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Evaluation of new herbicides in transplanted summer rice (*Oryza sativa)*

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ABSTRACT

Two new generation herbicides were evaluated for their efficacy in transplanted summer rice. The major weed flora recorded in the experimental field comprised Echinochloa crus-galli, Cyperus iria, Marselia quadrifolia, Eclipta alba and Enhydra flutes. Significantly lowest weed dry weight and maximum weed control efficiency were recorded with application of pyrazosulfuron-ethyl at 10 g ha^{-1}. Maximum tiller numbers m^{-2}, spikelets panicle^{-1}, test weight and grain yield were obtained with pyrazosulfuron ethyl at 10 g ha^{-1}, followed by Acetachlor at 20 g ha^{-1}. Pyrazosulfuron-ethyl (PSE) at 10 g ha^{-1} recorded highest net return and benefit: cost ratio.

Key words: *Summer rice, Pyrazosulfuron ethyl, acetachlor, weed management*

Rice (*Oryza sativa* L.), one of the most important staple food crops is subjected to heavier yield loss (41.8%) due to weed infestation. In general, the yield loss due to uncontrolled weed growth range between 18-20% in transplanted rice (Balasubramanian and Duraiswamy, 1996). The age old cultural method like hand weeding or hoeing are not only slow and laborious but uneconomical. Therefore in recent years, farmers have developed inclination to use chemical method of weed control (Mukhopadhyay, 1992). Though several herbicides have been recommended, for controlling weeds in transplanted rice, the use of herbicides is quite limited due to lack of technology regarding dose, proper time and method of application. Strategic application of low dose herbicide can ensure controlling weeds in transplanted summer rice resulting in higher economic return to the farmers.

MATERIALS AND METHODS

A field experiment was conducted during the summer seasons of 2002 and 2003 at Bidhan Chandra Krishi Viswavidyalaya, Nadia, West Bengal. The soil of the experimental field was sandy clay loam in texture, pH 6.9, organic carbon 0.65%, total nitrogen 0.06%, available P_2O_5 20 kg ha^{-1} and available K_2O 120 kg ha^{-1}. The experiment was laid out in randomized block design with 3 replications. There were 9 treatments comprising 4 doses of pyrazosulfuron ethyl (PSE) 2, 2.5, 5 g and 100 g ha^{-1}, 3 doses of acetachlor *i.e.* 100g, 150g, and 200g ha^{-1} were compared with hand weeding twice (at 20 and 40 days after transplanting) and weedy check. Both PSE and Acetachlor were applied as pre-emergence herbicide at 6 and 7 days after transplanting, respectively. Herbicides were applied with high volume Knapsack sprayer using flat-fan nozzle.

Healthy seedlings (45 days old) of rice (*cv* Satabdi) were transplanted 20 cm x 10 cm spacing in 3rd week of January with 120 kg N, 60 kg P_2O_5 and 60 kg K_2O ha^{-1}. Half N, full of each P_2O_5 and K_2O were applied as basal and rest half of total N was top dressed at 4 weeks after transplanting. The recommended cultural practices and plant protection measures were adopted. Weed samples were collected from a quadrate size of 0.5m x 0.5m at 15, 30 and 60 DAT for assessing weed density and weed dry weight. Effects of treatments on yield attributes, yield and comparative economics were also worked out. Weed control efficiency (WCE) has been calculated with the formula.

$$WCE(\%) = \frac{(X - Y) \times 100}{X}$$

Where X= Weed dry weight in control plot *i.e.* unweeded plot,

Y= Weed dry weight in treated plots.

RESULTS AND DISCUSSION

Effects on weeds. The predominant weed species infesting the experimental plots were *Echinochola crus-galli, Cyperus iria, Fimbristylis littoralis, Eclipta alba, Marselia quadrifolia* and *Enhydra fluctuans*. Weed density and total dry weight of weeds varied significantly due to the weed control treatments. All the weed control treatments recorded significantly lower total weed population than in weedy check. Pyrazosulfuron ethyl at 10 g ha^{-1} showed significantly lower weed population at all the crop growth period (1.31 to 13.28 m^{-2}). Acetachlor at all three doses was on par with PSE at lower dose (Table-1). Among the weed control treatments, application of pyrazosulfuron ethyl at 10 g ha^{-1} gave significantly lower total dry weight (Table 1) as compared to rest of the treatments at 15, 30 and 60 DAT (0.078, 0.18 and 0.5 g m^{-2} respectively). In general all the herbicidal treatments have recorded lower weed biomass than unweeded control plots. So far the weed control efficiency is concerned, it was at its highest magnitude at all the date of observations (85.32, 87.6 and 81.76% respectively) under the treatment pyrazosulfuron-ethyl at 10 g ha^{-1}, followed by hand weeding at 20 and 40 DAT and pyrazosulfuron ethyl at 5 g $ha^{-1.}$ Application of PSE at all doses effectively reduced weed biomass at 15 DAT. But, at 30 and 60 DAT, it was effective only when applied at 5 g ha^{-1} or above. Similarly, Acetachlor was effective only when applied at 15 g ha^{-1} in all the crop growth periods. This was due to the fact that herbicides at higher doses exhibited better control of weeds due to their greater persistence in soil.

Effect on crop yield and yield attributes. Experimental results revealed that the number of effective tillers m^{-2} and number of spikelets $panicle^{-1}$ touched the maximum scale (455 and 199, respectively) in treatment receiving pyrazosulfuron-ethyl at 10 g ha^{-1} and the same was at the minimum scale (294 and 113 respectively) in weedy check condition. There was no significant variation of test weight among the treatments. However, it was at the maximum (17.82 g) in treatment receiving pyrazosulfuron ethyl at 10 g ha^{-1} (Table 2). This corroborates the earlier findings of Bhattacharya *et al.* (1998).

All the herbicidal treatments significantly increase the grain and straw yield over weedy check. Application of pyrazosulfuron ethyl at 10 g ha^{-1} produced significantly highest grain yield (7.19 t ha^{-1}). This is may be due to better control of weeds, which resulted in lower crop weed competition at the critical stages of crop development (Table 2). Straw yield also showed the similar trend. The highest straw yield was noted in the treatment receiving hand weeding at 20 and 40 DAT (11.0 t ha^{-1}), which was at par with the treatments receiving pyrazosulfuron-ethyl at 10 g ha^{-1} (9.11 t ha^{-1}) and Acetachlor at 200 g ha^{-1} (9.07 t ha^{-1}). Moorthy (1997) also observed that the application of PSE lowered the weed biomass and enhanced the grain yield.

Table 1. Effect of different weed control treatments on density and dry weight of weeds and weed control efficiency in summer rice (Mean data of 2 years)

Treatment	Weed density (No.m^{-2})	Weed dry weight (gm^{-2})	Weed control efficiency (%)
	60 DAT	60 DAT	60 DAT
PSE 20 g ha^{-1}	43.30	2.53	15.75
PSE 25 g ha^{-1}	38.31	2.28	23.85
PSE 50 g ha^{-1}	25.00	0.87	70.17
PSE 100 g ha^{-1}	13.28	0.50	81.76
Acetachlor 100 g ha^{-1}	35.36	2.15	29.44
Acetachlor 150 g ha^{-1}	29.66	1.93	37.24
Acetachlor 200 g ha^{-1}	23.34	0.88	68.43
Hand Weeding (at 20 & 40 DAT)	33.00	1.23	57.56
Weedy check	52.31	2.97	0.00
CD (P=0.05)	2.36	1.02	12.14

PSE, Pyrazosulfuron-ethyl; DAT= Days after transplanting.

Table 2. Yield, yield attributes and economics of summer rice as influenced by weed control treatments (Mean data of 2 years)

Treatment	Panicle numbers m^{-2}	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Cost of cultivation (Rs.ha^{-1})	Gross return (Rs.ha^{-1})	Net return (Rs.ha^{-1})	B:C ratio
PSE 20 g ha^{-1}	354	5.19	7.15	17947	38290	20343	1.13
PSE 25 g ha^{-1}	385	5.23	8.05	17952	39430	21478	1.20
PSE 50 g ha^{-1}	390	6.20	8.41	17977	45610	27633	1.54
PSE 100 g ha^{-1}	455	7.19	9.11	18027	52250	34223	1.90
Acetachlor 100 g ha^{-1}	378	5.70	8.20	17977	42400	24423	1.36
Acetachlor 150 g ha^{-1}	352	6.02	8.20	18002	44320	26318	1.46
Acetachlor 200 g ha^{-1}	430	6.30	9.07	18027	46870	28843	1.60
Hand Weeding (at 20 & 40 DAT)	360	6.11	11.00	21529	47660	26131	1.21
Weedy check	294	3.73	6.93	17803	29310	11507	0.65
CD (P=0.05)	20.9	1.26	2.11				

PSE, Pyrazosulfuron-ethyl; DAT= Days after transplanting; B: C, Benefit :Cost

Monetary returns. Maximum cost of cultivation was observed in hand weeding treatment. Pyrazosulfuron ethyl at 10 g ha^{-1} recorded the maximum net returns (Rs. 34,223 ha^{-1}), followed by acetachlor at 200 g ha^{-1} (Rs. 28,843 ha^{-1}). Highest benefit: cost ratio was also found under pyrazosulfuron ethyl at 10 g ha^{-1} (1.90) and lowest under weedy check (0.65). Thus, pyrazosulfuron ethyl at 10 g ha^{-1} may be recommended for controlling the weeds in transplanted summer rice under gangetic plains of West Bengal.

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