

Impact of Different Dose of Nitrogen Application on Late Sown Barley (*Hordeum vulgare*)

Ram Sawrup Banga*, Rattan Singh, Jagdish Chander Mehla, RP Srivastava, Manju Kumari, Gurpreet Singh, Rupinder Kaur

Bhai Gurdas Degree College, Punjab-India

*Corresponding Author E-mail: rsbanga99@gmail.com

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ABSTRACT

A Field experiment was conducted in rabi season in Bhai Gurdas Degree College, Sangrur, Punjab-India during 2021-2022. To find out the suitable dose of Nitrogen in barley crop and to study the time and dose of nitrogen application for higher productivity of barley. The experiment was laid out in split plot design with four levels of nitrogen (0, 20, 40, and 60 kg N ha⁻¹) and three time of application (½ at the time of sowing and ½ after first irrigation, 1/3 at sowing and 2/3 after first irrigation, 1/3 at sowing and 1/3 after first irrigation and 1/3 after second irrigation) with three replications. In all aspects of growth parameters, such as IPP, Plant height, Number of shoots, Dry matter accumulation, and Leaf area index, the nitrogen level (60 kg ha⁻¹) treatment and the time of application (1/3 at sowing and 2/3 after first irrigation) treatment were found to be superior to the other treatments (LAI), Treatment N3 (60 kg N ha⁻¹) results in a considerable increase in the number of shoots (393.45). A total amount of rainfall received during the crop season was 56.2 mm and maximum rainfall received during third week of January. The number of shoots m⁻² was influenced significantly by rates of nitrogen. Maximum numbers of shoots were recorded under 60 kg N ha⁻¹ at 90 days after sowing. . Maximum plant height was recorded under 60 kg N ha⁻¹ at all the crop growth stages, which was mainly due to more availability of nitrogen. Plant height (70.70 cm), Leaf area index (5.10) & Dry matter accumulation (621.25 g) under main plot treatments. Treatment T2 (1/3 at sowing and 2/3 after first irrigation) was found best with No. of shoots (389.96), Plant height (61.31 cm), Leaf area index (4.46) and Dry matter accumulation (554.94 g) as compared to other treatments and being at par with Treatment T3 (1/3 at sowing and 1/3 after first irrigation and 1/3 after second irrigation) in all aspects of growth parameters.

Keyword: Plant Height, Sowing, Treatment, Irrigation.

INTRODUCTION

Barley (*Hordeum vulgare* L.) is one of the world's fourth most important cereals after wheat, rice and maize. In India, it is popularly known as "Jau." India ranks 7th in world in

respect to total area and production. In India, barley crop was grown over an area of 695.0 thousand hectare with a production of 1743.2 thousand tones and productivity of 25.10 qha⁻¹ during 2020-21 (Anonymous, 2021).

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Uttar Pradesh is one of the most important barley growing states of India. In Uttar Pradesh, the area under cultivation of barley is about 168.0 thousand ha⁻¹ with a production of 441.0 thousand tones and productivity of 26.3 q ha⁻¹ (Anonymous, 2013). Half of the total area under this crop is irrigated and rest remains rainfed. This crop has wider adoptability and needs less water and it is more tolerant to salinity and other stress conditions. Therefore, it is of great significance in areas where successful wheat crop cannot be grown due to unsuitable soil and insufficient irrigation.

Barley is very sensitive to insufficient nitrogen and very responsive to nitrogen fertilization. The most important role of nitrogen in the plant is its presence in the structure of protein and nucleic acids, which are the most important building and formative substances from which the living material or protoplasm of every cell is made. In addition, nitrogen is also found in chlorophyll, the green coloring matter of plants. Excessive nitrogen causes excessive vegetative growth, resulting in greatly increased danger of lodging, delayed maturity and greater susceptibility to diseases and pests. Nitrogen application at proper dose has the most important effect in terms of increasing crop production. Farmers use nitrogen fertilizers indiscriminately without adequate information concerning actual soil requirements.

Nitrogen is a key factor in achieving an optimum yield in cereals and in their growing period requires lot amount of absorbed nitrogen. Proper dose of nitrogen increased leaf area, tillers formation, leaf area index and leaf area duration and this increase led to much greater production of dry matter and grain yield.

Seeding of barley is generally done in early November to late December. Late harvesting of preceding crops, excessive soil moisture after rainy season and increasing cropping intensity have pushed a sizable barley area under moderately late to late sown condition. Late sown plants experience low temperature at the vegetative stage, which

decrease the physiological processes particularly, root growth and nutrient and water uptake. On the contrary, reproductive stage of late sown plants experience high temperature, which reduces grain growth and ultimately crop productivity. There are few options regarding fertilizer requirement of late planted barley. Some argue for higher level of nutrient to the crop to compensate yield loss owing to delayed seeding (Kotrba et al., 1984), others advocate lower level of nutrient as the crop is unable to absorb higher level of nutrient owing to its reduced growth duration (Kahnt & Kubler, 1981).

The most important factors of maintenance of soil fertility status leading to the successful crop production. Thus dose of nitrogenous fertilizers and their time of application has to be carefully scheduled. To get maximum benefit from the fertilizer use the fertilizer should not only be applied in optimum quantity but also at right time as timely nitrogen application in one agronomic technique which has helped considerably in increasing the nitrogen use efficiency (NUE). It is now very well established that for most crops nitrogen must be applied in two or three split doses coinciding with the crop growth stages when its requirement is high therefore, it is high time to assess the effect of optimum dose of nitrogen and its time of application to increase the fertilizer use efficiency in barley.

Thus, nitrogen fertilization strategies must be so tuned as to balance the often contradicting goal of maximum production with desirable protein content in grain. Method of split application of nitrogen, to meet the crop requirement throughout life cycle for higher production and less accumulation of nitrogen in grain, may be one of the strategy to achieve the high yield and quality of barley for malting industries. However, little work has been done on this aspect of effect of time and levels of nitrogen application on late sown barley.

MATERIAL AND METHODS

The present investigation was under taken during *Rabi* 2021- 2022 at the Agronomy

Research Farm. The experiment was carried out at the agriculture farm, Bhai Gurdas Degree College, Sangrur, Punjab-India, Punjab-India. Geographically, experimental site located in Punjab between latitudes 76°-22'E and 76°-46'E and longitudes 30°-36'N to 30°-39'N, with a mean elevation of 279 metres above sea level. The experimental of site was uniform in topography and well-drained. The climate of Sangrur is typically semi-arid & sub tropical, characterized by extremes of temperature both in summer and winter with low rainfall and moderate humidity. Maximum temperature in summer is as high as 45 °C in May-June and minimum temperature in winter falls below 4 °C in Dec-Jan. The annual rainfall of Sangrur was 343 mm in 2021-2022.

Sangrur falls in a belt of semi-arid to sub-tropical climate. The normal period for the onset of monsoon in this region is the third week of June and it lasts up to the end of September or sometimes extends to the first week of October. Winter showers are often experienced in between the month of December to mid of February. On the basis of which soil of experimental plot was classified as sandy loam in texture acidic in reaction, poor in nitrogen as well as phosphorus and moderate in potash content.

Soil samples were collected from experimental farm at various loci un methodically, up to a depth of 15 cm, using a soil auger. All of the soil samples were combined to create a compound sample. After air drying, the sample was sieved through a 2 mm sieve. This sample was used for mechanical and chemical analysis, as well as determining the soil's nutrient status. The experiment was laid out in split plot design with four levels of nitrogen (0, 20, 40, and 60 kg N ha⁻¹) and three time of application (1/2 at the time of sowing and 1/2 after first irrigation, 1/3 at sowing and 2/3 after first irrigation, 1/3 at sowing and 1/3 after first irrigation and 1/3 after second irrigation.) with three replications. The treatments were allocated to different plots at random in all the three replications.

Hundred seeds of barley (var. Narendra Barley-1) were tested to determine the germination percentage. Sowing was done on 29 December 2018 using 100 kg seed ha⁻¹ in row 20 cm apart and 4.0cm in furrow opened by deshi plough. The nitrogen was applied as per treatment through urea, however, 30 kg P₂O₅ ha⁻¹ through SSP and 20 kg K₂O ha⁻¹ through muriate of potash was applied at the time of sowing as a basal dose. Tube-well was the source of irrigation, three irrigations were given, coinciding with the critical stage of the plant growth, beside pre- sowing irrigation. The crop was harvested at proper stage of maturity as determined by visual observations on (30 April 2018). Half meter length on either end of each plot and 2 border rows from each side as border were first removed from the field to avoid error.

Observations were recorded at different growth stages of wheat. Initial plant population of each treatment was taken at 20 DAS from three randomly selected locations with quadrat in each plot and averaged figure were converted in to number of plants m⁻². Five plants were selected randomly in each plot and tagged for measuring height at different intervals. Height was measured at 30, 60, 90 DAS and at harvest stage with the help of meter scale from ground surface to the tip of the top most leaf before heading and up to the base of ear head after heading. The number of shoot m⁻² were counted at 30, 60, 90 DAS and at harvest by placing quadrat at three places in each plot and the plants which come within the quadrat were average out to express shoots per square meter. The leaf area was measured at 30, 60, 90 DAS stage to calculate the leaf area index. The plants of 0.25 m row length were taken and green leaves were separated to record their surface area by automatic leaf area meter. All the leaves were grouped into three viz. small, medium and large. Five leaves from each group were taken and their surface area was measured. Area of leaves was multiplied with respective leaf number of a group and sum of all three gave the total leaf area. For obtaining leaf area index, Plant samples for dry matter

accumulation purpose were taken randomly from two spots by using a quadrat of 25 x 25 cm in each plot at 30 days interval till maturity. The plants were sun dried separately and then oven dried at $70 \pm 20^\circ\text{C}$ till a constant weight was obtained. The weight of dried sample were recorded and expressed in g m⁻².

RESULT AND DISCUSSION

The different levels of nitrogen had significant effect on plant height at all the growth stages of crop, except at 30 DAS. Increasing nitrogen levels increased the plant height. The maximum plant height was recorded under 60 kg N ha⁻¹ which was significantly superior over rest of the treatments. Initial plant population taken at 20 days after sowing was not influenced significantly by rate and time of nitrogen application. In general, the tillers formation was very rapid from 30 to 60 DAS whereas the maximum number of tillers was recorded at 90 DAS and thereafter, there was gradual reduction in number of tillers. The number of tillers was influenced significantly by the rate of nitrogen at all the growth stages of crop. The maximum number of tillers m⁻² was obtained at 90 DAS with 60 kg N ha⁻¹ being at par with 40 kg N ha⁻¹. The number of tillers m⁻² was affected significantly due to time of nitrogen application at all the growth stages of crop. At 30, 60, 90 DAS and harvest stage, the number of tillers m⁻² was recorded significantly higher in T2 treatment (1/3 at sowing and 2/3 after first irrigation) as compared to rest of the treatments. lowest number of tillers was obtained under the treatment where nitrogen was applied as ½ at sowing and ½ after first irrigation (T1). The number of shoots m⁻² was influenced significantly by rates of nitrogen. Maximum numbers of shoots were recorded under 60 kg N ha⁻¹ at 90 days after sowing. This may be due to least plant competition for nutrient caused by sufficient supply of nitrogen which increased the better absorption of nutrients from the soil. Reduction in number of tillers

after 90 days of sowing may be due to mortality of shoots. Similar results were reported by Streigl (1978) and Hooda and Singh (1979). The time of nitrogen application had the profound effect on number of shoots. At all stages of crop growth the number of shoots m⁻² was recorded significantly higher in T2 treatment (1/3 at the time of sowing and 2/3 after first irrigation) over rest of the treatments. This might perhaps be ascribed to be adequate availability of nitrogen during entire grand growth period of the crop which increased the utilization and absorption of nitrogen by growing plant from the soil as the result of least competition for nitrogen. The lowest number of shoots was recorded under the treatment where nitrogen was applied as ½ at the time of sowing and ½ after first irrigation. Similar results was reported by Singh and Singh (2005) and Singh and Singh (2013). Number of shoots was recorded significantly more with 60 kg N ha⁻¹. The time of nitrogen application had significant influence on number of shoots m⁻² at all the stages. It was recorded significantly higher (401.48) under T2 treatment (1/3 at the time of sowing and 2/3 after first irrigation). The lowest number of shoots were recorded when nitrogen was applied as ½ at the time of sowing and ½ after first irrigation. Data pertaining to plant height of barley recorded at 30, 60, 90 DAS and at harvest have been presented in Table 2. Data revealed that the rate of growth was rather slow during the initial stage upto 30 DAS thereafter, a rapid increase in growth was observed till 90 DAS, referring to its grand growth period. Plant height increased successively till the harvest stage but the increase was rather slow after 90 DAS. It is quite evident from the data given in Table 2 that different levels of nitrogen had significant effect on plant height at all the growth stages of crop, except at 30 DAS. Increasing nitrogen levels increased the plant height. The maximum plant height was recorded under 60 kg N ha⁻¹ which was

significantly superior over rest of the treatments. The time of nitrogen application had significant effect on plant height at all successive stage of crop growth except at 30 DAS where the differences in plant height were found non-significant. At 60, 90 DAS and at harvest stages the plant height of barley were recorded significantly higher under T2 ($\frac{1}{2}$ at sowing and $\frac{2}{3}$ after first irrigation) treatment as compared to other treatments. Treatment T1 ($\frac{1}{2}$ at sowing and $\frac{1}{2}$ after first irrigation) produced significantly lower plant height at all the stages of crop growth. There was rapid increased in height of plant from 30 to 90 days after sowing thereafter, increased in height was rather slow. Maximum plant height was recorded under 60 kg N ha⁻¹ at all the crop growth stages, which was mainly due to more availability of nitrogen. Higher nitrogen levels resulted in higher nitrogen uptake, which could ultimately result in to increased protein synthesis, cell division and cell elongation and finally expressed morphologically on increased in height of the plant. Similar findings were reported by Raghuvanshi et al. (1987).

CONCLUSION

On the basis of the results presented and discussed in preceding chapters. The following conclusions may be drawn from the present study: A dose of 60 kg N ha⁻¹ seems to be suitable for better growth, yield and quality of late sown barley. Application of 60 kg nitrogen in two split application i.e. $\frac{1}{3}$ at the time of sowing and $\frac{2}{3}$ after first irrigation proved to be the best time for the cultivation of higher productivity of late sown barley. A dose 60 kg N ha⁻¹ applied as $\frac{1}{3}$ at the time of sowing and $\frac{2}{3}$ after first irrigation proved to be more remunerative and economical. In order to make recommendation these findings need to be further confirmed.

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Conflict of Interest:

There is no such evidence of conflict of interest.

Author Contribution

All authors have participated in critically revising of the entire manuscript and approval of the final manuscript.

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