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Bio-Efficacy of Sulfosulfuron on Weed Flora and Irrigated Wheat (*Triticum aestivum* L.) Yield

AMITESH KUMAR SINGH[1*], RAKESH KUMAR[2], ANIL KUMAR SINGH[3] AND ANUPMA KUMARI[1]

V. B. S. Purvanchal University, Jaunpur 222002, UP, India
[1]Department of Agronomy, IAS, BHU, Varanasi 221005, India
[2]KVK Lakhisarai 811312, Bihar, India
[3] Department of Agronomy T. D. P. G. College, Jaunpur 222002, UP, India
E-mail : aamiteshsingh82@gmail.com
**Correspondence*

Abstract

A field investigation was carried out during the *rabi* seasons of 2005 and 2006 to standardize the dose of sulfosulfuron to maximize wheat production through proper weed control. Results revealed that dominant weed flora in field were *Cynodon dactylon, Cyprus rotundus. Anagallis arvensis* and *Convolvulus arvensis* which constituted 87.95 and 82.19% under weedy check at 60 at 90 DAS of crop growth, respectively. Application of sulfosulfuron and 35 g/ha treated plot recorded significantly less no. of total weed per unit area and weed dry weight when compared with sulfosulfuron at 20 and 25 g/ha and weedy check at all the stages of crop growth. However, drastic reductions in the density of various weeds were observed with sulfosulfuron at 35, 40 and 45 g/ha treated plots. Significantly higher grain yield (37.83 q/ha) was obtained from weed-free plot, which was at par with various doses of sulfosulfuron at 40 g/ha treated plot recorded significantly superior (36.25 q/ha) grain yield as compared all other treatments and weedy check.

Key words : Sulfosulfuron, *Cynodon dactylon,* Weed control, Wheat, Yield.

Wheat is the most widely grown winter cereals and is the backbone of food security in India. In India, it is the second most important source of staple food after rice which occupies 26 m ha of area in the country with the production of 76.08 m tones. In recent years, however, there are signs that the productivity and economic gains of wheat are consistently becoming smaller. Excessive tillage and soil degradation are considered important factors limiting the wheat productivity particularly under rice-wheat cropping system (1). Another formidabl factor that limits its productivity of wheat crop is severe weed infestation (2). The availability and the recommendations of selective herbicides including metaxuron, methabonzthrazuron, isoproturon, diclofopmethyl (3) made it possible to realize the potential yield of this crop. In the past two decades the sole application of isoproturon over a period of 10—12 years posed the problem of its resistance in *Phalaris minor* as it stared defying the killing potential of this herbicides even at its higher rates (4). The use of new alternate herbicides including sulfosulfuron was recommended which provides a great relief to the wheat crop from the resistant population of *Phalaris minor* (5). The present study was therefore planned to evaluate the effect of sulfosulfuron again complex weed flora and wheat yield.

Methods

A field experiment was laid out in a randomized block design at the Agricultural Research Farm (Pili Kothi) of the Department of Agronomy, T. D. P. G. Collage in V. B. S. Purvanchal University, Jaunpur during 2005-06 and 2006-07. The soil of the experimental plot was sandy loam with slightly alkaline in reaction (pH 7.64), poor organic carbon (0.46%), available nitrogen (261.36 kg/ha), available phosphorus (7.46 kg/ha) and medium in potash (193.15 kg/ha). The experiment comprising eight weed control treatments (sulfosulfuron 20, 25, 30, 35, 40, 45 g/ha, weed-free and weedy check) . Wheat crop was sown 23 cm apart on 1 December during both the year. The crop was fertilized with 120, 60 and 40 kg/ha of N, P_2O_5 and K_2O, respectively, and irrigated based on need. Half the dose of N and full dose of P_2O_5 and K_2O were

Table 1. Relative density of major weed species at different stages in weedy check.

Weeds species	Day after sowing 60	90	120
Cynodon dcctylon	41.39	37.93	49.56
Cyprus rotundus	22.40	6.90	9.17
Anagallis arvensis	10.35	29.31	0.90
Convolvulus arvensis	13.81	8.05	6.42
Other Weeds	12.05	17.81	33.95

applied as basal, while the remaining N was applied at first irrigation, given after 25 days after sowing (DAS). Herbicides were applied at 35 DAS with a manually operated knapsack sprayer delivering a spray volume of 600 liter water/ha through flat fan nozzle. Data a weed was recorded 60, 90 and 120 days in each plot in two quadrates, each measuring 50 × 50 cm. Weeds were counted species wise and were removed for recording their total dry weight. Weed samples were sun dried before oven drying at 70 C until constant weight was attained. Data on weeds were subjected to square-root transformation ($\sqrt{X}$ + 1.0) before statistical analysis. Crop was manually harvested in second week of May in each year. The grain yield data was recorded and adjusted to 14% of the moisture content.

Results and Discussion

Effect of Various Doses of Sulfosulfuron on Weed Flora

The experimental field was infested mainly with grassy and broad leaf weeds during both the years (Tables 1 and 2). There were 13 weed species out them three grassy weeds, nine non-grassy weeds and one sedges in the experimental field. Grassy weeds decline to increase up to 90 DAS and declined thereafter, while the broad leaf weeds increased upto 60 DAS and declined thereafter, and similar trand was reflected in the population of total weeds (Table 3). Different dose of sulfosulfuron reduced the density of weeds of the extent of 72.3%. Sulfosulfuron has been reported to be very effective against grassy weeds (6) and to some extent against broad leaf weeds (7). The dominant weeds in the experimental field were *Cynodon dactylon, Cyperus rotundus, Anagallis arvensis* and *Convolvulus arvensis* which constituted 41.39, 20.40, 10.35 and 13.81%, respectively under weedy check at 60 days stage of crop growth (Table 1). Relative density of grassy weeds were comparatively higher than non-grassy and sedges at 60 and 120 days stage of crop growth in weedy check where as at 90 days stage of crop growth non-grassy weeds were higher than grassy and sedges. The might be due to fallowing of experimental field in *kharif* season. The relative density of sedges to the total weed biomass was lower at all the stages of crop growth as compared to grassy and non-grassy weeds. The increase in total weed population in weedy check plot was observed up to 90 days stage of crop growth there after its decrease at 120 days stages of crop growth. This indicates that all weeds emerged during first 90 days there after competition among weeds and with the crop plant caused reduction in total weed population. However, the higher number of total weeds at 90 days stage as compared to 60 days stage was also reported by Dixit and Bhan (8). The highest average weed dry weight. 71. 92 g/m^2 was recorded in weedy check at 90 days stage of crop growth. The rates of weed dry weight accumulation in weedy check were 0.28 and 1.84 g/m^2 per day during 0— 60 and 60—90 DAS, respectively. This indicates that rate of dry matter production increased with advancement of crop growth upto 90 days because weed crop competition was intensified during 60 to 90 days period. The emergence of *Cynodon dactylon* is most dominant weed was over by 90 DAS and first 60 days accounted about 36% of total *Cynodon dactylon* emergence. The weed density of *Cynodon dactylon* was more at all the stages of crop growth than all other weed spacies. Relative density of *Cynodon dactylon* was more than one third of total weed at 60, 90 and 120 days stage (3). Percent contribution of *Cynodon dactylon* to total weeds was decreased at 90 days while it's again increases at 120 days. At 120 DAS weeds *Anagallis arvensis* were dried therefore percent contribution of *Cynodon*

Table 2. Percent composition of grassy, non-grassy weeds and sedges in weedy check at different stages of crop growth.

Days after sowing	Grassy weeds	Non-grassy weeds	Sedges
60	43.97	33.63	22.40
90	39.22	55.88	6.90
120	50.93	39.90	9.17

Table 3. Effect of various treatments on density of different weed flora at different stages in wheat (pooled mean.). Figures in parentheses indicate original values (√ X + 1.0). DAS = Days after sowing.

Treatments	Dose (g/ha)	*Cynodon dactylon* on DAS 60	90	120	*Cyperus rotundus* on DAS 60	90	120	*Anagallis arvensis* on DAS 60	90	120
Sulfosulfuron	20	4.36 (18.00)	8.06 (64.00)	7.19 (50.68)	3.51 (11.32)	3.21 (9.32)	3.00 (8.00)	2.31 (4.32)	7.30 (52.32)	1.00 (0)
Sulfosulfuron	25	3.70 (12.68)	7.09 (49.32)	6.24 (38.00)	3.42 (10.68)	3.11 (8.68)	2.70 (6.32)	2.16 (3.68)	6.24 (38.00)	1.00 (0)
Sulfosulfuron	30	3.21 (9.32)	6.30 (38.68)	5.23 (26.32)	3.05 (8.32)	2.77 (6.68)	2.58 (5.68)	1.92 (2.68)	4.97 (23.68)	1.00 (0)
Sulfosulfuron	35	2.70 (6.32)	5.94 (34.32)	4.47 (19.00)	2.70 (6.32)	2.31 (4.32)	2.45 (5.00)	1.73 (2.00)	4.16 (16.32)	1.00 (0)
Sulfosulfuron	40	2.58 (5.68)	5.89 (33.68)	4.39 (18.32)	2.64 (6.00)	2.24 (4.00)	2.38 (4.68)	1.64 (1.68)	3.96 (14.68)	1.00 (0)
Sulfosulfuron	45	2.51 (5.32)	5.86 (33.32)	4.36 (18.00)	2.58 (5.68)	2.16 (3.68)	2.24 (4.00)	1.64 (1.68)	3.91 (14.32)	1.00 (0)
Weed-free	-	1.00 (0)	1.00 (0)	1.00 (0)	1.00 (0)	1.00 (0)	1.00 (0)	1.00 (0)	1.00 (0)	1.00 (0)
Weedy	-	5.74 (32.00)	9.43 (88.00)	8.54 (72.00)	4.28 (17.32)	4.12 (16.0)	3.78 (13.32)	3.00 (8.00)	8.31 (68.00)	1.52 (1.32)
CD (P = 0.05)	-	0.75	1.25	1.16	0.61	0.55	0.49	0.40	1.11	0.12

Table 3. Continued.

Treatments	Dose (g/ha)	*Convolvulus arvensis* on DAS 60	90	120	Other weeds on DAS 60	90	120
Sulfosulfuron	20	3.11 (8.68)	4.00 (15.00)	3.05 (8.32)	3.00 (8.00)	5.38 (28.00)	5.97 (34.68)
Sulfosulfuron	25	2.70 (6.32)	3.70 (12.68)	2.77 (6.68)	2.70 (6.32)	5.13 (25.32)	5.57 (30.00)
Sulfosulfuron	30	2.64 (6.00)	3.60 (12.00)	2.64 (6.00)	2.58 (5.68)	5.00 (24.00)	4.93 (23.32)
Sulfosulfuron	35	2.31 (4.32)	3.36 (10.32)	2.58 (5.68)	2.24 (4.00)	3.96 (14.68)	4.28 (17.32)
Sulfosulfuron	40	2.24 (4.00)	3.32 (10.00)	2.51 (5.32)	2.24 (4.00)	3.78 (13.32)	4.12 (16.00)
Sulfosulfuron	45	22.24 (4.00)	5.16 (25.63)	2.38 (4.68)	2.16 (3.68)	3.70 (12.68)	4.08 (15.68)
Weed-free	-	1.00 (0)	1.00 (0)	1.00 (0)	1.00 (0)	1.00 (0)	1.00 (0)
Weedy	-	3.42 (10.68)	4.44 (18.68)	3.21 (9.32)	3.42 (10.68)	6.50 (41.32)	7.09 (49.32)
CD (P = 0.05)		0.50	0.65	0.47	0.48	0.97	1.03

dactylon and all other dominant weed increased at latter stages of crop growth. Application of different doses of sulfosulfuron resulted into significantly less total weed density and weed dry weight as compared to weedy check but none of them were able to provide completely control of dominant weeds at 60 and 90 days stages of crop growth. However, sulfosulfuron at 35, 40 and 45 g/ha at 35 DAS recorded lower weed population and proved significantly superior to its later stage application. At lower doses of sulfosulfuron, earlier timing of sulfosulfuron application showed high activity against weeds resulting in significant reduction in weed biomass. Hence, in this trial best efficacy of total weed biomass control obtained by sulfosulfuron at 30 g/ha. Finally, it was concluded that all the herbicide treatment were however,

Table 4. Effect of different treatments of total weeds (per m^2), and weeds biomass (g/m^2), grain and straw yield. Figures in parentheses indicate original values ($\sqrt{X + 1.0}$), DAS = Days after sowing.

Treatments	Dose (g/ha)	Total weeds (m^2) on DAS 60	90	120	Weeds dry weight (g/m^2) on DAS 60	90	120	Grain (q/ha)	Straw (q/ha)	Biological yield (q/ha)
Sulfosulfuron	20	7.16 (50.32)	13.02 (168.64)	10.13 (101.68)	2.96 (7.75)	2.87 (60.88)	4.79 (21.96)	31.03	37.48	68.51
Sulfosulfuron	25	6.38 (39.68)	11.62 (134.00)	9.05 (81.00)	2.67 (6.11)	7.03 (48.37)	4.30 (17.50)	33.52	38.00	71.52
Sulfosulfuron	30	5.74 (32.00)	10.30 (105.04)	7.89 (61.32)	2.43 (4.93)	6.24 (37.92)	3.77 (13.24)	35.00	38.52	73.52
Sulfosulfuron	35	4.89 (22.96)	8.99 (79.96)	6.93 (47.00)	2.12 (3.53)	5.46 (28.86)	3.34 (10.15)	36.15	39.00	75.15
Sulfosulfuron	40	4.73 (21.36)	8.76 (75.68)	6.73 (44.32)	2.07 (3.29)	5.32 (27.32)	3.25 (9.57)	36.25	39.30	75.58
Sulfosulfuron	45	4.62 (20.36)	8.48 (71.00)	6.58 (42.36)	2.03 (3.14)	5.16 (25.63)	3.18 (9.15)	36.16	39.64	75.80
Weed-free	-	1.00 (0)	1.00 (0)	1.00 (0)	1.00 (0)	1.00 (0)	1.00 (0)	37.83	40.03	77.86
Weedy	-	8.85 (77.32)	15.26 (232.00)	12.09 (145.28)	4.20 (16.70)	8.54 (71.92)	5.69 (31.38)	25.00	30.23	55.23
CD (P = 0.05)	-	1.21	1.97	1.55	0.48	1.23	0.66	4.86	3.43	8.36

equally effective on broadleaves weed and recorded significantly lower dry weight as compared to weed check.

Effect of Sulfosulfuron on Wheat Yield

An average yield decrease by 29% was observed due to season-long weed crop competition as compared to repeated manual weeding. All the weed control treatments resulted in significantly higher wheat grain yield than weedy check (Table 4). The weed-free condition produced significantly higher grain yield (37.83 q/ha), which was at par with sulfosulfuron at 25, 30, 35, 40 and 45 g/ha treated plots an remained at par with sulfosulfuron at 20 g/ha and weedy check. The reason for higher grain yield in various doses of sulfosulfuron treated plots was due to low dry weight of weeds and less density of total weed, which in turn provided favorable environment for growth and development of crop. Singh and Singh (9) also reported similar results. The higher grain yield hectare in weed-free plots and various doses of sulfosulfuron treated plots were mainly due to higher yield attributing characters i.e. spikes/m^2, spike length, grains/spike, test weight and harvest index. The higher yield attributing characters in weed-free and different doses of sulfosulfuron treated plots as compared to weedy plot might be due to better growth of plant as evident from higher dry matter accumulation at different stages of crop growth. Application of various doses of sulfosulfuron significantly increased the grain yield over weedy check. This is attributed to higher dry matter accumulation in crop leading to higher number of grains/spike and test weight. The application of sulfosulfuron at 40 g/ha increased the grain yield by 45% over weedy check and was at par with weed-free. The increase in grain yield under other doses of sulfosulfuron were accompanied with an increase in spike length, spikes/m^2, grains/spike and test weight. The data revealed that grain yield was significantly higher in all herbicide treatments as compared to unsprayed control in both the years whereas all the herbicide treatments were at par in respect of straw yield. Higher grain yield in herbicide treatments was due to better weed control which gave reduction in weed dry matter compared to unweeded control thus resulting in better crop development including tillering, dry matter production and grain formation there by favoring the grain yield. However, increase in grain yield might be attributed to significant reduction in weed-crop competition owing to effective control of weeds and marked improvement in crop growth and yield attributes. The herbicides sulfosulfuron increased the grain yield of wheat to the tune of 28—30% over weedy check.

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