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Studies on the effectiveness of herbicides for direct seeded rice (*Oryza sativa* l.) under puddled irrigated condition

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ABSTRACT

Field experiment was conducted during *kharif* seasons of 2003 and 2004 at the Regional Research Sub-Station (RRS), Chakdaha, Nadia, West Bengal to evaluate the effectiveness of herbicides for direct seeded rice (*Oryza sativa* L.) under puddled irrigated condition. The experiment was laid out in a randomized block design (RBD) having ten treatments replicated thrice. The observation revealed that the predominant weed flora in the experimental field were *Echinochloa crusgalli, Cyperus iria, Sagittaria sagittifolia, Eclipta alba* and *Monochoria vaginalis*. The experimental result showed that weed free check gave the highest grain and straw yield (4.48 and 6.81 t/ha, respectively) which, however, did not differ significantly with two hand weedings (20 & 40 DAS) and Almix + 0.2% surfactant @ 0.004 kg a.i. /ha at 15 DAS. Among different chemical treatments tried in this investigation Almix + 0.2% surfactant @ 0.004 kg a.i./ha at 15 DAS showed promising result to control all categories of dominant weeds resulting in the lowest weed dry weight and finally gave the highest yield (4.30 t/ha for grain and 6.50 t/ha for straw), exhibiting no phytoxicity symptoms to the crop plant.

Key words : Chemical weed control, direct seeded rice.

Rice crop is grown as direct-seeded under puddled irrigated condition in shallow low land (0–25 cm) situation of West Bengal state during *kharif* season. Weed competition is a crucial factor limiting the yield of this crop. Rice crop is affected by severe competition from diverse weed flora such as grasses and sedges at the initial stages and hydrophytic weeds and aquatic at later stages. Unchecked weed competition causes a reduction in grain yield to the tune of 30-36% in this crop (Sharma and Das, 1993). Hence, timely weed control is imperative for realizing desired level of productivity in this crop. Herbicide technology offers an alternative method to traditional hand weeding. But continuous use of a single herbicide like butachlor (which is commercially available at all places) may lead to build-up of resistance of weeds to this herbicides. Hence, there is a need for identifying other alternative herbicides to give wider options to the farmers for use in rotation. Of late, low dosage – high efficacy herbicides have been identified to be promising. Keeping this in view, a field experiment was carried out to evaluate the effectiveness of herbicides for direct seeded rice (*Oryza sativa* L.) under puddled irrigated condition.

MATERIALS AND METHODS

A field experiment was carried out during *kharif* seasons of 2003 and 2004 at the Regional Research Sub-Station (RRS), Chakdaha, Nadia, West Bengal to evaluate the effectiveness of herbicides on direct seeded rice (*Oryza sativa* L.) under puddled irrigated condition. The farm where the experiment was conducted is situated at new alluvial zone (NAZ) of West Bengal at $23^0$5.3' N latitude and $83^0$5.3' E longitude and at an elevation of 9.75 meters above the mean sea level. The variety of rice used in this experiment was IET 4786 (Satabdi). The experiment was laid out in a randomized block design (RBD) having ten treatments replicated thrice (Table-1). The rice seed was dibbled adopting a spacing of 20 cm x 10 cm on 12th and 15th June during 2003 and 2004 respectively. A common fertilizer dose of 60 kg N and 30 kg each of P_2O_5 and K_2O/ha was given to the crop. All the other recommended agronomic management practices were followed to raise the crop. Different biometrical observation were recorded on weed and crop at 30, 45 and 60 DAS whereas, data on yield components and yield were taken at harvest.

RESULTS AND DISCUSSION

Weed flora of the experimental field was composite in nature consisting of grasses, sedges and broad leaved weeds. The major weed flora observed in the experimental field were :– *Echinochloa crussgali, Cyperus iria, Sagittaria sagittifolia, Eclipta alba* and *Monochoria vaginalis*.

Effect on weeds

Highest weed density and their dry matter yield at 30, 45 and 60 DAS were recorded in unweeded control plots. All the treatments significantly registered lower weed density and dry matter. Among all the chemical treatments Almix + 0.2% surfactant @ 0.04 kg a.i./ha at 15 DAS and Butachlor @ 1.00 kg a.i./ha + Safener at 3 DAS proved better in reducing weed density and dry matter yield at 30, 45 and 60 days after sowing over other herbicide treatments (Table-2). This might be due to the fact that such herbicides had the optimum lethal effect for all the dominant weeds and could persist in the soil upto the critical growth period of paddy crop. Similar kind of result was also obtained by Banerjee *et al.* (2004).

Maximum weed control efficiency (71.97, 65.44 and 58.40% at 30, 45 and 60 DAS). was recorded with weed free check followed by two hand weedings at 20 and 40 DAS (68.48, 63.22 and 56.77% at 30, 45 and 60 DAS) and Almix + 0.2% surfactant @ 0.004 kg a.i./ha at 15 DAS (65.88, 57.56 and 52.65% at 30, 45 and 60 DAS) Bhattacharya *et al.* (1997) opined in the same way.

Effect on Crop

Herbicide treatments had significant positive impact on yield and all yield attributes (Table 3). The experimental results showed that weed free check gave the highest grain and straw yield (4.48 and 6.81 t/ha, respectively) which, however, did not differ significantly with the treatments, two hand weedings (15 and 25 DAS), Almix + 0.2% surfactant @ 0.004 kg a.i./ha at 15 DAS and Butachlor + safener @ 1.0 kg a.i./ha at 3 DAS. Among different chemical treatments tried in this investigation Almix + 0.2% surfactant @ 0.004 kg a.i./ha at 15 DAS gave the highest yield (4.30 t/ha for grain and 6.50 t/ ha for straw yield), exhibiting no phytotoxicity symptoms to the crop plant. So far as harvest index, and weed index were concerned, similar trend of results were obtained. These findings corroborates with the findings of Banerjee *et al.* (2004).

It can therefore be concluded that Almix + 0.02% surfactant @ 0.004 kg a.i./ha at 15 DAS can profitably be used as an alternative measure to manual weeding to combat the weed infestation especially in situation of labour scarcity at the peak period to overcome the costly hand weeding.

Table 1 Treatment details for *kharif* rice (2003 and 2004)

Sl. No.	Treatments	Concentrations (%)	Dosage (kg ai/ha)	Time of application (DAS)
1	Butachlor + Safener	45 EC	1.0	0-3
2	Petiachlor +Safener	45 EC	0.50	7
3	Petiachlor +Safener	45 EC	0.750	7
4	Pyrazosulfuron ethyl	5 WP	0.020	8-10
5	Pyrazosulfuron ethyl	5 WP	0.025	8-10
6	Almix + 0.2% surfactant	20 WP	0.004	20
7.	Almix + 0.2% surfactant	20 WP	0.004	25
8.	Weed free check	-	-	-
9.	Two hand Weedings	-	-	20 & 40
10.	Non-weeded control	-	-	-

Table 2 Effect of weed control treatments on weed density, weed dry weight and weed control efficiency (2003 and 2004)

Treatments	Weed density /m^2									Weed dry weight (g/m^2)									Weed control efficiency (%)								
	30 DAS			45 DAS			60 DAS			30 DAS			45 DAS			60 DAS			30 DAS			45 DAS			60 DAS		
	1st	2nd	Pooled	1st	2nd	Pooled	1st	2nd	Pooled	1st	2nd	Pooled	1st	2nd	Pooled	1st	2nd	Pooled	1st	2nd	Pooled	1st	2nd	Pooled	1st	2nd	Pooled
T_1	12.00	14.6	13.30	19.0	24.2	21.60	24.66	30.0	27.33	6.0	7.3	6.65	9.0	10.9	9.95	13.11	15.57	14.34	41.29	49.30	45.97	47.02	47.62	47.35	47.45	37.99	42.70
T_2	15.00	17.6	16.30	24.66	21.34	23.00	31.0	30.32	30.66	7.50	8.44	7.97	12.50	11.0	11.75	16.70	15.2	15.95	2661	41.38	35.25	26.42	47.14	37.83	33.06	39.46	36.27
T_3	16.33	14.87	15.60	20.2	24.66	22.33	27.66	28.34	28.00	8.01	7.01	7.51	12.0	11.04	11.52	12.95	16.93	14.95	21.62	51.31	38.99	29.37	46.94	39.04	48.09	32.57	40.27
T_4	18.00	22.6	20.30	28.33	26.99	27.66	35.0	32.32	33.66	9.51	8.53	9.02	11.95	15.93	13.94	18.22	15.88	17.05	6.94	40.76	26.72	29.66	23.45	26.24	26.97	36.75	31.88
T_5	17.33	18.67	18.00	27.0	24.32	25.66	31.33	32.67	32.00	7.61	9.41	8.51	12.10	13.54	12.82	16.0	16.82	16.41	25.53	34.62	30.86	28.78	34.93	32.16	35.87	33.01	34.43
T_6	10.66	8.54	9.60	17.33	12.67	15.00	24.33	20.27	22.30	3.45	4.95	4.20	6.95	9.09	8.02	11.91	11.79	11.85	66.24	65.62	65.88	59.19	56.31	57.56	52.26	53.04	52.65
T_7	11.33	9.27	10.30	15.0	20.32	17.66	23.66	25.66	24.66	3.92	5.28	4.60	10.11	6.73	8.42	14.50	12.1	13.30	61.64	63.33	62.63	40.49	67.65	55.44	41.88	51.81	46.86
T_8	8.60	6.72	7.66	14.66	12.00	13.33	21.66	19.66	20.66	3.11	3.79	3.45	7.0	6.06	6.53	9.21	11.61	10.41	69.56	73.68	71.97	58.79	70.87	65.44	63.08	53.76	58.40
T_9	9.00	7.66	8.33	13.66	15.00	14.33	22.0	20.66	21.33	4.56	3.2	3.88	6.42	7.48	6.95	9.45	12.19	10.82	55.38	77.77	68.48	62.21	64.05	63.22	62.12	51.45	56.77
T_{10}	26.33	28.27	27.30	36.0	40.6	38.30	48.33	51.67	50.00	10.22	14.4	12.31	16.99	20.81	18.90	24.95	25.11	25.03	0	0	0	0	0	0	0	0	0
S.Em ±	0.42	0.45	0.43	0.64	0.69	0.68	0.85	0.89	0.88	0.35	0.37	0.36	0.43	0.41	0.42	0.40	0.36	0.38	-	-	-	-	-	-	-	-	-
CD (P=0.05)	1.23	1.32	1.27	1.88	2.03	2.01	2.50	2.62	2.60	1.03	1.09	1.06	1.26	1.20	1.24	1.18	1.06	1.12	-	-	-	-	-	-	-	-	-

Table 3 **Effect of weed control treatments on yield components, yield (both grain and straw) harvest index and weed index (2003 and 2004)**

Treatments	No. of effective tillers/m²			No. of filled grains/ panicle			1000 grain weight (g)			Grain yield (t/ha)			Straw yield (t/ha)			HI (%)			Weed index (%)		
	1st	2nd	Pooled	1st	2nd	Pooled	1st	2nd	Pooled	1st	2nd	Pooled	1st	2nd	Pooled	1st	2nd	Pooled	1st	2nd	Pooled
T_1	247.0	254.6	250.8	82.3	88.9	85.6	20.50	21.50	21.00	4.20	4.36	4.28	6.50	6.32	6.41	39.2	40.8	40.0	6.6	2.2	4.4
T_2	231.5	226.3	228.9	81.5	80.2	80.8	22.10	21.70	21.90	3.50	4.12	3.81	6.00	6.06	6.03	36.5	40.5	38.7	22.2	7.6	14.9
T_3	210.5	219.0	214.8	75.0	77.9	76.5	22.0	22.26	22.13	3.25	3.95	3.60	5.51	6.13	5.82	37.1	39.2	38.2	27.8	11.4	19.6
T_4	245.1	235.4	240.3	81.6	82.6	82.1	21.51	22.45	21.98	3.99	3.89	3.94	6.35	6.05	6.20	38.6	39.1	38.8	11.3	13.7	12.0
T_5	245.0	244.2	244.6	85.0	84.2	84.6	21.95	22.05	22.00	4.25	3.75	4.00	6.05	7.29	6.67	41.3	33.9	37.5	5.5	15.9	10.7
T_6	260.1	252.4	256.3	89.3	88.1	88.7	22.31	31.69	22.00	4.40	4.20	4.30	6.75	6.25	6.50	39.5	40.2	39.8	2.2	6.6	4.0
T_7	246.5	254.4	250.5	84.6	87.3	85.9	22.0	22.16	22.08	4.15	4.25	4.20	6.01	7.09	6.55	40.8	37.5	39.0	7.8	4.7	6.2
T_8	272.3	269.3	270.8	88.1	90.3	89.2	21.65	22.59	22.12	4.50	4.46	4.48	6.95	6.67	6.81	39.3	40.0	39.7	0	0	0
T_9	265.1	254.9	260.0	88.9	92.5	90.7	21.88	22.32	22.10	4.40	4.30	4.35	6.61	6.95	6.78	39.9	38.2	39.0	2.2	3.6	2.9
T_{10}	185.4	186.8	186.1	69.3	67.2	68.3	20.10	23.70	21.90	3.05	2.97	3.01	4.32	4.70	4.51	39.0	38.7	40.0	32.2	33.4	32.8
S.Em ±	2.99	3.03	3.01	1.49	1.63	1.58	0.8	0.10	0.09	0.06	0.09	0.08	0.21	0.27	0.25	-	-	-	-	-	-
CD (P=0.05)	8.82	8.93	8.92	4.39	4.80	4.68	0.23	0.29	0.28	0.17	0.26	0.26	0.61	0.79	0.74	-	-	-	-	-	-

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