

Performance of barley (*Hordeum vulgare* L.) varieties in relation to sowing dates and row spacing in central Punjab

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Abstract

Two field experiments were conducted at the research farm of the Punjab Agricultural University, Ludhiana. The soil of the experimental field was low in organic carbon content and slightly alkaline in nature. One experiment was conducted in two dates (Timely and late sown) in main plot and four barley varieties (DWRUB 52, DWRB 101, BH 902 and RD 2849) in sub-plot during 2014-15 and 2015-16. Another experiment was conducted on row spacing (20.0, 22.5 and 25.0 cm) as main plot and three barley varieties (BH 902, BH 946 and RD 2552) in sub-plot during 2015-16 and 2016-17. Timely sown (15th-19th November) barley recorded higher grain yield than late sown (December 15). Varieties DWRUB 52 and DWRB 101 performed better than BH 902 and RD 2849 under different sowing dates. The grain yield recorded in 22.5 cm row spacing was better than 20.0 cm but similar to 25.0 cm row spacing. The variety BH 946 recorded higher grain yield than BH 902 and RD 2552 in different row spacing.

Keywords: Agro meteorological indices, barley varieties, grain yield, row spacing, sowing time

1. Introduction

Barley (*Hordeum vulgare* L.) is an important cereal crop grown for feed, fodder and malt purposes. It occupied 677 thousand hectares area with total production of 1.79 m tonnes during 2017-18 (ICAR-IIWBR, 2018). The sowing time of this crop is crucial for raising successful crop in central Punjab. Too much early sowing leads to more vegetative growth which may leads to high lodging and poor yield attributes and yield. Similarly, very late sowing leads to poor vegetative growth and lesser yield. The crop should be sown at optimum swing time. Ram *et al.*, (2010) in earlier studies concluded that 15th November sowing was statistically at par with 15th October sowing but significantly higher than 15th December sowing. Row spacing is also an important agronomic practice which influences light interception and its penetration, distribution of light in crop canopy and average light utilization efficiency of the leaves in the canopy, and ultimately affect grain yield of a crop. In narrow spacing sometimes clogging of the drill may occur whereas in wider row spacing solar radiation use efficiency may be

reduced. Wider row spacing not only allow more light to reach the lower leaves at the time of grain formation but also allows easy inter-culture for weed control and inter-cropping. Different barley varieties have different genetic ability for grain yield potential (Ram *et al.*,2010). As the behavior of different barley varieties may vary with sowing dates and row spacing so the present study was conducted to understand the effects of alteration in sowing dates on growing degree days accumulation and yielding ability of barley under different sowing dates and row spacing to recommend the particular barley variety in central Punjab.

2. Material and methods

The field experiment was conducted at the Punjab Agricultural University (30° 56'N, 75° 52'E; 247 m ASL), Ludhiana during 2014-15 to 2016-17. The soil of experimental site was alluvial loamy sand with low in organic carbon (0.38%) and slightly alkaline (pH 7.7). Central Punjab has a sub-tropical climate having cool

and dry winters in the crop season. Two experiments were conducted separately. The first experiment was conducted in split plot design with sowing dates (13 November, 2015 and , 19 November, 2016 as timely sown and 15 December in both years as late sown) as main plot treatments and varieties (DWRUB 52, DWRB 101, BH 902 and RD 2849) as sub plot treatments with three replications. The crop was sown at line to line spacing of 22.5 cm using seed rate @ 100 kg/ha. In second experiment, row spacing of 20.0, 22.5 and 25.0 cm were kept as main plot and the barley varieties BH 902, BH 946 and RD 2552 were kept as sub plot treatment. The nitrogen dose of 37.5 kg and phosphorus dose of 30 kg P₂O₅/hectare were applied at the time of sowing. Remaining dose of N was applied at 1st irrigation. The crop received two irrigations at 40 and 105 days after sowing in study during 2014-15 and three irrigations during 2015-16. The herbicides (isoproturon @ 1kg a.i./ha + 2,4-D @ 0.62 kg a.i./ha) were applied as tank mix to control wild oats and other broad leaf weeds in barley crop. The manually harvested crop was threshed with engine operated thresher. The data on emergence count, yield attributes, days to maturity, lodging score, biological yield and grain yield were collected from all the plots. Agro-meteorological indices such as growing degree days (GDD) and helio-thermal unit (HTU) were measured in each replica (Monteith, 1984).

$$\text{GDD (}^{\circ}\text{C day)} = \sum \frac{T_{\max} + T_{\min}}{2} - 4.5$$

$$\text{HTU (}^{\circ}\text{C day hour)} = \sum (\text{GDD} \times \text{SS})$$

The emergence count and ear density were recorded from one metre row length at two spots from each. Randomly selected ten ears were threshed manually to calculate grains/ear. Out of the plot produce, 1000-grains sample was collected to present 1000-grain weight. The data were analyzed using ANOVA for split plot design at 5% level of significance. Pooled data have been presented in this paper.

3. Result and discussion

3.1 Performance of varieties at different sowing dates

Effect of date of sowing: Emergence count, yield attributes, physiological maturity, lodging score and agro-meteorological induces were significantly influenced by the sowing dates except earheads per square metre (Table 1). Emergence count, earheads per square metre, grains per earhead and 1000-grain weight reduced by 32.7%, 11.8%, 14.5% and 10.4% respectively. It was due to less congenial

environment provided under the late sown conditions. Mani *et al.*, (2009) reported significant influence of sowing date on the yield attributes and yield of barley. They reported higher number of spikes per plant in 30 November sown crop as compared to other late sowing. Singh and Dixit (1995) also reported reduction in grains/ear with delayed sowing in wheat. Based on the pooled mean, the crop season was reduced by about 26 days under late sown conditions than timely sown conditions. The reduction in growth period might be the reason for significantly less yield attributes. Lodging score was higher under timely sown conditions. It might be due to higher biomass accumulation in timely sown conditions. Timely sowing recorded higher growing degree days (GDD) and heliothermal units (HTU) than late sown conditions respectively. Timely sowing recorded 19.4 and 14.3% higher GDD and HTU than under late sown conditions. It was due to higher number of days taken to mature under timely sown conditions. Similar finding were also reported in by Ram and Gupta (2016) in wheat crop. The biological yield was significantly higher in timely sown conditions. The reduction in biomass was found to be 31.1% under late sown conditions. It might be due less emergence count, shorter growing period and lesser yield attributes. The grain yield of barley was significantly influenced by sowing date. Late sown recorded 32.0% reductions in grain yield as compared to timely sown. It was due less emergence count, effective tillers, grains per earhead, 1000-grain weight, physiological maturity, lower GDD, HTU and biomass yield. Timely sown crop accumulated higher biomass which was partitioned to the grain yield. Ram *et al.*, (2010) also reported that November 15 sowing was found to be superior in yield attributes, grain yield and accumulated growing degree days than December 15 sowing date. Razzaque and Rafiqzaman (2016) also reported considerable reduction in yield attributes and grain yield of barley when sowing date was delayed from November 20 to December 10.

Effect of varieties: Varieties influenced emergence count, grains per earhead, 1000-grain weight, physiological maturity, GDD, helio-thermal units and lodging score significantly by different genotypes (Table 1). The emergence count was the highest in DWRB 101 which was statistically at par DWRUB 52. It was due to genotypic variation in emergence count of different genotypes. Although earheads per square metre recorded in DWRUB 52 was about 3% higher than RD 2849 but the results were found to be non-significant. Grains per earheads were found to be the highest in BH 902 which was significantly higher than all other varieties. It might be due to six

rowed barley variety. The highest 1000-grain weight was recorded in variety DWRB 101 which was statistically at par with DWRUB 52 and RD 2849 but significantly higher than rest of the varieties. Generally, 1000-grain weight of two rowed barley was found to be higher and grains per earhead were lower than six rowed (feed) barley. Significantly higher lodging score was recorded in BH 902 than other varieties. It might be due to six rowed

barley having heavier head weight due to higher number of grains per earhead and higher biomass yield. Among the barley varieties, BH 902 recorded the highest GDD and HTU which was statistical as par with DWRUB 52 and DWRB 101. Variation among varieties for GDD and HTU was also recorded by Ram *et al.*, (2010). The highest biological yield was recorded in variety BH 902 which was statistically at par all the barley varieties.

Table 1. Effect of sowing dates and varieties on emergence count, yield attributes, lodging score, physiological maturity, growing degree days (GDD), Helio-thermal units (HTU), biological yield and grain yield of barley (pooled data of two years)

Treatment	Emergence count m-2	Earheads m-2	Grains Earhead-1	1000-grain weight (g)	Lodging score (0-9)	Physiological maturity (days)	Growing degree days (oC day)	Helio-thermal units (oC day hour)	Biological yield (q ha-1)	Grain yield (q ha-1)
Date of sowing										
Timely	159	348	28.4	52.1	1.7	146	1642	10426	127.6	50.15
Late	107	307	24.3	46.7	0.3	120	1375	9123	87.94	34.1
CD (5%)	17.5	15.6	3.2	NS	0.8	0.3	5	58	7	2.77
Varieties										
DWRUB 52	137	336	25.9	49.6	0.9	133	1513	9788	111.55	43.16
DWRB 101	145	333	24.3	53	0.7	133	1509	9790	102.72	42.78
BH 902	130	314	29	44.2	2	134	1520	9907	108.84	40.12
RD 2849	120	326	26.1	50.6	0.3	132	1493	9611	107.98	42.44
CD (5%)	9.38	NS	2.8	3.5	1.2	0.7	16	167	NS	NS
Interaction	NS	NS	NS	NS	NS	0.98	22.7	236	NS	NS

Although, the results were non-significant for grain yield, but varieties DWRUB 52 and DWRB 101 recorded 7.6 and 6.36% higher grain yield than variety BH 902 respectively. Higher grain yield in these varieties was found to be due higher yield attributes, less lodging and more GDD and HTU found in these varieties. Razzaque and Rafiqzaman (2006) also found genetic variability in yielding ability of different varieties. They found BSH 2 recorded significantly higher grain yield than varieties BSH 32 and BSHL 2. Ram *et al.* (2010) found that grain yield recorded in PL 807 was the highest among the varieties under study and was statistically at par with BH 902 but significantly higher than RD 2552 and RD 2035.

3.2 Performance of varieties at different spacing

Row spacing: Row spacing significantly influenced earheads per square metre and 1000-grain weight (Table 2). The highest emergence count was recorded in 25 cm which was 5-6 plants/m² higher than 20.0 and 22.5 cm row spacing. The highest earheads were recorded in 20.0 cm row spacing which was statistically at par with 22.5 cm but significantly higher than 25.0 cm row spacing. It was due to optimum spacing for the growth and development of the barley crop. Results were non-significant for grains per earhead but 25.0 cm row spacing recorded 14.4% higher grains per earhead than 20.0 cm row spacing. It might be due to less inter row competition. Thousand grain weight was the highest in 25.0 cm row spacing which was

significantly higher than 20.0 and 22.5 cm row spacing. It was due to less earheads per square metre recorded in 25.0 cm row spacing. Physiological maturity was similar in all the row spacing treatments. Although the results were non-significant for lodging score but 20.0 cm row spacing recorded the lowest lodging score. The biological yield and grain yield were found to be non-significant but higher yields were recorded in 22.5 cm row spacing. The biological yield recorded in 22.5 cm row spacing was 3.3 and 6.6% higher than 20.0 and 25.0 cm row spacing respectively. The grain yield recorded in 22.5 was 5.2% higher than 20.0 cm row spacing.

Varieties: The barley variety RD 2552 recorded the highest emergence count and earheads per square metre which was significantly higher than BH 902 but at statistically at par with BH 946. Grains per earhead were found to be the highest in BH 946 and was at par with other varieties. The variety BH 902 recorded the highest 1000-grain weight which was statistically at par with BH 946 but significantly higher than RD 2552. Variety BH 902 recorded one more day than other varieties to mature which was significant higher. The biological yield recorded in RD 2552 was the highest but results were found to be non-significant. The barley variety BH 946 recorded 5.9 and 7.6% higher grain yield than BH 902 and RD 2552 respectively. It can be concluded that as the barley should be sown under timely sown conditions using DWRUB 52 and DWRB 101

varieties. The row spacing should be kept as 22.5 cm in feed barley using variety BH 946 for higher productivity. As the results for 20.0 and 22.5 cm row spacing is same, so, wider planting geometry technology can be recommended

without any risk of reduction in yield and also facilitate to run the seed drill in residues and inter-tillage devices for effective weed control.

Table 2. Emergence count, earheads, grains per earhead and 1000-grain weight, physiological maturity, lodging score, biological and grain yield as influenced by row spacing and varieties (pooled data of two years)

Treatment	Emergence count m-2	Earheads m-2	Grains Earhead-1	1000-grain weight (g)	Physiological maturity (days)	Lodging score (0-9)	Biological yield (q ha-1)	Grain yield (q ha-1)
Row spacing (cm)								
20	138	387	30.5	47.3	142	0.4	165.19	54.2
22.5	137	367	33.8	47.5	142	1.6	170.65	57.01
25	143	338	34.9	50.2	142	1.2	160.75	56.96
CD (5%)	NS	22.4	NS	2.3	NS	NS	NS	NS
Varieties								
BH 902	131	351	32.6	50.1	142	1.3	165.77	55.25
BH 946	143	364	34.4	47.9	141	0	163.9	58.52
RD 2552	145	377	32.2	46.9	141	2	166.92	54.41
CD (5%)	5	16	NS	2.6	1	1.2	NS	NS
Interaction	NS	NS	NS	NS	NS	NS	NS	NS

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