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Comparative study on efficacy of sulfonylurea herbicides and traditional recommended herbicides in transplanted rice *(Oryza sativa)*

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ABSTRACT

The efficacy of some potent low-dose herbicides of sulfonylurea group in conjunction with other traditional recommended herbicides for control of wide-spectrum of weed flora in transplanted rice *(Oryza sativa* L.) field was studied during the wet season of 2004 and 2005 at Cuttack, under rainfed shallow lowland. The major weeds found were *Echinochloa* spp., *Cyperus iria, Fimbristylis miliacea, Sphenochlea zeylanica, Ludwigia parviflora* and *Aeschynomene indica.* Triasulfuron + Pretilachlor (9 + 500 g/ha) applied 7 days after transplanting was found most effective in controlling weeds and maximizing rice-grain yield (59.3). This was at par with weed-free check. There was more than 44% reduction in the grain yield of rice due to competition with weeds in the weedy plots. All the new-generation herbicides showed better control of weeds (weed-control efficiency 79.9–95.1%) in comparison with the traditional recommended rice herbicides (weed-control efficiency 73.3–78%) and gave higher yield of rice irrespective of their dose of application.

Key words : Efficacy, Herbicide, Transplanted rice

India is the leading rice *(Oryza saiva* L.)-producing country in terms of area and is the second largest producer next to China. Rice is grown in 45 million ha annually with a production of 90 million tonnes, contributing 45% to the total foodgrain production of the country. Weed competition is one of the prime yield-limiting biotic constraints in rice. Transplanted rice in particular, is infested by heterogeneous types of weed flora under rainfed shallow lowland, which reduces yield up to 48% (Singh and Bhan, 1986). Therefore timely weed control is imperative for realizing the desired level of productivity. The use of herbicides offers selective and economic control of weeds right from the beginning, giving the crop an advantage of good start and competitive superiority (Saha, 2005). A number of herbicides like butachlor, pretilachlor, anilofos etc. have been recommended as pre-emergence for the control of early flushes of grassy weeds in transplanted rice field (Budhar *et al.,* 1991). However, increased trend of non-grassy weeds has been observed due to continuous use of these herbicides in transplanted rice field (Upadhyay and Gogoi, 1993). In view of the above facts, it would be desirable to use some alternative herbicides that may provide wide-spectrum weed control. One of the most important classes of herbicides that has become popular all over the world is sulfonylurea group of herbicides, which represent high level of activity, application flexibility, excellent selecivity and low mammalian toxicity even at a very low dose with broad-spectrum of weed control. Therefore the present investigation was undertaken to find out the efficacy of new-generation herbicides of sulfonylurea group on sedges and non-grassy weeds in transplanted rice field under rainfed shallow lowland.

MATERIALS AND METHODS

A field experiment was carried out during the wet season of 2004 and 2005 at Central Rice Research Institute, Cuttack in an alluvial (Haplaquept) clay-loam soil with pH 6.1, organic carbon 0.57%, total nitrogen 0.07%, Olsen's P 24 kg/ha and available K 98 kg/ha to study the weed-control spectrum and the efficacy of different herbicides of sulfonylurea group in comparison with the traditional recommended herbicides, with special reference to sedges and non-grassy weeds in transplanted rice field. The treatments consisted of butachlor (1500 g/ha), pretilachlor (500 and 750 g/ha), pyrazosulfuronethyl (PSE) (20 and 25 g/ha), bensulfuron methyl (BSM) (50 and 60 g/ha), trisulfuron (TSF) (6 and 9 g/ha), TSF + pretilachlor (6+500 and 9+500 g/ha) along with hand-weeding twice as recommended practice (20 and 40 DAT), weed-free (15, 30, 45 and 60 DAT) and weedy check (Table 1). Total 14 treatments were evaluated in randomized block design with four replications. All the herbicides were applied in saturated soil moisture as per the protocol of application

time using knapsack sprayer fitted with flat fan nozzle at spray volume of 500 litres/ha (Table 2). Seedlings of the test variety 'Gayatri' (photo-sensitive, flowered during third week of October) at 25 days were transplanted at a spacing of 20 cm × 15 cm on 22 July 2004, and 24 July 2005. Half the recommended dose of N (40 kg/ha) and full dose of P_2O_5 and K_2O (40 kg/ha) were applied before transplanting at final land preparation, and the remaining N (40 kg/ha) was top-dressed in two equal splits, half at active tillering and the rest half at panicle-initiation stage. All the other recommended agronomic and plant protection measures were adopted to raise the crop. The data on weed density and dry weight of weeds (90 DAT) were recorded at different growth stages of rice crop with the help of a quadrate (0.5 m × 0.5 m) at two places and then converted into per square metre. These were subjected to square-root transformation to normalize their distribution. Weed-control efficiency (%) was computed using the dry weight of weeds (Mani *et al.,* 1973). Grain yield of rice along with other yield-attributing characters like effective panicles/m^2 were recorded at harvest.

RESULTS AND DISCUSSION

Effect on weeds

All the treatments registered significantly lower number of weeds and total dry-matter accumulation than weedy check. The mean relative density in weedy plots recorded at 30 days after transplanting was 14.3, 25.3, 20.9, 12.1, 17.6 and 9.8% for *Echinochloa* spp., *Cyperus iria, Fimbristylis miliacea, Sphenochlea zeylanica, Ludwigia parviflora* and *Aeschynomene indica* respectively (Table 1). Thus grasses constituted 14.3%, sedges 46.2% and broad-leaf weeds 39.5% of the total weed population at 30 days stage. Almost similar trend was seen at 60 DAT. All the herbicides of sulfonylurea group were found effective in arresting the weed population and their growth compared with the traditional recommended herbicides, viz. butachlor and pretilachlor. However, the butachlor at 1,500 g/ha and pretilachlor at 750 g/ha controlled the *Echinochloa* spp. effectively. Among sulfonylurea herbicides, pyrazosulfuron ethyl at 25 g/ha reduced the density of grasses but not of sedges and broad-leaf weeds, whereas bensulfuron methyl was found ineffective in controlling the grassy weeds. The density of *Echinochloa* spp. was also reduced due to tank mixing of pretilachlor at reduced dose of 500 g/ha with both the doses of triasulfuron in comparison with the application of triasulfuron alone. It shows compatibility of tank mixing of pretilachlor with triasulfuron Triasulfuron at both the doses (6 and 9 g/ha) applied alone or as tank mixture with pretilachlor along with bensulfuron methyl (at 60 g/ha) reduced the density of all the sedges as well as of broad-leaf weeds observed in the experimental field (Table 1). All the weed-control measures significantly reduced the dry-matter accumulation (90 DAT) compared with he weedy check. The effects of various treatments on total dry-mater production were similar to that of weed density (Table 2).

Among the tested herbicides, triasulfuron + pretilachlor at both the doses (6+500 and 9+500 g/ha) showed very good suppression of all the types of weeds, with WCE 92.5 and 95.1% respectively. However, there was an ef-

Table 1. Effect of treatments on distribution patterns of different weed flora at vegetative growth stages of rice (pooled data of 2 years)

Treatment	Dose (g/ha)	Weed density (no./m^2)											
		Echinochloa spp.		*Cyperus iria*		*Fimbristylis miliacea*		*Sphenochlea zeylanica*		*Ludwigia parviflora*		*Aeschynomene indica*	
		30 DAT	60 DAT	30 DAT	60 DAT	30 DAT	60 DAT	30 DAT	60 DAT	30 DAT	60 DAT	30 DAT	60 DAT
Batachlor	1,500	0	0	14	10	11	7	10	14	12	14	7	13
Pretilachlor	500	4	0	12	8	10	6	9	11	10	16	8	12
Pretilachlor	750	0	0	7	5	8	4	9	12	6	11	7	11
PSE	20	4	1	11	4	9	4	9	13	6	11	6	9
PSE	25	1	0	8	4	7	3	3	7	5	8	5	4
BSM	50	10	5	3	0	2	0	0	4	5	9	6	9
BSM	60	8	4	2	0	0	0	0	4	2	4	2	3
TSF	6	9	4	3	1	2	0	4	5	5	9	5	8
TSF	9	5	2	2	0	0	0	1	2	2	4	2	4
TSF + Pretilachlor	6+500	2	0	2	1	1	0	3	3	2	5	3	6
TSF + Pretilachlor	9+500	2	0	1	0	0	0	0	2	1	3	1	3
Hand-weeding (2)		3	3	4	6	4	7	5	8	4	10	5	8
Weed-free		0	0	0	0	0	0	0	0	0	0	0	0
Weedy		13	6	23	12	19	13	11	19	16	20	9	13

PSE=Pyrazosulfuron ethyl, BSM=bensulfuron methyl; TSF = triasulfuron

Table 2. Effect of weed-control treatments on weed density, dry-matter production of weeds, weed-control efficiency, panicle number and grain yield of transplanted rice (pooled data of 2 years)

Treatment	Dose (g/ha)	Time of application (DAT)	Weed density (no./m^2) at 90 DAT	Dry weight of weeds (g/m^2) at 90 DAT	Weed-control efficiency (%)	Effective panicles (no./m^2)	Grain yield (q/ha)
Butachlor	1,500	5	44 (6.65)	30.6	73	202	47.2
Pretilachlor	500	5	42 (6.49)	26.9	77	210	48.4
Pretilachlor	750	5	37 (6.10)	25.2	78	226	52.2
PSE	20	7	29 (5.35)	23.3	80	230	53.2
PSE	25	7	23 (4.82)	16.4	86	245	56.3
BSM	50	20	16 (4.02)	17.7	85	239	54.7
BSM	60	20	14 (3.76)	11.3	90	256	57.7
TSF	6	7	18 (4.26)	18.2	84	238	54.6
TSF	9	7	10 (3.17)	7.2	94	268	58.5
TSF + Pretilachlor	6+500	7	11 (3.41)	8.6	93	263	58.1
TSF + Pretilachlor	9+500	7	7 (2.66)	5.6	95	276	59.3
Hand-weeding (2)	20, 40		27 (5.21)	21.2	82	233	53.7
Weed-free treatment		15, 30, 45, 60	0.7 (0.0)	0	100	284	61.2
Weedy			117 (11.1)	114.4		188	31.6
CD (P=0.05)			0.4	3.8		15	2.2

DAT, Days after transplanting
Figures in parentheses indicate original values

fective control of sedges and non-grassy weeds during both the years in the plots of triasulfuron alone (at 9 g/ha) and bensulfuron methyl (at 60 g/ha) with WCE 93.7 and 90.1% respectively. All the sulfonylurea herbicides were found superior in arresting the total weed density and dry-matter production irrespective of their dose with WCE ranging from 79.9 to 95.1% in comparison with the traditional recommended rice herbicides with WCE 73.3–78.0% (Table 2).

Effect on crop

On an average, there was more than 44% reduction in the grain yield of rice due to competition with weeds in weedy plots (Table 2). All the herbicide-treated plots gave grain yields significantly more than the weedy plots. The highest grain yield of rice (61.2 q/ha) was obtained in weed-free check, which was on a par with that of triasulfuron + pretilachlor at 9 + 500 g/ha. The traditional herbicides, viz. butachlor at 1,500 g/ha and pretilachlor at both the doses (500 and 750 g/ha), yielded significantly less than all the doses of different sulfonylurea herbicides, i.e. pyrazosulfuron ethyl, bensulfuron methyl and triasulfuron whether applied alone or as tank mixture with pretilachlor at 500 g/ha. The poor yields with traditional herbicides were mainly due to non-control of predominant sedges and broad-leaf weeds. The differences in grain yields due to two different tank mixtures of triasulfuron + pretilachlor were non-significant. There was marginal increase in the grain yields due to tank mixing of pretilachlor with triasulfuron at 9 + 500 g/ha over the application of triasulfuron at 9 g/ha. However, there was significant yield increase in triasulfuron, bensulfuron methyl and pyrazosulfuron ethyl at their respective higher doses of application over lower doses as well as with the recommended practice of hand-weeding twice (at 20 and 40 DAT). There was no phytotoxic effect of any sulfonylurea herbicides at any of the doses applied alone or tank mixed with pretilachlor on transplanted rice crop.

Thus the application of sulfonylurea herbicides proved superior for wide-spectrum weed control especially of sedges and non-grassy weeds, in transplanted rice field. Tank mix of triasulfuron + pretilachlor at 9 + 500 g/ha was found most effective in checking all the types of weed population and their growth and hence may be recommended for transplanted rice cultivation.

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