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Response of new wheat (*Triticum aestivum* L.) varieties under late sown conditions

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Abstract
A field experiment was conducted during *Rabi* season of 2023-24 at Agricultural Research Farm, Department of Agronomy, R.B.S. College, Bichpuri, Agra (U.P.) the investigation "Performance of new wheat (*Triticum aestivum* L.) varieties under late sowing conditions". The Variables involved in this study were two dates of sowing D_1 (Late-10th Dec.) and D_2 (Very Late-10th Jan.) and five varieties of wheat *viz*. HD 3059 (V_1), PBW771 (V_2), HD 3428 (V_3), DBW 173 (V_4) and JKW261 (V_5). Thus, in all 10 treatment and combinations were compared in a split plot design having dates of sowing in main plots and varieties in sub plots with three replications. The results indicated that the December (10th) sowing date was found best for different varieties of wheat under irrigated conditions. Among the tested wheat varieties PBW771 (V_2) exhibited superior performance concerning grain yield. Based on the highest net return and B:C ratio, it is recommended that farmers in the Agra region sown Wheat varieties PBW771 (V_2) on December 10th.

Keywords: Irrigated conditions, late sowing, sowing date, varieties, wheat, yield

Introduction

Wheat (*Triticum aestivum* L.) is the most important staple food crop of the world and emerged as the backbone of India's food security. It is grown all over the world for its wider adaptability and high nutritive value. It is an important winter cereal contributing about 35 percent of the total food grain production in India. Wheat straw is an important source of fodder for a large animal population in India. (Kumar *et al.*, 2019) [3]. In general wheat contains carbohydrate (70%), protein (12%), lipid (2%), vitamins & minerals (2% each) and crude (Archna, *et al*., 2023) [1]. But over the past few centuries, human activity particularly since the industrial revolution has significantly altered the makeup of the atmosphere. In spite of a changing climate, climate-resilient agronomy aims to maintain sustainable food production and stable livelihoods for farmers. (Singh *et al*., 2023) [1].

Selection of suitable varieties plays a vital role in crop production. The choice of right varieties of wheat helps to augment crop productivity by about 20-25 percent. Any varieties of wheat before being recommended for general cultivation for particular region must be judged for its potential, tolerance against disease in general and in particular responsiveness to added water and fertilizer and adaptability to different agro-climatic conditions. Thus, the value of stable and high yielding genotypes has been universally recognized as an important factor for boosting crop production. (Kumar *et al*., 2019) [3]. Phosphorus is also important in cell division and development of new tissues. (Singh *et al.,* 2022) [2]. On the other hand, enhanced cultivars that have been chosen for high yields under high nutrient input circumstances are frequently generated without taking into account their capacity to grow and yield under low soil nutrient status. (Lokendra *et el.,* 2024) [5]. In spite of a changing climate, climate-resilient agronomy aims to maintain sustainable food production and stable livelihoods for farmers. (Singh *et al.,* 2023) [1]. The dates of sowing trial conducted during past 25 year under AICWP showed that delay in barley sowing from normal to late decrease the yield by 34.2 kg ha-1 per day or 19.8 percent in NWPZ. Similarly, for late sown varieties, delay in barley sowing from late to very late lead to decline by the grain yield. Islamuddeen, *et al.,* (2022) [2].

Materials and Methods

A field experiment was conducted at agricultural research farm of Raja Balwant Singh Collage, Bichpuri, Agra, during *Rabi* season of 2023-24 to the investigation reported here was carried out during Rabi season on 2023. The Barley varieties were procured from the Indian Institute of Wheat and Barley Research (IIWBR), Karnal, Haryana, through the all-India Co-ordinated Wheat and Barley Improvement Project, and treated with Agrosan GN @ 2g kg^{-1} seed. The sowing was accomplished in furrows 5 cm. depth at a distance of 18 cm. apart, employing a seed rate of 100 kg ha^{-1} (seed rate was adjusted by considering the weight of 1000 seeds 40 g). The soil of experimental field was moderately fertile, being low in organic carbon (0.31%), available nitrogen (181.50 kg ha^{-1}), available phosphorus (27.5 kg P_2O_5 ha^{-1}) and rich in available potassium (285.0 kg K ha^{-1}). The Variables involved in this study were two dates of sowing D_1 (Late-10th Dec.) and D_2 (Very Late-5th Jan.) and five varieties of wheat *viz*. HD 3059 (V_1), PBW771 (V_2), HD 3428 (V_3), DBW 173 (V_4) and JKW261 (V_5). Thus, in all 10 treatment and combinations were compared in a split plot design having dates of sowing in main plots and varieties in sub plots with three replications. One third of recommended dose of nitrogen (120 kg N ha^{-1}), full doses of phosphorus (60 kg P_2O_5 ha^{-1}) and potash (40 kg K_2O ha^{-1}) were supplied through DAP and MOP, respectively as basal dose at sowing time. Remaining 2/3rd nitrogen was applied through urea top dressing 1/3rd after 1st irrigation and 1/3rd after 2nd irrigation.

Results and Discussion

Yield attributes

The yield-attributing characters of wheat were significantly influenced by different dates of sowing. Late sowing (10th December) resulted in a higher stand count (287.57 m²), number of earheads per square meter (276.27), and number of grains per earhead (55.26), compared to very late sowing (10th January), which recorded lower values of 260.30, 248.33, and 48.07, respectively. Similarly, the number of grains per spike and weight of grains per spike were also higher under late sowing conditions (56.27 and 1.87 g, respectively) compared to very late sowing (51.14 and 1.67 g, respectively). The 1000-grain weight was also affected by the sowing dates, with late sowing recording a significantly higher weight (40.28 g) compared to very late sowing (37.30 g). The reduction in yield attributes under very late sowing could be attributed to the exposure of the crop to higher temperatures during the reproductive phase, leading to poor grain filling. The statistical analysis showed significant differences (p=0.05) for most of the parameters, except for the number of grains per earhead and weight of grains per spike, which were non-significant. Similar findings have also been reported by Kumar *et al*., (2019) [3], Singh *et al.*, (2022) [2], Singh *et al.*, (2023) [1], Singh *et al.*, (2024) [10], Lokendra *et el.,* (2024) [5] and Singh *et al.* (2024) [10].

Table 1: Yield attributing characters of wheat as influenced by different treatments

Treatments		Stand count m^{-2}	Number of earhead m^{-2}	Number of grains earhead^{-1}	Number of grains spike^{-1}	Weight of grains spike^{-1}	1000 grain weight (g)
Dates of sowing							
Late (10 Dec.)	D_1	287.57	276.27	55.26	56.27	1.87	40.28
Very late(05 Jan.)	D_1	260.30	248.33	48.07	51.14	1.67	37.30
SEm±		0.63	0.65	2.61	0.45	0.05	0.24
CD (p=0.05)		3.86	3.98	NS	2.72	NS	1.48
varieties							
HD 3059	V_1	271.33	260.17	52.58	52.50	1.06	38.00
PBW771	V_2	278.58	265.50	53.86	56.50	2.76	40.05
HD 3428	V_3	274.08	262.83	54.24	54.17	1.53	38.89
DBW 173	V_4	269.58	259.00	43.12	50.50	1.36	37.38
JKW261	V_5	276.08	264.00	54.55	54.85	2.14	39.65
SEm±		1.66	1.25	3.20	0.84	0.06	0.42
CD (p=0.05)		4.99	3.76	NS	2.51	0.19	1.26

Among the varieties, JKW261 (V_5) recorded the highest number of grains per earhead (54.55) and grains per spike (54.85), followed by PBW771 (V_2) and HD 3428 (V_3). The lowest number of grains per earhead (43.12) was observed in DBW 173 (G4). The stand count per square meter ranged from 269.58 (DBW 173) to 278.58 (PBW771), with PBW771 also exhibiting a higher number of earheads per square meter (265.50). In terms of grain weight parameters, PBW771 recorded the highest weight of grains per spike (2.76 g), followed by JKW261 (2.14 g). The 1000-grain weight was also highest in PBW771 (40.05 g), whereas the lowest was observed in DBW 173 (37.38 g). The statistical analysis indicated significant differences (p=0.05) for most parameters, except for the number of grains per earhead, which was non-significant. The variation in yield attributes among varieties could be due to genetic differences influencing growth, grain filling capacity, and adaptation to environmental conditions. PBW771 and JKW261 showed superior performance in terms of yield parameters, suggesting their suitability for obtaining higher productivity under the given conditions. Similarly finding data to supported by Ramesh *et al*., 2023 [6], Sonia, *et al*., 2023 [6], Sonia, *et al*., 2023) [6], Singh *et al*., (2023) [1], Singhal *et al.,* (2023) [14], Singh *et al*., (2024) [10]. Kumar *et al.* (2025) [4].

Yield

The data presented in Table 2 indicate that the sowing date significantly influenced the biological, grain, and straw yields of wheat. The late sowing date (10th December) recorded a significantly higher biological yield (134.00 q/ha) compared to very late sowing (5th January), which produced 96.50 q/ha. Similarly, grain yield was significantly higher under late sowing (52.67 q/ha) than very late sowing (38.13 q/ha), showing a reduction in yield due to delayed sowing. The straw yield followed a similar trend, with late sowing producing 81.32 q/ha, significantly higher than the 58.36 q/ha recorded in very late sowing. The decline in grain and straw yields under very late sowing can be attributed to a shortened growing period, reduced biomass accumulation, and increased temperature stress during grain filling, leading to lower productivity. The harvest index, which represents the efficiency of biomass conversion into economic yield, remained statistically non-significant between the two sowing dates. However, very late sowing (39.55%) showed a slightly higher harvest index than late sowing (39.30%), indicating that despite the overall yield reduction, the partitioning of biomass into grains remained relatively stable. Similar results were also reported by Singh *et al.*, (2022) [2], Singh *et al.* (2024) [10] and Verma *et al.* (2025) [16].

Table 2: Biological, grain and straw yields and harvest index as influenced by various treatments.

Treatments		Biological yield (qha^{-1})	Grain Yield (qha^{-1})	Straw Yield (qha^{-1})	Harvest index (%)
Dates of Sowing					
Late (10 Dec.)	D_1	134.00	52.67	81.32	39.30
Very late (05 Jan.)	D_2	96.50	38.13	58.36	39.55
SEm±		0.45	0.86	0.42	0.54
CD (p=0.05)		2.71	5.24	2.57	NS
Varieties					
HD 3059	V_1	114.53	45.37	69.16	39.46
PBW771	V_2	118.87	48.49	70.38	40.96
HD 3428	V_3	116.50	45.93	70.57	39.44
DBW 173	V_4	107.85	41.62	66.23	38.58
JKW261	V_5	118.49	45.61	72.88	38.68
SEm±		1.27	1.02	1.60	1.01
CD (p=0.05)		3.79	3.06	NS	NS

Among the wheat varieties, PBW771 (V_2) recorded the highest biological yield (118.87 q/ha), followed closely by JKW261 (118.49 q/ha) and HD 3428 (116.50 q/ha). The lowest biological yield was observed in DBW 173 (107.85 q/ha). This variation in biological yield suggests genetic differences in growth potential and adaptability to environmental conditions. Grain yield was also significantly influenced by varieties, with PBW771 producing the highest yield (48.49 q/ha), followed by HD 3428 (45.93 q/ha) and JKW261 (45.61 q/ha). The lowest grain yield was recorded in DBW 173 (41.62 q/ha), which also had the lowest biological yield. The variation in grain yield among varieties can be attributed to differences in their genetic potential for grain formation, grain filling efficiency, and adaptation to prevailing environmental conditions. The straw yield ranged from 72.88 q/ha in JKW261 to 66.23 q/ha in DBW 173, but the differences were not statistically significant. The harvest index showed minor variations among varieties, with PBW771 recording the highest value (40.96%), suggesting efficient partitioning of biomass into grains. However, the differences in the harvest index were statistically non-significant. These results highlight that both sowing date and varieties selection are crucial factors influencing wheat productivity. Timely sowing ensures favorable growing conditions, while selecting high-yielding varieties such as PBW771 and JKW261 can further enhance yield potential under the given agro-climatic conditions. Similar results were also reported by Singh *et al.*, (2024) [10], Singh *et al.* (2024) [10] and Singh *et al.* (2025) [7].

Conclusion

The conclusion indicates that late sowing on December 10th resulted in significantly higher biological yield (134.00 q/ha), grain yield (52.67 q/ha), and straw yield (81.32 q/ha) compared to very late sowing on January 10th, which recorded lower yields due to shortened growing periods and increased temperature stress during grain filling. Among the tested wheat varieties, PBW771 (V2) exhibited the highest biological yield (118.87 q/ha), grain yield (48.49 q/ha), and harvest index (40.96%), making it the most suitable variety for maximizing wheat production under late-sown conditions. JKW261 (V5) also performed well, demonstrating good adaptability and yield potential. The results suggest that to achieve optimal wheat yields in the Agra region, farmers should prefer sowing wheat on December 10th and consider high-yielding varieties like PBW771 and JKW261. This approach can enhance productivity, profitability, and resource-use efficiency under late-sown conditions.

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