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Research Article

Effect of Sowing Time, Seed Rates and Row Spacing on Yield of Barley (*Hordeum vulgare* L.) in Haryana

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ABSTRACT

The field experiment was conducted at the Regional Research Station (Bawal) Department of Agronomy, CCS Haryana Agricultural University, Hisar (India) during the year 2015-16 and 2016-17. To evaluate the optimum sowing time, seed rate and row spacing on yield of barley The experiment was conducted with split-split plot design replicated three times. Treatments consisted of four dates of sowing viz. D_1 (last week of October), D_2 (1st week of November), D_3 (2nd week of November) and D_4 (3rd week of November) and two seed rates viz. recommended and 110 % of recommended was kept as main plot and three row spacings viz. (17.5 cm), (20 cm) and (22.5 cm recommended) was kept as sub plot. The received results that yield was increased significantly under D_1 (last week of October) and statistically similar to 1st week of November sown crop than another sowing dates. Yield were increased significantly under (20 cm) row spacing over the rest row spacing and not significant effects of that two seed rates. The highest grain yield was computed under D_1 (last week of October) with (20 cm) row spacing.

Key words: *Sowing dates, Seed rate, Row spacing, Productivity, Barley.*

INTRODUCTION

Barley (*Hordeum vulgare* L.) is a hardy crop which is grown throughout the temperate and tropical regions of the world. It is an important cereal crop after wheat, rice and maize, in the world and third important cereal after rice and wheat in India. Barley requires less water and can be cultivated in areas where irrigation water is not easily available. It grows successfully in a wider range of climatic conditions than any other cereal. As grain crop under Haryana conditions, its potential is less as compared to wheat crop but it performs well under rainfed conditions depending upon the rainfall[1]. In recent year's reduction in rainfall and increase in overall average temperature of earth's surface have been observed in Haryana as well as India. The rising temperature i.e. temperature stress results into shortening of the crop growth (especially from heading to ripening) of the cereal crops and decreased water availability which in turn reduce in dry matter production and ultimately low grain yield[2]. Among cultural practices, sowing date is an important factor to achieve production potential of barley crop.

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Thus, weather conditions to which the crop is exposed during its life cycle is considered to be principle input parameter affecting its productivity despite availability of other input parameters and improved crop husbandry practices[3]. Sowing time depends on the weather, topography and harvesting time of preceding crop. Optimum time of sowing plays an important role in enhancing the yield of crop. It is well known that barley varieties respond sharply for yield and other characters to climatic variations according to the time of sowing. Row spacing and seed rate in barley is an important agronomic practice to maximize the yield and quality of barley crop. Proper row spacing is important for maximizing light interception, penetration, distribution in crop canopy and average light utilization efficiency of the leaves in the canopy, and thus affect yield of a crop[4]. Thus, an implication of looming temperature stress necessitates strategic technology development for sustainable barley production under the prevailing weather conditions in Haryana. At through productivity of barley in the state is higher than that of productivity of India yet enough scopes exist for its further improvement under changing climate scenario. So, an experiment was planned to study the Productivity of barley can be increased with better package of technologies including optimum sowing time, row spacing and seed rate of barley under Haryana conditions.

MATERIAL AND METHODS

The field experiment was conducted at Regional Research Station of Chaudhary Charan Singh Haryana Agricultural University, Bawal in *rabi* (winter) season during of 2015-16 and 2016-17. The experimental Site (28º4' N latitude and 76º35' E longitude at an altitude of 266 meters above mean sea level) was having sandy loam soil, low in organic carbon (2.2 g C kg^{-1}) and slightly alkaline (pH 7.5). The region has a tropical and semi-arid climate having cool winters in the crop season (Fig. 1).

The experiment was conducted in split-split plot design with four sowing dates *viz;* (Last week of October, 1st week of November, 2nd week of November and 3rd week of November x two seed rates 100 % recommended 87.5 kg/ha and 110 % of recommended *i.e.* 96.25 kg/ha) as main plot treatments and three row spacing *viz;* (17.5, 20 and 22.5 cm) as sub plot treatments with three replications. The crop was sown were in manually by *pora* method. The total recommended dose applied to the crop was N, P, K = 60: 30: 20 kg ha^{-1} in the form of Urea, Single Super Phosphate and Muriate of potash were applied ½ N+ full P and K at the time of sowing and remaining ½ N after first irrigation. The total rainfall of 21.10 mm and 64.30 mm was received during 2015-16 and 2016-17, respectively.

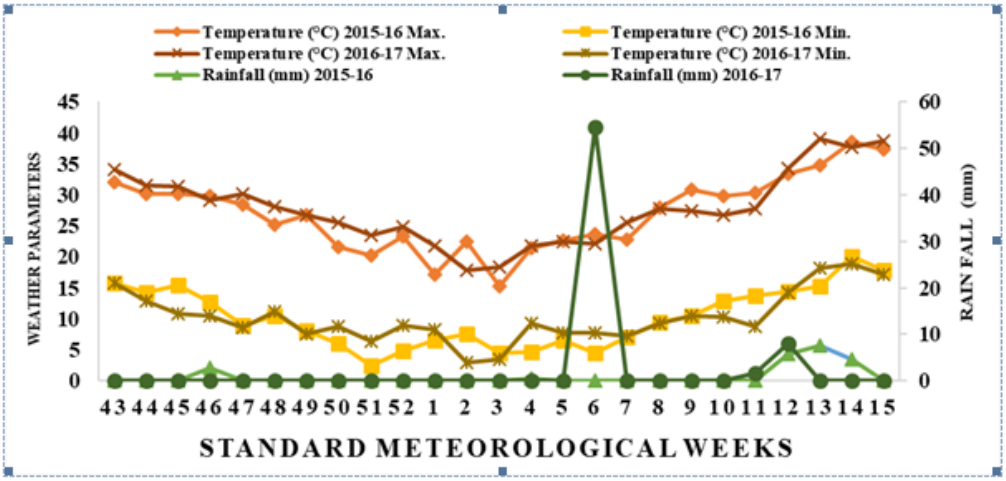

Fig. 1: Weather conditions for the cropping seasons in 2015-16and 2016-17

The crop received three irrigations at 30-35, 65-70 and 90-95 days after sowing in study. The herbicides (Metsulfuron @ 87.5 ml/ha + Pinoxaden @ 10 gm/ha) were applied as tank mix application after first irrigation to control wild oats and other broad leaf weeds. The crop was harvested manually at maturity and threshed with engine operated thresher. The observations on grain yield were recorded at the time of harvesting and the data were analyzed using standard method of ANOVA.

RESULTS AND DISCCUSSION

Sowing time

The data tells that to grain yield during both the years of study were presented in Table 1. Significantly highest grain yield (5319 kg/ha) was observed with (D_1) last week of October as compared to other three sowing dates *viz;* (5146 kg/ha) with (D_2) 1st week of November followed by (4852 kg/ha) with (D_3) 2nd week of November and (4562 kg/ha) with (D_4) 3rd week of November sown crop in 2015-16. In the 2016-17, significantly highest grain yield (5646 kg/ha) was observed with (D_1) last week of October and at par (5540 kg/ha) was with (D_2) 1st week of November sown crop whereas, lowest grain yield (5235 kg/ha) was with (D_3) 2nd week of November followed by (4919 kg/ha) was with (D_4) 3rd week of November sown crop.

Among the sowing times, (D_1) last week of October sown crop significantly maximum straw yield (8511 and 8672 kg/ha) was registered and statistically similar to (D_2) 1st week of November straw yield (8304 and 8474 kg/ha) was registered. Whereas, (D_3) 2nd week of November sown crop minimum straw yield (8012 and 8191 kg/ha) was registered followed by (D_4) 3rd week of November (7588 and 7776 kg/ha) during the both years.

It might be due to favourable conditions prevailed at the time of tillering and at the time of fertilization in case of last week of October and 1st week of November sown crop. Nass *et al*.[5] reported yield reduction for late sowing due to shorter growing period in the vegetative phase and steep rise in temperature at the grain filling stage. Mani *et al*.[7] reported that delay in sowing date of barley beyond 10 November resulted in a significant decrease in grain yield.

Seeding rate

The effect of seed rates on grain yield and straw yield was did not significant during the both years study.

Table 1: Effect of sowing dates, seed rate and row spacing on grain yield and straw yield q/ha of barley during 2015-16 and 2016-17

Treatments	Grain Yield kg/ha		Straw Yield kg/ha	
	2015-16	2016-17	2015-16	2016-17
Date of sowing				
D_1 (Last week of October)	5319	5646	8511	8672
D_2 (1st week of November)	5146	5540	8304	8474
D_3 (2nd week of November)	4852	5235	8012	8191
D_4 (3rd week of November)	4562	4910	7588	7776
Sem±	55	051	124	141
CD (P=0.05)	162	152	378	427
Seed rates				
S_1 (100% recommended)	4967	5307	8097	8271
S_2 (110% of recommended)	4973	5358	8111	8286
Sem±	12	17	88	099
CD (P=0.05)	NS	NS	NS	NS
Row spacings				
R_1 (17.5 cm)	4797	5126	7900	8092
R_2 (20 cm)	5163	5547	8305	8460
R_3 (22.5 cm recommended)	4950	5325	8105	8283
Sem±	72	57	105	131
CD (P=0.05)	213	174	303	392

Row Spacings

In case of row spacing significantly highest grain yield (5163 kg/ha) was observed in R_2 (20 cm) and at par with (4950 kg/ha) in R_3 (22.5 cm) while significantly lowest (4797 kg/ha) was observed in (17.5 cm) row spacings sown crop in 2015-16. In 2016-17, row spacing significantly highest grain yield (5547 kg/ha) was observed in R_2 (20 cm) while lowest grain yield (5325 kg/ha) was in R_3 (22.5 cm) followed by (5126 kg/ha) was observed in (17.5 cm) row spacings sown crop. In study of row spacing, significantly maximum straw yield (8305 and 8460 kg/ha) was registered in R_2 (20 cm) and at par with (8105 and 8283 kg/ha) in R_3 (22.5 cm) while significantly minimum straw yield (7900 and 8092 kg/ha) was registered in (17.5 cm) row spacings during the both years.

Spacing is another significant factor to obtain high yield in barley. In optimum row spacing plants utilized all available resources more efficiently including light, water, air and nutrients and accumulate higher dry matter. Finally, so optimum row spacing play an important role in good crop establishment and high yield, Nandi *et al.*[6]. same finding was reported by Rehmani *et al.*[9] and Mekomen[8].

From the two years investigations, it can be concluded that optimum sowing time of barley should range from last week of October to 1st week of November with 20 cm row spacing in Haryana conditions.

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