International Journal of Agricultural Research

ISSN 1816-4897

Academic Journals Inc.

www.academicjournals.com

OPEN ACCESS International Journal of Agricultural Research

ISSN 1816-4897
DOI: 10.3923/ijar.2022.1.4

Research Article
Effect of Nitrogen Levels and Barley Varieties on Yield Attributes and Yields of Barley Crops

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Abstract

Background and Objective: Barley is one of the ancient crop domesticated by humans and has been cultivated in marginal land due to its desirable characteristics like drought-tolerant With appropriate use of nitrogen fertilizer, the growth and development can be achieved at a higher level and thus to evaluate the effect of nitrogen fertilizer on yield parameters and yield on barley varieties, a field experiment was conducted to study the effect of nitrogen levels and varieties on yield attributes and yields of the barley crop. **Materials and Methods:** The experiment was laid out on a split-plot design with six levels of nitrogen (0, 20, 40, 60, 80 and 100 kg N ha^{-1}) as the main plot treatment and four barley varieties (BH 946, BH 393, BH 885 and Karan 16) as a subplot treatment. **Results:** It was found that a higher level of nitrogen significantly influenced the yield attributes and was maximum when 100 kg N ha^{-1} were applied. The maximum grain yield (41.40 q ha^{-1}) was recorded with the application of 100 kg N ha^{-1}. The application of 20, 40, 60, 80 and 100 kg N ha^{-1} increases the grain yield by 44.83, 59.02, 67.13, 71.14 and 72.29%, respectively over control. Among varieties, the number of effective tillers and 1000 grain weight were found significantly higher in two-rowed barley variety BH 885. Whereas, BH 946 recorded the maximum number of grains per spike. The grain yield was significantly higher in BH 946 (33.11 q ha^{-1}) which was at par with BH 393 but significantly higher than BH 885 and Karan 16. **Conclusion:** The study acknowledges the roles of nitrogen in imparting the yield attributes which are an important factor that decides the yield in a barley crop. It is also noted that varieties genetic makeup can influence yield and yield attributes given the same level of nitrogen.

Key words: Barley, nitrogen levels, yield attributes, grain yield, genetic makeup

Citation: Adhikari, S. and B. Singh, 2022. Effect of nitrogen levels and barley varieties on yield attributes and yields of barley crops. Int. J. Agric. Res., 17: 1-4.

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Barley (*Hordeum vulgare* L.) is cultivated worldwide and ranks fourth after Wheat, Rice and Maize in terms of production and acreage. The major producer of barley is concentrated more in brewery industries to produce whiskey, beer, alcohol, malt syrups, brandy and vinegar. Apart from brewery industries, barley is also used as livestock feed, food grains and in medicines. The domestication of barley has greatly advanced from food grain to a feed and a malting grain[1]. In the present scenario where food security issues are emerging along with the climatic factors affecting food production, selection of the crops that can withstand adverse environmental conditions with contributing to food security has been the utmost choice in the present context. Barley is known to adapt to a wide range of agro-ecology including extremes of latitude, longitude and high altitude. Barley can sustain better under unfavourable weather conditions compared to other cereal crops. With the global concern has been focused on food and environmental sustainability, the demands on cereals, especially those that are hardy and drought-tolerant, such as barley have tremendously increased[2]. However, it is not true that barley crops can sustain well without or with little nutrients, especially nitrogen. Barley is very sensitive to insufficient nitrogen and response to nitrogen is directly observed in the barley. Unlike other crops, low or poor nutrition has been associated with the yield and grain quality in barley crop which further invades the door to food insecurity. Among nutrients, barely is very sensitive to insufficient nitrogen and shows responsive behaviour when nitrogen fertilizers are added. The proper application of nitrogen can lead to quality grain production, proper physiological functioning and can give maximum benefits from the inputs used. The response of nitrogen fertilizer may vary from varieties in barley and to maximize the benefits, it is necessary to know the optimum dose and study various characteristics associated with nitrogen fertilization.

According to Jankovik *et al.*[3] Nitrogen is the main governing factor for both crop yield and quality. According to Reddy and Singh[4], application of nitrogen (75 kg N ha^{-1}) significantly produced higher growth attributes i.e., plant height (78.34 cm), number of $tillers^{-1}$ (5.21) and dry matter $plant^{-1}$ (18.77 g) as compared to lower levels. Plant height was increased by 5.52 and 4.895% at 60 DAS and 20.14 and 16.11% at 90 DAS with the application of 120 and 90 kg N ha^{-1}, respectively as compared to control. According to Parashar *et al.*[5] application of 120 kg N ha^{-1} recorded the highest number of total tillers m^{-2}, effective tillers m^{-2}, number of grains $spike^{-1}$ and 1000 grain weight. Application of 120 kg N ha^{-1} and 90 kg N ha^{-1} increased the total tillers m^{-2} by 4.03 and 3.02%, effective tillers by 4.53 and 3.05%, number of grains $spike^{-1}$ by 8.40 and 6.23%, 1000 grain weight by 13.11 and 12.69%, respectively over control. He also revealed that variety RD 2849 was found superior to varieties DWRUB 52 and RD 2668 in terms of plant height at 90 DAS and physiological maturity. Dry matter accumulation was also maximum in the variety RD 2849 over DWRUB 52 and RD 2668[6]. Patel and Meena[7] studied the effect of barley varieties on nitrogen level and revealed that among ten cultivars, RD 2552 recorded significantly maximum plant population and growth parameters like plant height.

The study on the effect of nitrogen levels on barley varieties helps to analyze the roles of nitrogen in the overall growth of the barley crop as well as it gives an idea of how barley genetic makeup makes differences in response to nitrogen fertilizer. It further opens an opportunity to evaluate the local landraces varieties and enhances research to flourish. As demands for crops varies from crop variety to variety.

The purpose of this research was to evaluate the performance of barley varieties on nitrogen levels. The research was centred to further explore the research potentiality in the places where landraces exist or little research has been done.

MATERIALS AND METHODS

Study area: A field experiment was conducted during the Rabi season of 2019-20 at the research farm of Wheat and barley section, CCSHAU, Haryana. The experimental site is situated in subtropics at an elevation of 215.2 m above sea level with coordinates at 29°10'N latitude and 75°46'E longitudes. Semiarid, subtropical climate with the severe cold during winter, hot and dry days during summer and humid warm in monsoon season are the climatic conditions of the experimental area.

Soil analysis: Soil analysis to find out the nutritional status of soil sample before sowing of the barley crop was carried out. The soil was sandy loam in texture with pH 7.8. The available N, P, K were 135, 16 and 363 kg ha^{-1}, respectively. The experiment was laid out in a split-plot design, with six nitrogen levels (0, 20, 40, 60, 80 and 100 kg N ha^{-1}) as main plot treatments and barley varieties (BH 946, BH 393, BH 885 and Karna 16) as subplot treatments replicated thrice. The sowing was done on 13th November, 2019. Half dose of nitrogen was applied and a full dose of phosphorus and

potassium (30 kg P_2O_5+K_2O) was applied as basal dose. The remaining half dose of nitrogen was top-dressed at first irrigation. Yield attributing parameters and yields were recorded. The crop was harvested on 15th April, 2020.

Data analysis: The data were analysed by the software OPSTAT.

RESULTS AND DISCUSSION

The data about yield attributes are presented in Table 1. Application of nitrogen fertilizer significantly influenced the yield attributing characters i.e., number of effective tillers, spike length, 1000 grain weight and grains per spike. The improvement in these characters was due to the nitrogen application leading to vigorous growth during the initial growth stage which resulted in higher plant height, more assimilating area, tillering and more dry matter accumulation. The role of nitrogen in increasing the yield attributes might be due to improvement in the source-sink relationship[8-10]. It is apparent from the study that BH 885 was superior to other varieties in respect to effective tillers, spike length and 1000 grain weight (Table 1), which may be due to the high tillering capacity associated with the genetic makeup. Whereas, BH 885 recorded the least number of grains per spike (23.92) being a two-row barley variety. BH 946 recorded the highest number of grains per spike (50.52) and it may be due to a fact that six-row barley varieties have more grains per spike as compared to the two-row barley type. The variation in yield attributes by the varieties may be due to the genotypic variation of the varieties and their interaction with the environment. Genetically variation among the varieties concerning yield attributes has been in line with the results reported by Sharma *et al.*[11] Bagheri and Sadeghipour[12] and Aleinew and Legas[13].

The grain yield of barley is the summation of all yield attributing parameters governed by environmental factors, genetics of varieties and the manipulations through agronomic methods. Grain yield is generally a complex process and interaction between the sources and sinks components. The application of 20, 40, 60, 80 and 100 kg N ha^{-1} resulted in an increase of grain yield respectively over control. The increase in grain yield was mainly due to the positive effect of nitrogen on yield attributes. The number of effective tillers is directly linked with the grain yield as the application of 80 kg N ha^{-1} increased effective tillers over 0, 20, 40 and 60 kg N ha^{-1}, respectively and thus there is the increment in grain yield. The application of 80 kg N ha^{-1} increased grain yield over 0, 20 and 60 kg N ha^{-1}, respectively. The results obtained are following the results of Terefe *et al.*[14] that narrates the significant increase in grain yields of barley with the increase in nitrogen levels. The positive correlation between the yield attributing characters and grain yield of the crop suggests the role of nitrogen fertilization in improving the major yield determination aspects i.e., development of vegetative organs for proper absorption, photosynthesis and sink organs development through reproductive structure and assimilation of photosynthate with the improved source-sink relationship can be credited the major reason for higher grain yield with increase in nitrogen doses.

The straw yield also increased with the increase in the nitrogen levels and maximum straw yield (58.69 q ha^{-1}) was recorded with 100 kg N ha^{-1} (Table 1) and it was due to the reason that nitrogen resulted in the meristematic activity of

Table 1: Effect of nitrogen levels and varieties on yield attributes and yields of barley during the cropping year 2019

Treatment	No. of effective tillers per mL	Spike length (cm)	No. of grains per spike	1000-grain weight (g)	Biological yield (q ha^{-1})	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})	HI (%)
Nitrogen levels (kg ha^{-1})								
0	44.83	7.81	37.78	38.86	29.96	11.47	18.49	38.36
20	58.75	8.69	40.18	40.47	53.80	20.79	33.01	38.49
40	64.58	9.17	42.22	41.73	69.65	27.99	41.66	39.92
60	67.67	9.36	43.74	42.87	85.53	34.90	50.63	40.59
80	73.66	9.81	44.76	43.52	96.70	39.75	56.95	41.01
100	75.75	9.92	45.47	43.80	100.09	41.40	58.69	41.28
SEM±	0.93	0.24	0.40	0.35	0.74	0.52	0.76	0.71
CD	2.98	0.76	1.30	1.10	2.37	1.67	2.44	NS
Varieties								
BH 946	64.11	9.14	50.52	41.74	79.40	33.11	45.40	42.18
BH 393	61.83	9.01	47.23	42.02	78.11	33.06	45.05	41.90
BH 885	70.78	9.41	23.92	46.61	66.85	26.55	40.30	39.43
Karna 16	60.11	8.95	47.06	37.14	66.13	23.93	42.20	36.25
SEM±	0.85	0.22	0.42	0.30	0.95	0.39	0.92	0.61
CD	2.46	NS	1.22	0.86	2.74	1.13	2.66	1.77

plant cells which led to higher photosynthetic efficiency as a seen in plant growth and this is the reason for higher straw yield. The maximum biological yield was obtained with the application of 100 kg N ha^{-1}, which was higher than 0, 20, 40, 60 and 80 kg N ha^{-1}, respectively. Harvest index was higher with nitrogen application as compared to control. The significant influence of nitrogen levels on yield attributes and yield of barley crop has also been reported[6].

The grain yield of varieties was significant with each other and it was mainly due to the varietal characteristics of varieties and their performances. Grain yield was found maximum in variety BH 946 which was 6.56 and 9.18% higher than BH 885 and Karan 16, respectively. Varieties were varied differently in their capacity to produce effective tillers, grains per spike which are directly related to the yield of the grain[5,6]. The straw yield was also maximum (45.40 q ha^{-1}) in variety BH 946 and it may be due to maximum plant height throughout the growing season and more dry matter accumulation during the vegetative growth. Whereas minimum straw yield (40.30 q ha^{-1}) in BH 885 may be due to the lowest dry matter accumulation.

CONCLUSION

Based on one year study, it is concluded that application of 80 kg N ha^{-1} was found optimum in terms of yield attributes and yield of Barley. Barley variety BH 946 was found most suitable in terms of the number of grains per spike and yields while BH 885 were suitable in terms of yield attributes such as 1000 grain weight and effective tillers.

SIGNIFICANCE STATEMENT

This research is based on a study to evaluate the effect of nitrogen levels on barley varieties. As we can get to acknowledge the role of nitrogen in the development of yield attributes and contribution to yield. The study can further open doors for the researcher to evaluate the performance of existing barley varieties (landraces) under nitrogen management. In places where the least research studies have been done in barley crop (Such as my home country), the study can set an idea on how nitrogen can influence barley yield attributes and yields.

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