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ORIGINAL ARTICLE

Evaluation of Seed rate and Nitrogen Management for Enhancing growth, yield and Economics of two-row Barley (*Hordeum vulgare* L.)

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ABSTRACT
A field experiment was conducted during the Rabi season of 2024–25 at the Research Farm, School of Agricultural Sciences, GD Goenka University, Sohna- Haryana. The experiment was laid out in a Factorial Randomized Block Design (FRBD) with three seed rates (87.5, 100, and 112.5 kg/ha) and four nitrogen levels (60, 75, 90, and 105 kg N/ha), replicated three times. The barley variety BH 885 was used for the study. The results indicated that both seed rate and nitrogen levels significantly influenced growth, yield attributes, biological yield, and economic returns. Among the seed rates, 100 kg ha^{-1} recorded the highest plant height (111.75 cm), effective tillers (91.89 m.r.l.), spike length (14.57 cm), biological yield (106.25 q/ha), gross returns (₹105,366 ha^{-1}), net returns (₹69,791 ha^{-1}), and benefit-cost ratio (1.96). Similarly, the application of 90 kg N/ha produced the maximum plant height (112.52 cm), dry matter accumulation (910.81 g/m^2), effective tillers (92. m.r.l), net returns (₹70,832 ha^{-1}), and benefit-cost ratio (1.99), remaining statistically at par with 75 kg N/ha for most parameters. The interaction between seed rate and nitrogen levels was non-significant for all the characters studied. Overall, a seed rate of 100 kg/ha combined with 90 kg N/ha proved to be the most effective treatment for maximizing growth, productivity, and profitability of two-row barley under the agro-climatic conditions of Haryana.
Keywords: *Barley, seed rate, nitrogen levels, growth, yield.*

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INTRODUCTION

Barley (*Hordeum vulgare* L.) is an important cereal crop widely cultivated under diverse agro-climatic conditions due to its adaptability and stable performance. Its ability to withstand environmental stresses such as drought, salinity, alkalinity and low soil fertility makes it particularly suitable for cultivation in arid and semi-arid regions [7]. Among its different types, two-row barley is known for its efficient utilization of growth resources and better grain characteristics. Enhancing growth and yield of barley is a key concern in modern agriculture, especially under resource-limited conditions.Crop growth and yield in barley are largely influenced by agronomic practices, particularly seed rate and nitrogen fertilization. Seed rate plays a crucial role in determining plant population density, which directly affects crop growth, development and yield potential. An optimum seed rate ensures proper plant spacing, enabling efficient utilization of light, water and nutrients. Lower seed rates often result in inadequate plant population, leading to poor canopy development and reduced yield. In contrast, excessively high seed rates can cause overcrowding, increased intra-specific competition, reduced tillering and ultimately lower productivity. Thus, appropriate seed rate is essential to achieve optimal plant growth and maximize yield [19, 4].

Nitrogen is a key nutrient that significantly influences barley growth and yield. It plays a vital role in physiological processes such as chlorophyll formation, photosynthesis and protein synthesis, which are

essential for plant development. Adequate nitrogen supply enhances vegetative growth, promotes tiller formation and increases leaf area, leading to higher biomass accumulation and improved yield attributes. Barley has been reported to respond more favourably to nitrogen fertilization compared to other cereals; however, efficient nitrogen management is necessary to achieve maximum yield benefits [3]. Nitrogen deficiency can severely limit plant growth, resulting in poor tillering and reduced grain formation, whereas excessive nitrogen application may lead to excessive vegetative growth, lodging and inefficient assimilate partitioning, ultimately reducing yield [16]. The interaction between seed rate and nitrogen levels is critical in determining crop growth and yield. An optimal combination ensures efficient utilization of available resources and improves yield-contributing characters such as number of tillers, spike development, grains per spike and grain weight. Studies have shown that increasing nitrogen levels enhances biomass production and yield up to an optimum level, beyond which the benefits may decline [9]. Therefore, synchronization of appropriate seed rate with balanced nitrogen application is essential to achieve improved crop growth and higher yield. However, optimizing seed rate along with suitable nitrogen levels is crucial for enhancing the growth, yield and economics of two-row barley under varying agro-ecological conditions.

MATERIAL AND METHODS

A field experiment entitled "Study on the response of seed rate and nitrogen levels on the growth and yield of two-row barley (*Hordeum vulgare* L.)" was conducted during the Rabi season of 2024–25. The experiment was carried out at the Research Farm of the School of Agricultural Sciences, GD Goenka University, Sohna, Haryana. The experiment comprised 12 treatment combinations, consisting of two factors: seed rate (Factor A) with three levels (87.5, 100 and 112 kg/ha) and nitrogen levels (Factor B) with four levels (60, 75, 90 and 105 kg N/ha). The treatments were laid out in a factorial randomized block design (FRBD) with three replications. Each plot had a gross size of 4.0 m × 3.0 m (12.0 m^2). The crop was sown with a spacing of 22 cm between rows and 10 cm between plants. The seed rate was maintained according to the respective treatment combinations. The barley variety used for the study was BH 885, a two-rowed malt barley cultivar. Plant height was measured from the ground surface to the base of the emerging growth during early stages and up to the base of the ear head after anthesis. For recording dry matter accumulation, plants from a 0.25 m row length were sampled from three locations in the second row on either side of each plot to represent the entire plot. The number of effective tillers was counted from the selected rows in each plot. For spike length measurement, five spikes were randomly selected from the sampled plants in each plot. The length of each spike was measured from the neck node to the tip using a meter scale and the average was expressed in centimetres. The harvested produce from the net plot area was thoroughly sun-dried and weighed using a spring balance to record the biological yield in kilograms per plot. The values were subsequently converted into quintal per hectare (q/ha).The benefit to cost ratio was worked out by using the following formula:

$$\text{B:C ratio} = (\text{Net returns (₹/ha)})/(\text{Cost of cultivation (₹/ha)})$$

The collected data were subjected to statistical analysis using the method of analysis of variance (ANOVA) as outlined by Panse and Sukhatme [13].

RESULTS AND DISCUSSION

Growth Parameters

Plant height was significantly influenced by both seed rate and nitrogen levels at all growth stages (Table 1). Among the seed rates, 100 kg/ha (S_2) recorded the highest plant height, reaching 111.75 cm at harvest, which was significantly superior to S_3 (109.76 cm), while the lowest plant height was recorded under S_1 (107.90 cm). Nitrogen application significantly increased plant height up to 90 kg N/ha (N_3), which recorded the maximum plant height of 112.52 cm at harvest and remained statistically at par with N_2 (111.09 cm). The lowest plant height (106.33 cm) was observed under N_1. Dry matter accumulation was not significantly affected by seed rate (Table 2), although S_2 recorded the highest value (908.80 g/m^2 at harvest) compared to S_1 (900.80 g/m^2). Nitrogen levels significantly affected dry matter accumulation from 60 DAS onwards, with N_3 recording the highest dry matter accumulation (910.81 g/m^2 at harvest), followed by N_2 (906.29 g/m^2), whereas the lowest value was observed under N_1 (897.91 g/m^2). The interaction effect between seed rate and nitrogen levels was non-significant for both parameters. The superior growth under S_2 may be attributed to optimum plant population and efficient utilization of light, moisture and nutrients, while enhanced growth under N_3 resulted from improved chlorophyll synthesis, cell division and photosynthetic efficiency [10, 20]. Similar findings were reported by Khan and Khalil [6], Singh and Sarlach [17], Sadiq *et al.* [14], Gyawali *et al.* [5] and Kumar *et al.* [8].

Table 1: Effect of seed rate and nitrogen levels on plant height of two row Barley

Treatment	Plant height (cm)				
	30 DAS	60 DAS	90 DAS	120 DAS	At harvest
Factor A : Seed rate (S)					
S_1-87.5 kg seed ha^{-1}	21.67	51.80	98.47	104.79	107.90
S_2-100 kg seed ha^{-1}	23.28	54.56	101.86	108.98	111.75
S_3-112.5 kg seed ha^{-1}	22.03	52.74	99.60	106.95	109.76
SEm ±	0.18	0.39	0.81	0.93	0.66
CD at 5%	0.54	1.15	2.37	2.74	1.94
Factor B : Nitrogen levels (N)					
N_1-60 kg N ha^{-1}	20.99	50.69	97.16	103.06	106.33
N_2-75 kg N ha^{-1}	22.80	54.02	101.07	108.25	111.09
N_3-90 kg N ha^{-1}	23.77	55.16	102.59	109.83	112.52
N_4-105 kg N ha^{-1}	21.75	52.26	99.07	106.50	109.29
SEm ±	0.21	0.45	0.93	1.08	0.76
CD at 5%	0.62	1.32	2.73	3.16	2.24

Table 2: Effect of seed rate and nitrogen levels on dry matter accumulation of two row Barley

Treatment	Dry matter accumulation (g/m^2)				
	30 DAS	60 DAS	90 DAS	120 DAS	At harvest
Factor A : Seed rate (S)					
S_1-87.5 kg seed ha^{-1}	26.91	250.37	553.99	877.73	900.80
S_2-100 kg seed ha^{-1}	28.46	255.22	559.92	885.26	908.80
S_3-112.5 kg seed ha^{-1}	27.28	251.68	556.85	879.69	904.65
SEm ±	0.66	1.49	1.72	2.55	2.49
CD at 5%	NS	NS	NS	NS	NS
Factor B : Nitrogen levels (N)					
N_1-60 kg N ha^{-1}	26.15	248.32	551.01	874.39	897.91
N_2-75 kg N ha^{-1}	28.07	254.00	559.34	883.37	906.29
N_3-90 kg N ha^{-1}	28.94	256.28	560.88	887.47	910.81
N_4-105 kg N ha^{-1}	27.03	251.08	556.44	878.35	904.00
SEm ±	0.76	1.72	1.99	2.94	2.87
CD at 5%	NS	5.05	5.83	8.63	8.42

Yield attributes and Yield

Seed rate and nitrogen levels significantly influenced effective tillers, spike length and biological yield (Table 3). The highest number of effective tillers (91.89 m^{-1} row length), spike length (14.57 cm) and biological yield (106.25 q ha^{-1}) were recorded under S_2 (100 kg seed ha^{-1}), whereas the lowest values were observed under S_1 (89.99 m^{-1} row length, 14.37 cm and 100.22 q ha^{-1}, respectively). Among nitrogen levels, N_3 (90 kg N ha^{-1}) produced the maximum effective tillers (92.17 m^{-1} row length), spike length (14.61 cm) and biological yield (107.13 q ha^{-1}), which remained statistically at par with N_2 (91.58 m^{-1} row length, 14.51 cm and 104.44 q ha^{-1}, respectively). The interaction effect was non-significant for all yield parameters. The enhanced yield attributes under S_2 may be due to optimum crop stand and reduced inter-plant competition, whereas adequate nitrogen supply under N_3 promoted vegetative growth, assimilate production and their translocation towards reproductive structures [11]. Similar observations were reported by Alazmani [1], Babu *et al*. [2], Sadiq *et al*. [15], Saikia and Bora [16] and Gyawali *et al*. [5].

Economics

The economic parameters were significantly affected by seed rate and nitrogen levels (Fig. 1). Among seed rates, S_2 (100 kg seed ha^{-1}) recorded the highest gross returns (₹105,366 ha^{-1}), net returns (₹69,791 ha^{-1}) and B ratio (1.96), which were significantly superior to S_1 and S_3. The lowest gross returns (₹98,031 ha^{-1}), net returns (₹62,832 ha^{-1}) and B ratio (1.78) were recorded under S_1. Similarly, N_3 (90 kg N ha^{-1}) recorded the highest gross returns (₹106,504 ha^{-1}), net returns (₹70,832 ha^{-1}) and B ratio (1.99), which were significantly superior to N_4 and N_1 but statistically at par with N_2 (₹102,948 ha^{-1} gross returns, ₹67,574 ha^{-1} net returns and B ratio of 1.90). The lowest economic returns were recorded under N_1, with gross returns of ₹95,694 ha^{-1}, net returns of ₹60,412 ha^{-1} and a B ratio of 1.71. The interaction effect between seed rate and nitrogen levels was non-significant, indicating independent effects of both factors on profitability. Higher economic returns under S_2 and N_3 were mainly associated with enhanced

growth and biological yield, resulting in improved productivity and resource-use efficiency. These findings corroborate the reports of Narolia and Yadav [13], Luikham *et al.* [12] and Kumar *et al.* [8].

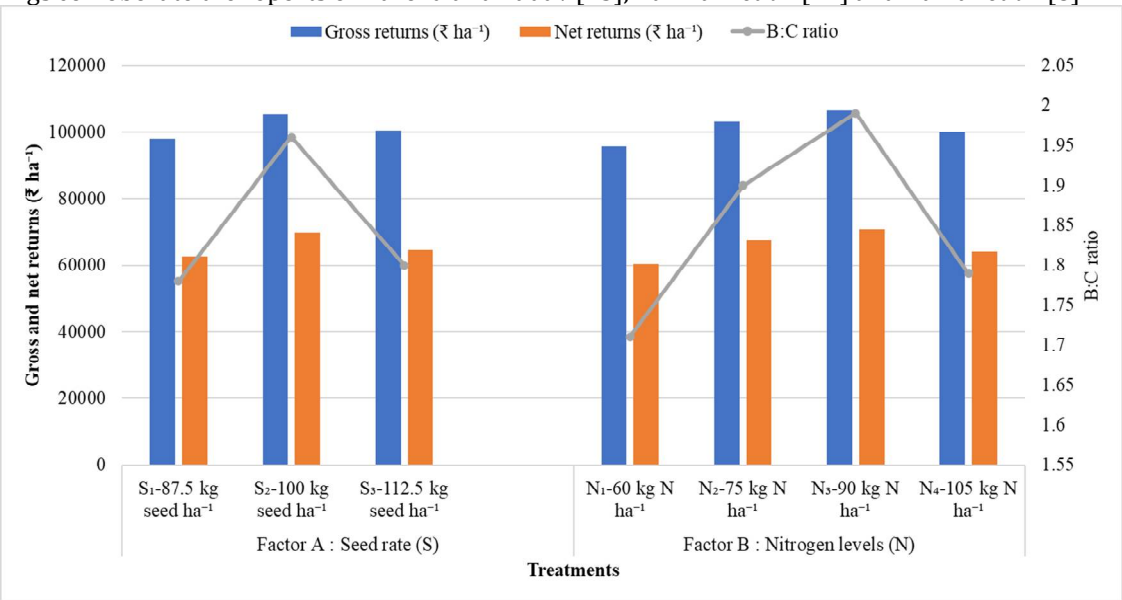


Fig. 1: Effect of seed rate and nitrogen levels on economics of two row barley cultivation

Table 3: Effect of seed rate and nitrogen levels on number of effective tillers, spike length and biological yield of two row Barley (*Hordium vulgare*L.)

Treatment	No. of effective tillers/m.r.l.	Spike length (cm)	Biological yield (q/ha)
Factor A : Seed rate (S)			
S_1-87.5 kg seed ha^{-1}	89.99	14.37	100.22
S_2-100 kg seed ha^{-1}	91.89	14.57	106.25
S_3-112.5 kg seed ha^{-1}	90.79	14.45	102.52
SEm ±	0.43	0.03	0.56
CD at 5%	1.25	0.10	1.64
Factor B : Nitrogen levels (N)			
N_1-60 kg N ha^{-1}	89.20	14.30	98.39
N_2-75 kg N ha^{-1}	91.58	14.51	104.44
N_3-90 kg N ha^{-1}	92.17	14.61	107.13
N_4-105 kg N ha^{-1}	90.61	14.43	102.02
SEm ±	0.49	0.04	0.65
CD at 5%	1.44	0.11	1.90

CONCLUSION

The findings of the present study demonstrated that both seed rate and nitrogen levels significantly influenced the growth, yield attributes, biological yield, and economic returns of two-row barley. Among the treatments, a seed rate of 100 kg/ha and nitrogen application at 90 kg N/ha recorded superior performance with respect to plant height, dry matter accumulation, effective tillers, spike length, biological yield, gross returns, net returns, and benefit-cost ratio. However, the interaction effect between seed rate and nitrogen levels was found to be non-significant for all the parameters studied. Based on the overall results, the application of 100 kg seed/ha in combination with 90 kg N/ha can be considered the optimum agronomic practice for enhancing the productivity and profitability of two-row barley under the agro-climatic conditions of Haryana.

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REFERENCES

1. Alazmani, A. (2015). Effect of cutting time under different amounts of nitrogen on yield and yield components of barley. *European Journal of Agronomy*, **4**: 309–316.

2. Babu, U., Shukla, A.K., Kumar, A. and Meena, R.K. (2021). Effect of sowing methods and nutrients on growth and yield of wheat (*Triticum aestivum* L.). *Agricultural Review*, **33**: 42–66.
3. Beillouin, D., Trépos, R., Gauffreteau, A. and Jeuffroy, M.H. (2018). Delayed and reduced nitrogen fertilization strategies decrease nitrogen losses while still achieving high yields and high grain quality in malting barley. *European Journal of Agronomy*, **101**: 174-182.
4. Chhokar, R.S., Kumar, N., Sharma, R.K., Gill, S.C., Kharub, A.S., Khippal, A.K. and Tripathi, S.C. (2022). Improved agronomic practices for enhancing the resource use efficiency and productivity of wheat and barley. In: *New Horizons in Wheat and Barley Research: Crop Protection and Resource Management*. Springer Nature Singapore, pp. 393–426.
5. Gyawali, C., Upadhayaya, B.T., Pokharel, B., Pandey, B.P., Gyawaly, P. and Moi, T. (2025). Effect of different nitrogen levels on growth, yield and nitrogen use efficiency (NUE) of Hardinath Hybrid Dhan-1 in Madhesh Province, Nepal. *International Journal of Plant & Soil Science*, **37**: 56–66.
6. Khan, A. and Khalil, S.K. (2010).Effect of leaf area on dry matter production in aerated mung bean seed. *International Journal of Plant Physiology and Biochemistry*, **2**(4): 52–61.
7. Kim, Y.G., Park, H.H., Lee, H.J., Kim, H.K. and Kuk, Y.I. (2022). Growth, yield and grain quality of barley (*Hordeum vulgare* L.) grown across South Korean farmlands with different temperature distributions. *Agronomy*, **12**(11): 2731.
8. Kumar, I., Singh, A.P. and Verma, S.K. (2025).Effect of nitrogen levels on growth and fodder yield of different varieties of pearl millet [*Pennisetum glaucum* (L.) R. Br.] undershisham (*Dalbergia sissoo*) based silvi-pastoral system. *Discover Life*, **55**(1): 32.
9. Laver, J.G. and Partridge, J.R. (1990). Planting date and nitrogen rate effects on spring malting barley. *Agronomy Journal*, **82**(6): 1083–1088.
10. Leghari, S.J., Wahocho, N.A., Laghari, G.M., Hafeez Laghari, A., Mustafa Bhabhan, G., Hussain Talpur, K., Bhutto, T.A., Wahocho, S.A. and Lashari, A.A. (2016). Role of nitrogen for plant growth and development: A review. *Advances in Environmental Biology*, **10**(9): 209–219.
11. Luikham, E., Neetarani, S. and Mariam, A. (2016). Fodder and grain yield of barley (*Hordeum vulgare* L.) as influenced by nitrogen doses and varieties. *Journal of Forage Research*, **41**(4): 253–254.
12. Narolia, G.P. and Yadav, R.S. (2013). Effect of nitrogen levels and its scheduling on growth, yield and grain quality of malt barley (*Hordeum vulgare* L.) under normal and late sown conditions in North-West Rajasthan.*Annals of Arid Zone*, **52**(2): 95–99.
13. Panse, V.G. and Sukhatme, P.V. (1985) Statistical Methods for Agricultural Workers. Indian Council of Agricultural Research Publication, 87-89.
14. Sadiq, G.A., Azizi, F., Khaleeq, K., Farkhari, Z. and Amini, A.M. (2023). Effect of different seeding rates on growth and yield of common bean. *Journal of Environmental and Agricultural Studies*, **4**(3): 41–45.
15. Saikia, R. and Bora, P.C. (2025). Effect of seed rate on growth and productivity of rapeseed (*Brassica campestris* var. Toria) in Assam, India.*Asian Journal of Advances in Agricultural Research*, **25**(6): 60–65.
16. Sharma, R.P., Sure, V.K. and Datt, N. (2001). Integrated nutrient management in summer barley (*Hordeum vulgare* L.) in a cold desert of Himachal Pradesh.*Indian Journal of Agricultural Sciences*, **71**(12): 752–755.
17. Singh, H. and Sarlach, R.S. (2022). Effect of seeding rate on growth and yield of barley (*Hordeum vulgare* L.). *Pharma Innovation Journal*, **11**(9): 1848–1852.
18. Soleymani, A. and Shahrajabian, M.H. (2011). Influence of planting date and plant density on grain and biological yields of barley cultivars. *Research on Crops*, **12**(3): 698–700.
19. Thapa, R., Dhakal, S.C. and Subedi, S. (2025). Profitability and resource use efficiency of rice seed production: A case of Chitwan, Nepal. *Cogent Food & Agriculture*, **11**(1): 2444341.
20. Zhou, S., Liu, K., Zhuo, X., Wang, W., Zhang, W., Zhang, H., Gu, J., Yang, J. and Liu, L. (2023). Optimizing nitrogen regime improves dry matter and nitrogen accumulation during grain filling to increase rice yield. *Agronomy*, **13**(8): 1983.

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