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Influence of Application Stage of Sulfonylurea Herbicides for the Control of *Phalaris minor* in Wheat

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ABSTRACT

Sulfosulfuron at 25 g ha^{-1} and mesosulfuron+iodosulfuron at 12 g ha^{-1} were applied 4, 7, 10, 15, 18 and 21 days after first irrigation (DAFI) to the wheat crop. First irrigation was given 25 days after sowing the wheat crop. The bioefficacy of these herbicides for controlling *Phalaris minor* was not affected due to stage of application and was similar to clodinafop. Herbicides applied 4 or 7 DAFI caused reduction in grain yield of wheat. However, application of these herbicides at other stages produced similar grain yields. Herbicides treated plots produced higher grain yield (67.4-86.7%) than unweeded crop.

INTRODUCTION

Wheat (*Triticum aestivum* L.) occupies the prime position among the food crops of the world in terms of production and consumption. In India, it is second important cereal, next to rice. This crop is commonly infested with grassy and broadleaf weeds, which cause yield loss to the tune of 30-50% (Brar *et al.*, 2003). *Phalaris minor* is the dominating weed of rice-wheat cropping system and it is also accompanied by many broadleaf weeds. Isoproturon was in use since 1980's in the wheat belt of India for effective control of grassy weeds, particularly *P. minor,* but its efficiency has declined from last one decade due to the development of resistance in *P. minor* (Walia *et al.*, 1997). In order to control isoproturon resistant *P. minor*, sulfosulfuron, clodinafop-propagyl and fenoxaprop-p-ethyl were recommended as post-emergence.

The efficiency of sulfonylurea group of herbicides depends upon many factors and among these, soil moisture is very important, as these herbicides are taken up by the plants both through root and foliage. Rahman and James (1991) reported that adequate soil moisture at the time of application of sulfonylurea herbicides was necessary for their optimal effectiveness and they observed high reduction in damage to crop plants from sulfonylurea herbicides, when soil moisture was reduced to 55%, and in many cases to 70% of field capacity at the time of application compared to the pots watered to 100% of field capacity. Two sulfonylurea herbicides sulfosulfuron (Leader 75 WDG) at 25 g ha^{-1} and mesosulfuron+iodosulfuron (Atlantis 3.6 WDG) at 12 g ha^{-1} were applied at different stages after first irrigation to the wheat crop in order to find out their toxic effect on crop, if any, as well as their bioefficacy for controlling *P. minor.*

MATERIALS AND METHODS

Field experiment was conducted at the experimental farm, Department of Agronomy and Agrometeorology during 2003-04 and 2004-05. The experimental field was under rice-wheat sequence for last many years. The soil of the experimental field was sandy loam in texture having 72.7, 11.7 and 15.6% of sand, silt and clay, respectively. The experimental field had enough natural population of *P. minor.* Sowing of wheat variety PBW 343 was done on November 12, 2003 and November 4, 2004 at 100 kg seed rate ha^{-1}. Crop was supplied with 125 kg N, 62.5 kg P_2O_5 and 30 kg K_2O ha^{-1}. Whole of phosphorus, potash and half of N was applied at the time of sowing and remaining half of N was applied with the first irrigation. First irrigation (7.5 cm) was given 26 and 25 days after sowing (DAS) during 2003 and 2004, respectively. Recommended

doses of sulfosulfuron (25 g ha^{-1}) and mesosulfuron+iodosulfuron (12 g ha^{-1}) were sprayed 4, 7, 10, 15, 18 and 21 days after first irrigation (DAFI) to wheat crop. These treatments were compared with clodinafop 60 g ha^{-1} applied 30-35 DAS. An unweeded (control) treatment was also kept for comparison. This experiment was laid out in randomized block design with 14 treatments and four replications. Herbicides were sprayed as per treatment with knapsack sprayer fitted with flat fan nozzle at discharge rate of 250 l ha^{-1}. 2, 4-D at 0.5 kg ha^{-1} was sprayed uniformly in all plots to control broadleaf weeds at maximum tillering stage of wheat as follow up treatment.

RESULTS AND DISCUSSION

Effect on Dry Matter of *P. minor*

The experimental field had medium to heavy infestation of *P. minor* with 300-400 plants m^{-2} of *P. minor*. Application of sulfosulfuron at 25 g ha^{-1} as well as mesosulfuron+iodosulfuron at 12 g ha^{-1} provided excellent control of *P. minor* recorded at 75 DAS and at the time of harvest, irrespective of their stage of application (Table 1). All herbicide treatments resulted in significant reduction in population and dry matter accumulation by *P. minor* as compared to unweeded treatment. Singh *et al.* (2003a) also reported that sulfosulfuron applied before first irrigation (20 DAS) had more density of *P. minor* than its application after first irrigation (30 DAS).

Effect on Crop

The differences in crop plant height due to different treatments were found to be non-significant indicating no toxic effect on crop due to any treatment. All the herbicide treatments produced significantly more number of wheat spikes than unweeded crop (Table 2). Among the herbicide treatments, application of sulfosulfuron, 4 and 7 DAFI as well as mesosulfuron+iodosulfuron 4 DAFI

Table 1. Dry matter of *P. minor* as influenced by different treatments

Treatment	Application stage (DAFI)	Dose (g ha^{-1})	No. of *P. minor* plants m^{-2}		Dry matter of *P. minor* 75 DAS (g m^{-2})		Dry matter of *P. minor* at harvest (g m^{-2})	
			2003-04	2004-05	2003-04	2004-05	2003-04	2004-05
Sulfosulfuron	4	25	1.0 (0)	1.0 (0)	1.0 (0)	1.0 (0)	1.0 (0)	1.0 (0)
Sulfosulfuron	7	25	1.0 (0)	1.0 (0)	1.0 (0)	1.0 (0)	1.0 (0)	1.0 (0)
Sulfosulfuron	10	25	1.0 (0)	1.0 (0)	1.0 (0)	1.0 (0)	1.0 (0)	1.0 (0)
Sulfosulfuron	15	25	1.0 (0)	1.0 (0)	1.0 (0)	1.0 (0)	1.0 (0)	1.0 (0)
Sulfosulfuron	18	25	1.0 (0)	1.0 (0)	1.0 (0)	1.0 (0)	2.4 (5)	1.0 (0)
Sulfosulfuron	21	25	1.0 (0)	1.0 (0)	1.0 (0)	1.0 (0)	3.4 (11)	3.6 (12)
Mesosulfuron+iodosulfuron	4	12	1.0 (0)	1.0 (0)	1.0 (0)	1.0 (0)	1.0 (0)	1.0 (0)
Mesosulfuron+iodosulfuron	7	12	1.0 (0)	1.0 (0)	1.0 (0)	1.0 (0)	1.0 (0)	1.0 (0)
Mesosulfuron+iodosulfuron	10	12	1.0 (0)	1.0 (0)	1.0 (0)	1.0 (0)	1.0 (0)	1.0 (0)
Mesosulfuron+iodosulfuron	15	12	1.0 (0)	1.0 (0)	1.0 (0)	1.0 (0)	1.0 (0)	1.0 (0)
Mesosulfuron+iodosulfuron	18	12	1.0 (0)	1.0 (0)	1.0 (0)	1.0 (0)	1.0 (0)	1.0 (0)
Mesosulfuron+iodosulfuron	21	12	1.0 (0)	1.0 (0)	1.0 (0)	1.0 (0)	3.7 (13)	4.4 (19)
Clodinafop	10	60	1.0 (0)	1.0 (0)	1.0 (0)	1.0 (0)	1.0 (0)	1.0 (0)
Unweeded	-	-	19.9 (350)	18.4 (375)	9.9 (98)	11.2 (127)	15.5 (242)	19.3 (373)
LSD (P=0.05)	-	-	1.7	1.6	0.42	0.51	3.04	3.51

DAFI–Days after first irrigation, DAS–Days after sowing.

Table 2. Yield and yield attributes as influenced by treatments

Treatment	Application stage (DAFI)	Dose (g ha^{-1})	Plant height (cm)		Spikes m^{-2}		Spike length (cm)		Grain yield (kg ha^{-1})		
			2003-04	2004-05	2003-04	2004-05	2003-04	2004-05	2003-04	2004-05	Mean
Sulfosulfuron	4	25	64.6	67.7	295.7	307.8	9.3	9.5	3720	4070	3900
Sulfosulfuron	7	25	62.5	65.9	298.8	313.7	10.2	9.9	3980	4290	4140
Sulfosulfuron	10	25	64.5	66.1	327.2	329.4	10.2	10.4	4090	4440	4270
Sulfosulfuron	15	25	63.9	65.1	321.3	330.3	10.2	10.3	4130	4410	4270
Sulfosulfuron	18	25	64.5	67.2	324.0	328.1	10.3	10.3	4040	4380	4210
Sulfosulfuron	21	25	62.7	66.9	323.6	324.5	10.2	10.2	4000	4310	4160
Mesosulfuron+iodosulfuron	4	12	63.1	66.2	298.8	310.5	9.5	9.8	3870	4110	3990
Mesosulfuron+iodosulfuron	7	12	63.4	67.7	303.8	316.8	10.1	10.2	3990	4280	4140
Mesosulfuron+iodosulfuron	15	12	63.2	67.1	323.6	328.1	10.2	10.3	4210	4490	4350
Mesosulfuron+iodosulfuron	1	12	64.0	67.5	324.9	329.0	10.2	10.4	4170	4470	4320
Mesosulfuron+iodosulfuron	18	12	63.9	66.2	322.7	330.3	10.3	10.3	4140	4440	4270
Mesosulfuron+iodosulfuron	21	12	62.4	67.4	321.3	324.5	10.2	10.2	4050	4370	4210
Clodinafop	10	60	63.2	65.2	323.1	327.6	10.3	10.4	4210	4440	4330
Unweeded	-	-	60.1	62.7	325.8	256.1	7.7	8.3	2510	2160	2330
LSD (P=0.05)	-	-	NS	NS	21.2	20.34	0.85	0.70	454	515	-

NS–Not Significant.

resulted in significant reduction in the number of spikes during 2003-04 as compared to their other stages of application, excepting mesosulfuron+ iodosulfuron 7 DAFI. During 2004-05, among herbicide treatments, lowest number of spikes was recorded due to application of sulfosulfuron 4 DAFI and these were significantly less than sulfosulfuron application at 10 and 15 DAFI, mesosulfuron+ iodosulfuron 15 and 18 DAFI.

Lowest spike length was recorded due to application of sulfosulfuron 4 DAFI and these values were significantly less than that of mesosulfuron+ iodosulfuron (4 and 7 DAFI) during 2003-04 and sulfosulfuron 7 DAFI, mesosulfuron + iodosulfuron (4 DAFI) during 2004-05.

Crop treated with sulfosulfuron or mesosulfuron+iodosulfuron at variable stages of application resulted in significant increase in grain yield as compared to unweeded treatment. Among the herbicide treatments, the lowest grain yield was recorded due to early application of sulfosulfuron or mesosulfuron+iodosulfuron. The grain yield of wheat was not influenced by different stages of application of sulfosulfuron or mesosulfuron+ iodosulfuron during both the years except during 2003-04, where application of sulfosulfuron 4 DAFI resulted in significantly less grain yield than that of mesosulfuron+iodosulfuron 10 DAFI only. However, such differences during 2004-05 were non-significant. On an average of two seasons, variation in grain yield to the tune of 450 kg ha^{-1} was observed with different stages of application of these herbicides. Highest grain yield of 4350 kg ha^{-1} was recorded in mesosulfuron+iodosulfuron 10 DAFI and minimum in sulfosulfuron 4 DAFI and these values were 86.7 and 67.4% higher than unweeded treatment, respectively. Singh *et al.* (2003b) reported that highest wheat yield (5220-5446 kg ha^{-1}) was recorded in weed-free plots, which was statistically at par with that of sulfosulfuron at 25 g ha^{-1} (5195-5411 kg ha^{-1}) and ready mix combination of mesosulfuron+iodosulfuron at 15+3 g ha^{-1} (5152- 5323 kg ha^{-1}).

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