



## Effect of different weed control techniques on growth and yield attributes of Wheat (*Triticum aestivum* L.)

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### ABSTRACT

An experiment had been conducted in the Crop Research Centre of the School of Agriculture Uttaranchal University to find an effective solution for the problem of weeds which are responsible for hampering the quality as well as quantity of the weeds. The design selected was Randomised Block Design with three replications and seven treatments. The treatments were Atrazine @ 1 kg/ha, Atrazine @ 1 kg/ha + Isoproturon @ 1 kg/ha, 2-4, D Ethyl easter @ 1 kg/ha, Pendimethalin @ 1 kg/ha + 2 Hand weeding, Atrazine @ 1 kg/ha + 2-4, D Ethyl easter @ 1 kg/ha, Isoproturon @ 1 kg/ha + 2 Hand weeding and control. Out of all these treatments best outcome was observed in Pendimethalin @ 1 kg/ha + 2 Hand weeding. The best growth as well as yield attributes were observed in T<sub>5</sub> which was Pendimethalin @ 1 kg/ha + 2 Hand weeding along with best weed control.

**KEYWORDS:** weed control, leaf area index, spike length, Atrazine, Pendimethalin

### INTRODUCTION

Wheat is the third most significant food grain crop after rice and maize. In India it is observed as main source of food security. It can be cultivated in a variety of agro-climatic settings. Wheat is grown on 217 million/ha worldwide, with a production of 731 million tonnes and a productivity of 33.90 q ha<sup>-1</sup> each year. The European Union is the world's top wheat producer, followed by China, India, and the United States of America. Wheat is the staple food of around 23 per cent of the world's population. In India wheat was grown 5312 M ha while production was 5419 million tonnes (FAO, 2020). In comparison to major wheat-producing countries such as Russia (27016 kg/ha), the United States (34748 kg/ha), France (77428 kg/ha) and China, India's wheat productivity is quite low (56294 kg/ha).

Wheat in India covers a large area of agro-climatic conditions and subjected to a variety of biotic and abiotic challenges. In the north-western plain zone, the three states of Uttar Pradesh, Punjab, and Haryana are agriculturally significant, contributing 68.29 per cent of India's wheat output. In India, Uttar Pradesh has the most output (32.59 M tonnes) and area (9.50 M ha), whereas Punjab has recorded the highest productivity (5188 kg ha<sup>-1</sup>), followed by Haryana, Rajasthan, U.P, Uttarakhand, Bihar and Madhya Pradesh (4925 kg ha<sup>-1</sup>, 3501 kg ha<sup>-1</sup>, 3432 kg ha<sup>-1</sup>, 2910 kg ha<sup>-1</sup>, 2998 kg ha<sup>-1</sup> and 2993 kg ha<sup>-1</sup> respectively) (Directorate of Economics and Statistics, 2020).

Weeds have always been one of the most common obstacles in production of wheat. The advent of high-yielding types that require a lot of water and fertilizers to flourish has produced ideal circumstances for weed invasion and proliferation. It is contaminated with a significant number of weeds, which compete for resources, causing reduced growth, yield characteristics, and grain production. *Phalaris minor*, *Avena ludoviciana*, *Chenopodium album*, *Medicago denticulata*, *Malilotus alba*, *Melilotus indica*, *Fumeria parviflora*, *Vicia hirsuita*, *Vicia sativa*, *Coronopus didymus*, and *Reumex acetocela* are the most common weeds found in wheat field. Yield can decrease from 15 to 50 per cent, depending on weed density and kind of plant flora. (Jat et al., 2003). *Phalaris minor* is one of the most serious concerns in wheat with reports of output reductions ranging from 18 to 73 per cent owing to severe weed infestation (Pandey et al., 2004).

This observation had been undertaken to find the most suitable way of controlling the weed population as weeds causes loss in quantity as well as quality of the weeds.

### MATERIALS AND METHODS

The experiment had been conducted in the Crop Research Centre of Uttaranchal University, Dehradun in the Rabi season of the year 2021-22. The selected design was Randomised Block Design with seven treatments as well as three replications. Atrazine @ 1 kg/ha, Atrazine @ 1 kg/ha + Isoproturon @ 1 kg/ha, 2-4, D Ethyl easter @ 1 kg/ha, Pendimethalin @ 1 kg/ha + 2 Hand weeding,

Atrazine @ 1 kg/ha + 2-4, D Ethyl ester @ 1 kg/ha, Isoproturon @ 1 kg/ha + 2 Hand weeding and control were the treatments provided to the plots. The soil texture was sandy loam type. Soil had been observed to be good in soil organic carbon content (1.32%), medium in Nitrogen availability (301.4 kg/ha), and lower available Phosphorous (12.7 kg/ha), and medium in available potassium (235.7 kg/ha). The recommended dose of fertilizers had been given to the crop. Proper irrigation at the critical irrigation stages had been provided. All the weed control practices like herbicide application, hand weeding were done timely.

## RESULTS AND DISCUSSION

Plant height rose as it grew older, and between 60 and 90 DAS, the pace of growth was the fastest. Weed control techniques have a considerable impact on plant height at all phases of crop growth, according to data on plant height provided in Table 1. With the exception of 30 DAS, where treatment (T<sub>5</sub>) remained considerably higher in height while significantly treatment (T<sub>3</sub>) and treatment (T<sub>7</sub>) have similar heights to all herbicidal management, all weed management approaches reported significantly greater plant height over control. The maximum plant height measured at 60, 90, and the harvest stage was Pendimethalin PE @ 1 kg/ha + 2 Hand weeding, and it was comparable to 2-4, D Ethyl ester PoE @ 1 kg/ha, and Atrazine PE @ 1 kg/ha + 2-4, D Ethyl ester PoE @ 1 kg/ha while being much higher than the rest of the weed control techniques. At harvesting Atrazine PE @ 1 kg/ha + Isoproturon PoE @ 1 kg/ha and Atrazine PE @ 1 kg/ha has similar plant height. While much higher than other herbicides, the maximum plant height obtained with Pendimethalin PE @ 1 kg/ha + 2 Hand weeding was comparable to that obtained with Isoproturon PoE @ 1 kg/ha + 2 Hand weeding.

**Table: 1 Impact of different weed control techniques on the plant height at different growth stages**

Treatments		Plant height (cm)			
		30 DAS	60 DAS	90 DAS	AT HARVEST
T <sub>1</sub>	CONTROL	13.47	43.73	84.66	87.00
T <sub>2</sub>	Atrazine PE @ 1 kg/ha	17.93	46.53	95.52	98.85
T <sub>3</sub>	Atrazine PE @ 1 kg/ha + Isoproturon PoE @ 1 kg/ha	18.36	47.26	95.27	99.27
T <sub>4</sub>	2-4, D Ethyl ester PoE @ 1 kg/ha	18.50	49.66	96.69	100.36
T <sub>5</sub>	Pendimethalin PE @ 1 kg/ha+ 2 Hand weeding	19.03	54.66	100.63	106.63
T <sub>6</sub>	Atrazine PE @ 1 kg/ha + 2-4, D Ethyl ester PoE @ 1 kg/ha	18.06	50.36	99.98	100.98
T <sub>7</sub>	Isoproturon PoE @ 1 kg/ha + 2 Hand weeding	17.86	48.30	95.43	99.10
SEm±		0.59	0.56	1.12	0.91
CD (P ≥ 0.05%)		1.36	1.34	1.88	1.07

At the 30, 60, and 90-day, and harvest phases of crop growth, the various weed management techniques dramatically enhanced plant height. The greatest plant height under the herbicidal treatments was noted at 30 DAS. It can be because of how the therapies are being used. Tallest plant (106.33cm) was recorded under Pendimethalin PE @ 1 kg/ha + 2 Hand weeding which was a par with application of Atrazine PE @ 1 kg/ha + 2-4, D Ethyl ester PoE @ 1 kg/ha, (100.98cm) and 2-4, D Ethyl ester PoE @ 1 kg/ha, (100.36cm). The shortest plant height (87.00 cm) was observed under control at all growth stages. Due to increased nutrient availability, plants of all development phases grew voluminously, contributing to the rise in plant height. Also reported by Singh *et al.* (2006), Pandey and Kumar, (2005), and Upadhyay *et al.* (2005).

### Leaf Area Index

With the exception of 30 DAS, when the impact of weed management techniques was not noticeable, the data on leaf area index shown in Table 2 show that and weed management approaches demonstrated considerable variation in leaf area index of wheat at all development stages. In comparison to Pendimethalin PE @ 1 kg/ha + 2 Hand weeding, (3.75 and 4.22) 2-4, D Ethyl ester PoE @ 1 kg/ha, (3.63 and 4.04) and Atrazine PE @ 1 kg/ha + 2-4, D Ethyl ester PoE @ 1 kg/ha, (3.51 and 3.96) which had a considerably higher LAI at 60 and 90 DAS, respectively, control had the lowest LAI at 3.13 and 2.65.

The leaf area grew as crop age increased up until the 90<sup>th</sup>-day stage before declining, primarily because of senescence. The leaf area index increased significantly with several weed management practices recording the maximum leaf area index in Pendimethalin PE @ 1 kg/ha + 2 Hand weeding (4.22) statistically superior over rest treatment while at par with 2-4, D Ethyl ester PoE @ 1 kg/ha (4.04) and Atrazine PE @ 1 kg/ha + 2-4, D Ethyl ester PoE @ 1 kg/ha (3.96) the better leaf area index with these treatments might be due to fact that sufficient moisture and nutrient availability due to less weed density resulted in better growth i.e. leaf number and size leading to increased leaf area and leaf area index. Better LAI with the best weed managed conveyed by Tiwari *et al.* (2005), and Singh *et al.* (2006).

**Table: 2 Impact of different weed control techniques on the leaf area index at different growth stages**

Treatments		Leaf Area Index		
		30 DAS	60 DAS	90 DAS
T <sub>1</sub>	CONTROL	1.30	2.65	3.13
T <sub>2</sub>	Atrazine PE @ 1 kg/ha	1.35	3.09	3.46
T <sub>3</sub>	Atrazine PE @ 1 kg/ha + Isoproturon PoE @ 1 kg/ha	1.38	3.30	3.66
T <sub>4</sub>	2-4, D Ethyl ester PoE @ 1 kg/ha	1.41	3.63	4.04

T <sub>5</sub>	Pendimethalin PE @ 1 kg/ha + 2 Hand weeding	1.42	3.75	4.22
T <sub>6</sub>	Atrazine PE @ 1 kg/ha + 2-4, D Ethyl ester PoE @ 1 kg/ha	1.39	3.51	3.96
T <sub>7</sub>	Isoproturon PoE @ 1 kg/ha + 2 Hand weeding	1.38	3.39	3.81
SEm±		0.01	0.08	0.03
CD (P ≥0.05%)		0.04	0.15	0.10

### Dry matter accumulation (g per m<sup>2</sup>)

The accumulation of dry matter statistics shown in Table 3 show that dry matter accumulation increased as crop stages advanced, with the greatest rise occurring between 60 and 90 DAS. Different weed management methods have an impact on the crop's ability to accumulate dry matter up to 30 DAS. At later stages, all weed control methods significantly increased the amount of dry matter that the crop accumulated; the highest amounts were in the Pendimethalin PE @ 1 kg/ha + 2 Hand weeding treatment and were 330.067, 640.4, and 1082.6g m<sup>-2</sup>, respectively, at 60, 90, and harvest. These values were comparable to that of treatments Isoproturon PoE @ 1 kg/ha + 2 Hand weeding for weeds at 60, 90, and harvest. At 60, 90, and harvest stages of the herbicidal treatment, Pendimethalin PE @ 1 kg/ha + 2 Hand weeding was statistically significant compared to the rest of the treatment while being comparable to control.

The sum of all growth as well as yield characteristics, including plant heights, shoot m<sup>-2</sup>, and leaf area, is the accumulation of dry matter. With the exception of the 30-day development stage, when the dry matter range was unaffected, the dry matter accumulation rose dramatically with the implementation of weed control measures at all the development phases. At harvest, the highest accumulation of dry matter was recorded in Pendimethalin PE @ 1 kg/ha + 2 Hand weeding (1082.60) which was statistically at par with the application of 2-4, D Ethyl ester PoE @ 1 kg/ha (1066.53) and Atrazine PE @ 1 kg/ha + 2-4, D Ethyl ester PoE @ 1 kg/ha (1060.66). This might be attributed to more synthesis of food materials in plants under less weedy conditions. Kumar *et al.* (2006), Singh *et al.* (2006), and Chaudhari *et al.* (2017) have also reported an increase in dry matter production with herbicides as compared to Control.

**Table: 3 Impact of different weed control techniques on plant dry matter accumulation at different growth stage**

Treatments		Dry matter accumulation (g per m <sup>2</sup> )			
		30 DAS	60 DAS	90 DAS	AT HARVEST
T <sub>1</sub>	CONTROL	90.50	270.63	561.43	801.53
T <sub>2</sub>	Atrazine PE @ 1 kg/ha	92.56	293.5	591.63	1051.63
T <sub>3</sub>	Atrazine PE @ 1 kg/ha + Isoproturon PoE @ 1 kg/ha	91.63	282.00	581.63	1031.56
T <sub>4</sub>	2-4, D Ethyl ester PoE @ 1 kg/ha	94.73	322.43	636.83	1066.53
T <sub>5</sub>	Pendimethalin PE @ 1 kg/ha + 2 Hand weeding	95.61	330.06	640.4	1082.60
T <sub>6</sub>	Atrazine PE @ 1 kg/ha + 2-4, D Ethyl ester PoE @ 1 kg/ha	93.60	301.43	624.83	1060.66
T <sub>7</sub>	Isoproturon PoE @ 1 kg/ha + 2 Hand weeding	91.26	274.76	574.67	1027.3
SEm±		0.07	1.46	1.02	1.12
CD (P ≥0.05%)		0.48	2.15	1.80	1.88

### Yield attributes

#### No of spike (per m<sup>2</sup>)

The results regarding the number of spikes m<sup>-2</sup> are shown in Table 4, which demonstrate that all weed control techniques considerably increased the count of productive tillers as compared to control. The greater number of Spikes m<sup>-2</sup> seen with Pendimethalin PE @ 1 kg/ha + 2 Hand weeding was comparable to that of Atrazine PE @ 1 kg/ha, Atrazine PE @ 1 kg/ha + Isoproturon PoE @ 1 kg/ha, 2-4, D Ethyl ester PoE @ 1 kg/ha, Isoproturon PoE @ 1 kg/ha + 2 Hand weeding, and Atrazine PE @ 1 kg/ha + 2-4, D Ethyl ester PoE @ 1 kg/ha but much higher than that of the remaining weed control techniques. The herbicide Pendimethalin PE @ 1 kg/ha + 2 Hand weeding, which was comparable to Atrazine PE @ 1 kg/ha + 2-4, D Ethyl ester PoE @ 1 kg/ha and 2-4, D Ethyl ester PoE @ 1 kg/ha which shows similarities in the number of spike but much higher than other herbicidal treatments, generated the greatest number of Spikes per m<sup>2</sup>.

#### Length of spike (cm)

Data exhibiting information related to the length of the wheat spike is given below. The duration of the spike was significantly impacted by various weed control techniques. The maximum spike length (12.24) was seen under Pendimethalin PE @ 1 kg ha<sup>-1</sup> + 2 Hand weeding, which was considerably greater than control and Isoproturon PoE @ 1 kg ha<sup>-1</sup> + 2 Hand weeding while remaining on par with the remainder of the weed management approaches.

## No. of spikelets per spike

Table 4 statistics on the number of spikelets per wheat spikelet clearly show that weed control strategies had a considerable impact on the number of spikelet spikes. The highest number of spikelets per spike (18.533) were discovered in Pendimethalin PE @ 1 kg/ha + 2 Hand weeding, which was considerably better than the other weed control techniques while being on par with 2-4, D Ethyl ester PoE @ 1 kg/ha. The highest number of spikelets per spike reported with an herbicide was Pendimethalin PE @ 1 kg/ha + 2 Hand weeding, which was comparable to Atrazine PE @ 1 kg/ha + 2-4, D Ethyl ester PoE @ 1 kg/ha, Atrazine PE @ 1 kg/ha + Isoproturon PoE @ 1 kg/ha, and Isoproturon PoE @ 1 kg/ha + 2 Hand weeding.

## No. of grain per spike

The results on the number of grains per wheat spike that were tallied are shown in Table 4 and they show that all weed control techniques yield considerably more grains per spike than weedy check. The highest number of grains (65.267) were detected in the Pendimethalin PE @ 1 kg/ha + 2 Hand weeding, which was substantially greater than the remainder of the herbicide and on par with 2-4, D Ethyl ester PoE @ 1 kg/ha, Atrazine PE @ 1 kg/ha + 2-4, D Ethyl ester PoE @ 1 kg/ha, and Atrazine PE @ 1 kg/ha. In control, the fewest grains per spike were noted (34.133).

**Table: 4 Impact of different weed control techniques on yield attributes of wheat**

Treatments		No. of spike (per m <sup>2</sup> )	Length of Spike (cm)	No. of spikelets per Spike	Grain per ear head (m <sup>2</sup> )
T <sub>1</sub>	CONTROL	263.66	7.66	12.10	34.71
T <sub>2</sub>	Atrazine PE @ 1 kg/ha	282.43	9.40	17.27	43.69
T <sub>3</sub>	Atrazine PE @ 1 kg/ha + Isoproturon PoE @ 1 kg/ha	289.43	10.23	16.26	39.33
T <sub>4</sub>	2-4, D Ethyl ester PoE @ 1 kg/ha	288.43	10.56	18.80	49.17
T <sub>5</sub>	Pendimethalin PE @ 1 kg/ha + 2 Hand weeding	319.73	12.24	23.90	65.29
T <sub>6</sub>	Atrazine PE @ 1 kg/ha + 2-4, D Ethyl ester PoE @ 1 kg/ha	309.90	10.70	22.16	57.08
T <sub>7</sub>	Isoproturon PoE @ 1 kg/ha + 2 Hand weeding	295.93	7.96	15.43	36.42
SEm±		0.43	0.24	0.54	0.89
CD (P ≥0.05%)		1.72	0.87	1.31	1.68

## Conclusion

Wheat is an important cereal crop and plays an important role in food security in India. It has been grown on a large scale covering a large area under its cultivation. Weeds have been a major issue which not only hampers the quantity of yield but the quality also. The observation undertaken helps in suggesting better methods to control weeds and to reduce crop loss. According to the above mentioned observation, the best growth as well as yield attributes were observed in T<sub>5</sub> which was Pendimethalin @ 1 kg/ha + 2 Hand weeding along with best weed control. Atrazine PE @ 1 kg/ha + 2-4, D Ethyl ester PoE @ 1 kg/ha was at par to the previous.

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