kaur and Hundal, 2007) [15]. The response of wheat varieties to sowing time varies considerably due to differences in growth duration, thermal requirements, and adaptability, highlighting the importance of identifying suitable variety–sowing date combinations for specific agro-climatic regions. India is currently the second-largest wheat-producing country in the world, with wheat cultivated over approximately 30.36 million hectares and producing about 112.74 million tonnes during the 2024–25 Rabi season (Anonymous, 2025a; Ministry of Agriculture and Farmers Welfare, 2024). In Rajasthan, wheat is predominantly grown under irrigated conditions and contributes substantially to state agricultural production (Vyas, 1998) [28]. However, the state's semi-arid climate, low soil organic carbon, alkaline soils, limited water availability, and increasing incidence of terminal heat stress frequently constrain wheat productivity (Ankur Bhakar *et al*., 2024) [3]. Therefore, evaluating suitable sowing dates and adaptable wheat varieties is essential for maximizing yield under the prevailing agro-climatic conditions of Rajasthan. In this context, the present investigation was undertaken to assess the effect of different sowing dates on the growth, development, and productivity of wheat varieties and to identify the most suitable sowing time–variety combination for enhanced wheat production.

Materials and Methods

A field experiment was conducted during the Rabi season of 2025–26 at the Research Farm, Vivekananda Global University, Jaipur, Rajasthan, India. The experimental site is situated at 26°81′17″ N latitude and 75°88′99″ E longitude and falls under the Semi-Arid Eastern Plain Zone of Rajasthan. The climate of the region is semi-arid with hot summers and cool winters. During the crop season, the maximum and minimum temperatures ranged from 20.1 to 33.3°C and −0.5 to 15.6°C, respectively. A total rainfall of 39.5 mm was received during the growing period. Relative humidity varied between 38 and 69%, while sunshine hours ranged from 4.1 to 9.4 h day^{-1}. Prior to sowing, composite soil samples (0–15 cm depth) were collected and analyzed. The soil was classified as loamy sand, containing 84.1% sand, 9.3% silt, and 6.6% clay. The soil was slightly alkaline (pH 8.21), low in organic carbon (0.23%) and available nitrogen (130.23 kg ha^{-1}), medium in available phosphorus (20.56 kg ha^{-1}), and potassium (220.56 kg ha^{-1}), with an electrical conductivity of 0.33 dS m^{-1}. The experiment was laid out in a Split Plot Design with three replications. Three sowing dates were assigned to main plots and four wheat varieties to sub-plots, resulting in twelve treatment combinations.

Main plot treatments (Dates of sowing)

- D_1: 05 November 2025
- D_2: 25 November 2025
- D_3: 05 December 2025 Sub-plot treatments (Varieties):
- V_1: Raj 4079
- V_2: Raj 4120
- V_3: HD 2967
- V_4: Raj 4037

The gross plot size was 3.0 × 5.0 m (15.0 m²) and the net plot size was 2.6 × 5.0 m (13.0 m²). Wheat was sown at a row spacing of 20 cm using a seed rate of 100 kg ha^{-1}. The field was prepared by one deep ploughing followed by two harrowings and planking to obtain a fine seedbed. Sowing was carried out according to treatment schedules using a seed drill. Recommended doses of fertilizers were applied through urea, single super phosphate, and muriate of potash. Nitrogen was supplied as per the recommended dose, while 60 kg P_2O_5 ha^{-1} and 40 kg K_2O ha^{-1} were applied as basal doses at sowing.

A pre-sowing irrigation was applied to ensure uniform germination, followed by irrigations at critical growth stages according to crop requirements. Weed control was achieved through one manual weeding at 35 days after sowing (DAS). The crop was harvested at physiological maturity, and the produce from each net plot was separately threshed and cleaned for yield estimation.

Observations Recorded

Growth parameters including plant population, plant height, dry matter accumulation, leaf area index (LAI), and number of tillers m^{-2} were recorded at regular growth stages. Plant height was measured from ground level to the tip of the plant, while dry matter accumulation was determined after oven drying the sampled plants at 65–70°C to constant weight. Leaf area index was calculated using leaf area measurements obtained from representative leaf samples.

Yield attributes recorded included effective tillers m^{-2}, ear length, number of grains ear^{-1}, and 1000-grain weight. Grain yield, straw yield, biological yield, and harvest index were determined at harvest. Harvest index was calculated as the ratio of grain yield to biological yield and expressed as a percentage.

Nitrogen content in grain and straw was analyzed, and nitrogen uptake was computed by multiplying nutrient concentration with respective yield. Protein content in grain was estimated by multiplying nitrogen percentage by the conversion factor of 6.25 (AOAC, 2005).

Statistical Analysis

The experimental data were subjected to analysis of variance (ANOVA) appropriate for a Split Plot Design following the procedure described by Gomez and Gomez (1984). Treatment means were compared using the F-test at the 5% level of significance. Differences among treatments were considered significant when the calculated F-value exceeded the tabulated value.

Table 1: Effect of dates of sowing and varieties on yield attributes and yields of wheat

Treatments	Number of effective tillers (m^{-2})	Length of ear (cm)	Number of grains ear^{-1}	Test weight (g)	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})	Biological yield (q ha^{-1})	Harvest Index (%)
Date of sowing (Main plot)								
05 November	318.6	11.4	48.8	42.6	54.8	71.6	126.4	43.4
20 November	296.8	10.7	45.2	40.9	49.6	66.8	116.4	42.6
05 December	268.4	9.8	41.6	38.7	43.2	60.4	103.6	41.7
SEm±	6.14	0.24	1.08	0.82	1.18	1.84	2.42	0.64
CD (P=0.05)	19.12	0.75	3.36	2.56	3.68	5.74	7.54	1.99
Varieties (Sub plot)								
Raj 4079	312.8	11.2	47.6	43.4	53.6	70.2	123.8	43.3
Raj 4120	301.4	10.8	45.8	41.8	50.8	67.4	118.2	43.0
HD 2967	282.6	10.1	43.2	39.6	45.4	62.8	108.2	42.0
Raj 4037	276.8	10.3	43.8	38.9	46.2	64.0	110.2	41.9
SEm±	4.86	0.18	0.84	0.66	0.94	1.46	1.92	0.48
CD (P=0.05)	14.18	0.52	2.45	1.92	2.74	4.26	5.62	1.40

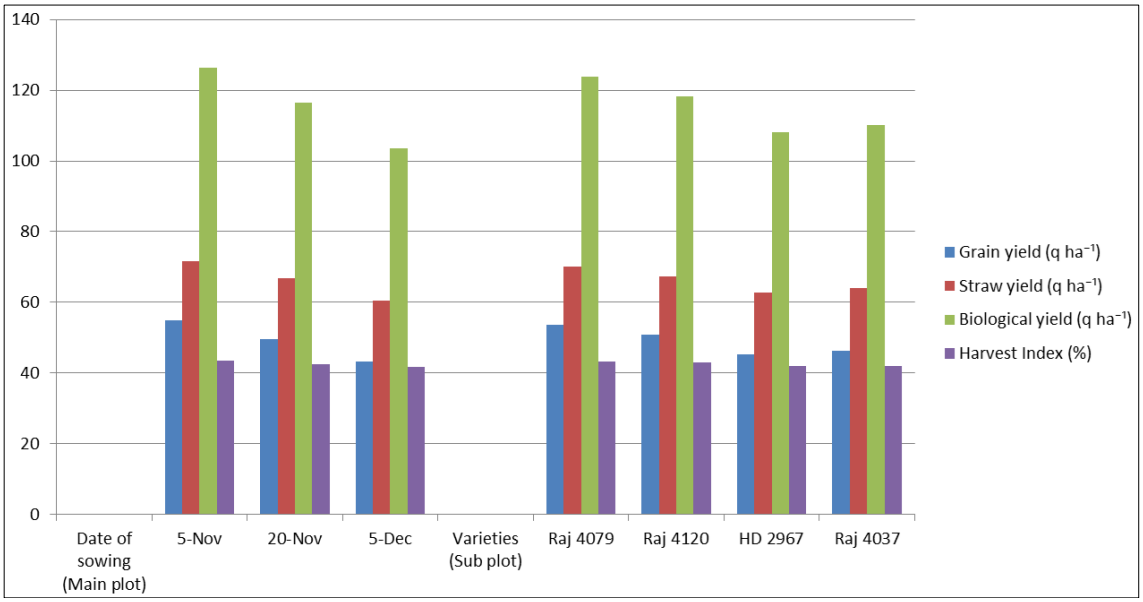

Fig 1: Effect of dates of sowing and varieties on yield and harvest index of wheat

Table 2: Effect of dates of sowing and varieties on Nitrogen Content, Nitrogen Uptake and Protein Content of wheat

Treatments	Nitrogen Content (%)	Nitrogen Uptake (kg ha^{-1})	Protein Content (%)
Date of sowing (Main plot)			
05 November	1.82	128.4	12.85
20 November	1.76	120.6	12.21
05 December	1.68	108.2	11.46
SEm±	0.03	2.85	0.21
CD (P=0.05)	0.09	8.31	0.62
Varieties (Sub plot)			
Raj 4079	1.72	114.5	11.92
Raj 4120	1.79	124.8	12.48
HD 2967	1.84	130.2	13.02
Raj 4037	1.67	105.9	11.34
SEm±	0.04	3.29	0.24
CD (P=0.05)	0.11	9.60	0.71

Result and Discussion

The present investigation clearly demonstrated that growth parameters, yield attributes and productivity of wheat were markedly influenced by different sowing dates and varieties under the agro-climatic conditions of Jaipur. The experimental findings revealed that timely sowing on 05 November along with variety Raj 4079 produced superior growth and yield performance compared to delayed sowing conditions.

Yield attributes and yield

Yield attributes such as number of effective tillers, ear length, number of grains ear^{-1} and test weight were significantly improved under timely sowing and superior varieties. Sowing on 05 November recorded maximum number of effective tillers (318.6 m^{-2}), ear length (11.4 cm), grains ear^{-1} (48.8) and test weight (42.6 g), while delayed sowing on 05 December recorded minimum values of 268.4 m^{-2}, 9.8 cm, 41.6 and 38.7 g, respectively. The higher yield

attributes under timely sowing may be due to favorable environmental conditions which promoted efficient assimilate production and translocation from source to sink. Similar findings regarding effective tillers were reported by Sial *et al*. (2005) [23]. The increase in ear length under timely sowing is in close agreement with Tomar *et al*. (2015) [26], while the higher grains ear^{-1} observed in the present investigation are supported by Ram *et al*. (2012) [22].

Among the varieties, Raj 4079 recorded maximum number of effective tillers (312.8 m^{-2}), ear length (11.2 cm), grains ear^{-1} (47.6) and test weight (43.4 g), whereas Raj 4037 and HD 2967 recorded comparatively lower values. The superiority of Raj 4079 may be attributed to better genetic makeup, efficient nutrient utilization and superior reproductive efficiency. Similar results were reported by Alam *et al*. (2013) [2], who observed higher yield attributes in superior wheat genotypes.

Grain yield, straw yield, biological yield and harvest index were significantly influenced by sowing dates and varieties. Timely sowing on 05 November produced the highest grain yield (54.8 q ha^{-1}), straw yield (71.6 q ha^{-1}), biological yield (126.4 q ha^{-1}) and harvest index (43.4%), whereas delayed sowing on 05 December produced the lowest grain yield (43.2 q ha^{-1}), straw yield (60.4 q ha^{-1}), biological yield (103.6 q ha^{-1}) and harvest index (41.7%). The reduction in yield under delayed sowing may be due to exposure of the crop to terminal heat stress during grain filling stage, resulting in reduced photosynthesis and assimilate translocation. Similar findings were reported by Qasim *et al*. (2008) [21], who observed higher grain yield under timely sowing conditions. The superiority of timely sowing for straw yield and biological yield is also supported by Kaur *et al*. (2016) [16] and Jat *et al*. (2013) [13], respectively.

Among the varieties, Raj 4079 produced the highest grain yield (53.6 q ha^{-1}), straw yield (70.2 q ha^{-1}), biological yield (123.8 q ha^{-1}) and harvest index (43.3%), whereas HD 2967 and Raj 4037 recorded comparatively lower productivity. Higher productivity of Raj 4079 may be due to better growth performance, higher tillering, superior dry matter accumulation and improved yield attributes. Similar observations were reported by Pathak *et al*. (2003) [20], who found superior grain yield in high-performing wheat varieties. The findings related to biological yield are also supported by Weber *et al*. (2003) [29].

Quality traits

The significantly higher nitrogen content and nitrogen uptake observed under 05 November sowing may be attributed to favourable temperature and environmental conditions that enhanced root growth, nutrient absorption, dry matter production and translocation of nutrients within the plant. Delayed sowing reduced the crop growth period and exposed plants to terminal heat stress, resulting in lower nitrogen accumulation and uptake. Similar findings were reported by Chaudhary *et al*. (2017) [7], who observed higher nutrient uptake under timely sowing compared with delayed sowing. Likewise, Kumar *et al*. (2018) reported that timely sowing improved nutrient uptake due to favourable growing conditions. Among the varieties, HD 2967 recorded the highest nitrogen content and uptake, which may be due to its superior genetic potential, higher biomass production and efficient nutrient utilization. Varietal differences in nutrient uptake have also been reported by Singh *et al*. (2019) [24], who found significant variation among wheat cultivars in nutrient accumulation and utilization efficiency.

Protein content was significantly higher under 05 November sowing and decreased with delayed sowing. The increase in protein content under timely sowing may be attributed to enhanced nitrogen uptake and assimilation, leading to greater protein synthesis in grains. Delayed sowing adversely affected nutrient accumulation and grain filling, resulting in reduced protein content.

Similar results were reported by Chaudhary *et al*. (2017) [7], who observed superior grain quality and protein content under optimum sowing time. Among the varieties, HD 2967 recorded the highest protein content, which could be attributed to its greater capacity for nitrogen uptake and translocation to developing grains. Since grain protein content is closely associated with nitrogen concentration, varieties with higher nitrogen uptake generally produce grains with higher protein levels. These findings are in agreement with those reported by Verma *et al*. (2020) [27], who observed significant varietal differences in protein content due to genetic variability in nutrient utilization and protein synthesis.

Overall, the present investigation clearly demonstrated that that sowing wheat on 05 November with variety Raj 4079 is the most suitable combination for achieving higher productivity and profitability under Jaipur conditions, whereas HD 2967 may be preferred when grain quality, nitrogen uptake, and protein content are the primary objectives. Thus, timely sowing remains a key agronomic practice for maximizing wheat growth, yield, and quality.

Conclusion

Based on the findings of the present investigation, it may be concluded that timely sowing on 05 November significantly enhanced growth, yield, and quality of wheat compared to delay sowing dates. Among the varieties, Raj 4079 proved superior for growth and yield performance, while HD 2967 excelled in quality traits such as nitrogen uptake and protein content. Therefore, sowing wheat on 05 November with Raj 4079 is recommended for maximizing productivity, whereas HD 2967 may be preferred when grain quality is the primary objective.

References

1. Agrawal PK, Sinha SK. Effect of probable increase in carbon dioxide and temperature on wheat yields in India. J Agric Meteorol. 1993;48(5):811-4.
2. Alam MZ, Haider SA, Paul NK, Hossain MI. Performance of wheat varieties under different sowing dates. Bangladesh J Agric Res. 2013;38(3):441-51.
3. Bhakar A, Sharma R, Kumar P, Singh D. Wheat production and varietal adaptation under semi-arid conditions of Rajasthan. Indian J Agron. 2024;69(2):145-51.
4. Association of Official Analytical Chemists. Official methods of analysis. 18th ed. Washington (DC): AOAC International; 2005.
5. Bhat MA. Wheat production and food security in India: recent trends and challenges. Indian J Agric Sci. 2025;95(1):1-8.
6. Bobade PN. Influence of temperature regimes on growth and yield of wheat. J Maharashtra Agric Univ. 2010;35(2):215-8.

7. Chaudhary R, Singh V, Kumar A. Effect of sowing dates on nutrient uptake and quality of wheat. Int J Curr Microbiol Appl Sci. 2017;6(9):1542-8.
8. David BL, Sharon AC. Climate change impacts on wheat production and grain quality. Agric Syst. 2012;108:1-12.
9. Donald CM. In search of yield. J Aust Inst Agric Sci. 1962;28:171-8.
10. Draganka D, Mladenov N, Przulj N. Wheat adaptation and climatic requirements. Genetika. 2004;36(2):123-32.
11. Easterling WE, Aggarwal PK, Batima P, Brander KM, Erda L, Howden SM, *et al*. Food, fibre and forest products. In: Parry ML, Canziani OF, Palutikof JP, van der Linden PJ, Hanson CE, editors. Climate change 2007: impacts, adaptation and vulnerability. Cambridge: Cambridge University Press; 2007. p. 273-313.
12. Gomez KA, Gomez AA. Statistical procedures for agricultural research. 2nd ed. New York: John Wiley & Sons; 1984.
13. Jat ML, Gupta R, Sharma SK. Influence of sowing time on productivity of wheat under irrigated conditions. Indian J Agron. 2013;58(3):321-6.
14. Kanwar RS. Status of wheat productivity in Rajasthan. Rajasthan J Agric Sci. 2025;16(1):25-31.
15. Kaur P, Hundal SS. Forecasting growth and yield of wheat under changing climate scenarios. J Agrometeorol. 2007;9(2):222-8.
16. Kaur R, Singh S, Brar AS. Effect of sowing dates on growth and straw yield of wheat. J Wheat Res. 2016;8(1):45-9.
17. Kumar R, Singh M, Yadav V. Effect of sowing dates on nutrient uptake and productivity of wheat. Int J Chem Stud. 2018;6(4):2215-9.
18. Ministry of Agriculture and Farmers Welfare. Fourth advance estimates of production of food grains for 2024-25. New Delhi: Government of India; 2024.
19. Parry ML, Rosenzweig C, Iglesias A, Livermore M, Fischer G. Effects of climate change on global food production under SRES emissions and socio-economic scenarios. Glob Environ Change. 2004;14(1):53-67.
20. Pathak H, Ladha JK, Aggarwal PK, Peng S, Das S, Singh Y, *et al*. Trends of climatic potential and on-farm yields of rice and wheat in the Indo-Gangetic Plains. Field Crops Res. 2003;80(3):223-34.
21. Qasim M, Qamar M, Alam MS, Alam MZ. Sowing dates effect on growth and yield of wheat. J Agric Res. 2008;46(3):211-20.
22. Ram H, Singh G, Mavi GS, Sohu VS. Effect of sowing dates on yield attributes and productivity of wheat. Indian J Agron. 2012;57(4):347-52.
23. Sial MA, Arain MA, Khanzada S, Naqvi MH, Dahot MU, Nizamani NA. Yield and quality parameters of wheat under different sowing dates. Pak J Bot. 2005;37(4):1051-8.
24. Singh AK, Kumar R, Singh RP. Nutrient uptake and utilization efficiency among wheat cultivars. J Plant Nutr. 2019;42(7):789-98.
25. Tadesse W, Amri A, Sanchez-Garcia M, El Bouhssini M, Karrou M, Baum M. Improving wheat production in the face of climate change. Adv Agron. 2016;139:1-37.
26. Tomar SS, Verma NK, Singh R. Influence of sowing dates on growth and yield attributes of wheat. Int J Agric Sci. 2015;11(2):249-53.
27. Verma S, Kumar V, Sharma P. Genetic variability in protein content and nutrient uptake among wheat cultivars. J Cereal Res. 2020;12(1):54-61.
28. Vyas SP. Wheat production technology in Rajasthan. Udaipur: Rajasthan Agricultural University Publication; 1998.
29. Weber EA, Singh M, Sharma RK. Growth analysis and biomass accumulation in wheat varieties. Crop Res. 2003;25(1):35-40.