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Integration of varying weed and pest management in rice based cropping system of Sornavari season

K Chelladurai**Abstract**

Field experiments were conducted to “Integration of varying weed and pest management in rice based cropping system of Sornavari season” at Department of agronomy, Annamalai university experimental farm, Annamalai Nagar during Sornavari (2010 march – July) with rice cultivars of ADT 43. The experiments were taken up in a split plot design with the main treatments viz., during Sornavari untreated fallow during off- season (M₁), allowing pigs into the puddle field for burrowing the soil for 3 days (M₂), duck scavenging in puddled field for 10 days (M₃), duck scavenging in cropped field (M₄), glyphosate spraying @ 1.0 kg ai ha⁻¹ at 45 days before transplanting (M₅), which were compared with an Weed control and cultural measures taken up during the compared with unweeded control (S₁), twice hand weeding at 20 and 40 DAT (S₂), brown manuring application @ 25 kg / ha⁻¹ (S₃). Interculturing with conoweeder using 30 and 45 DAS (S₄). Brown manuring + one hand weeding (S₅), and conoweeder + one hand weeding (S₆) were as sub treatments. Among the off- season practices compared as main treatments, duck scavenging in puddled field for 10 days excelled the other treatments registered significantly higher growth attributes and grain yield (3.97 t ha⁻¹) in Sornavari. Glyphosate spraying @ 2.0 kg ai ha⁻¹ 45 days before transplanting was next in order. Off- season ploughing 30 days before transplanting was also reduced the weed biomass and favored the grain yield significantly, when compared to leaving the land fallow in the off-season. Leaving the land fallow during the preceding off-season encouraged all types of weeds with the highest weed counts, weed dry matter production and lowest weed control index resulting in poor grain yield. Among the rice weed control measures conoweeder + one hand weeding was superior and was on par with brown manuring + one hand weeding recording higher growth attributes and grain yield (3.87 t ha⁻¹) in Sornavari. These treatments were significantly superior than the rest in reducing the weed infestation and ultimately increasing grain yield. Unweeded control recorded the highest weed counts, weed biomass resulting in the least grain yield. Significant interaction effects between the main treatments and sub treatments were also observed.

Keywords: Sornavari, duck scavenging, conoweeder, glyphosate and hand weeding

Introduction

Rice (*Oryza sativa* L.) is the main staple food crop of India, covering an area of about 44.6 million hectares (m ha) with a production of 90 million tonnes (mt) but the productivity level is very low (2.97 t ha⁻¹) and assumes food security in India, for more than half of the total population. To feed the exploding population, projection of India’s rice production target for 2025 A.D. is 140 mt which can be achieved only by increasing the population by over 2.0 mt per year in the coming decade. In contrast, recent slowdown of yields in irrigated rice based cropping system was noticed as a result of deterioration of soil health and decline in productivity level. Weed infestation in transplanted rice a critical stage reduces the yield to the extent of 15-45 percent. Among the weed flora associated *Cyperus rotundus*, *Cyperus iria*, *Echinochloa colonum*, *Marsilea quadrifoliata*, *Leptochloa chinensis* and *Bergia capensis* is more competitive and difficult to control. Research workers from time to time have suggested various cultural, mechanical, chemical and biological measures. As the production of food evolves towards greater sustainability, weed management system will be subjected to many internal constraints. So a systematic programming of weed management for the entire farming period through a series need in order to improve the efficient of farming system as a whole, with recent emphasis on herbicide use alternative options need to be explored. Diversification of agricultural activities which links farm based enterprises with the cultivation would help the farmer to get more income and generate additional employment and further supplement in pest - weed complex suppression. Farming system approach was observed to be a resource management strategy for achieving economic and sustainable agricultural production to meet the diverse requirement of farm household while preserving the resource base and maintaining

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high environmental quality (Mangala Rai, 2004) [4]. Duck rearing occupy an important position next to chicken farming in India. They contribute about 10% of the total poultry population and 6.7% of total eggs in the country. The Central Duck Breeding Farm under Ministry of Agriculture GOI was established in the year 1981 during the V five year plan with technical collaboration with UK to release high yielding duck varieties for the benefit of farming community. In general ducks are quite hardy more easily brooded, resistant to common avian diseases require less attention, thriving well in scavenging conditions. Therefore integration of ducks subsystem has cleared a path to resolve the problem of weed control which has been a major obstacle for organic rice farming. The comprehensive effect of duck - rice integration has six main effects viz., weeding effect, pest control effect, nutrient supplying effect, full time ploughing and muddying effect, golden snail control effect, rice stimulation effect.

Materials and Methods

Field experiments were conducted to “Integration of varying weed and pest management in rice based cropping system of Sornavari season” at Department of agronomy, Annamalai university experimental farm, Annamalai Nagar during Sornavari (2010 march – July) with rice cultivars of ADT 43. The experiments were taken up in a split plot design with the main treatments viz., during Sornavari untreated fallow during off- season (M_1), allowing pigs into the puddle field for burrowing the soil for 3 days (M_2), duck scavenging in puddled field for 10 days (M_3), duck scavenging in cropped field (M_4), glyphosate spraying @ 1.0 kg ai ha^{-1} at 45 days before transplanting (M_5), which were compared with an Weed control and cultural measures taken up during the compared with unweeded control (S_1), twice hand weeding at 20 and 40 DAT (S_2), brown manuring application @ 25 kg ha^{-1} (S_3). Interculturing with conoweeder using 30 and 45 DAS (S_4). Brown manuring + one hand weeding (S_5), and conoweeder + one hand weeding (S_6) were as sub treatments. The soil of the experimental field was clayey loam in texture with a pH of 7.3. The soil was low in available N (239 Kg ha^{-1}), medium in available P_2O_5 (20.3 Kg ha^{-1}) and high in available K_2O (312.8 kg ha^{-1}). Brown manuring-reusing of green manure in transplanted paddy fields and transplanting during first hand weeding.

Results

Plant height at 60 DAT

The observation on plant height recorded at 60 DAT in Sornavari are presented in table - 1. In both the crops the treatment exerted significant influence over the plant height. During the first season among the main treatment duck scavenging in puddled field at the time of land preparation favored taller plants during the cropping season viz., 89.06 cm in Sornavari. The interaction effect between off - season land management practices and crop weed control measures were also significant duck scavenging in puddled field followed by conoweeder + one hand weeding lead to the tallest plants 94.26 cm in Sornavari. Least plant height of 71.42 cm in Sornavari by unweeded control.

Number of tillers clump⁻¹

The data on number of tillers clump⁻¹ recorded at maximum tillering stage in Sornavari season are presented in table - 2. All the treatment significantly influenced the tiller number in

Sornavari seasons.

During the first season, among the off - season land management practices, duck scavenging in puddled field recorded the highest number of tillers clump⁻¹ viz., 14.14 in Sornavari duck scavenging in puddled and cropped field.

The interaction effect between off - season land management practices and rice weed control measures were also significant. Duck scavenging in puddled field followed by conoweeder + one hand weeding in recorded highest number of tillers clump⁻¹ viz., 16.85 in Sornavari and duck scavenging in puddled and cropped field. Off - season fallow followed by unweeded control in rice recorded least tillers number, 8.02 in Sornavari.

Leaf area index (LAI) at flowering stage

Data regarding leaf area index of the crop recorded at flowering stage in Sornavari seasons are presented in Table – 3. All the treatments significantly altered the leaf area index of the crop in both the season.

During the first season among the main treatment duck scavenging in puddled field at the time of land preparation recorded the highest leaf area index of 6.61 in Sornavari duck scavenging in puddled and cropped field.

Significant interaction was also observed among the off - season land management practices and crop weed control strategies. Duck scavenging in puddled field followed by conoweeder + one hand weeding recorded the highest leaf area index of 6.90 in Sornavari duck scavenging in puddled and cropped field. Least leaf area index of 2.82 in Sornavari recorded in off - season fallow followed by unweeded control in rice.

Crop dry matter production at harvesting stage

The observation recorded on crop dry matter production in Sornavari and Samba are presented in table - 4. All the treatments attained significance in influencing the crop dry matter production.

During the first season among the main treatment duck scavenging in puddled field during land preparation contributed for the highest crop dry matter during the succeeding cropping period (14.09 t ha^{-1} in Sornavari and duck scavenging in puddled and cropped field).

Off - season land management was observed to significantly interact with weed control during cropped period. The higher crop biomass was recorded in duck scavenging in puddled field at the timing into the field land preparation followed by conoweeder + one hand weeding (16.24 t ha^{-1} in Sornavari duck scavenging in puddled and cropped field). The least crop biomass of 8.70 t ha^{-1} in Sornavari recorded in off - season fallow (control) followed by unweeded control in rice.

Grain yield (t ha^{-1})

The data recorded on grain yield in Sornavari and Samba season are presented in table-5. All the treatments significantly influenced the grain yield in both the seasons.

During the first season among the main treatment duck scavenging in puddled field at the time of land preparation recorded the highest grain of 3.97 t ha^{-1} in Sornavari and duck scavenging in puddled and cropped field.

Interaction effect between off - season land management and rice weed control measures were also significant. Duck scavenging in puddled field at the time of land preparation followed by conoweeder + one hand weeding recorded higher

grain yield of 4.72 t ha⁻¹ in Sornavari duck scavenging in puddled and cropped field. The least grain yield of 1.56 t ha⁻¹ in Sornavari recorded in the off - season fallow control

followed by unweeded control in rice.

Results

Table 1: Effect of duck integration and weed control options on plant height at 60 DAT (cm) Sornavari season.

Sub Treatments	Sornavari					
	Main treatments					
	M ₁ Control	M ₂ Allowing pigs	M ₃ Duck scavenging in puddled field	M ₄ Duck Scavenging in cropped field	M ₅ Glyphosate application	Mean
S ₁ - Un weeded control	71.42	77.31	83.42	81.94	74.12	77.64
S ₂ - Twice Hand Weeding	78.40	84.30	90.70	87.24	81.51	84.43
S ₃ - Brown Manuring	74.59	80.58	86.47	84.55	77.50	80.74
S ₄ - Inter culturing with Conoweeder	75.26	81.75	87.38	85.46	78.31	81.63
S ₅ - Brown Manuring + one Hand Weeding	80.30	86.82	92.16	89.55	83.12	86.39
S ₆ - Conoweeder + One Hand Weeding	82.76	88.55	94.26	91.33	85.32	88.44
Mean	77.12	83.22	89.06	86.68	79.98	

(Figures in parenthesis indicate original values)

	Main treatments	Sub treatments	Interaction	
			M × S	S × M
SE _D	0.29	4.70	4.90	4.85
CD (p= 0.05)	0.58	9.30	9.80	9.70

Table 2: Effect of duck integration and weed control options on numbers of tillers clump⁻¹ Sornavari season.

Sub Treatments	Sornavari					
	Main treatments					
	M ₁ Control	M ₂ Allowing pigs	M ₃ Duck scavenging in puddled field	M ₄ Duck Scavenging in cropped field	M ₅ Glyphosate application	Mean
S ₁ - Un weeded control	8.02	10.30	12.58	11.80	9.45	10.43
S ₂ - Twice Hand Weeding	11.04	14.02	15.40	14.30	12.42	13.43
S ₃ - Brown Manuring	9.49	11.94	14.00	12.10	10.00	11.50
S ₄ - Inter culturing with Conoweeder	10.00	11.23	14.35	12.35	10.25	11.63
S ₅ - Brown Manuring + one Hand Weeding	12.06	14.84	16.50	15.00	13.02	14.28
S ₆ - Conoweeder + One Hand Weeding	12.25	14.20	16.85	15.48	13.40	14.43
Mean	10.47	12.75	14.94	13.50	11.42	

(Figures in parenthesis indicate original values)

	Main treatments	Sub treatments	Interaction	
			M × S	S × M
SE _D	0.24	0.29	0.50	0.49
CD (p= 0.05)	0.48	0.59	1.01	0.98

Table 3: Effect of duck integration and weed control options on leaf area index at flowering stage Sornavari season.

Sub Treatments	Sornavari					
	Main treatments					
	M ₁ Control	M ₂ Allowing pigs	M ₃ Duck scavenging in puddled field	M ₄ Duck Scavenging in cropped field	M ₅ Glyphosate application	Mean
S ₁ - Un weeded control	2.82	5.02	6.14	5.24	4.28	4.70
S ₂ - Twice Hand Weeding	3.70	5.79	6.84	5.92	4.92	5.43
S ₃ - Brown Manuring	3.08	5.32	6.44	5.55	4.56	4.99
S ₄ - Inter culturing with Conoweeder	3.15	5.50	6.51	5.60	4.62	5.07
S ₅ - Brown Manuring + one Hand Weeding	3.98	5.08	6.85	5.94	4.96	5.36
S ₆ - Conoweeder + One Hand Weeding	4.20	5.82	6.90	5.99	5.01	5.58
Mean	3.48	5.42	6.61	5.70	4.72	

(Figures in parenthesis indicate original values)

	Main treatments	Sub treatments	Interaction	
			M × S	S × M
SE _D	0.08	0.15	0.24	0.22
CD (p= 0.05)	0.16	0.32	0.47	0.45

Table 4: Effect of duck integration and weed control options on crop dry matter production (t ha⁻¹) Sornavari season.

Sub Treatments	Sornavari					
	Main treatments					
	M ₁ Control	M ₂ Allowing pigs	M ₃ Duck scavenging in puddled field	M ₄ Duck Scavenging in cropped field	M ₅ Glyphosate application	Mean
S ₁ - Un weeded control	8.70	9.78	12.10	10.64	9.52	10.15
S ₂ - Twice Hand Weeding	11.20	12.28	14.16	13.22	12.00	12.57
S ₃ - Brown Manuring	10.36	11.13	12.92	12.04	11.02	11.49
S ₄ - Inter culturing with Conoweeder	10.62	11.72	13.12	12.20	11.22	11.77
S ₅ - Brown Manuring + one Hand Weeding	12.82	13.21	16.01	14.92	13.02	13.99
S ₆ - Conoweeder + One Hand Weeding	12.15	13.92	16.24	15.92	13.60	14.36
Mean	10.97	12.00	14.09	13.15	11.73	

(Figures in parenthesis indicate original values)

	Main treatments	Sub treatments	Interaction	
			M × S	S × M
SE _D	0.24	0.28	0.52	0.51
CD (p= 0.05)	0.49	0.56	1.04	1.01

Table 5: Effect of duck integration and weed control options on grain yield (t ha⁻¹) Sornavari season.

Sub Treatments	Sornavari					
	Main treatments					
	M ₁ Control	M ₂ Allowing pigs	M ₃ Duck scavenging in puddled field	M ₄ Duck Scavenging in cropped field	M ₅ Glyphosate application	Mean
S ₁ - Un weeded control	1.56	2.23	3.12	2.54	2.10	2.31
S ₂ - Twice Hand Weeding	2.56	3.20	4.17	3.51	2.72	3.23
S ₃ - Brown Manuring	1.86	2.60	3.52	3.07	2.12	2.63
S ₄ - Inter culturing with Conoweeder	2.01	2.96	3.64	3.19	2.44	2.89
S ₅ - Brown Manuring + one Hand Weeding	3.04	3.54	4.63	4.08	3.28	3.71
S ₆ - Conoweeder + One Hand Weeding	3.21	3.87	4.72	4.17	3.37	3.87
Mean	2.37	3.07	3.97	3.43	2.67	

(Figures in parenthesis indicate original values)

	Main treatments	Sub treatments	Interaction	
			M × S	S × M
SE _D	0.11	0.07	0.16	0.15
CD (p= 0.05)	0.22	0.13	0.32	0.31

Discussion

Among the treatments, duck scavenging in puddled and transplanted field and allowing the pigs to burrow the field at the time of land preparation excelled all others, in reducing the population of *Marsilea quadrifoliata* and *Cyperus rotundus* that was contributing largely for the total weed count. This is because the ducks scavenging within the rows enabled the exposure of tubers and weeds and in turn, were fed by them. Moreover the movement of these water fowls in the inter row spaces frequently disturbed the soil, thus deprived germinated weed seeds to emerge and establish. This was earlier reported by (Alejar and Aragonés, 1989) [1]. Following duck integration, allowing pigs in the puddled field was next in order. This is because, the burrowing of the puddled field by pigs before transplanting of rice brought all the underground tubers of *Cyperus rotundus* to the surface, many of which were eaten by the pigs, other skimmed away before final land preparation and leveling. Thus, the treatment was very effective in depleting the soil reserve of tubers of *Cyperus rotundus* which were chiefly responsible for the perennation of the World's Worst Weed. This observation of

exhausting soil tubers reserves of tubers to *Cyperus rotundus* by pigs burrowing in rice, during the land preparation was reported earlier by Chinnamuthu, (1996) [3].

Glyphosate application as a blanket spray 1.0 kg ai ha⁻¹ over the weed vegetation during off - season, 45 days before land preparation as next in order in reducing the *Cyperus rotundus* population as the herbicide is known for its excellent translocation to underground tuber of *Cyperus rotundus* and interference with aromatic amino acid synthesis through EPSP pathway (Wangchengyuh, 2001) [5]. However the dormant tubers and daughter rhizomes that were left unhurt or partially damaged contributed for a lesser magnitude of control of *Cyperus rotundus* compared to allowing pigs for burrowing.

Similarly, the interaction effect of ducks scavenging during puddle condition followed by conoweeder + one hand weeding showed remarkable suppression of total weed population. This is because already the duck scavenging had suppressed the weed emergence up to flowering stage and further the subsequent hand weeding followed by conoweeder gave remarkable results on weed control. This is turn

favoured crop performance as evidenced from further the same main treatment supplemented by brown manuring + one hand weeding performing superior to twice hand weeding performing superior to twice hand weeding was found to be on par.

During the second season magnificent weed control in rice with particular impact of *Marsilea quadrifoliata* and *Cyperus rotundus*, the duck scavenging in puddle and cropped field was highly pronounced when coupled with conoweeder + one hand weeding. This might be due to soil disturbance offered by duck movement in the transplanted field, which suppressed the emerged weed seedlings and burying the exposed weed seed. This was earlier reported by (Cagauan, 1997) ^[2].

Conclusion

From the present investigation, it could be concluded that pre-season management practices such as duck scavenging in puddled and cropped field with weed control measures, like Conoweeding + one hand reading, followed by duck scavenging and allowing pigs during off -season, played very significant role in managing the weeds with improve the paddy growth characters and grin yield in wetland conditions.

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