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Weed management in tranplanted, lowland rice (*Oryza sativa*)

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ABSTRACT

The field experiment was carried out during rainy (*kharif*) season of 1990 and 1991 at Jorhat to find out effective weed-management practice in transplanted rice (*Oryza sativa* L.). Closer spacing (15 cm x 15 cm) and weeding with rottary weeder reduced the weed growth effectively and increased the grain yield comparable to weed-free condition. Among the herbicides, butachlor @ 1.0, cinmethyline @ 0.06 and anilofos @ 0.40 kg/ha proved effective in controlling weeds and recording crop yields similar to that under weed-free condition. The highest additional net return (Rs 2,250) was obtained in rottary weeder (days after transplanting). Amongst the herbicides, butachlor @ 1.0 kg/ha gave the maximum additional return (Rs 2,122).

Unlike other cereals, rice (*Oryza sativa* L.) suffers more weed competition. Weeds offer competition to the crop plants for nutrients, solar radiation and space and thereby reduce crop yield. The loss in yield occurs 25–30% due to unchecked weed growth (Upadhyay and Gogoi, 1993) in transplanted rice. The conventional method of weed control (hand-weeding or hoeing) is very laborious, expensive and inefficient. Moreover, weeding during critical growth stages is not possible due to intermittent rains. Chemical weeding is easier, time-saving and economical as compared to hand-weeding alone (Brar and Mehra, 1989). Thus chemical control of weeds becomes inevitable. In the present investigation, chemical weed-killers, closer spacing and rottary weeding were evaluated for their relative efficacy in controlling weeds and increasing yield of transplanted rice.

MATERIALS AND METHODS

The field experiment was conducted at Jorhat during rainy (*kharif*) season of 1990 and 1991 on sandy-loam soil of pH 5.6. The experiment comprising 5 pre-emergence herbicides (anilofos @ 0.40, pretilachlor @ 0.75, cinmethyline @ 0.06, butachlor @ 1.0 and thiobencarb @ 1.0 kg/ha), closer spacing (15 cm x 15 cm), weeding with rottary weeder, hand-weeding besides weed-free and weedy checks, was laid out in randomized block design with 4 replications. The herbicides were applied 3 days after planting on a thin film of water in the field. Rottary and hand-weedings were done 25 days after transplanting. Weeds were removed by hand at 15-day intervals up to 60 days after planting to maintain weed-free condition. 'Mahsuri' (140 days duration) rice @ 2–3 seedlings/hill was transplanted during the last week of July maintaining a normal spacing of 25 cm x 20 cm. The crop was fertilized with the recommended dose of 40 kg N, 20 kg P_2O_5 and 20 kg K_2O/ha. Half of N and entire quantity of P_2O_5 and K_2O were applied just before the last puddling, and the remaining N was top-dressed in 2 equal splits, at tillering (20–30 days after plant-

Table 1. Effect of weed-control treatments on yield and economics in lowland rice

Treatment	Dose (kg ai/ha)	Grain yield (q/ha)			Straw yield (q/ha)			Economics (pooled)			
		1990	1991	Pooled	1990	1991	Pooled	Gross return (Rs/ha)	Manpower required (no./ha)	Additional cost of treatment (Rs/ha)	Additional return over weedy check (Rs/ha)
Weedy check		22.4	21.9	22.1	33.0	29.0	31.0	5,924			
Weed-free		34.4	33.5	33.9	51.0	50.0	50.5	9,146	40	1,200	2,022
Hand-weeding	25 days*	24.8	26.4	25.6	38.0	39.4	38.7	6,918	12	380	613
Rottary weeder	25 days*	30.9	30.6	30.8	46.2	45.0	45.6	8,304	4	130	2,250
Closer spacing (15 cm x 15 cm)		29.4	27.7	28.5	39.3	37.1	38.2	7,604	8	340	1,340
Anilfos	0.4	32.7	27.9	30.3	43.1	46.2	44.7	8,168	3	386	1,858
Pretilachlor	0.75	26.8	29.1	28.0	41.3	43.0	42.2	7,564	3	430	1,210
Butachlor	1.0	30.1	31.3	30.7	49.0	47.2	48.1	8,330	3	284	2,122
Thiobencarb	1.0	31.1	25.5	28.3	43.4	45.4	44.4	7,680	3	300	1,456
Cinmethyline	0.06	31.4	30.1	30.7	46.0	47.0	46.5	8,298	3	NA	
CD (P = 0.05)		3.2	5.0	5.6	4.6	5.9	8.5				

*Days after transplanting

Price (Rs/q): rice grain, 240; rice straw, 20; NA, herbicide price not available

ing) and panicle initiation (55–60 days after planting) stages of crop growth. Observations on weeds were recorded at 60 days after transplanting. Weed-count data were subjected to $\sqrt{X+1}$ transformation before statistical analysis. Weed-control efficiency (WCE) and weed index (WI) were computed using the following formulae:

$$\text{WCE (\%)} = \frac{\text{Weed dry weight in weedy plot} - \text{Weed dry wight in treated plot}}{\text{Weed dry weight in weedy plot}} \times 100$$

$$\text{WI (\%)} = \frac{\text{Grain yield of weed-free check} - \text{Grain yield of other treatment}}{\text{Grain yield of weed-free check}} \times 100$$

Additional return (Rs/ha) from a treatment was computed as difference between gross return from a treatment less the sum of gross return from weedy check and additional cost of that treatment.

RESULTS AND DISCUSSION

Weed flora

The weedflora of the experimental field comprised 29% grasses, 50% sedges and 21% broad-leaf weeds. The weed flora in the rice field consisted of grasses, viz. *Panicum austroasiaticum* Ohwi, *Paspallum conjugatum* Bergius and *Echinochloa colona* (L.) Link; sedges, viz. *Cyperus iria* L. and *Scirpus juncoides* Roxb.; and dicot weeds, viz. *Monocoria vaginalis* (Burm. f.) Kirk., *Fissendocarpa linifolia* (Vahl) Bennet., *Hydrolea zeylanica* (L.) Vahl, *Cuphea balsamona* Ch. & Schl., *Rotala indica* (Willd.) Kochne., *Fissendocarpa linifolia* and *Hydrolea zeylenica* were found most dominant in the later stages of crop growth. All the tested herbicides were less effective against the late-germinating dicot weeds.

Effect on weeds

All the weed-management practices significantly reduced the population build-up and dry-matter accumulation by weeds during both the years compared with the weedy check (Table 2). Weed population and biomass (3.3 g/m^2) were negligible in weed-free plots, which accounted for 93.4% weed-control efficiency. The other weed-management practices were at par in reducing weed population and their dry-matter production. However, pooled analysis showed that cinmethyline, butachlor, thiobencarb and closer spacing reached the level of weed-biomass reduction as under weed-free condition, recording 67.9, 61.9, 69.1 and 65.5% weed-control efficiency respectively. The efficacy of butachlor was also reported by Pandey and Sukla (1990). The closely spaced crop effectively smothered the weeds growing under crop canopy by not providing sufficient space for weed growth complemented by restricting sunlight from penetrating down under.

Effect on crop yields

Grain and straw yields were affected due to weed management during both the years (Table 1). Minimum and maximum grain yields were obtained in weedy (22.1 q/ha) and weed-free (33.9 q/ha) plots respectively. Anilfos, cinmethyline, butachlor and closer spacing and rottary weeding being at par resulted in grain yield of 30.3, 30.7, 30.7, 28.5 and 30.8 q/ha respectively, being similar to that under weed-free condition. Straw yields were also higher in these treatments. Increased crop yield with the pre-emergence application of anilfos and butachlor was reported by Budhar *et al.* (1991).

Gogoi (1992) reported efficacy of rottary weeder in controlling weeds and increasing grain yield of transplanted rice. Higher crop yield was obtained by maintaining higher plant population in direct-seeded rice by Raghupathi *et al.* (1992). Thus closer spacing

Table 2. Treatment effects on weed population, dry weight, weed-control efficiency and weed index in lowland rice

Treatment	Dose (kg ai/ha)	Weed population (no./m²)		Weed dry weight (g/m²)			Weed-control efficiency (%)	Weed index (%)
		1990	1991	1990	1991	Pooled		
Weedy check		10.0 (99)	9.1 (81)	48.9	51.3	50.1		34.9
Weed-free		1.0 (0)	3.9 (14)	0	6.5	3.3	93.4	
Hand-weeding	25 days*	5.9 (34)	6.3 (39)	33.4	14.2	23.8	52.5	24.5
Rice rottary weeder	25 days*	5.6 (30)	7.0 (48)	21.5	21.7	21.6	56.9	9.1
Closer spacing (15 cm x 15 cm)		6.2 (37)	6.7 (44)	14.4	20.2	17.3	65.5	15.9
Anilfos	0.4	7.0 (48)	7.3 (53)	29.1	23.4	26.3	47.5	10.6
Pretilachlor	0.75	7.8 (60)	7.0 (47)	17.0	24.7	20.9	58.3	17.4
Butachlor	1.0	6.1 (35)	5.6 (30)	21.6	16.5	19.1	61.9	9.4
Thiobencarb	1.0	7.1 (50)	6.6 (42)	12.8	18.1	15.5	69.1	16.5
Cinmethyline	0.06	5.8 (32)	6.2 (38)	12.7	19.4	16.1	67.9	9.4
CD (P = 0.05)	2.1	1.8	14.9	10.3	17.1			

*Days after transplanting
Figures in parentheses are original values days

(15 cm x 15 cm) in transplanted 'Mahsuri' rice could be the effective, economical, practically feasible and environmentally safe weed-management practice for sustainable crop production. Yield reduction due to weed was 9.4–34.8%.

Economics

Economics of different treatments (Table 2) indicated that rottary weeder used at 25 days after transplanting accrued the highest additional return of Rs (2,250 ha), followed by butachlor 1.0 kg/ha (Rs 2,122 ha). However, highest gross return of (Rs 9,146/ha) was recorded under the weed-free treatment. Application of butachlor, cinmethyline or anilfos alone gave nearly the same gross returns as accrued by using rottary weeder at 25 days. This indicated that pre-emergence application of butachlor, cinmethyline or anilfos is more economical.

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