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Effect of nitrogen and moisture conservation practices on growth and yield of barley (*Hordeum vulgare* L.) under rainfed condition

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Abstract

A field experiment was carried out at the Agricultural Research Farm, R.B.S. College, Bichpuri, Agra Uttar Pradesh during rabi season to study the effect of nitrogen and moisture conservation practices on growth and yield of barley crop under rainfed condition. The experiment was laid out in randomized block design with three replications. The results revealed that the plant height, plant population, ear length, No. of grain ear^{-1}, test weight, grain yield and straw yield increased significantly with the application of @ 100 kg ha^{-1} N and 5t ha^{-1} paddy straw, over their respective controls. Application of @ 100 kg ha^{-1} N gave 28.9, 15.7, 15.7, 32.9, 25, 24.3, 62.4 and 59.3 per cent higher plant height, plant population, ear length, No. of grain ear^{-1}, test weight, grain yield and straw yield over control, respectively. The respective increase of plant height, plant population, ear length, No. of grain ear^{-1}, test weight, grain yield and straw yield with the application of paddy straw @ 5.0 t ha^{-1} was 27.4, 12.4, 16.3, 24.3, 18.8, 19.8, 36.5 and 32.4 percent respectively compared to dust mulch during the pooled data of the two years.

Keywords: Nitrogen, paddy straw, yield attribute, yield, barley

Introduction

Barley is an important *Rabi* cereal crop in northern plains of India comprising the states of Uttar Pradesh, Haryana, Rajasthan, Punjab, Madhya Pradesh and Uttaranchal. Its greatest concentration in the states of Uttar Pradesh, Rajasthan and Bihar which account for approximately 52, 18 and 11 percent of the total area, respectively. The barley is grown around the year in the world and highest yield is obtained in Europe. In India barley crop is grown over an area of 0.690 m ha with a production of 1.63 mt and productivity of 25.1 q ha^{-1} (Anonymous, 2018). Nitrogen is an integral component of many compounds, including chlorophyll and enzymes, essential for plant growth processes. It is an essential component of amino acids and related proteins, which are critical not only as building blocks for plants tissue but also in the cell nuclei and protoplasm in which hereditary control is vested. Nitrogen is essential for carbohydrate use within plant and stimulates root and shoot growth and development as well as the uptake of other nutrients. Mulching is one of the important agronomic practices in conserving the soil moisture and modifying the soil physical environment. Mulching not only conserving the soil by preventing evaporation but also control weed, moderate soil temperature, reduce runoff and increase infiltration. The use of different mulching materials is an efficient way to reduce the exchange of water vapor between the soil surface and the atmosphere. Consequently, the evaporation of water

from a mulched soil decreases than a bare soil, and more water is available for beneficial crop transpiration (Sarkar and Singh, 2007).

Materials and Methods

The field experimental was conducted during rabi season at R.B.S. Collage Research farm Bichpuri, Agra (U.P.). The soil was sandy loam in texture having pH 8.34, EC 0.25 dSm^{-1}, organic carbon 4.3 g kg^{-1}, available N 202.32 kg ha^{-1}, P 12.83 kg ha^{-1} and K 218.62 kg ha^{-1} The experiment was laid out in randomized block design with four levels of nitrogen (N0 – Control, N1 - 50 % (RDF 50 kg ha^{-1}), N2 - 75 % (RDF 75 kg ha^{-1}), N3 - 100 % (RDF 100 kg ha^{-1})), three levels of mulch (M1- Dust mulch, M2 - Paddy straw mulch 3t ha^{-1}, M3 - Paddy straw mulch 5t ha^{-1}) with three replications. Nitrogen and paddy straw were applied according to treatments. The recommended dose of phosphorus and potash were supplied through single super phosphate and muriate of potash, respectively at the time of sowing. Barley was sown in last week of November in both the years. Other agronomic management practices were followed as per standard recommendation. The crop was harvested at the maturity stage. The data were statistically analysed using standard procedures of ANOVA at 5% level of significance.

Results and Discussion

Plant height

Among the four nitrogen levels, application of N @ 100 kg ha^{-1} recorded significantly higher plant height of barley crop (94.8, 96.6, 95.7 cm) followed by N applied @ 75 kg ha^{-1} (85.3, 87.1, 86.2 cm) and @ 50 kg ha^{-1} (79.0, 81.7, 80.4 cm) compared to control (73.3, 75.2, 74.3 cm) during both the years of experimentation and pooled analysis. These findings are consistent with reported by Ali et al. (2016) and Singh and Dhillon (2022). Plant height of barley crop (92.6, 95.9, 94.2 cm) was observed to be significantly higher with the application of paddy straw @ 5 t ha^{-1} followed by 3 t ha^{-1} (83.4, 85.0, 84.2 cm) compared to control (73.4, 74.6, 74.0 cm) at both the years of experimentation and pooled analysis. These findings are consistent with reported by Parashar et al. (2022) and Tuppad et al. (2023).

Plant population at maturity stage

Among the four nitrogen levels, application of N @ 100 kg ha^{-1} recorded significantly plant population at maturity stage height of barley crop (374.0, 387.8, 380.9 m^{-2}) followed by N applied @ 75 kg ha^{-1} (341.6, 352.3, 346.9 m^{-2}) and @ 50 kg ha^{-1} (341.6, 352.3, 346.9 m^{-2}) compared to control (324.5, 333.7, 329.1 m^{-2}) during both the years of experimentation and pooled analysis. Our results align with those of Ali et al. (2016) and Singh and Dhillon (2022). The plant population at maturity stage of barley crop (366.6, 380.9, 373.8 m^{-2}) was observed to be significantly higher with the application of paddy straw @ 5 t ha^{-1} followed by 3 t ha^{-1} (349.1, 361.9, 355.5 m^{-2}) compared to control (328.7, 336.3, 332.5 m^{-2}) at both the years of experimentation and pooled analysis. Our results align with those of Mishra *et al.* (2001) and Rundla & Bairwa (2018).

Ear length

Among the four nitrogen levels, application of N @ 100 kg ha^{-1} recorded significantly higher ear length of barley crop (8.82, 9.00, 8.91cm) followed by N applied @ 75 kg ha^{-1} (8.42, 8.61, 8.52 cm) and @ 50 kg ha^{-1} (7.95, 8.09, 8.02 cm) compared to control (7.31, 7.43, 7.37 cm) during both the years of experimentation and pooled analysis. Earlier reported Sadeghi and Bahrani (2009), Singh and Dhillon (2022) and Sahu et al. (2024). The ear length of barley crop (8.78, 8.98, 8.88 cm) was observed to be significantly higher with the application of paddy straw @ 5 t ha^{-1} followed by 3 t ha^{-1} (8.04, 8.15, 8.10 cm) compared to control (7.55, 7.72, 7.64 cm) at both the years of experimentation and pooled analysis. These finding are in favor of Mishra *et al.* (2001) and Rundla & Bairwa (2018).

No. of grain ear^{-1}

Among the four nitrogen levels, application of N @ 100 kg ha^{-1} recorded significantly higher no. of grain ear^{-1} of barley crop (48.7, 50.2, 49.4) followed by N applied @ 75 kg ha^{-1} (44.9, 46.2, 45.6) and @ 50 kg ha^{-1} (42.0, 43.2, 42.6) compared to control (39.0, 40.1, 39.6) during both the years of experimentation and pooled analysis. These results are in opinion of Sadeghi and Bahrani, (2009) and

Table 1: Effect of nitrogen and moisture conservation practices on plant height, plant population at maturity stage, ear length, no. of grain, test weight, grain yield and straw yield of barley crop during the pooled data of the two years

Treatments	Plant height (cm)	Plant population at maturity stage (m^{-2})	Ear length (cm)	No. of grain(ear^{-1})	Test weight (gm)	Grain yield(q ha^{-1})	Straw yield (q ha^{-1})
Nitrogen (kg ha^{-1})							
N_0	74.3	329.1	7.37	39.6	39.0	28.6	48.9
N_1	80.4	346.9	8.02	42.6	42.1	33.7	57.2
N_2	86.2	358.9	8.52	45.6	44.4	39.7	67.0
N_3	95.7	380.9	8.91	49.4	48.5	46.4	77.9
SEm±	2.23	7.25	0.12	1.03	0.95	0.96	1.30
CD @ 5%	4.62	14.99	0.25	2.14	1.96	2.00	2.69
Mulching (t ha^{-1})							
M_0	74.0	332.5	7.64	40.5	39.8	31.6	54.3
M_1	84.2	355.5	8.10	44.3	42.9	36.7	62.1
M_2	94.2	373.8	8.88	48.1	47.7	43.1	71.9
SEm±	1.93	6.28	0.11	0.89	0.82	0.84	1.13
CD at 5%	4.00	12.99	0.22	1.85	1.70	1.73	2.33

Al-Menaie et al. (2024). The no. of grain ear^{-1} of barley crop (47.4, 48.8, 48.1) was observed to be significantly higher with the application of paddy straw @ 5 t ha^{-1} followed by 3 t ha^{-1} (43.7, 45.0, 44.3) compared to control (39.8, 41.1, 40.5) at both the years of experimentation and pooled analysis. These results are opinion of Mishra *et al.* (2001) and Parashar et al. (2022).

Test weight

Among the four nitrogen levels, application of N @ 100 kg ha^{-1} recorded significantly higher test weight of barley crop (47.9, 49.0, 48.5 gm) followed by N applied @ 75 kg ha^{-1} (43.6, 45.1, 44.4 gm) and @ 50 kg ha^{-1} (41.7, 42.5, 42.1 gm) compared to control (38.7, 39.3, 39.0 gm) during both the years of experimentation and pooled analysis. These results are in opinion of Sadeghi and Bahrani (2009) and Al-Menaie et al. (2024). The test weight of barley crop (47.2, 48.2, 47.7 gm) was observed to be significantly higher with the application of paddy straw @ 5 t ha^{-1} followed by 3 t ha^{-1} (42.3, 43.5, 42.9 gm) compared to control (39.4, 40.2, 39.8 gm) at both the years of experimentation and pooled analysis. Our findings are in those of Mishra *et al.* (2001) and Parashar et al. (2022)

Grain yield

Among the four nitrogen levels, application of N @ 100 kg ha^{-1} recorded significantly higher grain yield of barley crop (45.3, 47.6, 46.4 q ha^{-1}) followed by N applied @ 75 kg ha^{-1} (38.8, 40.7, 39.7 q ha^{-1}) and @ 50 kg ha^{-1} (32.8, 34.6, 33.7 q ha^{-1}) compared to control (27.9, 29.3, 28.6 q ha^{-1}) during both the years of experimentation and pooled analysis. These results were obtained by Lal et al. (2012), Sharma *et al.* (2018) and Singh and Dhillon (2022). The grain yield of barley crop (41.9, 44.2, 43.1 q ha^{-1}) was observed to be significantly higher with the application of paddy straw @ 5 t ha^{-1} followed by 3 t ha^{-1} (35.6, 37.8, 36.7 q ha^{-1}) compared to control (31.0, 32.1, 31.6 q ha^{-1}) at both the years of experimentation and pooled analysis. These results were obtained by Kumar (2021) and Parashar et al. (2022).

Straw yield

Among the four nitrogen levels, application of N @ 100 kg ha^{-1} recorded significantly higher straw yield of barley crop (76.3, 79.6, 77.9 q ha^{-1}) followed by N applied @ 75 kg ha^{-1} (65.6, 68.4, 67.0 q ha^{-1}) and @ 50 kg ha^{-1} (55.9, 58.5, 57.2 q ha^{-1}) compared to control (48.1, 49.7, 48.9 q ha^{-1}) during

both the years of experimentation and pooled analysis. Those results align with those of Lal, et al. (2012), Sharma *et al.* (2018) and Singh and Dhillon (2022). The straw yield of barley crop (70.5, 73.3, 71.9 q ha^{-1}) was observed to be significantly higher with the application of paddy straw @ 5 t ha^{-1} followed by 3 t ha^{-1} (60.6, 63.6, 62.1 q ha^{-1}) compared to control (53.4, 55.3, 54.3 q ha^{-1}) at both the years of experimentation and pooled analysis. Similar results were obtained by Kumar (2021) and Parashar et al. (2022).

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