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Growth and Yield Performance of Wheat (*Triticum aestivum* L.) Varieties under Different Sowing Times

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ABSTRACT

The present investigation was carried out during the *rabi* season of 2016-17 at the research farm of Wheat and Barley Section, Chaudhary Charan Singh Haryana Agricultural University, Hisar. The experiment was laid out in a split plot design with four sowing times (5th November, 15th November, 25th November, 5th December) in main plots and four wheat varieties (WH 1105, HD 2967, HD 3086, DBW 88) in subplots with three replications. A delay in sowing time from 5th November to 5th December significantly reduced the growth parameters in terms of plant height, dry matter accumulation and number of tillers. Among wheat varieties, the maximum number of tillers and dry matter accumulation were registered in HD 3086 whereas, the maximum plant height was in HD 2967. Sowing of wheat on 5th November resulted in significantly higher yield attributes viz., effective tillers, grains per earhead and 1000 grain weight resulting in 27.4 and 9.7 % higher grain yield and harvest index, respectively as compared to 5th December sowing. Among wheat varieties, the highest numbers of effective tillers and 1000 grain weight were recorded with HD 3086 whereas, the maximum number of grains per earhead was recorded in WH 1105. Maximum grain yield (5822 kg/ha) and biological yield (14023 kg/ha) were obtained from HD 3086.

Keywords Sowing time, Varieties, Growth, Yield, Harvest index.

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INTRODUCTION

Wheat (*Triticum aestivum* L.) is one of the important staple food crops of the world after rice and it occupies a significant place in the world economy. The cultivation of wheat has also been symbolic of the green revolution, self-sufficiency in food and sustained production. India ranks second among wheat producing countries in the world after China. It is a major winter season cereal crop of north-west India and Haryana. The area, production and productivity of wheat in India is 30.7 million ha, 97.4 m tonnes and 3172 kg/ha, respectively. The area, production and productivity of wheat in Haryana state is 2.54 million ha, 11.4 m tonnes and 4407 kg/ha, respectively (ICAR-IIWBR, 2019). In India, wheat cultivation is spread between 10°N to 37°N latitudes (Kumar 2012). The yield or productivity of wheat has become almost stagnant in India. A wide gap in potential productivity

and actual yield of wheat still exists there under real farming situations (Dhaka *et al*. 2006). Major factors responsible for lower yield are delayed planting, selection of unsuitable varieties, inappropriate seeding rates, improper planting geometry and soil type. Sowing time and selection of variety are the most important factors responsible for the lower yield of wheat in the country. A sustainable increase in grain yield of wheat varieties can be achieved by sowing the wheat crop at the optimum time, which varies according to variety or genotype, climatic conditions and availability of resources. Suitability of varieties to a particular agro-climate is the most important factor in realizing their yield potential because production efficiency of the plants is determined by genotype and environment. Environmental conditions prevailing over a particular agro-climatic zone can not be altered. However, the sowing time of a crop can be adjusted to take maximum advantage of the environmental factors to best suit various growth stages of the crop. Selection of suitable wheat varieties according to the agro-climatic conditions may play a crucial role in realizing the optimum yield of wheat crop as all the varieties of wheat may not perform equally in timely and late sown conditions (Singh *et al.* 2008, Kumar *et al.* 2010). The crop environment varies with the date of sowing and determines the wheat yield. Therefore, the sowing time and selection of variety play a significant role in deciding the wheat productivity.

MATERIALS AND METHODS

The experiment was conducted during *rabi* season 2016-17 at Research Farm of Wheat and Barley Section, Department of Genetics and Plant Breeding, Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana (India) situated at 29°10' N latitude and 75°46' E longitude at an elevation of 215.2 m above mean sea level. The soil of the field was sandy loam in texture, slightly alkaline in reaction with pH of 8.3, low in organic carbon (0.29-0.32 %) and available nitrogen, medium in available phosphorus and high in available potassium. The experimental design used was split plot with three replications. In main plot, fourosowing dates i.e. D_1 - 5th November, D_2 - 15th November, D_3 - 25th November and D_4 - 5th December were taken and wheat varieties i.e.,V_1- WH 1105, V_2- HD 2967, V_3- HD 3086 and V_4- DBW 88 were taken in subplot. Sowing of different varieties of wheat was done manually with the help of hand plough by pora method at 5 cm depth according to treatments. Recommended dose of fertilizers (half dose of N, full dose of P_2O_5, K_2O and $ZnSO_4$) was applied to all the plots one day before sowing. Remaining half dose of nitrogen was top dressed at 1st irrigation. Weeding was done with hand hoe in all the plots after 30-35 days of sowing. Other management practices were adopted as per recommendations of the wheat crop.Plant height, dry matter accumulation (per meter row length) and total number of tillers (per meter row length) were recorded at maturity. Data on yield and its attributes viz., number of effective tillers per meter row length, number of grains per earhead, 1000 grain weight, grain yield (kg/ha), straw yield (kg/ha), biological yield (kg/ha) and harvest index (%) were also recorded.

RESULTS AND DISCUSSION

Growth studies

Plant height

The plant height was maximum in 5th November sowing which was significantly higher than 25th November and 5th December sowing but at par with 15th November sowing (Table 1). Among the varieties, maximum plant height at maturity was attained by HD

Table 1. Effect of sowing times and wheat varieties on growth parameters at maturity stage.

Treatments	Plant height (cm)	Dry matter accumulation (g per meter row length)	No of tillers (per meter row length)
Sowing times			
5th November	108.1	418.0	112.6
15th November	105.8	398.3	110.2
25th November	102.9	363.1	106.0
5th December	98.1	312.4	100.2
SEm±	1.3	3.2	2.0
CD (p=0.05)	4.3	10.5	6.4
Varieties			
WH 1105	100.1	364.4	105.2
HD 2967	107.2	374.0	108.6
HD 3086	103.1	384.4	111.9
DBW 88	104.6	369.0	103.4
SEm±	1.4	4.3	2.2
CD (p=0.05)	4.0	12.5	6.3

2967, which was at par with DBW 88 but significantly higher than WH 1105 and HD 3086. Late sown wheat crop had short plant height as compared to timely sown crop because rise in temperature during the vegetative growth of later sown crop forced early flowering by cutting short the vegetative growth and results in dwarf plants. The variation in height among different varieties is due to the inherent characteristics of varieties. Similar results were also reported by Mukherjee (2012).

Dry matter accumulation

Among the different treatments, dry matter accumulation was maximum in 5th November sowing, which was significantly higher than15th November, 25th November and 5th December sowing (Table 1). Late sown wheat had short plants, reduced growing period and lesser time for tillering that results in a lower number of leaves and ultimately lower dry matter production as compared to timely sown. Among varieties, HD 3086 produced significantly higher dry matter as compared to other varieties and it was statistically at par with HD 2967. Whereas, minimum dry matter was accumulated by WH 1105. Significant differences among varieties with respect to dry matter accumulation were due to genetic differences among genotypes. These findings are in close conformity with those of Alam *et al*. (2013), Singh *et al*. (2017).

Number of tillers

The maximum number of tillers was recorded in 5th November sowing which was significantly higher than 25th November and 5th December sowing but at par with 15th November sowing (Table 1). Among the varieties, HD 3086 produced the maximum number of tillers, which was significantly higher than WH 1105 and DBW 88 but at par with HD 2967.Under late sown conditions, the growing period reduced and less time for tillering that results in lower number of tillers as compared to timely sown crop.Variability among the varieties with respect to the number of tillers might be due to their genetic makeup (Mukherjee 2012, Mumtaj *et al.* 2015).

Yield attributes

Number of effective tillers per meter row length

Among different treatments, the maximum number of effective tillers was recorded in 5th November sowing (109.4), which was significantly higher than 25th November (102.1) and 5th December (96.9) sowing but at par with 15th November sowing (105.8) (Table 2). Among different varietal treatments, variety HD 3086

Table 2. Effect of sowing times on the yield attributes, yield and harvest index of wheat varieties.

Treatments	Effective tillers per meter row length (no)	Grains per earhead (no)	1000 grain weight (g)	Grain yield (kg/ha)	Straw yield (kg/ha)	Biological yield (kg/ha)	Harvest index (%)
Sowing times							
5th November	109.4	49.6	40.7	6178	8588	14766	41.8
15th November	105.8	48.4	38.7	5845	8429	14275	41.0
25th November	102.1	47.0	34.1	5395	8182	13577	39.7
5th December	96.9	45.7	30.7	4850	7890	12740	38.1
SEm±	2.2	0.7	0.6	93	131	205	0.3
CD (p=0.05)	7.2	2.2	1.8	302	426	667	1.1
Varieties							
WH 1105	101.0	53.2	36.1	5707	8004	13711	41.6
HD 2967	105.0	44.5	34.2	5402	8488	13890	38.8
HD 3086	108.9	44.6	38.5	5822	8201	14023	41.5
DBW 88	99.4	48.4	35.4	5336	8397	13733	38.7
SEm±	1.9	0.6	0.4	71	126	183	0.3
CD (p=0.05)	5.5	1.7	1.2	204	363	NS	0.8

produced the maximum number of effective tillers (108.9), which was significantly more than WH 1105 (101.0) and DBW 88 (99.4) but at par with HD 2967 (105.0). The reduction in number of effective tillers (mrl^{-1}) at delayed sowing is due to delayed emergence of seedlings resulted in the curtailing of the number of days available from the emergence to maturity.

Number of grains per earhead

The wheat crop sown on 5th November produced the maximum number of grains per earhead (49.6), which was significantly superior to later sowings on 25th November (47.0) and 5th December (45.7) but statistically at par with 15th November sowing (48.4) (Table 2).The maximum number of grains per earhead was recorded in WH 1105 (53.2) whereas, the minimum was recorded in HD 2967 (44.5). Higher temperature at the grain filling stage in later sowing and fewer days available for grain filling resulted in a lesser number of grains per earhead. These results were in close conformity with Nainwal and Singh (2000), Alam *et al.* (2010).

1000 grain weight

Highest 1000 grain weight was recorded with 5th November sowing (40.7 g) which was significantly higher than later sowings viz., 15th November (38.7 g), 25th November (34.1 g) and 5th December (30.7 g). Among varieties, the highest 1000 grain weight was recorded in HD 3086 (38.5 g) and the lowest 1000 grain weight was recorded in HD 2967 (34.2 g). HD 3086 recorded 6.7, 8.5 and 12.6 % higher 1000 grain weight as compared to WH 1105, DBW 88 and HD 2967, respectively (Table 2).Under late sowing due to forced maturity that shortens the duration of each development phase which ultimately reduces the grain filling period leading to reduction of test weight. Similar findings were reported by Singh and Dhaliwal (2000), Spink *et al*.(2000).

Yields and harvest index

The wheat crop sown on 5th November recorded the highest grain (6178 kg/ha), straw (8588 kg/ha) and biological yields (14766 kg/ha) which was significantly higher than subsequent later sowings (Table 2). It was found that each delay in sowing by 10 days from 5th November to 5th December resulted in a 5.4, 12.7 and 21.5% reduction in grain yield, 1.9, 4.7 and 8.1 % reduction in strawyield and 3.3, 8.1 and 13.7% reductionin biological yield, respectively. Among wheat varieties, the highest grain yield was recorded in HD 3086 (5822 kg/ha) which was significantly higher than HD 2967 (5402 kg/ha) and DBW 88 (5336) but at par with WH 1105 (5707 kg/ha) while HD 2967 produced maximum straw yield (8488 kg/ha) which was significantly superior to WH 1105 (8004 kg/ha) but at par with DBW 88 (8397 kg/ha) and HD 3086 (8201 kg/ha).The maximum biological yield was recorded in HD 3086 (14023 kg/ha) while the minimum was recorded in WH 1105 (13711 kg/ha), though the differences among different wheat varieties were non-significant. The highest harvest index was recorded in 5th November sowing (41.8%),which was significantly higher than 25th November and 5th December sowing. Wheat variety WH 1105 recorded highest the harvest index (41.6%) which was at par with HD 3086 (41.5%) but significantly higher than HD 2967 (38.8%) and DBW 88 (38.7%). Due to the prevailing favorable temperature when wheat was sown on 5th November, higher photosynthate accumulation took place, consequently resulting in higher yield parameters. In later sowing times, biomass and grain yield decreased due to undesired environmental conditions and lack of translocation of reserved assimilates into grain as a result of increased temperature at the end of growth season. Differences among varieties were due to their genetic makeup. These results are in line with those of Pandey *et al.* (2010), Dahiya *et al*. (2017).

CONCLUSION

Sowing of wheat on 5th November resulted in better growth and higher yield as compared to late sowing and the wheat variety HD 3086 had the highest number of tillers, dry matter accumulation and yield as compared to WH 1105, HD 2967 and DBW 88.

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