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Effect of different irrigation and mulch levels on growth and yield of barley (*Hordeum vulgare* L.)

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Abstract

A field experiment was conducted to assess the improving barley productivity under different irrigation and mulching practices at School of Agricultural Sciences, CPU, Kota (Rajasthan) during *Rabi*, 2023-24. The experiment was laid out in a split plot design with three replications. The experiment consisting of 12 treatments combinations with irrigation levels in main plot *viz.*, one irrigation at active tillering stage (30-35 DAS), two irrigation at active tillering and milking stage and three at active tillering, boot stage (60-65 DAS) and milking stage (80-85 DAS) and four mulching levels in sub plot No mulch, 2 t/ha, 4 t/ha and 6 t/ha. Growth and yield parameters were significantly increased with application of three irrigation at active tillering stage, boot stage (60-65 DAS) and milking stage (80-85 DAS) over one irrigation at active tillering stage (30-35 DAS). The maximum plant height (114.6 cm and 112.1 cm), number of tillers/m^2 (365.32 and 351.34), dry matter accumulation (320.3 and 307.14 g/meter row length) and effective tillers/m^2 (84.2 and 78.9), no. of grains/ear (40.2 and 37.4), test weight (41.37g and 40.27g) highest seed yield (4320 and 4180 kg/ha), straw yield (6530 and 6355 kg/ha) and biological yield (10850 and 10535 kg/ha) fetched net return (₹49972 and ₹ 47910) and benefit cost ratio (1.46 and 1.43) of barley were recorded under application of three at active tillering, boot stage (60-65 DAS) and milking stage (80-85 DAS) and application of 4 t/ha mulch followed by application of two irrigation at active tillering and milking stage and 6 t/ha mulch application over one irrigation at active tillering stage (30-35 DAS) and no mulch.

Key words: Barley, Irrigation, Mulch, Growth, Yield and Economics

Introduction:

Barley (*Hordium vulgare* L.) is one of the first domesticated plant species in the world, belong to family Poaceae. The hulled and awned type barley is believed to be originated from Abyssinia, considering this place as principle centre of origin, whereas, south eastern Asia is the centre of origin for hull-less, six rowed varieties with short or no awn. With a share of 7 per cent of the global cereal production barley is considered fourth largest cereal crop in the world (Pal *et al*., 2012). It has been traditionally considered as poor man's crop because it is one of the most input efficient crops and can be cultivated in adverse climatic conditions like drought, salinity, alkalinity and marginal lands etc. Among the cereals, it ranks fourth with respect to area and production after wheat, rice and maize. Barley grain is also valuable for smothering and cooling effect on the body for easy digestion. Besides these conventional uses, it is an important industrial crop as it is used as raw material for beer, whisky and brewing industries. In India, barley is mainly grown in the northern plains and concentrated in the states of Utter Pradesh, Haryana and Rajasthan. In India, barley was cultivated on 453 thousand ha area with 1371 thousand tons of production at an average productivity of 33.04 q/ha. In India, Rajasthan is the largest state having more than 52% in production and 46 % area followed by Uttar Pradesh. In Rajasthan, barley was cultivated on 408 thousand ha area with 1399.6 thousand tons of production at an average productivity of 29.16 q/ha (IIWBR, 2022-23). In the recent years it has been observed that because of severe drought in drier part of northern plains, there is an acute shortage of green fodder in the months of November to January. Since the common forage crops, Berseem, Oats and Sugarcane require frequent irrigation and cannot be grown under water scarcity condition. Barley can be an option, both for grain as well as fodder. However its industrial demand as raw material has also increased. Malt extracted from barley grain is used as a source of fermentable material for beer and certain distilled beverages like whisky, brandy etc. As a food barley is mixed with gram or wheat and then ground to flour for preparing better quality „*chapatis*‟. Roasted grains of barley after grinding can be used as „*Sattu*‟. Apart from this barley is used as a component of various health foods. Barley grain contains approximately 12.5 per cent moisture, 11.5 per cent albuminoids, 74 per cent carbohydrates, 1.3 per cent fats, 3.9 per cent crude fibre and 1.5 per cent ash (Singh *et al.*, 2018). The barley water helps in better urine filtration, increased kidney efficiency due to its high enzymatic constitution. Regular consumption of barley lowers the plasma blood cholesterol content because of its high beta glucan content and thus

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helps in prevention of high blood pressure and related heart problems (Truswell, 2002). The other important property of barley is its potential use in diabetic problems. The soluble fiber from barley improves glucose utilization and insulin sensitivity in acute and chronic studies of normal-weight and overweight adults, and individuals with the metabolic syndrome (Rimm *et al.* 2002).

Water is the most crucial input in agriculture as major share of water resources is used in agriculture and food requirements are increasing while water resources are shrinking. The global water crisis has drawn worldwide attention to the urgency of achieving a more efficient use of water resources particularly, to increase crop production and national food security. Since agriculture uses infiltrated water that forms soil moisture in the root-zone of the crops and subsequently loss through evaporation and transpiration (ET), water conservation is the most important for sustaining food and livelihood security of people practicing agriculture. In this context mulching is one of the important agronomic practices in conserving the soil moisture and modifying the soil physical environment.

Mulching is a common practice to cover soil surface and it not only conserves moisture but also moderates temperature besides effectively controlling the weeds. It creates congenial conditions for the growth and ameliorates various environmental stresses (Macilwain, 2004). It exerts decisive effects on earliness, yield and quality of the crop. Straw mulching has a major effect on soil water and thermal regimes. The mulch probably acts as an insulator, resulting in smaller fluctuations in soil temperature in mulched treatments as compared to without mulch. Mulches can be more effective under extreme weather conditions as compared to normal conditions. Mulching is a common practice recommended for tropical small farming holder, due to its ability to conserve soil and moisture and also suppress weeds (Sah 2015). Mulching increased soil moisture content, improved the soil structure and decreased the weed growth, and thereby enhanced yield in crops (Govindappa 2014). The yield and water productivity gains were due to greater root proliferation which was the result of moderation of soil temperature and water conservation with straw mulching (Arora *et al.* 2011).

Material and Methods

A field experiment was conducted at Research farm, School of Agricultural Sciences, CPU, Kota (Rajasthan) during *Rabi* season 2023-24. The details of experimental techniques, materials used and methods adopted for treatment evaluation during the course of investigation are described in this chapter.The soil of the experimental field was sand (22.6%

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silt, 37.1% and 39.9% clay) in texture clay loam (vertisols), was alkaline in reaction(pH 7.8), medium in organic carbon (0.56%), medium in available nitrogen (314 kg/ha), phosphorus (22.1 kg/ha) but higher in available potassium (298 kg/ha).

The experiment was laid out in a split plot design with three replications. The experiment consisting of 12 treatments combinations with irrigation levels in main plot *viz.*, one irrigation at active tillering stage (30-35 DAS), two irrigation at active tillering and milking stage and three at active tillering, boot stage (60-65 DAS) and milking stage (80-85 DAS) and four mulching levels in sub plot No mulch, 2 t/ha, 4 t/ha and 6 t/ha. Barley is sown at 20 cm as inter row spacing and 10 cm is followed as intra row spacing using 100 kg/ha seed rate. Seeding was done by seed drill in the second week of November and reaped during the last week of March. At the time of harvest, information on growth and yield attributes such as plant height, no. of tillers/meter row length, dry matter accumulation/meter row length, tiller/m^2, seeds/ear, test weight, seed yield, straw yield and biological yield, net return, B:C ratio of barley. The data collected on different parameters was statistically analyzed using the analysis of variance approach, and the significant differences were assessed at 5% level of significance.

Results and discussion

Growth and yield attributes

Effect of irrigation levels

The results showed that irrigation levels had significant influence on growth and yield attributes (table 1). Plant height at harvest (114.6 cm), no. of tillers/m^2 (365.32), Dry matter accumulation/meter row length (320.32 g), number of effective tillers/m^2 (84.2), number of grain/ear (40.2) and test weight (41.37 g) were recorded under the application of three irrigation at active tillering, boot stage (60-65 DAS) and milking stage (80-85 DAS) followed by two irrigation at active tillering and minimum recorded under one irrigation at active tillering stage (30-35 DAS), respectively. This might due to all growth attributing parameters of experimental crop of barley were influenced significantly due to irrigation levels as supported by Singh *et al.* (2022). Increased effective tillers under more irrigations *i.e.* up to three may be attributed to the fact that the loamy sand soil had limited water holding capacity and increased moisture content in the soil might have resulted in better nutrient use efficiency thereby leading to profuse plant growth. Similar results have been reported by Singh *et al.*

(2021). The reason is obvious that adequate supply of water might have kept all the nutrient ions in proper available form. Similar results have been reported by Jan *et al*. (2001).

Effect of mulching levels

The results showed (table 1) that mulching levels had significant influence on growth and yield attributes (table 1). Plant height at harvest (112.1 cm), no. of tillers/m^2 (351.34), Dry matter accumulation/meter row length (307.14 g), number of effective tillers/m^2 (78.9), number of grain/ear (37.4) and test weight (40.27 g) were recorded significantly maximum under the application of 4 t/ha mulch which was statistically at par with 6 t/ha mulch over no mulch and 2 t/ha mulch, respectively. This might due to all growth attributing parameters of experimental crop of barley were influenced significantly due to mulching has double actions; controlling weeds and providing soil cover, both of which reduce water loss through decreased transpiration and evaporation and increased availability of soil moisture contents improves plant height (Khurshid *et al.*, 2006 and Ahmed *et al.*, 2007). dry matter accumulation under mulching in combination with irrigation can be explained in light of role of soil water in increasing nutrient availability and its transport for utilization in cell growth and its differentiation in production of tillers, leaves and therefore, dry matter accumulation (reported by Kar *et al.* 2007).

Yield and economics

Effect of irrigation levels

Data presented in Table 2 concluded that among the irrigation levels significantly increased seed, straw and biological yield was obtained significantly higher seed, straw and biological yield from application of three irrigation (4320, 6530 and 10850 kg/ha) at active tillering, boot stage (60-65 DAS) and milking stage (80-85 DAS) which was statistically at par with two irrigation at active tillering at active tillering and milking stage and minimum over one irrigation (3620, 5525 and 9145 kg/ha) at active tillering stage (30-35 DAS). Application of three irrigation increased seed, straw and biological yield 19.33, 18.19 and 18.64 per cent as compared to one irrigation at active tillering stage (30-35 DAS). However, different irrigation levels did not significant influence the harvest index. This might due to source-sink relationship (sink components - test weight and source components – dry matter accumulation). An optimally green crop, accumulate more dry matter and partitions large proportion of it to seed. Dry matter accumulation and its partition to seed yield is a function of crop growth. As seed yield is primarily a function of cumulative effect of yield determining characters, significantly higher values of these characters might be ascribed as the most probable reason of getting higher seed yield of barley. The biological yield is a function of grain and straw yields, thus significant increase in biological yield with the three irrigation increased seed and straw yield. The effect of irrigation levels on grain yield of barley was significant. Similar results have been reported by Jan *et al*. (2001). The reason is obvious that adequate supply of water might have kept all the nutrient ions in proper available form. Similar results have been reported by Singh *et al.* (2021). The economics of treatments was affected with numbers of irrigations levels and presented in Table 2. The maximum net return (₹ 49972/ha) were calculated under the treatment of three irrigation) at active tillering, boot stage (60-65 DAS) and milking stage (80-85 DAS). The data on B: C ratio revealed that irrigation levels at three irrigation at active tillering, boot stage (60-65 DAS) and milking stage (80-85 DAS) has been noticed more remunerative in terms of benefits of Rs 1.46 by investing ₹ 1.00 compared to one irrigation at active tillering stage (30-35 DAS) similarly reported by Pandey *et al.* (2017) and Singh *et al.* (2022).

Effect of mulching levels

The yield of barley presented in Table 2 concluded that among the mulching levels significantly increased seed, straw and biological yield, it was obtained significantly higher seed, straw and biological yield from application of 4 t/ha mulch (4180, 6355 and 10535 kg/ha) which was statistically at par with application of 6 t/ha mulch and over no mulch application (3320, 5126 and 8446 kg/ha). Application of 4 t/ha mulch increased seed, straw and biological yield 25.90, 23.97 and 24.73 per cent as compared to no mulch application. However, various mulch levels did not significant influence the harvest index. Mulching might have reduced the fluctuation of soil temperature and increased the soil moisture and resulted in more rapid crop growth and produced more number of tillers. The result was partially similar to the findings of Mishra (1996). These results are in line with those of Khurshid *et al*. (2006), who reported that mulch increases the soil moisture and nutrients availability to plant roots, in turn, leading to higher grain yield Hingonia *et al.* (2016). Economics of different levels of mulch and presented in Table 2. The maximum net return (₹ 47910/ha) were calculated under the treatment of three irrigation). The data on B:C ratio revealed that mulch levels at M_3 (4 t/ha) has been noticed more remunerative in terms of benefits of Rs 1.43 by investing ₹ 1.00 compared to no mulch similarly results finding by Hingonia *et al.* (2016) and Singh *et al.* (2021).

Table 1 Effect of irrigation and mulching levels on growth and yield attributes of barley

Treatments	Plant height (cm)	No. of tiller/m^2	Plant dry weight (g/m row length)	Effective tillers/m^2	No. of seeds/ear	Test weight (g)
Irrigation levels						
One irrigation	105.2	268.17	285.17	63.3	36.8	39.12
Two irrigation	109.8	357.41	303.41	72.8	38.5	40.81
Three irrigation	114.6	365.32	320.32	84.2	40.2	41.37
SEm$\pm$	1.2	4.21	4.21	2.17	0.53	0.21
CD (P=0.05)	3.6	12.63	12.63	6.51	1.6	0.62
Mulching levels						
No mulch	102.4	259.46	282.43	56.2	34.3	38.12
2 t/ha	106.2	336.21	293.26	72.6	35.9	39.43
4 t/ha	112.1	351.34	307.14	78.9	37.4	40.27
6 t/ha	113.8	359.17	311.45	82.8	38.6	40.72
SEm$\pm$	1.3	3.95	3.80	2.13	0.47	0.19
CD (P=0.05)	3.9	10.85	11.40	6.39	1.4	0.56

Table 2 Effect of irrigation and mulching levels on yield and economics of barley

Treatments	Seed yield (kg/ha)	Straw yield (kg/ha)	Biological yield (kg/ha)	Net return (₹/ha)	B:C ratio
Irrigation levels					
One irrigation	3620	5525	9145	40745	1.37
Two irrigation	4007	6095	10102	45999	1.43
Three irrigation	4320	6530	10850	49972	1.46
SEm$\pm$	101.9	143.5	245.4		
CD (P=0.05)	305.7	430.5	736.2		

Mulching levels					
No mulch	3320	5126	8446	36802	1.32
2 t/ha	3785	5770	9555	42758	1.38
4 t/ha	4180	6355	10535	47910	1.43
6 t/ha	4250	6442	10692	48925	1.44
SEm±	99.4	138.9	238.3		
CD (P=0.05)	298.2	416.7	714.9		

Conclusion

On the basis of one year field experimentation, it seems quite logical to indicate that higher production, net return and B: C ratio was observed under the application of three irrigation at active tillering, boot stage (60-65 DAS) and milking stage (80-85 DAS) along with 4 t/ha mulch has been found most effective and profitable in grain, straw and biological yield of barley.

References

1. Ahmad, T.A. and Husein, N.S. (2007). The effect of tillage practices on barley production under rainfed conditions in Jordan. *American-Eurasian Journal of Agricultural and Environmental Science*, **2**(1): 75-79.
2. Arora VK, Singh CB, Sidhu AS, Thind S.S. (2011). Irrigation, tillage and mulching effects on soybean yield and water productivity in relation to soil texture. Agric Water Manag; 98:563-68.
3. Govindappa M, Pallavi CS. (2014) Importance of mulching as a soil and water conservative practice in fruit and vegetable production-review. *Int J Agric Innov Res,* 3(4):1014-1017.
4. Hingonia K, Singh RK, Meena NR, Verma HP, Meena R. P (2016) Effect of mulch and irrigation levels on yield and quality of barley (*Hardeum vulgare* L.). *Journal of Pure and Applied Microbiology;* 10(4):2925-2930.
5. IIWBR (2022). Progress Report, All India coordinated wheat and barley improvement project. Indian Institute of Wheat and Barley Research, Karnal, Haryana **6**: pp-1.1.
6. Jan, M.T., Ali, A., Jan, A. (2001) Influence of sowing methods and mulching on yield & yield components of wheat. *Pakistan Journal of Biological Science* 4: 657- 659.

7. Kar, G., Kumar, A. (2007) Effects of irrigation and straw mulch on water use and tuber yield of potato in eastern India. *Agricultural Water Management* 94:109-116.
8. Khurshid, K., Iqbal, M., Arif, M.S., and Nawaz, A (2006) Effect of tillage and mulch on soil physical properties and growth of maize. *International Journal of Agriculture and Biology* 8: 593-596.
9. Mishra, O.R. (1996) Influence of mulching and anti-transpirants on water consumption, yield and yield contributing characters of different rainfed wheat varieties. *Crop Research* **11**: 1-8.
10. Pal, D., Kumar, S. and Verma, R.P.S. (2012). Pusa Losar (BHS 380) - the first dual-purpose barley variety for northern hills of India. *Indian Journal of Agricultural Sciences,* **82**: 164-165.
11. Pandey N, Kumar S, Raghuvansi N, Singh RA. (2017) Effect of sulphur nutrient and moisture regimes on economics of wheat (*Triticum aestivum* L.) varieties. Journal of Pharmacognosy and Phytochemistry, 6(6):2294-2297.
12. Rimm, E.B., Ascherio, A., Giovannucci, E., Spiegelman, D., Stampfer, M.J. and Willett, W.C. (2002). Whole grain intake and risk of type 2 diabetes: A perspective study in men. *Amarican Journal of Clinical Nutrition,* **76**: 535-540.
13. Sah D, Dubey RK, Singh V, Debnath P, Pandey AK. (2015) Study of weed management practices on growth, root nodulation and yield components of vegetable cowpea (Vigna unguiculata). The Bioscan, 10(1):421-424.
14. Singh, A., Niwas, R., Yadav,A.S., Kumar, J., Maurya, K. S and Patel, D (2022) Effect of irrigation scheduling on growth and yield of late sown wheat (*Triticum aestivum* L.). *The Pharma Innovation Journal,* 11(7): 788-790.
15. Singh, C., Singh, P. and Singh, R. (2018). *Modern Techniques of Raising Field Crops,* Oxford and IBH publishing Co. Pvt. Ltd. New Delhi. 2nd ed. Pg.147.
16. Singh, H., Singh, Sharma, S. K and Bhat, M. A (2021). Performance of wheat under different tillage methods and potassium levels under irrigated and rainfed conditions of Northern-India. *Journal of Crop and Weed.* 17 (1): 99-109.
17. Truswell, A.S. (2002). Cereal grains and coronary heart disease. *Europian Journal of Clinical Nutrition,* **56**: 1-14.