Indian J. Weed Sci. **37** (1 & 2) : 23-25 (2005)

Bio-efficacy of Sulfosulfuron against Weeds in Wheat in Vertisols

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ABSTRACT

Sulfosulfuron (except at 100 g ha^{-1}) did not control wild oat population but reduced its dry matter significantly as compared to isoproturon and weedy check. Sulfosulfuron (either of its doses) was not effective against *Cichorium intybus* but gave effective control of *Phalaris minor* and *Medicago hispida*. Isoproturon was less effective against wild oat but gave very good control of *C. album*. Sulfosulfuron at 50 and 100 g ha^{-1} was phytotoxic to wheat crop during 2001-02. Isoproturon (1000 g ha^{-1}) gave the maximum grain yield of wheat in absence of wild oat, while sulfosulfuron (50-100 g ha^{-1}) in presence of wild oat.

INTRODUCTION

An enormous increase in the weed population in wheat has occurred since the introduction of dwarf, high yielding varieties highly responsive to intensive irrigation and fertilizers. A mixed population of grasses, broad leaved and sedges grow with the wheat crop under different agro-climatic conditions. In Madhya Pradesh, the problem of *Chenopodium album, Medicago hispida, Cichorium intybus, Vicia sativa* and *Lathyrus aphaca* is more severe in wheat than that of grass weeds. Among grasses, wild oat (*Avena ludoviciana*) is more dominant than *P. minor*. Commonly used herbicides viz., isoproturon, 2, 4-D, etc., though efficient, may not control all the weeds. Therefore, effective herbicides are needed for the control of both grass as well as broad leaved weeds in wheat. Sulfosulfuron, a new herbicide, was found effective for broad-spectrum weed control in wheat (Kumar *et al.*, 2003). The present investigation was, therefore, carried out to evaluate the efficacy of sulfosulfuron on weeds in wheat in vertisols.

MATERIALS AND METHODS

The present experiment was conducted during winter seasons of 2001-02 and 2002-03 in two different sites at the National Research Centre for Weed Science, Jabalpur. The soil was clay loam, low in available nitrogen, medium in available phosphorus and high in available potassium with neutral pH. The treatments comprising sulfosulfuron at 20, 25, 50 and 100 g ha^{-1}, isoproturon 1000 g ha^{-1}, hand weeding (30 DAS) and untreated control were replicated thrice in a randomized block design. Wheat cv. WH-147 was sown on December 10, 2001-02 and on November 25, 2002-03 using 125 kg seed rate ha^{-1} in 20 cm wide rows with fertilizer dose of 120 kg N+60 kg P_2O_5+40 kg K_2O ha^{-1}. The herbicides were applied in 500 l water ha^{-1} using flat fan nozzle at 30 DAS. Sulfosulfuron was sprayed alongwith its tank mixed surfactant (sulfosulfuron emulsifier). The crop was raised under irrigated condition with recommended package of practices. Population and dry matter of weeds were recorded at 90 DAS. The data on weeds were subjected to square root transformation before analysis wherever necessary.

RESULTS AND DISCUSSION

Effect on Weeds

During 2001-02, the experimental field was dominated with broad-leaved weeds (91%) viz., *Cichorium intybus, Medicago hispida, Chenopodium album* and *Vicia sativa. Phalaris minor* was the only grass weed (9%) during first year. However, during 2002-03, grass weeds especially *Avena ludoviciana* (91.5%) dominated the field. *P. minor* (3.5%) and *M. hispida* (4.5%) were low in intensity.

During 2001-02, sulfosulfuron at 100 g ha^{-1} significantly reduced the population and dry matter of almost all the weeds at 90 DAS as compared to its lower doses and control (Table 1). Isoproturon gave

Table 1. Population (No. m^{-2}) and dry matter (g m^{-2}) of weeds at 90 DAS (2001-02)

Treatment	Dose (g ha^{-1})	*P. minor*	*C. intybus*	*M. hispida*	*C. album*	*V. sativa*	Total
Sulfosulfuron	20	5.0	10.8	2.2	4.3	1.0	13.0
		(1.8)	(4.4)	(0.8)	(1.1)	(0.8)	(5.3)
Sulfosulfuron	25	4.9	8.7	3.0	5.2	0.7	12.2
		(1.4)	(4.3)	(1.1)	(1.1)	(0.7)	(5.1)
Sulfosulfuron	50	5.1	9.3	1.7	5.4	0.7	12.4
		(1.5)	(4.2)	(0.8)	(1.0)	(0.7)	(4.4)
Sulfosulfuron	100	2.4	7.8	1.7	3.6	2.3	9.4
		(0.8)	(3.6)	(0.7)	(1.1)	(0.8)	(3.7)
Isoproturon	1000	3.9	8.5	5.8	1.2	0.7	11.2
		(1.2)	(2.1)	(2.0)	(0.7)	(0.7)	(3.2)
Hand weeding		2.9	9.2	4.7	5.8	1.8	12.4
30 DAS		(1.4)	(4.0)	(2.5)	(1.4)	(0.9)	(5.1)
Weedy		4.4	10.8	5.4	6.66	2.1	14.6
		(1.6)	(4.6)	(2.5)	(1.50)	(1.2)	(5.6)
LSD (P=0.05)		1.0	2.8	0.8	1.3	0.4	2.4
		(0.4)	(1.0)	(0.6)	(0.3)	(0.2)	(0.4)

Data transformed to square root transformation. Values in parentheses are weed dry matter.

Table 2. Population and dry matter of weeds at 90 DAS (2002-03)

Treatment	Dose (g ha^{-1})	Weed population (No. m^{-2})				Wild oat dry weight (g m^{-2})	Wild oat control efficiency (%)	Total weed dry weight (g m^{-2})
		P. minor	*A. ludoviciana*	*M. hispida*	Total			
Sulfosulfuron	20	2.0	147	1.67	151	136	61	140
Sulfosulfuron	25	0.3	138	0.3	139	133	62	137
Sulfosulfuron	50	0	130	0	130	127	64	127
Sulfosulfuron	100	0	120	0	120	123	65	123
Isoproturon	1000	0	134	4.67	139	277	21	287
Hand weeding 30 DAS		0.67	62	6.67	69	168	52	187
Weedy		7.33	184	9.33	201	351	-	383
LSD (P=0.05)		-	55	-	32	92	-	95

very good control of *C. album*. During 2002-03, sulfosulfuron (except at 100 g ha^{-1}) being at par with isoproturon failed to reduce the wild oat population significantly, however, its dry matter was significantly reduced due to sulfosulfuron application as compared to isoproturon and weedy check. Isoproturon was less effective against wild oat. Poor control of wild oat in hand weeding treatment was due to mimicry of wild oat plants with wheat, which made separating wild oat with wheat plant difficult during hand weeding. Total population and dry matter of weeds were also reduced significantly due to sulfosulfuron (Table 2). The reduced dry weight of various grass and broad-leaved weeds due to sulfosulfuron has also been reported by Dixit *et al.* (1998), Loubser (1998) and Kumar *et al.* (2003).

Effect on Crop

Yield attributes viz., spikes m^{-1} row length, spike length, grains $spike^{-1}$ and 1000-grain weight were higher under isoproturon during 2001-02, however, during 2002-03, increasing levels of sulfosulfuron increased these attributes (Table 3). The highest

Table 3. Growth, yield attributes and grain yield of wheat

Treatment	Dose ($g\ ha^{-1}$)	Spikes ($No.\ m^{-1}$ row length)		Grains $spike^{-1}$		1000-grain weight (g)		Grain yield ($kg\ ha^{-1}$)	
		2001-02	2002-03	2001-02	2002-03	2001-02	2002-03	2001-02	2002-03
Sulfosulfuron	20	75	51	34.8	30.6	38.7	35.7	3348	2944
Sulfosulfuron	25	79	54	35.7	31.9	39.1	36.1	3718	3167
Sulfosulfuron	50	77	59	32.0	32.1	38.6	36.3	3215	3556
Sulfosulfuron	100	73	59	31.8	34.7	36.3	38.8	3185	3778
Isoproturon	1000	80	37	38.3	28.4	41.9	34.9	4103	1833
Hand weeding 30 DAS		79	47	37.5	29.8	39.9	35.6	3933	2445
Weedy		73	30	34.5	27.1	38.7	32.2	3333	1111
LSD (P=0.05)		NS	12	3.2	3.5	3.5	3.7	366	335

NS–Not Significant.

grain yield of wheat (4103 kg ha^{-1}) was recorded with isoproturon in 2001-02, which was at par with hand weeding. Among different doses of sulfosulfuron, the maximum yield (3718 kg ha^{-1}) was obtained with 25 g ha^{-1}. Further increase in dose significantly reduced the yield. This was due to phyto-toxicity of sulfosulfuron at higher doses, which reduced the yield attributes and yield of the wheat. However, in 2002-03, sulfosulfuron 100 g being at par with 50 g gave significantly higher yield over rest of the treatments without any phyto-toxic effect on wheat crop. Higher growth of wild oat as compared to wheat at the time of sulfosulfuron application might have allowed more herbicide to fall on wild oat leaf surface as compared to wheat and saved the wheat plants from phyto-toxicity of higher doses of sulfosulfuron resulting in higher wheat yield. Increase in grain yield of wheat due to various doses of sulfosulfuron was also reported by Kumar *et al.* (2003). Although sulfosulfuron inhibited the plant height, the higher yield was due to better control of weeds particularly wild oat (61-65%). Reduced wheat yield with isoproturon and hand weeding during second year was due to their poor efficacy against wild oat (21 and 52%, respectively).

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