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Efficacy of new herbicides to manage weeds in transplanted rice

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Abstract

Oxadiargyl 70, 100 and 130 g ha^{-1} (5 days after transplanting, DAT), ready mix formulation of arozin + ethoxysulfuron 1.25 and 1.50 kg ha^{-1} (10 DAT), acetachlor 150 g ha^{-1} (5 and 10 DAT), anilophos 0.6 kg ha^{-1} (10 DAT), butachlor 1.5 kg ha^{-1} (5 DAT) alone or fb 2, 4-DEE 1.0 kg ha^{-1} (30 DAT), hand weeding twice and weedy check were evaluated for weed control in transplanted rice. All treatments were effective in reducing the population of *Echinochloa colona* and *Panicum dichotomiflorum*; acetachlor at 150 g ha^{-1} 5 and 10 DAT was most effective against *E. colona*. Butachlor 1.50 kg ha^{-1} and arozin + ethoxysulfuron 1.25 kg ha^{-1} 10 DAT effectively managed *Commelina cummunis*. Acetachlor 150 g ha^{-1} 10 DAT and anilophos gave more than 85 per cent reduction in dry matter accumulation by weeds. Butachlor + 2,4-DEE, anilophos and butachlor increased rice yield by 143.5, 143.0 and 134.9 per cent, respectively. Weed management index, agronomic management index and integrated weed management index were highest for arozin + ethoxysulfuron 1.25 kg ha^{-1} followed by butachlor, butachlor + 2,4-DEE, oxadiargyl 100 g ha^{-1} and hand weeding twice. Rice yield was negatively associated with weed biomass. With every g/m^2 increase in weed dry weight, the yield was expected to decrease by 8.34 kg ha^{-1}.

Key words: Alternative herbicides, weeds, yield, transplanted rice.

Introduction

Weed competition is one amongst various factors in reducing yield in transplanted rice. Uncontrolled weeds cause reduction to the extent of 35-55 per cent in grain yield under transplanting system of paddy (Gautam and Mishra, 1995). Therefore, timely and effective weed management is imperative for realizing desired level of productivity. The continuous use of herbicides with similar mode of action has to be restricted to avoid undesirable weed shifts as well as development of resistance. The present investigation was undertaken to find out the effect of doses and times of application of alternative herbicides to control weeds in transplanted rice.

Material and Methods

A field experiment was conducted during the Kharif seasons of 2001 and 2002 on the experimental farm of Department of Agronomy, CSK HPKV, Palampur. The area represents the mid hill wet temeprate Zone of Himachal Pradesh. The soil of the experimental field was silty clay loam in texture with pH 5.7 and it was medium in available nitrogen (312.6 kg ha^{-1}) and phosphorus (17.6 kg ha^{-1}) and high in available potassium (298.5 kg ha^{-1}). Twelve treatments [oxadiargyl 70, 100 and 130 g ha^{-1} (5 DAT), arozin + ethoxysulfuron 1.25 and 1.50 kg ha^{-1} (10 DAT), acetachlor 150 g (5 DAT), 150 g ha^{-1} (10 DAT), anilophos 0.6 kg ha^{-1} (10 DAT), butachlor 1.5 kg ha^{-1} (5 DAT) alone and fb 2, 4-DEE 1.0 kg ha^{-1} (30 DAT), hand weeding twice and weedy check] were evaluated in randomized block design with three replications. The herbicides were applied with knapsack sprayer fitted with flat fan nozzle at spray volume of 700 litres/ha. Thirty days old seedlings of rice variety 'RP-2421' were transplanted on 12 July 2001 and 10 July 2002. Except weed control, the crop was raised in accordance with the recommended package of practices. The data on species wise and total weed dry weight were recorded at harvest using quadrate of 50 cm x 50 cm from two locations and expressed as number and g m^{-2}. The data on weed count and dry matter were transformed to square root ($\sqrt{x+1.0}$) transformation. Yields were recorded from net plot which was 9.6 m^2. Weed control efficiency (WCE), Treatment efficiency index (TEI) and weed management index (WMI) were estimated as per Walia (2003) as,

$$WCE = \frac{DMC - DMT}{DMC} \times 100$$

Where,

DMC= Dry matter of weeds in unweeded treatment

DMT= Dry matter of weeds in a treatment

$$TEI = \frac{\frac{(YT - YC)}{YC} \times 100}{\frac{DMT}{DMC} \times 100}$$

Where,

YT = Yield from treatment

YC = Yield from unweeded check

$$WMI = \frac{\text{\% yield over unweeded check}}{\text{\% control of weeds}}$$

Results and discussion

Panicum dichotomiflorum was the most predominant weed constituting 53.0% of the total weed population during 2001. This was followed by *Echinochloa colona* (39.3%). The other weeds were *Cyperus iria* (3.5%), *Ammania baccifera* (3.5%) and *Commelina communis* (0.6%). In 2002, *E. colona* was the dominant weed with 48.2% population. It was followed by *C. communis* (18.4%), *P. dichotomiflorum* (14.3%), *C. iria* (12.5%) and *Digitaria sanguinalis* (6.5%). *Aeschynomene indica* was the other notable weed in the experimental field.

All weed control treatments were significantly superior to weedy check in curtailing the population of *E. colona* and *P. dichotomiflorum* (Table 1).

Table 1. Effect of treatments on weed count, weed dry matter accumulation and weed control efficiency in transplanted rice

Treatments	Dose (g ha^{-1})	Time (DAT)	*Echinochloa*		*Panicum*		*Commelina*		Weed dry matter			WCE (%)
			2001	2002	2001	2002	2001	2002	2001	2002	Mean	
Oxadiargyl	70	5	3.7 (17.3)	6.4 (50.6)	1.0 (0.0)	1.6 (2.6)	1.0 (0.0)	4.3 (20.0)	5.3 (27.4)	13.7 (189.3)	10.4 (108.4)	44.0
Oxadiargyl	100	5	2.3 (8.0)	7.7 (69.3)	1.0 (0.0)	2.5 (6.6)	1.4 (1.3)	3.3 (13.3)	4.2 (16.4)	13.6 (188.2)	10.1 (102.3)	54.3
Oxadiargyl	130	5	3.4 (14.6)	6.1 (45.3)	1.0 (0.0)	2.4 (9.3)	2.0 (5.3)	4.8 (28.0)	4.2 (16.4)	10.3 (108.5)	7.9 (62.5)	67.3
Arozin + Ethoxysulfuron	1250	10	3.8 (14.6)	9.0 (85.3)	2.3 (8.0)	2.5 (10.6)	1.0 (0.0)	1.4 (1.3)	5.9 (34.0)	12.4 (156.8)	9.8 (95.4)	43.3
Arozin + Ethoxysulfuron	1500	10	3.0 (18.6)	8.6 (74.6)	3.8 (18.6)	2.5 (10.6)	1.4 (1.3)	4.4 (20.0)	4.4 (18.3)	10.4 (110.4)	7.9 (64.4)	65.2
Anilophos	600	10	3.2 (12.0)	6.3 (58.6)	1.0 (0.0)	1.4 (1.3)	1.6 (2.6)	3.0 (8.0)	3.2 (9.3)	6.0 (34.5)	4.8 (21.9)	85.9
Butachlor fb 2,4-DEE	1500 fb 1000	5 fb 30	2.1 (6.6)	7.8 (64.0)	1.0 (0.0)	2.2 (5.3)	1.0 (0.0)	2.5 (6.6)	3.5 (11.2)	11.3 (130.0)	8.5 (70.6)	68.5
Acetachlor	150	5	1.4 (1.3)	5.7 (45.3)	2.4 (6.6)	2.2 (5.3)	1.0 (0.0)	4.0 (22.6)	3.5 (11.2)	10.5 (110.9)	7.9 (61.1)	71.6
Acetachlor	150	10	2.3 (5.3)	5.4 (25.3)	2.8 (13.3)	1.4 (1.3)	1.4 (1.3)	6.7 (46.6)	2.2 (4.0)	8.3 (68.1)	6.1 (36.1)	85.2
Butachlor	1500	5	1.8 (4.0)	8.6 (80.0)	1.0 (0.0)	3.3 (12.6)	1.6 (2.6)	1.4 (1.3)	4.2 (16.9)	12.8 (163.7)	9.6 (90.3)	57.8
Hand weeding		30 and 60 DAT	1.4 (1.3)	7.3 (53.3)	2.1 (6.6)	2.4 (9.3)	1.0 (0.0)	1.8 (4.0)	3.7 (11.2)	11.8 (143.7)	8.9 (77.5)	66.3
Weedy check			6.3 (40.0)	10.4 (108.0)	6.3 (54.0)	5.7 (32.0)	1.2 (0.6)	6.5 (41.3)	7.4 (54.7)	17.4 (306.1)	13.5 (180.4)	-
LSD (P=0.05)			1.8	1.4	1.8	2.1	NS	1.9	1.0	2.5	1.8	

DAT-days after transplanting; fb - followed by; Figures in the parentheses are the means of original values

Acetachlor 150 g ha^{-1} applied at 5 and 10 DAT was quite effective in reducing the count of *E. colona*. However, hand weeding twice, butachlor 1.50 kg ha^{-1} alone, butachlor 1.50 kg ha^{-1} + 2,4-DEE 1.0 kg ha^{-1}, arozin + ethoxysulfuron 1.50 kg ha^{-1} and oxadiargyl 130 g ha^{-1} in 2001 and anilophos and oxadiargyl 70 and 130 g ha^{-1} 5 DAT in 2002 were equally good for *E. colona*. Effectiveness of acetachlor, butachlor, anilophos and arozin + ethoxysulfuron in controlling *E. colona* in rice has been reported (Narwal *et al.*, 2002; Singh *et al.*, 2004;

Munegowda *et al.*, 1990). All herbicides were as good as hand weeding twice in decreasing the count of *P. dichotomiflorum*. Butachlor 1.50 kg ha^{-1} and arozin + ethoxysulfuron 1.25 kg ha^{-1} effectively controlled *C. cummunis* in 2002. Hand weeding, anilophos 0.6 kg ha^{-1} and butachlor 1.50 kg ha^{-1} + 2,4-DEE 1.0 kg ha^{-1} were equally effective in reducing the count of *C. cummunis*. Acetachlor 150 g ha^{-1} (10 DAT) and anilophos 600 g ha^{-1} 10 DAT resulted in significantly lower mean dry matter accumulation by weeds having WCE 85.2 and 85.9 per cent, respectively. Effective reduction in weed dry matter accumulation owing to acetachlor (Sharma and Upadhyay, 2002) and anilophos (Kumar and Basavaraj, 1996) has been documented. These were followed by butachlor 1.50 kg ha^{-1} + 2,4-DEE 1.0 kg ha^{-1} (68.5%), oxadiargyl 130 g ha^{-1} (67.3%), hand weeding twice (66.3%) and arozin + ethoxysulfuron (65.2%).

The significant reduction in species-wise count of grasses and broadleaved weeds and weed dry matter accumulation was reflected in paddy grain yield (Table 2). All weed control treatments were significantly superior to weedy check in increasing rice yield. The herbicidal treatments were as good as hand weeding twice in terms of grain yield. The equal effectiveness of herbicides and hand weeding twice has been amply documented (Kumar and Basavaraj, 1996; Tripathy and Misra, 2000; Mukerjee and Singh, 2005). However, butachlor 1.50 kg ha^{-1} + 2,4-DEE 1.0 kg ha^{-1}, anilophos 600 g ha^{-1} and butachlor 1.50 kg ha^{-1} were superior to oxadiargyl 70 and 130 g ha^{-1} (5 DAT). Butachlor 1.50 kg ha^{-1} + 2,4-DEE 1.0 kg ha^{-1}, anilophos 600 g ha^{-1} and butachlor 1.50 kg ha^{-1} increased paddy grain yield by 143.5, 143.0 and 134.9%, respectively over weedy check.

Table 2. Effect of treatments on grain yield and different indices in transplanted rice

Treatments	Doses (g ha^{-1})	Time (DAT)	Grain yield (kg ha^{-1})			Treatment efficiency index	Weed management index
			2001	2002	Mean		
Oxadiargyl	70	5	1586	2296	1941	1.3	1.82
Oxadiargyl	100	5	1846	2607	2227	2.4	2.17
Oxadiargyl	130	5	1660	2495	2078	2.7	1.33
Arozin + Ethoxysulfuron	1250	10	2021	2945	2483	2.3	2.87
Arozin + Ethoxysulfuron	1500	10	1994	2859	2427	3.4	1.85
Anilophos	600	10	2244	3067	2656	10.7	1.64
Butachlor fb 2,4-DEE	1500 fb 1000	5 fb 30	2160	3162	2661	4.8	2.18
Acetachlor	150	5	1838	2709	2274	3.8	1.54
Acetachlor	150	10	1865	2789	2327	8.9	1.34
Butachlor	1500	5	2118	3015	2567	3.2	2.47
Hand weeding twice		30 and 60	1994	2945	2470	4.0	2.03
Weedy check			1008	1178	1093	-	-
LSD (P=0.05)			417.7	639.0	528		

DAT-days after transplanting; fb - followed by

Transplanted rice yield was negatively correlated with weed biomass (r= -0.745**, -0.773** and -0.785** for 2005, 2006 and mean, respectively; ** denotes significance at 1% level of significance) showing high degree of association as affected due to the presence of weeds. Since weed dry weight (X) was linearly correlated at the significant level of 1%, with the yield (Y), the relationship was given by linear equation (Y = A + BX, A being intercept and B regression coefficient) as below,

$$Y = 2942.1 - 8.344\ X \quad (R^2 = 0.616)$$

The equation explains that 61.6% variation in yield due to weed control could be explained by the regression equation. The further analysis of the regression equation indicated that with every gm^{-2} increase in dry weed weight, the yield was expected to decrease by 8.344 kg ha^{-1}.

The highest treatment efficiency index (TEI) was recorded in anilophos 600 g ha^{-1} (10.7) followed by acetachlor 150 g ha^{-1} 10 DAT (8.9), butachlor 1.50 kg ha^{-1} + 2,4-DEE 1.0 kg ha^{-1} (4.8) and hand weeding twice as compared to other treatments. Weed management index (WMI) was highest for arozin + ethoxysulfuron 1250 g ha^{-1}. This was followed by butachlor 1.50 kg ha^{-1}, butachlor 1.50 kg ha^{-1} + 2,4-DEE 1.0 kg ha^{-1}, oxadiargyl 100 g ha^{-1} and hand weeding twice.

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