Indian J. Weed Sci. **40** (1 & 2) : 37-40 (2008)

Evaluation of Different Herbicides Against Broadleaf Weeds in Wheat and their Residual Effects on Sorghum

R. S. Malik, Ashok Yadav and R. K. Malik
Department of Agronomy
CCS Haryana Agricultural University, Hisar -125 004 (Haryana), India

ABSTRACT

Based on two years' (2004-05 and 2005-06) field experimentation, it was found that chlorsulfuron 30 g/ha, metsulfuron 4 g/ha and triasulfuron 60 g/ha reduced the density of different broadleaf weeds in wheat to the extent of 90-100% and proved better than sulfosulfuron (20 and 25 g/ha) and 2, 4-D Na salt (500 and 750 g/ha). Weed control efficiency (WCE) against total broadleaf weeds based on average dry weight of two years due to chlorsulfuron 30 g/ha, metsulfuron 4 g/ha and triasulfuron 60 g/ha varied between 86-89%; however, triasulfuron 40 and 60 g/ha was at par in this respect. Effective tillers and grain yield of wheat were maximum in the plots kept weed free throughout the crop season; however, statistically it was at par with chlorsulfuron 30 g, triasulfuron 40 and 60 g and metsulfuron 4 g/ha during both the years. Weeds growing throughout the crop season reduced the grain yield to the extent of 46 and 40% during 2004-05 and 2005-06, respectively. Plant height of succeeding crop of sorghum at 45 DAS was significantly reduced by triasulfuron 60 g/ha both under prepared and unprepared field conditions and also by sulfosulfuron 25 g/ha only under unprepared field situation. Similarly, fresh weight of sorghum under prepared field situation at 45 DAS during both the years and fodder yield at harvest during 2004-05 only were significantly reduced due to residual toxicity of triasulfuron 60 g/ha applied in wheat.

Key words : Broad-spectrum weed control, herbicide residue, crop safety

INTRODUCTION

In south-west Haryana, irrigated wheat (*Triticum aestivum*) is heavily infested with broadleaf weeds with infestation of wild oat (*Avena ludoviciana*) in few pockets. In north-east Haryana, under rice-wheat cropping system, enormous build-up of broadleaf weeds, mainly *Rumex dentatus* (jangli palak) has been observed in the last 5-6 years. This has been due to effective and selective control of littleseed canary grass (*Phalaris minor*) with the use of new herbicides like clodinafop, fenoxaprop and sulfosulfuron. 2, 4-D recommended to control broadleaf weeds in wheat showed poor efficacy against several weeds. Many wheat cultivars like HD 2009, WH 283, WH 416 and Sonak produced malformed spikes due to 2, 4-D spray which led to reduced wheat yield (Balyan, 1999). Sulfonylurea herbicides including sulfosulfuron have already been reported to cause residual adverse effects on sorghum. Hence, it was realized to look for broad spectrum alternate herbicides having no adverse effect on succeeding crop of sorghum generally grown for fodder after wheat.

MATERIALS AND METHODS

A two-year field investigation was conducted during 2004-05 and 2005-06 at the Agronomy Research Farm of Chaudhary Charan Singh Haryana Agricultural University, Hisar to evaluate the efficacy of different herbicides against broadleaf weeds in wheat and their carry-over effect on growth of succeeding crop of sorghum. The soil of the experimental field was sandy loam in texture, low in available nitrogen (118.4 kg/ha), medium in available phosphorus (18.2 kg/ha) and high in available potash (504.7 kg/ha) and slightly alkaline in reaction (pH 8.2). Wheat variety PBW 343 using seed rate of 125 kg/ha was sown on November 19 and 21 during 2004-05 and 2005-06, respectively. The crop was raised with all recommended package of practices. The experiment consisted of 16 treatments viz., sulfosulfuron 20 and 25 g/ha, chlorsulfuron 10, 20 and 30 g/ha, metsulfuron 3 and 4 g/ha, triasulfuron 20, 40 and 60 g/ha, isoproturon 750 and 1000 g/ha and 2,4-D Na salt 500 and 750 g/ha alongwith weedy and weed free check. The experiment was laid out in randomized block design replicated thrice. The plot size was 4.5 x 3.6 m. All the herbicides were applied at 30-35 days after sowing (DAS) with knapsack sprayer fitted with flat fan nozzle using 625 l water/ha. The experimental field was infested mainly with broadleaf weeds viz., *Chenopodium album* (bathu) 30.9%, *Melilotus alba* (metha) 14.6%, *Melilotus. indica*

(senji) 19.5%, *Rumex dentatus* (jangli palak) 8.1%, *Cororopus didymus* (pithpapra) 6.5%, *Circsium arvense* (kandai) 6.5% and other miscellaneous grassy as well as broadleaf weeds (13.8%) during both the years. The data on density of individual weeds and dry weight of total weeds were recorded with the help of 50 x 50 cm quadrate placing it randomly at two spots/plot at 60 days after treatment (DAT), and number of effective tillers/m^2 and grain yield of wheat were also recorded at harvest to draw inference of results.

After wheat harvest (April 18, 2005 and April 16, 2006), all the plots were divided half and half across width keeping the original layout undisturbed. One half portion of all the plots was kept as such without any plowing (unprepared or zero tillage) and rest half part of all plots was subjected to one harrowing fb one pass of cultivator fb planking (prepared situation). Sorghum was sown for fodder on May 5 during both the years to study the residual impact of different herbicides treatments applied in wheat. All the plots of sorghum were kept weed free by one manual weeding at initial stage of crop growth (20 DAS). Plant height of sorghum (10 plants/plot) and fresh weight of sorghum (q/ha) at 45 DAS and fodder yield of sorghum at harvest (70 DAS) were recorded during both the years of investigation.

RESULTS AND DISCUSSION

Effect on Weeds

All the herbicidal treatments resulted in significant reduction in the density and dry weight of weeds during both the years (Tables 1 and 2). There was considerable increase in the efficacy of herbicides with the corresponding increase in the dose of application (Table 1). Chlorsulfuron 30 g/ha, metsulfuron 4 g/ha and triasulfuron 40 and 60 g/ha being at par with each other reduced the density of different weeds in wheat to the extent of 90-100% and these proved better than sulfosulfuron 20 and 25 g/ha, chlorsulfuron 10 g/ha, triasulfuron 20 g/ha, isoproturon 750 and 1000 g/ha and 2,4-D Na 500 and 750 g/ha. Control of *C. arvense*, in general, was less compared to other weeds. Based on an average of two years, chlorsulfuron 30 g/ha, metsulfuron 4 g/ha and triasulfuron 40 and 60 g/ha reduced the dry weight of total weeds to the extent of 85-89% (Table 2) and these treatments proved superior to all other herbicidal treatments. Triasulfuron, chlorsulfuron and metsulfuron have been reported very effective against broadleaf weeds in wheat earlier also (Sharma *et al.*, 2002; Yadav *et al.*, 2004).

Table 1. Density of different weeds as influenced by different treatments (Pooled data of 2004-05 and 2005-06)

Treatment	Dose (g/ha)	Weed density (No./m^2 at 60 days after treatment)						
		C. album	*M. alba*	*M. indica*	*R. dentatus*	*C. didymus*	*C. arvense*	Others
Sulfosulfuron	20	4.74 (22)	3.53 (12)	3.93 (15)	3.07 (10)	2.34 (5)	3.07 (8)	3.80 (14)
Sulfosulfuron	25	4.30 (18)	3.23 (10)	3.86 (13)	2.91 (8)	2.34 (5)	2.73 (7)	3.80 (14)
Chlorsulfuron	10	3.38 (11)	2.73 (7)	2.73 (7)	1.8 6(3)	1.86 (3)	2.34 (5)	3.08 (9)
Chlorsulfuron	20	2.34 (5)	2.11 (4)	1.86 (3)	1.48 (2)	1.17 (1)	2.11 (4)	2.54 (6)
Chlorsulfuron	30	1.58 (2)	1.47 (2)	1.67 (1)	0.70 (0)	1.17 (1)	1.86 (3)	2.11 (4)
Metsulfuron	3	2.72 (7)	2.11 (4)	2.54 (6)	1.56 (2)	1.86 (3)	1.86 (3)	2.34 (5)
Metsulfuron	4	1.86 (3)	1.87 (3)	1.86 (3)	1.17 (1)	1.58 (2)	1.56 (2)	1.86 (3)
Triasulfuron	20	2.73 (7)	1.86 (3)	2.34 (5)	2.34 (5)	1.17 (1)	2.34 (5)	1.86 (3)
Triasulfuron	40	2.11 (4)	1.56 (2)	2.11 (4)	2.11 (4)	0.70 (0)	2.11 (4)	1.47 (2)
Triasulfuron	60	1.56 (2)	1.17 (1)	1.56 (2)	1.56 (2)	0.70 (0)	1.56 (2)	1.18 (1)
Isoproturon	750	3.80 (14)	3.38 (11)	3.93 (15)	3.08 (9)	2.54 (6)	3.08 (9)	3.93 (15)
Isoproturon	1000	3.23 (10)	3.24 (10)	3.80 (14)	3.07 (9)	2.34 (5)	2.91 (8)	3.80 (14)
2,4-D Na	500	2.73 (7)	1.86 (3)	2.34 (5)	2.34 (5)	1.58 (2)	2.34 (5)	2.73 (7)
2,4-D Na	750	2.34 (5)	1.86 (3)	1.86 (3)	1.86 (3)	1.56 (2)	1.86 (3)	2.11 (4)
Weed free	-	0.70 (0)	0.70 (0)	0.70 (0)	0.70 (0)	0.70 (0)	0.70 (0)	0.70 (0)
Weedy	-	6.20 (38)	4.29 (18)	4.94 (24)	3.23 (10)	2.91 (8)	2.91 (8)	4.18 (17)
LSD (P=0.05)		0.93	0.47	0.56	0.59	0.41	0.39	0.46

Original data given in parentheses are subjected to square root vx + 0.5 transformation before analysis.

Table 2. Total dry weight of weeds and grain yield of wheat as influenced by different treatments

Treatment	Dose (g/ha)	Total weed dry weight (g/m^2) 0 DAT		Mean	WCE (%)	Effective tillers ($No./m^2$)		Grain yield (kg/ha)	
		2004-05	2005-06			2004-05	2005-06	2004-05	2005-06
Sulfosulfuron	20	61.4	67.8	64.6	28.9	376.2	381.0	3737	3823
Sulfosulfuron	25	53.6	59.3	56.4	37.9	397.4	408.4	3966	4134
Chlorsulfuron	10	32.9	36.6	34.7	61.8	457.7	473.5	4602	4800
Chlorsulfuron	20	19.5	20.8	20.1	77.9	487.4	490.2	5028	5201
Chlorsulfuron	30	10.4	11.2	10.8	88.1	542.8	538.8	5491	5592
Metsulfuron	3	21.6	24.4	23.0	74.7	491.0	479.7	4927	5144
Metsulfuron	4	12.8	13.5	13.1	85.6	541.0	542.0	5484	5578
Triasulfuron	20	27.0	30.6	28.8	68.3	472.1	483.2	4779	4937
Triasulfuron	40	13.3	13.4	13.3	85.4	592.6	577.4	5468	5545
Triasulfuron	60	9.6	9.9	9.7	89.3	544.4	549.0	5504	5618
Isoproturon	750	60.2	66.4	63.3	30.4	379.3	384.1	3782	3860
Isoproturon	1000	54.0	62.0	58.0	36.2	402.0	407.6	4019	4177
2,4-D Na	500	26.8	30.6	28.7	68.4	475.0	471.5	4707	4892
2,4-D Na	750	17.2	19.4	18.3	79.9	495.6	489.4	5076	5170
Weed free	-	0.0	0.0	0.0	100.0	566.5	568.0	5682	5775
Weedy	-	84.7	97.2	90.9	0.0	309.0	313.4	3064	3456
LSD (P=0.05)		3.5	3.8			69.0	76.2	221	233

Effect on Wheat Crop

Effective tillers (566 and 568/m^2) and grain yield of wheat (5682 and 5775 kg/ha) were the maximum under weed free situation during both the years of investigation. However, chlorsulfuron 30, metsulfuron 4 and triasulfuron 40 and 60 g/ha produced effective tillers and grain yield of wheat statistically similar to weed free check (Table 2). All these treatments were at par with each other and were superior to rest of all herbicidal treatments. Weeds growing throughout the crop season resulted in 46 and 40% reduction in grain yield of wheat during 2004-05 and 2005-06, respectively. There was considerable increase in the number of effective tillers and grain yield of wheat due to enhanced dose of each individual herbicide but the differences were non-significant when compared within themselves. Sulfosulfuron (20 and 25 g/ha), chlorsulfuron (10 to 20 g/ha), triasulfuron 20 g/ha, isoproturon (750 and 1000 g/ha) and 2, 4-D Na (500-750 g/ha) resulted in significantly lesser yield compared to all other herbicidal treatments (Table 2) and this could be obviously due to poor control of weeds due to these treatments (Table 1). Satisfactory performance of chlorsulfuron, metsulfuron and triasulfuron in terms of grain yield of wheat has already been documented (Sharma *et al.*, 2002; Yadav *et al.*, 2004).

Residual Effects on Sorghum

Among different herbicides applied at varying doses in wheat, only sulfosulfuron 25 g/ha and triasulfuron 60 g/ha resulted in residual toxicity on succeeding crop of sorghum (Table 3). Rest all herbicidal treatments did not show any residual impact on sorghum. Plant height of sorghum recorded at 45 DAS was significantly reduced due to triasulfuron 60 g/ha both under prepared and unprepared (no tillage) field conditions after wheat harvest and this reduction was to the tune of 12.7 and 16.6% in prepared field and 22.5 and 14.2% in unprepared field situation during 2005 and 2006, respectively. Sulfosulfuron at 25 g/ha also reduced plant height significantly only under prepared field situation (Table 3). Similarly, fresh weight of sorghum (kg/m^2) at 45 DAS under prepared field situation during both the years and fodder yield of sorghum at harvest (70 DAS) during 2005 only were significantly reduced due to residual toxicity of triasulfuron applied at 60 g/ha in wheat. More residual toxicity under prepared field situation could be because of the possibilities that some amount of herbicides might have leached which could have come to upper surface and might have come in close contact of seed. Residual toxicity of sulfosulfuron on succeeding crops of sorghum and maize though erratic has been observed

Table 3. Residual effect of herbicides applied in wheat on succeeding crop of sorghum

Treatment	Dose (g/ha)	Plant height (cm) 45 DAS				Fresh weight (kg/m^2) 45 DAS				Fodder yield (q/ha) at harvest			
		Prepared field		Unprepared field		Prepared field		Unprepared field		Prepared field		Unprepared field	
		2005	2006	2005	2006	2005	2006	2005	2006	2005	2006	2005	2006
Sulfosulfuron	20	42.0	45.4	38.6	38.8	4.84	5.04	3.22	3.82	656.2	687.8	578.0	591.0
Sulfosulfuron	25	41.2	42.8	33.4	35.4	4.50	4.97	2.74	3.23	652.2	659.5	513.8	567.2
Chlorsulfuron	10	44.3	46.3	40.2	43.2	5.20	5.32	3.43	3.52	732.7	711.8	576.4	580.6
Chlorsulfuron	20	43.0	44.8	38.7	42.0	5.01	5.16	3.19	3.64	720.9	716.4	546.8	563.4
Chlorsulfuron	30	40.4	42.9	37.6	41.7	4.73	5.00	2.69	3.00	700.7	702.0	520.7	570.0
Metsulfuron	3	40.8	43.0	38.6	39.6	4.38	4.91	3.09	3.29	732.7	740.3	556.6	572.6
Metsulfuron	4	39.5	42.6	37.9	38.8	4.89	4.16	2.94	3.40	688.4	705.5	513.9	553.0
Triasulfuron	20	42.3	44.0	36.6	39.0	4.79	4.88	3.05	3.41	672.3	680.4	564.8	584.2
Triasulfuron	40	41.8	42.4	36.8	38.7	4.57	4.59	2.88	3.06	656.2	670.2	538.5	567.4
Triasulfuron	60	37.6	39.0	31.7	36.2	3.84	4.02	2.78	2.92	640.1	656.8	522.6	544.3
Isoproturon	750	42.7	45.2	39.0	41.9	4.74	5.06	3.79	3.90	736.7	752.5	543.5	569.9
Isoproturon	1000	42.9	44.6	37.6	38.8	4.53	4.97	3.05	3.45	708.5	723.2	517.1	542.4
2,4-D Na	500	41.8	43.4	37.9	38.9	4.59	4.96	3.87	4.01	684.4	700.2	536.9	545.3
2,4-D Na	750	39.7	41.0	38.7	36.4	4.52	4.83	3.25	3.89	688.0	680.4	521.2	544.0
Weed free	-	43.1	46.8	40.9	42.2	5.21	5.40	3.84	3.90	719.8	706.2	528.7	580.2
Weedy	-	43.6	45.0	39.4	40.1	5.07	5.27	3.41	3.71	714.7	691.7	511.4	541.9
LSD (P=0.05)		4.1	4.5	3.3	3.8	1.1	1.26	NS	NS	62.7	NS	NS	NS

NS–Not Significant.

at research farm as well as at farmers' fields earlier also (Yadav *et al.*, 2003). Residual toxicity of triasulfuron being sulfonylurea herbicide at very high dose (60 g/ha) can obviously be expected as realized in the present investigation. Amarjeet (2002) has reported residual toxicity of chlorsulfuron 30 g/ha applied in wheat on maize crop; however, no such adverse effect was observed on the sorghum crop in the present study.

Based on the present study, it might be concluded that chlorsulfuron 30 g/ha, triasulfuron 40 g/ha and metsulfuron 4 g/ha could be very effective against most of the broadleaf weeds in wheat. But residual toxicity of chlorsulfuron and triasulfuron cannot be ruled out on sensitive crop such as sorghum in rotation and, therefore, care must be taken before planning crop rotation keeping in mind the possible herbicidal use.

REFERENCES

Amarjeet, 2002. Persistence of chlorsulfuron in soil. Ph. D. thesis submitted to CCSHAU, Hisar, India.

Balyan, R. S. 1999. Efficacy of sulfosulfuron, tralkoxydim and metribuzin applied alone and tank mix on weeds in wheat. *Ind. J. Weed Sci*. **31** : 80-83.

Sharma, R., S. S. Pahuja, R. S. Balyan and R. K. Malik, 2002. Effect of sulfonylurea herbicides applied alone and tank mix with metribuzin on weeds in wheat and their residual effect on succeeding crops of sorghum. *Ind. J. Weed Sci*. **34** : 178-183.

Yadav, A., R. K. Malik, S. K. Pahwa and R. R. Bellinder, 2004. Evaluation of triasulfuron alone and as tank mixture with clodinafop, fenoxoprop, sulfosulfuron and tralkoxydim against complex weed flora in wheat. *Ind. J. Weed Sci*. **36** : 41-46.

Yadav, A., R. Mehta, S. S. Punia, V. Hooda, R. K. Malik, V. Rana and R. R. Bellinder, 2003. Residual effects of four sulfonylurea herbicides applied in wheat on succeeding crops in the rotation. *Ind. J. Weed Sci*. **35** : 259-261.