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Effect of Herbicides in Relation to Varying Water Regimes in Controlling Weeds in Direct Seeded Puddled Rice

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ABSTRACT

Anilofos at 0.45 kg ha^{-1} reduced density of *C. iria* and *E. colona* by 59.5 and 61.0%, respectively, resulting in 50.6% increase in grain yield over untreated. Butachlor at 1.5 kg ha^{-1} proved to be next effective herbicide in controlling the weeds. Metsulfuron-methyl+chlorimuron-ethyl at 4 g ha^{-1} provided excellent control of broad-leaved weeds and sedges. All the herbicides under test performed well when applied in presence of standing water.

INTRODUCTION

In direct seeded puddled rice, yields are reduced to the magnitude of 20-60% depending upon the nature and intensity of weed flora. Butachlor, anilofos and thiobencarb have been recommended for weed control in wet seeded rice. It has been established that efficacy of herbicides is directly related with the moisture availability in soil at the time of herbicide application. In this investigation, an effort was made to find out the interactive effects of herbicides and moisture availability at the time of application of herbicides in direct seeded puddled rice in controlling weeds and grain yield of rice.

MATERIALS AND METHODS

Efficacy of anilofos at 0.45 kg ha^{-1}, butachlor at 1.5 kg ha^{-1}, pretilachlor at 0.75 kg ha^{-1} at 6th day after sowing as pre-emergence and metsulfuron-methyl +chlorimuron-ethyl at 4 g ha^{-1} at 17th day after sowing as early post-emergence was evaluated under three water regimes (spraying at saturation, saturation followed by light watering and spraying under shallow standing water) in a three replicated randomized block design during **kharif** 2003 and 2004 at Students' Instructional Farm of this University. Weedy and weed-free manually were also included in study for comparison. Sprouted seeds of crop "Pant-12" at 100 kg ha^{-1} were broadcasted on a well puddled soil on July 15, 2003 during first year and July 4, 2004 during second year. Crop was fertilized with 100, 50, 50 kg NPK ha^{-1} and 25 kg $ZnSO_4$ ha^{-1}. A uniform application of half dose of N and full doses of P, K and $ZnSO_4$ was done as basal dose. The remaining half of nitrogen was top dressed in two equal instalments at maximum tillering and panicle initiation stages. All the herbicides were applied with the help of knapsack sprayer fitted with flood jet nozzle at spray volume of 500 l ha^{-1}.

RESULTS AND DISCUSSION

Effect on Weeds

The experimental field was infested with *Echinochloa colona* (23.7%), *E. glabrescens* (13.1%), *Cyperus iria* (37.5%), *P. niruri* (14.1%) and *E. alba* (11.0%). Butachlor recorded highest mortality of *E. colona* (66.4%) and *E. glabrescens* (65.2%) followed by anilofos (61.0 and 55.1%). Metsulfuron-methyl+chlorimuron-ethyl (MSM+CME) was inferior in controlling *E. colona* and *E. glabrescens* (Table 1).

Anilofos registered its superiority in controlling *C. iria* over other herbicides. Pretilachlor was next in order in terms of *C. iria* mortality. Butachlor and MSM+CME provided satisfactory control of this

Table 1. Weed density (No m^{-2}) at 60 DAS as influenced by different treatments

Treatment	*E. colona*			*E. glabrescens*			*C. iria*			*P. niruri*			*E alba*		
	2003	2004	Pooled	2003	2004	Pooled	2003	2004	Pooled	2003	2004	Pooled	2003	2004	Pooled
Herbicides															
Anilofos 0.45 kg ha^{-1}	3.68	3.81	3.75	2.96	3.08	3.02	4.74	4.80	4.77	2.92	3.01	2.97	2.70	2.82	2.76
	(13)	(14)	(13)	(8)	(8)	(8)	(21)	(22)	(22)	(8)	(9)	(8)	(7)	(7)	(7)
Butachlor 1.5 kg ha^{-1}	3.43	3.56	3.49	2.60	2.77	2.68	5.36	5.42	5.39	3.59	3.66	3.62	3.28	3.32	3.30
	(11)	(12)	(12)	(6)	(7)	(7)	(28)	(29)	(28)	(12)	(13)	(13)	(10)	(10)	(10)
Pretilachlor 0.75 kg ha^{-1}	3.90	4.02	3.96	3.23	3.34	3.28	4.90	4.97	4.93	3.35	3.43	3.39	3.14	3.20	3.17
	(15)	(16)	(15)	(10)	(11)	(10)	(23)	(24)	(24)	(11)	(11)	(11)	(9)	(10)	(9)
Metsulfuron-methyl+	4.29	4.45	4.37	3.65	3.75	3.70	5.15	5.19	5.17	3.14	3.22	3.18	2.54	2.61	2.57
Chlorimuron-ethyl 4 g ha^{-1}	(18)	(19)	(19)	(13)	(12)	(11)	(26)	(26)	(26)	(9)	(10)	(10)	(10)	(6)	(6)
LSD (P=0.05)	0.20	0.19	0.14	0.23	0.2!	0.15	0.17	0.20	0.13	0.22	0.19	0.14	0.18	0.194	0.13
Weedy	5.82	6.06	5.94	4.35	4.53	4.44	7.40	7.48	7.44	4.52	4.67	4.60	4.13	4.19	4.16
	(33)	(36)	(35)	(18)	(20)	(19)	(54)	(56)	(55)	(20)	(21)	(21)	(17)	(17)	(17)
Weed-free	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71
	(00)	(00)	(00)	(00)	(00)	(00)	(00)	(00)	(00)	(00)	(00)	(00)	(00)	(00)	(00)
LSD (P=0.05)	0.26	0.24	0.17	0.29	0.27	0.27	0.22	0.26	0.17	0.27	0.24	0.18	0.23	0.25	0.16
(weedy/weed-free) vs. Herbicides															
LSD (P=0.05)	0.35	0.33	0.23	0.39	0.37	0.26	0.30	0.35	0.23	0.38	0.32	0.24	0.32	0.34	0.22
(weedy/weed-free)															
Water regimes															
Herbicide spray at	3.97	4.12	4.05	3.35	3.48	3.41	5.17	5.22	5.20	3.38	3.46	3.42	3.19	3.21	3.20
saturation	(15)	(16)	(16)	(11)	(12)	(11)	(26)	(27)	(26)	(11)	(11)	(11)	(10)	(10)	(10)
Herbicide spray at	3.87	4.02	3.94	3.20	3.32	3.26	5.08	5.12	5.10	3.34	3.41	3.37	2.99	3.05	3.02
saturation fb flooding	(14)	(16)	(15)	(10)	(10)	(10)	(25)	(25)	(25)	(11)	(11)	(11)	(8)	(9)	(8)
Herbicide spray in	3.63	3.74	3.68	2.78	2.90	2.84	4.86	4.94	4.90	3.04	3.12	3.03	2.56	2.65	2.61
standing water	(13)	(13)	(13)	(7)	(8)	(8)	(23)	(24)	(23)	(9)	(9)	(9)	(6)	(6)	(6)
LSD (P=0.05)	0.18	0.16	0.12	0.20	0.19	0.13	0.15	0.18	0.11	0.19	0.16	0.12	0.16	0.17	0.11

Original data given in parentheses were subjected to square root transformation ($\sqrt{x + 0.5}$) before analyses.

Table 2. Dry matter of weeds, yield attributes and yield of rice as influenced by different weed control treatments

Treatment	Dry matter of weeds (kg ha^{-1})			Panicles m^{-2}			Grains panicle^{-1}			Grain yield (kg ha^{-1})		
	2003	2004	Pooled	2003	2004	Pooled	2003	2004	Pooled	2003	2004	Pooled
Herbicides												
Anilofos 0.45 kg ha^{-1}	24.24 (587)	24.52 (600)	24.38 (594)	369.29	365.34	367.32	70.8	69.3	70.0	3377	3263	3320
Butachlor 1.5 kg ha^{-1}	25.45 (647)	25.74 (662)	25.60 (655)	355.59	351.42	353.50	67.9	66.4	67.2	3150	3016	3083
Pretilachlor 0.75 kg ha^{-1}	26.39 (696)	26.71 (713)	26.55 (705)	344.76	340.70	342.73	66.2	64.6	65.4	2961	2829	2895
Metsulfuron-methyl+ Chlorimuron-ethyl 4 g ha^{-1}	27.13 (736)	26.45 (753)	27.29 (745)	335.13	331.04	333.08	64.7	63.2	63.9	2798	2666	2732
LSD (P=0.05)	0.569	0.666	0.740	16.68	19.42	12.48	2.8	2.5	1.9	156	168	112
Weedy	36.23 (1312)	36.71 (1347)	36.47 (1330)	308.42	304.46	306.44	59.1	57.8	58.5	2248	2160	2204
Weed-free	0.71 (00)	0.71 (00)	0.71 (00)	393.26	388.44	390.85	77.8	76.0	76.9	3724	3643	3683
LSD (P=0.05) (weedy/ weed-free) vs. Herbicide	0.719	0.848	0.545	21.26	24.76	15.91	3.5	3.1	2.4	199	214	143
LSD (P=0.05) (weedy/ weed-free)	0.985	1.154	0.740	28.90	33.65	21.63	4.8	4.3	3.3	271	292	194
Water regimes												
Herbicide spray at saturation	26.35 (694)	26.65 (710)	26.50 (702)	337.67	333.57	335.62	65.2	63.7	64.4	2920	2809	2864
Herbicide spray at saturation fb flooding	22.04 (678)	26.36 (694)	26.20 (686)	349.88	345.83	347.85	66.7	65.2	66.0	3034	2919	2976
Herbicide spray in standing water	25.03 (626)	25.31 (640)	25.17 (633)	366.02	361.99	364.00	70.3	68.6	69.5	3261	3103	3182
LSD (P=0.05)	0.492	0.577	0.427	14.45	16.82	10.81	2.4	2.1	1.6	135	146	97

weed. Spectacular mortality of *P. niruri* due to MSM+CME was recorded when applied as early post-emergence. The performance of MSM+CME was found superior in controlling *E. alba* followed by anilofos. Butachlor recorded poor mortality of *E. alba*.

Anilofos excelled all the treatments in reducing dry matter of weeds followed by butachlor (Table 2). MSM+CME proved inferior in reducing weed dry weight. Spraying of herbicides under shallow water was significantly superior in reducing dry matter of weeds, over herbicides spraying at saturation or spraying at saturation followed by light watering. Ahmad *et al.* (1975) found increased herbicidal efficacy with continuous flooding (3 cm deep) for 10 days after herbicide application. The interaction effects between herbicides and moisture availability were non-significant.

Effect on Yield Attributes and Yield

Weed-free plots recorded significantly higher values of panicles m^{-2} and grains $panicle^{-1}$ over herbicide treatments (Table 2). Among the herbicides, anilofos registered significantly higher yield contributing characters followed by butachlor than rest of the herbicide treatments. Application of herbicides in shallow standing water established its superiority over other water regime treatments in respect of panicles m^{-2} and grains $panicle^{-1}$.

Anilofos applied as pre-emergence excelled all the herbicidal treatments in respect of grain yield and recorded 7.7, 14.7 and 21.5% more grain yield than butachlor, pretilachlor and MSM+CME, respectively. On an average, 40.2% reduction in grain yield was recorded in weedy plots. The better efficacy of anilofos under puddled rice has also been documented by Kalia and Bindra (1996). Application of herbicides in shallow standing water recorded, on an average, 10.0 and 6.5% increased grain yield over herbicides spray at saturation and herbicides spray at saturation followed by watering.

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