

Impact of sowing dates on different growth attributes and yield of wheat in North Western Himalayas

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ABSTRACT

Sowing time is an important agronomic factor that significantly affects plant growth, development and yield. Similarly, suitable cultivar also plays an appreciable role in final productivity. Therefore, the present study was conducted to determine the Impact of sowing dates and varieties on different growth attributes and yield of wheat in North Western Himalayas. A Field experiment were conducted at Hill Agricultural Research and Extension Centre (HAREC), Bajaura (1074m altitude) and HAREC, Dhaulakuan (411m altitude) during *rabi* season of 2016-17 which comprises of three dates of sowings (25th October, 25th November, 25th December) and four varieties (HS-542, HS-490, HPW-349, VL-907) which was laid down in Factorial Randomized Block Design (FRBD) with three replications. Altitude plays a major role at both the locations and found that with decrease in temperature in delayed sowing the number of days taken to complete the physiological maturity decreased in all the dates and at all the locations. For grain and straw yield, Bajaura was found to be the most suitable location, showing significant superiority over all other locations. 25th October and 25th November sowings being at par with each other was significantly higher than 25th December sowing at all the locations. Among varieties, VL-907, HS-542 and HPW-349 being at par with each other had significantly higher grain and straw yield than HS-490. Bajaura gave significantly more number of effective tillers/m² and emergence count. Sowing at 25th October and 25th November being at par with each other gave significantly more number of plants per metre square than 25th December sowing at both of the locations.

Introduction

Wheat is undoubtedly one of the World's major crops and a vital component of the global food security issue. Wheat is often regarded as the king of grains, as it feeds 38 percent of the World's population and accounting for almost 22 percent of all global dietary calories (Kumar *et al.*, 2013). Being a *rabi* crop, wheat necessitates precise climatic conditions for optimal emergence, growth,

and flowering, and is susceptible to high temperatures during reproductive stages (Kalra *et al.*, 2008). In 2016-17, Wheat was being cultivated across an area of 340 thousand hectares with yield of 650 thousand tonnes and an average productivity of 19.21 q/ha in Himachal Pradesh (Anonymous, 2017). In a rice-wheat system, late sowing of wheat exposes the pre-anthesis stage to higher

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temperatures, which affect grain maturity and subsequently yield (Nagarajan *et al.*, 2008). The build-up of heat units above the threshold temperature is related to the phenological development of crops. To achieve a specific phenophase, a specified value of heat units is required. In cereal crops; various developmental stages are evident during which key physiological processes occur (Sikder, 2008). Before reaching phenological stages, plants require a specified temperature. At grain filling stage, the greatest loss for crop production is due to extremely high temperature i.e., temperature is the foremost determinant of development and as well as productivity of wheat. (Balla *et al.*, 2009). Several studies have discovered that optimum temperatures being 12-25 °C, affect wheat phenology, growth, development, and yield (Hakim *et al.*, 2012).

Wheat is grown in altitudes ranging from below sea level near the Dead Sea and in California's Imperial Valley to as high as 5000 metres in Tibet. In India, it is grown upto an elevations of 4000 m above mean sea level in the Himalayas. This wider adaptability of wheat is by virtue of large variability in the genotypes/varieties available. The climate of lower or mid altitudes differ greatly from that of high altitudinal regions at the same latitude. Its altitude does not only govern climate/weather condition at a given location but other physiographic characteristics also play a significant role. Sowing time in different altitudes provide differential growth conditions such as maximum and minimum temperature, daily sunshine, precipitation, growth period and genetic potential of wheat variety (Safdar *et al.*, 2008). These periodic changes in the weather elements brings about sharp changes in the growth, development and ultimately yield of a given variety. The purpose of this research is to give an overview of the influence of elevated temperatures affect wheat phenology.

Material and Methods

A field experiment was conducted during the *Rabi* season of 2016-17, field experiments were conducted with the combination of three dates of sowing (25th October, 25th November, 25th December) and four varieties (HS-542, HS-490, HPW-349, VL-907) which was replicated three times in Factorial Randomized Block Design

(FRBD) at two different location sites which were situated at Hill Agricultural Research and Extension Centre (HAREC), Bajaura about 1074m amsl and Hill Agricultural Research and Extension Centre (HAREC), Dhaulakuan about 411m amsl. The mean weekly temperature at Dhaulakuan ranged between, 12.5 °C - 27.8 °C, Bajaura, 5.8 °C - 23.6 °C, during crop growing season (October to May). The lowest minimum temperature at Bajaura has reflected in more number of days taken for completion of different phenophases at the station. The lines of mean temperature for Dhaulakuan indicating higher mean temperature. The rainfall of 425mm at Bajaura and 275mm at Dhaulakuan. The emergence count was recorded from the sampling area (1 square metre) every alternate day from the first date of seeding until emergence was constant. The number of plants per square metre were counted. To control the weeds manual weeding or hand weeding was done two times after appearing of weeds. The stage on which plants in each plot turned golden yellow and the grains did not crush with teeth was carefully judged. The date on which grains attained sufficient hardness was recorded and days taken for physiological maturity were counted from the sowing date. The number of tillers per running metre length were counted before harvest and expressed as effective tillers per metre square by multiplying with factor 4.44. After sun drying, the produce from each net plot was gathered and threshed. After threshing, the grains were cleaned and weighed. Weight of grains recorded on each plot was calculated and converted to q/ha. Weighing the sun dried harvested crop yielded the total biological yield (grain + straw) for each net plot. By deducting the grain yield from the biological yield q/ha, the straw yield was calculated.

Results and Discussion

Emergence count

Emergence count (number of plants/m²) in different dates and varieties at different locations. With the delay in sowing from 25th October to 25th December, the emergence count decreased. All the varieties were at par with each other at both locations (Table 1). This might be due to delayed sowing of wheat tends to face high temperature which leads to reduction in emergence count.

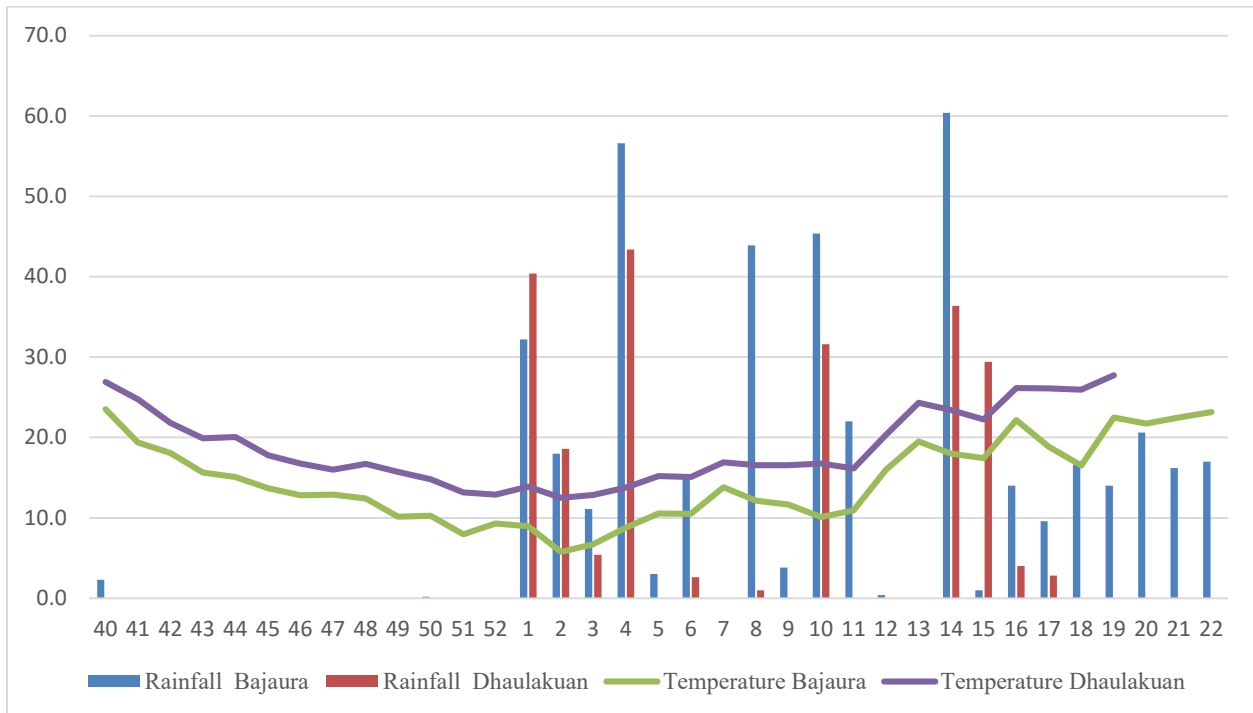


Figure 1: Mean temperature and rainfall recorded at Bajaura and Dhaulakuan locations.

Moreover, each day of sowing delay beyond the optimum time (up to mid-November) results in more days taken to emergence and also emergence count throughout the region. Similar results have been reported by Abhishek et al. (2016).

Days to physiological maturity

To complete physiological stage 25th October followed by 25th November sowing took significantly more number of days than 25th December dates at both locations. At Bajaura, it took highest number of days than Dhaulakuan (Table 1). At Bajaura, HS-542, HS-490 and HPW-349 and at Dhaulakuan, HS-542 and VL-907 were at par with each other.

As a result of the longer time between sowing to physiological maturity, the average temperature increased. The number of days taken decreased as the temperature is raised. Sial et al. (2005) discovered that delayed planting had a significant impact on plant growth and transfer of nutrients from source to sink, as well as days taken to heading, grain-filling period and days to maturity.

Number of effective tillers/m²

Number of effective tillers per metre square in different dates and varieties at both locations. 25th October and 25th November sowing at Bajaura

produced significantly more number of effective tillers per metre square than 25th December and at Dhaulakuan, first (25th October) date of sowing gave significantly more number of effective tillers per metre square than other dates of sowing (Table 1). Differences in number of effective tillers among varieties might be attributed to their genetic diversity (Shah et al. 2006).

Grain yield

Grain yield was significantly higher on 25th December sowing at both the locations and was at par with 25th October and 25th November sowing (Table 1). The four varieties evaluated at two locations exhibited significantly different response. At Bajaura, HS-490 produced significantly lower yield as compared with other varieties, which produced statistically similar yield and at Dhaulakuan, yield trend was similar, but VL-907 and HPW-349 remaining at par with each other, produced significantly higher grain yield over the other two varieties.

The partitioning of biomass from vegetative to reproductive stages were affected due to high temperature in December sowing. This leads to decrease in initials tillers, which ultimately results in small reproductive organs and consequently

Table 1: Effect of date of sowing and varieties on growth attributes and yield of wheat

Treatment	Emergence count (No. of plants/m ²)		Physiological Maturity (Days)		Number of effective tillers		Grain yield (q/ha)		Straw yield (q/ha)	
	Bajaura (1074m)	Dhaulakuan (411m)	Bajaura (1074m)	Dhaulakuan (411m)	Bajaura (1074m)	Dhaulakuan (411m)	Bajaura (1074m)	Dhaulakuan (411m)	Bajaura (1074m)	Dhaulakuan (411m)
Date of sowing										
D ₁ (25 th Oct)	206.5	173.3	182.0	162.0	389.1	379.2	51.1	46.8	81.7	77.6
D ₂ (25 th Nov)	187.9	169.3	168.8	143.7	373.7	355.1	47.8	46.3	81.4	78.6
D ₃ (25 th Dec)	164.4	172.2	141.3	121.2	334.9	313.5	39.7	34.6	65.3	58.8
CD 5%	17.3	2.8	1.5	2.1	22.9	10.7	3.4	3.3	5.5	5.5
Variety										
V ₁ (HS-542)	191.7	173.7	165.3	143.1	376.3	353.8	46.8	41.4	84.0	72.4
V ₂ (HS-490)	189.2	170.0	163.7	140.2	366.7	352.7	41.9	36.9	69.4	64.6
V ₃ (HPW-349)	178.3	170.8	164.8	141.9	358.2	345.0	48.0	45.4	74.2	72.3
V ₄ (VL-907)	192.5	171.9	162.3	144.0	362.5	345.6	48.0	46.4	77.0	77.3
CD 5%	NS	NS	1.7	1.2	NS	NS	4.0	3.8	6.4	6.4

Table 2: Interaction effect of date of sowing and varieties yield of wheat (q/ha)

Variety	Bajaura (1074m)		
	25 th Oct.	25 th Nov.	25 th Dec.
HS-542	55.8	50.1	34.4
HS-490	39.1	41.4	45.3
HPW-349	53.0	49.3	41.7
VL-907	56.4	50.3	37.4
CD 5%			
For comparison of dates*varieties			6.8
Variety	Dhaulakuan (411m)		
	25 th Oct.	25 th Nov.	25 th Dec.
HS-542	50.0	44.8	29.5
HS-490	35.1	37.5	38.1
HPW-349	50.3	52.5	33.6
VL-907	51.8	50.3	37.1
CD 5%			
For comparison of dates*varieties			6.6

reduced yield (Mukherjee 2012). Yield variations amongst various sowing dates explains the effect of temperature rise as sowing delayed and hence, offer opportunity for yield improvement by shifting sowing time of wheat crop in last week of November.

Straw yield

Straw yield in different dates and varieties at different locations. 25th October and 25th November sowings were at par with each other and gave significantly higher straw yield than 25th December sowing across the locations. Among varieties, VL-907, HS-542 and HPW-349 were at par with each other at Dhaulakuan and VL-907 and HPW-349 at Bajaura were at par with each other. HS-490 gave significantly lower straw yield at both the locations, which were at par with HPW-349. Among locations, Bajaura in general produced higher straw yield as compared to other locations (Table 1).

Interaction Effect

Interaction among sowing dates and varieties at both locations is being presented in Table 2, which

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shows that all the varieties remained at par with each other for first two dates of sowing at both locations. At all, locations late sowing of VL-907, HPW-349 and HS-542 resulted in decreased grain yield. In case of HS-490, however, with delay in sowing there was increase in yield but was non-significant at Bajaura and Dhaulakuan.

Conclusion

For higher altitude like Bajaura, it was found that 25th October sowing date was recommended except others date of sowings with VL-907 and HPW-349 excepts other varieties. and low altitude areas like Dhaulakuan, it was recommended that 25th October sowing dates with VL-907 varieties gives better results as compare to other date of sowings and varieties.

Conflict of interest

The authors declare that they have no conflict of interest.

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