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Bioefficacy of Azimsulfuron against Sedges in Direct Seeded Rice

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In the 21st century alongwith population pressure, rising scarcity of agricultural land and water and continuing shortage of labour will maintain pressure for a shift towards direct seeding method in rice production system (Mortimer *et al.*, 2005). Despite several advantages, various production obstacles are also encountered in direct seeded rice in which heavy weed infestation is major one. Weeds cause heavy damage to direct seeded rice (DSR) crop which can be to the tune of 5-100% (Moody and Mian, 1979; Kolhe, 1989). Weeds also deteriorate the grain quality and enhance the cost of production. Generally pre-emergence herbicides are used in direct seeded rice. However, sometimes due to unavailability of herbicides or lower soil moisture leads to the situation where application of pre-emergence herbicide is questionable. Also pre-emergence herbicides in DSR impart only partial control and weeds like *Cyperus rotundus* becomes highly competitive. In such situations, post-emergence herbicides are needed for use in combination with pre-emergence herbicides for the control of weeds in direct seeded rice. Azimsulfuron (50DF) is a post-emergence herbicide, which was used in the experimental plots with the objective to evaluate its bio-efficacy alone and in tank-mix application with metsulfuron methyl (MSM 20 SG) as post-emergence application in direct dry seeded rice and crop safety against these herbicides.

The experiment was conducted at Crop Research Centre of G. B. Pant University of Agriculture & Technology, Pantnagar during **kharif** 2006. The soil of experimental plot was silty clay loam in texture, high in organic carbon (0.80%), medium in available P (19 kg/ha) and high in available K (225 kg/ha) with a soil pH of 7.65. The experiment was planned in a randomized block design with three replications. Ten treatments viz., azimsulfuron (25 g/ha), azimsulfuron (27.5 g/ha), azimsulfuron (30.0 g/ha), azimsulfuron (25, 27.5 and 30 g/t)+mixed with MSM (2g), MSM alone (2 g), pendimethalin (1 kg), pendimethalin (1 kg) followed by MSM (2 g) and untreated control were tested on the rice crop. Rice variety NDR-359 was sown on 25 June 2006. Pendimethalin was applied as pre-emergence and azimsulfuron and metsulfuron were applied as post-emergence (25 DAS) by knapsack sprayer fitted with flat fan nozzle delivering 300 l water/ha. Crop was fertilized at the rate of 120 kg/ha N through urea and 60 kg P_2O_5/ha through diammonium phosphate (DAP). Full dose of phosphorus and half of nitrogen was applied as basal and the remaining half nitrogen was top dressed in two equal proportions at tillering and panicle initiation stages. Weed count was recorded with the help of 1.0 x 0.25 m quadrat from two places in each plot. Weed biomass was weighed for fresh and dry weight at 45 and 70 DAS. Recommended package of practices were adopted to raise the crop in direct dry seeded situation.

The experimental plot was largely infested with grasses. Among the grasses, major weeds were *Leptochloa chinensis, Eragrostis japonica, Echinochloa colona* and *Echinochloa crusgalli*. Grassy weeds accounted for 63.4 and 24.7% and sedges accounted for 27.5 and 11.1% of total weed density at 45 and 70 DAS, respectively. As dose of azimsulfuron was increased, weed density and dry weight of weeds reduced at all the stages. Azimsulfuron was found to be effective against *Cyperus* species as it was completely eliminated from the treated plot (Table 1). Among broadleaf weeds, *Cynotis axillaris, Caesulia axillaris* and *Commelina diffusa* were infesting the field. Pendimethalin fb MSM recorded the lowest grassy weed density at both the stages which was significantly superior to pendimethalin at initial stage, whereas at later stage it was comparable with it. Azimsulfuron+MSM at all the doses proved effective against *C. rotundus* compared to other treatments. However, pendimethalin was not effective against sedges and broad-leaved weeds as it recorded the highest weed density among the treatments at both the stages.

Azimsulfuron 30 g/ha was found comparable to pendimethalin applied alone at 1.0 kg/ha at 45 DAS for grassy weed density, whereas at later growth stages,

Table 1. Effect of weed management practices on relative weed density in diret seeded rice

Treatments	Dose (g/ha)	Stage of application (DAS)	Weed density (No./m^2)					
			45 DAS			70 DAS		
			Grasses	Sedges	Broadleaf weeds	Grasses	Sedges	Broadleaf weeds
Azimsulfuron+MSM+0.2% Surf.	25.5+2	25	8.0 (65.0)	1.0 (0)	1.0 (0)	8.7 (75.3)	1.0 (0)	1.4 (1.3)
Azimsulfuron+MSM+0.2% Surf.	27.5+2	25	7.0 (50.0)	1.0 (0)	1.0 (0)	7.6 (57.3)	1.0 (0)	1.8 (2.7)
Azimsulfuron+MSM+0.2% Surf.	30.0+2	25	6.4 (40.7)	1.0 (0)	1.7 (2.0)	6.8 (46.0)	1.0 (0)	2.1 (4.0)
Azimsulfuron+0.2% Surf.	25.0	25	8.7 (74.7)	1.0 (0)	3.1 (8.7)	8.5 (72.7)	1.0 (0)	2.2 (4.0)
Azimsulfuron+0.2% Surf.	27.5	25	7.3 (52.0)	1.0 (0)	2.8 (7.3)	7.8 (59.3)	1.0 (0)	2.1 (4.0)
Azimsulfuro+0.2% Surf.	30.0	25	6.8 (46.0)	1.0 (0)	2.5 (5.3)	6.9 (46.7)	1.0 (0)	2.8 (7.3)
MSM+0.2% Surf.	2.0	25	7.3 (52.0)	1.2 (0.7)	1.7 (2.0)	7.8 (62.7)	1.2 (0.7)	1.2 (0.7)
Pendimethalin	1000	1	5.1 (26.0)	6.9 (47.3)	3.1 (9.3)	4.2 (17.3)	4.2 (17.3)	4.0 (15.3)
Standard check (Pendi. fb MSM/CLM)	1000 fb 4	1 fb 28	2.6 (6.0)	2.1 (4.0)	1.4 (1.3)	3.5 (12.0)	2.1 (3.3)	1.9 (3.3)
Untreated check	0		7.8 (60.0)	5.1 (26.7)	3.0 (8.7)	8.2 (68.0)	3.0 (9.3)	2.6 (6.0)
LSD (P=0.05)			2.0	1.3	1.2	1.6	0.9	1.4

MSM–Metsulfuron methyl, CLM–Chlorimuron-ethyl.
Figures in parentheses are original values, observations on weed density are transformed to ($\sqrt{x+1}$).

it was comparable with azimsulfuron (30 g)+MSM (2 g) but superior to pendimethalin (Table 1). Azimsulfuron (25 g)+MSM (2 g/ha) and azimsulfuron with its lower doses of 25 and 27.5 g was not effective against grasses and was similar to weedy plots at both the stages of crop growth. Pendimethalin was not found effective against sedges as it recorded the highest weed density at both the stages, whereas treatments having azimsulfuron completely controlled sedges in treated plots. Azimsulfuron with all doses when applied with MSM recorded at par broadleaf weeds population and dry weight when MSM applied alone at both stages of the study.

Both at 45 and 70 DAS, plots treated with pendimethalin followed by MSM recorded lowest total weed density (94.7 and 83.3, respectively). At initial stage (45 DAS), it was followed by azimsulfuron (30 g) alongwith MSM which was at par with other treatments except azimsulfuron at 25 g either alone or with MSM and weedy check (Table 2). Whereas at later stage (70 DAS), pendimethalin+MSM was at par with pendimethalin alone with respect to weed density. As the crop growth progressed the weed dry matter also increased from 45 to 70 DAS. Azimsulfuron was found comparable to pendimethalin and MSM alone but recorded significantly higher weed dry matter as compared to pendimethalin fb MSM at first stage of study (Table 2). Pendimethalin alone and azimsulfuron (30 g) combined with MSM were comparable to standard check i. e. pendimethalin 1.0 kg/ha fb MSM 4 g/ha in terms of weed dry weight at 70 DAS. No significant difference was observed in weed dry weight at this stage when azimsulfuron applied either alone or followed with MSM. Weed dry weight at 70 DAS was almost similar at all doses of azimsulfuron application. However, at initial crop growth stage (45 DAS), as the dose of azimsulfuron was increased, the

Table 2. Effect of weed management practices on weed density and dry weight of direct seeded rice

Treatments	Dose (g/ha)	Stage of application (DAS)	Total weed density (No./m^2)		Weed dry weight (g/m^2)	
			45 DAS	70 DAS	45 DAS	70 DAS
Azimsulfuron+MSM+0.2% Surf.	25.0+2	25	8.2 (60.0)	8.5 (71.3)	420.27	697.37
Azimsulfuron+MSM+0.2% Surf.	27.5+2	25	7.1 (50.0)	7.8 (60.0)	433.67	519.10
Azimsulfuron+MSM+0.2% Surf.	30.0+2	25	6.5 (42.7)	7.6 (57.3)	308.67	495.00
Azimsulfuron+0.2% Surf.	25.0	25	9.3 (86.0)	8.5 (72.0)	350.80	679.03
Azimsulfuron+0.2% Surf.	27.5	25	7.8 (60.0)	8.0 (62.7)	292.10	655.67
Azimsulfuro+0.2% Surf.	30.0	25	7.2 (51.3)	7.4 (54.0)	486.93	636.87
MSM+0.2% Surf.	2.0	25	7.4 (54.7)	7.9 (63.3)	468.03	854.53
Pendimethalin	1000	1	7.7 (58.0)	7.1 (50.0)	340.07	426.2
Standard check (Pendi. fb MSM/CLM)	1000 fb 4	1 fb 28	3.5 (11.3)	5.3 (30.7)	55.97	283.48
Untreated check	-	-	9.7 (94.7)	9.1 (83.3)	547.17	900.67
LSD (P=0.05)			1.9	1.9	228.38	226.23

MSM–Metsulfuron methyl, CLM–Chlorimuron-ethyl.
Figures in parentheses are original values, observations on weed density are transformed to ($\sqrt{x+1}$).

weed dry weight decreased. It was due to more toxicity of herbicide on weeds.

Pendimethalin fb MSM (1000 fb 4 g/ha) recorded the highest grain yield followed by pendimethalin 1000 g/ha which may be attributed to their more number of panicles per unit area and grains per panicle (Table 3). It was followed by pendimethalin alone, azimsulfuron (30 g/ha) fb MSM, MSM (2 g/ha) alone, azimsulfuron (25 g/ha) fb MSM and azimsulfuron (30 g/ha) alone. Azimsulfuron 30 g/ha alongwith MSM 2 g/ha recorded significantly higher yield (554 kg/ha) as compared to 25 g/ha along with MSM. Higher doses of azimsulfuron recorded the higher grain yield as compared to lower doses; however, the differences were non-significant between the different doses. Lower grain yield in azimsulfuron treated plots was mainly due to infestation of grassy weeds in the experimental plot, since azimsulfuron was not effective against the grassy weeds; however, it was found to be effective against sedges and broadleaf weeds. Under the phytotoxicity observation, yellowing of leaf was seen when azimsulfuron applied, but crop recovered in 15-20 days.

Table 3. Effect of weed management practices on weed density and dry weight of direct seeded rice

Treatments	Dose (g/ha)	Stage of application (DAS)	Panicles (No./m^2)	Grains/ panicle	1000-grain weight (g)	Grain yield (q/ha)	Straw yield (q/ha)
Azimsulfuron+MSM+0.2% Surf.	25.0+2	25	48.7	34.5	26.7	4.38	6.57
Azimsulfuron+MSM+0.2% Surf.	27.5+2	25	50.3	35.1	27.3	4.83	7.23
Azimsulfuron+MSM+0.2% Surf.	30.0+2	25	57.7	35.2	27.1	5.54	8.50
Azimsulfuron+0.2% Surf.	25.0	25	41.0	35.0	26.7	4.17	6.36
Azimsulfuron+0.2% Surf.	27.5	25	44.0	36.6	27.1	4.29	6.67
Azimsulfuron+0.2% Surf.	30.0	25	45.3	37.9	27.2	4.80	7.67
MSM+0.2% Surf.	2.0	25	44.6	41.3	27.0	4.96	7.73
Pendimethalin	1000	1	62.0	42.0	27.8	6.83	10.52
Standard check (Pendi. fb MSM/CLM)	1000 fb 4	1 fb HW at 28	121.0	56.0	27.8	18.75	28.33
Untreated check	-	-	33.7	33.6	27.3	3.13	4.76
LSD (P=0.05)			16.7	2.2	NS	1.08	1.71

MSM–Metsulfuron-methyl, CLM–Chlorimuron-ethyl, NS–Not Significant.

Thus, it can be concluded that azimsulfuron is effective against sedges and broadleaf weeds in direct seeded rice particularly against *C. rotundus*–a noxious weed in DSR. There is no advantage of tank mixing of azimsulfuron with MSM over azimsulfuron alone for the control of sedges and broad-leaved weeds.

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