Eco. Env. & Cons. 29 (1) : 2023; pp. (156-160)
Copyright@ EM International
ISSN 0971–765X

DOI No.: http://doi.org/10.53550/EEC.2023.v29i01.025

Effect of Nitrogen Levels on the Growth and Yield of Barley (*Hordeum vulgare* L.) Varieties

Pramod Tuppad, Awadhesh Kishore, Srivatsa S. Kharad and Jai Dev Sharma

School of Agriculture, ITM University, Gwalior 474 001 (M.P.), India

(Received 13 August, 2022; Accepted 1 October, 2022)

ABSTRACT

A field experiment entitled "Effect of nitrogen levels on the growth and yield of barley (*Hordeum vulgare* L.) Varieties" was carried out during the Rabi season of 2021-22 near the polyhouse research farm of wheat, barley, and mustard section, ITM University, Gwalior. The experiment was carried out in a randomized block design with three replications. Twelve treatments consist of four levels of nitrogen (0, 40, 80, and 120 kg N ha^{-1}) and three barley varieties (RD-2035, KBS-D-341, and BH-393). Results indicated that the application of different nitrogen levels and varieties had significant effects on plant growth parameters such as plant height, number of tillers, leaf area, and dry matter accumulation. Increased levels of nitrogen considerably influenced the yield characters and were maximum when 120 kg N ha^{-1} was applied; however, it was at par with 80 kg N ha^{-1}. The highest grain yield (4312.23 kg ha^{-1}) was recorded with the application of 120 kg N ha^{-1} which was significantly higher as compared to lower levels (0 and 40 kg N ha^{-1}) of nitrogen except for 80 kg N ha^{-1}.The application of 40, 80, and 120 kg N ha^{-1} increased the grain yield by 57.13, 73.48, and 74.29 per cent, respectively over 0 kg N ha^{-1}. Among varieties, KBS-D-341 produced maximum plant height, number of tillers, leaf area, and dry matter accumulation compared to other varieties. It also recorded a maximum grain yield, no. of effective tillers, no of grains per spike, and 1000 grain weight. This was followed by the variety BH-393 and RD-2035 performed poorly. In terms of economics KBS-D-341 obtained maximum net returns of (Rs. 88887.05 ha^{-1}) with a BC ratio of (2.11) at 80kg N ha^{-1} as compared to other varieties.

Key words: *Nitrogen levels, Varieties, Grain yield*

Introduction

Barley (*Hordeum vulgare L.*) is the fourth most important cereal crop in the world, next to rice, wheat, and maize both in terms of production and acreage in the world. It is a specific rabi season crop, which is frequently described as the most cosmopolitan of the cereal crops as it is grown over a wide environmental range than any other cereal crop. It is also considered one of the ancient crops which was domesticated by human beings due to its various characteristics such as wider adaptability and hardiness. Barley can be grown successfully in tropical and sub-tropical climatic conditions. In terms of agro-ecology, extremes in latitude, longitude, and altitude are well-known and widely accepted. Barley is considered as a poor man's crop because of its low input requirements and better adaptability to extreme conditions like salinity, drought, alkalinity, and marginal lands (FAO, 2002). Barley is mainly cultivated as a rabi season crop and it is known by the name "Jau" in India. This crop requires around 12-15 ^{0}C temperature during its growth period and around 30-32 ^{0}C at its maturity stage. Barley is greatly resistant to dry heat than other smaller grain crops. The global production of barley is about 160 mt from 70 m ha. In India, it secures the second rank after wheat in acreage and production among different Rabi crops. The total production of barley in India is about 0.17 mt, area under cultivation is 0.65 m ha with a productivity of 2.4t ha^{-1} by 2021. The major barely growing state in India is Rajasthan, U.P, M.P, Haryana, Punjab, H.P. and Uttarakhand. Rajasthan consistently ranks first in terms of barley acreage (0.29 m ha) in 2021-22, an acceptable reason that it shares higher production as well (52%). During the Rabi season, the average productivity in barley was highest in the case Punjab (3.7 t ha^{-1}), followed by Haryana (3.6 t ha^{-1}), U.P (2.9 t ha^{-1}), and Rajasthan (2.8 t ha^{-1}). In Haryana, the area under barley is 0.12 m ha, with the production of 44 mt and the average yield is 3.6 t ha^{-1} (ICAR-IIWBR, 2020). Barley has multiple purposes of usage and it is an economically very important cereal crop for brewing industries. It is mostly used for making bread, soups, stews, and certain breakfast foods. Itis mainly used for animal fodder and it is malted to be used in alcoholic beverages such as beers, it is also used as a flavor, vinegar, sweeteners, malt flours, etc. The major consumers of barley are from the brewing and cattle industry. Typically local varieties are used in Rajasthan and U.P for self-consumption purposes. The malt manufactured from barley is used to make alcohols, whisky, malt, syrups, brandy, vinegar, and yeast. Barley is the fourth most important cereal crop because of its nutritious value and an excellent source of protein and vitamin-B groups. Thus it plays important role in food security. The whole barley grain itself contains about 65-68% starch, 15-17% of excellent protein, 2-3% of free lipids and 4-9% ß-glucans, and 1.5-2.5% minerals. The protein quality of barley is higher than that of corn and beans since it provides eight useful amino acids. Each 100 g of barley grain consists of 10.6 g protein, 2.1 g fat, 73.5 g of carbohydrate, 50 mg calcium, 3 g crude fibers, 6 mg iron, 12 mg sodium, 50 mg folate, 31 mg vitamin $B_{6,}$ 0.31 mg vitamin B_2 (Vaughan *et al.*, 2006). Barley is a resilient cereal crop that has been seen as a crop for marginal soils due to its greater adaptability to the environment. While the world's attention has been drawn to food and environmental sustainability, demand for cereals, particularly those that are hardy and drought-tolerant, such as barley, has surged. However, it is false to believe that barley crops can thrive without or with little nitrogen. Barley is very sensitive to nitrogen deficiency, and the effect of nitrogen is seen in the barley. Insufficient or low nitrogen has been linked to poor yield, grain arrangement, and quality in barley crops, just as it has been in other crops. This might worsen food insecurity. Among the numerous nutrients, barley is particularly sensitive to a lack of nitrogen and responds to the addition of nitrogen fertilizer to its development. Among the various essential nutrient elements, nitrogen plays a pivotal role in the growth and metabolic process in barley plants. It is the basic structure of protein and nucleic acid; it also plays an important role in internal and external metabolic processes and also in plant physiological phenomena. Nitrogen is also a key component of amino acids, which forms a building block of plant proteins and enzymes. It contributes more than 50% of the yield increases under normal growing conditions. Nitrogen is the most important mineral nutrient for cereal crops since high yields depend on adequate N supply and a cereal seed contains storage protein reserves of about 6% N. Thus, the barley grain yield, protein content in the grain, and kernel appearance are the characteristics that are strongly related to available nitrogen. It also plays important role in maintaining yield attributes in barley higher benefits are delivered by proper physiological functioning. The utilization of nitrogen varies from variety to variety and functions accordingly and gives benefits. It is very important to know the proper dosage of nitrogen in barley crop production and study various characteristics associated with it.

Materials and Methods

A field experiment entitled "Effect of nitrogen levels on the growth and yield of barley (*Hordeum vulgare* L.) Varieties" was carried out during the Rabi season of 2021-22 near the polyhouse research farm of wheat, barley, and mustard section, School of Agriculture ITM University, Gwalior. The research field is situated in the subtropics at an elevation of 196 mabove sea level with coordinates at 26º 21' N latitude and 78º 17' E longitude which represents the Indo-Gangetic plains region. Gwalior is characterized by very hot summers and cold winters. Gwalior has a semiarid, subtropical climate with moderate to severe cold during the winter, hot and dry days with desiccating hot winds during summer, and humid warm in the monsoon season. The annual rainfall ranges from 600 to 700mm with uneven variations in its distributions. Gwalior receives about 80 to 90% of the total rainfall between July to

September from the southwest monsoon and the region's regular climate ranges from a max of 48°C in the summer with hot desiccating winds to a minimum of 0 °C lower in the winter with frost. Before planning the layout, 5 samples were collected randomly from 0-15 cm depth of soil profile for chemical analysis of experiment area soil in the field. The soil texture of the experimental site was sandy loam having available N of (178.03) P (24.45) and K of (382.15) kg/ha with organic carbon of soil (0.41%) with (7.4) available soil pH. The experimental was laid out in Randomized block Design having 12 treatments combining different nitrogen levels of (0, 40, 80, and 120 kg N/ha) and varieties (RD-2035, KBS-D-341, BH-393) in the experimental plots and also complete RDF of **P** and **K** with three replications with a gross plot size of 12 m^2 (4m × 3m) having total 36 number of plots, the details of the treatments are as T_1: 0 kg/ha Nitrogen + RD-2035 variety, T_2: 40 kg/ha Nitrogen + RD-2035 variety, T_3: 80 kg/ha Nitrogen + RD-2035 variety, T_4: 120 kg/ha Nitrogen + RD-2035 variety, T_5: 0 kg/ha Nitrogen + KBS-D-341 variety, T_6: 40 kg/ha Nitrogen + KBS-D-341 variety, T_7: 80 kg/ha Nitrogen + KBS-D-341 variety, T_8: 120 kg/ha Nitrogen + KBS-D-341 variety, T_9: 0 kg/ha Nitrogen + BH-393 variety, T_{10}: 40 kg/ha Nitrogen + BH-393 variety, T_{11}: 80 kg/ha Nitrogen + BH-393 variety, T_{12}: 120 kg/ha Nitrogen + BH-393 variety, and the recommended dose of fertilizer 80:60:40 kg/ha NPK. During the experimentation growth and yield, parameters were observed and recorded at periodic intervals of 30, 60, 90, and at the harvest stage randomly from each treatment.

Results and Discussion

The results of the present experiment revealed that an increase in the application of nitrogen levels gradually impacted and lead to produce maximum growth attributes like plant height(cm), the number of tillers (mrl^{-1}), leaf area (cm^2), dry matter accumulation (g) at 120 kg N/ha, however, it was at par with 80 g N/ha. Compared to 0 and 40 kg N/ha, 80 and 120 kg N/ha show a non-significant difference among them. Over 60 and 90 DAS plants show maximum utilization of nitrogen was seen in all aspects of crop growth. With a plant height of (88.92 cm) at 120 kg N/ha and (87.56 cm) at 80 kg N/ha at the harvest stage, it produced a maximum plant height of over 0 and 40 kg /ha. They also produced (79.12) a maximum number of tillers to 120 kg N/ha at 90DAS recorded. Similarly with the leaf area and dry matter accumulation 120 kg N/ha produced a maximum (82.93 cm^2) of leaf area and (481.74 g) of dry matter accumulation. Where 80 kg N/ha showed always at par with 120 kg N/ha. Among the varieties, KBS-D-341 produced the highest plant height of (84.28 cm) the number of tillers of (79.31 mrl^{-1}) leaf area of (74.63 cm^2) and dry matter accumulation of (468.78 g), followed by BH-393 and RD-

Table 1. Effect of nitrogen levels on the growth attributes of barley (*Hordeum Vulgare L.*)

Treatment	Plant height (cm) at harvest	No of tillers (mrl^{-1}) at 90 DAS	Leaf area (cm^2) at 90 DAS	Dry matter accumulation (g) at harvest
(A) Nitrogen levels (kg/ha)				
0	68.62	61.12	54.62	344.55
40	78.41	70.06	65.41	410.24
80	87.56	78.36	80.57	461.40
120	88.92	79.12	82.93	481.74
SEm±	2.92	2.77	2.56	12.42
CD	8.57	8.14	7.32	36.45
(B) Varieties				
RD-2035	74.80	66.17	66.13	366.48
KBS-D-341	84.28	79.31	74.63	468.78
BH-393	83.56	71.01	71.89	438.19
SEm±	2.53	2.40	2.22	10.76
CD	7.42	7.05	6.51	31.56
Interaction				
SEm±	5.06	4.81	4.44	21.52
CD	NS	NS	NS	NS

Table 2. Effect of nitrogen levels on the yield attributes of barley (*Hordeum Vulgare L.*)

Treatment	Grain yield (kg/ha)	1000 grain weight (g)	Biological yield (kg/ha)
Nitrogen levels (kg/ha)			
0	1274.60	38.77	4133.14
40	3106.01	43.46	8211.84
80	4266.00	48.84	10266.84
120	4312.23	49.70	10336.63
SEm±	118.28	1.52	213.54
CD	327.85	4.48	626.29
Varieties			
RD-2035	3060.50	41.80	7975.14
KBS-D-341	3442.81	48.00	8778.31
BH-393	3215.82	45.77	7957.88
SEm ±	102.43	1.32	184.93
CD	300.42	3.88	542.39
Interaction			
SEm ±	204.86	0.83	369.86
CD	NS	NS	NS

2035.where RD-2035 produced the lowest growth rates.

The yield attributes like grain yield, 1000 grain weight, and biological yield was also recorded highest at 120 kg N/ha which is also at par with the 80 kg N/ha and 120 kg N/ha. The application of 120 kg N ha^{-1} (41.40 q ha^{-1}) resulted in the maximum grain production, which was considerably greater than lower nitrogen levels except for 80 kg N ha^{-1}; the lowest yield was obtained from the 0 kg N ha^{-1} (1247.60 kg ha^{-1}). The grain yield is increased by 31.06, 42.66, and 43.12 q ha^{-1} for applications of 40, 80, and 120 kg N ha^{-1}, respectively. Among the varieties KBS-D-341obtained the highest yield of about (3442.81 kg ha^{-1}) compared other two varieties; it has an excellent response to nitrogen. Meanwhile, BH-393 has produced a grain yield of (3215.82 kg ha^{-1}) and RD-2035 is (3060.50 kg ha^{-1}) which is the lowest among the varieties.

The application of nitrogen effectively increased the 1000 grain weight (Table 2). In comparison to control and 40 kg N ha^{-1}, nitrogen application at 120 kg ha^{-1} is significantly greater than 80 kg N ha^{-1} in 1000-grain weight. Application of 120 kg N ha^{-1} produced the highest test weight (49.70g), followed by 80 kg N/ha, and the lowest result (38.77g) was in the 0 kg N ha^{-1} (no nitrogen).When it came to 1000 grain weight, the varieties differed significantly (Table 2). The variety KBS-D-341 had the highest 1000 grain weight (48g), followed by BH-393 (45.77g) while variety RD-2035 had the lowest (41.80g).

The biomass of a crop was considerably impacted by nitrogen levels, as seen in Table 2. Crop biomass increased noticeably when nitrogen levels increases from 0 to 120 kg N ha^{-1}. The biological yield increased by 41.33, 82.84, 102.84, and 103.63 q ha^{-1} respectively, over 0, 40, 80, and 120 kg N ha^{-1} were applied. Biological yield varied significantly across varieties (Table 2). The KBS-D-341 variety produced the highest biological output (87.78 q ha^{-1}), but much higher than BH-393's and RD-2035's (both of which had 79.75 q ha^{-1}). BH-393 and RD-2035 were also found to be comparable to one another in the experiment.

Conclusion

Based on the experimental study, it is concluded that the application of 80 kg N ha^{-1} was found to be optimum in terms of growth, yield attributes, and economics of barley. However application of 120 kg N ha^{-1} recorded the highest growth and yield attributes than 80 kg N ha^{-1} but it produced lower economics than 80 kg N ha^{-1}, Barley variety KBS-D-341 was found most suitable in terms of yields and economics.

Acknowledgements

I express my gratitude to my advisor Prof. Awadhesh Kishore for continuous support, guidance, and for his valuable suggestions for improving the quality of this work and Prof. J d Sharma HOD of the agronomy Dept, and all faculty members of the Department of Agronomy, School of Agriculture ITM University Gwalior (M.P) India. For providing necessary facilities for their cooperation, encouragement, and support.

References

Alam, M.Z. and Haider, S.A. 2006. Growth attributes of barley (*Hordeum vulgare L.*) cultivars in relation to different doses of nitrogen fertilizer. *Journal of Life and Earth Science*. 1(2): 77-82.

Alazmani, A. 2015. Evaluation of yield and yield components of barley varieties to nitrogen. *International Journal of Agriculture and Crop Sciences*. 8(1): 52-54.

Alghabari, A. and Al-Solaimani, S.G. 2015. Effect of sowing date and nitrogen fertilization on growth, yield, and yield components of barley *(Hordeum vulgare L.). International Journal of Innovation Science and Research.* 18: 136-140.

Dahiya, S., Singh, J., Singh, B. and Khedwal, R.S. 2019. Yield and quality of malt barley *(Hordeum distichum L.)* as influenced by seed rate, row spacing and nitrogen levels. *Applied Biological Research.* 21(1): 35-40.

Devaraja, M. and Hedge, Rajendra, 2006. Yield attributes of malt barley *(Hordeum vulgare* L.) as influenced by nitrogen, phosphorus, potassium and their correlation and regression with yield. *Agricultural Science Digest.* 26(1): 48-50.

Dubey, S.N., Tiwari, A., Pandey, V.K., Singh, V. and Singh, G. 2018. Effects of nitrogen levels and its application on growth parameters of barley *(Hordeum vulgare* L.). *Journal of Pharmacognosy and Phytochemistry*. 7(1): 333-338.

Hadi, F., Arif, M. and Hussain, F. 2012. Response of dual purpose barley to rates and methods of nitrogen application. *Journal of Agricultural and Biological Science*. 7: 533-40.

Kassa, M. and Sorsa, Z. 2015. Effect of nitrogen and phosphorus fertilizer rates on yield and yield components of barley *(Hordeum vulgare L.)* varieties at Damot Gale District, Wolaita Zone. *American Journal of Agriculture and Forestry*. 3: 271-275.

Kassie, M. and Fanataye, K. 2019. Nitrogen uptake and utilization efficiency of malting barley as influenced by variety and nitrogen level. *Journal of Crop Science and Biotechnology*. 22(1): 65-73.

Kassie, M. and Tesfaye, K. 2019. Influence of variety and nitrogen fertilizer on productivity and trait association of malting barley. *Journal of Plant Nutrition*, 42(10): 1254-1267.

Kumar, R., Yadav, S., Nand, V., Verma, S.K., Yadav, N. and Kumari, A. 2018. Effect of different nitrogen levels and varieties on yield of barley (*Hordeum vulgare* L.) under sodic soil. *Multilogic in Science,* 8: 242-245.

Kumar, V., Rathee, S.S. and Yadav, A. 2007. Response of barley genotypes to varying levels of nitrogen and phosphorus. *Haryana Journal of Agronomy.* 23(1&2): 14-17.

Mali, H., Choudhary, J., Kumar, A., Singh, A. and Chopra, R. 2017. Growth, quality, and yield of barley *(Hordeum vulgare L.)* as influenced by varieties and precision nutrient management practices. *Journal of Pharmacognosy and Phytochemistry.* 6: 35-41.

Meena, L.R. and Mann, J.S. 2010. Response of barley to nitrogen management at varying growth stages under semi-arid conditions of Rajasthan. *Range Management and Agroforestry*. 31: 20- 23.

Mian, M.A.K., Islam, M.N. and Matin, A. 2001. Effect of irrigation and nitrogen on the yield of barley in high Ganges river flood plain soil. *Bangladesh Journal of Agricultural Research*. 26(1): 47- 51.

Moreno, A., Moreno, M.M., Ribas, F. and Cabello, M.J. 2003. Influence of nitrogen fertilizer on grain yield of barley (*Hordeum vulgare*) under irrigated conditions. *Spanish Journal of Agricultural Research*. 1:91-100.

Narolia, G.P., Yadav, R.S., Narolia, R.S. and Reager, M.L. 2013. Response of malt barley *(Hordeum vulgare L.)* to levels and scheduling of nitrogen application on yield attributes, yield, and economics under normal and late sown conditions. *International Journal of Agricultural Sciences.* 9 (2): 629-632.

Parashar, A. 2018. *Response of malt barley (Hordeum vulgare* L.) *varieties to nitrogen and sulphur application.* Ph.D. (Ag.) Thesis, Department of Soil Science, SKNAU, Jobner.

Parashar, A., Sharma, S., Dogra, P., Parashar, K. and Tyagi, B.S. 2020. Response of malt barley (*Hordeum vulgare* L.) varieties to different levels of nitrogen and sulphurapplication under agro-climatic zone IIIa (Semi-arid eastern plain zone) of Rajasthan. *International Journal of Chemical Studies.* 8(4): 2059-2062.

Rashid, A., Khan, U.K. and Khan, D.J. 2007. Comparative effects of varieties and fertilizer levels on barley *(Hordeum vulgare* L.). *Pakistan Journal of Soil Science*. 1: 1-13.

Reddy, B.C. and Singh, R. 2018. Effect of sowing dates and levels of nitrogen on growth and yield of barley *(Hordeum vulgare* L.). *International Journal of Current Microbiology and Applied Sciences.* 7(7): 2319-7706.

Shafi, M., Bakht. J., Jalal, F., Khan, M.A. and Khattak, S.G. 2011. Effect of nitrogen application on yield and yield components of barley *(Hordeum vulgare L.). Pakistan Journal of Botany*. 43: 1471-1475.

Shajaripour, S. and Mojaddam, M. 2015. The effect of spilt application of nitrogen fertilizer and nitrogen level on the yield and yield components of barley. *Indian Journal of Fundamental and Applied Life Sciences.* 5: 195-202.