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Effect of Different Levels of Nitrogen and Phosphorus Fertilizers on Yield and Malting Quality of Different Barley Genotypes

VINOD KUMAR*, S. S. RATHEE AND ASHOK YADAV

Department of Agronomy, CCS Haryana Agricultural University
Hisar 125004, India
E-mail : vkmohan@hau.ernet.in
**Correspondence*

Abstract

An experiment to study the response of barley genotypes to fertilizer levels was conducted during 2004-2005 and 2005-06. Genotype BH 393 yielded higher than all other genotypes viz. BH 331, BH 338 and BH 646. Increasing fertility levels up to 80 kg N/ha + 45 kg P_2O_5/ha resulted into significant increase in growth, yield attributes, grain and straw yield, and also quality of barley during both years.
Key words : *Hordeum vulgare,* Nitrogen, Phosphorus, Malt yield, Grain yield.

Barley (*Hordeum vulgare*) is an important cereal in India. Normally heavy dressing of nitrogen raises the N-content in grain deteriorating the malting and brewing quality of the grain, but it is equally important to increase the grain yield too. So the question arises how to safeguard the yield potential and attain malting quality of barley grain by applying desirable balanced quantity of fertilizer. The potential of latest developed genotypes of barley can be fully exploited through appropriate management practices. Its production can be further increased by adopting suitable genotypes and proper doses of nitrogen and phosphorus. Keeping these in view, the present investigation was carried out to study the relative yield, yield attributes and quality of different barley genotypes under different fertility levels of N and P.

Methods

A field experiment was carried out at Research Farm of Department of Plant Breeding, CCS Haryana Agricultural University, Hisar during winter (*rabi*) seasons of 2004-05 and 2005-06. The experiment was laid out in split-plot design keeping fertilizer levels in main plots and genotypes in sub-plots with three replications. The experiment comprised five fertilizer levels viz. T_1—($N_0 + P_0$), T_2—N + P (40 and 15 kg/ha) ($^1/_2$ N at sowing and $^1/_2$ N at first irrigation), T_3— N +P (60 + 30 kg/ha) ($^1/_2$ N at sowing and $^1/_2$ N at first irrigation), T_4—N + P (80 + 45 kg/ha) ($^1/_2$ N at sowing and $^1/_2$ N at first irrigation), T_5—N + P (80 + 45 kg/ha) ($^1/_3$ N at sowing + 1/3 N at first irrigation and 1/3 N at second irrigation), and four barley genotypes (BH 393, BH 331, BH 338 and BH 646).

The soil of the experimental field was sandy loam in texture. The quantity of N, P and K was applied based on treatments through urea, single super phosphate and murate of potash, respectively. The crop was sown in the last week of November using a seed rate of 75 kg/ha with a row-to-row spacing of 23 cm and was harvested in the first week of April during both the years. Two irrigations (45 and 85 DAS) were given to the crop in both the years. For quality analysis, a representative sample of grains was collected from each plot after harvesting.

Results and Discussion

Genotype BH 393 performed better in terms of grain yield than all other varieties viz. BH 331, BH 338 and BH 646 during the both years. Table 1 shows that BH 393 was significantly superior to all other varieties in terms of 1,000-grain weight, grains/head, dry - matter production at maturity, grain and straw yield. Application of nitrogen significantly decreased the malt yield. The migration of nutrients to growing rootlets and leaching of solutes during steeping may also

Table 1. Yield contributing characters, grain and straw yields of barley genotypes as affected by different fertility levels.

Treatment	Dry matter at harvest (g/m) 2004-05	Dry matter at harvest (g/m) 2005-06	Grains/ ear head 2004-05	Grains/ ear head 2005-06	1000-grain weight (g) 2004-05	1000-grain weight (g) 2005-06
Fertilizer						
T_1 — (N_0 + P_0)	108.3	100.4	49.0	47.4	43.5	43.1
T_2 —N +P (40 and 15 kg/ha)(1/2 N at sowing and 1/2 N at 1st irrigation)	138.6	129.8	53.7	51.8	44.1	43.7
T_3—N+P (60+30 kg/ha) (1/2 N at sowing and 1/2 N at 1st irrigation)	153.1	148.6	56.8	54.7	45.3	45.0
T_4—N + P (80+45 kg/ha)(1/2 N at sowing and 1/2 N at 1st irrigation)	167.2	161.7	58.5	56.6	45.8	45.4
T_5—N + P (80 + 45 kg/ha) (1/3 N at sowing +1/3 N at 1st irrigation and 1/3 N at 2nd irrigation)	178.4	170.1	59.1	57.8	46.0	45.5
CD at 5%	2.9	2.4	2.8	2.0	0.9	1.7
Varieties						
BH 393	143.7	138.4	61.4	58.3	46.9	46.4
BH 331	135.1	129.6	59.2	56.1	42.7	43.8
BH 338	133.8	127.8	57.0	54.6	41.6	42.7
BH 646	129.6	124.3	54.7	51.4	39.6	40.1
CD at 5%	2.1	2.4	2.2	2.4	1.2	2.3

Table 1. Continued.

Treatment	Grain yield (q/ha) 2004-05	Grain yield (q/ha) 2005-06	Straw yield (q/ha) 2004-05	Straw yield (q/ha) 2005-06
Fertilizer				
T_1 —(N_0 + P_0)	30.6	29.3	37.6	36.5
T_2— N + P (40 and 15 kg / ha)(1/2 N at sowing and 1/2 N at 1st irrigation)	40.5	39.1	49.3	47.4
T_3 —N + P (60 + 30 kg/ha)(1/2 N at sowing and 1/2 N at1st irrigation)	44.6	43.2	55.5	53.8
T_4— N + P (80 + 45 kg/ha)(1/2 N at sowing and 1/2 N at 1st irrigation)	46.7	45.3	58.8	56.7
T_5—N + P (80 + 45 kg/ha) (1/3 N at sowing +1/3 N at 1st irrigation and 1/3 N at 2nd irrigation)	48.9	47.1	60.8	58.1
CD at 5%	2.8	3.2	6.1	5.3
Varieties				
BH 393	48.6	47.5	59.0	57.4
BH 331	43.0	42.3	50.3	45.7
BH 338	41.2	40.2	46.8	43.5
BH 646	38.2	37.2	40.7	38.8
CD at 5%	2.3	2.5	4.9	2.7

contribute in lower malt yield (1). Malt yield of BH 393 was significantly higher than other varieties. The variation among different varieties for malt yield was also reported by Verma et al. (2). β-glucan was statically similar among all genotypes. Amongst the genotypes BH 393 had significantly higher diastatic power than other genotypes. Similar trend was observed by Verma et al. (2). The protein content in barley grain was significantly higher in BH 393 than all other varieties. Table 2 shows that lowest protein content was found

Table 2. Grain quality characters of barley genotypes as affected by different fertility levels.

Treatment	Grain protein (%) 2004-05	Grain protein (%) 2005-06	β−glucan (%) 2004-05	β−glucan (%) 2005-06	Diastatic power (⁰L) 2004-05	Diastatic power (⁰L) 2005-06	Malt yield (%) 2004-05	Malt yield (%) 2005-06
Fertilizer								
T_1 — (N_0 + P_0)	7.8	7.7	3.3	3.2	94.4	90.8	90.0	89.7
T_2— N +P (40 and 15 kg/ha) (1/2 N at sowing and 1/2 N at 1st irrigation)	8.7	8.2	2.8	2.7	102.0	100.8	86.6	86.1
T_3—N + P (60 + 30 kg/ha) (1/2 N at sowing and 1/2 N at 1st irrigation)	9.0	8.6	2.9	2.8	105.4	103.6	84.4	84.0
T_4 —N + P (80 + 45 kg/ha) (½ N at sowing and 1/2 N at 1st irrigation)	9.2	9.1	3.0	2.9	107.9	106.1	82.4	82.0
T_5 — N + P (80 +45 kg/ha) (1/3 N at sowing +1/3 N at 1st irrigation and 1/3 N at 2nd irrigation)	9.4	9.3	3.1	3.0	108.0	106.2	82.0	81.0
CD at 5%	0.2	0.3	NS	NS	1.9	1.7	1.3	1.9
Varieties								
BH 393	9.5	9.4	3.0	3.2	110.4	105.5	89.0	88.8
BH 331	9.1	8.9	2.4	2.9	98.3	97.1	84.4	83.4
BH 338	9.3	9.2	2.9	2.8	104.4	102.2	86.5	85.9
BH 646	9.0	8.8	2.3	2.1	98.9	97.4	80.9	80.0
CD at 5%	0.2	0.2	NS	NS	5.6	0.7	2.1	2.6

in BH 646. McKenzie et al. (3) reported that grain protein concentration was strongly affected by cultivars and N rates at all sites.

The number of grains per spike and 1,000-grain weight were significantly improved with the increase in fertility levels (Table 1) and the maximum were recorded with 80 kg N/ha (1/3 N as basal + 1/3 N at first irrigation + 1/3 N at second irrigation) + 45 kg P_2O_5/ha). Ryan et al. (4) observed that N and P significantly increased grain yields. The protein content of barley grain increased significantly with the increase in fertility levels. Ruiter et al. (5) reported that nitrogen fertilizer improved the protein content. Application of different fertility levels did not influence the β−glucan content. Table 2 shows that the increase in nitrogen levels significantly increased the malt diastatic power. Similar trend was observed by Verma et al. (2).

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