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Effect of herbicides with or without paddy weeder on weeds in transplanted summer rice (*Oryza sativa*)

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ABSTRACT

A field investigation was carried out during the winter (*rabi*) season of 2003–04 and 2004–05 at Jorhat, with herbicides, viz. butachlor, oxadiargyl, pyrazosulfuron ethyl, pretilachlor, chlorimuron + metsulfuron methyl, fenoxaprop-p-ethyl applied alone or followed by paddy weeder to test their efficiency in controlling weeds in transplanted summer rice. All the weed-control treatments increased the grain yield of rice significantly over unweeded check and decreased the population and dry weight of weeds significantly. Uncontrolled growth of weeds caused 49% reduction in crop yield. Treatment of pretilachlor 0.75 kg/ha (pre-emergence) + paddy weeder, resulted in the highest grain yield, maximum weed-control efficiency (88%) and monetary returns (Rs 8,300/ha). Herbicides alone were inferior to their use with paddy weeder.

Key words : Grain yield, Herbicide, Net returns, Paddy weeder, Summer rice

In recent times the summer rice is gaining much popularity in Assam as a result of the development of shallow tubewell irrigation facilities. Control of diverse weed flora in rice is one of the important aspects for realizing higher productivity as the uncontrolled weed growth can reduce the productivity by 76% (Singh *et al.,* 2004). Hand weeding though efficient is cost-intensive, time-consuming and often limited by scarcity of labourer in time. Use of herbicide offers economic and efficient control of weed from the very beginning, providing the crop better establishment and competitive ability. However, herbicide alone many a times fails to provide control of diverse weed flora emerged in several flushes. Repeated use of herbicide with same mode of action also results in weed shift towards more persistent perennials and build up of herbicide residue in soils and consumable products (Kathiresan, 2001). Integration of mechanical method may provide economic, efficient and sustainable weed management in rice. In view of the above, the present study was proposed.

MATERIALS AND METHODS

A field experiment was conducted during winter (*rabi*) season of 2003–04 and 2004–05 at Research Farm of Assam Agricultural University, Jorhat. The soil was acidic (pH 5.3) with 0.78% organic carbon and had 250, 21.8 and 86 kg/ha N, P and K respectively. Twelve treatments, viz. weedy, paddy weeder (20 and 40 DAT), butachlor 1.0 kg/ha, butachlor 1.0 kg/ha + paddy weeder, oxadiargyl 70 g/ha, oxadiargyl 70 g/ha + paddy weeder, pyrazosulfuron ethyl 25 g/ha, pyrazofulfuron ethyl 25 g/ha + paddy weeder, pretilachlor 0.75 kg/ha, pretilachlor 0.75 kg/ha + paddy weeder, chlorimuron + metsulfuron methyl 4 g/ha + paddy weeder, fenoxaprop–*p*–ethyl 70 g/ha + paddy weeder, were arranged in randomized block design with 3 replications. A recommended dose of 40:8.7:16.7 kg/ha N, P and K was applied uniformly to the crop. Half the recommended dose of nitrogen and full dose of phosphorus and potassium was applied basal and remaining half of the nitrogen was applied in 2 equal splits at maximum tillering and panicle initiation stage. Twenty four days old seedlings of rice variety 'Joymoti' was transplanted on 19 December 2003 and 20 December 2004 with a spacing of 20 cm × 15 cm. The pre-emergence herbicides were applied as per treatment at 3 days after transplanting (DAT) while post-emergence herbicides, viz. fenoxaprop-*p*-ethyl and chloromuron + metsulfuron methyl were applied at 25 DAT using knapsack sprayer fitted with a flat-fan nozzle with 500 litres/ha spray volume. Weed population and dry weight were recorded at 30 and 60 DAT by placing a quadrate of 0.5 m × 0.5 m size randomly at 3 places in a plot. The data were transformed using $\sqrt{x+0.5}$.

RESULTS AND DISCUSSION

The major weed species recorded in the weddy plots during 2003–04 were: *Echinochloa crus-galli* (32%), *Polygonum hidropiper* (17.7%), *Gnaphalium indicum*

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(8.93%), *P. plebejum* (8.8%), *Dichanthium annulatum* (8.0%), *Spilanthes calva* (4.0%), and those during 2004–05, were *Cyperus pilosus* (47.%), *Scirpus maritimus* (15.8%), *C. difformis* (10.5%), *Eleocharis dulcis* (10.5%), *Echinochloa crus-galli* (5.26%), *S. juncoides* (5.0%), *Sacciolepsis interrupta* (5.2%) were the dominant weeds.

Butachlor 1 kg/ha, oxadiargyl 70 g/ha, pyrazosulfuron ethyl 25 g/ha and pretilachlor 0.75 kg/ha followed by paddy weeder significantly reduced the population of *Echinochloa crus-galli,* whereas chlorimuron +

Table 1. Effect of weed-control treatments on weed density and dry-matter accumulation

Treatment	Weed density (no./m²)				Weed dry weight (g/m²)				Weed-control efficiency (%)	
	2003–04		2004–05		2003–04		2004–05			
	30 DAT	60 DAT	30 DAT	60 DAT	30 DAT	60 DAT	30 DAT	60 DAT	2003–04	2004–05
Weedy plot	7.9 (62.0)	9.4 (88.2)	6.7 (44.0)	7.0 (48.0)	4.4 (19.2)	6.0 (36.0)	2.8 (7.3)	4.1 (16.3)		
Paddy weeder (PW)	4.5 (20.2)	3.9 (15.0)	0.7 (0.0)	3.4 (11.0)	3.2 (9.9)	4.3 (18.1)	0.7 (0.0)	1.7 (2.4)	49.7	85.3
Butachlor 1 kg/ha	6.3 (39.2)	6.4 (40.5)	0.7 (0.0)	4.3 (18.0)	3.5 (12.1)	5.0 (25.0)	0.7 (0.0)	1.3 (1.2)	30.6	92.6
Butachlor 1 kg/ha + PW	5.8 (33.2)	4.4 (19.1)	1.0 (3.0)	2.1 (4.0)	3.5 (12.1)	4.7 (22.0)	1.0 (0.5)	1.3 (1.2)	38.8	92.6
Oxadiargyl 70 g/ha	5.2 (27.0)	6.1 (37.0)	2.1 (4.0)	2.3 (5.0)	4.2 (17.2)	5.6 (31.4)	1.1 (0.7)	1.0 (0.5)	12.7	96.9
Oxadiargyl 70 g/ha + PW	4.7 (22.0)	3.5 (12.1)	0.7 (0.0)	1.9 (3.0)	4.2 (17.2)	5.4 (29.2)	0.7 (0.0)	1.0 (0.5)	18.8	96.9
Pyrazosulfuron ethyl 25 g/ha	5.8 (33.0)	5.9 (34.5)	6.2 (38.0)	5.7 (32.0)	3.7 (13.2)	4.6 (21.1)	1.3 (1.2)	1.1 (0.7)	41.4	95.7
Pyrazosulfuron ethyl 25 g/ha + PW	6.6 (43.2)	3.6 (12.2)	0.7 (0.0)	1.2 (2.0)	3.6 (12.8)	3.8 (14.2)	0.7 (0.0)	0.7 (0.0)	60.6	100
Pretilachlor 0.75 kg/ha	7.2 (51.2)	6.4 (40.2)	0.7 (0.0)	2.1 (4.0)	3.8 (14.4)	3.1 (9.2)	1.0 (0.5)	0.8 (0.1)	74.4	99.4
Pretilachlor 0.75 kg/ha + PW	6.6 (43.1)	3.5 (12.1)	2.0 (8.0)	3.0 (9.1)	3.5 (12.3)	2.9 (8.0)	0.7 (0.0)	0.9 (0.3)	77.8	98.2
Chlorimuron + metsulfuron methyl 4 g/ha PW	6.3 (39.4)	7.9 (62.1)	7.1 (50.0)	2.9 (8.0)	4.8 (21.9)	5.3 (28.0)	1.2 (0.9)	1.0 (0.5)	22.2	96.9
Fenoxaprop-*p*-ethyl 70 g/ha + PW	6.9 (47.2)	4.7 (22.0)	2.3 (5.0)	4.0 (16.2)	4.2 (17.5)	3.9 (15.0)	1.0 (0.5)	1.1 (0.7)	58.3	95.7
CD (P=0.05)	0.9	0.8	2.3	1.2	0.6	1.7	0.1	1.0		

Figures in parentheses are actual data

Table 2. Effect of weed-control treatment on species-wise weed density (no./m²) at 60 DAT (2003-04)

Treatment	*E. crus-galli*	*P. hydropiper*	*G.. indicum*	*P. plebium*	*I. himalaica*	Others
Weedy plot	24	13	6	6	6	25
Paddy weeder (PW)	10	2	1	0	0	1
Butachlor 1 kg/ha	18	15	0	4	0	0
Butachlor 1 kg/ha + PW	6	0	0	3	9	2
Oxadiargyl 70 g/ha	20	3	4	0	0	4
Oxadiargyl 70 g/ha + PW	5	0	0	0	0	4
Pyrazosulfuron ethyl 25 g/ha	14	0	0	0	2	17
Pyrazosulfuron ethyl 25 g/ha + PW	4	0	0	0	4	3
Pretilachlor 0.75 kg/ha	12	16	0	0	0	11
Pretilachlor 0.75 kg/ha + PW	8	0	0	9	0	2
Chlorimuron + metsulfuron methyl 4 g/ha + PW	34	2	13	1	2	0
Fenoxaprop-*p*-ethyl 70 g/ha + PW	18	2	0		0	0

Table 3. Effect of weed-control treatment on species-wise weed density (no./m²) at 60 DAT (2004-05)

Treatment	*C. pilosus*	*S. meritimus*	*C. difformis*	*E. dulcis*	*E. crus-galli*	*S. juncoides*	Others
Weedy	23	8	6	5	2	2	3
Paddy weeder (PW)	6	0	5	3	2	3	2
Butachlor 1 kg/ha	4	6	1	0	0	0	0
Butachlor 1 kg/ha + PW	0	4	0	0	2	6	0
Oxadiargyl 70 g/ha	0	0	0	0	0	0	0
Oxadiargyl 70 g/ha + PW	0	0	0	5	0	0	0
Pyrazosulfuron ethyl 25 g/ha	12	10	0	0	3	0	0
Pyrazosulfuron ethyl 25 g/ha + PW	2	0	0	0	10	0	0
Pretilachlor 0.75 kg/ha	0	0	4	0	0	0	0
Pretilachlor 0.75 kg/ha + PW	2	0	5	0	0	0	5
Chlorimuron + metsulfuron methyl 4 g/ha + PW	8	0	0	0	0	0	0
Fenoxaprop-*p*-ethyl 70 g/ha + PW	14	0	2	0	0	0	0

metsulfuron methyl 4 g/ha followed by paddy weeder failed to control *E. crus-galli* which was the major grassy weed during the first year of experimentation. This might be due to the fact that chlorimuron + metsulfuron methyl is effective against broad-leaf weeds only. *P. hydropiper*, a relatively late-emerged weed, was effectively controlled by paddy weeder. Chlorimuron + metsulfuron methyl 4 g/ha + paddy weeder and pyrazasulfuron ethyl 25 g/ha applied alone or with paddy weeder also effectively controlled *P. hydropiper* (Table 2). During the second year, the sedges were the major weed species (Table 3). This might be due to variation in the weed seed bank in the plough sole layer and prevalence of alternate wetting and drying conditions during the initial growth period. butachlor 1 kg/ha, oxadiargyl 70 g/ha, and pretilachlor 0.75 kg/ha effectively controlled the sedges particularly *C. pilosus*, while fenoxaprop-*p*-ethyl 70 g/ha and pyrazosulfuron ethyl 25 g/ha and chlorimuron + metsulfuron methyl 4 g/ha failed to provide effective control of *C. pilosus*.

Effect on weeds

All the weed-control practices significantly reduced the weed population and dry weight of weeds over unweeded control. Pretilachlor 0.75 kg/ha followed by paddy weeder showed consistently the lowest weed population and dry weight during both the years of study and was at par with the treatments receiving butachlor 1.0 kg/ha, pyrazosulfuron ethyl 25 g/ha and oxadiargyl 70 g/ha along with paddy weeder. The reduction in weed population and dry weight with the use of paddy weeder at 20 and 40 DAT was comparable to the integrated use of herbicide and paddy weeder. Though significant and satisfactory reduction in weed density and dry-matter accumulation was achieved with the use of herbicides, the extent of reduction was substantially higher with integrated use of herbicides and paddy weeder. This might be due to effective control of late-emerged weeds with the use of paddy weeder. The highest weed-control efficiency (88%) was obtained from the treatment receiving pretilachlor 0.75 kg/ha with paddy weeder at 40 DAT.

Effect on crop

Weed-control treatments significantly improved the yield attributes in rice over unweeded control. The increase in panicle number, panicle length and grains/panicle due to weed-control treatments might be due to decreased weed–crop competition during the critical crop-growth stages and thereby providing better crop-growing environment and nutrition to the crop. Our results corroborate the findings of Gopinath and Pandey (2004). The losses in grain yield due to unchecked weed growth were 45 and 49% during 2003–04 and 2004–05 respectively. All the weed-control practices significantly increased the grain yield of rice compared to weedy check. Pretilachlor 0.75 kg/ha + paddy weeder was at par and gave consistently higher grain yield of rice over rest of the weed control treatments. Fenoxaprop-*p*-ethyl 70 g/ha + paddy weeder and pyrazosulfuron ethyl 25 g/ha, though recorded similar yield and was at par with the above 2 treatments during the first year, could not show similar results during the second year. This might be due to poor efficacy of these herbicides against the sedges. Timely and effective control of weeds with integrated use of herbicide and paddy weeder might have resulted in increased growth and yield components which ultimately reflected in increased grain yield. Similar observations were also reported by Ram *et al.* (2004) and Mukherjee *et al.* (2005). The maximum monetary returns (Rs 8,300) were also obtained from the treatment that received pretilachlor 0.75 kg/ha with paddy weeder, followed by butachlor 1.0 kg/ha with paddy weeder (Rs 7,800).

Table 4. Effect of weed-control treatment on yield and yield components in rice

Treatment	Panicles/ m^2		Panicle length (cm)		Grains/ panicle		Grain yield (t/ha)		Straw yield (t/ha)		Cost due to treatments (Rs/ha)	Net returns (Rs/ha)
	2003-04	2004–05	2003-04	2004–05	2003-04	2004–05	2003-04	2004–05	2003-04	2004–05		
Weedy plot	321	246	16.4	18.6	135	139	1.58	1.33	4.72	3.73		
Paddy weeder (PW)	321	267	17.9	19.4	136	174	1.96	2.45	3.84	3.35	2,100	4,500
Butachlor 1 kg/ha	378	264	16.9	19.3	175	184	2.10	2.03	3.12	2.56	640	3,720
Butachlor 1 kg/ha + PW	354	297	17.3	17.4	167	159	2.68	2.82	3.16	3.22	1690	7,800
Oxadiargyl 70 g/ha	348	306	18.7	19.9	175	176	2.39	1.68	2.96	3.48	2390	3,600
Oxadiargyl 70 g/ha + PW	318	318	19.9	19.3	181	182	1.97	2.21	3.82	3.23	3440	3,840
Pyrazosulfuron ethyl 25 g/ha	402	237	18.8	19.9	177	173	2.15	1.76	3.26	3.57	800	3,060
Pyrazosulfuron ethyl 25 g/ha + PW	453	300	17.4	19.6	201	206	2.67	2.37	3.17	4.20	1,850	6,420
Pretilachlor 0.75 kg/ha	408	351	16.5	20.1	178	181	2.23	1.79	3.96	3.48	1590	3,900
Pretilachlor 0.75 kg/ha + PW	327	354	17.9	20.3	188	169	2.83	2.96	3.55	2.83	2390	8,300
Almix 4 kg/ha + PW	402	237	18.9	18.9	171	176	2.48	1.79	2.93	2.65	610	4,140
Fenoxaprop-*p*-ethyl 70 g/ha + PW	327	237	18.3	18.1	170	166	2.88	2.05	3.89	2.82	1660	6,120
CD (P=0.05)	66	69	1.3	NS	28	31	0.33	0.31	0.30	0.27		

It was concluded that pre-emergence application of either pretilachlor 0.75 kg/ha or butachlor 1.0 kg/ha followed by the use of paddy weeder provides effective and profitable control of broad spectrum weeds in transplanted summer rice.

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