

## EFFECTS OF INTEGRATED WEED MANAGEMENT ON WHEAT YIELD AND YIELD ATTRIBUTES

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Received-05.10.2022, Revised-14.10.2022, Accepted-25.10.2022

**Abstract:** The present investigations entitled “Effect of integrated weed management on growth and yield of Wheat (*Triticum aestivum* L.)” was conducted in the crop research farm of Agronomy department of CPU Kota, during ‘Rabi’ seasons of 2019-20 and 2020-21. The experiment was design in a Randomized Block Design with fourteen treatments with three replications including control. The treatments were allocated randomly in all the plots with three replications with crop spacing 22.5 × 5 cm. The major weeds that were present in wheat were *Parthenium hysterophorus* L., *Phalaris minor* L., *Chenopodium album* L., *Vicia hirsuta* L., *Cynodon dactylon* (L.) Pers and *Cyperus rotundus* L. In general, it was observed in the two years field trial that the emergence pattern of the major weeds in wheat in the experimental field were almost similar and did not differ much in both the years. On the basis of the current investigation, it can be said that in a wheat tank, a pre-emergence application of Metribuzin at 0.3 a.i. kg/ha and a post-emergence application of metsulfuron methyl at 0.3 a.i. kg/ha produced the lowest weed population, the highest yield, and the most favourable yield attributes, as well as the highest net return and benefit-cost ratio.

**Keywords:** Wheat, Grain, Yield, Weed management, Investigation

### INTRODUCTION

Wheat (*Triticum aestivum* L.) is a staple food across the world and belong to family of Poaceae family. It is primarily grown in temperate regions and also at higher altitude under tropical climatic areas in winter season. It is the single most important cereal crop that has been considered as integral component of the food security system of the several nations. The demand of wheat by 2030 has been projected to be between 145 to 149 million tonnes in the country. Most of the increase in production will have to manage from integrated use of resources, as the land area under wheat is not expected to expand further the productivity of wheat in Rajasthan is very low (3501 kg ha<sup>-1</sup>) might be due to adoption of cereal-cereal (Rice-Wheat) cropping system, late sowing, poor weed management and imbalance fertilization, etc. Among these causes of low productivity, reduction in wheat yield has been very substantial due to the infestation of weeds. Weeds are considered as one of the major constraints in wheat cultivation. The prominent weeds noted in wheat fields are *Phalaris minor*, *Chenopodium album*, *Anagallis arvensis*, *Avena fatua*, *Convolvulus arvensis*, *Lathyrus sphaecolus*, *Cyperus rotundus* and *Cynodon dactylon* etc. which alone cause 33 percent reduction in wheat yield.

It is necessary to sustain the wheat crop production for meet the demand of wheat in India as well as world. Yield reducing factors in wheat are soil fertility decline, weeds, disease, and insects. Weeds compete with crop plants for essential growth factors like light, moisture, nutrients and space. Weeds can also increase harvesting costs, reduce quality of

product [Bibi *et al.*, 2008]. Apart from increasing the production cost, weeds also intensify the disease and insect pest problem by serving as alternative hosts, and uncontrolled weed growth throughout the crop growth caused a yield reduction of 57.6 to 73.2% [Tefayet *et al.*, 2014]. Though manual and physical methods of weed control are very effective in India, however, non-availability of labor during peak period under intensive farming, high labor cost; regeneration of weeds which require frequent operation and weeds cannot effectively be managed merely due to crop mimicry.

Therefore, the use of chemical weed control has become necessary (Marwat *et al.*, 2008) and this has created a scope for using herbicides and they are becoming more popular in developing countries like India. Weed management systems that depend heavily on herbicides are now accepted as unsustainable and it has also created a problem of evolution of herbicide resistant weeds. Hence, development of more comprehensive and sustainable weed management system is warranted for economic production of wheat. Moreover, control of weeds by a single method usually does not give positive results and may also not be socio-economically acceptable. An integrated weed management involves specific control measures to be directed not only against one weed species, but also for all the species affecting a crop in a particular area [Syed *et al.*, 2008], and crop species and cultivars that compete better is an important component of IWM

Metribuzin (4-amino-6-tert-butyl-3-(methylthio)-1, 2, 4-triazin-5(4H)-one) is an herbicide used both pre- and post-emergence in crop. Pendimethalin is an herbicide of the dinitroaniline class used in pre-

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mergence and post-emergence applications to control annual grasses and certain broadleaf weeds. Metsulfuron-methyl is a post-emergence herbicide. It is highly active to control broad-leaf weeds in cereals, pasture and plantation crops. Traditional methods of weed control such as crop rotation, manual hoeing or tractor drawn cultivator and costly labour have made the use of herbicides more popular among the Indian farmers. The herbicide like Metribuzine, Metasulfuronmethyl reported to be promising against weeds in wheat at different locations in India. Pandey and Kumar (2005) reported that hand weeding done at 35 DAS increased the effective tillers  $m^{-2}$ .

Surin *et al.* (2013) reported that hand weeding at 25 DAS in wheat crop recorded higher yield attributes like as, 31.3% higher productive tillers  $m^{-2}$ , 5.3% higher spike length and 8.6% higher straw yield compared to weedy check. Verma, (2014) application of metribuzin at 210 g  $ha^{-1}$  in wheat field recorded higher plant height (33.9 cm) and number of tillers ( $80 m^{-1}$  row length) as compared to weedy check. Sharma (2009) revealed that maximum grain and straw yield of wheat 2530  $kg ha^{-1}$  and 2900  $kg ha^{-1}$  respectively, were recorded with post-emergence application of metsulfuron methyl @ 4 g  $ha^{-1}$ . This treatment was also responsible to give length of spike (39.1 cm) and test weight (39.1 g).

Patro *et al.* (2016) comprised of 12 weed management practices as treatments i.e. Pendimethalin @ 1.0  $kg ha^{-1}$

(2DAS), metribuzin @ 0.3  $kg ha^{-1}$  (2DAS), metsulfuron @ 0.02  $kg ha^{-1}$  (25DAS), pendimethalin + One HW (25DAS), pendimethalin + 2,4-DEE @ 0.5  $kg ha^{-1}$  (25 DAS), metsulfuron + One HW (25 DAS), metsulfuron + 2, 4-D EE @ 0.5  $kg ha^{-1}$  (25 DAS), pendimethalin + metsulfuron (25 DAS), metribuzin + metsulfuron (25DAS), 2, 4-D @ 0.5  $kg ha^{-1}$  (25 DAS), Two hand weeding at 25 and 45 DAS and Unweeded control. The results showed that when Pendimethalin was applied along with one hand weeding at 25 days after sowing had the highest weed control efficiency percentage (95.35%) and also the crop gave the highest grain yield i.e. 2784  $kg ha^{-1}$  followed by two hand weeding at 25 and 45 DAS (grain yield 2677  $kg ha^{-1}$ ), but in this case the weed control efficiency percentage was very low (17.44%).

## MATERIALS AND METHODS

The proposed investigations entitled “Effect of integrated weed management on growth and yield of Wheat (*Triticum aestivum* L.)” was conducted in the crop research farm of Agronomy department of CPU Kota, during ‘Rabi’ seasons of 2019-20 and 2020-21. The experiment was design in a Randomized Block Design with fourteen treatments with three replications including control. The treatments were allocated randomly in all the plots with three replications with crop spacing 22.5 × 5 cm.

**Table 1.** Experimental Details:

Symbols	Treatment Combinations
T1	Metribuzine @ 0.3 kg/ha at 2 DAS + hand weeding at 25 DAS
T2	Metribuzine @ 0.3 kg/ha 2 DAS + hoeing at 25 DAS
T3	Metribuzine @ 0.3 kg/ha 2 DAS + metasulfuron methyl 0.3 kg/ha at 25 DAS
T4	Pendimethalin @ 1.0 kg/ha 2 DAS + hand weeding at 25 DAS
T5	Pendimethalin @ 1.0 kg/ha 2 DAS + hoeing at 25 DAS
T6	Pendimethalin @ 1.0 kg/ha as 2 DAS + metasulfuron methyl 0.3 kg/ha at 25 DAS
T7	Metasulfuron methyl 0.3 kg/ha at 25 DAS + hand weeding at 45
T8	Metasulfuron methyl 0.3 kg/ha at 25 DAS + hoeing at 45 DAS
T9	Two hand weeding at 25 and 45 DAS
T10	Two hoeing at 25 and 45 DAS
T11	Hand weeding at 25 DAS and hoeing at 45 DAS
T12	Hoeing at 25 DAS and Hand weeding at 45 DAS
T13	Weed free check (minimum competition)
T14	Weedy check

Number of grains spike of wheat was counted the ten selected spikes of wheat, grains were separated, cleaned and counted and the mean value of grains per spike was computed and grain yield (q/ha) find by after threshing and winnowing, grain produce from each net plot was weight and converted into yield  $q ha^{-1}$ . Straw yield (q/ha) calculated by weighing of total produce per net plot was recorded before threshing. The straw yield was calculated by

subtracting the grain yield from the weight of total produce of net plot and expressed in quintal per hectare. Harvest index was find by harvest index is the ratio between the economic yield and biological yield, multiply by 100 and calculated by formula as given by Donald (1976). It measures the partitioning of photosynthates towards grains, expressed in percentage.

## RESULTS

### Number of grains per ear head

Numbers of grains per earhead as affected by different weed control treatments are presented in Table 2. The data revealed that a significant difference existed in number of grains per ear head due to treatments in the year of 2019-20 and 2020-21. The maximum number of grains per earhead in wheat was observed in the year 2019-20 and 2020-21, respectively. The maximum number of grains per earhead was observed in plots treated with tankmixedpre emergence application of Metribuzin @ 0.3 a. i. kg/ha and Metsulfuron methyl @ 0.3 a. i. kg/ha. It might be due to availability of plant dryweight and number of effective tillers per plant of wheat plants. This treatment was statistically at par with hand weeded plots. The least number of grains per ear head was observed in unweeded plot.

### Test weight

Test weight of wheat as affected by different weed control treatments are presented in Table 3. The data revealed that a significant difference existed in test weight due to treatments in the year of 2019-20 and 2020-21. The maximum test weight of wheat was 42.03 g and 44.10 g was in the year 2019-20 and 2020-21, respectively. The maximum test weight was observed in plots treated with tankmixedpre emergence application of Metribuzin @ 0.3 a. i. kg/ha and Metsulfuron methyl @ 0.3 a. i. kg/ha. It might be due to availability of number of effective tillers plant and number of grains per earhead of wheat plants. This treatment was statistically at par with handweeded plots during 2019-20 and 2020-21. The least test weight was observed in unweeded plots (Table 4.11).

### Grain Yield (q/ha)

Screening of the data indicated that the different weed control treatments had significant effect in influencing the grain yield of wheat during both the years of study as shown in Table 4. The maximum grain yield was 52.87 q/ha and 53.53 q/ha in the year of 2019-20 and 2020-21, respectively was observed. The maximum grain yield was observed in plots treated with tankmixedpre emergence application of Metribuzin @ 0.3 a. i. kg/ha and Metsulfuron methyl @ 0.3 a. i. kg/ha. It may possibly due to maximum test weight, number of tillers, plant height, and number of grains per earhead and also due least emergence and density of weeds. This finding confirm with the result of Pandey and Verma, (2002). This treatment was statistically at par with handweeded plots during 2019-20 and 2020-21. The minimum grain yield was observed in unweeded plots.

### Straw Yield

The straw yield of wheat was significantly different due to weed control treatments during both the years

of study as sown in Table 5. The maximum straw yield of wheat was 64.47 q/ha and 65.27 q/ha in the year of 2019-20 and 2020-21, respectively. The maximum straw yield of wheat was observed in plots treated with tankmixed pre-emergence application of Metribuzin @ 0.3 a. i. kg/ha and Metsulfuron methyl @ 0.3 a. i. kg/ha. It might be due to plant dryweight, maximum number of tillers per plant, and also due density of weeds. This treatment was statistically at par with handweeded plots during 2019-20 and 2020-21. The minimum straw yield of wheat was recorded in unweeded plots.

### Harvest index

Harvest index of wheat was not significantly different due to weed control treatments in the year 2019-20 and 2020-21. The maximum harvest index of wheat was 45.06 % and 45.07% in the year of 2019-20 and 2020-21, respectively. The maximum harvest index of wheat was observed in plots treated with tank mixed post emergence application of pre emergence application of Metribuzin @ 0.3 a. i. kg/ha and Metsulfuron methyl @ 0.3 a. i. kg/ha. It might be due to maximum grain and straw yield. This treatment was statistically at par with handweeded plots during both the year. The minimum harvest index of wheat was observed in unweeded plots (Table 6).

## DISCUSSION

The number of effective tillers per plant and number of grains per earhead of wheat in the year 2019-20 and 2020-21 was highest in the plots treated with pre- emergence application of Metribuzine @ 0.3 a.i. kg/ha + post emergence application of metsulfuron methyl @ 0.3 a.i. kg/ha. This treatment was statistically at par with hand weeded plots during both the year. The least number of effective tillers per plant and number of grains per ear head was observed in unweeded plots. The major weeds that were present in wheat were Parthenium hysterophorus L., Phalaris minor L., Chenopodium album L., Viciahirsuta L., Cynodonectylon (L.) Pers and Cyoperusrotundus L. In general, it was observed in the two years field trial that the emergence pattern of the major weeds in wheat in the experimental field were almost similar and did not differ much in both the years.

## CONCLUSION

On the basis of present investigation, it may be concluded that: In wheat tankmixed pre-emergence application of Metribuzine @ 0.3 a.i. kg/ha + post emergence application of metsulfuron methyl @ 0.3 a.i. kg/ha resulted in least weed population, maximum yield and yield attributes with maximum net return and benefit cost ratio.

**Table 2.** Effect of different weed control treatments on number of grains per earhead of wheat.

Treatments	Rates (a.i.kg/ha)	Number of grains/earhead		
		Year		Mean
		2019-20	2020-21	
Pendimethalin + hand weeding	1.0	52.00	52.66	52.33
Pendimethalin + hoeing	1.0	48.33	49.66	49.00
Pendimethalin + metsulfuron methyl	0.3	53.00	53.66	53.33
Metsulfuron methyl + hand weeding	0.3	50.00	50.33	50.17
Metsulfuron methyl + hoeing	0.3	54.33	55.00	54.67
Metribuzine + hand weeding	0.3	53.66	54.33	54.00
Metribuzine + hoeing	0.3	55.00	55.66	55.33
Metribuzine + metsulfuron methyl	0.3 + 0.3	56.66	57.66	57.16
Two hand weeding		54.13	55.42	54.78
Two hoeing		53.02	53.16	53.09
Hand weeding + hoeing		51.10	52.30	51.70
Hoeing + Hand weeding		53.83	54.85	54.34
Weed free		55.33	56.00	55.67
Weedy check		48.00	49.33	48.67
F- test		s <sup>1</sup>	s	
<b>SEd ±</b>		<b>3.154878</b>	<b>3.6305</b>	
<b>CD (5%)</b>		<b>6.628399</b>	<b>7.627771</b>	

**Table 3.** Effect of different weed control treatments on test weight of wheat.

Treatments	Rates (a.i.kg/ha)	Test weight-1000 (g)		
		Year		Mean
		2019-20	2020-21	
Pendimethalin + hand weeding	1.0	38.00	41.17	39.59
Pendimethalin + hoeing	1.0	36.13	37.67	36.90
Pendimethalin + metsulfuron methyl	0.3	38.73	41.67	40.20
Metsulfuron methyl + hand weeding	0.3	37.47	39.37	38.42
Metsulfuron methyl + hoeing	0.3	40.83	43.00	41.92
Metribuzine + hand weeding	0.3	39.13	42.60	40.87
Metribuzine + hoeing	0.3	41.10	43.03	42.07
Metribuzine + metsulfuron methyl	0.3 + 0.3	42.03	44.10	43.07
Two hand weeding		40.90	43.01	41.96
Two hoeing		38.40	39.17	38.79
Hand weeding + hoeing		40.23	42.00	41.12
Hoeing + Hand weeding		39.03	41.61	40.32
Weed free		41.97	44.07	43.02
Weedy check		36.27	37.37	36.82
F- test		s <sup>1</sup>	s	
<b>SEd ±</b>		<b>2.087988</b>	<b>2.1688</b>	
<b>CD (5%)</b>		<b>4.386863</b>	<b>4.556638</b>	

**Table 4.** Effect of different weed control treatments on grain yield of wheat.

Treatments	Rates (a.i.kg/ha)	Grain yield (q/ha)		
		Year		Mean
		2019-20	2020-21	
Pendimethalin + hand weeding	1.0	49.93	50.40	50.17
Pendimethalin + hoeing	1.0	46.97	48.10	47.54
Pendimethalin + metsulfuron methyl	0.3	50.10	51.73	50.92
Metsulfuron methyl + hand weeding	0.3	48.07	50.13	49.10
Metsulfuron methyl + hoeing	0.3	51.17	52.13	51.65

Metribuzine + hand weeding	0.3	50.33	52.03	51.18
Metribuzine + hoeing	0.3	51.40	52.37	51.89
Metribuzine + metsulfuron methyl	0.3 + 0.3	52.87	53.53	53.20
Two hand weeding		52.57	53.23	52.90
Two hoeing		47.53	49.95	48.74
Hand weeding + hoeing		49.17	50.13	49.65
Hoeing + Hand weeding		48.63	49.03	48.83
Weed free		52.90	53.67	53.29
Weedy check		44.53	46.97	45.75
F- test		s <sup>1</sup>	s	
<b>SEd ±</b>		<b>3.449667</b>	<b>2.2711</b>	
<b>CD (5%)</b>		<b>7.247749</b>	<b>4.771594</b>	

**Table 5.** Effect of different weed control treatments on straw yield of wheat.

Treatments	Rates (a.i.kg/ha)	Straw yield (q/ha)		
		Year		Mean
		2019-20	2020-21	
Pendimethalin + hand weeding	1.0	57.50	62.10	59.80
Pendimethalin + hoeing	1.0	53.07	61.53	57.30
Pendimethalin + metsulfuron methyl	0.3	59.30	62.13	60.72
Metsulfuron methyl + hand weeding	0.3	57.03	61.30	59.17
Metsulfuron methyl + hoeing	0.3	61.60	63.97	62.79
Metribuzine + hand weeding	0.3	59.97	63.90	61.94
Metribuzine + hoeing	0.3	62.90	64.60	63.75
Metribuzine + metsulfuron methyl	0.3 + 0.3	64.47	65.27	64.87
Two hand weeding		61.53	62.17	61.85
Two hoeing		63.60	64.97	64.29
Hand weeding + hoeing		60.97	61.90	61.44
Hoeing + Hand weeding		61.90	62.60	62.25
Weed free		65.53	65.17	65.35
Weedy check		51.87	61.30	56.59
F- test		s <sup>1</sup>	s	
<b>SEd ±</b>		<b>4.322977</b>	<b>1.8879</b>	
<b>CD (5%)</b>		<b>9.082575</b>	<b>3.966445</b>	

**Table 6.** Effect of different weed control treatments on harvest index of wheat.

Treatments	Rates (a.i.kg/ha)	Harvest Index (%)		
		Year		Mean
		2019-20	2020-21	
Pendimethalin + hand weeding	1.0	46.48	44.80	45.64
Pendimethalin + hoeing	1.0	46.95	43.87	45.41
Pendimethalin + metsulfuron methyl	0.3	45.80	45.43	45.61
Metsulfuron methyl + hand weeding	0.3	45.74	44.99	45.36

Metsulfuron methyl + hoeing	0.3	45.38	44.90	45.14
Metribuzine + hand weeding	0.3	45.63	44.88	45.26
Metribuzine + hoeing	0.3	44.97	44.77	44.87
Metribuzine + metsulfuron methyl	0.3 + 0.3	45.06	45.07	45.06
Two hand weeding		46.07	46.13	46.10
Two hoeing		42.77	43.47	43.12
Hand weeding + hoeing		44.64	44.75	44.70
Hoeing + Hand weeding		44.00	43.92	43.96
Weed free		44.67	45.16	44.91
Weedy check		46.19	43.38	44.79
F- test		ns <sup>1</sup>	ns	
SEd ±		<b>1.101658</b>	<b>1.0705</b>	
CD (5%)				

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