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Influence of Different Herbicides on Weed Control and Yield of Wheat (*Triticum aestivum*)

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ABSTRACT

A field experiment was carried out during winter (rabi) seasons of 2007-08 at the research form of Pilikothi, Jaunpur, Uttar Pradesh, to evaluate the influence of different herbicides on weed control and yield of wheat (Triticum aestivum). Among the herbicidal treatments sulfosulfuron (30 g/ha) recorded the lowest weed density. However, this treatment remained statistically at par with clodinafop +2,4-D @ 60+ 500 g/ha, and sulfosulfuron (25 g/ha). Application of sulfosulfuron (30 g/ha) recorded the maximum values of plant height (93.54 cm at harvesting), number of tillers/m^2 (316 at harvest), dry- matter accumulation, grain yield (41.98 q/ha), which was closely followed by weed-free, sulfosulfuron (30 g/ha, clodinafop +2,4-D @ 60+ 500 g/ha and sulfosulfuron (25 g/ha.

Key words: *Herbicide efficacy, Herbicide mixture, Weed-management, Wheat yield*

INTRODUCTION

Wheat is the most important staple food crop for the whole world. Its production is directly affected by several factors and one of the most limiting factor is infestation of weeds. Weed reduces the yield of wheat up to 50% based on the infestation[1]. It is due to some dominated weed flora appearing at early stage and the luxuriant growth of weeds because of frequent irrigation and dominancy of monotony cropping system. For realizing full genetic yield potential of the crop, the proper weed control is one of the indispensible aspect. Weeds not only reduce the yield but also make the harvesting operation difficult. Therefore, for sustaining foodgrain production to feed burgeoning population and ensuring food security, effective weed management is very essential. Manual removal of weeds in wheat crop is laborious, time-consuming and uneconomical due to higher rate of labour wages. Therefore, chemical control of weeds is the preferred option. Farmers of the region generally used herbicides for weed control in wheat which has monotonous mode of action. This type of herbicide patterns has caused a shift in weed flora in favour of some broad-leaf weeds. It has also led to the development of resistance against widely used herbicide in weed species like *Phalaris minor* against isoproturon[5].

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The herbicides used patterns need to be rationalized in such a way that problem associated with such type of use pattern can be avoided in the future.

Use of herbicides in rotation or as tank-mix application may help not only increase the spectrum of weed control but also prevent or delay the development of weed resistance. 2,4-D is still providing excellent control of broadleaf weeds though is known to cause developmental deformities in certain wheat cultivars which subsequently results in reduction of the yield[2]. Use of non-conventional herbicides may not be expectable due to their injury/toxicity to wheat crop[3]. Under such conditions we need to evaluate suitable alternative herbicides for the control of complex weed-flora in wheat amongst new herbicide groups introduced recently against grasses and broad-leaf weeds. Some of the new herbicides which belong to sulfonylurea group are known to control grassy weeds effectively. While some other herbicides of the same group are reported to provide effective control of broad-leaf weeds including hardly weeds. To avoid the use of herbicides separately for the control of broad-leaf and grassy weeds, a selective herbicides alone or mix application for broad spectrum of weed control is needed. Hence, a comprehensive study was undertaken to keep the weeds below threshold level and assess the effect of different herbicide mixtures on crop growth, yield performance and nutrients acquisition of wheat.

MATERIAL AND METHODS

A field experiment was carried out during winter (*rabi)* season of 2007-08 at Department of Agronomy, at the research form of Pilikothi, Jaunpur, Uttar Pradesh. The soil of the experimental field was sandy loam in texture with pH 7.6. It was moderately fertile, being medium in available organic carbon (0.45%), low in available nitrogen (261 kg/ha) and medium in available phosphorus (7.46 kg/ha) and available potassium (193.15 kg/ha). The experiment was laid out in randomized block design with 8 weed-control treatments, *viz.*, sulfosulfuron @ 25 g/ha, sulfosulfuron @ 30 g/ha, clodinafop @ 60 g/ha, 2,4-D @ 500 g/ha, clodinafop +2,4-D @ 60+ 500 g/ha, isoproturon @ 1000 g/ha, weedy check and weed-free. All the treatments replicated thrice during the year. Field was prepared using disc harrowing twice at workable condition fallowed by planking with wooden plank for proper levelling. After laying out the experiment, recommended doses of nitrogen and phosphorus were given in the form of urea and single superphosphate. Half of the recommended dose of N (120 kg/ha) and full dose of P (60 kg P_2O_5/ha) and K (60 kg K_2O/ha) were applied basal and remaining nitrogen was top-dressed into 2 equal spli;s. The seed of wheat variety HUW 468' was sown in rows, spaced 22.5 cm using seed rate of 100 kg/ha 24 November during the years of experimentation. All the herbicides were applied at 35 DAS with the help of knapsack sprayer fitted with a flat-fan nozzle with a spray volume of 500 litres/ha. The weed-free plot was maintained by repeated manual weeding. The wheat crop was growth as per recommended practices and was harvested on 7 April during the year. For counting of weed population, an area of 0.25 m^2 was selected randomly by throwing a metallic quadrate of size 0.5m x 0.5 m at 2 places at 60,90 and 120 days after sowing (DAS) and expressed on square meter basis (No./m^2). Observation on crop growth, yield attributes and yield were recorded. The original data on weed density at all stages were subjected to square-root transformed ($\sqrt{x+1}$) before statistical analysis to analyze the significant effect of weed-control treatments on weed growth.

RESULTS AND DISCUSSION

Weeds

All the weed-control treatments recorded significantly lower weed density than weedy check (Table 1). Among the herbicides treatments, application of sulfosulfuron @ 30 g/ha exerted the maximum herbicidal effect and caused the highest reduction n the total weed density at all stages of crop growth, which however, was statistically at par with clodinafop +2,4-D (60+ 500 g/ha). This attributed to the inhibition of the germination of weeds due to paralysis of vital metabolic process of germination, viz. cell-division, protein synthesis and secretion of hydrolytic enzymes, and subsequently drying of susceptible weeds species. This might be due to fact that combined application of 2 herbicides known for controlling grassy and non-grassy weeds separately, provided effective control of all the weeds to achieve high level of weed control. These results confirm the findings of Singh *et al.*[8], and Zivesh and Mahdavi,[9].

Crop

Variation in crop growth attributes viz. plant height (cm), tillers (no./m^2) and dry-matter accumulation (g/m^2) of the wheat at both stage of crop growth was observed with the weed-control treatment (Table 2). The tallest plant, maximum number of tillers/running m^2, and dry-matter accumulation were recorded in weed free plot, although this remained statistically at par with some of the herbicidal treatments, namely sulfosulfuron @ 30 g/ha , clodinafop +2,4-D (60+ 500 g/ha), sulfosulfuron @ 25 g/ha and isoproturon (1000 g/ha). This might be owing to better performance of both combined application of herbicide for controlling grassy and broad-leaf weeds and therefore resulted in less weed-crop competition as compared to their alone application. These results are in close conformity with those reported by Singh *et al.*[7]. Amongst the herbicidal treatments, application of sulfosulfuron @ 30 g/ha revealed the highest values of all growth parameters which remained statistically at par with all the remained herbicidal treatments except clodinafop +2,4-D (60+ 500 g/ha) and sulfosulfuron @ 25 g/ha. This might be because of better performance of sulfosulfuron @ 30 g/ha against both grassy and non-grassy weeds. Comparative improvements in growth parameters of wheat with the application of new herbicides molecules as compared to the traditional herbicides were also reported by Paighan *et al.*[6]. Relatively poor performance of isoproturon was due to the fast that it could not control dominant population of broad-leaf weeds.

The data showed that the weed-control treatment has significant influence on grain, straw and biological yields. However, the weed-control treatments had failed to affect the harvest index (Table 2). The highest grain, straw and biological yields was recorded in plots which were kept weed free for the entire crop season. However, weed-free treatment resulted in statistically similar yields with sulfosulfuron @ 30 g/ha, clodinafop +2,4-D (60+ 500 g/ha) and sulfosulfuron @ 25 g/ha. As recorded to herbicidal treatments, sulfosulfuron @ 30 g/ha provided the highest grain, straw and biological yields, which however remained statistically at par with clodinafop +2,4-D (60+ 500 g/ha) and sulfosulfuron @ 25 g/ha. The better performance of these treatments could be attributed to better expressions of their yield due to reduction in crop-weed competition. This could be due to their selectivity to crop and significant effects on both grassy and non-grassy weeds. The sulfosulfuron @ 25 g/ha, isoproturon (1000 g/ha), 2,4-D @ 500 g/ha and clodinafop @ 60 g/ha application were statistically similar in to producing grain, straw and biological yields. These results confirm the findings of Singh *et al.*[8], and Bharat *et al.*[4].

Table: 1. Effect of weed-control treatments on weed dynamics of wheat

Treatment	Weeds density (Nos. per m^2)					
	60 DAS		90 DAS		120 DAS	
Sulfosulfuron (25 g/ha)	9.22	(83.99)	9.29	(85.32)	8.32	(68.33)
Sulfosulfuron (30 g/ha)	8.18	(66.01)	8.26	(67.34)	7.35	(53.00)
Clodinafop(60 g/ha)	11.12	(122.67)	11.40	(129.00)	10.34	(106.00)
2,4-D (500 g/ha)	10.66	(112.67)	10.78	(115.33)	9.83	(95.67)
Clodi +2,4-D (60 +500 g/ha)	8.64	(73.66)	8.64	(73.66)	7.85	(60.67)
Isoproturon (1000 g/ha)	9.90	(97.01)	10.03	(99.67)	9.07	(81.33)
Weedy check	13.82	(190)	14.19	(200.33)	13.10	(170.66)
Weed-free	1.00	(0.00)	1.00	(0.00)	1.00	(0.00)
SEm(±)	0.61	-	0.66	-	0.59	-
C.D. at 5%	1.85	-	2.00	-	1.78	-
C.V.	11.61	-	12.41	-	12.14	-

Figures in the parentheses are original value. Data were transformed through ($\sqrt{x+1}$)

Table: 2. Effect of weed-control treatment on growth and yield of wheat

Treatment	Plant height (cm) at harvest	Tillers (Nos./m^2) at harvesting	DMA (g/m^2) at 60 DAS	Grain yield (q/ha)	Straw yield (q/ha)	Biological yield (q/ha)
Sulfosulfuron (25 g/ha)	92.76	312	258.44	39.50	56.84	96.34
Sulfosulfuron (30 g/ha)	93.54	316	272.22	41.98	57.97	99.95
Clodinafop(60 g/ha)	90.75	295	244.52	36.33	59.27	95.60
2,4-D (500 g/ha)	91.86	302	252.32	38.00	59.00	97.00
Clodi +2,4-D (60 +500 g/ha)	93.43	314	265.42	41.20	56.89	98.09
Isoproturon (1000 g/ha)	92.52	310	254.51	38.50	57.75	96.25
Weedy check	87.49	260	204.82	28.23	47.50	75.73
Weed-free	94.32	320	282.22	43.25	59.00	102.25
SEm(±)	2.93	10.45	11.20	1.73	2.31	2.80
C.D. at 5%	N.S.	31.71	33.98	5.26	6.99	8.49
C.V.	-	5.97	7.63	7.83	7.03	5.10

NS – Non-significant

CONCLUSION

On the basis of the above results it is concluded that application of sulfosulfuron @ 30 g/ha, is advisable for reducing the weed present and obtaining the higher grain yield of wheat.

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