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EFFECT OF LEVELS OF IRRIGATION AND NITROGEN ON AGRO-PHYSIOLOGICAL YIELD AND ECONOMICS OF BARLEY (*Hordeum vulgare* L.).

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Abstract: A field experiment was conducted during *Rabi* season 2021-22 at Shradhdhey Bhagwati Singh Agriculture Research Farm Hajipur, Chandra Bhanu Gupta Krishi Mahavidyalaya**,** B.K.T., Lucknow, U.P. to study "Effect of levels of irrigation and nitrogen on yield and economic of barley". The nine treatments comprised of three levels of irrigation *viz.*, I_0=no irrigation, I_1= one irrigation at 35 DAS, I_2=two irrigation at 35&75 DAS and three nitrogen levels *viz*., N_0=control, N_1=50 kg /ha, N_2=100 kg/ha were tested in with three replication split plot design. Results revealed that crop received two irrigation at 35 & 75 DAS recorded significantly highest growth parameters *viz*., plant height, dry matter accumulation, and leaf area index as compared to one irrigation applied at 35 DAS and no irrigation treatment. This treatment also gave significantly highest value of yield attributes, grain yield and straw yield over one irrigation at 35 DAS and no irrigation. Application of nitrogen @ 100 kg /ha resulted significantly highest values of growth, yield attributes and yields over 50 kg N/ha and no nitrogen. Crop received two irrigation at 35 & 75 DAS along with 100 kg N/ha gave the highest net income (Rs 30539.7 /ha) and benefit: cost ratio (1.07). Crop received two irrigations gave the highest consumptive use of water over one irrigation and no irrigation treatment water use efficiency was reduced with no. of irrigation and being highest with crop without irrigation. Crop received two irrigations gave the highest consumptive use of water over one irrigation and no irrigation treatment water use efficiency was reduced with number of irrigation and being highest with crop without irrigation.
Keywords: Irrigation, nitrogen, moisture extraction pattern, yield, barley.

Introduction

Barley (*Hordeum vulgare* L.) is occupying fourth position after wheat in total cereal production with 7% share of global cereal production **(Pal *et al*., 2012) [1].** Under adverse environment conditions, barley is more productive than other cereals **(Alazmani, 2014) [2]**. Barley is also regard as poor man's crop because of its low input demands and its more adaptability to adverse conditions such as droughts, salinity and alkalinity **(FAO 2002) [3].** In India, barley crop is grown on an area of about 0.757 m ha with production of 1.47 million tones with average productivity of 19.41 q/ha in 2017. In Uttar Pradesh, Barley occupied 2.869 lakh ha area, 6.384 lakh tones production and 22.25 q/ha productivity **(FAO, 2017) [4].**

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Water has a great role in availability of plant nutrients and its absorption and translocation in different parts of plant. The adverse effect of water deficit, is reducing leaf number and leaf area per plant, dry matter production and finally yield **(Wang *et al.*, 2006) [5].** Many researchers found that water deficit reduced the plant height**,** the leaf area, shoot growth and yield of crop **(Payero *et al.*, 2006) [6].**

Among the essential plant nutrients, nitrogen plays an important role in augmenting agriculture production and its deficiency in soil limits crop production. The most important role of nitrogen in plant is its presence in the structure of protein, which is the most important building substances from which the living material or protoplasm of every cell is made **(Blumnanthal *et al.*, 2008) [7].**

Nitrogen is very limiting nutrient for crop production in the most of the world's agricultural areas and its application not only upgrade biomass production but yield components and yield **(Amanullah *et al.*, 2008) [8].** Barley crop responds significantly to varying nitrogen levels and shows symptom of deficiency and thus, highly responsive to nitrogen fertilization. Therefore, this study was undertaken to find out the effect of irrigation and nitrogen on growth, yield attributes, yield and economics of barley crop in central plain zone of Uttar Pradesh.

Materials and methods

The field experiment was conducted during *Rabi* season of 2021-22 at Shradhay Bhagwati Singh Agriculture Research Farm, Hajipur, Chandra Bhanu Gupta Krishi Snatakottar Mahavidyalaya, B.K.T., Lucknow, (U.P.). The mean maximum temperature is 41.8 ^{0}C and minimum temperature 4.2 ^{0}C. The mean annual rainfall is about 7.92mm. The soil of experimental site was silty-loam in texture, with pH 8.1, available nitrogen 271 kg/ha, available P 28 kg/ha, available K 263 kg/ha and organic carbon 0.62 per cent. The experiment comprised of 3 irrigation levels, I_0 - No irrigation, I_1 - One irrigation at 35DAS, I_2 - Two irrigation at 35 & 75 DAS and 3 nitrogen levels N_0 - control, N_1 – 50 and N_2 - 100 kg/ha were tested in split plot design with three replication. Irrigation levels was kept in main plot and Nitrogen level in sub plot. A common dose of phosphorus and potassium @ 30 kg/ha and 25 kg/ha respectively was applied to all plots at sowing. The required quantity of nitrogen as per treatment was applied in 3 splits i.e. half dose basal, ¼ dose at 35 DAS and ¼ at 45 DAS through urea. The barley variety Jyoti was sown on 26/11/21 at 20 cm apart rows. The data on growth attributes were recorded on already tagged plant in each plots yield attributes were recorded on five spikes selected randomly from each plot at the harvest of crop.

The crop received a total rainfall during the crop period was 5.6 mm.

Result and Discussion

Table 1 Effect of different levels of irrigation and nitrogen growth and yield attributes.

Treatment	Plant height (cm)	Dry matter Accumulation (g/m^2)	Leaf aera index (LAI)	Length of spike (cm)	No. of grain/spike	Grain weight/spike (g)	Test weight (g)
Levels of irrigation							
I_0	84.57	346.42	3.59	7.07	39.66	2.84	44.58
I_1	88.42	540.55	4.10	8.21	48.22	3.10	46.17
I_2	92.42	569.38	5.10	9.28	51.00	3.16	48.50
SEm±	0.16	0.81	0.001	0.04	0.23	0.005	0.090
CD(P=0.05)	0.64	3.28	0.004	0.16	0.93	0.004	0.361
Levels of nitrogen (kg/ha)							
N_0	79.72	422.03	3.65	7.36	39.66	2.88	43.10
N_1	89.50	480.53	4.37	8.23	48.33	2.97	45.36
N_2	94.65	542.53	4.77	8.97	50.66	3.24	46.72
SEm±	0.16	0.91	0.001	0.03	0.17	0.005	0.110
CD(P=0.05)	0.50	2.85	0.002	0.10	0.52	0.020	0.343

I_0 – Rainfed, I_1 – One irrigation at 35 DAS, I_2-Two irrigation at 35 and 75 DAS, N_0-control, N_1 - 50 kg /ha, N_2-100 kg/ ha

The data presents in table 1 reveled that crop received two irrigation (I_2) recorded significantly the maximum growth parameters like plant height dry matter accumulation, effective tillers and leaf area index as compared to rest of irrigation levels. Crop without irrigation observed the lowest values of growth parameters. The higher growth parameters with 2 irrigation treatment might be due to increased availability of nutrients and water which improved the metabolic activities and synthesis of more photosynthetes and higher meristemic tissues increased the cell division, cell elongation and cell enlargement thus, resulted higher growth parameters like plant height, no. of tillers, dry matter accumulation of experimental crop. Contrary to this, the availability of plant nutrients was hampered due to moisture stress under no irrigation affected the photosynthesis and formation of photosynthetes and reduced the metabolic activities of plant due to poor availability of

nutrients and water caused reduction in all growth parameters. Similar higher growth parameters under higher moisture supply in barley crop was reported by **Shirazi *et al.*, 2014 [9].**

Increasing levels of nitrogen from 0 to 100 kg/ha increased the growth parameters (table-1) significantly. Application of 100 kg N/ha recorded significantly the maximum growth parameters over rest dose of nitrogen. The might be due to higher availability of plant nutrients and its uptake with higher levels of nitrogen enhanced the metabolic activity and accelerated meristematic tissues which in turn improved cell division and cell elongation resulted in higher growth parameters like plant height, leaf area index, dry matter accumulation and no. of tillers. Similar higher growth of barley crop under application of nitrogen was reported by **Dubey *et al.*, 2018 [10].**

Yield attributes were improved significantly with increasing supply of irrigation water and being maximum length of spike (9.28 cm), no. of grains/spike (51.00) and test weight (48.50 g) with 2 irrigations significantly over rest of the irrigation levels. Crop under without irrigation resulted significantly the lowest values of all yield attributes like, Length of spike (7.07cm), no. of grains/spike (39.66) and 1000-grain weight (44.58g). Significant improvement in yield attributes with two irrigation treatment over one irrigation and no irrigation treatment might be due to higher growth parameters like higher dry matter accumulation, higher plant height owing to higher availability of nutrients and synthesis of more photosynthetes which were translocated to sink resulted in significant improvement in all yield attributes like spike length, no of grains /spike and test weight. Similar higher values of yield attributes under frequent supply of irrigation was reported by **Kaur and Singh, (2011) [11], Turk *et al.*, (2011) [12].** However, moisture stress in no irrigation treatment caused poor availability of nutrients and its translocation to crop and hence, poor synthesis of photosynthetes resulted significant reduction in plant growth and yield attributes. Similar, lower growth and yield attributes under moisture stress was also reported by **Zaiden (2007) [13].**

Application of nitrogen @ 100 kg/ha improved the all yield attributes significantly as compared to its lower dose of nitrogen.

Significant improvement in all yield attributes with increasing dose of nitrogen was mainly attributed to treatment supply of nitrogen and its uptake to crop which had the favourable effect on growth and synthesis of higher photosynthetes and its translocation to sink. Similar

higher yield attributes of barley crop with higher nitrogen application was recorded by **Paramjit *et al.*, 2001 [14].**

Crop received two irrigations at 35 and 75 DAS produced significantly the highest grain yield (25.97q/ha), straw yield (34.21 q/ha) over one irrigation at 35 DAS and without irrigation treatment. The percent increase in grain yield due to two irrigation treatment was recorded to be (7.14%) and (27.16%) over one irrigation and no irrigation treatment, respectively.

Significantly highest grain yield (26.24 q/ha) and straw yield (35.46 q/ha) was obtained with 100 kg N/ha as compared to 50 kg N/ ha and control.

Table 2: Effect of different levels of irrigation and nitrogen moisture studies and yield.

Treatment	**Moist. Extraction. Pattern (%)**			**C.U. (mm.)**	**W.U.E.**	**Yield (q/h)**		**Net income**	**B:C ratio**
Levels of irrigation	0-30	30-60	60-90			Grain	Straw		
I_0	37.52	28.09	17.10	91.00	22.28	20.28	25.69	12273.3	0.45
I_1	44.14	27.40	15.07	142.00	16.95	24.07	31.34	24173.0	0.89
I_2	45.78	26.50	16.09	215.00	11.99	25.79	34.21	26758.3	0.97
SEm±	-	--	-	-	-	0.04	0.004	-	-
CD(P=0.05)	-	-	-	-	-	0.017	0.016	-	-
Levels of nitrogen (kg/ha)									
N_0	40.10	34.80	17.05	175.00	10.92	18.90	23.51	16388.7	0.64
N_1	43.10	30.27	16.03	185.00	13.45	24.90	32.27	22498.7	0.82
N_2	44.10	30.10	15.90	190.00	13.81	26.40	35.46	24317.3	0.85
SEm±	-	-	-	-	-	-	-	-	-
CD(P=0.05)	-	-	-	-	-	-	-	-	-

I_0 – Rainfed, I_1 – One irrigation at 35 DAS, I_2-Two irrigation at 35 and 75 DAS, N_0-control, N_1 - 50 kg /ha, N_2-100 kg/ ha

It is clear from the data presented in table 2 that moisture extraction pattern (%) was increased with increasing no. of irrigation in 0-30 cm soil depth and being maximum (45.78%) at 0-30 cm soil depth with 2 irrigations followed by one irrigation (44.14%) and no irrigation treatment (37.52%). At 30-60 cm and 60-90 cm soil depth, the moisture extraction was reduced with increasing number of irrigations. Crop without irrigation recorded the maximum moisture extraction (28.09%) at 30 - 60 cm and 17.10 % at 60-90 cm, as compared to 26.50% at 30-60cm and 16.09% at 60-90 cm soil depth with 2 irrigation treatment. The

higher extraction of moisture (%) under no irrigation treatment was because of the facts that crop roots goes deeper in search of water to extract the moisture. However, higher availability of moisture on 0-30cm soil depth under two irrigation treatment resulted higher moisture extraction (%) from upper layer.

Increasing levels of N from 0-100 kg /ha increased the moisture extraction pattern(%) at 0-30 cm soil depth, however, the maximum moisture extraction pattern (44.10%) was recorded with 100kg N/ ha and reduced with decreasing levels of N .Increasing levels of N reduced the moisture extraction pattern (%) in 30-60 cm and 60-90 cm soil depth, however, crop received no nitrogen recorded the maximum moisture extraction (34.80% and 17.05%) at 30-60 cm and 60-90 cm soil depth, respectively as compared to 50 kg N /ha and 100 kg N/ ha, respectively.

The maximum CU was recorded with 2 irrigation (215.00 mm) and lowest being (91.00mm) with no irrigation (Rainfed). On the other hand, water use efficiency (WUE) was reduced with increasing moisture supply. Application of 2 irrigation recorded the lowest WUE (11.99 kg/ha/mm) and maximum being (22.28 kg/ha/mm) with no. irrigation treatment.

The lower WUE with under frequent supply was due to higher CU of water and higher evaporation losses thus resulted lower increase in grain yield and hence 2 irrigations recorded the lower water use efficiency. Contrary to this, WUE was improved with reducing no. of irrigation was because of economise use of water proportionately to applied irrigation water gave higher increase in yield and WUE.

Conclusion

Application of 100 kg N/ha recorded the highest growth, yield attributes and yield significantly over 50 kg N/ha and no nitrogen.

Application of two irrigation along with nitrogen @100kg/ha recorded higher the net income and benefit: cost ratio.

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