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Effect of low doses of herbicides on weeds, nutrient uptake and yield of transplanted rice (*Oryza sativa*)

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ABSTRACT

A field experiment was conducted during the rainy season of 2001 and 2002 at Research farm of Institute of Agricultural Science, Banaras Hindu University, Varanasi. Pre-emergence application of mixture of almix + 2,4-DEE 15 + 500 g/ha recorded the minimum weed density and their biomass than rest of the herbicidal treatments. This treatment registered higher weed-control efficiency next to hand-weeding thrice. Hand-weeding and chemical weeding treatment with almix + 2, 4 DEE 15 + 500 g/ha significantly increased the nutrient uptake by crop and gave higher grain yields. However, the minimum nutrient uptake by crop was noted under unweeded check. On an average, almix + 2, 4-DEE 15 + 500 g/ha registered 88 and 83% higher grain yield in 2001 and 2002, respectively, compared to weedy check.

Key words : Transplanted rice, Weeds, Almix, Nutrient

Transplanted rice crop faces diverse type of weed flora, consisting of grasses, sedges and some broad-leaf weeds. Attack of these weeds are predominant at initial 15–30 days after transplanting (DAT). Competition of these weeds brought about reduction in yield of transplanted rice by about 50% (Anantha Kumari and Rao, 1993). Several herbicides such as butachlor, anilofos and pretilachlore, have been recommended for the control of weeds in transplanted rice which are effective against grassy weeds only. Some herbicides like 2, 4-DEE controlled only broad-leaf weeds. Further, these herbicides are applied in very large volume, which will distort our ecosystem and increase chemical load to environment. Thus, for control of mixed flora, evaluation of new herbicide with low application rate is required. The present investigation was therefore conducted to study effect of low doses herbicides on weeds, nutrient uptake 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 Science, Banaras Hindu University. The soil was sandy clay loam having pH 7.3, organic carbon 0.44% and available N, P_2O_5 and K_2O 205, 14.9 and 232.8 kg/ha respectively. The experiment comprising 16 weed-control treatments, viz. metsulfuron methyl (MSM) (4, 6 and 8 kg/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 DAT) and weedy check. The experiment was laid out in randomized block design with 3 replications. Twenty five days old seedling 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 P_2O_5 and K_2O (60 kg/ha) were applied before transplanting and remaining amount of 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 600 litres/ha water with help of knapsack, fitted with flat-fan nozzle. The data on total weed population and weed biomass were taken at 30 days after transplanting (DAT) with the help of random quadrat (0.5 m × 0.5 m) at 2 places and then converted into per square meter. These were subjected to square-root transformation x + 0.05 to normalize their distribution. The content of nitrogen, phosphorus and potassium were determined by modified Kjeldhal, vando-molybdate and flame photometer methods, respectively.

RESULTS AND DISCUSSION

Effect of weeds

The major weed flora of the experimental site consisted of grasses, viz. *Echinochloa crus-galli* (L.) Beauv. *E.*

colonum (L.) Link, *Cyndon dactylon* (L.) Pers.; sedges, viz. *Cyperus rotundus* L., *Cyperus iria* L., *Cyperus difformis* L., *Fimbristylis miliaceae* (L.) Vahl; and broad-leaf weeds, *Ammania baccifera* (L.) Rottb. and *Ludwigia parviflora* L.

All the treatments registered significantly lower number of weeds and dry matter than the weedy check. Mixed application of almix + 2, 4 DEE 15 + 500 g/ha maintained a lower crop-weed competition from the very commencement of crop and registered lower weed density, resulting in higher weed-control efficiency. Almix + 2,4-DEE (15 + 500 g/ha) was significantly superior to rest all chemical treatments in controlling total weed density at 30 (DAT) in both the years. However, in second year it was on par with hand-weeding.

Among different measures, minimum weed biomass was noted with hand-weeding which was followed by almix + 2,4-DEE (15 + 500 g/ha) and alimx 25 g/ha. All the treatments significantly reduced weed biomass compared with weedy check (Table 1). Almix + 2,4 + DEE (15 + 500 g/ha) could suppress weed biomass by 96.06 and 94.9% over weedy check in 2001 and 2002 respectively. This treatment was significantly superior to rest all the herbicidal treatment in arresting weed biomass.

Application of almix + 2, 4-DEE (15+500 g/ha) was most effective against grasses and sedges and resulting the highest weed-control efficiency, which was followed by almix 25 g/ha.

Table 1. Effect of low doses of herbicides on weed density, weed biomass and weed-control efficiency

Treatment	Dose (g/ha)	Weed density at 30 DAT (no/m²)		Weed biomass at 30 DAT (g/m²)		WCE(%) at 30 DAT	
		2001	2002	2001	2002	2001	2002
Unweeded	-	13.0 (167.3)	13.6 (183.3)	9.0 (79.8)	9.0 (80.8)		
Hand-weeding (20, 40, 60 days)	0.7	3.2 (0.0)	0.7 (10.0)	1.2 (0.0)	100.0 (0.9)	98.9	
Metsulfuron methyl	4	8.2 (66.3)	8.9 (78.3)	6.2 (38.4)	6.9 (47.1)	51.9	41.7
Metsulfuron methyl	6	7.5 (55.7)	8.2 (66.3)	5.6 (31.2)	6.4 (41.2)	60.9	49.0
Metsulfuron methyl	8	6.8 (46.3)	7.4 (53.7)	5.3 (27.1)	5.4 (28.4)	66.0	64.8
Chlorimuron ethyl	10	7.9 (62.0)	8.7 (75.3)	5.8 (32.9)	6.0 (35.9)	58.8	55.5
Chlorimuron ethyl	15	7.2 (50.7)	8.2 (66.7)	5.4 (29.0)	5.6 (30.7)	63.6	62.0
Chlorimuron ethyl	20	5.0 (25.3)	5.7 (32.0)	3.9 (14.8)	3.9 (14.6)	81.4	81.9
Almix	15	7.3 (52.7)	8.0 (63.7)	5.6 (30.6)	5.9 (33.7)	61.7	58.3
Almix	20	5.55 (30.3)	6.98 (48.3)	4.15 (16.7)	4.46 (19.4)	79.0	75.9
Almix	25	4.6 (21.0)	5.0 (24.7)	2.9 (7.9)	3.9 (14.7)	90.0	81.9
Metsulfuron methyl + 2,4 DEE	4+500	7.4 (54.0)	7.0 (49.3)	4.9 (23.6)	5.0 (25.2)	70.4	68.8
Chlorimuron ethyl + 2,4-DEE	10+500	6.4 (40.4)	5.5 (29.7)	4.9 (23.2)	5.0 (24.6)	71.0	69.6
Almix + 2,4-DEE	15+500	1.9 (3.0)	2.9 (7.7)	1.9 (3.1)	2.2 (4.4)	96.1	94.6
Anilofos	500	6.5 (42.3)	7.7 (58.7)	5.3 (28.1)	5.58 (29.6)	51.7	63.4
Anilofos + 2,4- DEE	400+500	5.8 (33.3)	6.2 (37.3)	4.4 (18.7)	4.5 (19.5)	61.1	61.3
CD (P=0.05)	-	0.35	0.38	0.25	0.35	-	-

WCE, Weed-control efficiency; DAT, days after transplanting
Figures in parentheses are original value

Table 2. Effect of herbicides on N, P, K uptake and grain yield of rice crop

Treatment	Dose (g/ha)	Nutrient uptake by crop (kg/ha)						Grain yield (q/ha)	
		Nitrogen		Phosphorus		Potassium			
		2001	2002	2001	2002	2001	2002	2001	2002
Unweeded		45.0	40.4	10.3	8.7	65.7	61.6	32.4	30.5
Hand-weedings		111.3	103.1	24.9	25.0	140.9	136.5	60.3	58.3
Metsulfuron methyl	4	52.3	50.4	11.0	10.2	75.0	70.7	36.3	34.8
Metsulfuron methyl	6	62.2	58.3	12.9	12.1	88.9	87.1	42.6	40.7
Metsulfuron methyl	8	74.7	68.7	15.6	13.7	106.7	101.2	46.3	44.5
Chlorimuron ethyl	10	56.9	55.2	12.2	11.3	82.0	82.3	38.6	37.5
Chlorimuron ethyl	15	64.7	61.2	14.3	13.3	94.4	91.6	43.1	41.7
Chlorimuron ethyl	20	77.9	74.1	17.0	15.8	109.0	104.6	47.9	47.1
Almix	15	59.9	57.0	12.5	11.6	88.7	84.9	40.6	38.7
Almix	20	93.1	88.9	18.1	17.9	122.7	118.3	53.6	53.2
Almix	25	99.8	93.3	19.7	20.1	128.5	123.3	56.3	55.0
Metsulfuron methyl + 2,4 DEE	4+500	85.7	80.4	16.4	16.5	115.7	112.8	50.9	49.3
Chlorimuron ethyl + 2,4	10+500	88.9	83.8	17.0	17.5	117.2	116.0	51.7	51.2
Almix+2, 4DEE	15+500	107.3	98.0	22.1	23.1	137.4	132.4	59.3	57.4
Anilofos	500	69.5	65.0	15.4	14.5	97.3	92.4	45.6	43.2
Anilofos + 2,4 DEE	400+500	91.3	70.5	17.4	16.92	119.4	116.2	53.4	51.7
CD (P=0.05)		1.8	13.5	1.6	1.9	6.0	5.4	0.9	1.2

Nutrient uptake by rice

All the control measures caused higher nutrient uptake than weedy check (Table 2). Of all the measures rice crop with 3 hand-weedings showed the maximum N, P and K uptake. This was due to less weed competition and low weed biomass production. Amongst different chemical treatments nitrogen uptake by crop was maximum with almix + 2, 4-DEE (15 + 500 g/ha) and significantly superior to rest of the treatments. However, in the first year and in second year this was on par with hand-weeding. The minimum uptake of N was observed with metsulfuron methyl 4 g/ha.

Uptake of phosphorus was the maximum with almix + 2, 4 DEE (15 + 500 g/ha) amongst chemical treatments and this was followed by almix 25 g/ha.

Potassium uptake was maximum with almix + 2, 4 DEE (15 + 500 g/ha) and it was statistically superior to rest of all chemical treatments and was on a par with hand-weeding during both the years.

Grain yields

Yield of rice revealed that all the measures proved superior to weedy check (Table 2). Among chemical treatments, the maximum grain yield was recorded with almix + 2, 4-DEE (15 + 500 g/ha) and was on a par with hand-weeding and superior to rest of treatments in both the years. Plants under this treatment produced 83.1 and 88.1% higher grain yield than weedy check in 2001 and 2002 respectively. Higher grain yields with almix + 2,4-DEE due to least crop-weed competition, higher weed-control efficiency and more nutrient uptake by crop plant. This finding is in agreement with the finding of Mukherjee and Bhattacharya (1999).

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