

Original Research Article

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Effect of Different Nitrogen Level and Rice Straw Incorporation on the Productivity of Barley (*Hordeum vulgare* L.) in South-West Punjab

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ABSTRACT

The field experiment entitled Effect of different nitrogen levels and rice straw incorporation on growth and Productivity of Barley (*Hordeum vulgare* L.) in south-west Punjab was conducted during the *rabi* season of 2017-18 at Research Farm of Guru Kashi University, Talwandi Sabo, Bathinda (Punjab). The trail was laid out in split plot design with four nitrogen levels *viz.*, 0 kg N/ha (N₀), 40 kg N/ha (N₁), 60 kg N/ha (N₂) and 80 kg N/ha (N₃) in main plot and two levels of rice straw incorporation *viz.*, Control (S₀) and 10 tonnes/ha (S₁) in sub plot. The results showed that the 80 kg N/ha recorded maximum plant height (88.9 cm), dry matter accumulation (107.4 q/ha), number of effective tillers/m² (275.1), ear length (17.9 cm), number of grains per ear (59.8) and test weight (50.4 g), grain yield (40.7 q/ha), straw yield (75.6 q/ha) and harvest index (35.00%) than other nitrogen levels. Similarly, application of rice straw incorporation@10 tonnes/ha recorded higher plant height (85.4 cm), dry matter accumulation (98.1 q ha⁻¹) and yield attributes *i.e.* number of effective tillers/m² (263.8), ear length (18.0 cm), number of grains/ear (57.9) and test weight (50.8 g) as compared to control.

Keywords

Barley, Grain yield, Nitrogen and rice straw incorporation

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Introduction

Barley (*Hordeum vulgare* L.) is an ancient and major cereal grown in temperate climate, globally. It is the fourth largest cereal in the world with 7% of total cereal production. This crop requires temperature of 12⁰C to 16⁰C at growing stage and about 30⁰C to 32⁰C at maturity. It is considered as poor man's crop. Barley is considered as a valuable crop because it is grown for several purposes such as food and processed food products for human being and feed for cattle and poultry birds. Barley grain is also valued for

smothering and cooling effect on the body for easy digestion. Barley helps in the prevention of gallstones in women, thus helps in improving the immunity system. It is highly beneficial for the anemia tic patients, prevents cancer, diabetes, and makes bones stronger. Besides these conventional uses, it is an important industrial crop as it is used as raw material for beer, whisky and brewing Barley. The small and marginal farmers of Rajasthan cut the green barley and feed it to farm and mulch animals. Each 100 g of barley grain comprise 10.6 g protein, 2.1 g fat, 64 g carbohydrate, 50 mg calcium. In recent past,

India has made an impressive progress in achieving self sufficiency in food grain production by elevating productivity of several crops but the breakthrough has not been achieved in barley. Besides other factors, nutritional supply may be crucial for successful as well as profitable cultivation of barley.

Nitrogen (N) is the main constituent of chlorophyll and amino acids which are precursor to protein. Malt barley's grain yield, grain protein and kernel plumpness are characteristics strongly related to available nitrogen (Grant, 2000). Lauer and partridge (1990) observed that grain yield and protein content increased significantly with increase in N levels. Insufficient nitrogen can reduce grain yield and quality below acceptable levels. Application of N significantly increased the yield from 22.5q/ha with 60kg N/ha to 29.3q/ha. However, 80 kg N/ha usually produces undesirable high protein level (Yadav *et al.*, 2003). Straw mulch also provides benefit in terms of increasing maintains the optimum temperature, improves fertilizer availability and increase the crop yield (Dushouyu *et al.*, 1995). The intensive and continuum use of rice-wheat rotation in Punjab leads to excessive use of irrigation water and soil health problems. The problems of handling the rice straw can be solved by incorporate the straw by cutter cum spreader, disc harrow and rotavator etc. Barley offers a good scope for crop diversification. Keeping in view the present study was planned to study the effect of different levels of nitrogen and rice straw incorporation on the performance of barley.

Materials and Methods

A field experiment "Effect of different nitrogen level and rice straw incorporation on the productivity of barley" was conducted at Research Farm, College of Agriculture, Guru

Kashi University, Talwandi Sabo, Bathinda during *rabi* season 2017-18. Talwandi Sabo is located at 29°57' N latitude and 75°7' E longitudes and altitude (213 m above sea level). The tract is characterized by semi humid climate. The mean annual rainfall fluctuates around 150 mm, major part of which is during the month of July to November with a few shower of cyclonic rains during winter and spring month.

The soil was alkaline (pH 8.2) with normal electrical conductivity (0.34 dSm^{-1}). The soil was low in both organic carbon content (0.32%) and CaCO_3 content (2.5%). The available nitrogen (125 kg/ha) was low, whereas the available phosphorus (13.9 kg/ha) and available potash (245.6 kg/ha) were both medium. The experiment was laid out in split plot design with three replications. The treatments comprised of four level of nitrogen (0, 40, 60 and 80 kg/ha) and two rice straw incorporation (no straw and 10 tones/ha).

The height of five randomly selected plants was measured at maturity. Tillers bearing panicles were counted and recorded as productive tillers. The observations were taken differently from every five randomly selected plants from each plot. The number of ear grains per ear counted from the best ears of the selected plants. Dry matter accumulation was recorded from each plot. The plant biomass harvested from individual plots was first sun dried followed by oven drying at 65°C till constant weight was obtained. After complete drying, dry weight at 120 days after sowing (DAS) was recorded and converted into g/m^2 . The samples of 1000-grains were drawn from each plot after cleaning mean value was worked out after recording their weight. The weight of total production from the net plot was recorded after harvest with help of electronic balance. The weight of the grain per net plot was

record in kilogram after threshing of the produce. Later on it was converted into grain yield (q/ha). The straw yield was worked out from the weight of total biomass and expressed as q/ha. The biological yield was calculated by the addition of grain yield and straw yield. Harvest index (HI) was calculated by using following formula;

$$\text{Harvest Index (\%)} = \frac{\text{Seed yield}}{\text{Biological yield}} \times 100$$

Fisher's ANOVA technique and least significant difference (LSD) test at 5% probability level was used to compare differences among treatment means (Steel *et al.*, 1997).

Results and Discussion

Growth parameters of barley

The highest plant height was recorded in 80 kg N/ha treatment than other nitrogen levels i.e. 0, 40 and 60 kg N/ha (Table 1). Among the rice straw incorporation, maximum plant height was observed in rice straw incorporation@10 t/ha than control. Among N levels, 80 kg N/ha recorded significantly higher dry matter accumulation than other nitrogen treatments, while minimum dry matter accumulation was obtained in control. Nitrogen applied @80 kg/ha with rice straw incorporation (10 t/ha) resulted in significantly higher dry matter accumulation than other treatment combinations. Similar results were also reported by Alam *et al.*, (2005), Chandra *et al.*, (2015), Mohammadi and Farideh (2014), Awasthi and Suraj Bhan (1993), Prokhorov *et al.*, (1998) and Nagarajan and Wahab (2001).

Yield attributes of barley

The ear length of barley was highest in N @ 80kg/ha treatment which was significantly higher than other nitrogen levels i.e. 0, 40 and

60 kg/ha (Table 2). Rice straw incorporation (10 tonnes/ha) recorded significantly higher ear length than control. The number of effective tillers/m² of barley in 80 kg N/ha treatments was significantly higher than other nitrogen levels. Rice straw incorporation recorded the maximum effective tillers was than control. Nitrogen applied @80 kg/ha with 10 t/ha rice straw incorporation recorded significantly higher number of effective tiller/m² than other treatments. The variation in the above mentioned growth parameters have also been reported by many research workers Shafi *et al.*, (2011), Singh *et al.*, (2013),

The data indicated that application of 80 kg N/ha and rice straw incorporation produced maximum number of grains per ear as compared to other treatments. It may be contributed due to higher ear length for optimum grain development and better partitioning of photosynthesis on higher availability of nitrogen per ear. Rice straw incorporation recorded significantly higher number of grains per ear than control. The variation in the above mentioned growth parameters have also been reported by many research workers Dev and Chauhan (2009) Jan *et al.*, (2011).

The data showed a significant effect of different nitrogen levels and rice straw incorporation on 1000-grain weight of barley. Maximum 1000-grain weight of barley was observed in N@ 80 kg/ha than other nitrogen level i.e. 0, 40 and 60 kg/ha. While rice straw incorporation recorded significantly higher 1000-grain weight than control. Similar results were also reported by Singh *et al.*, (2005).

Yield of barley

The grain yield increased with increase in nitrogen levels and the maximum grain yield was recorded in 80 kg N/ha treatment which

was significantly higher than other nitrogen levels (Table 3). Rice straw incorporation observed maximum grain yield than control. Nitrogen applied @80 kg/ha with 10 tonnes/ha rice straw incorporation resulted in

significantly higher grain yield than other treatment combinations. Similar results were also reported by Singh and Singh (2005), Singh *et al.*, (2013) and Shirazi *et al.*, (2014).

Table.1 Effect of different nitrogen level and rice straw incorporation on growth parameters of barley

| Treatment | Plant height (cm) | Dry matter accumulation (q ha ⁻¹) |
|---------------------------------|-------------------|---|
| Nitrogen levels (kg/ha) | | |
| 0 | 75.8 | 87.6 |
| 40 | 82.1 | 96.7 |
| 60 | 85.1 | 101.5 |
| 80 | 88.9 | 107.4 |
| LSD (P=0.05) | 1.5 | 0.11 |
| Rice straw incorporation | | |
| Control | 80.5 | 92.1 |
| Straw incorporation (10 t/ha) | 85.4 | 98.1 |
| LSD (P=0.05) | 2.4 | 0.3 |
| Interaction | 1.8 | 0.2 |

Table.2 Effect of different nitrogen level and rice straw incorporation on yield attributes of barley

| Treatment | No. of effective tillers/m ² | Ear length (cm) | No. of grains/ear | 1000-grain weight (g) |
|---------------------------------|---|-----------------|-------------------|-----------------------|
| Nitrogen levels (kg/ha) | | | | |
| 0 | 233.8 | 16.2 | 49.7 | 48.1 |
| 40 | 252.0 | 16.9 | 55.2 | 49.3 |
| 60 | 264.1 | 17.5 | 58.4 | 49.7 |
| 80 | 275.1 | 17.9 | 59.8 | 50.4 |
| LSD (P=0.05) | 3.2 | 0.4 | 2.1 | 0.6 |
| Rice straw incorporation | | | | |
| Control | 248.7 | 16.7 | 53.6 | 48.0 |
| Straw incorporation (10 t/ha) | 263.8 | 18.0 | 57.9 | 50.8 |
| LSD (P=0.05) | 2.4 | 0.3 | 1.6 | 0.6 |
| Interaction | 2.8 | NS | NS | NS |

Table.3 Effect of different nitrogen level and rice straw incorporation on productivity of barley

| Treatment | Grain yield (q/ha) | Straw yield (q/ha) | Biological yield (q/ha) | Harvesting index (%) |
|---------------------------------|--------------------|--------------------|-------------------------|----------------------|
| Nitrogen levels (kg/ha) | | | | |
| 0 | 31.9 | 68.0 | 99.6 | 31.9 |
| 40 | 36.5 | 72.4 | 108.9 | 33.5 |
| 60 | 39.0 | 74.4 | 113.4 | 34.4 |
| 80 | 40.7 | 75.6 | 116.3 | 35.0 |
| CD (P=0.05) | 0.9 | 1.3 | 2.9 | 0.4 |
| Rice straw incorporation | | | | |
| Control | 35.7 | 71.5 | 107.3 | 33.2 |
| Straw incorporation (10 t/ha) | 38.3 | 73.7 | 112.0 | 34.1 |
| LSD (P=0.05) | 1.2 | 1.5 | 3.6 | 0.3 |
| Interaction | 0.9 | 1.12 | 3.10 | NS |

The highest straw yield was obtained in 80 kg N/ha treatment than other nitrogen levels i.e. 0, 40 and 60 kg/ha. Rice straw incorporation (10 tonnes/ha) recorded significantly higher straw yield than control. Nitrogen applied @80 kg/ha with 10 tonnes/ha rice straw incorporation resulted in significantly higher straw yield than other treatment combinations. The variation in the above mentioned growth parameters have also been reported by many research workers (Chakrawartha *et al.*, 2006; Shafi *et al.*, 2011; Jena *et al.*, 2014).

The maximum biological yield was obtained at 80 kg N/ha than other nitrogen levels. Rice straw incorporation (10 tonnes/ha) obtained significantly higher biological yield than other control. The higher grain yield obtained with more nitrogen application might be attributed to better growth as evident from significantly higher growth attributes i.e. plant height, leaf area index, dry matter accumulation, number of grains per ear, ear length and 1000-grain weight. Rice straw incorporation with 80 kg N/ha recorded significantly higher biological yield than other treatment combinations. The variation in the above mentioned growth

parameters have also been reported by many research workers Singh and Singh (2005), Shafi *et al.*, (2011) and Jena *et al.*, (2014). The highest harvest index was found in N @ 80 kg/ha than other nitrogen levels. The different rice straw incorporation had significant effect on Harvest index. Rice straw incorporation recorded significantly higher harvest index than control.

In conclusion, application of 80 kg N/ha gave the maximum grain yield as compared to other N treatments. 60 kg N/ha gave at par the 80 kg/ha. Incorporation of 10 tonnes/ha rice straw resulted in increased the grain yield of barley. Application of 80 kg N/ha and 10 tonnes/ha rice straw incorporation in produced maximum grain yield of barley.

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