

COMPARATIVE STUDY ON WEEDS MANAGEMENT IN RICE (*Oryza sativa* L.) UNDER SRI (SYSTEM OF RICE INTENSIFICATION)

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ABSTRACT

A field experiment was conducted in rice (cv. GR 12) during kharif season of the year 2010 at Main Rice Research Station, Anand Agricultural University, Nawagam to study the comparative performance of different weed management practices in rice under system of rice intensification. Results revealed that maximum grain yield, straw yield, yield attributes characters and lowest weed population under SRI (System of Rice Intensification) was observed under the treatment of three hand weeding carried out at 15, 30 and 45 DATP. Application of post emergence of pyrazosulfuron @ 25 g/ha in 500 litre water at 10-12 DATP or pre emergence application of butachlor @ 1.5 kg/ha in 500 litre water at 5 DATP integrated with one hand weeding at 30 DATP were the other most effective treatments in controlling the weeds and getting the higher grain and straw yield.

KEY WORDS: management, rice, (SRI) system of rice intensification, weed

INTRODUCTION

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 up to about 100 million tonnes by the end of eleventh plan period (2011-12) to meet the growing demand of rapidly increasing population (Kumar *et al.*, 2009). 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 SRI methodology is of interest because of its potential to achieve higher yield at lower cost of production along with saving of water (Krishna *et al.*, 2008). In early 1980's, the SRI (System of Rice Intensification) was developed at Madagascar by Henri De Laulanie (Laulanie, 1993). Farmers across the country are adopting System of Rice Intensification (SRI), as it gives equal or more produce than the conventional rice cultivation ; with less water, less seed and less chemicals. The net effect is a substantial reduction in the investments on external inputs. Conversely, increased labour needs for weeding and cultivation in saline lands are the two areas of major concern in SRI, on which innovations

are forthcoming from various quarters. Farmers are leading the innovations and spreading that technology, while the scientific community is still to catch up with this emerging rice revolution.

The results of experiments on SRI (System of Rice Intensification) techniques in middle Gujarat since 2004 to 2008 are encouraging and as compared to standard practices, the SRI technique increased yield to the tune of 12 to 22 per cent with nearly 30-40 per cent saving of water and 20 per cent saving in cost of production (Anonymous, 2008).

Certain factors tend to restrict the crop's potential performance. Weed competition is one of the major factors responsible for low yield of rice. Competition offered by weeds is most important and it reduces the grain yield up to the extent of 32% (Singh *et al.*, 2007). Kolhe *et al.*, 1983 also reported that weeds are the foremost factor that causes heavy yield reduction, which varies from 40 to 76 % in broad cast seeded, 20 % in drilled seeded and 11-20 % in transplanted rice in puddled fields. Thus, it is important that they are controlled in time to avoid unproductive use of growth factors to enable the crop plant to express fully by utilizing these factors meant for them. Herbicides are effective against weed species, but most of them are specific and are effective against narrow range of weed species (Mukerjee and Singh, 2005). Kipping this in view, comparative study of different weed management practices were studied under system of rice intensification.

MATERIALS AND METHODS

A field experiment was conducted during *kharif* 2010 in rice (cv. GR 12) at Main Rice Research Station, Anand Agricultural University, Nawagam. The soil of experimental site was medium in organic carbon, available nitrogen, phosphorus and high in available potassium. The variety was sown in nursery during first week of August with seed rate of 5 kg/ha. The plot was kept

ready through tractor drawn cultivator for preparing nursery beds. The beds of 10 meters long and 1 meter wide were prepared. 500 kg FYM was mixed with soil and beds were leveled perfectly. The seeds treated with *thiuram* @ 3 g/kg of seed were sown in the 10 cm apart in line and covered with powder form of FYM. The nursery obtained healthy seedlings of two leaves within 10-12 days. Proper care of nursery beds was taken by proper watering and weeding in the nursery as and when necessary.

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 and 45 DATP) (W_2), two conoweeding at 10 and 20 DATP (W_3), Three conoweeding at 10, 20 and 30 DATP (W_4), Four conoweeding at 10, 20, 30 and 40 DATP (W_5), Butachlor @ 1.5 kg/ha at 5 DATP (W_6), Butachlor @ 1.5 kg/ha at 5 DATP + one conoweeding at 30 DATP (W_7), Butachlor @ 1.5 kg/ha at 5 DATP + one HW at 30 DATP (W_8), Pyrazosulfuron @ 25 g/ha at 10-12 DATP (W_9) and Fenoxaprop-p-ethyl @ 70 g/ha at 10-12 DATP (W_{10}). Pre-emergence and post-emergence herbicides were sprayed with Knapsack sprayer fitted with flat fan nozzle using 500 liter of water per ha.

Intensity of total weed (number/m²) and weed dry biomass of total weeds (g/m²) was measured at 25 and 50 days after transplanting. At Harvest, the observations were recorded on number of grains per panicle, panicle length (cm), panicle weight (g), test weight (g), grain yield (kg/ha) and straw yield (kg/ha). Weed Index (%) and Weed Control Efficiency (%) were worked out as per the formula suggested by Gill and Kumar (1969) and Kondap and Upadhyay (1985), respectively.

RESULTS AND DISCUSSION

Effect of different treatments on weeds

Among the grassy weeds, most dominant weed flora *Echinochloa crus-galli* L.

(31 %) and *Cynodon dactylon* L. (22 %) were found in field experiment, whereas *Cyperus rotundus* L. (18 %) and *Cyperus irida* L. (15 %) among sedges and *Eclipta alba* L. (9 %) and *Amisophacelus cucuttala* L. (5 %) among broad leaf weeds were reported in the experiment. The results are in consonance with the results of Ravishankar *et al.* (2008) and Reddy (2010). Ravishankar *et al.* (2008) reported that the wet seeded rice was infested with composite weed flora comprising of 51.5% grasses, 30.9% sedges and 17.5% broad-leaved weeds. Reddy (2010) reported that predominant weed species in the direct seeded rice were *Echinochloa crus-galli* (L.) under grasses; *Cyperus difformis* (L.) and *Fimbristylis miliacea* (L.) under sedges and *Eclipta alba* (L.) Hassak and *Ammania baccifera* (L.) under the broad leaved weeds.

At 25 and 50 days after transplanting, significantly the lowest weed dry bio-mass and number of total weed counts were registered under the treatment of three hand weeding carried out at 15, 30 and 45 DATP (W₂) as compared to other weed management treatments (Table 1). At 50 DATP, significantly lower total weed dry bio-mass registered under the treatment of three hand weeding carried out at 15, 30 and 45 DATP (W₂) was remained at par with the treatments of pre emergence application of butachlor @ 1.5 kg/ha at 5 DATP + one HW at 30 DATP (W₈) and four conoweeding at 10, 20, 30 and 40 DATP (W₅). Significantly maximum weed dry bio-mass were recorded in weedy check (W₁) at 50 DATP. The present results are in close association with the findings of Moody and Mukhopadhyay (1982) and Saha *et al.* (1999).

At 25 DATP, it is cleared from the data that treatment of three hand weeding carried out at 15, 30 and 45 DATP (W₂) had the maximum Weed Control Efficiency (WCE) followed by the treatments of four conoweeding at 10, 20, 30 and 40 DATP (W₅), pre-emergence application of butachlor

@ 1.5 kg/ha at 5 DATP + one HW at 30 DATP (W₈), post emergence application of pyrazosulfuron @ 25 g/ha at 10-12 DATP (W₉), butachlor @ 1.5 kg/ha at 5 DATP + one conoweeding at 30 DATP (W₇) and butachlor @ 1.5 kg/ha at 5 DATP (W₆). Weed control efficiency varied between 69.5 to 100 per cent. Dutta *et al.* (2005) reported that hand weeding twice at 21 and 42 DAS recorded the highest weed control efficiency. Babar and Velayutham (2012) observed higher weed control efficiency in the treatment of application of butachlor @ 1 kg a.i. /ha as pre-emergence + 4 times conoweeding from 10 DAT at 10 days interval.

The weed index was observed to be significantly lower under the treatment of three hand weeding carried out at 15, 30 and 45 DATP (W₂) followed by the treatments of pre emergence application of butachlor @ 1.5 kg/ha at 5 DATP + one HW at 30 DATP (W₈), four conoweeding at 10, 20, 30 and 40 DATP (W₅), post emergence application of pyrazosulfuron @ 25 g/ha at 10-12 DATP (W₉), butachlor @ 1.5 kg/ha at 5 DATP + one conoweeding at 30 DATP (W₇), fenoxaprop-p-ethyl @ 70 g/ha at 10-12 DATP (W₁₀) and butachlor @ 1.5 kg/ha at 5 DATP (W₆). The weedy check (W₁) recorded the maximum weed index.

Effect of treatments on yield and yield attributes

Among the yield attributing characters recorded significantly higher panicle weight, panicle length, test weight and number of grains per panicle under the treatment of three hand weeding carried out at 15, 30 and 45 DATP (W₂), which was remained at par with the treatment of pre emergence application of butachlor @ 1.5 kg/ha at 5 DATP + one HW at 30 DATP (W₈), four conoweeding at 10, 20, 30 and 40 DATP (W₅), post emergence application of pyrazosulfuron @ 25 g/ha at 10-12 DATP (W₉) and butachlor @ 1.5 kg/ha at 5 DATP + one conoweeding at 30 DATP W₇ (Table 2).

Significantly higher grain and straw yield of rice was recorded under treatment of three hand weeding carried out at 15, 30 and 45 DATP (W_2), which was remained at par with the treatments of pre emergence application of butachlor @ 1.5 kg/ha at 5 DATP + one HW at 30 DATP (W_8), four conoweeding at 10, 20, 30 and 40 DATP (W_5), post emergence application of pyrazosulfuron @ 25 g/ha at 10-12 DATP (W_9) and butachlor @ 1.5 kg/ha at 5 DATP + one conoweeding at 30 DATP (W_7) (Table 2 and Figure 1). Significantly the lowest grain yield was recorded under weedy check (W_1), which might be due to higher infestation of weeds in the plot resulted in strong competition of weeds with the crop for various growth factors (moisture, light, nutrients and space). The present results are in close association with the findings of Kaithiresan and Manoharan (2002), Kumar *et al.* (2009), Moody and Mukhopadhyay (1982) and Saha *et al.* (1999).

CONCLUSION

Maximum grain yield, straw yield, yield attributes characters and lowest weed population under SRI (System of Rice Intensification) was observed under the treatment of three hand weeding carried out at 15, 30 and 45 DATP. Under labour crises (scarce, costly and not timely available) situations, it is recommended that application of post emergence of pyrazosulfuron @ 25 g/ha in 500 litre water at 10-12 DATP or pre emergence application of butachlor @ 1.5 kg/ha in 500 litre water at 5 DATP integrated with one hand weeding at 30 DATP was found effective under middle Gujarat condition.

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Table 1: Effect of weed management treatments on intensity of total weeds, weed dry biomass of total weeds, WI and WCE at different stages.

Treatments	Intensity of Total Weeds (Number/m ²)		Weed Dry Biomass of Total Weeds (g/m ²)		WI (%)	WCE (%)
	At 25 DATP	At 50 DATP	At 25 DATP	At 50 DATP		
W ₁ -Weedy check	9.71 ^a (93.75)	13.51 ^a (181.75)	87.60 ^a	145.69 ^a	40.95	0.00
W ₂ -Weed free (three HW at 15, 30 & 45 DATP.)	2.17 ^g (3.75)	3.72 ^g (13.00)	5.18 ^h	39.63 ^f	0.00	76.38
W ₃ -Two conoweeding at 10 & 20 DATP	6.53 ^b (41.75)	9.97 ^b (98.75)	44.98 ^b	88.17 ^b	14.23	40.92
W ₄ -Three conoweeding at 10, 20 & 30 DATP	4.29 ^d (17.50)	7.95 ^c (62.25)	26.86 ^d	70.30 ^c	13.19	53.45
W ₅ -Four conoweeding at 10, 20,30 & 40 DATP	2.82 ^f (7.00)	4.58 ^f (20.25)	9.23 ^g	48.90 ^e	6.68	71.92
W ₆ - Butachlor @ 1.5 kg ha ⁻¹ at 5 DATP	5.06 ^c (24.75)	6.57 ^d (42.25)	26.69 ^d	61.40 ^d	12.50	63.50
W ₇ - Butachlor @ 1.5 kg ha ⁻¹ at 5 DATP + one conoweeding at 30 DATP	4.60 ^{cd} (20.25)	5.74 ^e (32.00)	24.72 ^d	57.48 ^d	8.36	67.69
W ₈ -Butachlor @ 1.5 kg ha ⁻¹ at 5 DATP +one HW at 30 DATP	3.84 ^e (13.75)	4.92 ^f (23.25)	13.68 ^f	47.97 ^e	6.46	71.97
W ₉ - Pyrazosulfuron @ 25 g ha ⁻¹ at 10-12 DATP	4.38 ^d (18.25)	6.39 ^{de} (40.00)	20.01 ^e	57.44 ^d	6.87	66.81
W ₁₀ - Fenoxaprop-p-ethyl @ 70 g ha ⁻¹ at 10-12 DATP	6.82 ^b (45.75)	8.24 ^c (67.00)	38.30 ^c	61.62 ^d	12.33	56.83
S.Em. ±	0.16	0.23	1.14	2.44		
C. D. at 5 %	Sig.	Sig.	Sig.	Sig.		
C. V. %	6.64	6.40	7.70	7.20		

Note: Figures in parentheses are original values. All figures subjected to transformed values to square root $\sqrt{(X+1)}$. 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

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

Treatments	Number of Grains Per Panicle	Panicle Length (cm)	Panicle Weight (g)	Test Weight (g)	Grain Yield (kg/ha)	Straw Yield (kg/ha)
W ₁ - Weedy check	149.75 ^c	18.42 ^c	1.98 ^c	14.05 ^c	2945 ^c	3473 ^c
W ₂ - Weed free (three HW at 15, 30 & 45 DATP.)	239.25 ^a	24.50 ^a	3.38 ^a	17.35 ^a	4988 ^a	5491 ^a
W ₃ - Two conoweeding at 10 & 20 DATP	199.75 ^b	21.00 ^b	2.94 ^b	14.90 ^{bc}	4278 ^b	4579 ^b
W ₄ - Three conoweeding at 10, 20 & 30 DATP	215.75 ^{ab}	22.38 ^{ab}	2.83 ^b	15.33 ^{abc}	4330 ^b	4818 ^b
W ₅ - Four conoweeding at 10, 20, 30 & 40 DATP	226.00 ^a	23.28 ^{ab}	3.15 ^{ab}	17.03 ^a	4655 ^{ab}	5102 ^{ab}
W ₆ - Butachlor @ 1.5 kg ha ⁻¹ at 5 DATP	217.50 ^{ab}	22.53 ^{ab}	3.01 ^{ab}	16.95 ^{ab}	4364 ^b	4846 ^b
W ₇ - Butachlor @ 1.5 kg ha ⁻¹ at 5 DATP + one cono weeding at 30 DATP	219.00 ^{ab}	22.63 ^{ab}	3.19 ^{ab}	17.00 ^a	4571 ^{ab}	5013 ^{ab}
W ₈ - Butachlor @ 1.5 kg ha ⁻¹ at 5 DATP + one HW at 30 DATP	226.75 ^{ab}	23.45 ^{ab}	3.21 ^{ab}	17.15 ^a	4665 ^{ab}	5123 ^{ab}
W ₉ - Pyrazosulfuron @ 25 g ha ⁻¹ at 10-12 DATP	225.00 ^a	23.00 ^{ab}	3.17 ^{ab}	17.13 ^a	4645 ^{ab}	5096 ^{ab}
W ₁₀ - Fenoxaprop-p-ethyl@70 g ha ⁻¹ at 10-12DATP	219.00 ^{ab}	21.83 ^b	3.05 ^{ab}	16.68 ^{ab}	4373 ^b	4888 ^b
S.Em. ±	7.65	0.78	0.12	0.64	188.05	175.51
C. D. at 5 %	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
C. V. %	7.16	6.95	8.18	7.77	8.58	7.25

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

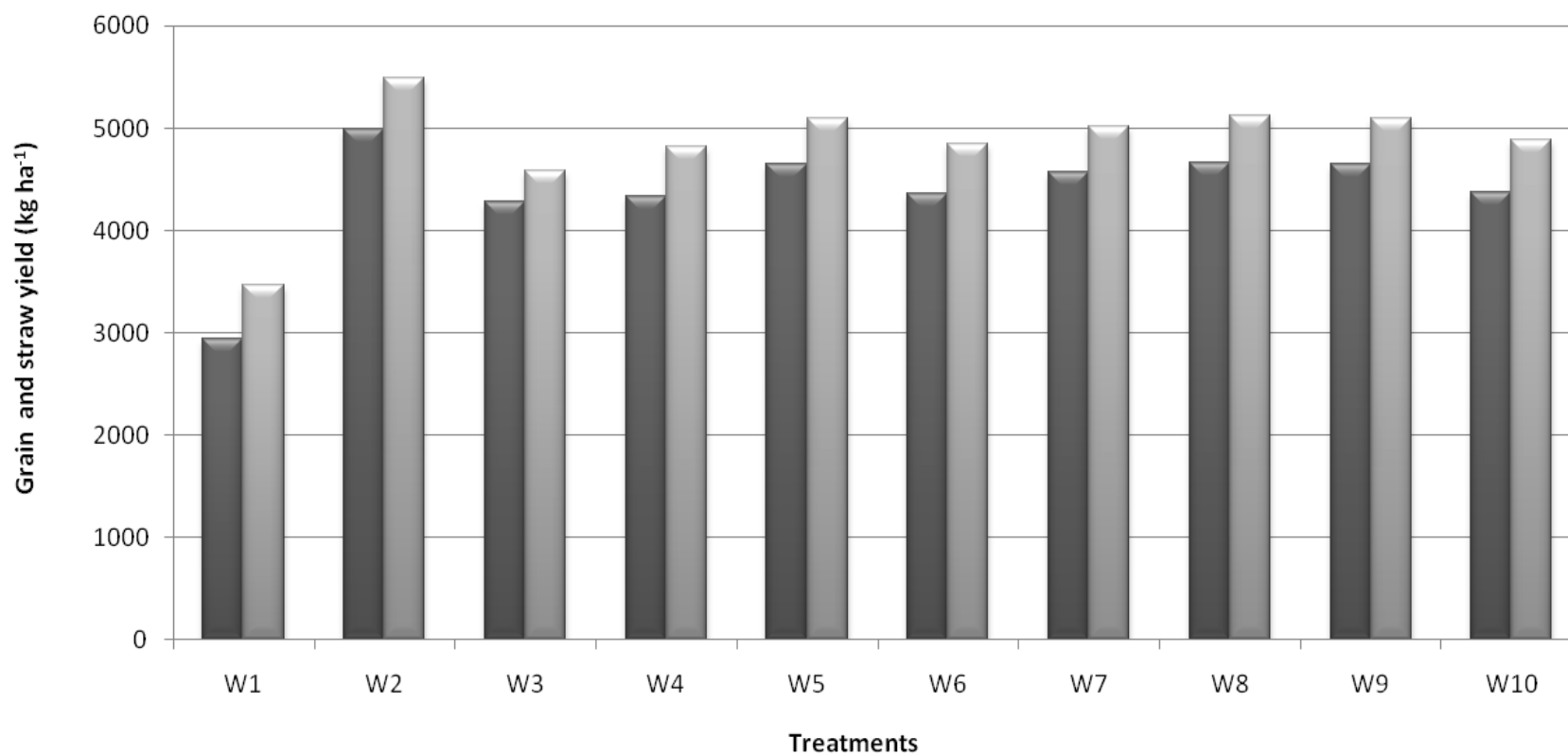


Fig. 1: Effect of different weed management treatments on grain and straw yield (kg/ha) at harvest

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