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Effect of various broad spectrum herbicide combinations on productivity of wheat (*Triticum aestivum* L.)

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Abstract

Keeping above view in mind the present investigation entitled “Effect of various broad spectrum herbicide combinations on productivity of wheat (*Triticum aestivum* L.)” was carried out at “KVK Farm, IGKV, Raipur (C.G.) during *Rabi* season of 2020-21. Variety of Wheat under experimentation was CG AMBER which has special gluten quality. The crop was grown under irrigated condition after harvest of rice. The experiment was laid out in randomized complete block design with 3 replications and 10 treatments. The treatments consisted of different weed management practices in wheat Sulfosulfuron (75 WP) + Metsulfuron-methyl (5 WP) (pre-mix) (T₁), Mesosulfuron-methyl (3WG) + Iodosulfuron-methyl (0.6WG) (pre-mix) (T₂), Sulfosulfuron (75WP) + Metribuzine (70 WP) (tank mix) (T₃), Clodinafop-propargyl (15WP)+ Metribuzine (70WP) (tank mix) (T₄), Clodinafop-propargyl (15WP) + Metsulfuron-methyl (1WP) (pre-mix) (T₅), Pinoxaden (5.1WP)+ Metsulfuron-methyl (20WP) (tank Mix) (T₆), two hand weeding at 20 and 40 DAS (T₇), Inter row mechanical weeding + hand weeding intra row at 20 DAS (T₈), two hand weeding at 20 and 40 DAS + mechanical weeding by hand hoe at 25 DAS (T₉), Weedy check (T₁₀). The wheat crop was supplied with the recommended dose of fertilizer @ 120:60:40 N: P: K kg ha⁻¹. Soil of the experimental field soil was sandy loam (Inceptisol) with low N, medium P and high K content. The result revealed that among different weed management practices. Two hand weeding at 20 and 40 DAS + mechanical weeding by hand hoe at 25 DAS produced the maximum value of growth, yield attributes, grain yield (42.72 q ha⁻¹) and straw yield (56.10 q ha⁻¹). However, grain yield of wheat was statically at par with two hand weeding at 20 and 40 DAS (T₇), Mesosulfuron-methyl + iodosulfuron methyl (12g+2.4g ha⁻¹ POE) (pre-mix) (T₂) at 30,60,90 and 120 DAS over weedy check plot. The higher cultivation cost (45358 ₹ ha⁻¹), gross monetary returns (95628 ₹ ha⁻¹) were noticed with two hand weeding at 20 and 40 DAS + mechanical weeding by hand hoe at 25 DAS (T₉) being comparable to Two hand weeding at 20 and 40 DAS (T₇). Maximum net returns (59080 ₹ ha⁻¹) and higher B: C (2:73) ratio was noticed under (Mesosulfuron-methyl +iodosulfuron methyl) (12g+2.4g ha⁻¹ POE) (pre-mix) (T₂) over weedy check plot.

Keywords: Wheat, *Triticum aestivum*, special gluten quality

Introduction

Wheat (*Triticum aestivum* L.) is the extensively cultivated main food crop of the world Major wheat producing countries of the world are China, India, United States of America, France, Russia, Canada, Germany, Turkey, Australia, Ukraine, and Pakistan. It is grown in 219.61 million ha area with production of 729.10 million tonnes in the world (FAO). For food security its secure production and supply is needed, the area, production and productivity of wheat in India are 30.72 million ha, 97.44 million ton and 3172 kg ha⁻¹, respectively (ICAR-IIWBR 2017 [2]. Directors’ Report of AICRP on wheat). Wheat is the single most important crop that has been considered as an integral component of the food security system of several nations, it has been considered as the “king of cereals” because of the acreage and high productivity. Wheat being the extensively important cereal crop after rice in the country, contributes nearly one third to total production. It is an excellent health – building food containing approximately 78% carbohydrate, 10-12% protein, 2% minerals and significant amounts of vitamin (Kumar *et al.* 2011) [5]. The progress in Indian economy can be made by increasing the productivity of wheat in the country. Wheat is cultivated in rotation with a number of crops under irrigated conditions; the major area is under rice-wheat system. The productivity of wheat is higher in northern states, wheat crop is mainly grown in the northern states and Uttar Pradesh is at the top with total production of 25.22 million tone followed by Punjab with 15.78 million tonnes, but the productivity of wheat crop is highest in Punjab.

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Wheat is sown from the month of September to December in various states of India and harvesting is done from February to May. The winter temperature when the sowing is to be done should range from 10 to 15 degree Celsius and at the time of harvesting it should be from 21 to 26 degree Celsius. The main wheat producing states are UP, Punjab, and Haryana participating 34%, 21%, and 13% correspondingly. In India different techniques are used to control weeds like physical, mechanical, cultural and chemical methods, Hand or manual weeding though very effective and commonly adopted in India is expensive, tedious and many times it becomes uneconomic, Chemical weed management is an important alternative, due to unavailability of labour and high labour cost, also there is lesser feasibility of mechanical weeding in wheat. There is a need to evaluate such molecules of herbicides, which are safe to soil health as well as grain quality. Weed control cost is major portion of input cost in crop production and herbicide, provides a better opportunity to control weeds in wheat crop where manual or mechanical weeding is not possible.

Material and Methods

The present study, entitled “Effect of various herbicide combinations on productivity of wheat (*Triticum aestivum* L.)” was carried-out during *Rabi* season of 2020-21. The soil was clay in texture (vertisoles) with low N, medium P and high K content. The experiment was laid out in Randomized Block Design with 3 replications and 10 treatments. *Viz.* Sulfosulfuron (75WP) + Metsulfuron-methyl (5WP) (pre-mix) (T₁), Mesosulfuron-methyl (3WG) + Iodosulfuron-methyl (0.6WG) (pre-mix) (T₂), Sulfosulfuron (75WP) + Metribuzine (70WP) (tank mix) (T₃), Clodinafop-propargyl (15WP) + Metribuzine (70WP) (tank mix) (T₄), Clodinafop-propargyl (15WP) + Metsulfuron-methyl (1WP) (pre-mix) (T₅), Pinoxaden (5.1 WP) + Metsulfuron-methyl (20WP) (tank Mix) (T₆), Two hand weedings at 20 and 40 DAS (T₇), Inter row mechanical weeding + hand weeding intra row at 20 DAS (T₈), Two hand weedings at 20 and 40 DAS + mechanical weeding by hand hoe at 25 DAS (T₉), Weedy check (T₁₀), the wheat crop was supplied with the recommended dose of fertilizer @ 120:60:40 N: P: K kg ha⁻¹. Five consecutive irrigations were given by controlled flooding method just after sowing at 20 days interval in order to ensure proper germination of the crop. The grain and straw yield were recorded from net plot area after removing border area. The gross return cost of cultivation and net return were calculated from market price of the different input and outputs. B:C ratio was calculated by dividing gross returns to cost of cultivation.

Results and Discussion

Length of ear head (cm)

The data in respect to length of ear head (cm) as influenced by different weed control treatments are presented in Table 1. The Length of ear head (cm) varied significantly under different herbicidal treatment. Two hand weedings at 20 and 40 DAS + mechanical weeding by hand hoe at 25 DAS (T₉) (10.62 cm) produced significantly maximum length of ear head however it was at par with two hand weedings at 20 and 40 DAS (T₇) (10.52 cm), Mesosulfuron-methyl (3%WG) + Iodosulfuron-methyl (0.6%WG) (pre-mix) (12g+2.4g ha⁻¹) (pre-mix) (T₂) (9.84 cm), Sulfosulfuron (75%WP) + Metsulfuron-methyl (5%WP) (pre-mix) (30 g + 2 g ha⁻¹ POE)

(T₁) (9.68 cm). Pradhan and Chakraborti (2010)^[9] also found similar results, which revealed that two hand weedings at 20 to 40 das gave higher ear head length.

No. of grains ear⁻¹

The data in respect to number of grains ear⁻¹ under different treatments are presented in the Table 1. The significantly maximum number of grains ear⁻¹ was obtained under two hand weedings at 20 and 40 DAS + mechanical weeding by hand hoe at 25 DAS (T₉) (57) which was at par with two hand weedings at 20 and 40 DAS (53.67) (T₇), Mesosulfuron-methyl (3%WG) + Iodosulfuron-methyl (0.6%WG) (pre-mix) (12g +2.4g ha⁻¹) (pre-mix) (T₂), Sulfosulfuron (75WP) +Metsulfuron-methyl (5WP) (pre-mix) (30 g + 2 g ha⁻¹ POE) (T₁) and the lowest number of grain ear⁻¹ were recorded under weedy check (T₁₀), respectively. Owing to maximum tiller number recorded in (T₉) two hand weedings at 20 and 40 DAS + mechanical weeding by hand hoe at 25 DAS, the highest number of grains ear⁻¹ was also produced under the same treatment. Similar results have also been reported by Chaudhary *et al.*, (2017)^[8].

1000 seed weight (g)

The results on 1000 seed weight showed that weed control activities have a major impact on 1000 wheat seed weight. Data pertaining to 1000 seed weight (g) as influenced by different weed control treatments are presented in Table 1. The 1000 seed weight (g) varied significantly under different weed management practices. two hand weedings at 20 and 40 DAS + mechanical weeding by hand hoe at 25 DAS (T₉) (44.83 g) produced significantly higher 1000 seed weight at par with two hand weedings at 20 and 40 DAS (T₇) (44.25), followed by Mesosulfuron-methyl (3WG) + Iodosulfuron-methyl (0.6WG) (12g +2.4g ha⁻¹) (T₂), Sulfosulfuron (75WP) + Metsulfuron-methyl (5WP) (pre-mix) (pre-mix) (30 g + 2 g ha⁻¹ POE) (T₁) (42.10g). Similar results have been also reported by Patel *et al.* (2017)^[8].

Effective tillers m⁻²

Data pertaining to number of effective tillers (m⁻²) as influenced by different weed control treatments are presented in Table 1. The effective tillers (m⁻²) varied significantly under different treatments. two hand weedings at 20 and 40 DAS + mechanical weeding by hand hoe at 25 DAS (T₉) (394 m⁻²) recorded maximum effective tillers (m⁻²) however it was at par with two hand weedings at 20 and 40 DAS (T₇) (378 m⁻²) followed by Mesosulfuron-methyl (3WG) + Iodosulfuron-methyl (0.6WG) (12g + 2.4g) (T₂) (375 m⁻²). Similar results have also been reported by Verma *et al.* (2017)^[10].

Grain yield (q ha⁻¹)

Grain yield as influenced by different weed control treatments on wheat are seen in Table 2. The findings revealed that two hand weedings at 20 and 40 DAS + mechanical weeding by hand hoe at 25 DAS (T₉), recorded significantly higher grain yield among different weed management practices (42.72 q ha⁻¹), however it was statistically at par with the treatment of two hand weedings at 20 and 40 DAS (T₇) (42.20 q ha⁻¹), mesosulfuron-methyl (3WG) + iodosulfuron-methyl (0.6WG) (12g + 2.4g ha⁻¹ POE) (pre- mix) (T₂) (41.32 q ha⁻¹) whereas the minimum grain yield was recorded under weedy check (31 q ha⁻¹), Different weed management methods substantially increased grain yield over weedy check plot, this may be

attributed to better weed protection combined with reduced weed population and enhanced yield contributing characteristics in those treatments. Nayak *et al.* (2003) also found similar result, which revealed that 2 hand weeding gave maximum grain yield. Singh (2011) [11] explained highest increase in grain yield (35.4 to 45.1%) was registered with twice mechanical weeding at 15 and 30 days after sowing over weedy check treatment.

Straw yield (q ha⁻¹)

Straw yield as influenced by different weed management practices on wheat is presented in Table 2. From the data it can be reported that straw yield was significantly affected by different weed management practices. The results indicated that the yield of straw was significantly higher in (T₇) two hand weedings at 20 and 40 DAS, however it was at par with (T₂) mesosulfuron-methyl (3WG) + iodosulfuron-methyl (0.6WG) (12g + 2.4g ha⁻¹ POE) (pre-mix), (T₉), Two hand weedings at 20 and 40 DAS + mechanical weeding by hand hoe at 25 DAS were significantly superior over weedy check plot.

Harvest index (%)

Data pertaining to harvest index (%) as affected by different weed control treatments are given in Table 2. Harvest index of wheat varied significantly due to weed control treatments Harvest index was also significantly influenced by various weed management practices. In weed management practices, two hand weedings at 20 and 40 DAS + mechanical weeding by hand hoe at 25 DAS (T₉) (43.14%) showed the maximum harvest index (%) during the years. However, it was at par with two hand weedings at 20 and 40 DAS (T₇) (42%), Mesosulfuron-methyl + iodosulfuron-methyl (pre-mix) (12g + 2.4g ha⁻¹POE) (T₂) (41.64%) under weedy check plot.

Weed index (%)

Weed index is the degree to which weeds compete in decreasing yield. Weed index data are presented in Table 2. The weed index has been affected by the weed control

practices considerably. Under weedy check (T₁₀), which was (27.43%), the maximum weed index was found. Whereas, the lowest weed index was reported under two hand weedings at 20 and 40 DAS + mechanical weeding by hand hoe at 25 DAS (T₉), followed by two hand weedings at 20 and 40 DAS (T₇), Mesosulfuron + iodosulfuron methyl (pre-mix) (12g + 2.4g ha⁻¹POE) (T₂) Similar results have also been reported by Meena *et al.* (2019) [17].

Economics

Highest gross return (95628 Rs ha⁻¹) was found with two hand weedings at 20 and 40 DAS + mechanical weeding by hand hoe at 25 DAS (T₉) followed by two hand weedings at 20 and 40 DAS (T₇) (94984 Rs ha⁻¹). The lowest gross monetary return was recorded under weedy check plot (72458 Rs ha⁻¹). Among various broad spectrum herbicide combination treatments mesosulfuron-methyl (3%WG) + iodosulfuron-methyl (0.6%WG) (pre-mix) (93175 Rs ha⁻¹) (12g+2.4g ha⁻¹POE) (T₂) produced maximum gross return followed by sulfosulfuron (75%WP) + metsulfuron-methyl (5%WP) (pre-mix) (86130 Rs ha⁻¹) (30 g + 2 g ha⁻¹ POE), (T₁) Among all the weed management practices, weedy check plot showed lowest net monetary return as suggested by Shakya *et al.* (2017) [12].

Highest net return (59080 Rs ha⁻¹) was found under mesosulfuron-methyl (3%WG) + iodosulfuron-methyl (0.6%WG) (pre-mix) (T₂) (93175 Rs ha⁻¹) (12g+2.4g ha⁻¹POE) followed by Sulfosulfuron (75% WP) +Metsulfuron-methyl (5% WP) (pre-mix) (30 g + 2 g ha⁻¹ POE) (T₁) (52045 Rs ha⁻¹), two hand weedings at 20 and 40 DAS (T₇) (51858 Rs ha⁻¹), two hand weedings at 20 and 40 DAS + mechanical weeding by hand hoe at 25 DAS (T₉) (50270 Rs ha⁻¹). Similar results have also been reported by Meena *et al.* (2017) [16].

The highest B:C ratio was recorded with Mesosulfuron-methyl (3%WG) + Iodosulfuron-methyl (0.6% WG) (12g + 2.4g ha⁻¹ POE) (pre-mix) (T₂) followed by Sulfosulfuron (75% WP) + Metsulfuron-methyl (5% WP) (30 g + 2 g ha⁻¹ POE) (pre-mix) (T₁).

Table 1: Effect of different weed management practices on yield attributes of wheat

Treatment	Dose (g ha ⁻¹)	Ear head length (cm)	1000 seed weight (g)	No of grain ear ⁻¹	No of effective tillers (m ⁻²)
T ₁ Sulfosulfuron (75WP) + Metsulfuron-methyl (5WP) (pre-mix)	30+2	9.68	42.10	53.00	373
T ₂ Mesosulfuron-methyl (3WG) + Iodosulfuron-methyl (0.6WG) (pre-mix)	12+2.4	9.84	42.81	53.33	375
T ₃ Sulfosulfuron (75WP) + Metribuzine (70WP) (tank mix)	25+210	9.57	41.66	50.67	367
T ₄ Clodinafop-propargyl (15WP) + Metribuzine (70WP) (tank mix)	60+210	9.41	40.34	49.33	365
T ₅ Clodinafop-propargyl (15WP) + Metsufuron-methyl (1WP) (pre-mix)	60+4	9.22	39.36	49.00	364
T ₆ Pinoxaden (5.1 WP) + Metsulfuron-methyl (20WP) (tank Mix)	60+4	9.04	39.21	48.67	359
T ₇ Two hand weedings at 20 and 40 DAS		10.52	44.25	53.67	378
T ₈ Mechanical weeding inter row +hand weeding intra row at 20 DAS		8.93	35.78	46.67	353
T ₉ Two hand weedings at 20 and 40 DAS + mechanical weeding at 25 DAS		10.62	44.83	57.00	394
T ₁₀ Weedy check		7.61	32.22	36.33	317
S.Em±		0.32	1.00	1.48	6.55
CD at 5%		0.95	2.98	4.39	19.47

Table 2: Effect of different weed management practices on grain yield, straw yield, harvest index and weed index of wheat

Treatment	(Dose g ha ⁻¹)	Grain yield (q ha ⁻¹)	Straw yield (q ha ⁻¹)	HI (%)	WI (%)
T ₁ Sulfosulfuron (75WP) +Metsulfuron-methyl (5WP) (pre-mix)	30+2	38.00	55.40	40.67	11.04
T ₂ Mesosulfuron-methyl (3WG) + Iodosulfuron-methyl (0.6WG) (pre-mix)	12+2.4	41.32	57.84	41.64	3.27
T ₃ Sulfosulfuron (75WP) + Metribuzine (70WP) (tank mix)	25+210	37.02	55.37	40.01	13.34
T ₄ Clodinafop-propargyl (15WP) + Metribuzine (70WP) (tank mix)	60+210	36.17	53.38	40.39	15.32
T ₅ Clodinafop-propargyl (15WP) + Metsufuron-methyl (1WP) (pre-mix)	60+4	36.08	53.23	40.38	15.54
T ₆ Pinoxaden (5.1 WP) + Metsulfuron-methyl (20WP) (tank Mix)	60+4	35.45	50.18	40.36	17.01

T ₇	Two hand weedings at 20 and 40 DAS	--	42.20	58.20	42.00	1.21
T ₁₀	Mechanical weeding inter row +hand weeding intra row at 20 DAS	--	35.03	50.17	41.11	17.99
T ₉	Two hand weedings at 20 and 40 DAS + mechanical weeding at 25 DAS	--	42.72	56.31	43.14	----
T ₁₀	Weedy check	--	31.00	56.17	35.57	27.43
	S.Em±		1.34	0.85	0.83	
	CD at 5%		3.98	2.54	2.46	

Conclusion

The maximum plant height, number of tillers per hill, leaf area index (LAI), crop growth rate (CGR), relative crop growth rate (RGR) was noted higher when two hand weedings at 20 and 40 DAS + mechanical weeding by hand hoe at 25 DAS (T₉). However, it was at par with two hand weedings at 20 and 40 DAS (T₇), Mesosulfuron-methyl + iodosulfuron-methyl (12g + 2.4g ha⁻¹POE) (pre-mix) (T₂) over weedy check plot.

Yield attributing characters like no of grains ear⁻¹, ear head length, and 1000 seed weight were higher under two hand weedings at 20 and 40 DAS + mechanical weeding by hand hoe at 25 DAS (T₉) found to be at par with two hand weedings at 20 and 40 DAS (T₇), Mesosulfuron-methyl + iodosulfuron-methyl (12g + 2.4g ha⁻¹POE) (pre-mix) (T₂) over weedy check plot.

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