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EFFECT OF HERBICIDES ON WEED AND PRODUCTIVITY OF WHEAT (*Triticum aestivum* L.)

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ABSTRACT

Wheat (*Triticum aestivum* L.) is the world's most widely cultivated food crop and it is grown as a dual purpose where it provides both grain and forage from the same patch of land. Weeds are considered as one of the major constraints in wheat cultivation which alone causes 30-33% average reduction in yield. Therefore an experiment entitled "Effect of herbicides on weed and productivity of wheat (*Triticum aestivum* L.)" was undertaken in Randomised block design with nine treatments *viz.,* T_1 - Weedy Check, T_2 - Weed Free, T_3 - Farmers Practice (Hoeing-15 DAS, Hand Weeding-21 DAS), T_4 - Sulfosulfuron @ 25 g a.i. ha^{-1} as post emergence at 25 DAS, T_5 - Metsulfuron-methyl @ 4 g a.i. ha^{-1} as post emergence at 25 DAS, T_6 - Clodinafop-propargyl @ 60 g a.i. ha^{-1} as post emergence at 25 DAS, T_7 - Metribuzin @ 210 g a.i. ha^{-1} as post emergence at 25 DAS, T_8 - Fenaxaprop-p-ethyl @ 120 g a.i. ha^{-1} as post emergence at 25 DAS and T_9 - Pinoxaden @ 60 g a.i. ha^{-1} as post emergence at 25 DAS replicated thrice at Agronomy Farm, College of Agriculture, Nagpur in *rabi* season of 2021-22. Results revealed that, the weed infestation throughout the growth period of crop was significantly controlled with weed free treatment (T_2). Maximum weed control efficiency and lowest weed index was observed under weed free treatment (T_2). Among herbicidal treatments, application of Metsulfuron-methyl @ 4 g a.i. ha^{-1} at 25 DAS (T_5) was found to be the most effective treatment in controlling weed population across the crop growth period which resulted in maximum weed control efficiency and lowest weed index followed by Sulfosulfuron @ 25 g a.i. ha^{-1} at 25 DAS (T_4) and Farmers Practice (Hoeing-15 DAS, Hand Weeding-21 DAS) (T_3). Grain and straw yield of wheat were found highest under weed free treatment (T_2) as compared to other treatments. Among herbicidal treatments, application of Metsulfuron-methyl @ 4 g a.i. ha^{-1} at 25 DAS (T_5) recorded significantly highest grain and straw yield and were found at par with application of Sulfosulfuron @ 25 g a.i. ha^{-1} at 25 DAS (T_4) and Farmers Practice (Hoeing-15 DAS, Hand Weeding-21 DAS) (T_3). Considering the treatments B:C ratio was found highest (3.09) with the application of Metsulfuron-methyl @ 4 g a.i. ha^{-1} at 25 DAS (T_5) followed by application of Sulfosulfuron @ 25 g a.i. ha^{-1} at 25 DAS (T_4) (2.94). Hence, these two treatments can be effective in controlling the weeds.

(Key words: Wheat, herbicide, weed, WCE, WI, yield)

INTRODUCTION

Wheat (*Triticum aestivm* L.) belongs to family "Gramineae" and genus "*Triticum*". Wheat serves as a staple food for about one billion people in as many countries of the world. It provides about 20% of total food calories for the human race. Among the cereal crops grown in India, wheat comes next only to rice in terms of area and production. It is believed to be originated from the Middle East region of Asia (Nanher *et al.,* 2015). Weed not only reduce the yield but also lower the quality of produce and increase the cost of harvesting, threshing and cleaning. Weed is the major cause of loss of yield in wheat crop, apart from improved agronomic practices and preventive measures. Chemical weed control is one of the key factor to enhance crop production and productivity (Twinkle and Kumar, 2022). Use of herbicides plays vital role in control of weeds at initial stages of crop growth hence, the search of new herbicides is of atmost important. Spraying of post emergence herbicides helps to reduce the crop weed competition at critical growth stages resulting higher crop yields. So, crop-weed competition at critical stages is most important for increasing the crop yields (Vanisree *et al.,* 2019). Conventional method of weed control being weather dependent, time consuming and costly due to high cost of labour and mechanical means being less efficient in controlling weed compare to use of herbicides. Under such circumstances, it is important to find out the economical ways of wheat cultivation with herbicides under different establishment methods (Pradhan *et al.,* 2016). Recent investigation have vouched the importance of herbicide in

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enhancing wheat productivity through wide spectrum weed control. Keeping in view the above facts, an experiment entitled "Effect of herbicides on weed and productivity of wheat (*Triticum aestivum* L.)" carried out to investigate the best weed management practice for control of weed in wheat cultivation.

MATERIALS AND METHODS

An experiment entitled "Effect of herbicides on weed and productivity of wheat (*Triticum aestivum* L.)" was conducted at Agronomy Section Farm, College of Agriculture, Nagpur, during *rabi* season of 2021-22. The experiment was laid out in Randomised block design with nine treatments *viz.,* T_1 - Weedy Check, T_2 - Weed Free, T_3 - Farmers Practice (Hoeing-15 DAS, Hand Weeding-21 DAS), T_4 - Sulfosulfuron @ 25 g a.i. ha^{-1} as post emergence at 25 DAS, T_5 - Metsulfuron-methyl @ 4 g a.i. ha^{-1} as post emergence at 25 DAS, T_6 - Clodinafop-propargyl @ 60 g a.i. ha^{-1} as post emergence at 25 DAS, T_7 - Metribuzin @ 210 g a.i. ha^{-1} as post emergence at 25 DAS, T_8 - Fenaxaprop-p-ethyl @ 120 g a.i. ha^{-1} as post emergence at 25 DAS and T_9 - Pinoxaden @ 60 g a.i. ha^{-1} as post emergence at 25 DAS, replicated thrice. Further data on weed count (at 30, 60, 90 DAS and at harvest), weed dry matter (at harvest), weed control efficiency (%) (at harvest), grain and straw yield were recorded and analysed statistically (Panse and Sukhatme, 1967). Weed index was calculated by formula given by Gill and Kumar (1969).

$$\text{Weed index (\%)} = \frac{X - Y}{Y} \times 100$$

Where, X = Grain yield (kg ha^{-1}) from weed free plot.

Y = Grain yield (kg ha^{-1}) from treated plot for which weed index is to be worked out.

RESULTS AND DISCUSSION

Total weed count

The weed free treatment (T_2) recorded significantly lowest total weed count amongst all other treatments whereas, highest total weed count was observed under weedy check treatment (T_1) at all periodical growth stages. At 30 DAS, Farmers Practice (Hoeing at 15 DAS and Hand Weeding at 21 DAS) (T_3) recorded significantly lowest total weed count (m^{-2}) as compared to all other treatments. Amongst herbicidal treatments, application of Metsulfuron-methyl @ 4 g a.i. ha^{-1} at 25 DAS (T_5) recorded significantly lowest total weed count and this treatment was found to be at par with application of Sulfosulfuron @ 25 g a.i. ha^{-1} at 25 DAS (T_4). At 60 DAS, 90 DAS and at harvest, application of Metsulfuron-methyl @ 4 g a.i. ha^{-1} at 25 DAS (T_5) recorded significantly lowest total weed count amongst all other treatments except application of Sulfosulfuron @ 25 g a.i. ha^{-1} at 25 DAS (T_4) and Farmers Practice (Hoeing at 15 DAS and Hand Weeding at 21 DAS) (T_3) which were found at par with the application of Metsulfuron-methyl @ 4 g a.i. ha^{-1} at 25 DAS (T_5).

The lowest weed count was observed in weed free treatment (T_2) followed by application of Metsulfuron-methyl @ 4 g a.i. ha^{-1} at 25 DAS (T_5) and Sulfosulfuron @ 25 g a.i. ha^{-1} at 25 DAS (T_4) might be due to keeping the weed free environment and application of post emergence herbicides that have continued effect on controlling both monocot and dicot weed population. At all stages of crop, total weed population were reduced significantly due to various weed management practices which were effective in timely reducing total weed population. Singh and Ali (2004) found that Metsulfuron-methyl at 4 g ha^{-1} was most effective in controlling broadleaf weeds and ultimately increased the yield of wheat. Paighan *et al.* (2013) recorded the lower weed density in weed free treatment and it was followed by Metsulfuron-methyl at 4 g ha^{-1}.

Dry matter accumulation by weeds

Treatments T_5 (Metsulfuron-methyl @ 4 g a.i. ha^{-1} at 25 DAS) followed by T_4 (Sulfosulfuron @ 25 g a.i. ha^{-1} at 25 DAS) and T_3 [Farmers Practice (Hoeing at 15 DAS and Hand Weeding at 21 DAS)] were found significantly superior in lowering dry matter accumulation by weeds over other treatments. The lowest dry matter accumulation by weeds was observed in weed free treatment (T_2) over weedy check treatment (T_1) might be due to keeping the weed free environment. Also the application of herbicides Metsulfuron-methyl @ 4 g a.i. ha^{-1} at 25 DAS (T_5) followed by application of Sulfosulfuron @ 25 g a.i. ha^{-1} at 25 DAS (T_4) suppressed the weed growth of broad-spectrum weed which reduced the dry matter accumulation by weed. Paighan *et al*. (2013) reported that lowest dry matter accumulation was recorded with weed free treatment followed by Metsulfuron-methyl @ 4 g a.i. ha^{-1}. This might be due to effective control of weeds, so it resulted in minimum weed-crop competition. Sharma (2009) recorded the lowest dry matter accumulation by weeds with the application of Metsulfuron-methyl @ 4 g a.i. ha^{-1} and 6 g a.i. ha^{-1}.

Weed control efficiency

The weed free treatment (T_2) recorded highest weed control efficiency amongst all other treatments, whereas lowest weed control efficiency was observed under weedy check treatment (T_1) at all periodical growth stages. Among the herbicidal treatments, application of Metsulfuron-methyl @ 4 g a.i. ha^{-1} at 25 DAS (T_5) recorded higher weed control efficiency followed by application of Sulfosulfuron @ 25 g a.i. ha^{-1} at 25 DAS (T_4) and Farmers Practice (Hoeing at 15 DAS and Hand Weeding at 21 DAS) (T_3).

The weed free treatment (T_2) recorded highest weed control efficiency due to weed free environment, very less crop- weed competition and ultimately produced less weed biomass. This treatment was found superior over all other treatments. Among the herbicidal treatments, application of Metsulfuron-methyl @ 4 g a.i. ha^{-1} (T_5) at 25 DAS and Sulfosulfuron @ 25 g a.i. ha^{-1} (T_4) at 25 DAS recorded higher weed control efficiency due to reduction in weed population

and weed biomass. Sharma (2009) reported that weed control efficiency of Metsulfuron-methyl treated plots was maximum at 0.004 kg ha^{-1} and 0.006 kg ha^{-1}. Paighan *et al*. (2013) also observed best weed control efficiency in case of weed free condition followed by the application of metsulfuron-methyl 4 g ha^{-1} at 30 DAS and at 60 DAS.

Weed index

Among the herbicidal weed management practices, application of Metsulfuron-methyl @ 4 g a.i. ha^{-1} at 25 DAS (T_5) showed the minimum weed index (3.23) followed by the application of Sulfosulfuron @ 25 g a.i. ha^{-1} at 25 DAS (T_4) and Farmers Practice (Hoeing at 15 DAS and Hand Weeding at 21 DAS) (T_3), whereas weedy check treatment (T_1) recorded maximum weed index (30.77) indicating reduction in grain yield due to presence of weeds throughout crop growth period.

Weed index indicates reduction in yield. Lowest weed index in herbicidal treatments might be due to better weed control as compared to weedy check (T_1), which provides favourable condition for crop growth that increased the grain yield. Chaudhary *et al.* (2022) and Sharma (2009) found that application Metsulfuron-methyl @ 4 g a.i. ha^{-1} lowered the value of weed index against weedy check.

Grain yield (q ha^{-1})

The grain yield ha^{-1} in wheat differed significantly due to various weed control treatments. The weed free treatment (T_2) recorded significantly highest grain yield amongst all other treatments, whereas the minimum grain yield ha^{-1} was observed under weedy check treatment (T_1) at harvest. Amongst herbicidal treatments, application of the Metsulfuron-methyl @ 4 g a.i. ha^{-1} at 25 DAS (T_5) recorded significantly higher grain yield and was found to be at par with the application of Sulfosulfuron @ 25 g a.i. ha^{-1} at 25 DAS (T_4) and Farmers Practice (Hoeing at 15 DAS and Hand Weeding at 21 DAS) (T_3).

The different weed management practices significantly improved the crop yield as compared to weedy check might be due to increase in the number of effective tillers, number of grains $spike^{-1}$ and increase in test weight owing to better weed control resulted into decrease in weed population, weed biomass and reduction in crop-weed competition. Chaudhary *et al.* (2022) found that weed management practices, hand weeding twice and metsulfuron-methyl 4 g ha^{-1} at 28 DAS recorded significantly higher grain yield. Paighan *et al*. (2013) observed low yield in weedy check might be due to poor root growth and higher weed population could have competed with wheat crop for space, water and nutrients, thereby adversely affecting grain yields.

Straw yield (q ha^{-1})

Straw yield in wheat differed significantly due to various weed control treatments. The weed free treatment (T_2) recorded significantly highest straw yield ha^{-1} amongst all other treatments, whereas minimum straw yield was observed under weedy check treatment (T_1) at harvest. Amongst herbicidal treatments, application of Metsulfuron-methyl @ 4 g a.i. ha^{-1} at 25 DAS (T_5) recorded significantly higher straw yield and was found to be at par with application of Sulfosulfuron @ 25 g a.i. ha^{-1} at 25 DAS (T_4) and Farmers Practice (Hoeing at 15 DAS and Hand Weeding at 21 DAS) (T_3).

Increase in straw yield might be due to luxurious crop growth, increase in dry matter accumulation in crop and decrease in dry matter accumulation in weeds, less crop-weed competition in weed free and herbicidal treated plots. Chaudhary *et al.* (2022) found that weed management practices, hand weeding twice and metsulfuron-methyl 4 g ha^{-1} at 28 DAS recorded significantly higher straw yield. Sharma (2009) showed that the maximum straw yield was recorded with post emergence application of metsulfuron methyl @ 0.004 kg ha^{-1}.

B:C ratio

Application of Metsulfuron-methyl @ 4 g a.i. ha^{-1} at 25 DAS (T_5) recorded highest B:C ratio (3.09) followed by application of Sulfosulfuron @ 25 g a.i. ha^{-1} at 25 DAS (T_4) (2.94), whereas lowest B:C ratio was recorded in weedy check treatment (T_1) (2.31).

Sharma (2009) and Chaudhary *et al.* (2022) recorded the maximum B:C ratio of 3.10 and 2.16 respectively with post emergence application of metsulfuron methyl at 0.004 kg ha^{-1}.

It can be inferred that highest reduction in total weed population, weed dry matter, and highest weed control efficiency, highest yield of wheat was observed under weed free treatment (T_2). Among the herbicidal treatments, application of Metsulfuron-methyl @ 4 g a.i. ha^{-1} at 25 DAS (T_5) followed by Sulfosulfuron @ 25 g a.i. ha^{-1} at 25 DAS (T_4) and Farmers Practice (Hoeing at 15 DAS and Hand Weeding at 21 DAS) (T_3) showed highest reduction in total weed population, weed dry matter, weed index and increase in weed control efficiency and yield of wheat. Application of Metsulfuron-methyl @ 4 g a.i. ha^{-1} at 25 DAS (T_5) recorded highest B:C ratio (3.09) followed by application of Sulfosulfuron @ 25 g a.i. ha^{-1} at 25 DAS (T_4). Hence, these two treatments (T_5 and T_4) can be effective in controlling the weeds and to enhance the productivity of wheat.

Table 1. Total weed count, weed dry matter, weed control efficiency, weed index and yield as influenced by different treatments in wheat

	Treatments	Total weed count (m^{-2})				Weed dry matter at harvest ($g\ m^{-2}$)	WCE (%) at harvest	Weed Index (%)	Yield		B:C ratio
		30 DAS	60 DAS	90 DAS	At harvest				Grain yield ($q\ ha^{-1}$)	Straw yield ($q\ ha^{-1}$)	
T_1	Weedy Check	138.67 (11.80)	153.00 (12.39)	163.00 (12.79)	150.00 12.27	254.96 (15.98)	-	30.77	25.89	34.42	2.31
T_2	Weed Free	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	100	-	37.40	45.14	2.42
T_3	Farmers Practice (Hoeing at 15 DAS and Hand Weeding at 21 DAS)	13.33 (3.71)	46.67 (6.87)	58.67 (7.69)	49.33 (7.06)	86.04 (9.30)	66.25	8.90	34.07	42.58	2.65
T_4	Sulfosulfuron @ 25 g a.i. ha^{-1} as post emergence at 25 DAS	122.67 (11.10)	45.00 (6.74)	57.33 (7.60)	48.00 (6.96)	85.29 (9.26)	66.54	6.76	34.87	43.12	2.94
T_5	Metsulfuron-methyl @ 4 g a.i. ha^{-1} as post emergence at 25 DAS	119.00 (10.93)	44.00 (6.67)	55.00 (7.45)	46.33 (6.84)	84.64 (9.23)	66.80	3.23	36.19	44.15	3.09
T_6	Clodinafop-propargyl @ 60 g a.i. ha^{-1} as post emergence at 25 DAS	127.67 (11.32)	56.67 (7.56)	70.00 (8.40)	60.00 (7.78)	97.60 (9.90)	61.71	13.10	32.50	40.60	2.74
T_7	Metribuzin @ 210 g a.i. ha^{-1} as post emergence at 25 DAS	131.67 (11.50)	82.33 (9.10)	96.33 (9.84)	76.33 (8.77)	118.44 (10.91)	53.54	24.54	28.22	36.39	2.40
T_8	Fenaxaprop-p-ethyl @ 120 g a.i. ha^{-1} as post emergence at 25 DAS	136.00 (11.68)	68.00 (8.28)	76.00 (8.74)	66.33 (8.17)	108.91 (10.46)	57.28	21.39	29.40	37.81	2.38
T_9	Pinoxaden @ 60 g a.i. ha^{-1} as post emergence at 25 DAS	130.33 (11.44)	60.67 (7.82)	72.00 (8.51)	61.33 (7.86)	98.96 (9.97)	61.18	16.52	31.22	39.54	2.49
	SE (m) ±	0.08	0.09	0.09	0.08	0.04			1.18	1.14	
	CD at 5%	0.24	0.27	0.27	0.23	0.11			3.54	3.42	

REFERENCES

Chaudhary A. N., A. M. Patel, V. B. Mor and H. N. Chaudhary, 2022. Effect of irrigation level and weed management practices on wheat growth, yield and economics. Indian J. Weed Sci. **54**(1): 46-50.

Gill, G. and S. Kumar, 1969. Weed index-A new method for repoeting weed control trials. Indian J. Agron. **14**: 96-98.

Nanher, A. H., R. Singh, S. Yadav, S. Tyagi, V. Kumar, A. K. Singh and S. Ashamim, 2015. Effect of metribuzin in combination with post emergence herbicide on weed and productivity of wheat. The Bioscan. **10**(3): 1345-1348.

Paighan, V. B., A. K. Gore and A. S. Chavan, 2013. Effect of new herbicides on growth and yield of wheat. Indian J. Weed Sci. **45**(4): 291-293.

Panse, V. G. and P. V. Sukhatme, 1967. Statistical methods for agriculture workers, ICAR, New Delhi.

Pradhan, A., A. Sao, S. K. Nag and S. C. Mukherjee, 2016. Effect of herbicidal weed management and different establishment methods on growth and yield of wheat (*Triticum aestivum* L.). Int. J. Sci. Environ. and Technol. **5**(5): 1-9.

Sharma, O. L. 2009. Efficacy of post emergence herbicides to control broad leaf weeds in wheat in Indira Gandhi canal command area of western Rajasthan. Indian J. Weed Sci. **41**(1&2): 52-54.

Singh, P. and M. Ali, 2004. Efficacy of metsulfuron-methyl on weeds in wheat and its residual effects on succeeding soybean crop grown on vertisols of Rajasthan. Indian J. Weed Sci. **36**(1&2): 34-37.

Twinkle and R. Kumar, 2022. Evaluation of bio efficacy of various herbicide for weed control and their effects on growth and yield of wheat (*Triticum aestivum* L.). J. Soils and Crops. 3**2**(2): 326-329.

Vanisree, G., V. S. Khawale, N. D. Parlawar and D. J. Jiotode, 2019. Efficacy of different herbicides on weed control in soybean. J. Soils and Crops. **29**(2): 293-296.

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