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Effect of time and levels of nitrogen application on malt barley (*Hordeum vulgare*)

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ABSTRACT

A field experiment was conducted to study the response of malt barley (*Hordeum vulgare* L.) cv. 'BCU 73' to N rates and time of its application at Varanasi, Uttar Pradesh, during the winter seasons of 1999–2001. Application of N significantly increased the number of ears, grains/ear and 1,000-grain weight up to 80 kg/ha. The maximum grain and straw yields, total N uptake and protein content in grain were recorded at 80 kg N/ha. Two split application of N (1/3 at sowing and 2/3 at first irrigation) had higher values of yield components and resulted in significantly higher grain and straw yields. The total N uptake was also the maximum in this treatment, but protein content was significantly higher in treatment receiving 3 splits of N. The benefit : cost ratio was the highest at 80 kg N/ha and with 2 split application of N.

Key words : Malt barley, Nitrogen rates, Time of application, Protein content.

Barley has been cultivated in India since ages and its area has declined in the past 3 decades. Among the various inputs influencing both yield and quality of barley, nitrogen is the most important one. Nitrogen, being the constituent of protein, enhances the protein content in grain, which is the most important parameter of malting quality (Pameranz *et al.*, 1971). High N rates can result in translocation of excessive amount of N from vegetative organs to grains (Pupakosta and Graginanas, 1991). Therefore, present study was undertaken to find out the optimum N level and its time of application for yield and protein content of barely for malting purpose.

MATERIALS AND METHODS

The field experiment was carried out at Varanasi, Uttar Pradesh, during the winter seasons of 1999–2001. The soil was sandy clay loam in texture with pH 7.4, containing 233 kg/ha available N, 17.9 kg/ha available P and 139.0 kg/ha available K. The experiment was conducted in split-plot design, keeping N levels (20, 40, 60 and 80 kg/ha) in main plots and 3 times of N application (T_1, 1/2 at sowing and 1/2 after first irrigation; T_2, 1/3 at sowing and 2/3 after first irrigation; and T_3, 1/3 at sowing, 1/3 after first irrigation and 1/3 after second irrigation) in sub-plots, replicated thrice. Full dose of P_2O_5 (30 kg/ha) and K_2O (20 kg/ha) was applied at sowing and N was applied as per treatment. Malt barley cv. 'BCU 73' ('Rekha') was sown with a seed of 75 kg/ha.

RESULTS AND DISCUSSION

Yield attributes and yield

A significant variation in ears/m^2, grains/ear and 1,000-grain weight of barley was recorded with each increment in rate of N (Table 1). All these yield attributes were the maximum at 80 kg/ha. Favourable effects of yield attributes resulted in significant yield increase at each rate of N. The maximum grain and straw yields were recorded at 80 kg N/ha (Table 2). Physiological role of N in enhancing dry-matter accumulation might have led to increased yield attributes and thereby yield of crop at higher rates of N (Prasad and Singh, 1987; Bark, 1980; Dhukia *et al.*, 1998).

The yield attributes of barley were not affected by time of N application in the first year, but during the second year, ears/m^2 and grains/ear increased significantly with application of 1/3 N at sowing and 2/3 N after first irrigation, whereas 1,000-grain weight was significantly higher in 3 equal splits of N (Table 1). This could be attributed to continuous supply of N up to late jointing stage. As a result of favourable influence of the split doses of N (1/3 at sowing and 2/3 after first irrigation) on ears/m^2 and grains/ear, the grain yield was also the maximum in this treatment.

Nitrogen uptake and protein content

The N uptake by crop increased significantly up to 80 kg N/ha. However, 40 and 60 kg N/ha were at par

Table 1. Effect of rates and time of N application on yield attributes of malt barley

Treatment	Ears/m²		Grains/ear		1,000-grain weight (g)	
	1999–2000	2000–2001	1999–2000	2000–2001	1999–2000	2000–2001
Nitrogen (kg/ha)						
20	182.7	302.9	21.4	18.6	39.9	50.5
40	218.7	332.6	22.4	20.3	41.2	51.4
60	269.9	387.7	24.2	22.0	42.6	51.7
80	284.5	404.9	26.3	22.8	44.6	52.3
CD (P=0.05)	10.0	6.0	1.6	0.8	1.1	0.6
Time of N application						
1/2 at sowing and 1/2 after first irrigation	239.8	345.4	23.5	19.8	40.5	51.1
1/3 at sowing and 2/3 after first irrigation	242.2	377.9	23.7	21.6	41.0	51.4
1/3 at sowing, 1/3 after first irrigation and 1/3 after second irrigation	234.7	348.9	23.6	21.5	42.2	52.0
CD (P=0.05)	NS	3.6	NS	0.3	1.1	0.3

Table 2. Effect of rates and time of N application on yield, N uptake, protein content and benefit : cost ratio

Treatment	Grain yield (q/ha)		Straw yield (q/ha)		N uptake (kg/ha)		Protein content (%)		Mean benefit : cost ratio
	1999–2000	2000–2001	1999–2000	2000–2001	1999–2000	2000–2001	1999–2000	2000–2001	
Nitrogen (kg/ha)									
20	15.30	17.80	20.94	24.56	35.9	41.7	10.1	10.2	1.3
40	21.00	23.71	29.91	33.40	59.6	59.8	10.7	10.7	1.7
60	24.60	26.50	39.13	41.60	67.8	72.0	11.4	11.2	1.9
80	29.00	31.50	46.13	48.25	81.7	88.1	11.6	11.7	2.2
CD (P=0.05)	1.05	1.54	3.79	3.67	11.6	12.6	0.5	0.5	
Time of N application									
½ at sowing and ½ after first irrigation	22.90	24.60	34.01	36.65	54.4	61.4	10.6	10.6	1.9
1/3 at sowing and 2/3 after first irrigation	24.40	25.10	37.41	38.66	63.5	65.5	11.0	10.9	1.9
1/3 at sowing 1/3 after first irrigation and 1/3 after second irrigation	20.90	24.90	30.68	36.23	60.3	61.5	11.3	11.3	1.8
CD (P=0.05)	0.92	0.60	3.79	3.63	1.2	1.6	0.1	0.2	

(Table 2). The crude protein content in grain also significantly increased with increasing levels of N, being the maximum at 80 kg N/ha. These results confirm the findings of Villers *et al.* (1988).

The maximum uptake of N was obtained with 2 splits of nitrogen (1/3 at sowing and 2/3 after first irrigation). This variation in N uptake was due to variation in yield level. The crude protein content in grain was the maximum with 3 equal splits of N. Application of N at later stage of crop growth might have led to more N accumulation and protein formation in barley grain (Chen and Zhang, 2000).

Benefit : cost ratio

Average data of years showed that the highest benefit : cost ratio was recorded at 80 kg N/ha. This corresponds to increased grain and straw yields at highest rate of 80 kg N/ha. Similarly, 2 split applications recorded the highest benefit : cost ratio.

Based on this study, malt barley responded significantly up to 80 kg N/ha with 2 split applications without any adverse effect on protein content.

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