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Efficacy of Herbicides in Wet Direct-sown Summer Rice

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ABSTRACT

Major weed flora associated with wet direct-sown summer rice during the dry season comprised mainly *Echinochloa colona* (9.5%), *Cyperus difformis* (30.2%), *Fimbristylis miliacea* (27.0%), *Sphenochlea zeylanica* (15.8%) and *Ludwigia parviflora* (17.5%). Pyrazosulfuron-ethyl (25 g ha^{-1}) applied at 10 days after sowing was most effective in controlling the weeds (95.6%) and maximizing rice grain yield (5.72 t ha^{-1}). This was at par with hand weeding twice at 20 and 40 DAS in terms of weed control efficiency and grain yield. Pyrazosulfuron ethyl (20 g ha^{-1}) applied at 10 DAS, pretilachlor+safener (750 g ha^{-1}) applied at 7 DAS and fentrazamide (120 g ha^{-1}) applied at 7 DAS also showed good suppression of weeds with weed control efficiency of 93.7, 91.4 and 90.5%, respectively. There was more than 45% reduction in the grain yield of rice due to competition with weeds in weedy plots.

INTRODUCTION

The system of wet direct-sown rice is becoming now very popular and spreading rapidly in several Asian countries like Malaysia, Thailand, Philippines, Vietnam and even in Bangladesh during the dry season as summer rice under controlled water condition. Sowing pre-germinated seeds in wet (saturated) puddle soils offers an attractive alternative stand establishment practice to transplanting system in summer rice. Asian rice farmers are shifting to direct seeding mainly to reduce labour input, drudgery and cultivation cost. It also offers several other advantages like faster and easier planting, earlier crop maturity by 7-10 days, more efficient water use and higher tolerance to water deficit and often higher profit in areas with an assured water supply. The increased availability of short duration rice varieties and cost efficient selective herbicides have further encouraged the farmers to try this method of establishing rice (Balasubramanian and Hill, 2002). However, transforming the crop establishment technique from transplanted to wet seeded rice cultivation has resulted in dramatic changes in the type and degree of weed infestation. The weed problems are more critical in direct seeding as compared to transplanting. Unchecked weed competition causes yield losses to the tune of 50-65% under such situations (Subbaiah and Sreedevi, 2000). The key to success to direct-sown rice is the availability of efficient weed control techniques (Pandey and Velasco, 2002). Of late, some new herbicide formulations with low dosage-high efficacy, herbicide mixtures and safened herbicides are showing promise (Moorthy and Saha, 2002). Hence, the present investigation was carried out to evaluate the efficacy of some newly developed herbicides for control of weeds in direct-sown summer rice under wet (puddle) soil conditions.

MATERIALS AND METHODS

A field experiment was conducted during the dry season of 2003 and 2004 at the Central Rice Research Institute, Cuttack in an alluvial (Haplaquept) clay loam soil with pH 6.5, organic carbon 0.67%, total nitrogen 0.083%, Olsen's P 29 kg ha^{-1} and available K 99 kg ha^{-1}. The treatments consisted of various doses of butachlor, butachlor+propanil, butachlor+safener, pretilachlor +safener, pyrazosulfuron-ethyl, fentrazamide, Almix (metsulfuron methyl+ chlorimuron ethyl)+surfactant with hand weeding twice as recommended practice

Table 1. Effect of treatments on weeds at vegetative growth stages of rice (Pooled data of two seasons)

Treatment	Dose (g ha^{-1})	Application stage (DAS)	Weed density (No. m^{-2})											
			E. colona		*C. difformis*		*F. miliacea*		*S. zeylanica*		*L. parviflora*		Total	
			30 DAS	60 DAS	30 DAS	60 DAS	30 DAS	60 DAS	30 DAS	60 DAS	30 DAS	60 DAS	30 DAS	60 DAS
Butachlor	1000	3	0	0	1	4	3	4	8	17	10	19	22	44
Butachlor+propanil	840+840	15	0	0	0	2	3	3	6	15	8	16	17	36
Butachlor+safener	1000	3	0	0	0	2	2	2	7	14	6	16	15	34
Pretilachlor+safener	500	7	1	0	2	3	3	3	6	16	9	20	21	42
Pretilachlor+safener	750	7	0	0	1	2	0	2	3	9	5	12	9	25
Pyrazosulfuron-ethyl	20	10	0	0	0	2	0	5	3	7	3	8	6	22
Pyrazosulfuron-ethyl	25	10	0	0	0	1	0	3	2	5	1	6	3	15
Fentrazamide	105	7	3	2	3	6	2	6	6	13	7	17	21	44
Fentrazamide	120	7	2	0	2	5	0	4	4	10	6	11	14	30
Almix+surfactant	4	20	8	5	0	2	0	3	2	9	4	13	14	32
Almix+surfactant	4	25	8	7	3	3	2	5	4	14	5	22	22	51
Hand weeding (2)		20 & 40	0	0	0	0	0	4	1	4	2	3	3	11
Weedy			9	6	18	15	16	13	9	26	11	24	63	84
C. D. (P=0.05)			0.10	0.12	0.14	0.11	0.13	0.15	0.17	0.19	0.18	0.22	0.27	0.31

DAS–Days after sowing.

Table 2. Effect of weed control treatments on weed dry matter production, panicle numbers and grain yield of direct-sown rice (Pooled data of two seasons)

Treatment	Dose (g ha^{-1})	Stage of application (DAS)	Weed dry weight (g m^{-2}) at 60 DAS	Panicles (No. m^{-2})	Grain yield (t ha^{-1})
Butachlor	1000	3	19.3	223	4.64
Butachlor+propanil	840+840	15	11.8	249	5.22
Butachlor+safener	1000	3	9.6	261	5.32
Pretilachlor+safener	500	7	13.0	244	5.14
Pretilachlor+safener	750	7	7.1	278	5.50
Pyrazosulfuron-ethyl	20	10	5.2	287	5.58
Pyrazosulfuron-ethyl	25	10	3.6	296	5.72
Fentrazamide	105	7	17.2	231	4.82
Fentrazamide	120	7	7.8	272	5.44
Almix+surfactant	4	20	8.5	267	5.37
Almix+surfactant	4	25	21.4	217	4.58
Hand weeding (2)		20 & 40	0.9	304	5.80
Weedy			82.4	199	3.17
C. D. (P=0.05)			2.84	11.4	0.15

DAS–Days after sowing.

(20 and 40 days after sowing) and weedy check (Table 1). The total 13 treatments were evaluated in a randomized complete block design with four replications. All the herbicides were applied in saturated soil moisture using knapsack sprayer fitted with flat fan nozzle at spray volume of 500 l ha^{-1}. Rice variety 'Naveen' (115 days duration) was sown on January 22, 2003 and January 24, 2004 by broadcasting at 80 kg seed ha^{-1}. Full dose of P_2O_5 and K_2O (40 kg ha^{-1}) was applied before sowing at final land preparation and N (80 kg ha^{-1}) was applied in three splits, half at early vegetative stage (two weeks after sowing) and the rest half at two equal splits at active tillering and panicle initiation stages. 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 were subjected to square root transformation to normalize their distribution.

RESULTS AND DISCUSSION

Effect on Weeds

The highest population of weeds was recorded in weedy check (Table 1). All the treatments registered significantly lower number of weeds than weedy check. The mean relative density in weedy plots recorded at 30 days after sowing was 9.5, 30.2, 27.0, 15.8 and 17.5% for *Echinochloa colona*, *Cyperus difformis*, *Fimbristylis miliacea*, *Sphenochlea zeylanica* and *Ludwigia parviflora*, respectively (Table 1). Thus, grasses constituted 9.5%, sedges 57.2% and broadleaf weeds 33.3% of the total weed population at 30 days stage. Butachlor at 1000 g ha^{-1}, butachlor+propanil at 840+840 g ha^{-1}, butachlor+safener at 1000 g ha^{-1} and pretilachlor+safener at 750 g ha^{-1} completely controlled *E. colona*. Pyrazosulfuron-ethyl at 20 and 25 g ha^{-1}, butachlor+propanil at 840+840 g ha^{-1}, butachlor+safener at 1000 g ha^{-1} and pretilachlor+safener at 750 g ha^{-1} reduced the density of *E. colona*, *C. difformis* and *F. miliacea* effectively. Almix + 0.2% surfactant at 4 g ha^{-1} was effective in suppressing sedges and broadleaf weeds when applied at 25 days after sowing but was ineffective in controlling the grassy weeds. All weed control measures registered a significant reduction in weed dry matter accumulation compared to weedy check. The effects of various treatments on total dry matter production were similar to that of weed density (Table 2).

Among the tested herbicides, the highest

weed control efficiency (based on dry weight) was observed in pyrazosulfuron-ethyl (95.6%) at 25 g ha^{-1} closely followed by pyrazosulfuron-ethyl at 20 g ha^{-1} (93.7%), pretilachlor+safener at 750 g ha^{-1} (91.4%) and fentrazamide at 120 g ha^{-1} (90.5%). The superior performance of pyrazosulfuron-ethyl in terms of crop safety and weed control efficiency in puddle-seeded rice during dry season was also recorded from earlier study (Moorthy and Saha, 2002). However, there was an effective control of sedges and broadleaf weeds during both the years in the plots of Almix+0.2% surfactant (at 4 g ha^{-1}) applied at 20 days after sowing with weed control efficiency 89.7% (Table 2).

Effect on Crop

On an average, there was more than 45% reduction in the grain yield of rice due to competition with weeds in weedy plots (Table 2). All the herbicide treated plots produced grain yields significantly more than the weedy plots. The highest grain yield of rice (5.80 t ha^{-1}) was obtained in hand weeding twice and it was at par with pyrazosulfuron-ethyl at 25 g ha^{-1}. Butachlor at 1000 g ha^{-1}, butachlor+propanil at 840+840 g ha^{-1}, butachlor+safener at 1000 g ha^{-1} and pretilachlor+safener at 500 g ha^{-1} yielded significantly less due to poor control of *S. zeylanica* and *L. parviflora* which were dominant at peak vegetative and flowering stages. The poor yield with Almix+0.2% surfactant at 4 g ha^{-1} applied at 25 days after sowing was mainly due to non-control of grasses and broadleaf weeds. However, there was significant yield increase due to pyrazosulfuron-ethyl at 20 and 25 g ha^{-1} and pretilachlor+safener at 750 g ha^{-1} as well as with the recommended practice of hand weeding twice (20 and 40 days after sowing). There was no phytotoxic effect of any herbicide at any of the doses on wet direct-sown rice crop.

Pyrazosulfuron-ethyl at 20 and 25 g ha^{-1} and pretilachlor+safener at 750 g ha^{-1} proved superior for wide spectrum weed control in wet direct-sown rice field during dry season. Pyrazosulfuron-ethyl at 25 g ha^{-1} applied 10 days after sowing was most effective to check all types of weed population and their growth and may be recommended for wet direct-sown summer rice cultivation.

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