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Effect of micro-herbicides on weed dynamics, yield and economics of transplanted rice (*Oryza sativa*)

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ABSTRACT

The efficacy of some potent micro-herbicides in conjunction with other herbicide for control of various weed flora in transplanted rice (*Oryza sativa* L.) was studied during the rainy season of 2001 and 2002 at Varanasi, Uttar Pradesh. The major weedS found were *Echinochloa colonum* L., *Echinochloa cruss galli* Beauv., *Cyperus rotundus* L., *Cyperus difformis* L., *Fimbristylis millacea* (L.) Vahl and *Ludwigia parviflora* Roxb. Almix + 2, 4-DEE (15 + 500 g/ha) applied 8 days after transplanting was found most effective in controlling weeds and maximizing rice grain yield (58.3 q/ha). This was on a par with hand-weeding done thrice at 20,40 and 60 days stage. This treatment recorded highest net return (Rs 46,392) and benefit : cost ratio (3.9). Hand-weeding treatments though significantly reduced the weed biomass and improved the grain yield, owing to higher labour cost reduced the benefit : cost ratio.

Key words : Economics, Micro-herbicide, Transplanted rice, Weed, Yield

Changes in morphological structure of rice varieties and shifting paradigm of cultivation have brought forth marked change in floristic composition of weed flora, weed density and their virulence. These have compounded weed problem further. Yield losses caused by weed species in transplanted rice are enormous (Singh *et al.*, 2003). With increasing weed density, yield losses are increasing markedly. Thus, it is important that they are controlled in time to avoid unproductive use of growth factors to enable the crop plant to express fully by utilizing these factors meant for them. Herbicides are effective against weed species, but most of them are specific and are effective against narrow range of weed species (Naryana *et al.*, 1999). Several new herbicides have been added to the array of herbicides. Not much study has been made on their efficacy. Besides, a few uncommon herbicides to rice are being tested to control weeds. Information on efficacy of these is also exiguous in literature. The present study was undertaken to study the effect of new and uncommon micro-herbicides and their combination on weeds dynamics and yield of transplanted rice.

MATERIALS AND METHODS

A field experiment was conducted during the rainy season of 2001 and 2002 at Research farm of Institute of Agricultural Sciences, Banaras Hindu University, Varanasi. The soil was sandy clay loam having pH 7.3, organic carbon 0.44% and available N, P_2O_5 and K_2O of 205, 14.9 and 232.8 kg/ha respectively. The experiment comprising 16 weed-control treatments, *viz.* metsulfuron methyl (MSM) (4,6 and 8 g/ha), chlorimuron ethyl (CME) (10, 15 and 20 g/ha), almix (15, 20 and 25 g/ha), MSM + 2, 4-DEE (4 + 500 g/ha), CME + 2,4-DEE (10 + 500 g/ha), almix + 2,4-DEE (15 +500 g/ha), anilofos (400 g/ha) and anilofos + 2,4-DEE (400 + 500 g/ha) along with hand-weeding [20, 40 and 60 days after transplanting (DAT)] and weedy check. The experiment was laid out in randomized block design with 3 replications. Twenty-five day old seedlings of rice variety 'Sarju 52' were transplanted on 22 and 24 July 2001 and 2002 respectively. One-third of the recommended dose of N (40 kg/ha) and full dose of P_2O_5 and K_2O (60 kg/ha) were applied before transplanting and remaining N was top-dressed in 2 equal splits, half at active tillering and half at panicle-initiation stage. Herbicides were applied as pre-emergence 8 days after transplanting using 500 litres/ha water with help of knapsack sprayer, fitted with flat-fan nozzle. The data on total weed population and weed biomass were taken at 60 DAT with the help of random quadrate (0.5 m × 0.5 m) at 2 places and then converted into per square meter. These were subjected to square-root transformation $\sqrt{x + 0.5}$ to normalize their distribution.

RESULTS AND DISCUSSION

Weeds

Predominant weed species that infested the field consisted of grasses [*Echinochloa crus-galli* (L.) Baeuv., *E. colonum* (L.) Link, *Cynodon dactylon* L.], sedges [*Cyperus rotundus* L., *Cyperus iria* L., *Cyperus difformis* L., *Fimbristylis milliaceae* (L.) Vahl] and broad-leaf weeds [*Ammania baccifera* (L.) Rottb. and *Ludwigia parviflora* L.]

The results for 2001 and 2002 were not significantly different and hence pooled for analysis. Of the herbicides, almix + 2,4-DEE 15 + 500 g/ha was the most potential killer of weeds and significantly superior to all herbicidal treatments to check weed population. It eliminated *Ammania baccifera* and *Ludwigia parviflora* and gave excellent control of *Echinochloa crus-galli* and *Fimbristylis milliacea* (Table 1). It was the only herbicidal combination that paralyzed severely the growth of grasses, sedges and broad-leaf weed population at 60 days of crop growth. The next best treatment was almix 25 g/ha, its effect on *Ammania baccifera* and *Ludwigia parviflora* was similar to that of almix + 2,4-DEE 15+500 g/ha combination. It gave an excellent control of *Cyperus rotundus* and *C. difformis* and good control of dicot weeds, but failed to bring about noticeable change in density of *Echinochloa* sp. Similar results were also reported

Table 1. Effect of treatments on distribution patterns of different weed flora (pooled data of 2 years)

Treatment	Dose (g/ha)	Grassy weed (No./m^2)		Sedges (No./m^2)		Broad-leaf weed (No./m^2)		
		Echinochloa colonum	*Echinochloa crus-galli*	*Cyperus rotundus*	*Cyperus difformis*	*Fimbristylis miliacea*	*Ammania baccifera*	*Ludwigia parviflora*
Unweeded		6.2	3.7	7.9	4.5	3.3	6.0	5.0
		(39.0)	(13.5)	(62.5)	(19.6)	(11.8)	(35.2)	(24.9)
Hand-weeding		0.7	0.7	0.7	0.7	0.7	0.7	0.7
(20, 40 and 60 DAT)		(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
MSM	4	4.6	3.8	6.6	4.0	3.2	2.9	2.6
		(22.2)	(14.0)	(42.5)	(15.5)	(11.0)	(8.0)	(6.4)
MSM	6	4.2	3.1	6.2	3.8	3.1	2.6	2.3
		(16.8)	(9.0)	(37.8)	(14.2)	(9.5)	(6.5)	(4.8)
MSM	8	4.0	3.1	5.8	3.5	2.9	2.5	1.9
		(15.3)	(8.9)	(33.5)	(12.2)	(8.5)	(5.8)	(3.2)
CME	10	4.1	3.1	6.3	3.8	3.1	2.7	2.3
		(16.0)	(8.8)	(38.9)	(14.3)	(9.7)	(6.8)	(4.7)
CME	15	3.8	3.0	5.7	3.7	3.0	2.1	2.0
		(14.5)	(8.2)	(32.2)	(13.2)	(8.7)	(4.5)	(3.8)
CME	20	3.4	2.8	5.5	3.4	2.8	1.9	1.9
		(11.2)	(7.5)	(29.5)	(11.3)	(8.3)	(3.5)	(3.5)
Almix	15	4.3	3.3	6.1	3.8	3.2	2.7	2.2
		(17.7)	(10.8)	(37.0)	(13.8)	(9.7)	(6.9)	(4.3)
Almix	20	3.6	2.7	4.2	3.2	2.5	1.3	1.6
		(12.5)	(7.0)	(17.8)	(9.6)	(6.5)	(1.5)	(2.0)
Almix	25	3.1	2.4	2.6	2.2	2.0	0.7	0.7
		(9.3)	(5.3)	(6.3)	(5.0)	(3.5)	(0.0)	(0.0)
MSM+ 2,4-DEE	4+500	4.2	2.9	5.3	3.7	2.9	2.1	2.1
		(16.8)	(8.3)	(28.0)	(13.5)	(8.5)	(4.2)	(3.8)
CME + 2,-DEE	10+500	3.9	2.7	5.2	3.7	2.8	2.1	1.8
		(14.5)	(7.2)	(26.5)	(13.2)	(7.3)	(3.9)	(3.4)
Almix + 2,4-DEE	15+500	2.3	1.5	4.6	3.1	1.7	1.1	0.9
		(5.2)	(2.2)	(19.5)	(9.0)	(3.0)	(1.0)	(0.6)
Anilophos	500	4.6	3.0	5.7	3.7	3.0	2.8	2.2
		(20.5)	(8.9)	(32.4)	(12.8)	(8.5)	(7.2)	(4.5)
Anilophos +	400+500	3.4	2.2	5.1	3.0	2.8	2.2	1.6
2,4-DEE		(11.2)	(4.7)	(26.3)	(8.6)	(7.2)	(4.5)	(2.7)
CD (P=0.05)		0.13	0.17	0.15	0.14	0.16	0.28	0.21

DAT, Days after transplanting
Figures in parentheses indicate original values.

Table 2. Effect of weed-control treatments on weed density, weed biomass, weed-control efficiency, grain yield and economics of rice crop (pooled data of 2 years)

Treatment	Dose (g/ha)	Weed density (No./m^2)	Weed biomass (g/m^2)	Weed-control efficiency (%)	Grain yield (q/ha)	Straw yield (q/ha)	Net returns (Rs/ha)	Benefit : cost ratio (Rs/rupee)
Unweeded		15.5 (240.4)	11.0 (120.4)	-	31.4	41.9	20,382	2.4
Hand-weeding (20,40 and 60 DAT)		0.7 (0.0)	0.7 (0.0)	100	59.3	72.1	45,809	3.6
MSM	4	12.1 (146.6)	7.7 (59.3)	50.7	35.5	46.7	24,110	2.6
MSM	6	11.3 (127.8)	7.4 (52.1)	56.8	41.6	54.5	30,514	3.1
MSM	8	10.8 (116.3)	6.7 (44.5)	63.1	45.4	61.0	34,798	3.3
CME	10	11.6 (134.2)	7.4 (54.8)	59.5	38.5	53.2	27,250	2.8
CME	15	10.7 (112.6)	6.8 (46.4)	61.5	42.4	56.5	31,071	3.1
CME	20	10.1 (101.7)	6.4 (39.9)	74.8	47.5	60.7	35,479	3.3
Almix	15	11.4 (129.5)	7.0 (48.3)	60.0	39.6	55.6	28,256	2.8
Almix	20	9.1 (88.4)	5.8 (32.3)	73.5	53.4	65.8	40,942	3.5
Almix	25	7.4 (54.8)	5.2 (26.4)	78.1	55.7	67.5	42,704	3.6
MSM + 2,4 DEE	4+500	10.7 (118.4)	6.8 (46.6)	61.5	50.0	63.3	39,133	3.6
CME + 2,4 DEE	10+500	10.1 (104.8)	6.3 (38.6)	68.0	51.4	64.0	40,045	3.7
Almix + 2,4 DEE	15+500	7.1 (49.8)	5.1 (24.9)	79.3	58.3	71.3	46,392	2.9
Anilophos	500	10.7 (113.1)	6.1 (44.7)	62.9	44.3	57.1	33,403	3.3
Anilophos + 2,4–DEE	400+500	9.7 (92.1)	6.4 (37.5)	68.6	52.5	64.5	41,318	3.8
CD (P=0.05)		0.20	0.25		1.21	2.30		

DAT, Days after transplanting
Figures in parentheses indicate original values

by Bhattacharya *et al.* (2002). The different behaviour of herbicides may be attributed to their differential reaction to weed species.

Almix + 2,4-DEE 15 + 500 g/ha was found superior to the other treatments in reducing the total weed density by 79.3% compared to weedy check. This reduction might be owing to effective control of grasses and sedges. All weed-control measures registered a significant reduction in weed dry matter compared to weedy check throughout the crop growth (Table 2). Hand-weeding recorded the lowest weed biomass probably due to effective control of the first flush of weeds from 20 to 40 days and second flushes of weeds from 40 days onwards. Almix + 2,4-DEE 15 + 500 g/ha amongst the herbicides reduced total dry matter significantly by 79.2% compared to weedy check. It remained on a par with almix 25 g/ha. As regard the weed-control efficiency, hand-weeding thrice was found superior to the other treatments with 100% control of weeds. Among chemical treatments, highest weed-control efficiency was found with almix + 2,4 DEE 15 + 500 g/ha, followed by almix 25 g/ha (78.1%).

Crop

Maximum and minimum grain yields were obtained in season-long weed-free and unweeded situation respectively (Table 2). This increase in grain yield was 85.5% over unweeded check. Among herbicidal treatments, maximum grain yield was obtained with almix + 2,4-DEE

15 + 500 g/ha, which was on par with hand-weeding thrice. The minimum grain yield was obtained with metsulfuron methyl 4 g/ha. These results are in close conformity with the results reported by Mukherjee and Bhattacharya (1999). However, all the weed-control treatments resulted in significantly higher grain yield than weedy check. A higher straw yield of 73% was registered with hand-weeding thrice over the unweeded control. Almix + 2,4-DEE 15 + 500 g/ha registered higher straw yield (71.3 q/ha) and significantly superior to rest of herbicidal treatments and was on a par with hand-weeding thrice.

The monetary advantage (Table 2) based on mean of 2 years of experimentation indicated that the maximum net return and benefit : cost ratio were obtained with almix + 2,4-DEE 15 + 500 g/ha. This could be due to high weed-control efficiency and higher grain yield obtained due to application of effective herbicide dose. Hand-weeding treatment, though improved grain and straw yields, yet owing to higher labour cost reduced the net return and benefit : cost ratio (3.6).

Thus application of almix + 2,4-DEE 15 + 500 g/ha proved to be more effective to check the weeds population and their growth and proved to be more remunerative and economical and may be recommended for the rice cultivation in Eastern Uttar Pradesh.

REFERENCES

Bhattacharya, S.P., Karan, A.K., Bera, P.S. and Sarkar, S. 2002. Performance of sulfonyl urea herbicides on *kharif* rice. *Environment and Ecology* **20**(3) : 625–629.

Mukherjee, P.K. and Bhattachrya, S.P. 1999. Comparative study of bioefficacy between new generation micro-herbicides and traditional voluminous herbicides on transplanted rice culture. *Annals of Agricultural Research* **29** (4) : 509–511.

Narayana, A.L., Veerbadram, V. and Poonguzhalan, R. 1999. Performance of low doses high efficacy herbicide for weed control in transplanted rice. *Oryza* **36** (3) : 290–292.

Singh, Akash, Dawson, Joy and Singh, S.S. 2003. Efficacy of herbicides on weeds present in transplanted rice. (In) *Proceedings of Conference of Indian Society of Weed Science,* held during 12–14 March 2003 at the Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, p. 10.