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Weed Management in Rice (*Oryza sativa L.*) under System of Rice Intensification Technique

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ABSTRACT

A field experiment was conducted during *kharif* season of 2010 to study the comparative performance of different weed management practices in rice under system of rice intensification (SRI) at Anand Agricultural University, Nawagam (Gujarat). Results revealed that maximum grain yield, straw yield, yield attributing characters, higher net realization and the lowest weed population under SRI (system of rice intensification) were recorded with the treatment of three hand weeding carried out at 15, 30 and 45 days after transplanting (DAT). While, under labour crises (scarce, costly and not timely available) situations, post emergence application of Pyrazosulfuron @ 25 g ha^{-1} in 500 litre water at 10-12 DAT or pre emergence application of Butachlor @ 1.5 kg ha^{-1} in 500 litre water at 5 DAT integrated with one hand weeding at 30 DAT was found better under middle Gujarat condition.

Key words *Date of sowing, Date of transplanting, pre-emergence, post-emergence, System of rice intensification*

India is the world's second largest rice producer and consumer next to China. Total area under rice in India is 44 million hectares with annual production of 90 million tonnes. Which needed to be enhanced from the present 90 million tonnes to about 100 million tonnes by the end of eleventh plan period to meet the growing demand of rapidly increasing population (Kumar, *et al.,* 2009). In Gujarat, the area under irrigated rice is 3.9 lakh ha with production of 9.3 lakh tones and productivity of 2345 kg ha^{-1}.The main reasons of low productivity and profitability are vagaries of nature, low water and fertilizer use efficiency and poor crop management practices (poor input use efficiency) including adherence of farmers to the traditional costlier practices, besides low market price of farm produce especially in the recent past.

Rice cultivation consumes 70 per cent water available for agriculture; hence economizing the water use in rice production has been very important and will be indispensable in coming years. The results of experiments on SRI (System of Rice Intensification) technique in middle Gujarat are encouraging. It increased yield to the tune of 12 to 22 per cent with nearly 30 to 40 per cent saving of water and 20 per cent saving in cost of production as compared to standard practices (DE&S., 2008). Nutrient use efficiency can be increased through its proper time of application, weed control measures and irrigation management. However, to exploit the production potentiality of *kharif* rice under SRI method, there is an urgent need for controlling the weeds, therefore the present experiment was carried out to study the effect of Weed management in (*Oryza sativa L.*) under SRI (System of Rice Intensification) technique.

MATERIALS AND METHODS

A field experiment was conducted on rice (cv. GR 12) at Main Rice Research Station, Anand Agricultural University, Nawagam during *kharif* 2010. The experimental site was medium in organic carbon (0.36 %), available nitrogen (254.34 kg ha^{-1}), available phosphorus (35.84 kg ha^{-1}) and high in available potassium (316.35 kg ha^{-1}). Rice was sown in nursery during first week of August with seed rate of 5 kg ha^{-1}. The plot was kept ready through tractor drawn cultivator for preparing nursery beds. The beds of 10 metres long and 1 metre wide were prepared. Five hundred kg FYM was mixed with soil and beds were leveled perfectly. The seeds were treated with Thirum @ 3 g kg^{-1} seed. It was sown in 10 cm apart line and covered with powder form of FYM. The healthy seedlings of two leaves was obtained within 10-12 days after sowing in nursery. Proper care of nursery beds was taken by proper watering and weeding in the nursery as and when necessary. The fertilizer at 100, 25 and 0 kg N, P_2O_5 and K_2O ha^{-1} was used. The half level of nitrogen and half level of phosphorous were applied at transplanting.

The experiment was laid out in randomized block design with four replications. Ten weed control treatments were studied *viz.,* Weedy check (W_1), Weed free (three HW at 15, 30 & 45 DAT) (W_2), Two conoweeding at 10, 20 DAT (W_3), Three conoweeding at 10, 20 & 30 DAT (W_4), Four conoweeding at 10, 20, 30 & 40 DAT (W_5), Butachlor @ 1.5 kg ha^{-1} at 5 DAT (W_6), Butachlor @ 1.5 kg ha^{-1} at 5 DAT + one conoweeding at 30 DAT (W_7), Butachlor @ 1.5 kg ha^{-1} at 5 DAT + one HW at 30 DAT (W_8), Pyrazosulfuron @ 25 g ha^{-1} at 10-12 DAT (W_9), Fenoxaprop-p-ethyl @ 70 g ha^{-1} at 10-12DAT (W_{10}). Pre-emergence and post-emergence herbicides were sprayed

Table 1. Effect of weed management treatments on total weed population, dry weight of weeds, WI and WCE at different stages.

Treatments	Total weed population			Dry weight of weeds			WI (%)	WCE (%)
	At 25 DAT (no. m^{-2})	At 50 DAT (no. m^{-2})	At harvest (no. m^{-2})	At 25 DAT (g m^{-2})	At 50 DAT (g m^{-2})	At harvest (kg ha^{-1})		
W_1: Weedy check	9.71^{a} (93.7)	13.51^{a} (181.7)	16.05^{a} (256.7)	87.60^{a}	145.69^{a}	1896.01^{a}	40.95	0.00
W_2 : Weed free (three HW at 15, 30 and 45 DAT)	2.17^{g} (3.75)	3.72^{g} (13.00)	9.43^{g} (88.0)	5.18^{h}	39.63^{f}	447.90^{f}	0.00	76.38
W_3: Two conoweeding at 10 and 20 DAT	6.53^{b} (41.7)	9.97^{b} (98.7)	13.21^{b} (173.7)	44.98^{b}	88.17^{b}	1120.24^{b}	14.23	40.92
W_4: Three conoweeding at 10, 20 and 30 DAT	4.29^{d} (17.5)	7.95^{c} (62.2)	11.76^{c} (137.2)	26.86^{d}	70.30^{c}	882.63^{c}	13.19	53.45
W_5: Four conoweeding at 10, 20,30 and 40 DAT	2.82^{f} (7.00)	4.58^{f} (20.2)	9.81^{f} (95.2)	9.23^{g}	48.90^{e}	532.33^{ef}	6.68	71.92
W_6: Butachlor @ 1.5 kg ha^{-1} at 5 DAT	5.06^{c} (24.7)	6.57^{d} (42.2)	10.87^{d} (117.2)	26.69^{d}	61.40^{d}	692.03^{d}	12.50	63.50
W_7: Butachlor @ 1.5 kg ha^{-1} at 5 DAT + one conoweeding at 30 DAT	4.60^{cd} (20.2)	5.74^{e} (32.0)	10.39^{e} (107.0)	24.72^{d}	57.48^{d}	612.58^{de}	8.36	67.69
W_8: Butachlor @ 1.5 kg ha^{-1} at 5 DAT + one HW at 30 DAT	3.84^{e} (13.7)	4.92^{f} (23.2)	9.96^{f} (98.25)	13.68^{f}	47.97^{e}	531.46^{ef}	6.46	71.97
W_9: Pyrazosulfuron @ 25 g ha^{-1} at 10-12 DAT	4.38^{d} (18.2)	6.39^{de} (40.0)	10.77^{de} (115.0)	20.01^{e}	57.44^{d}	629.25^{de}	6.87	66.81
W_{10}: Fenoxaprop-p-ethyl @ 70 g ha^{-1} at 10-12 DAT	6.82^{b} (45.7)	8.24^{c} (67.0)	11.96^{c} (142.0)	38.30^{c}	61.62^{d}	818.59^{c}	12.33	56.83
S.Em. ±	0.16	0.23	0.15	1.14	2.44	31.58	-	-
C. D. at 5 %	0.47	0.66	0.44	3.32	7.09	91.64	-	-

*Figures in parentheses are original values. All figures subjected to transformed values to square root "(X+1). Figures indicating common letters in column do not differ significantly from each other at 5 % level of significance according to Duncan New Multiple Range Test

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with Knapsack sprayer fitted with flat fan nozzle using 500 liter of water ha^{-1}. The remaining amount of nitrogen was top dressed in two equal splits at tillering and panicle initiation stages. Need based irrigation was given to the crop. The crop was harvested in the month of November.

RESULTS AND DISCUSION

Among the grassy weeds; most dominant weed flora of *Echinocloa crus-gulli* L. (31 %) and *Cynodon dactylon* L. (22 %) were found in field experiment. Where as, *Cyperus rotundus* L. (18 %) and *Cyperus irida* L. (15 %) were most dominant weeds among sedges. Among the total broad leaf weeds, *Eclipta alba* L.(9 %) and *Amiscophacelus cucuttala* L. (5 %) were the most dominant weeds.

Weed control measures had significant influence on weed population and dry matter accumulation at 25, 50 DAT and at harvest (Table 1). Weed free (three hand weedings at 15, 30 and 45 DAT) recorded the mínimum weed population and dry matter accumulation of weeds at 25 and 50 DAT. However, they remained *at par* with the treatments of four conoweeding at 10, 20, 30 and 40 DAT (W_5), pre emergence application of Butachlor @ 1.5 kg ha^{-1} at 5 DAT + one HW at 30 DAT (W_8), Butachlor @ 1.5 kg ha^{-1} at 5 DAT + one conoweeding at 30 DAT (W_7) and post emergence application of Pyrazosulfuron @ 25 g ha^{-1} at 10-12 DAT (W_9). Among the weed control measures, all the treatments caused reduction in the intensity of different weeds in comparision to weedy check.

Weed index lower observed under the treatment of three hand weeding carried out at 15, 30 and 45 DAT (W_2) followed by the treatments of pre emergence application of Butachlor @ 1.5 kg ha^{-1} at 5 DAT + one HW at 30 DAT (W_8), four conoweeding at 10, 20, 30 and 40 DAT (W_5), post emergence application of Pyrazosulfuron @ 25 g ha^{-1} at 10-12 DAT (W_9), Butachlor @ 1.5 kg ha^{-1} at 5 DAT + one conoweeding at 30 DAT (W_7), Fenoxaprop-p-ethyl @ 70 g ha^{-1} at 10-12 DAT (W_{10}) and Butachlor @ 1.5 kg ha^{-1} at 5 DAT (W_6). The weedy check (W_1) recorded the maximum weed index. These results are in agreement with the results reported by Saha, *et al.*, 2003.

It is clear from the data that treatment of three hand weeding carried out at 15, 30 and 45 DAT (W_2) had the maximum WCE followed by the treatments of pre emergence application of Butachlor @ 1.5 kg ha^{-1} at 5 DAT + one HW at 30 DAT (W_8), four conoweeding at 10, 20,

Table 2. Effect of weed management treatments on yield attributes, yield and economics of rice

Treatments	Number of grains panicle^{-1}	Panicle length (cm)	Grain weight Panicle^{-1} (g)	Test weight (g)	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Gross realization (` ha^{-1})	Total cost of production (` ha^{-1})	Net realization (` ha^{-1})	BCR
W_1: Weedy check	149.75^{c}	18.42^{c}	1.98^{c}	14.05^{c}	2945^{c}	3473^{c}	45050	27669	17380	1.63
W_2: Weed free (three HW at 15, 30 and 45 DAT)	239.25^{a}	24.50^{a}	3.38^{a}	17.35^{a}	4988^{a}	5491^{a}	75865	32821	43043	2.31
W_3: Two conoweeding at 10 and 20 DAT	199.75^{b}	21.00^{b}	2.94^{b}	14.90^{bc}	4278^{b}	4579^{b}	64926	30245	34680	2.15
W_4: Three conoweeding at 10, 20 and 30 DAT	215.75^{ab}	22.38^{ab}	2.83^{b}	15.33^{abc}	4330^{b}	4818^{b}	65912	31533	34379	2.09
W_5: Four conoweeding at 10, 20,30 and 40 DAT	226.00^{a}	23.28^{ab}	3.15^{ab}	17.03^{a}	4655^{ab}	5102^{ab}	70775	32821	37954	2.16
W_6: Butachlor @ 1.5 kg ha^{-1} at 5 DAT	217.50^{ab}	22.53^{ab}	3.01^{ab}	16.95^{ab}	4364^{b}	4846^{b}	66430	28807	37623	2.31
W_7: Butachlor @ 1.5 kg ha^{-1} at 5 DAT + one conoweeding at 30 DAT	219.00^{ab}	22.63^{ab}	3.19^{ab}	17.00^{a}	4571^{ab}	5013^{ab}	69501	30525	38976	2.28
W_8: Butachlor @ 1.5 kg ha^{-1} at 5 DAT + one HW at 30 DAT	226.75^{ab}	23.45^{ab}	3.21^{ab}	17.15^{a}	4665^{ab}	5123^{ab}	70948	30095	40853	2.36
W_9: Pyrazosulfuron @ 25 g ha^{-1} at 10-12 DAT	225.00^{a}	23.00^{ab}	3.17^{ab}	17.13^{a}	4645^{ab}	5096^{ab}	70635	28839	41796	2.45
W_{10}: Fenoxaprop-p-ethyl @ 70 g ha^{-1} at 10-12 DAT	219.00^{ab}	21.83^{b}	3.05^{ab}	16.68^{ab}	4373^{b}	4888^{b}	66591	29121	37471	2.29
S.Em. ±	7.65	0.78	0.12	0.64	188.05	175.51	2034.66	1218.37	1636.11	0.02
C. D. at 5 %	22.20	2.26	0.35	1.84	545.68	509.27	5904.03	3535.38	4747.54	0.07

*Treatments means with the letter/letters in common are not significant by Duncan New Multiple Range Test at 5 % level of significance

Selling price of grain = 14 Rs. kg^{-1} Selling price of straw = 1.1 Rs. kg^{-1} Cost of Butachlor = 660 Rs. liter^{-1}

Cost of Fenoxaprop-p-ethyl = 952 Rs. liter^{-1} Cost of Pyrazosulfuron = 690 Rs. liter^{-1}

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30 and 40 DAT (W_5), Butachlor @ 1.5 kg ha^{-1} at 5 DAT+ one conoweeding at 30 DAT (W_7) and post emergence application of Pyrazosulfuron @ 25 g ha^{-1} at 10-12 DAT (W_9). These results are in agreement with the findings of Shekhar and Mankotia, 2005 and Saha, *et al.,* 2003.

The yield attributing characters viz.; panicle weight, panicle length, test weight and number of grain panicle^{-1} were noted significantly higher under the treatment of three hand weedings carried out at 15, 30 and 45 DAT (W_2), which was remained *at par* with the treatment of pre emergence application of Butachlor @ 1.5 kg ha^{-1} at 5 DAT + one HW at 30 DAT (W_8), four conoweedings at 10, 20, 30 and 40 DAT (W_5), post emergence application of Pyrazosulfuron @ 25 g ha^{-1} at 10-12 DAT (W_9) and Butachlor @ 1.5 kg ha^{-1} at 5 DAT+ one conoweeding at 30 DAT (W_7) (Table 2).

Significantly higher grain and straw yield of rice were recorded under treatment of three hand weeding carried out at 15, 30 and 45 DAT (W_2) which was remained at par with the treatments of pre emergence application of Butachlor @ 1.5 kg ha^{-1} at 5 DAT + one HW at 30 DAT (W_8), four conoweeding at 10, 20, 30 and 40 DAT (W_5), post emergence application of Pyrazosulfuron @ 25 g ha^{-1} at 10-12 DAT (W_9) and Butachlor @ 1.5 kg ha^{-1} at 5 DAT + one conoweeding at 30 DAT (W_7). Significantly the lowest grain yield was recorded under weedy check (W_1). The highest grain yield was recorded under these treatment might be due to lower infestation of weeds in the plot resulted in less competition of weeds with the crop for various growth factors. The present results are in close association with the findings of Kumar, *et al.*, 2009 and Saha, *et al.*, 2003.

The treatment of three hand weeding carried out at 15, 30 and 45 DAT (W_2) recorded the higher net realization (Rs. 43043 ha^{-1}), followed by post emergence application of Pyrazosulfuron @ 25 g ha^{-1} at 10-12 DAT (W_9), pre emergence application of Butachlor @ 1.5 kg ha^{-1} at 5 DAT + one HW at 30 DAT (W_8), Butachlor @ 1.5 kg ha^{-1} at 5 DAT + one conoweeding at 30 DAT (W_7) and four conoweeding at 10, 20, 30 and 40 DAT (W_5).

The benefit cost ratio was higher (2.45) under the treatment of post emergence application of Pyrazosulfuron @ 25 g ha^{-1} at 10-12 DAT (W_9), followed by treatments of pre emergence application of Butachlor @ 1.5 kg ha^{-1} at 5 DAT + one HW at 30 DAT (W_8), three hand weeding carried out at 15, 30 and 45 DAT (W_2) and Butachlor @ 1.5 kg ha^{-1} at 5 DAT (W_6).

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