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Priyanka Kumari
M.Sc., Department of Agronomy, Birsa Agricultural University, Ranchi, Jharkhand, India

Md. Parwaiz Alam
Assistant Professor-cum-junior Scientist, Department of Agronomy, Birsa Agricultural University, Ranchi, Jharkhand, India

Md. Naiyar Ali
Junior Scientist-cum-Assistant Professor, Department of Agronomy, Birsa Agricultural University, Ranchi, Jharkhand, India

Satish Kumar Pandey
Ph.D. Scholar, Department of Agronomy, Birsa Agricultural University, Ranchi, Jharkhand, India

Rosy Khatoon
M.Sc., Department of Agronomy, Birsa Agricultural University, Ranchi, Jharkhand, India

Corresponding Author:
Priyanka Kumari
M.Sc., Department of Agronomy, Birsa Agricultural University, Ranchi, Jharkhand, India

Evaluation of various herbicide treatments on growth, yield and economics of barley (*Hordeum vulagre* L.) under the irrigated condition of Jharkhand

Priyanka Kumari, Md. Parwaiz Alam, Md. Naiyar Ali, Satish Kumar Pandey and Rosy Khatoon

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Abstract
A field experiment was conducted during Rabi season of 2023-2024 to study the evaluation of various herbicide treatments on growth, yield and economics of barley (*Hordeum vulagre* L.). The experiment was led out in randomized block design (RBD) and replicated thrice with the variety DWRB137. The treatment consists of (T_1)- Halauxifen- methyl (1.21% EC) + Fluroxypyr (38.9% EC), (T_2)- Metsulfuron methyl (20% WG) + Surfactant (0.2%), (T_3)-Carfentrazone(40% DF), (T_4)- Metsulfuron methyl (20% WG) + Carfentrazone (40% DF)+Surfactant (0.2%), (T_5)-2, 4-D-Sodium Salt (80% WP), (T_6)- 2, 4-D- Sodium Salt (80% WP) + Carfentrazone (40% DF), (T_7)-2, 4-D-Ethyl Ester (38% EC), (T_8)-2, 4-D- Ethyl Ester (38% EC) + Carfentrazone (40% DF), (T_9)- Weedy check, (T_{10})-Weed free. Application of Halauxifen- methyl (1.21% EC) + Fluroxypyr (38.9% EC) recorded significantly highest plant height at maturity (85.81cm). This combination of herbicide also resulted in the highest yield attributes and yield namely number of ear head/m^2 (305/m^2), ear head length (7.35 cm), number of grains per ear head (44.33), test weight of grain (38.03 g) and grain yield (3428.74 kg/ha), straw yield (5328.66 Kg/ha) net return (50039 Rs./ha) with highest B:C ratio (2.94) followed by Metsulfuron methyl (20% WG) + Carfentrazone (40% DF) + Surfactant (0.2%).

Keywords: Barley, plant population, plant height, yield attributes, yield, economics

Introduction
Barley (*Hordeum vulgare* L.) is an ancient cereal crop belonging to the Poaceae (Gramineae) family. It is primarily used as grain for animal fodder, a source of fermentable material for beer and distilled beverages and as an ingredient in various health foods. Barley is a highly nutritious grain rich in vitamin B-complex and protein of superior quality when compared to corn and beans. The composition of barley grain includes 12.5% moisture, 11.5% protein, 1.3% fat, 3.9% minerals and 69.6% carbohydrates.

Globally, barley is cultivated on approximately 70 million hectares with a production of 149.5 million metric tons. In India, during the 2023-24 period, barley covered 0.68 million hectares and produced 1.77 million tons of grain with a productivity rate of 3046 kg per hectare (Anonymous, 2023) [2]. The demand for barley increased significantly after the early 1990s due to economic liberalization. Currently, 25-30% of total barley production is used in the manufacturing of malt extract, which is further processed for brewing, distillation, baby foods, cocoa-malt drinks and medicinal syrups. Barley production in India faces significant challenges due to factors such as high weed infestations and cultivation on poor soils. Grass and broad-leaf weeds can reduce barley yields by as much as 6-79%, depending on weed density and the duration of weed competition (Watson *et al*., 2006) [16].

Weeds are an important constraint in agricultural production systems. Weeds capture a part of the available resources that are essential for plant growth and weeds compete with crop plants for various resources such as water and nutrients, resulting in low crop yields and quality (Kebede *et al*., 2017) [7]. Effective weed management practices are crucial to maintain weed density below the economic threshold level and to increase cropping intensity.

The weed flora associated with barley varies across different agro-ecological zones of India. Broad-leaved weeds such as *Chenopodium album L.*, *Rumex obtusifolius*, *Anagallis arvensis L.* and *Coronopus didymus L.* are common and can cause yield reductions of up to 25% (Bhullar *et al*. (2013) [3]. In India, these broad-leaved weeds are particularly dominant in wheat and barley fields. Other minor weeds, including *Cynodon dactylon L.*, *Avena fatua* and *Digitaria sanguinalis* also affect barley crops. The lack of effective weed control measures and insufficient knowledge of weed management in barley are significant challenges that hinder barley production. Hand-weeding was formerly the most widely used and effective method of weed control, but this practice was abandoned because its practical and economic feasibility is often limited by unfavourable climatic and soil conditions, unavailability of labor during critical period of weeding and also high wages of labor (Pandey *et al*., 2007) [9]. Herbicides like metsulfuron-methyl and carfentrazone-ethyl have proven highly effective in controlling broad-leaf weeds in barley (Zand *et al*., 2010) [18]. These herbicides work through different modes of action, and their rotational use with 2,4-D could help reduce the selection pressure for herbicide-resistant weeds. Taking into consideration the necessity of chemical weed control for stable barley production, the objective of this study was to investigate the effectiveness of post herbicides and herbicide combinations for better production and productivity of barley.

Materials and Methods

A field experiment was conducted at western section of Research Farm of Birsa Agricultural University, Kanke, Ranchi (23º317'N, 85º19'E, 625 m above mean sea-level) during the Rabi seasons of 2023-24. The climate of experiment site is sub-humid with hot summer and cold winter. Mean monthly maximum temperature and pan-evaporation was recorded highest in April whereas, the mean monthly minimum temperature was the lowest in December. An average amount of 210.4 mm rainfall received during cropping period. Initial status of soil (0–15 cm) of experimental field was clay loam (32.2% sand, 30.3% silt and 37.5% clay) in nature, low in organic carbon (4.5 g/kg) and available nitrogen (216 kg N/ha), high in available phosphorus (34.2 kg P/ha), medium in available potassium (158.1 kg K/ ha) and acidic in soil reaction (pH 5.9). The experiment was led out in randomized block design (RBD) and replicated thrice with the variety DWRB137 under the irrigated condition. The treatment consists of (T_1)- Halauxifen-methyl (1.21% EC) + Fluroxypyr (38.9% EC), (T_2)-Metsulfuron methyl (20% WG) + Surfactant (0.2%),(T_3)-Carfentrazone(40% DF), (T_4) -Metsulfuron methyl (20% WG) + Carfentrazone (40% DF)+Surfactant (0.2%), (T_5)-2, 4-D-Sodium Salt (80% WP), (T_6)- 2, 4-D- Sodium Salt (80% WP) + Carfentrazone (40% DF), (T_7)-2, 4-D-Ethyl Ester (38% EC), (T_8)-2, 4-D- Ethyl Ester (38% EC) + Carfentrazone (40% DF), (T_9)- Weedy check, (T_{10})-Weed free. As per treatment, herbicides were applied 35 DAS with the help of knapsack sprayer fitted with a flat-fan nozzle with a spray volume of 500 litres/ha. Barley variety "DWRB137" was seeded directly using 100 kg seed per ha on 24th November 2023 after basal application of fertilizer. Recommended dose of chemical fertilizer 60 kg N + 30 kg P_2O_5+ 20 kg K_2O/ha was applied through urea, di-ammonium phosphate and muriate of potash respectively.

Observation recorded

The growth parameters *viz.* plant height, number of tillers per square meter and dry matter accumulation was recorded at 30,60, 90 DAS and at maturity. The five plants were tagged at random in each plot and the height of the plant was measured at different stages from the base of the plant to the tip of the highest fully developed leaf before heading and up to tip of the ear head after heading. The number of ear head per meter square, length of ear head and number of grains per ear head were recorded at maturity by selecting five ear heads randomly from the tagged plants in each plot. The grain yield and straw yield was recorded at harvest and expressed in kg/ha. Harvest index is the ratio of grain yield and biological yield multiplied by 100 which was calculated by the following formula:

$$\text{Harvest index} = \frac{\text{Grain yield}}{\text{Biological yield (grain + straw)}} \times 100$$

Statistical analysis

The data for different characteristics were analyzed using analysis of variance (ANOVA) as per the method described by Gomez and Gomez (1984). Significance was tested at the 5% probability level. For significant F-values, critical difference (CD) values were calculated to make comparisons among the treatment means.

Results and Discussion

Plant population

The present study indicated that no significant difference was recorded among different treatments for plant population per m^2. Plant Population were recorded at 15 DAS and the maximum plant population (185.11/m^2) was observed in weed free (T_{10}) while weedy check (T_9) showed the minimum plant stands (166.27/m^2) in all treatments. As there was no application of herbicide at 15 DAS that would be the reason for no variation in any treatment. These results confirm the prior observation made by Yadav *et al.* (2022) [17].

Plant height

Plant height gradually increased with each stage of crop development. Data analysis revealed that plant height increased with crop age, but notable increases were only seen between 30, 60 and 90 DAS. There was no significant difference in the plant's height at 30 DAS (Table 1). It was found that several treatments had a significant impact on plant height at 60, 90 DAS and during maturity. The weed-free treatment recorded the tallest plant height. This could be due to the availability of more resources, such as water, sunlight and nutrients, which enabled the plants to grow more efficiently, while weed competition was reduced. On the other hand, the weedy check treatment had the lowest plant height throughout the study. The constant competition for resources between weeds and plants could be a reason for the lowest plant height in the weedy check treatment as it hindered plant growth. The results are in close conformity with the findings of Kaur *et al.* (2018) [6]. Among herbicide treatments plant height was found maximum at 60 DAS (61.20 cm), 90 DAS (84.99 cm) and at maturity (85.81 cm) with the application of Halauxifen- methyl (1.21% EC) + Fluroxypyr (38.9% EC) followed by Metsulfuron methyl (20% WG) + Carfentrazone (40% DF) +Surfactant (0.2%). These results are in accordance with the findings of Kumar *et al.* (2023).

Effect on yield attributes and yield

The highest number of ear heads per square meter, length of ear head, number of grains per ear head and test weight of grain was found in weed free treatment (Table 2). Among herbicide treatments highest number of ear head/m^2 (305/m^2), ear head

length (7.35 cm), number of grains per ear head (44.33) and test weight of grain (38.03 g) was recorded with Halauxifen- methyl (1.21% EC) + Fluroxypyr (38.9% EC) followed by Metsulfuron methyl (20% WG) + Carfentrazone (40% DF) +Surfactant (0.2%). Weedy check showed the lowest values for yield attributes where number of ear head/m^2 (236.67/m^2), ear head length (6.11 cm), number of grains per ear head (29.33) respectively. These results are in concurrence with Al-Khafaji *et al.* (2023) [1]. The 1000 grain weight was not significantly affected by specific weed control methods. The highest test weight was observed in the weed-free treatment. This can be attributed to lower weed density and improved crop growth due to reduced competition between the crop and weeds, which enhanced the availability of nutrients and moisture for the barley crop. These results are in accordance with the findings of Sahu *et al*. (2018) [10] and Pal *et al*. (2016) [8].

A perusal of data presented in (Table 3) revealed that application of Halauxifen- methyl (1.21% EC) + Fluroxypyr (38.9% EC) resulted in the highest grain yield (3428.74 kg/ha), straw yield (5328.66 Kg/ha) and biological yield (8757.80). The better yield and yield attributes in the above treatments might be due to their higher weed control efficiency, higher crop biomass and poor growth of weed. These findings are in confirmation with Singh *et al*. (2017) [11] and Verma *et al.* (2013). The lowest seed yield (2095.01Kg/ha), straw yield (3132.02 Kg/ha) and biological yield (9176.06) were observed with weedy check. Various weed control strategies led to a significant increase in seed yield compared to the weedy control. This improvement is likely due to better weed suppression, reduced weed populations, and the resulting enhancement in the barley crop's access to essential resources like moisture, nutrients, light, and space. With less competition from weeds, the barley was able to utilize these resources more effectively, ultimately boosting seed yield. These results align with those of Meena *et al.* (2021), who observed similar positive effects from weed management practices. Similarly, nitrogen fertilization significantly increased straw yield. This effect can be attributed to nitrogen's direct role in boosting dry matter accumulation during the crop's growth stages, as well as its indirect benefits on both vegetative and reproductive growth. The rise in biological yield, which combines both grain and straw yields, can be traced to the observed increases in both components. These findings are consistent with the research of Verma *et al.* (2018) [14], who reported that nitrogen fertilization enhances both grain and straw production, leading to higher biological yield.

Economics

Weed-free treatment resulted in the highest yields of grain and straw, leading to higher gross returns. However, due to higher labour charges, the net return was estimated to be lower than herbicidal treatments. Among various herbicide treatments, highest gross return (75803 Rs./ha), net return (50039 Rs./ha) and B:C ratio (2.94) was recorded by Halauxifen- methyl (1.21% EC) + Fluroxypyr (38.9% EC) followed by Metsulfuron methyl (20% WG) + Carfentrazone (40% DF) +Surfactant (0.2%). The lowest gross return, net return and B:C ratio was reported from weedy check. Due to better weed control efficiency and enhanced growth, yield attributing character and minimum loss of yield was reported from the plot where post emergence herbicides were applied and that was reflected in higher net return and B:C ratio. These findings agreed with those of Ram *et al.* (2023) and Trivedi *et al.* (2022) [13]. The benefit-cost ratio is the ratio of net returns and cost of cultivation hence, its higher values have been recorded in Halauxifen- methyl (1.21% EC) + Fluroxypyr (38.9% EC). These findings agreed with those of Dheeraj *et al*. (2023) [4]. The minimum gross return, net return and B:C ratio was estimated in weedy check due to the lowest grain and straw yields.

Table 1: Effect of different herbicide treatments on plant population (per m^2) and plant height (cm) at 30, 60, 90 DAS and at maturity in barley

Treatments	Plant population (per m^2)		plant height (cm)		
	15 DAS	30 DAS	60 DAS	90DAS	At Maturity
T_1- Halauxifen- methyl (1.21% EC) + Fluroxypyr (38.9% EC)	181.38	31.44	61.20	84.99	85.81
T_2- Metsulfuron methyl (20% WG) + Surfactant (0.2%)	179.40	28.98	53.70	80.09	81.09
T_3- Carfentrazone(40% DF)	177.46	30.00	52.96	73.82	76.88
T_4- Metsulfuron methyl (20% WG) + Carfentrazone (40% DF) +Surfactant (0.2%)	182.12	33.23	57.94	85.23	85.24
T_5- 2, 4-D-Sodium Salt(80% WP)	174.39	28.33	50.44	77.54	78.44
T_6- 2, 4-D- Sodium Salt (80% WP) + Carfentrazone (40% DF)	182.32	29.66	58.66	81.13	83.61
T_7- 2, 4-D-Ethyl Ester (38% EC)	180.91	29.91	54.62	82.72	80.91
T_8- 2, 4-D- Ethyl Ester (38% EC) + Carfentrazone (40% DF)	179.92	33.11	59.95	83.95	84.12
T_9- Weedy check	166.27	27.93	48.67	71.67	72.53
T_{10}- Weed free	185.11	30.17	64.70	87.21	88.66
SEm ±	10.02	2.42	3.32	3.79	3.60
CD (p=0.05)	NS	NS	9.88	6.95	8.66
CV %	9.70	13.87	10.24	6.01	6.18

Table 2: Effect of different herbicide treatments on yield attributes *viz.* Number of Ear head/m^2, Length of Ear (cm), No. of grains/ear head and 1000 grain weight(g) of barley

Treatments	Number of Ear head/m^2	Length of Ear (cm)	No. of grains/ear head	1000 grain weight(g)
T_1- Halauxifen- methyl (1.21% EC) + Fluroxypyr (38.9% EC)	305.00	7.35	44.33	38.03
T_2- Metsulfuron methyl (20% WG) + Surfactant (0.2%)	261.67	6.66	34.00	36.33
T_3- Carfentrazone(40% DF)	254.71	6.53	35.00	36.30
T_4- Metsulfuron methyl (20% WG) + Carfentrazone (40% DF) +Surfactant (0.2%)	286.67	7.27	40.00	37.13
T_5- 2, 4-D-Sodium Salt (80% WP)	259.95	6.82	35.67	36.50
T_6- 2, 4-D- Sodium Salt (80% WP) + Carfentrazone (40% DF)	273.85	7.03	38.33	36.13
T_7- 2, 4-D-Ethyl Ester (38% EC)	265.66	6.91	37.33	36.30
T_8- 2, 4-D- Ethyl Ester (38% EC) + Carfentrazone (40% DF)	283.33	7.09	39.33	36.90
T_9- Weedy check	236.67	6.11	29.33	35.73

T_{10}- Weed free	315.67	7.40	45.33	39.54
SEm ±	13.20	0.30	2.04	1.68
CD (p=0.05)	39.23	0.89	6.07	NS
CV %	8.33	7.53	9.34	7.92

Table 3: Effect of different herbicide treatments on Grain yield (kg/ha), Straw yield (kg/ha), Biological yield (kg/ha) and harvest index (%) of barley

Treatments	Grain Yield (kg/ha)	Straw Yield (kg/ha)	Biological Yield (kg/ha)	Harvest Index (%)
T_1- Halauxifen- methyl (1.21% EC) + Fluroxypyr (38.9% EC)	3428.74	5328.66	8757.40	39.15
T_2- Metsulfuron methyl (20% WG) + Surfactant (0.2%)	2602.63	4163.02	6765.65	38.47
T_3- Carfentrazone(40% DF)	2486.90	4084.32	6571.22	37.84
T_4- Metsulfuron methyl (20% WG) + Carfentrazone (40% DF) +Surfactant (0.2%)	3052.26	5097.58	8149.84	37.45
T_5- 2, 4-D-Sodium Salt(80% WP)	2689.05	4211.12	6900.17	38.97
T_6- 2, 4-D- Sodium Salt (80% WP) + Carfentrazone (40% DF)	2940.35	4793.72	7734.07	38.02
T_7- 2, 4-D-Ethyl Ester (38% EC)	2834.42	4480.09	7314.51	38.75
T_8- 2, 4-D- Ethyl Ester (38% EC) + Carfentrazone (40% DF)	2956.01	4829.06	7785.07	37.97
T_9- Weedy check	2095.01	3132.02	5227.03	40.08
T_{10}- Weed free	3687.02	5489.04	9176.06	40.18
SEm ±	146.27	224.21	309.41	1.68
CD (p=0.05)	434.59	666.18	919.30	NS
CV %	8.80	8.51	7.20	7.56

Table 4: Effect of different herbicide treatments on Cost of cultivation, Gross return (₹/ha), Net return (₹/ha) and Benefit: Cost ratio of barley

Treatments	Total cost of cultivation (₹/ha)	Gross return (₹/ha)	Net return (₹/ha)	Benefit: Cost ratio
T_1- Halauxifen- methyl (1.21% EC) + Fluroxypyr (38.9% EC)	25763	75803	50039	2.94
T_2- Metsulfuron methyl (20% WG) + Surfactant (0.2%)	25751	57775	32024	2.24
T_3- Carfentrazone(40% DF)	25590	55419	29469	2.17
T_4- Metsulfuron methyl (20% WG) + Carfentrazone (40% DF) +Surfactant (0.2%)	25950	68188	42237	2.63
T_5- 2, 4-D-Sodium Salt(80% WP)	25815	59514	33699	2.31
T_6- 2, 4-D- Sodium Salt (80% WP) + Carfentrazone (40% DF)	26340	65454	39114	2.48
T_7- 2, 4-D-Ethyl Ester (38% EC)	25597	62814	37216	2.45
T_8- 2, 4-D- Ethyl Ester (38% EC) + Carfentrazone (40% DF)	26122	65822	39699	2.52
T_9- Weedy check	24315	46069	21754	1.89
T_{10}- Weed free	39315	81031	41716	2.06
SEm ±	-	3005.8	3005.8	0.11
CD (p=0.05)	-	8930.8	8930.8	0.33
CV %	-	8.16	14.17	8.19

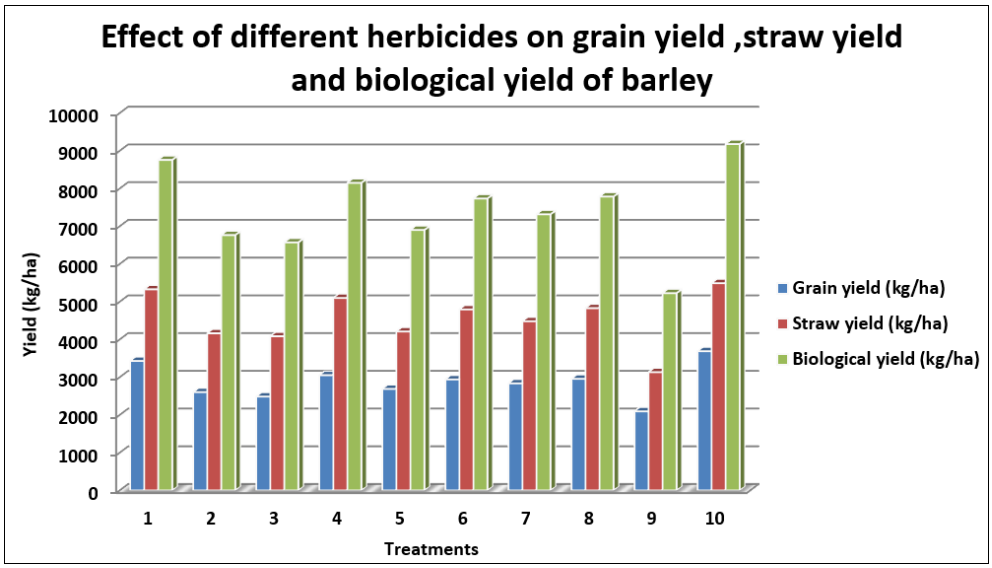

Fig 1: This figure clearly shows that Halauxifen- methyl (1.21% EC) + Fluroxypyr (38.9% EC) (T_1) recorded the highest grain yield, straw yield, biological yield and harvesting index during 2023-24

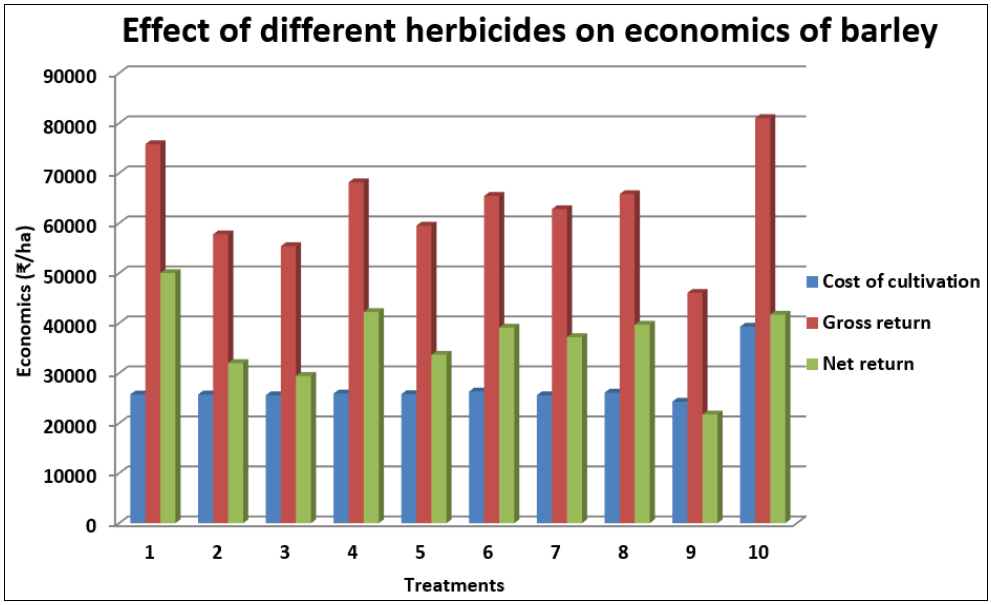

Fig 2: This figure clearly shows that Halauxifen- methyl (1.21% EC) + Fluroxypyr (38.9% EC) (T_1) recorded the highest gross return and net return during 2023-24

Conclusion

From the present study, it can be concluded that Halauxifen-methyl (1.21% EC) + Fluroxypyr (38.9% EC) was observed higher plant population, plant height, grain yield, straw yield and benefit cost ratio (B:C ratio) and that are most remunerative and effective herbicides for weed management in irrigated barley.

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References

1. Al-Khafaji MJ, Safi SMA, Hammood WF. Effect of herbicides on growth, grain yield and quality of barley. IRAQI Journal of Agricultural Sciences. 2023;54(4):1094-1100.
2. Anonymous. Progress report of All India Coordinated Wheat and Barley Improvement Project 2022-23. ICAR-Indian Institute of Wheat and Barley Research, Karnal, India; c2023.
3. Bhullar MS, Kaur S, Kaur T, Singh T, Singh M, Jhala AJ. Control of broadleaf weeds with post-emergence herbicides in four barley (*Hordeum* spp.) cultivars. Crop Protection. 2013;43:216-222.
4. Dheeraj BK, Moond V, Ninama J, Saharan K, Singh L. Effect of weed management practices on weed control efficiency, yield attributes, productivity and profitability of wheat. The Pharma Innovation Journal. 2023;12(10):390-393.
5. Gomez KA, Gomez AA. Statistical procedures for agricultural research (2nd ed.). New York: John Wiley & Sons; c1984.
6. Kaur A, Kumar S, Singh N, Kaur M. Effect of different herbicides on weeds and growth of barley (*Hordeum vulgare* L) in central Punjab. Agriways. 2018;6(2):37-40.
7. Kebede M, Bidira T, Gerama G, Chemeda G, Mamo K, Debela M, *et al*. Effect of various weed management options on weeds and yield of barley (*Hordeum vulgare* L.) at Shambo and Gedo, Western Oromia. Journal of Biology, Agriculture and Healthcare. 2017;7(21):74-83.
8. Pal S, Sharma R, Sharma HB, Singh R. Influence of different herbicides on weed control, nutrient removal and yield of wheat (*Triticum aestivum*). Indian Journal of Agronomy. 2016;61(1):59-63.
9. Pandey IB, Dwivedi DK, Pandey RK. Efficiency of herbicides and fertilizer management on weed dynamics in wheat (*Triticum aestivum* L.). Indian Journal of Weed Science. 2007;52(1):49-52.
10. Sahu R, Sharda K, Kumar D, Mandal SK. Weed population, weed biomass and grain yield of wheat as influenced by herbicides application. Indian Journal of Weed Science. 2018;50(3):302-304.
11. Singh B, Kumar M, Dhaka AK, Lamba RAS. Efficacy of Pinoxaden alone and in combination with Metsulfuron-Methyl and Carfentrazone-Ethyl against complex weed flora in barley (*Hordeum vulgare* L.). International Journal of Current Microbiology and Applied Sciences. 2017;6(4):134-143.
12. Singh S, Malik RK, Singh H, Narwal S. Evaluation of ready-mix of mesosulfuron + iodosulfuron for weed control in wheat. Indian Journal of Weed Science. 2007;35(3/4):190-193.
13. Trivedi J, Mundra SL, Kaushik MK. Nutrient uptake studies in barley (*Hordeum vulgare* L.) under the influence of weed control treatments and nitrogen levels. The Pharma Innovation Journal. 2022;11(5):1729-1732.
14. Verma G, Vivek RK, Jat L, Sachan DK, Tiwari R. Effect of weed management on weed dynamics, growth and yield of barley (*Hordeum vulgare* L.) under inceptisol of western Uttar Pradesh. International Journal of Chemical Studies. 2018;6(6):249-259.
15. Verma VK, Singh SK, Yadav MK, Patel CB. Effect of weed management practices on growth, yield attributes, yields and economics of wheat (*Triticum aestivum* L. emend Fiori & Paol.). Environment & Ecology. 2013;31(3A):1440-1444.
16. Watson PR, Derksen DA, VanAcker RC. The ability of 29 barley cultivars to compete and withstand competition. Weed Science. 2006;54:783-792.

17. Yadav R, Singh S, Yadav P, Yadav R, Singh CSJ. Effect of weed management practices on growth and yield of wheat (*Triricum aestivum*) crops. The Pharma Innovation Journal. 2022;11(6):2326-2329.
18. Zand E, Baghestani MA, Alikhani MA, Soufizadeh S, Khayami MM, Azar RP, *et al*. Chemical control of weeds in wheat (*Triticum aestivum* L.) in Iran. Crop Protection. 2010;29:1223-1231.