

Efficacy of cyhalofop-butyl alone and in combination with 2,4-D against mixed weed flora in direct-seeded upland rice (*Oryza sativa*)

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ABSTRACT

A field experiment was conducted during the rainy seasons of 1998 and 1999 at Agronomy Research Farm of the CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur, to find out the best combination of cyhalofop-butyl and 2,4-D in controlling mixed weed flora in direct-seeded upland rice (*Oryza sativa* L.). Cyhalofop-butyl 90 and 120 g/ha when tank mixed with 2,4-D 1.0 kg/ha lost its herbicidal property completely and did not control any of the grass weeds. However, 2, 4-D in mixture controlled broad-leaf weeds completely. When these herbicides were applied in sequence both grass and broad-leaf weeds were controlled effectively. Cyhalofop-butyl 120 g/ha (15 DAS) followed by 2, 4-D 1.0 kg/ha (20 DAS) and 2, 4-D 1.0 kg/ha (15 DAS) followed by cyhalofop-butyl 120 g/ha (20 DAS) being at par with each other and also with hand-weeding twice resulted in significantly lower weed dry weight and hence higher yield attributes and yield of rice over all other treatments.

Key words: Cyhalofop-butyl, 2, 4-D, Herbicide, Mixed weed flora, Upland rice

Direct-seeded upland rice suffers more from weed problem and consequently yield reduction compared to transplanted rice. Pandey and Shukla (1990) reported yield reduction to the extent of 30–35% due to weeds in direct-seeded rice. Most of the rice herbicides presently used are used at pre-emergence stage. Cyhalofop-butyl is relatively a new post-emergence herbicide that controls grassy weeds most effectively but not the broad-leaf weeds (Saini *et al.*, 2001). Tank mixture or sequential application of cyhalofop-butyl and 2, 4-D against mixed weed flora is to be evaluated in direct-seeded upland rice for successful cultivation. Keeping these points in view, the present study was carried out.

MATERIALS AND METHODS

A field experiment was conducted during the rainy (*kharif*) seasons of 1998 and 1999 at Agronomy Research Farm of the Chaudhary Sarwan Kumar Krishi Vishvavidyalaya, Palampur, Himachal Pradesh. The area represents the mid-hill sub-humid zone of Himachal Pradesh. The soil of the experimental site was silty clay loam in texture, acidic in reaction (pH 5.7), medium in organic carbon (0.8%), available nitrogen (375 kg/ha) and available phosphorus (16.5 kg/ha) and high in available potassium (260 kg/ha). The experiment was laid out in randomized block design with 3 replications. There were 11 treatments comprising 2 levels of cyhalofop-butyl (90 and 120 g/ha) applied alone at 15 days after sowing and in

combination with 2, 4-D 1.0 kg/ha, in mixtures and in sequence at 15 and 20 days after sowing, hand-weeding and unweeded control. 'HPU 2216' rice was sown in the second week of June during both years following all recommended package of practices.

RESULTS AND DISCUSSION

Effect on weeds

The major weed flora of the experimental field included *Echinochloa colonum* L. and *E. crus-galli* Beauv., *Digitaria sanguinalis* Scop. and *Setaria glauca* Beauv. among grasses and *Commelina benghalensis* L. and *Polygonum* sp. among broad-leaf weeds. The grass and broad-leaf weeds constituted 61.9 and 38.1% of total weed flora respectively.

All weed-control treatments significantly reduced the dry weight of grass and broad-leaf weeds and hence total weed dry weight as compared to unweeded control except cyhalofop-butyl 90 and 120 g/ha when applied alone which were at par with unweeded control because these herbicides control only grass weeds and did not have any effect on broad-leaf weeds (Table 1). These results are similar to those of Saini *et al.* (2001) who reported that cyhalofop-butyl is an effective herbicide against grass weeds but has no effect on broad-leaf weeds. Cyhalofop-butyl 120 g/ha (15 days) followed by 2, 4-D 1.0 kg/ha (20 days), 2, 4-D 1.0 kg/ha (15 days) followed by cyhalofop-butyl 120 g/ha (20 days), cyhalofop-butyl 120 g/ha (15

Table 1. Effect of treatments on weed dry weight and weed-control efficiency

Treatment Weed-control	Weed dry weight (g/m ²)				Total weed dry			
					weight (g/m ²)			
	1998		1999		1998	1999	1998	1999
	Grass	Broad leaf	Grass	Broad leaf				
Cyhalofop-butyl 90 g/ha (15 DAS)	8.7 (74.4)	7.3 (52.2)	7.9 (61.1)	6.1 (38.4)	11.3 (126.6)	10.0 (99.5)	30.2	43.7
Cyhalofop-butyl 120 g/ha 15 DAS)	5.1 (25.7)	9.3 (86.5)	5.8 (33.2)	7.1 (49.8)	10.6 (112.2)	9.2 (83.0)	36.8	52.9
2, 4-D, 1.0 kg/ha (15 DAS)	11.1 (122.4)	1.0 (0.0)	11.5 (130.5)	1.0 (0.0)	11.1 (122.4)	11.5 (130.5)	31.5	26.1
Cyhalofop-butyl 90 g + 2,4-D, 1.0 kg/ha (15 DAS)	10.8 (116.7)	1.0 (0.0)	11.2 (124.6)	1.0 (0.0)	10.8 (116.7)	11.2 (124.6)	35.4	30.1
Cyhalofop-butyl 10 g + 2,4-D, 1.0 kg/ha (15 DAS)	11.0 (120.0)	1.0 (0.0)	11.7 (135.4)	1.0 (0.0)	11.0 (120.0)	11.7 (135.4)	33.3	24.2
Cyhalofop-butyl 90 g/ha followed by 2,4-D, 1.0 kg/ha (20 DAS)	9.1 (81.7)	1.0 (0.0)	8.7 (74.4)	1.0 (0.0)	9.1 (81.7)	8.8 (74.4)	54.5	57.9
Cyhalofop-butyl 120 g/ha (15 DAS) followed by 2,4-D, 1.0 kg/ha (20 DAS)	5.6 (30.4)	1.0 (0.0)	5.5 (28.5)	1.0 (0.0)	5.5 (30.4)	5.4 (28.5)	82.8	83.6
2,4-D, 1.0 kg/ha (15 DAS) followed by Cyhalofop-butyl 90 g/ha (20 DAS)	8.9 (78.4)	1.0 (0.0)	9.1 (35.4)	1.0 (0.0)	8.9 (23.4)	9.1 (35.5)	56.3	53.8
2,4-D, 1.0 kg/ha (15 DAS) followed by Cyhalofop-butyl 120 g/ha (20 DAS)	4.9 (23.4)	1.0 (0.0)	6.0 (35.4)	1.0 (0.0)	4.9 (23.4)	6.0 (35.5)	87.0	80.1
Hand-weeding (15, 40 DAS)	4.8 (22.5)	3.7 (12.4)	4.1 (15.6)	3.4 (10.4)	6.0 (34.9)	5.2 (26.0)	80.5	85.1
Unweeded control	10.6 (110.6)	8.3 (68.7)	11.3 (127.4)	7.1 (48.8)	13.5 (179.7)	13.3 (176.2)		
CD (P=0.05)	1.1	1.3	0.9	1.2	1.6	1.4		

DAS, Days after sowing; X+1 transformation used; figures in parentheses are the means of original values

Table 2. Effect of treatments on yield attributes and yield of rice

Treatment	Panicles/ m ²		Panicle length (cm)		Grains/panicle (No.)		1,000-grain weight (g)		Grain yield (q/ha)	
	1998	1999	1998	1999	1998	1999	1998	1999	1998	1999
Cyhalofop-butyl 90 g/ha (15 DAS)	249	232	16.6	14.8	62.8	66.4	17.0	18.1	20.2	18.7
Cyhalofop-butyl 120 g/ha (15 DAS)	272	268	17.1	15.6	65.5	70.0	19.6	17.8	25.8	22.5
2, 4-D, 1.0 kg/ha (15 DAS)	239	256	15.6	15.4	63.6	67.4	17.3	16.6	18.6	19.8
Cyhalofop-butyl 90 g + 2,4-D, 1.0 kg/ha (15 DAS)	248	269	16.1	15.8	62.3	64.2	16.8	17.3	19.5	21.4
Cyhalofop-butyl 10 g + 2,4-D, 1.0 kg/ha (15 DAS)	253	265	15.2	14.6	65.6	71.1	18.6	19.0	20.1	19.8
Cyhalofop-butyl 90 g/ha followed by 2,4-D, 1.0 kg/ha (20 DAS)	261	274	17.6	18.2	72.7	75.2	18.5	20.0	21.5	22.4
Cyhalofop-butyl 120 g/ha (15 DAS) followed by 2,4-D, 1.0 kg/ha (20 DAS)	316	328	20.8	21.7	85.6	82.3	23.2	23.7	28.5	29.1
2,4-D, 1.0 kg/ha (15 DAS) followed by Cyhalofop-butyl 90 g/ha (20 DAS)	256	271	18.4	17.5	69.5	80.2	20.4	21.2	20.7	23.1
2,4-D, 1.0 kg/ha (15 DAS) followed by Cyhalofop-butyl 120 g/ha (20 DAS)	311	312	21.1	19.8	88.8	86.5	22.5	23.2	29.1	28.0
Hand-weeding (15, 40 DAS)	304	313	19.4	20.9	89.3	85.2	22.7	2.4	27.8	28.4
Unweeded control	226	207	14.3	13.2	58.6	64.2	16.5	17.6	1.5	16.8
CD (P=0.05)	12.8	8.4	1.8	1.1	4.3	5.2	1.8	1.5	1.6	2.8

DAS, Days after sowing

days) and hand-weeding being at par with each other resulted in significantly lower dry weight of grass weeds over other treatments during both the years of experimentation. Cyhalofop-butyl 90 and 120 g/ha when applied as tank mixed with 2,4-D did not control the grass weeds effectively because cyhalofop-butyl in mixture with 2,4-D lost its herbicidal property completely. However, 2, 4-D 1.0 kg/ha both in mixture and when applied in sequence completely killed the broad-leaf weeds and resulted in almost nil dry-matter accumulation of broad leaf weeds.

Cyhalofop-butyl 120 g/ha (15 days) followed by 2,4-D 1.0 kg/ha (20 days) and 2,4-D 1.0 kg/ha (15 days) followed by cyhalofop-butyl 120 g/ha (20 days), being at par with one another and also with hand-weeding twice produced significantly lower total weed dry weight and higher weed-control efficiency compared to other treatments. However, cyhalofop-butyl applied in mixture with 2,4-D resulted in significantly higher total weed dry weight and lower weeds control efficiency because cyhalofop-butyl in mixture did not control the grass weeds. Cyhalofop-butyl 90 g/ha (15 days) followed by 2,4-D 1.0 kg/ha (20 days) and 2,4-D 1.0 kg (15 days) followed by cyhalofop-butyl 90 g/ha (20 days) were the next best treatments in recording lower total weed dry weight.

Effect on crop

All weed-control treatments produced significantly higher values of most all the yield attributes and hence higher rice yield over unweeded control (Table 2). Cyhalofop butyl 120 g/ha (15 days) followed by 2,4-D 1.0

kg/ha (20 days), 2,4-D 1.0 kg/ha (15 days) followed by cyhalofop-butyl 120 g/ha (20 days) and hand-weeding twice being at par with each other resulted in significantly higher number of panicles/m², panicle length, grains/panicle and 1,000-grain weight which ultimately resulted in significantly higher rice yield over all other treatments due to comparatively lower weed dry weight and higher weed-control efficiency in these treatments. Cyhalofop-butyl 120 g/ha when applied alone was the next best treatment in recording significantly higher values of yield attributes and thus higher grain yield over remaining treatments except cyhalofop-butyl 90 g/ha (15 days) followed by 2, 4-D 1.0 kg/ha (20 days) and 2, 4-D 1.0 kg/ha (15 days) followed by cyhalofop-butyl 90 g/ha (20 days) during second year of study with which it was at par. Cyhalofop-butyl 90 and 120 g/ha when applied in mixture with 2, 4-D 1.0 kg/ha completely lost its herbicidal property and did not control the grass weeds and hence resulted in lower yield attributes and rice yield. However, these treatments were also at par with cyhalofop-butyl 90 g/ha and 2, 4-D 1.0 kg/ha for yield and most of the yield attributes.

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