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Effect of Sowing Dates and Varieties on Growth and Yield of Wheat (*Triticum aestivum* L.) in Central Plain Zone of U.P, India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

In Kanpur, a field experiment was carried out in sandy loam soil during the Rabi season of 2022–2023. Nine treatment combinations total—three sowing dates (November 23, November 8, and December 23) and three cultivars (K-307, K-9107, and HD-2967)—were used in the experiment. Because variety HD-2967 had higher grain ear^{-1}, grain weight ear^{-1}, and test weight than varieties K-307 and K, it yielded more. The date of sowing has a big impact on the grain yield and yield-contributing features. In comparison to the sowings on December 8 (36.34 q ha^{-1}) and December 23 (33.26 q ha^{-1}), the largest grain yield (41.66 q ha^{-1}) was reported on November 23rd. The research verified that planting after November 23rd considerably reduces production, irrespective of varieties.

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1. INTRODUCTION

The most important crop in India, after rice, which accounts for almost one-third of the country's total food grain production, is wheat (*Triticum aestivum* L.). Typically, it is eaten as "Chapati," or bread. With a production of 112.75 million tonnes and an average productivity of 3.41 tonnes per hectare, wheat is cultivated on an area of around 30.46 million hectares in India [1]. Roughly 35 % of the global population is fed by wheat, which also supplies 20% of the protein needed for human digestion. About 12 percent of wheat kernels are made up of water. The remaining contents include 65–80 percent carbohydrates, mostly in the form of starch, 8–15 percent protein, which includes sufficient amounts of all essential amino acids (apart from lysine, tryptophan, and methionine), 1.5-2 percent fats, 1.5-2 percent minerals, vitamins (like vitamin E and B complex), and 2.2 percent crude fibres. Feed and bedding for cattle are made from wheat straw [1].

Uttar Pradesh, Madhya Pradesh, Punjab, Haryana, Rajasthan, Bihar, Maharashtra, Gujarat, Karnataka, West Bengal, Uttarakhand, Himachal Pradesh, and Jammu and Kashmir are the main states that produce wheat. Almost all of the wheat produced in the nation is produced in these States. About 0.5% of the world's wheat is produced by the other states, which include Jharkhand, Assam, Chhattisgarh, Delhi, and other North Eastern states [2].

Wheat grows faster and more productively when seeded at the ideal time of year, which improves wheat quality and allows it to better adapt to its environment, physiology, and phenology. The best dates to plant provide a temperature that maximizes productivity, and choosing the right varietal is essential to producing a lot of wheat. Crop growth and yield features can be impacted by variations in the ideal temperature throughout many stages of development, such as germination, tillering, booting, ear emergence, anthesis, and maturity. However, the effects vary depending on the type of plant, variety, and phenological stage of the crop [3].

Wheat's phenological growth, yield, and efficient conversion of biomass into economic yield are all governed by the timing of sowing. Wheat that is sown on time has the best growing season, which allows the crop to gather more biomass and ultimately produce more grain and biological output. When wheat is seeded later than usual, it is subjected to lower temperatures during germination and seedling emergence, while high temperatures during the reproductive stage cause forced maturity, which lowers grain and biological yield [4].

The production of crops is also impacted by improper variety selection because different varieties perform differently based on their genetic potential and the environment in which they grow. However, wheat yield can be increased by cultivating multi-character high yielding varieties [5]. To achieve maximum yield and efficient conversion of biomass into economic yield, it is therefore important to optimize the sowing time and choose a well-performed wheat variety for the sowing time. This can be achieved by conducting a thorough investigation into the number of days required for the wheat crop to reach various phenophases and yield response throughout the growing season.

2. MATERIALS AND METHODS

The experiment was set up at the Chandra Shekhar Azad University of Agriculture and Technology's Student's Instructional Farm in Kanpur, Uttar Pradesh, India, in the Rabi season of 2022–2023. The field had certain irrigation and drainage capabilities and was levelled appropriately. Kanpur is located in a subtropical area geographically. It is located at 26o39'35" North latitude and 80o18'25" East longitude, at an elevation of 125.9 meters above mean sea level. It is located in the central region of Uttar Pradesh, which is inside the central plain zone, in the alluvial belt of the Indo- Gangetic plain. The region typically has a semi-arid climate with hot summers, little summer rainfall, and chilly winters. In this investigation, the factorial randomized block design (FRBD) was employed. Nine treatment combinations included three different sowing dates (crops sown on November 23, D_1), December 8, D_2), and December 23, D_3), as well as three different cultivars (K-307, K-9107, and HD-2967) with three replications and a plant spacing of 22.5 cm between rows. The wheat crop received a consistent recommended dose of 60 kg N, 60 kg P_2O_5, and 60 kg K_2O/ha with the application of urea, DAP, and murate of

potash as basal, respectively. At the stages of panicle start and tillering, the remaining half dose of N (60 kg) was top dressed in two equal splits. The experimental soil had a sandy loam texture with a pH of 7.7, an organic carbon content of 0.47%, 223 kg of available nitrogen/ha, 12.6 kg of available P_2O_5, and 155 kg of available K_2O. The additional cultural customs were incorporated as suggested practice bundles. Four irrigations were applied to the crop at pivotal moments during its growth. In order to measure height, ten randomly chosen plants from each plot were tagged. upon various phases, height was measured, and upon harvest, yield characteristics and yield were noted for each treatment.

3. RESULTS AND DISCUSSION

3.1 Crop Growth

The results showed that various sowing dates and varieties had a substantial impact on the growth of wheat varieties. Growth features include initial plant population, plant height, number of tillers, and dry matter accumulation of the plant. This could also be the result of favorable weather and optimal usage of the soil's moisture content during the maximum elongation period. The crop period attributed to the first, second, and third dates of sowing have all decreased, indicating that November 23 has had the most days available for plant development. The crop sown on November 23 performed better than the crop sown on December 23 in terms of dry matter accumulation (2.92 %), number of tillers (2.22 %), and growing plant height (1.0 %). Compared to late sowing, which has short growth and a short time period, the maximum growth of the plants under the 23rd November sowing may be because the plants get more time for their growth and development. In comparison to variety K-307, HD 2967 showed higher plant height (0.6 %), more tillers (0.7 %), and dry matter accumulation (2.5 %). Most likely as a result of HD 2967's superior genomes, which allow it to grow and develop better than other varieties—particularly under specific climatic conditions. These results are in conformity with the findings of Netam et al. [6], Chauhan et al. [7], Yusuf et al. [8], Singh et al. [9] and Mattas et al. [10].

3.2 Yield Attributes

According to the yield-attributing character data, the crop sown on November 23 performed noticeably better than the crops sown on December 8 and December 23. The maximum ear length (11.34 cm), the number of grains ear^{-1}, the weight of grains ear^{-1}, and the test weight below November 23 may be the result of more food material being synthesized when it is sown on time. The increase seen under various yield attributes differed according to the following parameters: test weight (2.37 %), length of ear (14.92 %), grain weight ear^{-1} (20.35 %), and grains ea^{r-1} (11.44 %) under 23rd November sowing compared to 23rd December sowing. In comparison to variety K-307, HD 2967 reported superior yield features in terms of test weight (0.89 %), grains ear^{-1} (10.63 %), length of ear length (8.62 %), and grain weight ear^{-1} (12.21 %). Similar findings were also reported by Pathania et al. [11], Mumtaz et.al. [12], and Chauhan et al [7].

3.3 Yield

The yield statistics of wheat was impacted greatly by the varieties and the times of sowing. The wheat's biological yield rose by 5.33 percent and 11.60 % on November 23 in comparison to the sowing dates of December 8 and December 23. In a similar vein, grain yield rose by 20.16 % during the 23 November and 23 December sowings. When comparing the 23rd December seeding to the 23rd November sowing, the straw yield improved by 7.08 %. Additionally, during 23rd November sowing as opposed to 23rd December sowing, the harvest index improved by 10.03 percent. Compared to K-307, HD 2967 yielded a higher maximum biological yield (3.79 %), grain yield (4.01 %), straw yield (4.24 %), and harvest index (0.50 %) under different varieties. It might be due to better genomics characters as well as better growth characteristics and yield attributes of the variety HD 2967. Similar findings were reported Singh et al. [13], Mumtaz et.al. [12], Jitendra et al. [14] and Gupta et al. [15,16].

Table 1. Effect of sowing dates and varieties on growth and yield of wheat during 2022-23

Treatments	Growth characters				Yield attributes				Yield			
	Plant population (m-2)	Plant height (cm)	Tillers (m-2)	Dry matter accumulation (g m-2)	Length of ear (cm)	Grain weight ear-1 (g)	Grains ear-1	Test weight (g)	Biological yield (q ha-1)	Grain yield (q ha-1)	Straw yield (q ha-1)	Harvest index (%)
Date of sowing												
23rd November	120.47	99.47	390.33	1133.77	11.34	2.32	44.11	37.44	120.83	41.66	79.16	34.69
8th December	120.44	99.08	384.33	1117.70	9.81	2.02	41.55	37.22	114.50	36.34	78.15	31.81
23rd December	120.22	98.55	381.66	1100.6	9.66	1.85	39.06	36.55	106.92	33.26	73.55	31.21
SE±(D)	0.29	0.32	1.728	1.381	0.103	0.03	0.550	0.345	0.659	0.381	1.129	0.410
CD (P=0.05)	NS	0.69	3.69	2.59	0.22	0.10	1.09	NS	1.41	0.81	2.41	0.87
Varieties												
K-307	120.05	98.21	385.33	1096.33	9.85	1.94	39.50	37.22	110.10	37.27	72.82	33.74
K-9107	120.41	99.25	383.11	1142.82	10.17	2.04	41.03	36.44	117.71	35.26	82.00	30.06
HD-2967	120.67	99.65	387.88	1113.01	10.78	2.21	44.20	37.55	114.44	38.83	76.05	33.89
SE±(V)	0.29	0.32	1.728	1.381	0.103	0.03	0.550	0.345	0.659	0.381	1.129	0.410
CD (P=0.05)	NS	0.69	3.69	2.59	0.22	0.10	1.09	NS	1.41	0.81	2.41	0.87
Interaction(D*V)												
SE	0.50	0.56	2.99	2.39	0.179	0.07	0.953	0.598	1.142	0.660	1.955	0.711
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

4. CONCLUSION

This study emphasizes the critical role of timely sowing and the selection of high-yielding varieties in enhancing wheat growth and yield in the central plain zone of Uttar Pradesh. The findings advocate for adopting the 23rd November sowing date and the HD-2967 variety to maximize wheat productivity

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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