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Effect of pyrazosulfuron-ethyl on yield of transplanted rice

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ABSTRACT

Efficacy of pyrazosulfuron-ethyl against weeds in transplanted rice was studied during 2008 and 2009 at Regional Research Sub-station, Chakdaha under Bidhan Chandra Krishi Viswavidyalaya, West Bengal. The experiment was laid out in randomized block design with seven treatments replicated thrice. The major associated weeds were: *Echinochloa colona, Cyperus difformis, Ammania baccifera, Ludwigia octovalvis* and *Monochoria vaginalis*. Pyrazosulfuron-ethyl at 42.0 g/ha applied at 3 DAT was most effective in managing associated weed species and yielded maximum grain yield (3.3 t/ha) of rice with lower weed index (10.8%).

Key words: Pyrazosulfuron-ethyl, Transplanted rice, Weeds, Yield

Weeds are a major cause of yield reduction in rice. Hand weeding is the traditional weed control measure and still being the most popular in rice cultivation in West Bengal. However, due to high labour cost, non-availability of labour and huge time requirement for manual weeding, farmers are forced to opt for other alternative measures like chemical weed control. Many herbicides are being used successfully for weed control in rice both as pre and post-emergence spray. New herbicides are available in the market and use of herbicides of different composition is desirable to reduce the problem of residue buildup, shift in weed problem (Rajkhowa *et al.* 2006) and development of herbicide resistance in weeds (Rao 1999, Saha *et al.* 2006). The recent trend of herbicide use is to find out an effective weed control measure by using low dose high efficiency herbicides which will not only reduce the total volume of herbicide use but also the application become easier and economical (Pal and Banerjee 2007).

The herbicide pyrazosulfuron-ethyl has both foliar and soil activity (Rajkhowa *et al.* 2006). It is generally recommended as a pre-emergence herbicide in transplanted rice (Angiras and Kumar 2005). Studies on bio-efficacy and phytotoxicity of pyrazosulfuron-ethyl for pre-emergence weed control in transplanted rice are scanty and there are different reports of various dosages and time of application required for effective weed control (Chopra and Chopra 2003). The present experiment was therefore undertaken to study the bio-efficacy and phytotoxicity of pyrazosulfuron-ethyl in pre-emergence control of major weeds in transplanted *Kharif* rice and to determine an optimum dosage and time of application that can be recommended to rice farmers of West Bengal, India.

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MATERIALS AND METHODS

An experiment was conducted during *Kharif* season of 2008 and 2009 at Regional Research Sub-Station (RRSS), Bidhan Chandra Krishi Viswavidyalaya, Chakdaha, Nadia under new alluvial zone of West Bengal, India (situated at 23^0 5.3' N latitude and $83^0$5.3' E longitude with an altitude of 10 m above mean sea level). The topography of land is known as medium land and the soil was sandy clay loam in texture having a pH of 7.2, EC 0.06 dS/m, organic C 0.67%, total N 0.065%, available P 18.0 kg/ha and available K 129.0 kg/ha. The experiment was laid out in a randomized block design with seven treatments, *viz.* T_1 - Pyrazosulfuron-ethyl 10.5 g/ha, T_2 - Pyrazosulfuron-ethyl 21.0 g/ha, T_3 - Pyrazosulfuron-ethyl 31.5 g/ha, T_4 - Pyrazosulfuron-ethyl 42.0 g/ha, T_5 - Standard herbicide, Metsufuron methyl + chlorimuron ethyl (Almix 20% WP) 4.0 g/ha, T_6 - Hand weeding at 15 and 30 DAT and T_7 - Untreated check and replicated thrice. The sown rice variety was *'IET 4786 (Shatabdi)'* of 123 days duration. The crop was transplanted during 1st week of August at a spacing of 20 × 15 cm and harvested during 2nd week of October in both the years. Full doses of phosphorus through single super phosphate (SSP) and potash through muriate of potash (MOP) each 30 kg/ha along with 25% recommended doses of nitrogen (60 kg/ha) through urea were applied at basal during the final land preparation. Remaining 75% nitrogen was applied

through urea in three equal splits at 25, 45 and 65 DAT. The test herbicide pyrazosulfuron-ethyl at 4 different doses along with standard herbicide metsufuron methyl + chlorimuron ethyl were sprayed at early post-emergence stage (3 DAT) with the spray volume of 500 l/ha using knapsack sprayer with flat fan nozzle under few cm standing water. In treated plots, water level was maintained static as far as possible. Excluding the weed management practice, all others cultural practices were uniformly applied to all the treatments.

An area of 0.25 m^2 was selected randomly at two spots by throwing a quadrat of 0.5 × 0.5 m, weed species were counted from that area and density was expressed in number per m^2. The collected weeds were first sun-dried and then kept in an electric oven at 70^0C till the weight became constant and weed biomass was expressed as g/m^2. As wide variation existed in data, number and biomass of weeds were transformed through square-root ($\sqrt{(X+0.5)}$) method before analysis of variance. Comparison of treatment means for significance at 5% level was done using the critical differences as suggested by Gomez and Gomez (1984). Data on grain yield were recorded from the net plot. Weed control efficiency (WCE) and weed index (WI) were worked out using the formula as suggested by (Mani *et al.* 1973, Gill and Vijayakumar 1969).

RESULTS AND DISCUSSION

Effect on weeds

In the experimental plots, the dominant weeds were *Echinochloa* spp. (*E. colona, E. crusgalli*), *Leersia hexandra, Cyperus difformis, Cyperus iria, Fimbristylis dichotoma, Monochoria vaginalis, Ammania baccifera, Eclipta alba, Marsilea quadrifolia* and *Alternanthera philoxeroides*. All the herbicides showed effective control of all categories of dominant weeds resulting in less weed dry matter and higher weed control efficiency as compared to untreated check (Table 1). The number of dominant broad-leaved, grass and sedge weeds was gradually decreased with the increase of doses of tested herbicide pyrazosulfuron-ethyl in all the four dates of observation. Better weed control was observed with application of maximum dose of the tested herbicide. Lowest weed biomass at 45 days after herbicide application (DAHA) was recorded with pyrazosulfuron-ethyl at 42.0 g/ha. Angiras and Kumar (2005) also found that broadcast application of pyrazosulfuron-ethyl at 15 g/ha mixed with sand at 150 kg/ha was effective to control weeds in rice which re-

Table 1. Density (no./m^2) of dominant weeds as affected by different weed control treatments (mean data of two years) at different days after herbicide application (DAHA)

Treatment	*Echinochloa colona*				*Cyperus difformis*				*Ammania baccifera*			
	10	20	30	40	10	20	30	40	10	20	30	40
T_1	0.96	1.50	3.42	4.10	1.00	1.35	3.21	3.72	0.92	1.46	2.70	3.34
T_2	0.92	1.64	3.25	3.80	0.90	1.20	2.60	2.95	0.85	1.40	2.56	3.30
T_3	0.75	1.00	2.45	3.00	0.81	0.99	2.55	2.60	0.34	0.75	1.16	2.51
T_4	0.31	0.92	1.31	2.51	0.40	0.67	1.00	1.31	0.35	0.41	0.95	1.00
T_5	0.25	0.56	1.12	1.31	0.34	0.72	1.20	1.81	0.26	0.86	0.91	2.64
T_6	0.92	0.62	1.31	1.25	0.32	0.65	0.92	1.54	0.31	0.41	0.80	1.00
T_7	1.25	2.69	6.00	6.61	1.31	2.51	4.10	6.00	1.64	2.11	4.42	6.01
LSD (P=0.05)	0.56	0.75	1.80	1.91	0.43	0.80	1.05	1.70	0.71	0.82	2.25	1.80
	Ludwigia octovalvis				*Monochoria vaginalis*				Others			
	10	20	30	40	10	20	30	40	10	20	30	40
T_1	0.62	1.61	1.85	3.61	1.25	1.66	3.96	4.10	1.00	1.72	3.30	4.00
T_2	0.72	1.29	2.20	2.99	0.99	1.42	2.95	3/84	1.20	2.00	3.24	4.90
T_3	0.62	0.92	1.95	2.40	0.69	1.29	2.02	3.45	1.13	1.70	3.00	4.80
T_4	0.49	0.62	1.25	1.60	0.40	0.77	1.34	1.82	0.44	1.15	1.18	3.00
T_5	0.46	0.66	1.26	1.62	0.64	0.73	1.75	1.66	0.62	1.26	1.72	3.11
T_6	0.44	0.71	1.03	1.50	0.58	0.75	1.00	1.52	0.21	0.92	0.45	2.51
T_7	1.82	2.45	5.45	6.11	2.11	2.69	5.63	7.00	2.31	2.10	4.90	5.00
LSD (P=0.05)	0.36	0.72	0.99	1.82	0.92	1.02	2.05	2.89	0.73	0.99	2.25	1.85

T_1 - Pyrazosulfuron-ethyl 10.5 g/ha, T_2 - Pyrazosulfuron-ethyl 21.0 g/ha, T_3 - Pyrazosulfuron-ethyl 31.5 g/ha, T_4 - Pyrazosulfuron-ethyl 42.0 g/ha, T_5 - Standard herbicide, Metsufuron-methyl + chlorimuron-ethyl (almix 20% WP) 4.0 g/ha, T_6 - Hand weeding at 15 and 30 DAT and T_7 - Untreated check, DAT - Days after transplanting

Table 2. Weed biomass and weed control efficiency at 40 days after herbicide application (DAHA) in rice field as affected by different weed control treatments (mean data of two years)

Treatment	*Echinochloa colona*		*Cyperus difformis*		*Ammania baccifera*		*Ludwigia octovalvis*		*Monochoria vaginalis*		Others	
	Weed biomass (g/m^2)	WCE (%)	Weed biomass (g/m^2)	WCE (%)	Weed biomass (g/m^2)	WCE (%)	Weed biomass (g/m^2)	WCE (%)	Weed biomass (g/m^2)	WCE (%)	Weed biomass (g/m^2)	WCE (%)
T_1	8.25	34.5	7.20	40.3	6.61	49.1	7.20	43.1	8.00	46.0	8.26	22.2
T_2	7.50	40.5	6.20	49.4	5.61	56.8	6.11	51.7	7.26	51.0	7.00	34.1
T_3	6.11	51.5	5.26	57.1	5.00	61.5	5.20	58.9	6.25	57.8	6.61	37.8
T_4	5.00	60.3	3.99	675	2.62	79.8	3.31	73.8	4.00	73.0	6.42	39.5
T_5	4.61	63.4	3.64	70.3	4.11	68.4	3.30	73.9	3.21	78.3	6.00	43.5
T_6	2.49	80.2	3.01	75.4	2.00	84.6	3.00	76.3	3.04	79.5	4.61	56.6
T_7	12.61	0	12.26	0	13.00	0	12.65	0	14.82	0	10.62	0
LSD (P=0.05)	2.81	-	3.10	-	3.11	-	3.20	-	3.45	-	3.42	-

Treatment details are given in Table 1

sulted in significantly lower weed density and biomass without any phytotoxic effect on rice plant. Pyrazosulfuron-ethyl at 20 and 25 g/ha significantly reduced weed density and total weed biomass of *Cyperus iria, Echinochloa colona etc*. when applied at 3 to 10 days after transplanting (Chopra and Chopra 2003). None of tested doses was phytotoxic to transplanted rice when applied alone. Weed control efficiency (WCE) with respect to grass, sedge and broad-leaved weeds (56.60 to 84.62%) was higher with hand weeding treatment (Table 2). Pyrazosulfuron-ethyl gave higher weed control efficiency (39.55 to 79.85%) when applied at 3 DAT with higher dose *i.e.* 42 g/ha. It was closely followed by the standard herbicide metsufuron-methyl + chlorimuron-ethyl 4.0 g/ha at 3 DAT (43.50 to 78.34%). Overall result showed that the tested herbicide pyrazosulfuron-ethyl was comparatively more effective against broad-leaved weeds than grassy and sedge weeds.

Effect on crop

The highest rice grain yield (3.7 t/ha) was recorded in hand weeded plot which was statistically at par with pyrazosulfuron-ethyl applied 42.0 g/ha (3.3 t/ha). The increase in grain yield under this treatment was due to less weed density and weed biomass as compared to all other treatments tried in this study. Lowest grain yield of rice was observed in untreated check (2.1 t/ha) which was due to high weed density and biomass (Table 3). Pyrazosulfuron-ethyl at 20 and 25 g/ha provided grain yield statistically similar to weed free treatment (Chopra and Chopra 2003). Harvest index of paddy crop was higher under hand weeding treatment (53.7%) which was comparable with the treatment having application of pyrazosulfuron-ethyl 70% WG applied at 42.0 g/ha (52.6%). The weed index was also minimum (10.81%) in this treatment. No residual effect of tested herbicide in soil was observed after the harvest of rice crop.

Table 3. Grain yield, harvest index and weed index as affected by different weed control treatments (mean data of two years)

Treatment	Grain yield (t/ha)	Harvest Index (%)	Weed Index (%)
T_1	2.6	45.6	29.73
T_2	2.9	52.2	21.62
T_3	3.1	51.4	16.22
T_4	3.3	52.6	10.81
T_5	2.7	50.0	27.03
T_6	3.7	53.7	0
T_7	2.1	40.8	43.24
LSD (P=0.05)	0.51	-	-

Treatment details are given in Table 1

It is, therefore, recommended that pyrazosulfuron-ethyl 42.0 g/ha can safely be used for controlling all three categories of weeds in transplanted rice in *Kharif* as well as to get higher yield of rice in West Bengal condition.

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