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Rahul Yadav

Department of Agronomy Rama
University Mandhana Kanpur,
Uttar Pradesh, India

Shubhranshu Singh

Department of Agronomy
(ANDUA&T), Kumarganj,
Ayodhya, Uttar Pradesh, India

Pooja Yadav

Department of Agronomy
(ANDUA&T), Kumarganj,
Ayodhya, Uttar Pradesh, India

Ramniwas Yadav

Assistant Professor, Department
of Agronomy Rama University
Mandhana Kanpur, Uttar
Pradesh, India

Chandan Singh

Department of Agronomy Rama
University Mandhana Kanpur,
Uttar Pradesh, India

Jayesh Singh

Department of Agronomy Rama
University Mandhana Kanpur,
Uttar Pradesh, India

Corresponding Author:

Rahul Yadav

Department of Agronomy Rama
University Mandhana Kanpur,
Uttar Pradesh, India

Effect of weed management practices on growth and yield of wheat (*Triticum aestivum*) crops

Rahul Yadav, Shubhranshu Singh, Pooja Yadav, Ramniwas Yadav, Chandan Singh and Jayesh Singh

Abstract

The present investigation entitled “Effect of weed management practices on growth and yield of wheat (*Triticum aestivum*) crops” was conducted at Agronomy Research Farm, Rama University Mandhana, Kanpur (U.P.) during *Rabi* season of 2021-22. The experiment was laid out in Randomized block design with three replications keeping eight weed management practices Prosulfocarb 80 EC (PE) 1600 ml/ha, Prosulfocarb 80 EC (PE) 2000 ml/ha, Prosulfocarb 80 EC (PE) 3000 ml/ha, Sulfosulfuron @ 25g/h, Clodinopop+Metsulfuron @ 60+4 gm. a.i./ha, Sulfosulfuron+Metsulfuron @30+4 gm.a.i./ha, Weed free up to 60 days, Weedy Check. Results revealed that among weed management practices weed free followed by Sulfosulfuron (30g) + metsulfuron (4g) a.i ha⁻¹ proved as superior than other treatments with respect to higher crop growth and yield attributes where as weed density, plant height, leaf area index, grain and straw yield. Maximum gross return and cost of cultivation was found with weed free treatment combination. While maximum net return was found with Sulfosulfuron (30g) + metsulfuron (4g) a.i ha⁻¹. Maximum B:C ratio was obtained in combination of Sulfosulfuron (30g) + metsulfuron (4g) a.i ha⁻¹. The planting was done on 4th december 2021. Among the various weed management treatment Sulfosulfuron (30g) + metsulfuron (4g) a.i ha⁻¹ recorded highest B:C ration and yield.

Keywords: Weed management, wheat

Introduction

Wheat (*Triticum aestivum* L.) is the most important grain crop both in regard to its antiquity and its use as a source of human food. Wheat serves as a staple food for about one billion people in as many as 43 countries of the world. It provides about 20 percent of total food calories for the human diet.

Wheat is grown worldwide, approximately 220 million ha. About half of which is in developing countries. The main wheat growing countries include, China, India, U.S.A., Russia, France, Canada, Germany, Turkey, Australia, and Ukraine. Wheat, in India, next only rice in terms of area and production. Wheat is member of Poaceae family and believed to be originated from the South-West Asia.

The major wheat production in India are Uttar Pradesh, Punjab, Haryana, with the production of 28.5, 15.73 and 11.23 mt, respectively, the U.P. ranked first in percentage share of wheat production (35.39%) with second of Punjab (19.80%) and third of Haryana (13.45%) but Punjab has the highest productivity followed by Haryana and U.P. with 4462 kg ha⁻¹, 4390 kg ha⁻¹ and 4351 kg ha⁻¹, respectively. (Anonymous, 2018). Phalaris minor is one of the very serious weed in rice wheat cropping system and sometimes almost 100 per cent crop losses have been reported Singh and Singh (2002) [7]. However, some broad leaf weeds are also causing a threat but their control is comparatively easier and effective but control of Phalaris minor has become a serious challenge.

Weed control indices influenced considerably due to weed management practices. Among different herbicidal treatments, the highest weed control efficiency (91.5 %) was recorded in metsulfuron + sulfosulfuron. The results corroborate with the finding of Khokhar and Nepalia (2010). Different weed management treatment significantly affected the grain yield of wheat crops as compared to weedy check. Grain yield increased significantly due to metsulfuron + sulfosulfuron closely followed by metsulfuron + isoproturon, 2, 4-D +isoproturon and 2,4-D +sulfosulfuron.

Result and Discussion

Density of weed

The data pertaining of weed density recorded at 30, 60, 90 Days and at harvesting stage were subjected to statistical analysis (1) and presented in table (1).

It is evident from the data presented in table that density of weed was affected statistically due to different weed management practices all stage of crop growth. It is further revealed that population of *phalaris minor* and other weed increased up to 90 days and reduced slightly at harvesting stage in all weed management treatment significantly. Weed free up to 60 days recorded the lowest density of weeds at 90 days and harvesting stage as compared to rest of the weed management treatment. Weed check till maturity recorded significantly the maximum population of weed at all the stage of crop growth.

It is further noted that post-emergence spray of sulfosulfuron @30 g. a.i. /ha being at par with pre-emergence spray of prosulfocarb 80EC@2000ml /ha but recorded significantly the lowest population of *phalaris minor* and other weed over pre-emergence spray of prosulfocarb either at 3000ml & 1600ml/ha. Among the prosulfocarb treatment, significantly lowest population of other weeds was recorded where applied @2000 ml over applied @3000 ml & 1600 ml.

Thus, it is inferred that population of *phalaris minor* & other weeds was recorded that lowest with sulfosulfuron +metsulfuron@ (30+4) a.i. /ha over rest of the treatments but

being at par with clodinopop+metsulfuron@ (60+4) g. a. i. /ha at all stage of crop growth.

Among the prosulfocarb, the lowest population of both type of weed was recorded under 2000ml/ha. However significantly over 1600ml/ha. It is further noted that sulfosulfuron @ 25 g. a. i. /ha (POE) being at par with prosulfocarb@2000ml/ha but recorded significantly the lowest population of *phalaris minor* & other weed at all stages of crop growth. Post emergence herbicide spray was done after 30 days but population of weeds (*P.minor* and other weeds) recorded at 30 days was similar to that weedy check treatments. However, the population of weed under weed free plot was not observed at 30 & 60 days' stage prosulfocarb herbicide was sprayed as pre-emergence. Thus, the population of both of *phalaris minor* and other weeds recorded at 30 days was significantly, the lowest with prosulfocarb @ 2000ml/ha over prosulfocarb @1600ml/ha, however being at par with prosulfocarb @3000ml/ha. The higher weed population with all prosulfocarb treatment as a compared to rest of the herbicide at 60, 90 days and harvesting stage was mainly due to Sulfosulfuron or herbicide in combination. On the other hand, higher control of weed (narrow leaved and broad leaved by herbicide use in combination caused heavy reduction in weed population resulted in lower weed density at 60, 90 days and harvesting stage. Poor efficiency of Sulfosulfuron as compared to herbicide used in combination rested in & significantly lower weed population of weed.

Table 1: Density of weed affected by different weed management practices (No. m⁻²).

Treatment	30DAS		60DAS		90DAS	
	<i>P. minor</i>	O. Weed	<i>P. minor</i>	O. Weed	<i>P. minor</i>	O. Weed
Prosulfocarb 80 EC (PE) 1600 ml a. i. /ha	2.99	10.73	3.58	7.63	3.77	11.18
Prosulfocarb 80 EC (PE) 2000 ml.a.i./ha	2.78	10.75	3.41	8.13	3.65	12.75
Prosulfocarb 80 EC (PE) 3000 ml.a.i./ha	2.72	9.3	3.37	7.9	3.60	12.69
Sulfosulfuron @25 g.a.i./ha (POE)	2.57	14.72	3.28	8.5	3.54	13.77
Clodinopop+Metsulfuron@60g+4g a.i./ha(POE)	2.52	15.43	3.02	9.73	3.20	16.71
Sulfosulfuron+Metsulfuron@30g+4a.i./ha (POE)	2.37	14.37	2.90	10.56	3.11	18.03
Weed free up to 25-50 DAS	--	--	--	--	2.67	--
Weedy check till maturity	4.52	14.1	5.21	11.31	5.60	18.97
SEm±	0.40	0.25	0.31	0.41	0.35	0.33
CD (P=0.05)	1.26	0.76	0.96	1.26	1.08	1.01

Lowest weed population of both (*P.minor* and other weed) under weed free up to 60 days was mainly due to the fact that poor emergence or slow emergence of weed after 60 days rested in lower weed population. Similar lower weed population to all stage of crop growth was recorded by Tomar & Tomar (2014), Singh *et al.* (2013)^{19,71}.

Plant height

Table 2: Plant height are affected by different weed management practices

Treatment	Plant height (cm)	
	60DAS	At harvest
Prosulfocarb 80 EC (PE) 1600 ml.a.i./ha	49.56	71.35
Prosulfocarb 80 EC (PE) 2000 ml.a.i./ha	49.97	73.94
Prosulfocarb 80 EC (PE) 3000 ml.a.i./ha	51.6	75.39
Sulfosulfuron @25 g.a.i./ha (POE)	51.89	77.36
Clodinopop+Metsulfuron @60g+4g a.i./ha(POE)	52.88	82.01
Sulfosulfuron+Metsulfuron@30g+4a.i./ha (POE)	53.07	84.55
Weed free up to 25-50 DAS	54.33	90.16
Weedy check till maturity	48.41	63.10
SEm±	0.52	2.08
CD (P=0.05)	1.57	6.33

Weed free up to 25-50 days recorded significantly tallest plant as compare to sulfosulfuron@30g a.i. /ha and all 3 formulation of @60 days and harvesting stage. Among the herbicide treatment application of sulfosulfuron + metsulfuron @ (60+4) recorded significantly more plant height over prosulfocarb at the rate of 2000ml & prosulfocarb 1600 ml at 60 days and harvesting stage. Among the prosulfocarb treatment pre-emergence spray of prosulfocarb 2000ml/ha recorded non-significantly more height followed by

prosulfocarb 3000ml/ha.

Leaf area index

The data presented in table 4.3 regarding leaf area index at different crop growth stage indicated that all weed control method affected leaf index significantly at all stages of crop growth except 30 days. It is further noted that leaf area index was recorded maximum at 30, 60 and 90 days.

Table 3: Leaf area index are affected by Different weed management practices

Treatment	Leaf area Index		
	30 DAS	60 DAS	90 DAS
Prosulfocarb 80 EC (PE) 1600 ml.a.i./ha	1.37	3.97	4.26
Prosulfocarb 80 EC (PE) 2000 ml.a.i./ha	1.52	4.11	4.33
Prosulfocarb 80 EC (PE) 3000 ml.a.i./ha	1.96	4.02	4.52
Salfosfuron @25 g.a.i./ha (POE)	2.15	4.30	4.84
Clodinopop+Metsulfuron@60g+4g a.i./ha(POE)	2.15	4.57	5.3
Sulfosulfuron+Metsulfuron@30g+4a.i./ha (POE)	2.19	4.70	5.45
Weed free up to 25-50 DAS	2.45	5.07	5.87
Weedy check till maturity	1.07	3.56	4.15
SEm±	0.38	0.06	0.16
CD (P=0.05)	NS	0.18	0.47

Weed free up to 25-50 days' treatment recorded significantly higher value (5.07,5.87) at 60,90 days except 30 day respectively as compare to rest of the treatment at all stage of crop growth. However, the difference between weed free up to 25-50 days and sulfosulfuron +metsulfuron@ (30+4) g. a. i. /ha was found non-significant at all stage of crop growth.

Amount the herbicide treatment sulfosulfuron+metsulfuron as post- emergence being at par with clodinopop+metsulfuron but produced significantly maximum leaf area over rest of the treatment at all stage at crop growth.

Among the prosulfocarb treatment, the maximum leaf area index was recorded with post –emergence spray of prosulfocarb @3000ml/ha followed by prosulfocarb @2000ml/ha and prosulfocarb 1600 ml/ha. Weedy check treatment recorded significantly the lowest value of leaf area index as compare to rest of the treatment.

Leaf area index was significantly higher in weed free upto 25-5- days' treatment. This was because of the fact that the crop was kept free from weeds upto 25-50 days hence, no crop-weed competition upto 60 days resulted in higher availability of light, space and plantnutrient to crop resulted in higher growth attributes. Similarly, efficient control of weed.

Yield attribute

Weed free up to 25-50 days after sowing produced significantly higher grain and straw yield over rest of the treatments, among the herbicide treatments, post- emergence application of sulfosulfuron + metsulfuron (30+4) g.a.i./ha recorded significantly higher grain & biological yield as compare to rest of the treatment except prosulfocarb @ 3000 ml and prosulfocarb @ 2000 ml/ha. Post-emergence application of prosulfocarb @ 2000 ml/ha recorded higher grain yield, straw yield, biological yield. Weedy check till maturity recorded significantly the lowest grain yield, straw yield as compare to rest of the treatment.

The percent increase in grain yield due to weed free up to 25-50 days was recorded to the 48.85 qha⁻¹ of 46.15, 45.75, 43.15, 42.05, 41.25, 39.80 and 35.20 and over sulfosulfuron + metsulfuron, clodinopop + metsulfuron, sulfosulfuron @ 30 g a.i./ha, prosulfocarb @ 3000 ml/ha, prosulfocarb @2000 ml /ha, prosulfocarb @1600 ml/ha and weedy check respectively. The higher grain yield under & weed free treatment was mainly because of lowest weed population & dry weight owing to continuous removal of weed up to 25-50 days and coupled with poor emergence of weed after 25-50 days.

Table 4: Grain yield and straw yield and harvest index are affected by different weed management practices

Treatment	Grain yield (q ha ⁻¹)	Straw yield (q ha ⁻¹)
Prosulfocarb 80 EC (PE) 1600 ml.a.i./ha	39.80	59.27
Prosulfocarb 80 EC (PE) 2000 ml.a.i./ha	41.25	71.27
Prosulfocarb 80 EC (PE) 3000 ml.a.i./ha	42.05	72.12
Salfosfuron @25 g.a.i./ha (POE)	43.15	73.00
Clodinopop+Metsulfuron @60g+4g a.i./ha(POE)	45.75	76.45
Sulfosulfuron+Metsulfuron@30g+4a.i./ha (POE)	46.15	71.75
Weed free up to 25-50 DAS	48.85	82.75
Weedy check till maturity	35.20	61.64
SEm±	1.01	1.85
CD (P=0.05)	3.06	5.60

Economics

Among weed management practices maximum cost of cultivation (Rs. 53931) found with weed free was higher than rest of the weed management practices. Data indicated that

weed free gave highest gross return Rs.106785 followed Sulfosulfuron + Metsulfuron 30+4 gm./ha with gross return Rs.99015. Maximum net return of Rs. 52854 received from weed free followed by Sulfosulfuron + metsulfuron 30+4

gm/ha (Rs.47175). The treatment Sulfosulfuron + Metsulfuron 30+4 gm/ha registered maximum benefit cost

ratio (1.91), Clodinopop+Metsulfuron60+4gm/ha (1.88). Minimum benefit cost ratio (1.69).

Table 5: Economic study of wheat as affected by different practices

Treatment	Cost of cultivation (Rs. ha ⁻¹)	Gross income (Rs. ha ⁻¹)	Net return (Rs. ha ⁻¹)	B:C (Rs. ⁻¹ invested)
Prosulfocarb 80 EC (PE) 1600 ml.a.i./ha	47760	83580	35820	1.75
Prosulfocarb 80 EC (PE) 2000 ml.a.i./ha	48394	86625	38231	1.79
Prosulfocarb 80 EC (PE) 3000 ml.a.i./ha	48519	88305	39786	1.82
Salfosulfuron @25 g.a.i./ha (POE)	48981	90615	41634	1.85
Clodinopop+Metsulfuron@60g+4g a.i./ha(POE)	51104	96075	44971	1.88
Sulfosulfuron+Metsulfuron@30g+4a.i./ha (POE)	51840	99015	47175	1.91
Weed free up to 25-50 DAS	53931	106785	52854	1.98
Weedy check till maturity	45654	73920	28266	1.61

Conclusion

- The results of experiments conducted at Agronomy research farm Rama University Mandhana Kanpur (U.P.) during 2021-22 conducted that to ensure maximum grain yield and remuneration from wheat.
- Weed free found most effective to weed control. Among the herbicide post emergence application of Sulfosulfuron +Metsulfuron (30+4) gm.a.i./ha which was found most effective weed control.
- Post emergence application of herbicide Sulfosulfuron +metsulfuron (30+4) gm.a.i./ha the net return (47175 Rs/ha) and B:C ratio 1.91 were also higher with Salfosulfuron+Metsulfuron (30+4) gm.a.i./ha.

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