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EFFECT OF DIFFERENT SOWING DATES ON PRODUCTIVITY AND PROFITABILITY OF WHEAT (*Triticum aestivum* L.)

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ABSTRACT

A field experiment was conducted at the experimental farm of Choudhary Sarwan Kumar Himachal Pradesh Krishi Vishvavidyalya, Palampur during *rabi* 2023-2024, to assess wheat performance under different sowing dates. The experiment followed a split plot design with four sowing dates (45th, 47th, 49th and 51st Standard Meteorological Weeks assigned to main plots and three varieties (HPW368, HPW373 and HS 562) to sub plots, with three replications. The experimental site had silty clay loam soil with an acidic reaction (pH 5.5). Yield attributes (effective tillers m^{-2}, grains per spike, spike length, and 1000-grain weight) and yields (grain yield, straw yield, and harvest index) were highest in wheat sown during the 45th SMW, while the 51st SMW recorded the lowest values. Among the varieties, HPW 368 showed exceptional performance, achieving top values for all evaluated parameters. In conclusion, sowing on 45th SMW with HPW 368 represents the most productive treatment combination.

Keywords **:** Attributes; standard meteorological week, wheat, yield.

Introduction

Wheat (*Triticum aestivum* L.) is the second major cereal crop in India, cultivated over 336 lakh hectares with a production of 106.57 million tonnes and an average productivity of 3591 kg ha^{-1} (Anonymous 2025). In Himachal Pradesh, it occupies about 324 thousand hectares with a production of 620 thousand metric ton and a productivity of 1913.58 kg ha^{-1} (Anonymous 2024).

Wheat is a temperature-sensitive crop, where exposure to low temperatures during the vegetative stage and high temperatures during the reproductive stage accelerates crop maturity, leading to reduced growth duration under North Indian conditions (Girijesh *et al.*, 2011). Temperature significantly influences the sowing time and ultimately the productivity of crop. A change in seasonal temperature affects wheat productivity by altering the crop's phenology. A decline in potential yield is primarily associated with decreasing solar radiation and increasing minimum temperatures in the Indo-Gangetic plains of India (Pathak *et al.*, 2003).

Crop productivity is majorly depend upon the sowing time and suitable variety selection. Optimum sowing dates are critical for maximizing yield as these provide favourable temperature during key growth stages, which help in avoiding high-temperature stress which may have the negatively impact on yield (Kajla *et al.*, 2015; Mumtaz *et al.*, 2015). Delayed sowing reduces tillering and crop growth due to suboptimal early temperatures and exposes the crop to high temperature during the reproductive phase, resulting in forced maturity and reduced yield components such as tiller number and grains per spike (Ansary *et al.*, 1989; Pathak *et al.*, 2003; Gupta *et al.*, 2019).

Sowing time and varietal selection are key determinants of grain yield and quality, particularly influencing traits such as 1000-grain weight (Ali *et al.*, 2010).Wheat yield and its components decrease with delayed sowing due to high temperature leading to shortening of the growing season (Suleiman *et al.*, 2014). Selection of inappropriate varieties reduces the yield. Therefore, cultivating well-adapted, high-yielding varieties offer an opportunity to boost wheat yield (Hussain *et al.*, 2012). In this context, the present

study was conducted to evaluate the effect of different sowing dates and wheat varieties on yield attributes, yield, and profitability.

Materials and Methods

The field experiment was conducted during *rabi* 2023-2024 at the Experimental Farm Department of Agronomy, CSK Himachal Pradesh Krishi Viswavidyalaya, Palampur. The location of the experiment was around 1290 m above sea level at 32º6' N latitude, 76º3' E longitude. During the crop growing season (November 2023 to May 2024), the weekly minimum and maximum temperatures varied between 1.8˚C to 19.1˚C and 13.6˚C to 32.4˚C, respectively. The total rainfall received during the crop season was 360 mm, however, it was unevenly distributed during the early stages of crop growth. The bright sunshine hours ranged from 3.4 hours to 11.1 hours and the mean relative humidity between 37 to 73 per cent during the cropping period.

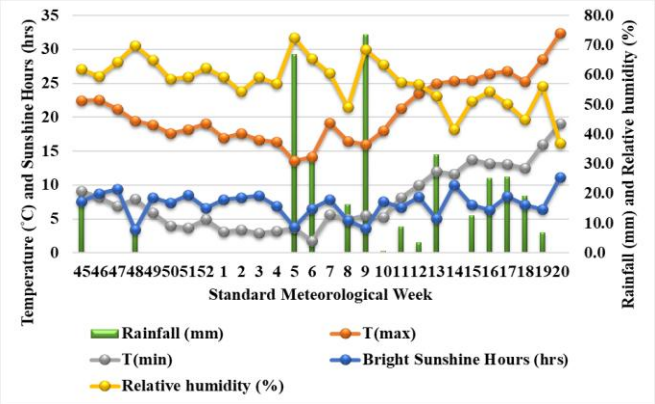

Fig. 1 : Mean weekly data during the crop season

The experiment was laid out in a split-plot design with four sowing dates in the main plots (5–11 November, 12–18 November, 3–9 December, and 17–23 December) and three varieties (HPW 368, HPW 373, and HS 562) in subplots, with three replications. The seed rate of 125 kg ha^{-1} was used for sowing at a row-to-row distance of 20 cm at a depth of 5 cm. All treatments received a uniform fertilizer dose of 120 kg N ha^{-1} (urea), 60 kg P_2O_5 ha^{-1} (single superphosphate), and 40 kg K_2O ha^{-1} (muriate of potash). During final field preparation, half of the nitrogen and the full amount of phosphate and potassium were applied. The remaining half-dose of nitrogen was top dressed after the first irrigation.

Results and Discussion

Yield attributes

The number of effective tillers is directly related to yield, which leads to higher productivity of the crop. Sowing during the 45th SMW (5th November) recorded a significantly higher number of effective tillers m^{-2}, which was statistically at par with the 47th SMW (20th November), followed by 49th and 51st SMW (Table 1). The reduction in effective tillers under delayed sowing can be attributed to a decrease in the initial plant stand, which affects the overall tiller formation.

Crops sown during the 45th SMW recorded a significantly higher number of grains per spike, remaining at par with the 47th SMW and followed by 49th and 51st SMW. Higher grains per spike under timely sowing may be associated with an extended vegetative growth period, promoting better development of reproductive structures. Spike length followed a similar trend, with significantly higher values observed under 45th SMW, which was at par with 47th SMW, followed by 49th and 51st SMW.

Improved performance under early sowing may be attributed to favourable temperature conditions during critical growth stages. Similar findings have been reported in previous studies (Tomar *et al.*, 2014; Basir *et al.*, 2015; Deshmukh *et al.*, 2015; Mukherjee *et al.*, 2018; Lal *et al.*, 2018; Sah *et al.*, 2022), where early sowing enhanced tiller number, spike length, grains per spike, and 1000-grain weight compared to delayed sowing. Among the varieties, HPW-368 performed superior to the others. However, the interaction effect of different sowing dates and varieties on number of grains per spike, length of spike and 1000-grain weight were found to be non-significant.

Among varieties, HPW 368 recorded a significantly higher number of effective tillers across sowing dates and remained at par with HS 562, except under the 51st SMW. Across sowing dates, all varieties produced higher tiller numbers under 45th SMW, which remained comparable with 47th SMW for HPW 368 and HS 562.

Table 1 : Effect of different sowing dates and varieties on yield attribute of wheat

Treatment	No. of effective tillers/m^2	No. of grains/spike	Length of spike (cm)	1000-grain weight (g)
Date of sowing				
45th SMW (5th November)	248.8	34.1	13.5	40.8
47th SMW (20th November)	240.2	32.3	12.9	40.1
49th SMW (5th December)	220.0	30.4	11.0	39.7
51st SMW (20th December)	205.4	28.0	9.9	38.5
SE (m) ±	3.4	0.6	0.3	0.1
CD (P=0.05)	11.9	2.0	0.9	0.2

Variety				
HPW 368	237.8	31.9	12.1	40.9
HPW 373	218.4	30.4	11.3	38.5
HS 562	229.6	31.3	11.9	39.9
SE (m) ±	1.5	0.3	0.1	0.1
CD (P=0.05)	4.6	1.1	0.4	0.3

Table 2 : Interaction effect of treatments on the number of effective tillers/m^2

Variety	**Date of sowing**			
	45th SMW (5th November)	47th SMW (20th November)	49th SMW (5th December)	51st SMW (20th December)
HPW 368	255	249	226	221
HPW 373	240	228	216	190
HS 562	252	244	218	205
CD (P=0.05)				
For comparison of varieties at same date				9.1
For comparison of dates at same or different varieties				14

YIELD

The grain yield of wheat was reduced with delayed sowing from 45th SMW (5th November) to 51st SMW (20th December). 45th SMW sown crop produced significantly highest grain yield, straw yield and harvest index followed by 47th SMW, 49th SMW and 51st SMW. The higher yield under 45th SMW sowing may be attributed to superior yield attributes, including higher tiller density, longer spikes, more grains per spike, and greater 1000-grain weight. Yield reduction under delayed sowing was associated with declines in effective tillers, grains per spike, and 1000-grain weight, leading to lower grain yield at 51st SMW. These findings are consistent with earlier reports (Said *et al.,* 2012; Meena *et al.,* 2015; Yusuf *et al.,* 2019; Sattar *et al.*, 2023).

Among the varieties, HPW 368 recorded higher grain yield, straw yield, and harvest index, followed by HS 562, due to superior yield attributes. The interaction effect of sowing dates and varieties on the grain yield was found to be significant. A date-wise comparison of varieties revealed that HPW 368 produced a significantly higher grain yield at all date of sowing, which was at par with HS 562 at all the sowing dates, except at 49th SMW. Across sowing dates, all varieties produced higher grain yield under the 45th SMW, followed by 47th, 49th, and 51st SMW. For HPW 368, yield declined consistently with delayed sowing. In HS 562, the 45th and 47th SMW remained statistically comparable, whereas in HPW 373, yields at 47th and 49th SMW were at par.

Table 3 : Effect of different sowing dates and varieties on yield of wheat

Treatment	**Grain yield (kg/ha)**	**Straw yield (kg/ha)**	**Harvest Index**
Date of sowing			
45th SMW (5th November)	3922	5692	40.8
47th SMW (20th November)	3635	5349	40.5
49th SMW (5th December)	3303	4926	40.1
51st SMW (20th December)	2891	4366	39.8
SE (m) ±	48.8	72.1	0.3
CD (P=0.05)	168.8	249.5	NS
Variety			
HPW 368	3692	5454	40.3
HPW 373	3120	4625	40.2
HS 562	3501	5171	40.3
SE (m) ±	48.3	71.2	0.2
CD (P=0.05)	144.8	213.5	NS

Table 4 : Interaction effect of different sowing dates and varieties on grain yield of wheat

Variety	**Date of sowing**			
	45th SMW (5th November)	47th SMW (20th November)	49th SMW (5th December)	51st SMW (20th December)
HPW 368	4269	3924	3564	3012
HPW 373	3435	3187	3110	2750
HS 562	4061	3795	3234	2913

CD (P=0.05)	
For comparison of varieties at same date	289.9
For comparison of dates at same or different varieties	290.1

Economics

The data presented in Table 5 revealed that the highest cost of cultivation (₹ 52,894 ha^{-1}) was observed on 45th SMW and 47th SMW sowing followed by 49th SMW and 51st SMW. The higher cost is attributed to the increased number of irrigations required for the earlier sowing dates. All varieties had similar cost of cultivation.

Higher gross returns, net returns and benefit-cost ratio was recorded when wheat was sown during 45th SMW and the returns decreased with delayed sowing for 51st SMW. The higher economic returns under early sowing were associated with greater grain yield under favourable growing conditions.

Among the different varieties, maximum gross returns, net returns and benefit-cost ratio were obtained from HPW 368 followed by HS 562 and HPW 373. The least gross returns, net returns and benefit-cost ratio were recorded for HPW 373.

Table 5 : Effect of different dates of sowing and varieties on economic studies of wheat

Treatment	Cost of cultivation (Rs./ha)	Gross returns (Rs./ha)	Net returns (Rs./ha)	B:C
Date of sowing				
45th SMW (5th November)	52894	136764	83870	1.59
47th SMW (20th November)	52894	126402	73509	1.39
49th SMW (5th December)	52144	115367	63223	1.21
51st SMW (20th December)	52144	104053	51909	1.00
Variety				
HPW 368	52519	130010	77492	1.47
HPW 373	52519	109392	56873	1.08
HS 562	52519	122537	70019	1.33

Conclusion

Early sowing (45th SMW, 5th November) resulted in the maximum number of effective tillers, grains per spike, spike length, 1000-grain weight, grain yield and straw yield followed by later sowing dates. HPW 368 consistently performed best across all yield attributes, followed by HS 562 and HPW 373. Harvest index was not significantly affected by sowing dates or varieties, although slightly higher values were observed under early sowing with HPW 368. The economic studies revealed that the highest cost of cultivation occurred with early sowing (45thand 47thSMW) because of more irrigation environment. The highest values of gross returns, net returns and benefit-cost ratio were recorded for wheat sown on the 45thSMW. Among the varieties, HPW 368 yielded the highest gross returns, net returns and benefit-cost ratio. Sowing during the 45th SMW (early November) with variety HPW 368 is recommended for maximizing wheat productivity and economic returns under mid-hill conditions of Himachal Pradesh.

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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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