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Effect of integrated rice - fish - azolla farming system on weed management in lowland rice fields

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Abstract : Field experiments were conducted at Annamalai University Experimental Farm, Annamalai Nagar during samba (Aug. -Jan.) and Navarai (Jan. -Apr.) seasons of 1995-96 to study the effect of component enterprises of an integrated rice farming system on weed control. Enterprises like fish culture (grass carp. Ctenopharyngodon idella (val.)@ 1 fish per m^2, in trenches occupying 15 per cent of rice area) and Azolla culture (*Azolla microphylla* @ 0.5 kg per m^2) were compared independently and in combination with rice as the main enterprise, each with and without the butachlor 1.5 kg ha^{-1}. The results revealed that integration of azolla and fish culture as component enterprises in rice farming along with the herbicide (butachlor) performed significantly superior in respect of weed control (weed control index of 61.85 and 65.11 per cent), grain yield of 4.45 t ha^{-1} and 4.4 t ha^{-1} during first and second season, respectively and net return of Rs. 58413 ha^{-1} for two seasons. (*Key Words : Rice, Weed management, Fish culture, Net return, Integrated farming system, Azolla.*).

Weeds are one of the principal causes of low rice production reducing the yield by 60-70 per cent (Rekha Ghosh *et al.*, 1994). Prevention of weed competition and provision of weed free environment is one of the vital strategies that helps in sustainable rice production. Herbicide alone or in combination with other components like azolla and fish culture provides better weed control and helps to realise the highest yield potential of a crop (Kannaiyan, *et. al.*, 1983). Dual culturing of azolla in rice fields besides suppressing weeds has the added benefit of fixing atmospheric N. Since azolla forms a mat over the water surface, it reduces the entry of sunlight and aeration into the soil-water system and so weed growth is suppressed (Lumpkin and Plucknett, 1980). The herbivorous feeding habits of many fish species in intensive rice cum fish culture has been reported to offer the opportunity of an ideal biological control. Several weed species were effectively controlled by fish culture (Das *et al.*, 1993).

Materials and Methods

Field experiments were conducted at Annamali University Experimental Farm, Annamalainagar during Samba (August - January) and Navarai (January - April) seasons. Medium and short duration rice cultivars viz., ADT 40 and ADT 36 were grown. Enterprises like fish culture (grass carp. *Ctenopharyngodon idella* (Val.) @ one fish per m^2, in trenches occupying 15 per cent of rice area) and azolla culture *Azolla microphylla* @ 0.5 kg per m^2) independently and in combination with rice as the main enterprise. (Each treatments with and without the butachlor 1.5 kg ha^{-1}). The treatments are as follows: T_1 - Rice alone (control), T_2 - Rice + azolla, T_3 - Rice + fish, T_4 - Rice + azolla + fish, T_5 - Rice + butachlor, T_6 - Rice + azolla + butachlor, T_7 - Rice + fish + butachlor and T_8 - Rice + azolla + fish + butachlor. The experiments were laidout in randomised block design replicated thrice. The soil of the experimental field was clay loam with pH of 8.0. The soil was low in available N (220.25 Kg ha^{-1}), medium in available P_2O_5 (22.0 Kg ha^{-1}) and high in available K_2O (312.75 Kg ha^{-1}). A fertilizer schedule of 150 kg N, 50 kg P_2O_5 and K_2O ha^{-1} was followed for medium duration variety and 120 Kg N, 38 Kg P_2O_5 and 38 kg K_2O ha^{-1} was followed for short duration variety. All the fertilizers were applied basally.

Weed control index (WCI) in each treatment was calculated by using the following formula suggested by Misra and Tosh (1976) and recorded in percentage.

$$WCI = \frac{a-b}{a} \times 100$$

Where,

a = Weed biomass of weedy check plot.

b = Weed biomass of treated plot.

Results and Discussion

Weed flora

Common weed of the experimental fields were *Leptochloa chinensis, Echinochloa colonum,*

Cyperus rotundus, Cyperus difformis, Fimbristylis littoralis, Rotala densiflora, Sphenoclea zeylanica, Eclipta alba and Marsilea quadrifolia. Out of them Echinochloa colonum and Sphenoclea zeylanica were dominant.

Weed Control index (%)

The data pertaining to weed control index in first and second season crop are presented in Table 1.

All the treatments exerted significant influence over weed control index in both seasons. Rice + azolla + fish + butachlor 1.5 Kg ha^{-1} (T_8) registered the highest weed control index of 61.85 per cent and 65.11 per cent in the first and second crop respectively. The treatment, rice + butachlor 1.5 Kg ha^{-1} (T_3) was observed to be on par with rice + azolla + fish (T_4). In both the seasons, the least weed control index was recorded in control (T_1).

Butachlor being a promising pre-emergence herbicide, effectively suppressed the germination and establishment of weed comprising grasses, sedges and broadleaved weeds, early in the season. Superior performance of butachlor in suppressing weed establishment at early stages of the crop is in conformity with the reports of Sharma and Singh (1981). At later stages, when the herbicide started dissipation, the mat of azolla thallus on the standing water column in the field interrupted the light interception by weed seeds and seedlings that might emerge later and thereby suppressed late emerging weeds. Role of azolla in supplementing rice weed control had been emphasised by Kannaiyan *et al.*, (1983). The results of azolla inoculation improving rice yield are in consonance with the reports of Nazeer and Prasad (1984) and Singh and Singh (1995). The fishes later started feeding on the weeds particularly on grasses supplementing the weed control as suggested by Rekha Ghosh *et al.*, (1994). Between the treatment combinations compared with and without butachlor, the treatments with butachlor suppressed the weeds more effectively due to the reason that in the absence of pre-emergence herbicide the weed control effect complemented by component enterprises like azolla and fish could not be achieved to perfection as initial emergence of weeds were high and mat formation and fish growth rate were poor at that early stage.

Grain yield and economics

The data recorded on grain yield and economics in the first and second crop are presented in Table 2. Among the treatments, rice + azolla + butachlor 1.5 kg ha^{-1} recorded higher total grain yield of 10.23 t ha^{-1} for the both the seasons. Rice + Fish (T_3) recorded the lowest total grain yield of 7.11 t ha^{-1} in both the seasons. Among the weed control measures, rice + azolla + fish + butachlor 1.5 kg ha^{-1} (T_8) registered the highest net income of Rs.58413 ha^{-1} with two rice crops and the return per rupee invested of 3.12. Control (T_1) registered the least net income of Rs. 25584 and the return per rupee invested of 2.32.

Integrated farming system comprising rice, fish and azolla with application of pre-emergence herbicide butachlor 1.5 kg ha^{-1} registered the highest net return and return per rupee invested in both the seasons. Though the grain, straw and biological yields were significantly higher in the treatment rice + azolla + butachlor the same was able to fetch only a lesser net return and return per rupee invested. This is due to the fact that the return from fish yield was very high compared to the return from crop produce from 15 per cent of the land area utilized for accommodating trenches. Higher return due to dual culture of fish in rice fields was earlier reported by Das *et al.*, (1993). Considering the above findings, it could be concluded that azolla and fish culture when practiced as component enterprises of rice farming system compliment weed control synergistically. Hence, azolla and fish culture in rice along with butachlor 1.5 kg ha^{-1} could be suggested as a promising sustainable weed management as well as farming system approach.

References

Das, D.N., Bardhan Roy, S.K., and Biswas, S. (1993). Fish growth and natural fish food sources in deep water and boro rice cropping system in Eastern India. *Indian agric.*, **37**(1): 15-20.

Kannaiyan, S., Thangaraju, M. and Oblisami, G. (1983). Effect of azolla inoculation on weed growth in wetland rice. *IRRN*, **8**(4) : 21.

Lumpkin, T.K. and Plucknett, D.L., (1980). Azolla, botany, physiology and use as a green manure. *Economic Bot.*, **34** :111-153.

Misra, A., and Tosh, G.C. (1976). Chemical weed control studies on dwarf wheat. *J.Res., Orissa Univ., of Agric. and Tech.*, **10** : 1-6.

Nazeer, M. and Prasad, N.N. (1984). Effect of azolla application on the yield and soil properties. *Phykos*, **23**(1012) : 269-272.

Rekha Ghosh, Ghosh, B.C., Mitra, A., Jana, M.K. and Mitra, B.N. (1994). Techniques of rice - cumfish culture for increasing productivity in low lands. *Indian Fmg.*, **44**(4): 23-26.

Sharma, G. and Singh, R.P. (1981). Studies on rice weed competition under different methods of rice cultivation and weed control. In : Proc. Eighth Asian - Pacific Weed Sci. Conf., Bangalore. India. Nov. 22-29 Vol. II P. 109-111.

Singh, D.P. and Singh, P.K. (1995). Influence of rate and time of Azolla caroliniana inoculation on its growth and nitrogen fixation and yield of rice (*Oryza sativa*) *Indian J. Agric. Sci.*, 65(1) : 10-16.

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Table 1. Weed control index (%)

Treatments	Weed control index (%)	
	Samba	Navarai
T_1 - Rice alone (control)		
T_2 - Rice + Azolla	35.84 (34.30)	34.14 (31.50)
T_3 - Rice + Fish	25.54 (18.60)	27.88 (21.88)
T_4 - Rice + azolla + Fish	39.69 (40.79)	39.34 (40.19)
T_5 - Rice + butachlor	41.57 (44.02)	41.30 (43.57)
T_6 - Rice + Azolla + Butachlor	49.37 (57.57)	57.28 (60.89)
T_7 - Rice + Fish + Butachlor	43.87 (44.03)	45.00 (50.00)
T_8 - Rice + Azolla + Fish + Butachlor	51.85 (61.85)	53.79 (65.11)
SE_d	2.06	1.86
CD (P=0.05)	4.14	3.75

* Figure in parenthesis indicate the original values.

Table 2. Grain yield and Economics of weed management in rice farming system.

Treatments	Total grain yield (t ha^{-1})	Fish yield (kg ha^{-1})	Gross income (Rs. ha^{-1})	Net income (Rs. ha^{-1})	Return per rupee invested
T_1 - Rice - Rice alone (control)	7.50	-	44900	25584	2.32
T_2 - Rice - Rice + Azolla	9.09	-	55947	36451	2.87
T_3 - Rice - Rice + Fish	7.11	900	75173	48596	2.83
T_4 - Rice - Rice + azolla + Fish	8.14	900	81657	54900	3.05
T_5 - Rice + butachlor	9.70	-	59270	38954	2.94
T_6 - Rice - Rice + Azolla + Butachlor	10.23	-	62489	42173	3.07
T_7 - Rice - Rice + Fish + Butachlor	8.50	900	83850	56453	3.04
T_8 - Rice - Rice + Azolla + Fish + Butachlor	8.85	900	85990	58413	3.12

Data not statistically analysed

Rice grain @ Rs. 5.40/kg Fish @ 35.00 kg
Rice straw @ Rs. 0.25/kg Butachlor @ 150.00/litre