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Efficacy of New Herbicides for Weed Control in Transplanted Rice under Rice-Wheat System

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ABSTRACT

A field experiment was conducted at CCSHAU Rice Research Station, Kaul during **kharif** (rainy) seasons of 2006 and 2007 to evaluate the efficacy of new herbicide penoxsulam with different rates and time of application in transplanted rice. Weeds caused 30 to 32% loss in grain yield in weedy check as compared to weed free treatment. Higher doses of penoxsulam i. e. 0.0250 kg/ha (1-5 DAT) and 0.0225 kg/ha (8-12 DAT), while at par with each other and also with hand weeding twice (20 and 40 DAT), proved significantly better in controlling grassy, sedges and broadleaf weeds and provided significantly higher grain yield (similar to hand weeding and weed free treatments) and higher weed control efficiency than the standard herbicide butachlor at 1.5 kg/ha (1-3 DAT). The lower doses of penoxsulam i. e. 0.0225 kg/ha (1-5 DAT) and 0.0200 kg/ha (8-12 DAT) were, however, similar to butachlor. The study also revealed that comparatively lower doses of the herbicide could be used when it was applied at early post emergence (8-12 DAT).

INTRODUCTION

Rice-wheat rotation is an important cropping system in north India contributing greatly to food security of the country. Severe competition from weeds is one of the important factors deterring productivity and sustainability of the system. Rice, being a rainy season crop, is infested with a wide variety of weeds viz., grasses, sedges and broadleaf weeds. The average loss in crop grain yield by unchecked growth of weeds is reported to be 43.2% (Nandal *et al.*, 1999). For the last many years, several recommended herbicides viz., butachlor, anilofos and pretilachlor are being used by farmers as pre-emergence for effective control of weeds, particularly grassy weeds. Due to continuous use of these herbicides there are chances of shift in weed flora in favour of non-grassy weeds and also the evolution of weed resistance was reported in *Phalaris minor* against isoproturon in wheat in rice-wheat system (Malik and Singh, 1995). Moreover, their application window is low i. e. 1 to 3 days after transplanting (DAT) and hence weeds emerging at later stages of the crop are not controlled effectively. Therefore, there is need of alternate herbicides with broader spectrum and wider application time window to combat multiple weed species in rice. Keeping this in view, the present study was conducted to test the efficacy of a new herbicide penoxsulam with different doses and time of application.

MATERIALS AND METHODS

The field experiment was conducted at CCSHAU Rice Research Station, Kaul during **kharif** 2006 and 2007 on a clay loam soil alkaline in reaction (pH 7.9), low in organic carbon (0.33%) and available N (167 kg/ha), medium in available P (12 kg/ha) and high in K (350 kg /ha). The experimental field had a crop history of rice-wheat system for the last several years. There were eight treatments viz., butachlor @ 1.5 kg/ha (1-3 DAT), penoxsulam at 0.0225 kg/ha (1-5 DAT), penoxsulam at 0.0250 kg/ha (1-5 DAT), penoxsulam at 0.0200 kg/ha (8-12 DAT), penoxsulam at 0.0225 kg/ha (8-12 DAT), weed free, hand weeding twice (20 and 40 DAT) and weedy check (control). The treatments were laid out in randomized block design with three replications. Thirty days old seedlings of rice variety HKR-47 were transplanted on 7 July 2006 and 9 July 2007 at a spacing of 20 x 15 cm in plots of size 6 x 4 m. The crop was raised with all the recommended practices except the weed control treatments. All the herbicides were applied by broadcasting after mixing with 150 kg sand/ha. Density of weed species and dry weight of total weeds were recorded at heading stage of rice crop and the density data were subjected to square root transformation for statistical analysis. The data on yield attributes and grain yield of the crop were recorded at harvest.

Table 1. Effect of herbicides on density of different types of weeds, total weed dry weight and weed control efficiency

Treatment	Dose (kg/ha)	Application stage (DAT)	Weed density (No./m^2) at heading						Total weed dry weight (g/m^2)		Weed control efficiency (%)	
			Grasses		Sedges		BLW					
			2006	2007	2006	2007	2006	2007	2006	2007	2006	2007
Butachlor	1.5	1-3	5.70 (32.50)	3.86 (14.93)	0.60 (0.36)	1.38 (1.92)	1.49 (2.20)	0.62 (0.39)	19.55	16.77	74.7	75.8
Penoxsulam	0.0225	1-5	5.67 (32.15)	3.91 (15.27)	0.38 (0.15)	0.58 (0.34)	1.47 (2.19)	0.61 (0.37)	19.01	15.27	75.4	77.9
Penoxsulam	0.0250	1-5	4.64 (21.57)	2.84 (8.07)	0.35 (0.12)	0.52 (0.27)	1.17 (1.37)	0.28 (0.08)	13.99	9.20	81.9	86.7
Penoxsulam	0.0200	8-12	5.62 (31.64)	3.85 (14.85)	0.41 (0.17)	0.60 (0.36)	1.44 (2.05)	0.57 (0.33)	18.96	14.77	75.5	78.6
Penoxsulam	0.0225	8-12	4.45 (19.84)	3.03 (9.18)	0.38 (0.15)	0.55 (0.30)	1.13 (1.27)	0.32 (0.10)	12.93	9.42	83.3	86.4
Weed free	-	-	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)	0.00	0.00	100.0	0.00
Hand weeding	-	20 & 40 DAS	4.65 (21.64)	2.98 (8.92)	0.43 (0.18)	0.57 (0.32)	1.23 (1.52)	0.22 (0.05)	12.71	8.90	83.5	87.1
Weedy check	-	-	10.47 (109.62)	7.46 (55.65)	1.19 (1.42)	2.98 (8.92)	1.57 (2.47)	0.91 (0.83)	77.29	69.21	0.00	0.00
LSD (P=0.05)			0.39	0.24	0.11	0.07	0.16	0.11	4.11	3.57	-	-

BLW : Broadleaf weeds. Figures in parentheses show the actual weed density.

Table 2. Effect of herbicides on yield attributes and yield of the crop

Treatment	Dose (kg/ha)	Application stage (DAT)	Panicles (No./m^2)		Grains/ panicle		1000-grain weight (g)		Grain yield (q/ha)		Straw yield (q/ha)	
			2006	2007	2006	2007	2006	2007	2006	2007	2006	2007
Butachlor	1.5	1-3	245.1	235.3	135.7	136.2	26.6	25.2	63.7	61.6	83.1	72.6
Penoxsulam	0.0225	1-5	248.0	236.7	137.7	136.1	25.8	25.3	65.4	61.3	85.5	71.0
Penoxsulam	0.0250	1-5	257.9	256.0	143.0	139.7	26.4	25.4	72.1	69.1	89.1	77.0
Penoxsulam	0.0200	8-12	248.2	237.3	139.8	137.6	26.3	25.3	65.3	62.6	85.0	70.9
Penoxsulam	0.0225	8-12	258.6	254.0	143.2	140.0	26.3	25.4	72.2	69.1	86.3	77.1
Weed free	-	-	258.1	257.3	143.7	139.0	25.5	25.3	72.3	70.9	86.5	77.3
Hand weeding	-	20 & 40 DAS	256.9	254.7	143.8	137.2	25.7	25.4	70.2	69.0	85.5	76.8
Weedy check	-	-	226.2	218.0	125.4	129.3	22.1	22.9	50.6	48.0	63.2	59.3
LSD (P=0.05)			8.1	13.6	7.1	5.8	2.6	2.0	3.3	5.1	7.1	6.6

RESULTS AND DISCUSSION

Effect on Weeds

Weed flora of the experimental field consisted mainly of *Echinochloa crus-galli, Ischaemum rugosum, Paspalum distichum* (grassy weeds), *Cyperus iria, Cyperus difformis* (sedges), *Eclipta alba* and *Ammania* spp. (broadleaf weeds).

All the herbicidal treatments and hand weeding significantly reduced the density of all types of weeds and total weeds dry weight as compared to weedy check (Table 1). But their efficiency in controlling different types of weeds varied significantly. Significant reduction in density of grassy and broadleaf weeds and total weed biomass was observed with the application of penoxsulam at 0.0250 kg/ha (1-5 DAT) or at 0.0225 kg/ha (8-12 DAT), which was statistically similar to each other and also with hand weeding, but significantly superior to standard herbicide butachlor at 1.5 kg/ha (1-3 DAT) in this respect. Penoxsulam at these doses also resulted in highest weed control efficiency among the herbicides (Table 2). The lower doses of penoxsulam at 0.0225 kg/ha (1-5 DAT) or at 0.0200 kg/ha (8-12 DAT) were the next best herbicidal treatments in reducing weed density and suppressing the growth of weeds, and were found similar to butachlor during both the years. All the treatments of penoxsulam, including the lower doses, being similar to one another and hand weeding, proved significantly superior to butachlor in reducing the density of sedges. The greater weed control efficiency obtained with higher doses of penoxsulam than with butachlor might be due to its greater phytotoxic effects on all types of weeds, particularly on sedges.

Effect on Crop

All the weed control treatments produced significantly higher number of panicles/m^2, number of grains/panicle, 1000-grain weight and hence higher grain and straw yield over the weedy check during both the years (Table 2). The losses in grain yield due to uncontrolled growth of the weeds in weedy check were found to be 30 and 32% during 2006 and 2007, respectively, compared to weed free treatment. The various weed control treatments differed significantly only in respect of panicle number. Among the herbicides, penoxsulam applied either at 0.0250 kg/ha (1-5 DAT) or at 0.0225 kg/ha (8-12 DAT) gave significantly higher number of panicles/m^2 and hence the highest grain yield, which, however, was similar to weed free and hand weeding treatments during both the years. Highest yield and number of panicles/m^2 with this herbicidal treatment could be due to better control of grasses, sedges and broadleaf weeds by the herbicide, thereby resulting in higher uptake of nutrients by the crop (Singh *et al*., 1999). This treatment was followed by lower doses of penoxsulam at 0.0225 kg/ha (1-5 DAT) or at 0.0200 kg/ha (8-12 DAT), which, however, were similar to butachlor at 1.5 kg/ha during both the years. Lower dose of penoxsulam (0.0225 kg/ha) applied at early post emergence (8-12 DAT) was found equally effective as the higher dose (0.0250 kg/ha) applied at pre-emergence (1-5 DAT). Similarly, the other doses of the herbicide i. e. 0.0225 kg/ha (1-5 DAT) and 0.0200 kg/ha (8-12 DAT) were equally effective, suggesting that comparatively lower doses of the herbicide can be used when these are to be applied at early post emergence (8-12 DAT) stage.

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