IJPS INTERNATIONAL JOURNAL OF PLANT SCIENCES
Volume **8** | Issue 2 | July, 2013 | 305-308

RESEARCH ARTICLE

Optimization of sowing and nitrogen levels and its scheduling on grain quality of malt barley (*Hordeum vulgare* L.) under irrigated condition

■ G.P. NAROLIA, R.S. YADAV, M.L. REAGER AND R.S. NAROLIA

SUMMARY

A field experiment was conducted to evaluate the effect of nitrogen levels and its split application on growth, yield and quality of malt barley (*Hordeum vulgare* L.) under normal and late sown conditions during winter seasons of 2005-06 and 2006-07 at Agronomy Farm, College of Agriculture,Bikaner. The results showed that significantly higher different quality parameters like as screening percentage, grain protein concentration and husk content of malt barley was observed under late sown condition compared to normal sown condition.While, plumpness and average grain weight was significantly higher under normal sown. Further, application of increasing levels of nitrogen from 60 to 90 kg ha^{-1} significantly enhanced grain protein concentration, average grain weight and alpha amylase activity of malt barley. While, starch concentration and husk content was significantly higher under 60 kg N ha^{-1}. Scheduling of nitrogen at 1/3 as basal +1/3 at Ist irrigation +1/3 at IInd irrigation brought a substantial improvement in grain protein concentration, plumpness and alpha amylase activity while starch concentration and husk content was decreased as compared to two splits *viz.*,½ at basal + ½ at Ist irrigation, 2/3 at basal +1/3 at Ist irrigation, 3/4 at basal +1/4 at Ist irrigation and full basal. Scheduling of N in three equal splits affect the quality of malt barley grains. The prescribed limit as per Indian standards in North-Western Rajasthan conditions.

Key Words : Screening percentage, Grain protein concentration, Starch concentration, Plumpness, Average grain weight, Husk content, Alpha amylase activity, Nitrogen levels, Sowing dates, Scheduling of nitrogen application, Malt barley

How to cite this article : Narolia, G.P., Yadav, R.S., Reager, M.L. and Narolia, R.S. (2013). Optimization of sowing and nitrogen levels and its scheduling on grain quality of malt barley (*Hordeum vulgare* L.) under irrigated condition. *Internat. J. Plant Sci.*, **8** (2) : 305-308.

Article chronicle : Received : 27.10.2012; **Revised :** 14.03.2013; **Accepted :** 07.05.2013

Barley (*Hordeum vulgare* L.) is one of the important cereal crops. Use of barley in malt industry is most significant out of its all uses where it is being used in making beer, different type of alcohol. Many crop management factors affect the yield and quality of this crop. For higher production and grain quality of malt barley, the influence of weather elements particularly the temperature on crop growth and development and their by own crop productivity is well established so, planting time may affect the productivity and quality of malt barley particularly the grain protein and husk content (Zhang *et al.*, 2002). Nitrogen is considered as most important element in production of cereals. Barley crop has also been found to respond significantly to varying levels to nitrogen fertilizations. However, there has been limited field research on the scheduling of N fertilizer that suit as both grain yield and grain quality for malting barley. Time of application of nitrogen is known to exert considerable influence on the yield and quality of crop. Nitrogen efficiency especially in light soils can be increased and losses reduced by regulating it through the scheduling of nitrogen application so as to match with its uptake by the growing plants. Method

MEMBERS OF THE RESEARCH FORUM

Author to be contacted :
G.P. NAROLIA, Agricultural Research Station (M.P.U.A.T.), UDAIPUR (RAJASTHAN) INDIA
Email: narolia.agro@gmail.com

Address of the Co-authors:
R.S. YADAV, Department of Agronomy, College of Agriculture, S.K. Rajasthan Agricultural University, BIKANER (RAJASTHAN) INDIA
Email: rsy.1961@gmail.com

M.L. REAGER, Department of Agronomy, Krishi Vigyan Kendra (S.K.R.A.U.) Keshwana, JALORE (RAJASTHAN) INDIA
Email: drmadanagro@gmail.com

R.S. NAROLIA, Department of Agronomy, Agricultural Research Station (M.P.U.A.T.) KOTA (RAJASTHAN) INDIA
Email: narolia2007@gmail.com

of application in malting barley is such that decrease the grain protein level to acceptable levels by the brewing industry. Too much splitting of N may increase the yield but affected the grain quality of malt barley. Barley grown for malt purpose must have low protein concentration and grain should be large enough (Chandola, 1990).

MATERIAL AND METHODS

The experiment was conducted at College of Agriculture, Bikaner during winter seasons of 2005-06 and 2006-07. The soil of the experimental field was loamy sand and low in organic matter. The soil pH was 8.28. The treatments comprised of two levels of growing environments (normal and late sown) and two nitrogen levels (60 and 90 kg ha^{-1}) as main plot treatments and five levels of scheduling of nitrogen application (Full basal, 3/4 at basal + 1/4 at 1^{st} irrigation, 2/3 at basal + 1/3 at I^{st} irrigation, 1/2 at basal + 1/2 at I^{st} irrigation and 1/3 at basal + 1/3 at I^{st} irrigation + 1/3 at II^{nd} irrigation) as sub plot treatments and were laid out in split plot design with four replications. The nitrogen as per treatments was applied through urea after adjusting the nitrogen supplied through DAP (applied for 40 kg P_2O_5 ha^{-1}) and potassium (30 kg K_2O ha^{-1}) also supplied through MOP. The calculated quantity of urea for different treatments was applied as basal and remaining nitrogen were given at I^{st} and II^{nd} irrigation as per treatments. The malt barley variety RD-2503 was sown on 12^{th} November (normal sown) and 2^{nd} December (late sown) during 2005, and 20^{th} November (normal sown) and 5^{th} December (late sown) during 2006, maintaining 22.5 cm row to row spacing. The screening percentage was determined by the timed sieve-shaker machine (Analytics-EBC, 2002). The per cent protein content in grain of each plot was worked out by multiplying the nitrogen content in grains with conversion factor 6.25 (A.O.A.C, 1960). Barley flour sample was treated with 80 per cent alcohol to remove sugars and then, the starch was extracted with perchloric acid (Sadasivam and Manickam, 1992a). Plumpness percentage was determined by the timed sieve-shaker machine expressed as (American Society of Brewing Chemists, 1992). A grain sample was taken from the produce of each of the net plot harvested and average five grains were weighed, calculated for average grain weight (Weston *et al.,* 1993). The reducing sugars produced by the action of alpha amylase react with dinitro-salicylic acid and reduce it to a brown coloring product of nitro amino-salicylic acid (Sadasivam and Manickam, 1992b). The husks were removed by treatment with sodium hypochlorite solution (Analytica-EBC, 1997). The husks was determined and formula given below :

Husk content (%) = [Sample weight (g) – Weight of dehusked grains (g)] x 100 / sample weight (g)

RESULTS AND DISCUSSION

The experimental findings obtained from the present study have been discussed in following heads:

Effect of growing environments :

Data in Table 1 revealed that their was no influence of sowing date on starch concentration and alpha amylase activity of malt barley on pooled basis. The data (Table 1) further revealed that effect of late sowing significantly increased the screening percentage, grain protein concentration and husk content of malt barley over normal sowing on pooled basis. This might be due to higher amounts of unutilized nutrients seem to have resulted in increasing their concentration in the plant parts. The significant increase in protein concentration under the influence of delayed planting appears to be on account of higher concentration of N in the grain (Patel *et al.,* 2004). While, plumpness, average grain weight and grain yield was significantly higher under normal sown on pooled basis. This may due to the fact that under normal sown conditions, the reproductive phase experienced optimum temperature conditions while under late sown conditions, steep rise in temperature at this stage reduced the duration of reproductive phase. It is also established fact that the prevalence of higher temperature shortens period from ear initiation anthesis thus reducing supply of photosynthates relative to the rate of development, consequently less grains per ear. Further estimates revealed that over a range of 12 to 26^0C, increased temperature during grain filling reduced wheat grain weight from 4 to 8 per cent (Fischer, 1984).

Effect of nitrogen levels :

Application of increasing levels of nitrogen from 60 to 90 kg ha^{-1} significantly enhanced grain protein concentration, average grain weight, alpha amylase activity and grain yield of malt barley on pooled basis (Table 1). But the protein concentration of 90 kg N ha^{-1} treatment remained in the prescribe limit (9.0 to 11.5 per cent content) as per the guidelines led out by DWR (Karnal) under Indian conditions (Verma *et al.,* 2005). The supply of nitrogen to soil might accelerated various physiological processes due to greater translocation of photosynthates from source to sink (grain) in plants increased yield in malt barley. While, starch concentration and husk content was significantly higher under 60 kg N ha^{-1}. Barley grown for malt purpose must have low starch concentration and husk content (Chandola, 1990).

Effect of scheduling of nitrogen application :

Data (Table 1) further, revealed that nitrogen application in three equal splits *viz.,* 1/3 at basal + 1/3 at I^{st} irrigation + 1/3 at II^{nd} irrigation recorded significantly higher grain protein concentration, plumpness, alpha amylase activity and grain yield while starch concentration and husk content of malt barley was decreased as compared to two splits *viz.,* 1/2 at

basal + 1/2 at Ist irrigation, 2/3 at basal + 1/3 at Ist irrigation, 3/4 at basal + 1/4 at Ist irrigation and full basal. Scheduling of N in three equal splits affect the quality of malt barley grains. In the present study, although N application in three splits had increased the protein content in grain of malt barley variety RD-2503 yet it was with in the prescribe limit (9.0 to 11.5 per cent) as per the Indian standards (Verma *et al.*, 2005) under North-west Rajasthan conditions. The probable cause for higher protein concentration in three equal splits was due to the continuity of nutrient availability through split application and leads to rational utilization of nutrients by plants, which facilated higher uptake of nitrogen as per requirement by plants. The increase in grain yield might be due to continued and timely availability of nitrogen under three splits of nitrogen to malt barley.

Interaction effect :

The interactive effect of growing environments and their various split applications on grain protein concentration (Table 2) revealed that maximum (9.72%) and significantly higher grain protein concentration was recorded with late sown applied in three equal splits *viz.*, 1/3 at basal + 1/3 at Ist irrigation + 1/3 at IInd irrigation as compared to two equal N splits treatment (1/2 at basal + 1/2 at Ist irrigation), however, there was no significant effect of these treatments was observed under normal sown condition on grain protein concentration.

Table 1 : Effect of growing environments, nitrogen levels and scheduling of nitrogen application on grain yield and quality of malt barley (pooled data)

Treatments	Screening percentage (%)	Grain protein concentration (%)	Starch concentration (%)	Plumpness (%)	Average grain weight (mg)	Husk content (%)	Alpha amylase activity (DU^0)	Grain yield (q/ha)
Growing environments								
Normal sown	3.04	8.74	60.39	82.75	43.86	10.75	44.50	28.55
Late sown	3.12	9.04	60.71	80.02	42.64	10.95	44.58	26.32
C.D. (P=0.05%)	0.06	0.08	NS	1.13	0.75	0.16	NS	0.09
Nitrogen levels								
60 kg/ha	3.05	8.80	61.77	81.04	42.60	10.95	44.45	25.31
90 kg/ha	3.11	8.97	59.33	81.73	43.89	10.75	44.63	29.55
C.D. (P=0.05%)	NS	0.08	1.21	NS	0.75	0.16	0.08	0.09
Scheduling of nitrogen application								
Full basal	3.06	8.31	61.52	80.02	42.92	10.95	44.00	21.76
3/4 Basal + 1/4 at Ist irrigation	3.06	8.62	61.21	80.58	43.04	10.94	44.26	25.26
2/3 Basal + 1/3 at Ist irrigation	3.08	8.79	60.79	81.48	43.19	10.88	44.37	28.25
1/2 Basal + 1/2 at Ist irrigation	3.09	9.25	59.85	82.13	43.39	10.77	44.91	30.09
1/3 Basal + 1/3 at Ist irrigation + 1/3 at IInd irrigation	3.10	9.48	59.37	82.70	43.69	10.71	45.17	31.80
C.D. (P=0.05%)	NS	0.08	1.30	1.33	NS	0.18	0.08	0.12

NS= Non-significant

Table 2 : Interaction effect of growing environments, nitrogen levels and scheduling of nitrogen application on grain protein concentration (%) of malt barley (pooled data)

Scheduling of nitrogen application	Normal sown		Late sown		Mean
	60 kg N ha^{-1}	90 kg N ha^{-1}	60 kg N ha^{-1}	90 kg N ha^{-1}	
Full basal	18.87	21.51	21.72	24.95	21.76
3/4 Basal + 1/4 at Ist irrigation	24.92	26.30	22.77	27.05	25.26
2/3 Basal + 1/3 at Ist irrigation	27.62	32.44	24.73	28.23	28.25
1/2 Basal + 1/2 at Ist irrigation	28.86	35.49	26.62	29.39	30.09
1/3 Basal + 1/3 at Ist irrigation + 1/3 at IInd irrigation	29.44	40.01	27.60	30.15	31.80
Mean	25.94	31.15	24.69	27.95	27.43
	S.E.±		C.D. (P = 0.05)		
A-means at same level of S and N	1.23		2.45		
S and N-means at same level of A	1.31		2.67		

Conclusion :

Keeping in view the objectives framed for undertaking the study and the results obtained after experimental period, under mentioned conclusions may be drawn. Application of nitrogen @ 90 kg N ha^{-1} in three splits as 1/3 at basal + 1/3 at I^{st} irrigation + 1/3 at II^{nd} irrigation with normal sown proved to be the best practice for different quality parameters of malt barley.

REFERENCES

A.O.A.C. (1960). *Official methods of analysis.* 9th Ed. Association of Official Agricultural Chemists, WASHINGTON DC. P: 119.

American Society of Brewing Chemists (1992). *Method of analysis.* 8th Ed. ASBC, St. Paul, MN.

Analytica-EBC (1997). Husk content of barley. Section-3 Barley, Method 3.9, Sep.,1997.1pp.

Analytica-EBC (2002). Sieving test for barley. Section-3 Barley, Method 3.11.1, Dec.,2002.1pp.

Chandola, R.P. (1990). *Jau ki kheti*, ICAR Publication, NEW DELHI, INDIA,76-103pp.

Fischer, R.A. (1984). Physiological limitations to producing wheat in semi-tropical and tropical environments and possible selection criteria. Processing for International symposium. September 24-28, Mexico, D.F. pp.209-230.

Patel, A.M., Patel, D.R., Patel, G.A. and Thakor, D.M. (2004). Optimization of sowing and fertilizer requirement of barley (*Hordeum vulgare*) under irrigated condition. *Indian J. Agron.*,**49**(3): 171–173.

Sadasivam, S. and Manickam, A. (1992a). Estimation of starch by anthrone reagent. In: *Biochemical methods for agricultural sciences*, Wiley Eastern Limited, NEW DELHI, INDIA 11-12pp.

Sadasivam, S. and Manickam, A. (1992b). Determination of amylase. In: *Biochemical methods for agricultural sciences*, Wiley Eastern Limited, NEW DELHI, INDIA.12-13pp.

Verma, R.P.S., Sharma, R.K. and Mishra, B. (2005). Future of barley for malt, feed and fodder in India. DWR-Karnal, Technical Bulletin No. 9.

Weston, D.T., Horsley, R.D., Schwarz, P.B. and Goos, R.J. (1993). Nitrogen and planting date effects on low protein spring barley. *Agron. J.*, **85** (6): 1170 – 1174.

Zhang, G.P., Wang, J.M., Chen, J.X., Yin, C. and Ding, S.R. (2002). The variation of beta-glucan and protein content in barley as affected by agronomic practices. *Agric. Sci. China*, **1**(10): 1162 – 1167.