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Full Length Research Article

SUSTAINABLE WEED MANAGEMENT IN TRANSPLANTED RICE

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ABSTRACT

The Field experiments were conducted to study the influence of off-season land management in combination with various rice weed control measures on the weed competition and yield of rice in two different locations in late samba rice (September 2002 – January 2003) with the rice cultivar of CO 43. The experiments were taken up in a split-plot design with the main-treatments comprising off-season land management practices *viz.*, ploughing the land twice at an interval of 45 days in off-season and raising a green manure in the off-season and ploughing in situ during land preparation, which were compared with an untreated fallow during off-season. Weed control and cultural measured taken up during the rice cropping period viz., hand weeding twice (at 20 and 40 days after transplanting), butachlor @1.25 kg ha^{-1}, pendimethalin @1.5 kg ha^{-1}, butachlor @1.25 kg ha^{-1} + 2, 4-D @1.0 kg ha^{-1} (tank mix), pendimethalin @1.5 kg ha^{-1} + 2,4-D @ 1.0 kg ha^{-1} (tank mix) as pre-emergent application were compared with unweeded control as sub-treatments. Among the off-season land management practices, off-season ploughing (twice at an interval of 45days) excelled the other treatments by recording least weed count and weed dry matter production DMP (in location 1 and Location 2) and higher weed control index (in location 1 and location 2) favouring higher yield attributes and grain yield (4.38 t ha^{-1} in location 1 and 4.47 t ha^{-1} in location 2), which was comparable with raising green manure in the preceding off-season and incorporating it just before preparing the land. Leaving the land fallow during the preceding off-season encouraged the highest weed count and weed DMP and recorded lowest weed control index resulting in poor yield attributes and grain yield. Among the rice weed control measures, hand weeding twice at 20 and 40 DAT recorded the lowest weed count and weed DMP (in location 1 and location 2) with higher weed control index (in location 1 and location 2) favouring higher yield attributes and grain yield (5.20 t ha^{-1} in location 1 and 5.27 t ha^{-1} in location 2). This was on par with pre emergence application of butachlor @ 1.25 kg ha^{-1} + 2, 4-D @1.0 kg ha^{-1} (tank mix). These treatments were significantly superior than the rest of the treatments in reducing the weed infestation and ultimately increased grain yield. The unweeded controls recorded the highest weed count and weed DMP resulting in the lowest yield attributes and grain yield. Significant interaction effects between the main treatments and sub treatments were also observed.

INTRODUCTION

Tropical ecosystems are more fragile and therefore are more prone to weed invasion. The low land rice production in India is attributed to weed infestation and uncontrolled weeds caused 89.9 per cent reduction in grain yield as compared with weed free conditions (Manu Malik *et al*., 2002). Hand weeding was more effective method in controlling weeds in transplanted rice however it was expensive, time consuming difficult and often limited by scarcity of labourers in time. At the same time sole dependence on herbicides in the rice based cropping system, resulted in a shift towards perennial weeds like nut sedge, where as hand weeding alone lead to the dominance of grassy weeds and exclusive unweeded rice culture caused the preponderance of broadleaved weeds (Kathiresan, 2002). The complexity of this situation has resulted in a need to develop a wholistic weed control programme throughout the farming period that is sustainable in terms of enhanced productivity without eroding the resource base. Integration of the off-season land management such as off-season ploughing and raising and incorporation of green manures offer weed suppression in the succeeding crops (Gnanavel and Kathiresan, 2002).

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Table 1. Effect of off-season land management and weed control options on weeds in rice crop

Treatments	Total weed count on 60 DAT		Weed DMP on 60 DAT (kg ha^{-1})		Weed Control Index (%)	
	Location 1	Location 2	Location 1	Location 2	Location 1	Location 2
Main treatments						
Raising green manure in off-season	7.33 (53.61)	6.88 (47.25)	494.40	430.34	53.36 (64.36)	54.69 (66.59)
Off-season ploughing	7.05 (49.60)	6.23 (38.78)	445.57	384.03	55.48 (67.88)	56.94 (70.24)
Off-season fallow	9.39 (88.07)	8.66 (74.88)	1129.70	1004.27	-	-
CD (p=0.05)	0.66	0.63	60.35	59.26	3.02	3.01
Sub treatments						
Unweeded control	10.93 (119.46)	9.93 (98.63)	925.75	822.21	-	-
Two hand weeding (20 & 40 DAT)	5.89 (34.67)	5.46 (29.80)	530.78	444.26	51.78 (61.73)	53.71 (64.97)
Butachlor @1.25 kg ha^{-1}	7.97 (63.52)	7.53 (56.68)	740.73	700.19	43.05 (46.10)	43.62 (47.60)
Pendimethalin @ 1.5 kg ha^{-1}	8.79 (77.16)	7.78 (60.48)	803.10	764.40	40.45 (42.10)	42.64 (45.89)
Butachlor @1.25 kg ha^{-1} + 2,4-D @ 1.0 kg ha^{-1}	6.23 (38.76)	5.78 (33.40)	548.01	473.92	51.06 (60.49)	53.32 (62.63)
Pendimethalin @ 1.5 kg ha^{-1} + 2,4-D @1.0 kg ha^{-1}	7.00 (48.89)	6.55 (42.81)	609.93	532.32	55.93 (48.41)	49.61 (58.02)
CD (p=0.05)	0.71	0.68	76.87	64.31	3.43	3.45

(Figures in parenthesis are original values)

Table 2. Effect of off-season land management and weed control treatment on yield attributes and grain yield in rice

Treatments	No. of panicles Clump^{-1}		No. of filled grains panicle^{-1}		Grain yield (t ha^{-1})	
	Location 1	Location 2	Location 1	Location 2	Location 1	Location 2
Main treatments						
Raising green manure in off-season	5.64	5.76	68.18	68.90	4.22	4.29
Off-season ploughing	6.17	6.24	76.68	83.58	4.38	4.47
Off-season fallow	4.59	4.72	54.28	55.22	3.49	3.58
CD (p=0.05)	0.57	0.57	4.09	4.10	0.27	0.29
Sub treatments						
Unweeded control	3.45	3.58	49.78	50.69	2.50	2.60
Two hand weeding (20 & 40 DAT)	6.94	7.01	81.07	81.39	5.20	5.27
Butachlor @ 1.25 kg ha^{-1}	4.77	4.88	58.43	59.41	3.67	3.79
Pendimethalin @ 1.5 kg ha^{-1}	4.95	5.01	60.92	61.94	3.42	3.50
Butachlor @ 1.25 kg ha^{-1}+ 2,4-D @1.0 kg ha^{-1}	6.71	6.80	77.62	78.08	4.89	4.96
Pendimethalin @ 1.5 kg ha^{-1}+ 2,4-D @ 1.0 kg ha^{-1}	6.00	6.19	70.45	71.33	4.50	4.56
CD (p=0.05)	0.63	0.62	4.87	4.87	0.38	0.39

In this situation exploring the complementary effect from off-season land management with weed management practices may offer useful lead in managing weeds in succeeding rice crop.

MATERIALS AND METHODS

Field experiments were conducted in *late samba* (September 2002 – January 2003) simultaneously in two locations to study the influence of off-season land management in combination with various rice weed control measures on the weed competition and yield of rice. Location 1 was the Annamalai University experimental farm and location 2 was the Paradhur Village, which is situated 25 km away to the west of location 1. The off-season land management practices such as ploughing the land twice during summer raising a leguminous green manure crop during summer and ploughing it *in situ* at the time of land preparation were compared with leaving the land fallow during summer, as main treatments of a split-plot design. These treatments were taken up individually in strips of size 5 m x 25 m. In off-season ploughing the field was ploughed first and second ploughing was done after 45 days of first ploughing. In green manuring treatment green manure (*Indigofera tinctoria*) seeds were sown in respective strips and incorporated 12 days before transplanting of rice and in off-season fallow treatment the field strips were left fallow without any disturbance. In the ensuing rice crop, each strip that received a particular off-season treatment was superimposed with crop weed control measures in individual plots of size 5 m x 4 m.

These treatments compared as sub-treatments were hand weeding twice, butachlor at 1.25 kg ha^{-1}, pendimethalin @ 1.5 kg ha^{-1}, butachlor @1.25 kg ha^{-1} + 2, 4 – D @ 1.0 kg ha^{-1}(tank mix), pendimethalin @ 1.5 kg ha^{-1} + 2, 4-D @1.0 kg ha^{-1}(tank mix) and an unweeded control. Herbicides were applied in respective treatment plots as pre-emergence spray on 3 days after transplanting (DAT) with 500 liters ha^{-1} of water using knapsack sprayer fitted with flood jet nozzle. All the data were statistically analysed and the critical difference was worked out at 5 per cent probability as suggested by Panse and Sukhatme (1978). The original values recorded in weed counts were subjected to square root transformation and weed control index were subjected to Arc sin transformation before analysis.

RESULTS AND DISCUSSION

The dominant weed flora in both the experimental sites were *Cyperus rotundus, C. difformis, Fimbristylis littoratlis* and *Sphenoclea zeylanica*. However, weeds that occurred sporadically with lesser densities varied were *Leptochloa chinensis, Marsilea quadrifolia, Echinochloa* sp., *Bergia capensis and Eclipta* alba in Annamalai University experimental farm and *L. chinensis, M. quadrifolia, Echinochloa* sp., *Scirpus* sp. *and B. capensis* in Paradhur. Among the off-season land management practices compared ploughing twice at an interval of 45 days recorder the least weed counts and weed dry matter production, highest weed control indices favouring higher yield attributes and grain yield. Raising green manure in the preceding off-season was on par with off-season ploughing.

Leaving the land fallow during the off-season recorded the highest weed counts and weed dry matter production, least weed control indices favouring lower yield attributes and grain yield (Tables 1 and 2) ,as summer ploughing exposed tubers and rhizomes of the weeds in the hot summer months with an ultimate exhaustion of their food reserves and perennation potential. Ploughing the soil at the first instance helped the dormant seed to break their dormancy and sprout, whose seedling or established aerial growth were destroyed during the second ploughing. Because of this multitude destruction of the weed vegetation and its soil seed bank, off–season ploughing surpassed the other off- season land management practices in respect of weed suppression in the succeeding crops. These findings are in line with the earlier reports of Tewari and Singh (1991) and Gnanavel and Kathiresan (2002). Raising a green manure crop during the off-season and ploughing it *in situ*, just before land preparation also proved to suppress the weeds in the succeeding crops and was comparable with that of off-season ploughing. This could be due to the smothering effect of standing green manure (*Indigofera tinctoria*) crop on the emergence and growth of weeds in the offseason contributing for the weed seed bank in the soil and the improved soil health due to addition of organic matter and improved fertility status of the soil with an ultimate enhanced competitive ability of the crop. This finding is in line with the result of Gracy Mathew and Alexander (1995). Among the weed control options compared as sub-treatments, twice hand weeding recorded the least weed counts and weed dry matter production, highest weed control indices favouring higher yield attributes and grain yield. The superior performance could be attributed to manual removal of existing vegetation of all the weeds without sparing any one group or individual weeds. This finding is in line with the earlier reports of Navarez and Moody (1989). However,the performance of tank mix spray of butachlor @ 1.25 kg ha^{-1} plus 2,4-D @1.0 kg ha^{-1} was comparable with twice hand weeding and these treatments were significantly superior than the rest of the treatments. This may be due to reduced crop-weed competition particularly at early growth stages of the crop growth and enlarged spectrum of activity of the mixture due to inclusion of 2,4-D. These results are in conformity with the reports of Malik and Samunder singh (1996) and Gogoi *et al*. (2000).

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