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Jagdish Choudhary
Assistant Professor and Project Incharge, AICRP on Wheat and Barley, Department of Agronomy, RCA, MPUAT, Udaipur, Rajasthan, India

Mohammed Mohsin
Ph.D. Scholar, Department of Agronomy, RCA, MPUAT, Udaipur, Rajasthan, India

Somdutt
M.Sc. Agronomy Research Scholar, Department of Agronomy, RCA, MPUAT, Udaipur, Rajasthan, India

Corresponding Author:
Jagdish Choudhary
Assistant Professor and Project Incharge, AICRP on Wheat and Barley, Department of Agronomy, RCA, MPUAT, Udaipur, Rajasthan, India

Effect of row spacing on growth, yield and economics of barley genotypes under sub humid agro-climatic zone of Rajasthan

Jagdish Choudhary, Mohammed Mohsin and Somdutt

Abstract
A field experiment was conducted at Rajasthan College of Agriculture, MPUAT, Udaipur (Rajasthan) during *rabi* season of 2015-16 and 2016-17 to study the response of different varieties of barley (*Hordeum vulgare* L.) under varying row spacing. The experiment results revealed that 20 cm row spacing enhancing the growth parameters *viz.* plant population, plant height and number of tillers over 22.5 and 25 cm row spacing. Amongst different barley varieties, RD 2786 recorded maximum plant population at 15 days after sowing and plant height at harvest, but maximum number of tillers was found in BD 959. However, different barley varieties failed to observe significant difference in numbers of days taken to flowering and maturity. Sowing of crop at wider row spacing (25 cm) resulted in highest test weight which was statistically at par with row spacing of 22.5 cm. whereas, non significant difference found in number of grains ear^{-1} under different row spacing. Highest number of grains ear^{-1} was found in variety BH 959 but different varieties failed to record perceptible variation in test weight. Sowing of barley at 20 cm row spacing results in significantly higher grain and biological yield over 22.5 and 25 cm row spacing. Amongst different barley varieties, BH 959 recorded highest grain and biological yield followed by RD 2786. Highest net return and B-C ratio was obtained when barley sown at spacing of 20 cm as compared to 22.5 and 25 cm row spacing. In case of different varieties, BH 959 obtained highest net return and B-C ratio followed by RD 2786.

Keywords: Row spacing, varieties, net return and B-C ratio

Introduction
Barley is the world's fourth most important cereal crop after wheat, rice and maize. It is grown throughout the temperate and tropical region of the world. It is usually used as food for human beings and feed for animals and poultry. It is also a valuable input for industries for extracting malt. In India, barley was cultivated on 0.67 m ha area during 2017-18 with 1.78 m t of production at an average productivity status of 26.41 q ha^{-1}. In Rajasthan, it is grown in 0.28 m ha of land with a production and productivity of 0.85 m t and 30.46 q ha^{-1}, respectively (IIWBR, 2017-18) [5].
Plant stand design is a key parameter for grain yield of barley and other row crops. Row spacing affects crop yield as it not only determines the optimum crop stand, but also facilitates inter-culture and convenient herbicide application for effective and efficient weed control. It also facilitates the inter-cropping of other crops with it. Moreover, plant spacing determines the area available to each plant which in turn determines nutrient and moisture availability to the plant. Row spacing determines resource availability and utilization by individual plants in a given species. Planting decisions require that optimum row widths for the seed crop be determined. In wider row spacing, solar radiation falling within the rows gets wasted particularly during the early stages of crop growth, whereas in closer row spacing upper part of the crop canopy may be well above the light saturation capacity but the lower leaves remain starved of light and contribute negatively towards yield. In addition, proper row spacing is important for maximizing light interception, penetration, light distribution in crop canopy and average light utilization efficiency of the leaves in the canopy and thus, affects yield of a crop (Hussain *et al.*, 2003) [4]. Row spacing requirements of rows crop like wheat and barley depend on architecture and growth pattern of the varieties. For higher yield, higher proportion of incident radiation at the soil surface must be intercepted by crop canopy (Eberbach *et al.*, 2005) [2]. In case of wider row spacing, solar radiation that falls between crop rows remains unutilized; plants become crowded and suffer from mutual shading if the row distance is too narrow. Moreover, yield may be reduced in narrow spacing due to increased competition of plants for nutrient and moisture (Das and Yaduraju, 2011) [1].

The other essential factor is barley varieties are generally selected for higher yield and greater tolerance to adverse conditions and early maturity. However, success of any crop production depends on the use of appropriate and selectivity of location-specific variety of high yield potential and additionally improved cultural practices is an imperative part, may not be ignored. In recent past, barley varieties developed by plant breeders have high yield potential. Cultural management plays a significant role in barley production. Row spacing and optimum variety are of prime importance, but all the varieties do not perform well in the same plant spacing, optimum plant densities vary greatly between areas, climatic conditions, soil and varieties. Therefore, selection of appropriate row spacing and varieties play an important role in enhancing barley productivity.

Materials and Methods

A field experiment was conducted at the Instructional Farm, Department of Agronomy, Rajasthan College of Agriculture, MPUAT, Udaipur in r*abi* (winter) seasons of 2015-16 and 2016-17 located at 28º4' N latitude, 73º42' E longitude with an altitude of 582.17 m above mean sea level. The soil of experimental field was clay loam in texture, alkaline in reaction pH (8.1), medium in organic carbon (0.65%), medium in available N (295.3 kg ha^{-1}), P_2O_5 (18.4 kg ha^{-1}) and medium in available K_2O (292.7 kg ha^{-1}). The field experiment comprising of 9 treatment combinations *viz.* three row spacing S_1: 20 cm, S_2: 22.5 cm and S_3: 25 cm as main plot and three varieties *viz.* V_1: BH 959, V_2: RD 2786 and V_3: RD 2715 as subplot treatments was laid out in split plot design with four replications. The barley varieties *viz*. BH 959, RD 2786 and RD 2715 were sown on 22nd and 18th November during 2015-16 and 2016-17 as per treatments. The recommended dose of fertilizers was 60:30:20 of N: P_2O_5 :K_2O kg ha^{-1}, respectively. Half doses of nitrogen and full basal dose of phosphorus and potassium applied at sowing. The remaining half dose of nitrogen was applied after first irrigation. The observation for plant population was taken by manually counting of number of plants from 1 metre row length from each plot. Observations for plant height were taken from five randomly selected plants in each plot at respective growth stage and their averages were used for calculation. Number of tillers m^{-1} row length was manually counted at 50 per cent maturity and number of grains ear^{-1} computed from 5 randomly selected ears and their mean were used for calculation. Grain and biological yield was recorded from each plot (kg $plot^{-1}$) and converted into q ha^{-1}. All the experimental data for various yield and growth characters were statistically analysed by usual method of 'Analysis of Variance as described by Gomez and Gomez (1984) [3].

Results and Discussion

Growth parameters

Results of experiments revealed that different growth parameters *viz.* plant population, plant height, number of tillers, flowering and maturity were significantly influenced by different row spacing of barley. At 15 days after sowing, 20 cm row spacing recorded maximum plant population over 22.5 and 25 cm row spacing whereas, lowest plant population was observed in row spacing of 25 cm. The reduced plant population in increased row spacing might be due to more interplant competition within the row. Row spacing of 20 cm recorded significantly highest plant height however it was statistically at par with row spacing of 22.5 cm. This increase was primarily due to fact that competition for light due to increased number of tillers in 20 cm row spacing forced the plant to grow higher to intercept the sunlight. Kumar *et al.* (2010) [6] also reported increased plant height in closer row spacing in wheat. On pooled data basis highest number of tillers was recorded in row spacing of 20 cm which was significantly superior over row spacing of 22.5 and 25 cm. Pooled data on number of days to taken flowering and maturity were significantly influenced by different row spacing. Sowing of barley at row spacing of 25 cm resulted in commencement of early flowering and maturity in barley.

Different growth parameters *viz.* plant population, plant height, number of tillers, flowering and maturity were significantly influenced by different varieties of barley. The maximum plant population was recorded in variety RD 2786 which was significantly superior over RD 2715 but statistically at par with BH 959. Barley variety RD 2786 recorded highest plant height (86.83 cm) followed by RD 2715 (83.56 cm). Under identical agronomical conditions, the marked variations in growth of varieties could be ascribed to their genetic capabilities to exploit available resources for their growth and development. On pooled data basis variety BH 959 recorded 4.52, 5.06 per cent higher number of tillers over RD 2786 and RD 2715 respectively. This might be due to more tillering ability and higher growth of variety BH 959. Variation in tillers count might be due to differences in genetic makeup of these varieties. These results are in conformity with the findings of Mali and Choudhary (2011) [7] who observed significant differences in the tillers count in wheat varieties. Numbers of days taken to flowering and maturity were not influenced by different varieties.

Yield attributes and yield

On pooled data basis row spacing of 25 cm recorded highest test weight (39.76 g) which was statistically at par with row spacing of 22.5 cm. Number of grain ear^{-1} did not vary significantly under varying row spacing. These results are in conformity with the findings of Kumar *et al.* (2010) [6] and Singh *et al.* (2006) [9]. Row spacing of 20 cm recorded highest grain yield (55.05 q ha^{-1}) followed by 22.5 cm row spacing (50.90 g ha^{-1}). On pooled data basis 20 cm row spacing recorded 8.15, 19.64 per cent higher grain yield over 22.5 and 25 cm row spacing respectively. The increase in grain yield can be attributed to higher number of tillers. Sowing of barley under a row spacing of 20 cm recorded significantly higher grain and biological yields over row spacing of 22.5 and 25 cm. The straw yield was also higher in row spacing of 20 cm as compared to 22.5 and 25 cm row spacing, which may be due to increased number of tillers and dry matter accumulation.

Data presented in Table 2 shows that different barley varieties failed to record any significant variation in test weight. Barley variety BH 959 recorded significantly higher number of grains ear^{-1} over varieties RD 2786 and RD 2715. However, it was statistically at par with RD 2786. Barley varieties significantly affect the grain yield on pooled data basis. Barley variety BH 959 recorded highest grain yield (53.19 q ha^{-1}) which was statistically at par with variety RD 2786. This increase can be ascribed to higher number tillers and number of grains ear^{-1} in BH 959. Straw yield among barley verities did not differ significantly however, barley variety RD 2715 recorded highest straw yield. Barley variety RD 2786 recorded highest biological yield (99.92 q ha^{-1}) which was statistically at par with variety BH 959. BH 959 produced maximum grain and biological yield, which was marked superior to RD 2786 and RD 2715. This increased in grain and biological yield in BH 959 due to higher number of tillers and grains ear^{-1} which ultimately enhanced the grain and biological yield. These results are in close agreement with finding of Rawat (2011) [8].

Economics

Row spacing of 20 cm provided highest net return (69946 Rs. ha^{-1}) and B-C ratio (2.43) followed by row spacing of 22.5 cm, this increased because of more grain yield with the use of equal amount of inputs. Barley variety BH 959 provided significantly higher net return and B-C ratio amongst tested barley varieties. On pooled basis variety BH 959 (2.32) registered an increase in benefit cost ratio by 3.57and 20.83 per cent over RD 2786 and RD 2715, respectively. It is obvious because of significantly higher grain yield of variety BD 959 as compared to other varieties which consequently resulted in higher net return and benefit cost ratio.

Table 1: Effect of row spacing and barley genotypes on growth attributes

Treatments	Growth attributes															Yield attributes					
	Plant Population ('000 ha^{-1})			Number of tillers			Plant height (cm)			Flowering (days)			Maturity (days)			Test wt (g)			Number of grains ear^{-1}		
	2015-16	2016-17	Pooled	2015-16	2016-17	Pooled	2015-16	2016-17	Pooled	2015-16	2016-17	Pooled	2015-16	2016-17	Pooled	2015-16	2016-17	Pooled	2015-16	2016-17	Pooled
Spacing (cm)																					
20.0	102.22	72.89	87.56	437	421	429	84.6	84.7	84.6	64	69	66	107	108	107	39.0	39.0	39.0	31.6	43.8	37.7
22.5	90.77	69.89	80.33	418	410	414	82.6	85.2	83.9	62	68	65	105	107	106	39.4	39.9	39.6	31.6	44.0	37.8
25.0	82.67	68.56	75.61	373	391	382	81.0	82.8	81.9	62	66	64	104	107	105	39.8	39.8	39.8	32.2	44.5	38.4
SEm±-	2.58	1.69	1.54	7.0	2.6	3.7	0.4	1.0	0.6	0.6	0.6	0.4	0.6	0.5	0.4	0.3	0.3	0.2	0.5	0.2	0.3
C.D. at 0.05	7.95	NS	4.50	22	8	11	1.4	NS	1.7	2	2	1	2	NS	1	NS	NS	0.6	NS	NS	NS
Genotypes																					
BH 959	90.49	70.89	80.69	401	404	403	76.3	77.7	77.0	63	67	65	106	107	106	39.3	39.5	39.4	33.8	44.5	39.1
RD 2786	94.68	71.56	83.12	428	413	421	87.4	92.2	89.8	63	68	65	105	108	106	39.8	40.1	40.0	32.6	44.8	38.7
RD 2715	90.49	68.89	79.69	398	403	401	84.3	82.8	83.6	62	67	65	105	107	106	39.0	39.1	39.1	29.0	43.0	36.0
SEm±-	0.64	1.94	1.02	6.9	3.0	3.8	0.3	1.4	0.7	0.6	0.6	0.4	0.9	0.5	0.5	0.2	0.5	0.3	0.3	0.3	0.2
C.D. at 0.05	2.51	NS	3.33	NS	NS	12	1.1	5.4	2.3	NS	NS	NS	NS	NS	NS	NS	NS	NS	1.3	1.0	0.7

Table 2: Effect of row spacing and barley genotypes on yield and economics

Treatments	Yield (q ha^{-1})									Economics					
	Biological			Grain			Straw			Net return (Rs. ha^{-1})			B - C ratio		
	2015-16	2016-17	Pooled	2015-16	2016-17	Pooled	2015-16	2016-17	Pooled	2015-16	2016-17	Pooled	2015-16	2016-17	Pooled
Spacing (cm)															
20.0	112.7	88.5	100.6	56.0	54.1	55.0	69.3	64.6	66.9	73188	66704	69946	2.6	2.2	2.4
22.5	114.0	85.2	99.6	54.1	47.7	50.9	66.9	57.0	61.9	69702	55345	62523	2.5	1.8	2.2
25.0	113.4	78.0	95.7	46.0	46.0	46.0	56.9	54.9	55.9	55172	52264	53718	2.0	1.7	1.9
SEm±-	1.5	1.7	1.1	1.2	0.6	0.7	1.4	0.7	0.8	2123	1072	1189	0.1	0.0	0.0
C.D. at 0.05	NS	5.1	3.2	3.7	1.8	2.0	4.3	2.2	2.3	6540	3304	3470	0.2	0.1	0.1
Genotypes															
BH 959	114.8	85.0	99.9	54.7	51.6	53.2	67.7	61.7	64.7	70877	62346	66612	2.6	2.1	2.3
RD 2786	113.7	88.3	101.0	53.4	50.6	52.0	66.0	60.4	63.2	68448	60434	64441	2.5	2.0	2.2
RD 2715	111.6	78.4	95.0	48.0	45.6	46.8	59.4	54.4	56.9	58737	51533	55135	2.1	1.7	1.9
SEm±-	2.4	1.8	1.5	1.2	0.9	0.7	1.5	1.1	0.9	2113	1660	1343	0.1	0.1	0.0
C.D. at 0.05	NS	7.1	4.8	4.5	3.6	2.4	6.0	4.4	3.1	8297	6516	4381	0.3	0.2	0.2

Conclusion

Based on two years of experimentation it can be concluded that growing of barley at closer row spacing of 20 cm recorded significantly highest growth parameters, grain yield, net return and B-C ratio compared to 22.5 and 25 row spacing. Amongst different varieties, BD 959 variety obtained significantly higher grain yield, net return and B-C ratio compared to RD 2786 and RD 2715 varieties.

References

1. Das TK, Yaduraju NT. Effects of missing-row sowing supplemented with row spacing and nitrogen on weed competition and growth and yield of wheat. Crop and Pasture Science. 2011; 62:48-57.
2. Eberbach P, Pala M. Crop row spacing and its influence on the partitioning of evapo-transpiration by winter grown wheat in Northern Syria. Plant and Soil 2005; 268:195-208.
3. Gomez KA, Gomez AA. Statistical procedures for agricultural research. 2nd Edition (IRRI). John Wiley and Sons, New York, Chichester, Brisbane, Toronto and Singapore, 1984.
4. Hussian I, Khan MA, Ahmad K. Effect of row spacing on the grain yield and yield component of wheat (*Triticum aestivum* L.). Pakistan Journal of Agronomy 2003; 2(3):153-59.
5. IIWBR, Progress Report, All India Coordinated Wheat and Barley Improvement Project. Indian Institute of Wheat and Barley Research, Karnal, Haryana, 2017-18; 6:7.
6. Kumar M, Sheoran P, Yadav A. Productivity potential of wheat in relation to different planting methods and nitrogen management strategies. Indian Journal of Agricultural. Science. 2010; 80(5):427-429.
7. Mali H, Choudhary J. Performance of bread wheat (*Triticum aestivum* L.) varieties under different row spacing. Journal of Wheat. 2011. 4(2):55-57.
8. Rawat DS. Performance of dual purpose barley (*Hordeum vulgare* L.) varieties under varying seed rate and fertility management. M.Sc. (Ag.) Thesis, Department of Agronomy, MPUAT, Udaipur, 2011.

9. Singh SS, Prasad LK, Upadhyaya A. Root growth, yield and economics of wheat (*Triticum aestivum* L.) as affected by irrigation and tillage practice in South Bihar. Indian Journal of Agronomy. 2006; 51(2):131-134