Indian Journal of Weed Science 43 (3&4) : 175-177, 2011

Chemical weed control in transplanted rice in Hirakud command area of Orissa

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ABSTRACT

A field experiment was conducted to evaluate the efficiency of herbicide mixture of almix (metasulfuron methyl + chlorimuron ethyl) and butachlor to control both grassy and broad leaved weeds. Application of almix 0.004 kg/ha mixed with butachlor 0.938 kg/ha at three days after transplanting (DAT) was at par with hand-weeding twice at 20 and 40 DAT in controlling weeds and higher grain yield. This application increased the grain yield by 45.1% over the unweeded check. There was a negative linear relationship between weed dry weight and grain yield.

Key words: Transplanted rice, Chemical weed control, Herbicide mixture

Like other cereal crops, rice also suffers severely from weed competition. The diverse weed flora under transplanted conditions (grasses, sedges and broad-leaved weeds) can cause yield reduction up to 76% (Singh *et al*. 2004). In order to realize maximum benefit of applied monetary inputs, two to three hand weedings (HW) were most effective against all types of weeds in this crop (Halder and Patra 2007). However, continuous rains during cropping season, scarcity and high wages of labour during weeding peaks particularly at early crop-weed competition make this operation difficult and uneconomic. Herbicides like butachlor, anilophos and pretilachlor, which are used currently, are more effective against grasses but less effective against many sedges and broad-leaved weeds of command area (Reddy *et al*. 2006). Therefore, application of herbicide mixtures may be useful, particularly in the absence of an effective broad-spectrum herbicide in rice to control highly diverse weed flora (Rao and Singh 1997). The present study was undertaken to evaluate the effectiveness of relatively new herbicides pyrazosulfuron-ethyl and fentrazamide and existing commonly weed herbicide butachlor both as a mixture and sequential application with almix (metasulfuron methyl + chlorimuron ethyl) to control weeds in transplanted rice in Hirakud command area of western Orissa.

MATERIALS AND METHODS

A field experiment was conducted at Chiplima Hirakund command area of Orissa during the rainy seasons of 2004 and 2005. The soil of the experimental field was sandy clay loam with pH 6.6, 43% organic content and 268, 13.4 and 132 kg/ha available N, P and K, respectively. The experiment consisted of 11 treatments (Table 1) was laid out in a randomized block design with three replications. Rice cultivar *'Lalat'* maturing in 125 days was the test crop. Thirty days old seedlings were transplanted with 15x15cm planting geometry during the third week of July in both the years, A recommended fertilizer dose of 80, 40 and 40 kg of N, P and K/ha, respectively was applied. Full dose of P and K and half dose of N were applied as basal and remaining N was top-dressed in two equal splits at maximum tillering and panicle-initiation stages of the crop. Plant protection measures and irrigations were provided as and when required. The required quantity of herbicides were applied with manually operated Knapsack sprayer using a spray volume of 500 liter water/ha with flat fan nozzle. A thin film of water was maintained in the field at the time of application of herbicides. Weed density and weed dry weight were sampled randomly at two places with the help of a 0.25 m^2 sized quadrate at 60-day growth stage and maturity. Weed population data were statistically analyzed after subjecting in to square root transformation. Yield and yield attributes of rice were recorded at crop harvest. Weed control efficiency (WCE) was also calculated on the basis of dry matter production by weeds.

RESULTS AND DISCUSSION

Weed flora

Major weed flora in the experimental field consisted of grasses *viz*., *Digitaria sanguinalis* (L.) Scop., *Echinochloa crusgalli* (L.), *Echinochloa colona* (L.) Link, *Panicum repens* (L.); sedges *viz.*, *Cyperus difformis* (L.), *Cyperus iria* (L.), *Cyperus rotundus* (L.), *Fimbristylis miliacea* (L.) Vahl; broad-leaved weeds (BLW) *viz.*, *Ammania baccifera* (L.), *Ludwigia paraviflora* (L.), *Eclipta prostrata* (L.), *Eclipta alba* (L.), *Lippa nodiflora* Nich, *Marsilea quadrifolium* (L.), *Sphenoclea zeylanica* Gaertn. and *Commelina benghalensis* (L.). The floristic composition of grasses, sedges and BLW in weedy check plot was 27.2, 36.8 and 36%, respectively.

Table 1. Effect of herbicides on weed population and weed biomass in transplanted rice (pooled data of 2004 and 2005)

Treatment	Weed population/m^2						Weed dry weight (g/m^2)		WCE (%)	
	60 DAT			At harvest						
	Grass	Sedge	BLW	Grass	Sedge	BLW	60 DAT	At harvest	60 DAT	At harvest
Butachlor (Machete)	3.3 (10.1)	4.4 (18.6)	4.4 (19.0)	2.9 (8.3)	3.9 (15.2)	3.8 (14.2)	45.9	38.7	57.7	61.7
Butachlor (MON 46996)	2.9 (8.4)	4.6 (20.3)	4.3 (18.2)	2.8 (7.6)	4.3 (17.6)	3.9 (15.3)	51.6	43.3	52.4	57.2
Fentrazamide	5.2 (26.2)	3.8 (14.2)	4.3 (17.8)	4.8 (22.3)	3.5 (12.1)	3.4 (11.6)	32.9	28.6	69.7	71.7
Fentrazamide	4.8 (22.1)	3.6 (12.5)	4.4 (19.2)	4.3 (17.7)	3.2 (10.0)	3.3 (10.2)	30.6	24.8	71.8	75.5
Pyrazosulfuron-ethyl	5.1 (25.7)	3.3 (10.1)	3.7 (13.6)	4.9 (23.6)	2.9 (8.2)	3.2 (10.0)	34.8	30.3	67.9	70.0
Pyrazosulfuron-ethyl	5.2 (27.0)	3.1 (9.5)	3.6 (12.5)	4.6 (21.2)	2.7 (6.8)	2.9 (8.2)	30.2	23.6	72.1	76.7
Almix + Butachlor	3.6 (12.3)	3.0 (9.0)	3.4 (11.4)	3.3 (10.7)	2.5 (6.0)	2.8 (7.4)	21.7	16.6	80.0	83.6
Butachlor *fb* almix	3.8 (14.2)	3.4 (11.1)	3.7 (13.5)	3.5 (12.0)	2.8 (7.6)	2.9 (8.1)	28.8	22.9	76.2	77.3
Weed free check	0.7 (0)	0.7 (0)	0.7 (0)	0.7 (0)	0.7 (0)	0.7 (0)	-	-	-	-
Two hand weeding	3.6 (12.2)	3.8 (14.0)	3.3 (10.3)	2.7 (7.1)	3.1 (9.3)	3.1 (9.2)	18.4	15.6	83.0	84.6
Non-weeded control	8.5 (72.3)	9.3 (86.4)	9.8 (94.6)	8.2 (67.0)	9.5 (90.7)	9.4 (88.6)	108.6	101.3	-	-
LSD (P=0.05)	1.4	1.2	1.3	1.3	1.5	1.3	3.9	3.5		

Figures in parentheses are original values, DAT- Days after transplanting, BLW- Broad leaved weeds, WCE- Weed control efficiency, fb - Followed by

Table 2. Effect of herbicides on yield and yield components of transplanted rice (pooled data of 2004 and 2005)

Treatments	Dose (kg/ha)	Time of application (DAT)	Tillers/m^2	Panicles /m^2	1000 grain weight (g)	Grain yield (kg/ha)	Straw yield (kg/ha)	B:C ratio
Butachlor (Machete)	1.5	5	389	320	21.8	4190	5590	1.20
Butachlor (Monu6996)	1.5	5	330	294	20.7	4070	5470	1.17
Fentrazamide	0.15	4	359	300	21.0	4150	5520	1.33
Fentrazamide	0.12	4	372	311	21.3	4310	5960	1.35
Pyrazosulfuron-ethyl	0.02	8	339	290	21.9	4490	6260	1.36
Pyrazosulfuron-ethyl	0.025	8	348	298	22.3	4590	6390	1.35
Almix + butachlor	0.004 + 0.938	3	401	341	22.8	4920	6500	1.66
Butachlor *fb* almix	0.938 *fb* 0.004	3 *fb* 25	392	330	22.8	4750	6200	1.64
Weed free check			414	348	23.4	5200	7120	1.61
Two hand weeding		20 *fb* 40	382	321	23.4	5050	6650	1.64
Non-weeded control			315	270	21.4	3390	4060	0.65
LSD (P=0.05)			32	18	NS	200	240	-

fb- followed by (applied sequentially), +- tank mixed, DAT- days after transplanting, B:C- benefit-cost ratio, fb - Followed by

Effect on weed flora

Weed density and weed dry weight were higher at 60 days after transplanting (DAT) than that at harvest. This was perhaps due to death of some of the weeds like *Digitaria sanguinalis, E. colona, C. difformis, M. quadrifolium* and *C. benghalensis* and the shading effect of the tall weeds like *crusgalli* and crop plants on short-statured weeds. Similar results were also recorded by Halder and Patra (2007).

Unweeded check recorded significantly higher weed population and dry weight than any other treatments during both the stages (Table 1). Two hand-weedings (HW) at 20 and 40 DAT recorded minimum weed population and dry weight and the highest WCE at both the stages. Among the herbicidal treatments, application of tank mixture of almix 0.004 kg/ha and butachlor 0.938 kg/ha at three DAT recorded the minimum weed population and dry weight with highest WCE. This treatment was followed by sequential application of butachlor 0.938 kg/ha at three DAT followed by almix 0.004 kg/ha at 25 DAT. The reduced weed density and dry weight may be attributed to broad-spectrum and season-long weed-control properties exhibited with the application of herbicide mixtures by confirming the earlier findings of Halder and Patra (2007). Unweeded control plot recorded the highest weed population and dry weight. Among the herbicidal treatments, application of butachlor 1.5 kg/ha at five DAT recorded the highest weed population and dry weight with the lowest WCE and thus indicated its ineffectiveness. Pyrazolsulfuron-ethyl 0.025 kg/ha was more effective in controlling weeds as compared to butachlor and fentrazamide.

Effect on crop

All the herbicidal treatments significantly influenced panicle/m^2, filled grains/panicle, grain and straw yields compared with unweeded check (Table 2). However, 1000-seed weight was not significantly influenced by different treatments. The grain yield was maximum with weed free check which was closely followed by two HW at 20 and 40 DAT. Among the herbicides, application of almix 0.004 kg/ha mixed with butachlor 0.938 kg/ha at three DAT recorded significantly higher grain yield than all other treatments and this treatment was comparable with two hand weeding for grain yards. The hand weedings twice, application of almix 0.004 kg/ha mixed with butachlor 0.938 kg/ha at three DAT increased the grain yield by 49.0 and 45.1%, respectively over the unweeded check. The increased grain yield in these treatments were owing to reduced weed density, weed dry weight and better WCE (Table 1), higher panicles per unit area and grains/panicle (Table 2). The minimum grain yield and yield attributes in unweeded check were the result of severe weed competition by the uncontrolled weed growth. Straw yield followed almost similar trend as that of grain yield. Narwal *et al.* (2002) and Halder and Patra (2007) also reported increased grain yield by sequential herbicide application and herbicide mixtures, respectively. Application of almix 0.004 kg mixed with butachlor 0.938 kg/ha recorded the maximum benefit-cost ratio indicating the high economic returns. This could be due to high WCE and higher grain yield obtained due to application of effective herbicide dose. Mukherjee and Singh (2005) also found superiority in grain yield and net monetary returns with the appliances of almix + 2,4-D for transplanted rice over other weed control means.

Regression analysis indicated that there was significant negative linear relationship between grain yield and weed dry weight at 60 DAT. The simple linear regression Y = 5.07 - 0.0164 X was obtained from pooled data, where Y is the expected grain yield (t/ha) and X is the observed weed dry weight (g/m^2) at 60 DAT. The correlating coefficient 'r' value was 0.88 indicating a high degree negative correlation between weed dry weight and grain yield. Rao and Singh (1997) also observed negative linear relationship between weed dry weight and grain yield in transplanted rice.

There was significant negative correlation (r=-0.88) between rice grain yield and need biomass at 60 DAT (Y = 5.090 - 0.0164 X). Rao and Singh (1997) also observed such negative relationship between weed dry weight and transplanted rice grain yield.

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