Indian J. Weed Sci. **42** (3 & 4) : 168-172 (2010)

Efficacy of Azimsulfuron Applied Alone and Tank Mixed with Metsulfuron+ Chlorimuron (Almix) in Dry Direct Seeded Rice

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ABSTRACT

Field experiments were conducted at Karnal (Haryana) and Pusa (Bihar) during **kharif** 2006 to assess efficacy of azimsulfuron alone and in combination with ready mix of metsulfuron+chlorimuron (almix) applied to the dry direct seeded rice (DSR) crop. Azimsulfuron at 25-30 g/ha applied 25 days after sowing controlled effectively broadleaf weeds and sedges especially *Cyperus rotundus* in DSR but failed to control grasses.Tank mixing of almix did not improve efficacy of azimsulfuron for the control of grasses, sedges or broadleaf weeds across the locations. Azimsulfuron alone or tank mixed with almix was not effective against grasses. On an average, uncontrolled weeds reduced the grain and straw yield of rice by 42 and 46%, respectively. Azimsulfuron applied alone or in tank mixed with almix and pre-emergence application of pendimethalin followed by almix had no toxicity in rice cultivar HBC-119 but phytotoxicity was observed in rice cultivar Rajshree at Pusa with higher doses of azimsulfuron.

Key words : Direct seeded rice, weed management, azimsulfuron, broadleaf weeds, sedges

INTRODUCTION

Introduction of high yielding dwarf rice cultivars, tailored to respond external inputs often transplanted after puddling replaced the traditional practice of direct dry seeding of rice in Indo Gangetic plains. The swift change-over was mainly due to non-availability of herbicide molecules (pre- or post-emergence) for control of weeds, a major problem of direct dry seeded rice (DSR) culture. Pandey and Velasco (2002) argued that low wage rates and adequate water supply favoured the transplanting, whereas direct seeding was likely to increase in circumstances of labour scarcity and high wages and low water availability. The alternative to puddling and transplanting could be aerobic direct-seeding, which requires less water, labour and capital input initially. In addition, DSR matures earlier (7-10 days) than the transplanted rice allowing timely planting of the succeeding wheat crop (Giri, 1998; Singh *et al*., 2006). Other benefits of DSR include faster and easier planting, improvement of soil health, higher tolerance to water deficit, less methane emission and often higher profit in areas with an assured water supply.

Weed control is major limitation for the success of DSR (Johnson and Mortimer, 2005; Singh *et al.,* 2006; Rao *et al*., 2007). Many studies have reported the potential of DSR as a replacement for transplanted rice if weeds are controlled effectively (Singh, 2005; Singh *et al.,* 2008). The yield loss due to poor weed management may vary from 10% to complete crop failure (Singh, 2005; Singh *et al*., 2008). Inspite of the weed menace, farmers in eastern UP and Bihar opt for direct dry seeded rice when it is difficult for them to complete rice transplanting in time or water supplies are uncontrolled such as unfavourable low or upland rice ecologies. Under such situations semi-tall rice cultivars that can tolerate drought or partial flooding are preferred by the farmers. These cultivars grow faster and compete with weeds, produce enough palatable fodder as crop livestock interactions are strong in such risk prone ecologies. Similarly, in western Indo Gangetic plains (IGP) the semi-tall basmati type cultivars are preferred by farmers over modern high yielding dwarf varieties or hybrids (Gopal *et al.*, 2010).

It has been observed that various grasses, broadleaf weeds and sedges become competitive and cause significant loss to dry direct seeded rice. Some herbicides are effective for the control of grasses and broadleaf weeds in DSR but not against the sedges particularly *Cyperus rotundus.* Sedges become highly

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competitive with the crop of DSR when other weeds are controlled. Azimsulfuron is introduced as post-emergence sulfonylurea herbicide useful for controlling weeds in rice fields (Valle *et al*., 2006). Therefore, some post-emergence herbicides alone or in tank mixture or in combination with pre-emergence herbicides need to be tried for effective control of grassy, broadleaf weeds and sedges in direct seeded rice. This study was designed to evaluate the efficacy and safety of azimsulfuron 50 DF applied alone and in tank-mix with ready mix of metsulfuron methyl+ chlorimuron ethyl 20 SG (almix) for effective post-emergence control of weeds in direct dry seeded rice.

MATERIALS AND METHODS

The field trials were conducted in rice-wheat belt on finer textured (clay loam) soils at two sites viz., Tilda Rice Land Farm, Karnal, Haryana and at experimental farms of Rajendra Agricultural University, Pusa, Samastipur, Bihar during **kharif** 2006. Rice-wheat systems have been practised at both experimental sites for many years.The two sites were not only varying in weed pressures but also in the composition of the weeds. All the treatments occupied a plot with 5 x 4 m dimensions. Treatments of azimsulfuron 50 DF, at four levels (22.5, 25, 27.5 and 30 g/ha) applied 25 DAS either alone or in combination with almix and pre-emergence application of pendimethalin followed by almix at 25 DAS were compared with the weedy and weed free check in randomized block design with three replications (Table 2). Azimsulfuron alone or in combination with almix was applied with 0.2% surfactant for post-emergence weed management.

Rice cultivars HBC-119 and Rajshree were seeded using a zero-till seed drill on June 30 and July 20, 2006 at Karnal and Pusa, respectively. The seed rate varied between 20-30 kg/ha between locations. Both the sites were infested with natural population of complex weed flora (Table 1). Herbicides were applied using knapsack sprayers fitted with flat-fan nozzles using 300 litres of water/ha. The agronomic and crop management practices were followed as per the DSR production technology (Gupta *et al*., 2006). Density and dry/fresh weight of weeds were recorded at 40 and 70 DAS with the help of quadrate (size 0.5 x 0.5 m), at two places in each plot.Visual phytotoxicity was observed using 0-10 scale, where 0 means no phytotoxicity and 10 means complete kill of crop.

Table 1. Weed flora at the experimental sites at Karnal (Haryana) and Pusa (Samastipur, Bihar)

Karnal (Haryana)	Pusa (Bihar)
Echinochloa colona and *Echinochloa crusgalli* (grassy weeds), *Cyperus iria, Cyperus difformis* and *Fimbristyllis quinquagularis* and few broadleaf weeds such as *Eclipta alba, Linderniasp*, *Amamia auriculata* etc.	*Cyperus rotundus* and *Cyperus dactylon (*major weeds), *Physalis* sp., *Cucumis* sp. *Echinochloa colona, Corchorus actutangulus* and *Dactyloctenium aegyptium*. *Cyperus rotundus* alone accounted for 63.8 and 31% of total weed density at 40 and 70 DAS.

RESULTS AND DISCUSSION

Effect on Weeds

At Karnal site, all the weed control treatments significantly reduced the density and dry weight of weeds over weedy check (Tables 2, 3 and 4). Pre-emergence application of pendimethalin followed by almix significantly reduced the density of grassy weeds compared to other herbicide treatments at both stages. Singh *et al*. (2005) have also reported that combination of pre-emergence application of pendimethalin at 1.0 kg/ha followed by post-emergence application of 2,4-D at 500 g/ha recorded highest weed control efficiency. Weed density and dry weight of grassy weeds were similar in the plots treated with azimsulfuron alone or in tank mixed with almix at different doses. Treatments of azimsulfuron applied alone or in tank mixed with almix proved significantly superior to alone application of almix in reducing the total density and dry weight of weeds at both the stages. Azimsulfuron alone provided 90 to 95% control of broadleaf weeds and sedges, however, tank mixing of azimsulfuron with almix didn't produce any additive advantage. Plots treated with pendimethalin fb

Table 2. Effect of different weed control treatments on weed densities at 40 DAS

Treatments	Dose (g/ha)	Weed density (No./m^2)					
		Grassy		Broadleaf		Sedges	
		Karnal	Pusa	Karnal	Pusa	Karnal	Pusa
Azimsulfuron	22.5	NA	8.72 (77)	NA	1.00 (0)	NA	10.14 (107)
Azimsulfuron	25.0	6	7.48 (57)	1	1.00 (0)	0	11.16 (124)
Azimsulfuron	27.5	5	8.58 (75)	0	1.00 (0)	0	12.54 (157)
Azimsulfuron	30.0	4	8.65 (75)	0	1.00 (0)	0	11.87 (142)
Azimsulfuron+Almix	25.0+2	6	6.86 (48)	0	1.00 (0)	0	9.98 (100)
Azimsulfuron+Almix	27.5+2	6	8.67 (75)	0	1.00 (0)	0	12.25 (149)
Azimsulfuron+Almix	30.0+2	4	7.68 (60)	0	1.00 (0)	0	9.56 (93)
Almix	2.0	11	7.18 (53)	3	1.00 (0)	6	14.46 (216)
Pendimethalin fb Almix	1000 fb 4	2	6.27 (39)	0	4.14 (21)	3	16.84 (284)
Weed free	0	0	1.00 (0)	0	1.00 (0)	0	1.00 (0)
Untreated check	0	15	8.42 (71)	5	7.45 (60)	8	16.99 (289)
LSD (P=0.05)		2.7	2.03	1.62	1.88	1.7	3.43

Values in parentheses are original values as observations on weed density are transformed (√x+1) for Pusa site. NA : Not tested.

Table 3. Effect of different weed control treatments on weed densities at 70 days in DSR

Treatments	Dose (g/ha)	Weed density (No./m^2)					
		Grassy		Broadleaf		Sedges	
		Karnal	Pusa	Karnal	Pusa	Karnal	Pusa
Azimsulfuron	22.5	NA	20.93 (445)	NA	2.45 (7)	NA	2.19 (7)
Azimsulfuron	25.0	13	19.24 (378)	3	2.34 (6)	1	1.67 (3)
Azimsulfuron	27.5	11	22.01 (492)	1	2.54 (7)	0	1.24 (1)
Azimsulfuron	30.0	12	21.23 (452)	0	2.04 (5)	0	1.00 (0)
Azimsulfuron+Almix	25.0+2	13	19.28 (389)	0	2.70 (8)	2	1.00 (0)
Azimsulfuron+Almix	27.5+2	10	19.44 (394)	0	1.00 (0)	1	1.00 (0)
Azimsulfuron+Almix	30.0+2	11	17.28 (309)	0	1.67 (3)	0	1.00 (0)
Almix	2.0	19	23.59 (567)	3	1.00 (0)	11	3.27 (11)
Pendimethalin fb Almix	1000 fb 4	4	8.69 (113)	0	5.54 (45)	4	17.62 (344)
Weed free	0	0	1.00 (0)	0	1.00 (0)	0	1.00 (0)
Untreated check	0	25	20.01 (401)	10	5.86 (51)	13	13.47 (201)
LSD (P=0.05)		3.7	5.71	1.9	3.53	2.6	4.08

Figures in parentheses are original values as observations on weed density are transformed (√x+1) for Pusa site, NA : Not tested.

almix (1000 fb 4 g/ha) and with azimsulfuron at 30 g/ha alone or in tank mixed with almix produced similar total weed dry weight at both the stages. Pendimethlin fb almix reduced the total weed dry weight by 76 and 83% over weedy check at 40 and 70 DAS, respectively.

At Pusa, different herbicide treatments except pre-emergence application of pendimethalin followed by almix produced similar density of grassy weeds compared to weedy check at both the stages. Density of grassy weeds was significantly less in the plots treated with pendimethalin followed by almix compared to the plots treated with azimsulfuron and almix alone and in tank mix. In treatments with azimsulfuron alone or tank mixed with almix, complete control of broadleaf weeds (*Physalis* sp., *Cucumis* sp.) and sedges (*Cyperus rotundus)* was observed at 40 and 70 DAS, respectively. Azimsulfuron alone or tank mixed with almix at varying doses arrested the growth of *C. rotundus* one week after application and it became almost inactive which was followed by slow senescence, chlorotic patches on leaves, leaf

Table 4. Effect of different weed control treatments on total weed density and dry weight of weeds

Treatments	Dose (g/ha)	Total weed density (No./m^2)				Total weed dry weight/fresh weight* (g/m^2)			
		40 DAS		70 DAS		40 DAS		70 DAS	
		Karnal	Pusa	Karnal	Pusa	Karnal	Pusa*	Karnal	Pusa*
Azimsulfuron	22.5	NA	13.58 (184)	NA	21.06 (459)	NA	13.56 (183)	NA	29.93 (900)
Azimsulfuron	25.0	7	13.47 (181)	17	19.69 (397)	6.7	12.65 (159)	54.5	27.04 (733)
Azimsulfuron	27.5	5	15.22 (232)	12	22.19 (500)	5.8	13.54 (183)	41.9	27.84 (833)
Azimsulfuron	30.0	4	14.76 (217)	12	21.42 (457)	4.5	16.10 (259)	21.3	25.07 (633)
Azimsulfuron+Almix	25.0+2	7	12.16 (148)	15	19.45 (397)	7.6	12.18 (157)	50.0	23.69 (520)
Azimsulfuron+Almix	27.5+2	6	14.99 (224)	11	19.43 (394)	6.7	12.71 (172)	42.0	23.09 (533)
Azimsulfuron+Almix	30.0+2	4	17.92 (153)	11	17.27 (312)	4.9	13.25 (185)	24.5	21.52 (467)
Almix	2.0	19	16.12 (269)	33	23.79 (578)	11.3	15.11 (231)	82.5	29.16 (867)
Pendimethalin fb Almix	1000 fb 4	5	18.54 (344)	8	22.7 (502)	3.2	22.82 (521)	17.1	35.1 (1233)
Weed free	0	0	1.00 (0)	NA	1.00 (0)	0	1.0 (0)	0	1.0 (0)
Untreated check	0	27	20.26 (420)	47	25.51 (653)	15.4	25.52 (675)	105.1	37.01 (1467)
LSD (P=0.05)		2.4	5.14	6.35	5.50	2.4	4.48	12.9	9.54

Figures in parentheses are original values as observations on fresh weight are transformed (√x+1) for Pusa site, NA : Not tested.

necrosis and eventual mortality at later stages. Yadav *et al*. (2007) have also reported better efficacy of azimsulfuron on sedges in direct seeded rice. Tank mixing of almix with azimsulfuron could not produce any complimentary effect over azimsulfuron alone.

Effect on Crop

Uncontrolled weeds reduced the grain and straw yield of rice by 42 and 46%, respectively. All the herbicide treatments except azimsulfuron applied alone at lower doses (22.5 and 25.0 g/ha) and almix alone at 2 g/ha produced significantly higher grain and straw yield compared to weedy check.

At Karnal, all the treatments produced significantly higher grain yield compared to weedy check. Grain yield was similar in the plots treated with azimsulfuron alone or tank mixed with almix at respective doses except azimsulfuron alone at 25 g/ha (Table 5). Plots treated with almix alone being at par with weedy check produced significantly lower grain and straw yield compared to the plots treated with azimsulfuron alone or

Table 5. Effect of different weed control treatments on grain and straw yield and phytotoxicity in DSR

Treatments	Dose (g/ha)	Grain yield (kg/ha)		Straw yield (kg/ha)		Visual phytotoxicity	
		Karnal	Pusa	Karnal	Pusa	Karnal	Pusa
Azimsulfuron.	22.5	NA	2092	NA	3852	NA	0
Azimsulfuron	25.0	2336	2593	3257	4037	0	0
Azimsulfuron	27.5	2401	2570	3368	3889	0	2
Azimsulfuron	30.0	2693	2259	3707	3919	0	2
Azimsulfuron+Almix	25.0+2	2338	2685	3274	4352	0	1
Azimsulfuron+Almix	27.5+2	2486	2648	3545	3922	0	2
Azimsulfuron+Almix	30.0+2	2646	2185	3737	3823	0	3
Almix	2.0	1914	2055	2618	3845	0	0
Pendimethalin fb Almix	1000 fb 4	2963	2370	4134	4363	0	0
Weed free	0	3047	2833	4255	5620	0	0
Untreated check	0	1780	1611	2330	2972	0	0
LSD (P=0.05)		243	355	392	1688		

NA : Not tested.

tank mixed with almix. The plots kept weed free for the whole season produced significantly higher grain yield of rice compared to all treatments except pendimethalin fb almix. Treatment of pre-emergence application of pendimethalin followed by post-emergence application of almix produced significantly higher grain and straw yield compared to all other herbicide treatments. Singh *et al*. (2005) also reported that combination of post-emergence application of 2, 4-D at 500 g/ha with pre-emergence application of pendimethalin 1.0 kg/ha recorded highest rice grain yield. Azimsulfuron applied alone or in combination with almix at 30 g/ha produced significantly higher grain and straw yield of rice compared to lower dose (25 g/ha). It was observed that azimsulfuron had no toxicity with rice cultivar HBC 119.

At Pusa, all herbicidal treatments except post-emergence application of almix alone produced significantly higher grain yield compared to unweeded check. Highest grain yield was observed in weed free treatment being at par with azimsulfuron at 25 or 27.5 g/ha applied alone or in combination with almix. Lesser grain and straw yield was recorded in treatment having azimsulfuron 30 g/ha alone or in combination with almix due to phytotoxicity at higher dose. The treatment with pendimethalin followed by almix failed to yield similar to weed free due to heavy infestation of weeds (*C. rotundus, Physalis* sp., *Cucumis* sp). Highest straw yield was observed in weed free treatment which was at par with treatments having azimsulfuron at 25 g/ha applied alone or in combination with almix or pendimethalin followed by almix. Phytotoxicity of azimsulfuron alone or tank mixed with almix was recorded at higher dose (27.5 and 30 g/ha) in rice cultivar Rajshree which resulted in yellowing and stunting of crop.

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