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EFFICACY OF DIFFERENT FORMULATIONS OF PENOXSULUM ON WEED AND YIELDS OF TRANSPLANTED RICE IN LOWLANDS

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ABSTRACT

A field experiment was conducted during wet season of 2006 and 2007 at the Crop Research Station, Ghaghraghat, (Bahraich) Uttar Pradesh to assess the comparative efficacy of different formulations of penoxsulum on weeds and yield of transplanted rice in low lands. The experiment was laid out in randomized block design with 7 treatments replicated 4 times. The major weed flora recorded in the experimental site was Echinochola crus-galli, Echinochola colona, Commelin benghalensis, Caesulia axillaris, Cynotis axillaries, Ammania baccifera, Cyperus spp., Cynodon dactylon. Weedy check till maturity reduced the grain yield of rice to the tune of 43.6 % as compared to weed free till maturity. The lowest density of weeds was recorded with two hand weeding at 20 and 40 days after transplanting, however, application of penoxsulum @22.5 g a.i.ha^{-1} at 8-12 days after transplanting resulted in the lowest dry weight of weeds and higher weed control efficiency at 30, 60 and 90 days after transplanting. The grain and straw yields were highest (2.95 t ha^{-1} and 3.67 t ha^{-1}), respectively with penoxsulum @22.5g a.i ha^{-1} 8-10 days after transplanting. This treatment also resulted in the lowest weed index (18.8 %) followed by Penoxsulum @25g a.i ha^{-1} @ 0-5 days after transplanting.
Keywords: Efficacy, for mulations, penoxsulum, weed yield, rice

INTRODUCTION

Rice (*Oryza sativa L.*) is an important crop of India contributing 45% to the total food grain production and staple food for more than 60% of the world population. The productivity of rice is adversely affected by heavy weed infestation and reduction in grain yield due to different weeds like grasses, sedges and broad leaf weeds in transplanted rice has been reported to the tune of 28-45% under weedy check (Singh *et al.*, 2003). Weeds pose a serious problem in rice crop and compete for space, light and nutrients. Though, control of weeds manually is easy and effective but unavailability of labour at right time and its high wages make it difficult and costly. Use of herbicides to control weeds though cheap and effective but most of the herbicides such as butachlor, anilophos, pretilachlor and pendimethalin are used in large quantity of active ingredient and these herbicides increase the chemical load in environment and pollute soil and ground water. There is need to find out an effective weed control measures by using low dose with high efficiency herbicides which are essentially required to reduce the total volume of herbicides and also make the application easier and economical. Moreover, the intensive and continuous use of herbicides over the last five decades has resulted in the evaluation of weeds resistant to several shift of weed flora from grassy to non grassy and annual sedges and is increased day by day. Thus, management of weeds is being more difficult and complex (Rao, 1999). Hence, evaluation of new herbicides to control wide spectrum of weed flora is imperative. Therefore, an experiment was planned to study the efficacy of Penoxsulum and butachlor against weeds in transplanted rice.

MATERIALS AND METHODS

Field experiment was conducted during wet season of 2006 and 2007 at the Crop Research Station, Ghaghraghat, (Bahraich) Uttar Pradesh. The soil of experimental site was sandy-loam in texture with pH 8.2, organic carbon, 4.3 g kg^{-1}, available N, 191 phosphorus, 19.8 and potash 189 kg ha^{-1}. The eight treatments consist of, T_{1-} butachlor 50 EC @1.5 kg a.i.ha^{-1} at 5-7 days after transplanting , T_2 - penoxsulum 24 SC @ 22.5 g a.i. ha^{1} 0-5 days after transplanting, T_{3-} penoxsulum 24 SC@25 g a.i ha^{-1} at 0-5 days after transplanting, T_{4-} penoxsulum 24 SC@20 g a.i.ha^{-1} at 8-12 days after transplanting, T_{5-} Penoxsulum 24Sc@22.5g a.i. ha^{-1} at 8-12 days after transplanting, T_{6-} hand weeding at 20

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and 40 days after transplanting, T_7- weed free till maturity, and T_8- weedy check till maturity were tested in randomized block design with four replications. The plot size was kept 20 m^2. Twenty five days old seedlings of rice variety 'NDR-359' was transplanted at 20 x 10 cm hill spacing using 2-3 seedlings $hill^{-1}$ on July 18, 2006 and July 23, 2007. The spray of herbicides was done using knapsack sprayer fitted with flat fan nozzle at a spray volume of 500 ltr. water ha^{-1} Rice crop was fertilized @ 120 N+ 60 P_2O_5 + 40 K_2O kg ha^{-1}. The half dose of nitrogen, full dose of phosphorus and potash was applied at transplanting as basal and rest amount of nitrogen was top dressed in two equal splits at tillering and panicle initiation stage. The crop was irrigated as per need before frequent rains. The crop has not received irrigation from 1st August to last September, and therefore, the crop received one irrigation in the month of October. The rice crop was harvested in third week of November during both years. Observations on weed counts and weed dry weight were taken at 30, 60 and 90 days after transplanting by placing a quadrate of (0.25 x 0.25 m) randomly at two spots. The weeds within quadrates were uprooted and washed gently in flowing water and then separated species wise, counted and then sun dried for 12 hrs and thereafter kept in electric oven for 24 hrs on 70^0C temperature. Weed control efficiency was calculated by using formula giving by Patel *et al.* (1987). Observation on different yield attributes were recorded on five panicles collected randomly from each plot. The data were analyzed statistically as per procedures (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

Yield attributes: All yield attributes were affected significantly due to various weed control treatments (Table 1). Significantly highest value of all yields attributes like panicle length, panicle weight, grains $panicle^{-1}$ and 1000 grain weight was recorded with weed free till maturity (T_7) as compared to rest of the treatments (Table 1). Two hand weeding at 20 and 40 days after transplanting (T6) being on par with penoxsulum @ 22.5 g a.i./ha at 8-12 days after transplanting (T_5) resulted in the highest values of all yield attributes over rests of the treatments. Among the herbicidal treatments, Penoxsulum applied @ 22.5 g a.i. ha^{-1} at 8-12 days after transplanting (T_5) resulted in significantly the highest value of the all yield attributes over rest of the treatments. Butachlore @ 1.5 kg a.i. ha^{-1} at 5-7 days after transplanting (T_1) resulted in higher values of all yield attributes as compared to penoxsulum applied @ 22.5 g a.i./ha at 0-5 days after transplanting (T_2), and penoxsulum @ 20 g a.i. ha^{-1} at 8-12 days after transplanting (T_4). The higher values of yield attributes with two hands weeding at 20 and 40 days after transplanting (T_6), and Penoxsulum @ 22.5 g a.i. ha^{-1} at 8-12 days after transplanting (T_5) was due to effective control of weeds which resulted in higher availability of nutrients to rice as compared to heavy competition of weeds in rest of the treatments.

Table 1: Yield attributes and yield of rice as affected by different weed control treatment

Treatments	Grain yield (t ha^{-1})			Straw yield (t ha^{-1})			Weed index (%)	Effective panicles m^{-2}	Panicle length (cm)	Panicle weight (g)	Grains $panicle^{-1}$	1000 grains wt (g)	LAI
	2006	2007	Mean	2006	2007	Mean							
T_1	2.96	2.61	2.78	3.75	3.26	3.50	22.20	258	22.44	2.77	43.8	22.70	4.95
T_2	3.15	2.42	2.78	4.01	3.05	3.53	22.26	255	22.40	2.80	43.5	22.68	4.89
T_3	3.19	2.47	2.83	4.17	3.15	3.64	20.92	270	22.50	2.84	44.8	23.05	5.15
T_4	2.94	2.35	2.64	3.97	2.96	3.30	26.17	250	22.10	2.45	2.45	22.19	4.58
T_5	3.28	2.53	2.90	4.16	3.15	3.67	18.88	275	22.80	2.85	45.8	23.10	5.32
T_6	3.06	2.84	2.95	3.89	3.55	3.72	17.51	287	22.85	2.87	46.4	23.20	5.43
T_7	3.68	3.48	3.58	4.51	4.32	4.42	-	298	23.18	2.95	48.6	23.45	5.79
T_8	2.10	1.94	2.02	2.82	2.42	2.62	43.65	192	21.50	2.11	31.3	21.66	4.30
SEm +	0.10	0.12	0.11	0.16	0.21	0.19	0.76	6.00	0.14	0.60	5.00	0.12	0.09
CD (P=0.05)	0.22	0.31	0.26	0.44	0.55	0.49	1.58	14.00	0.35	1.00	9.0	0.28	0.1

Effect on weed: The major weed flora recorded in experimental site was, Echinochloa crusgalli, Echinochloa colona, Commelin benghalensis, Caesulia axillaris, Cynotis axillaris, Ammania bacifera, Cyperus spp, Cynodon dactylon during both the year. However, the proportionate magnitude of different weed spices in weedy check plot was recorded to be. Echinochloa spp. (30.5%), Cyperus spp (29.8%), Commelin benghalensis (24.5%), Caesulia axillaris and Cynotis axillaris (9.8%) and Ammania bacifera (5.1%). The lowest density of weeds was recorded in 2 hand weeding at 20 and 40 days after transplanting (T_6) as compared to rest of the treatments (Table 1 and 2). All formulations of Penoxsulum reduced significantly the desnity and dry weight of weeds significantly as compared to butachlore @ 1.5 kg a.i. ha^{-1} (T_1). Among the different formulations of penoxsulum, applications of penoxsulum @ 22.5 g a.i. ha^{-1} at 8-12 days after transplanting (T_5) resulted in lowest density and dry weight of weeds followed by pneoxulam @ 25 g a.i. ha^{-1} at 0-5 days after transplanting (T_3). Among the tested herbicides, penoxsulum was found very effective against broad leaf weeds and sedges at all doses. However, penoxsulum @ 22.5 g a.i./ha at 8-12 days after transplanting (T_5) gave effective control of Cyperus sp., Commenlin benghalensis, Caesulia axilaris, Cynotis axillaris and Ammalia bacifera resulting in lowest density and biomass with higher weed control efficiency. Pal and Banerjee (2007) also reported similar results. The highest weed control efficiency i.e. 74.3 % , 63.1 and 56.1 % at 30, 60 and 90 days after transplanting, respectively was recorded with Penoxsulum @ 22.5 g a.i. ha^{-1} (T5) followed by Penoxsulum @ 25 g a.i. ha^{-1} (T3). This was mainly attributed to efficient control of both broad leaf weeds as well as grassy weeds.

Table 2: Weed population (m^{-2}) Weed dry weight (g m^{-2}) and week control efficiency (%) as affected by weed control treatments (Av. of 2 years)

Treatments	weed density			Weed dry weight			Weed Control efficiency (%)		
	Days After transplanting			Days after transplanting			Days after transplanting		
	30	60	90	30	60	90	30	60	90
T_1	(21.25) 4.66	(26.53) 5.20	(32.33) 5.72	(57.8) 7.63	(86.4) 9.32	(109.3) 10.47	53.76	46.99	44.43
T_2	(17.25) 4.21	(21.56) 4.69	(26.29) 5.18	(52.6) 7.29	(99.4) 9.99	(121.3) 11.04	57.92	39.01	38.33
T_3	(10.66) 3.34	(13.30) 3.72	(16.27) 4.10	(36.4) 6.07	(66.2) 8.16	(112.3) 10.62	70.88	59.38	42.90
T_4	(16.76) 4.15	(18.50) 4.36	(25.78) 5.13	(68.6) 8.31	(105.0) 10.27	(135.3) 11.65	45.12	35.58	31.21
T_5	(9.48) 3.16	(11.90) 3.52	(14.47) 14.97	(32.1) 5.70	(60.1) 7.78	(91.7) 9.60	74.32	63.12	56.12
T_6	(7.61) 2.85	(9.54) 3.16	(11.79) 3.50	(40.4) 6.39	(72.0) 8.51	(101.3) 10.08	67.68	55.82	48.50
T_7	-	-	-	-	-	-	-	-	-
T_8	(37.75) 6.18	(47.08) 6.89	(57.51) 7.61	(125.0) 11.20	(163.0) 12.78	(209.0) 14.47	-	-	-
SEM ±	0.09	0.18	0.16	0.05	0.06	0.5	-	-	-
CD (P=0.05)	0.22	0.43	0.40	0.12	0.15	0.12	-	-	-

Figures in parenthesis are original value

Effect on crop: Weedy check till maturity (T_8) reduced the grain yield to the tune of 43. 6 % as compare to weed free (T_7). The minimum reduction in grain yield (17.5%) was recorded with 2 hand weeding at 20 and 40 days after transplanting (T_6). Among the herbicidal treatments, the lowest reduction in grain yield (18.8%) was recorded with penoxsulum @ 22.5 g a.i. ha^{-1} at 8-12 days after transplanting (T5) followed by penoxsulum @ 25 g a.i. ha^{-1} at 0-5 days after transplanting (T_3). The lowest reduction in grain yield with 2 hand weeding (T_6), and penoxsulum 24 SC @ 22.5 g a.i. ha^{-1} (T_5) was mainly attributed to efficient control of

weeds as evidenced by lowest population and dry weight of weed with higher weed control efficiency with these treatment (Table 1 and 2).

Similar higher grain yield of rice with application of penoxsulum was recorded by Sing et al (2009).

Table 3: Weed population (m^{-2}) as affected by different weed control treatment

Treatments	Weed population														
	30 DAT					60 DAT					90 DAT				
	E	Cy	Co	Ca	Am	E	Cy	Co	Ca	Am	E	Cy	Co	Ca	Am
T_1	6.5	4.90	3.72	4.50	1.63	8.1	6.1	4.65	5.62	2.03	10	7.4	5.67	6.85	2.47
T_2	6.25	5.10	1.70	2.30	1.90	7.8	6.4	2.12	2.87	2.37	9.5	7.8	7.80	2.58	2.88
T_3	4.10	3.12	1.10	1.20	1.14	5.1	3.9	1.38	1.50	1.42	6.2	4.8	1.70	1.83	1.73
T_4	6.3	5.63	2.21	1.50	1.07	7.9	5.1	2.65	1.40	1.52	1.2	6.3	3.23	1.70	1.85
T_5	4.11	2.12	1.10	1.20	0.95	5.1	2.7	1.40	1.52	1.18	6.3	3.2	1.71	1.85	1.43
T_6	3.10	1.50	0.70	1.30	1.00	3.9	1.9	0.89	1.63	1.27	4.9	2.3	1.09	1.97	1.55
T_7															
T_8	11.50	11.2	9.25	3.80	1.95	14	14	11.6	4.63	2.43	17	17	14.10	5.64	2.96
SEm ±	0.22	0.35	0.15	0.12	0.08	0.5	0.7	0.15	0.14	0.40	0.6	0.6	0.16	0.10	0.08
CD (P=0.05)	0.57	0.87	0.37	0.32	0.20	1.3	1.6	0.38	0.35	0.95	1.2	1.6	0.42	0.24	0.20

E= Echinocloa Sp., Cy = Cyprus Sp., Co = Commelin Benghalensis, Ca= Caesularies axillaris, Am = Ammaneia bacifera, DAT= Days after transplant

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Weed free plot till maturity (T_7) produced significantly highest mean grain and straw yield (3.58 t ha^{-1} and 4.42 t ha^{-1}), respectively over rest of the treatments owing to higher values of yield attributes. Two hand weeding at 20 and 40 days after transplanting (T_6), being on par with penoxsulum @ 22.5 g a.i, ha^{-1} at 8-12 days after transplanting (T_5), and penoxsulum @ 25 g a.i ha^{-1} at 0-5 days after transplanting (T3) produced significantly higher grain yield over rest of the treatments. The higher yield with both treatments was mainly because of lower crop-weed competition due to lower density and dry weight of weeds resulted in higher availability of plant nutrients to crop which have contributed to higher yield. Among the herbicides treatments, the highest grain yield (3.28 t ha^{-1} and 2.53 t ha^{-1}) and straw yield (4.16 t ha^{-1} and 3.16 t ha^{-1}) in respective years was recorded with penoxsulum @ 22.5 g a.i ha^{-1} at 8-12 days after transplanting (T_5) followed by penoxsulum @ 25 g a.i ha^{-1} at 0-5 days after transplanting (T_3). Similar higher grain and straw yield of rice with penoxsulum @ 22.5 g a.i ha^{-1} at 8-12 days after transplanting (T_3) was recorded by Pal and Banerjee (2007).

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