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Effect of different dates of sowing on barley (*Hordeum Valgare* L.) varieties under limited irrigation

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Abstract
An experiment on effect of dates of sowing on barley varieties under limited irrigation was conducted at ITM University, Gwalior, M.P. to find out optimum time for barley sowing. Four dates of sowing (9,19 and 29 November and 9 December) and four varieties (NDB-1, Super luxmi, NDB-1445 and NDB-943) were tested in split plot design. The crop sown on 19 and 29 November recorded higher dry matter, effective tillers, grain number and higher grain yield over 9 December sown crop. The varieties NDB-943 and Super luxmi recorded significantly higher tiller number, effective tillers, dry matter, number of grain per spike, 1000 grain weight, grain yield and straw yield. The gross returns, net returns and B: C ratio were higher in the crop sown with varieties NDB-943 on 19 November followed by that of Super luxmi sown on 19 November.

Keywords: sowing on barley, irrigation.

Introduction
Barley importance derives from in ability to grow and produce in marginal environments. Which are often characterized by drought, low temperature and salinity (Baum *et al*., 2004; Lakew *et al*., 2011; El-awady and El-Tarras., 2014) [2, 7]. Barley is notably susceptible to heat stress at meiosis and anthesis stages (Sakata *et al*., 2000) [15]. Under rain fed conditions, barley frequently suffer from drought resulting in a significant loss of yield (Hossain *et al*., 2012a) [6]. Scientific improvement of barley was initial in the eary part of the 20th century. Systematic and more intensive effort were made from 1967-68 through AICRP on barley. Since then number of cultivars were evolved and released for cultivation by farmers. However, the cultivars are evolved for higher yield for different regions. Their suitability in different regions needs to be tested. Hence, three varieties are chosen are chosen for study under different dates of sowing. The difrferences in production of early and sown increase photosynthetic rate, assimilates supply for seed and growth rate in early sown crops than late planting (Rashid *et al*., 2010) [13]. Delay in planting decreases barley grain yield (Singh and Singh 2005) [14]. Sowing at an appropriate time with suitable variety is necessary for ensuring maximum yield and that is why sowing time needs to be adjusted so that the crop germinates well and utilize the soil moisture effectively. Enormous efforts are, therefore, needed to recommending proper sowing time. The present experiment was set up to find out a suitable time of sowing for better performance of barley varieties for successful barley production under a limited irrigated conditions at ITM University Gwalior.

Materials & methods
The present research work entitled "effect of different dates of sowing on barley Varieties (*Hordeum Vulgare* L.) under limited irrigation" was conducted at Research Farm, Department of Agronomy, School of Agriculture, ITM University, Gwalior (M.P.) during the winter season of 2015-16. Geographically, the experiment site falls under humid sub-tropical climate and located in between 23^0 10' N latitude and 79^0 54' E longitudes on an elevation of 411.98 meters above mean sea level in Morar block at Gwalior district of the gird region of northern Madhya Pradesh. The experiment was conducted in split plot design with four dates (9 Nov,19 Nov,29 Nov and 9 Dec) of sowing in main plots and four varieties (NDB-1, Super luxmi, NDB-1445 and NDB-943) in sub plots and replicated three times. The soil type of experimental field was sandy loam in nature. The seeds were sown by opening a furrow at a specified distance of 18cm and treated seed of the four varieties of barley were sown as per

dates. The crop was fertilized with 90, 50 and 20 and kg/ha^{-1} N, P_2O_5 and K_2O respectively. Entiye dose of P_2O_5 and K and 50% N was applied at sowing and remaining N was applied in two splits at and days after sowing. The basal dose of fertilizer was applied in the furrow and then seed were sown as a spacing or 10 cm with in row then seed and fertilizer was covered with soil.

Results

Yield attributes

The effective tillers were significantly influenced by the date of sowing and varieties while the interaction effect due to dates of sowing and varieties was not significant (Table 1). The number of effective tillers were significantly higher in 19 Nov sown crop over that of 29 Nov and 9 Dec sown crop and comparable with that of 9 Nov sown crop. The effective tillers were comparable in 9 Nov, 29 Nov and 9 Dec sown crop. The effective tillers were comparable in varieties Super luxmi and NDB-943 and the tillers in these varieties were significantly superiors over that of NDB-1 and NDB-1445, the effective tiller in latter two varieties were comparable.

The spike length was significantly influenced by dates of sowing and varieties which were not significant due to the interaction of dates of sowing and varieties (Table 1). The crop sown on 9, 19 and 29 Nov recorded significantly higher spike length over 9 Dec sown crop. The spike length in former three dates of sowing was comparable. The spike length of Super luxmi and NDB-943 was significantly superior over that of NDB-1 which in turn recorded significantly higher spike length over NDB-1445.

Table 1: Effect date of sowing and varieties on number of effective tillers per mater length, spike length, number of grain spike and 1000-grain weight (g)

Date of sowing	Effective tiller/m row length	Spike length, cm	Grain number /spike	1000-grain weight(g)
9 Nov	66.86	7.37	46.80	35.20
19 Nov	72.14	7.69	48.79	36.07
29 Nov	68.30	7.72	47.03	35.62
09 Nov	65.68	6.72	46.00	33.15
S.Em.±	1.17	0.16	0.25	0.32
CD at 5%	3.42	0.46	0.73	NS
Varieties				
NDB-1	63.58	7.08	46.02	34.33
Super luxmi	74.95	7.76	48.55	35.82
NDB-1445	60.77	6.74	44.43	33.96
NDB-943	73.68	7.56	49.11	35.93
S.Em.±	1.28	0.12	0.29	0.19
CD at 5%	4.42	0.43	1.02	0.67

Table 2: Effect date of sowing and varieties on grain yield(kg/ha^{-1}), straw yield(kg/ha^{-1}) and biological yield(kg/ha^{-1}) of barley

Date of sowing	Grain yield(kg/ha^{-1})	Straw yield(kg/ha^{-1})	Biological(kg/ha^{-1})
9 Nov	2893	3464	6358
19Nov	3057	3656	6713
29Nov	2895	3500	6396
9 Dec	2642	3417	6059
S.Em.±	78	112.43	191
CD at 5%	225	NS	NS
Varieties			
NDB-1	2694	3332	6026
Super luxmi	3236	3923	7199
NDB-1445	2415	2993	5408
NDB-943	3102	3789	6892
S.Em.±	70	101	152
CD at 5%	243	349	527

The grain per spike was significantly influenced by date of sowing and varieties and their interaction. The number of grains per spike were significantly higher in 19 Nov sown crop over that of all other dates of sowing. The grain number per spike was significantly more in 29 Nov sown crop over 9 Dec sown crop and comparable with that under 9 Nov sown crop. The number of spike under latter treatments was significantly greater than that under 9 Dec sown crop. The cultivar NDB-943 has recorded significantly higher number of grains over that of NBD-1 and NDB-1445 and comparable with that of Super luxmi. The grain number in the latter variety was significantly superior over NDB-1 which in turn was superior over NBD – 1445. The grain number in the latter variety was significantly inferior over other varieties.

The 1000 grain weight did not vary significantly due to dates of sowing and interaction of dates and varieties. However, it was significantly influenced by varieties (Table 2). The 1000 grain weight was comparable in NDB-943 and Super Luxmi varieties and significantly superior over NDB-1445 and NDB-1. The 1000 grain weight in latter two varieties was comparable.

Yield: The grain yield was significantly influenced by dates of sowing and varieties, while the interaction effect of dates of sowing and varieties was not significant (Table 2). The crop sown on 9 Nov, 19 Nov and 29 Nov recorded significantly higher grain yield than that observed in 9 Dec sown crop. The grain yield the former there dates of sowing was comparable with each other. The grain yield of Super Luxmi and NDB-943 varieties was comparable and significantly greater over that of NDB-1. The grain yield in latter variety was significantly higher than hat of NDB-1445.

The straw and biological yield was significantly influenced due to varieties while it was not significant due to dates of

sowing and interaction of dates of sowing and varieties. The straw yield observed with Super Luxmi and NDB-943 was comparable with each other and significantly superior over that of NDB-1 and NDB-1445.The straw yield in latter two varieties was comparable (Table 2). On the biological yield observed with varieties Super luxmi and NDB-943 was comparable and significantly superior to that with NDB-1. The biological yield recorded with NDB-1was significantly superior over that of NDB-1445

Discussion

Dates of Sowing: Crop yield is a complex character depending upon a large number of environmental, morphological and physiological characters. Significantly higher grain yield was obtained from 9, 19 and 29 November sown crop over that of 9 December sown crop. The decrease in yield in December sown crop was 8.6, 13.6 and 8.81%, as compared to 9 Nov, 19 Nov and 29 Nov sown crop. In the present study, yield and yield components were significantly affected by sowing times. It might be due to cumulative effect of optimum temperature at the vegetative and reproductive stages that provided higher number of fertile tillers plant^{-1}, spikelets spike^{-1}, and 1000-grain weight. Significantly lower yield obtained with crop sown on 9 December can be attributed to lower values of the above-mentioned characters due to lower temperature at the early vegetative stage and sharp rise in temperature at the reproductive stage, which eventually shortened the growth period. Further, the grain yield had positive correlation with growth and yield attributing parameters (Table 3) indicating that improvement in yield attributes and growth in the crop sown in November has resulted in higher grain yield.

Table 3: Correlation between grain yield and growth and yield attributes of barley

S.no.	Character	r value
1	Number of effective tillers per meter row length at harvest	0.94**
2	Dry weight per plant at 60days after sowing	0.64**
3	Dry weight per plant at harvest	0.61*
4	Spike length	0.87**
5	Number of grain /spike	0.76**
6	1000 grain weight	0.72*

** Significant at 1% * significant at 5%

Plant height is an important morphological character directly linked with the productive potential of plant in terms of grain yield. In the present investigation, significant reduction in plant height was noticed due to delay in sowing on 9 December Number of total and fertile tillers plant^{-1} is also another important character, which ensures higher yield. Delay in sowing reduced number of tillers and effective tillers plant^{-1}, spike length, (Tables 1). Reduction of panicle length at the later sowing dates might be due to low temperature at the vegetative stage and scarce soil moisture as well. These results are in agreement with Petr (1979) [12], Noworolnik and Leszczynska (1997) [11] and Chun (2000) [3] and Makki and Habib (1979) [8] Abdel-Raouf (1983b) [1].

In the early stages, the maximum temperature was 29.2 ^{0}C and minimum temperature 10.3 ^{0}C being favourable for the germination of barley varieties under study. During the experimental period, temperature started declining up last week of January. Later on temperature started increasing up to harvest, being much conducive for the maturity of all the genotypes under test. Relative humidity varied from 17.4.0% to 95.0% during the crop span which, in turn, favored the growth of barley varieties in general.

A definite trend with slight variations in the range of evaporation was observed during the course of the experimentation. In the beginning, the rate of evaporation was higher but went on decreasing till January, 2016 and thereafter again started increasing till harvest under the influence of higher temperature and wind velocity. The shows that the crop sown on Dec 9 must have experienced moisture sters and there by lower grain yield.

The grain yield of Super luxmi and NDB -943 varieties was comparable and significantly greater over that of NDB -1. The grain yield in the latter variety was significantly higher than that of NDB – 1445. The growth parameters like dry matter production and effective tillers were significantly greater in Super luxmi and NDB -943 over that of NDB -1 and NDB 1445. Similarly, the yield attributing charecters like Spike length, number of grain per spike were also higher in these two varieties over latter two varieties. The greater values of growth and yield attributes in these two varieties has resulted significant increase in grain yield in Super luxmi and NDB-943 over NDB-1 and NDB -1445. The significant increase in yield of NDB-1 over NDB-1445 was also due to significant increase in growth and yield attributes similar to above varieties over NDB -1445 there by resulted in significantly greater yield. Further, these charecters had positive correlation with grain yield indicating that any increase in yield attributes and growth result in increased grain yield (Table 3).

Conclusion

From the fore going discussion, it can be concluded that sowing of barley varieties Super luxmi and NDB -943 in the second fortnight of November gives higher yield than sowing in the first fortnight of December in grid region of northern M.P.

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