Indian J. Weed Sci. **39** (1 & 2) : 40-43 (2007)

Persistence of Sulfosulfuron Applied in Wheat on Succeeding Crop of Sorghum

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ABSTRACT

Field experiment was conducted during 2003 and 2004 in the Research Area of Agronomy Department, CCS Haryana Agricultural University, Hisar to study the effect of irrigation frequency on residual behaviour of sulfosulfuron applied in wheat on succeeding sorghum crop grown in rotation. Residual effect of sulfosulfuron was assessed by conducting bioassay studies on sorghum in a split plot design with three irrigation levels (3, 4 and 5) in the main plots and weed control treatments (sulfosulfuron 25 and 50 g/ha, weedy and weed free) in the sub-plots. After harvest of wheat, sorghum crop was planted after slight disking without disturbing the original layout. Sulfosulfuron applied in wheat was found to persist even after 150 days after its application in wheat and its residues in the soil medium caused phytotoxicity to succeeding crop of sorghum. Plant population, plant height, number of leaves per plant, dry shoot and root weight and fodder yield of sorghum were significantly reduced by sulfosulfuron. At 60 DAS, 50 g sulfosulfuron applied in wheat reduced sorghum plant height, dry shoot and root weight per plant by 56, 50, 70 and 57, 51, 71% during the first and second year, respectively, over untreated control. Similarly, fodder yield was reduced by 73 and 75% by 50 g sulfosulfuron compared to untreated control in first and second year of investigation, respectively. The residual effect of sulfosulfuron on sorghum was not found to be mediated by irrigation frequency. Neither the growth parameters nor the fodder yield of sorghum were affected significantly by number of irrigations applied in wheat. Therefore, it can be inferred that increasing irrigation frequencies neither helped in degradation nor in leaching of sulfosulfuron and sorghum should not be planted in rotation with wheat where sulfosulfuron has been applied in wheat.

INTRODUCTION

Sulfosulfuron, a sulfonylurea group of herbicides, is used for selective control of complex weed flora in wheat. Sulfonylureas exhibit soil activity at low application rates (Eleftherohorinos, 1987; Beyer *et al.*, 1988) and can restrict its use in rotations where sensitive crops are included in the cropping system. In India and particularly in Haryana, soil pH is high (around 8.0), organic matter content is low, rainfall is less, temperature is high and soil moisture content generally remains lower except in rice-wheat rotations. These conditions are entirely different than those prevailing in most of the western countries where these herbicides have been used and research work on their persistence has been studied. So, entirely different persistence behaviour can be expected under north-west Indian climatic conditions. Therefore, it is essential to study the persistence behaviour of sulfosulfuron in our soils before making any sound recommendation for farmers' use.

Soil moisture content is one of the important factors responsible for degradation of sulfonylurea herbicides (Joshi *et al.*, 1985; Streak, 1998). Irrigation scheduling and availability of moisture in the soil may further modify the residual behaviour of herbicide. In the light of these considerations, present study was planned to study the effect of irrigation levels on persistence of sulfosulfuron in soil and its residual effect on succeeding sorghum crop when applied in wheat.

MATERIALS AND METHODS

To study the effect of irrigation on persistence of sulfosulfuron applied in wheat and its residual effect on succeeding sorghum crop, field experiment was conducted during two consecutive **rabi** seasons of 2002-03 and 2003-04 at Agronomy Research Area of CCS Haryana Agricultural University, Hisar. Soil of the experimental field was sandy loam in texture with a pH of 8.1 and 0.31% O. C., low in available N (189 kg/ha), medium in available phosphorus (13 kg /ha) and available potash (365 kg/ha). Wheat variety PBW-343 was planted on beds on December 17 and November, 23 during 2002 and 2003, respectively, by using 100 kg seed/ha. Experiment was replicated thrice in split plot design by keeping three irrigation levels (two irrigations at 21 and

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85 DAS, three irrigations at 21, 65 and 105 DAS, and five irrigations at 21, 45, 65, 85 and 105 DAS) as main plot treatments and four weed control treatments (sulfosulfuron at 25 and 50 g/ha, weedy and weed free check). All other agronomic practices except irrigation and herbicide application were adopted as per university recommendations. Herbicide as per treatments was applied with a knapsack sprayer at 35 DAS by using 500 l water/ha. Data on weed density, dry matter accumulation by weeds at 60 and 90 DAS were recorded and WCE (%) was calculated based on dry matter accumulation by weeds at 90 DAS. At harvesting, data on grain yield and various yield attributes were recorded.

Field Bioassay

In order to study the residual effect of sulfosulfuron on succeeding sorghum crop, after the harvest of wheat, field was irrigated and disked slightly. Sorghum variety HC-136 was planted on May 15, 2003 and May 2, 2004, during the first and second year, respectively, without disturbing the original layout. Sorghum crop was raised as per recommended package of practices. To study the residual effect of sulfosulfuron on sorghum, data on visual toxicity (on 0-100 scale), number of plants/metre row length, plant height, number of leaves/plant, fresh shoot and root weight, dry shoot and root weight and fodder yield were recorded when sorghum crop was 60 days old. All the data recorded were analyzed by ANOVA method as suggested by Cochran and Cox (1957).

RESULTS AND DISCUSSION

Experimental field was dominantly infested with *Avena ludoviciana* (grassy weed) followed by *Chenopodium album* (broadleaf weed) during both the years of investigation. Sulfosulfuron at both the application rates (25 and 50 g/ha) showed excellent efficacy against all the weeds as shown by WCE in both the years (Table 1). Increasing irrigation number exhibited no impact in enhancing weed control efficiency. Increase in number of irrigations caused significant increase in number of grains per earhead and grain yield of wheat, but number of earheads per metre row length and WCE were not affected significantly with increasing number of irrigations in both the years. Das and Yaduraju (1999) also reported significantly higher grain and straw yield of wheat in high frequency than in low frequency of irrigations. Sulfosulfuron at both rates of application enhanced grain of wheat significantly. Both doses of sulfosulfuron (25 and 50 g/ha), being similar to each other, significantly increased number of grains per earhead and number of earheads per metre row length. These results are in conformity with Dixit *et al.* (1998).

Residual Toxicity of Sulfosulfuron Applied in Wheat on Succeeding Crop of Sorghum

Sulfosulfuron applied in wheat was found to persist even after 150 days after its application and its residue in the soil medium was phytotoxic to succeeding

Table 1. Effect of irrigation and weed control treatments on plant height and yield attributing characters of wheat

Treatment	2002-03				2003-04			
	WCE (%) 90 DAS	No. of earheads/ m. r. l.	No of grains/ earhead	Grain yield (kg)	WCE (%) 90 DAS	No. of earheads/ m. r. l.	No. of grains/ earhead	Grain yield (kg/ha)
Irrigation levels (No.)								
2	72	115.39	46.08	4413	74	112.80	47.49	4793
3	70	115.97	48.24	4668	72	115.11	48.57	4952
5	72	117.03	51.94	4850	71	115.81	51.58	4992
LSD (P=0.05)	NS	NS	3.36	193	NS	NS	2.31	147
Weed control treatments								
Weedy	0	101.59	44.12	3872	0	103.22	45.20	4263
Weed free	100	124.48	52.58	5147	100	120.81	51.98	5349
Sulfosulfuron 25 g/ha	92	118.22	48.54	4794	93	116.41	50.56	4961
Sulfosulfuron 50 g/ha	95	120.22	49.78	4854	94	118.85	50.22	5077
LSD (P=0.05)	NS	6.26	1.86	245	NS	5.06	1.77	204

m. r. l. : metre row length. NS–Not Significant.

crop of sorghum (Table 2).

When sorghum was grown in the field after harvest of wheat crop treated with 25 and 50 g/ha of sulfosulfuron (after about 150 days of sulfosulfuron application), the various growth parameters of sorghum viz., plant population, plant height, number of leaves per plant, dry shoot and root weight and fodder yield were significantly reduced (Tables 2 and 3). The maximum reduction in growth as well as in fodder yield was at higher concentration of sulfosulfuron. In comparison to untreated control, 50 g sulfosulfuron applied in wheat reduced plant height, dry shoot and root weight per plant of sorghum upto an extent of 56, 50, 70 and 57, 51, 71% during the first and second year, respectively, when recorded at 60 DAS. A similar trend was observed in terms of fodder yield also, which recorded 73 and 75% reduction with 50 g sulfosulfuron as compared to untreated control during both the years of investigation, respectively. The residual effect of sulfosulfuron on succeeding sorghum crop has been reported upto 31 to 32 months by Lyon *et al.* (2003) and upto 17 months by Kelley and Peeper (2003). Lyon *et al.* (2003) concluded that successful production of sorghum might require a minimum interval between treatment and planting of more than 36 months.

The residual effect of sulfosulfuron on sorghum

Table 2. Plant population, plant height and number of leaves of sorghum, 60 DAS as affected by irrigations and weed control treatments applied in wheat

Treatment	Visual toxicity (%)		Plant population/ m. r. l.		Plant height (cm)		No. of leaves/ plant	
	2002-03	2003-04	2002-03	2003-04	2002-03	2003-04	2002-03	2003-04
Irrigation levels (No.)								
2	28.58 (22.9)	30.11 (25.2)	11.87	12.20	72.2	70.5	6.78	6.93
3	32.39 (28.7)	33.55 (30.5)	1.04	12.54	83.3	72.6	7.03	7.11
5	30.19 (25.3)	34.94 (32.8)	13.43	12.67	86.5	87.6	7.60	7.61
LSD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS
Weed control treatments								
Weedy	4.05 (0.0	4.05 (0.0)	15.94	18.33	110.04	95.0	8.04	8.31
Weed free	4.05 (0.0)	4.05 (0.0)	15.28	17.72	107.6	93.7	7.93	8.31
Sulfosulfuron at 25 g/ha	48.42 (56.0)	53.72 (65.0)	6.94	7.67	56.5	44.8	5.78	6.20
Sulfosulfuron at 50 g/ha	65.03 (82.2)	69.63 (87.9)	5.44	6.7	48.1	40.6	5.70	5.70
LSD (P=0.05)	5.13	5.38	2.33	3.32	10.0	12.3	0.47	0.47

NS–Not Significant.

Table 3. Root, shoot weight and yield of sorghum as affected by number of irrigations and weed control treatments applied in wheat

Treatment	Dry shoot weight (g/plant)		Dry root weight (g/plant)		Fodder yield (q/ha)	
	2002-03	2003-04	2002-03	2003-04	2002-03	2003-04
Irrigation levels (No.)						
2	5.72	5.37	1.82	1.67	355.83	309.17
3	6.31	5.94	1.91	1.88	366.50	312.50
5	8.02	7.81	2.19	2.03	380.17	322.65
LSD (P=0.05)	NS	NS	NS	NS	NS	NS
Weed control treatments						
Weedy	8.48	8.22	2.90	2.69	532.22	485.56
Weed Free	8.94	8.39	2.91	2.55	514.44	465.55
Sulfosulfuron at 25 g/ha	5.05	4.91	1.17	1.04	202.23	198.89
Sulfosulfuron at 50 g/ha	4.27	4.07	0.87	0.79	141.11	118.88
LSD (P=0.05)	2.22	2.16	0.48	0.46	69.46	81.72

NS–Not Significant.

was not found to be mediated by irrigation frequency. The data in Tables 2 and 3 show that neither the growth parameters nor the fodder yield of sorghum were affected significantly by number of irrigations applied in wheat. These findings are similar to the results of Anderson and Barrett (1985) who observed that increasing moisture content of soil in sandy loam soils (like Hisar soil) does not affect the persistence of chlorsulfuron. Bergstrom (1990) found very low leaching of sulfonylureas and observed that only <1% of applied metsulfuron-methyl and chlorsulfuron applied at 4 or 8 g/ha appeared in the leachate from two sandy loam and one clay loam soil. Therefore, it can be inferred that increasing irrigation frequencies neither helped in degradation nor in leaching of sulfosulfuron that is why non-significant effects were observed.

From the present studies, it can be concluded that sulfosulfuron can be applied at 25 g/ha for excellent control of complex weed flora in wheat and sorghum should not be planted in rotation with wheat where sulfosulfuron has been applied to wheat.

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