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EVALUATION OF YIELD AND YIELD PARAMETERS IN DIFFERENT RICE FARMING SYSTEMS AND WEED MANAGEMENT PRACTICES

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ABSTRACT

An experiment was undertaken in a farmer's field in Chidambaram Sathamangalam, Cuddalore district of Tamil Nadu, during *Navarai* 2021 to the evaluation of yield and yield parameters in different rice farming systems and weed management practices. The experiment was conducted in split plot design with four replications, two main treatments with different rice farming systems *viz,* M_1-Monocropping and M_2-Annamalai rice + fish + poultry farming system and three sub treatments with weed management practices *viz.*, S_1 – unweeded control, S_2 – twice hand weeding on 20 and 40 DAT, S_3 – pre emergence (PE) application through tank mix of butachlor (50 % EC) @ 1.25 kg a.i. ha^{-1}+ 2,4-DEE (38 % EC) @ 0.6 kg a.i. ha^{-1}. The results indicated that, in farming systems the Annamalai rice + fish + poultry farming system (M_2) show significant performance on the various yield parameters than rice monocropping (M_1). In weed management practices, twice hand weeding in on 20 and 40 DAT (S_2) recorded the highest yield parameters. It was followed by PE application through tank mix of butachlor (50 % EC) @ 1.25 kg a.i. ha^{-1} + 2,4-DEE (38 % EC) @ 0.6 kg a.i. ha^{-1} (S_3). The lowest yield parameters were registered in unweeded control (S_1). Among interactions, Annamalai rice + fish + poultry farming system along with two hand weedings on 20 and 40 DAT (M_2S_2) recorded significantly the highest yield parameters during *Samba* 2020. This was followed by Annamalai rice + fish + poultry farming system along with PE application through tank mix of butachlor (50 % EC) @ 1.25 kg a.i. ha^{-1} + 2,4-DEE (38 % EC) @ 0.6 kg a.i. ha^{-1} (M_2S_3) in *Navarai* 2021 cropping season. The season's lowest yield characteristics were observed in monocultures of rice grown without weed management (M_1S_1). By recording the maximum yield parameters during *Navarai* 2021, the Annamalai rice + fish + poultry farming system performs much better than rice monocropping.

Keywords: IFS, Annamalai rice + fish + poultry farming system, Rice monocropping, Yield parameters, Twice hand weeding, Butachlor + 2,4-DEE.

INTRODUCTION

Rice (*Oryza sativa* L.) is consumed as a staple food by more than 60 % of the current world population. (Maharajan *et al.,* 2014). Globally rice is cultivated on 167.13 Mha of arable land

with production and productivity of 782 Mt and 4.67 t ha^{-1}, respectively (FAO,2018). India is one of the leading producers of rice in the world and more than 100 million metric tons of rice was produced in 2019–2020 (Economic Survey, 2020–2021). According to the World Bank, 2020, there are 41,21,000 hectares of land that is cultivated, of which 1.5 million hectares are planted with rice (Tripathi, 2019). Rice is grown in Tamil Nadu, a state in the south, on an area of 2.7 M ha, producing 7.98 billion kg (Department of Agriculture, Cooperation and Farmers Welfare 2019). With a total rice growing area of 0.74 million hectares and a rice production of 1.67 billion kg, the Cauvery delta region also referred to as the "Granary of Tamil Nadu" contributes a significant portion of rice production in the Indian state of Tamil Nadu (Department of Economics and Statistics 2017). However, given the current population growth rate of 1.5%, the total amount of rice needed by the world's expanding population by 2025 is expected to be roughly 125 million tonnes (Dey et al., 2020). Low yielding cultivars, weed infestation, unfavourable water and fertiliser management, and pest and disease infestation are all blamed for India's low land-based rice output. According to the farming community, the Indian government developed a number of training programmes to help small and marginal farmers secure their livelihoods and to support agriculture and animal output (Behera et al., 2013; Mahapatra and Behera, 2011).

IFS in the context of mixed farming systems has brought attention to these modern, specialised, intensive farming techniques that have an impact on the diversity of weed flora and fauna. Farmers with limited resources are more vulnerable to weather and market variations as a result of their dependence on fewer agricultural products (Manjunath et al., 2018; Paramesh et al., 2019; Paramesh et al., 2018).

Particularly for small-farmers, this integrated agricultural system method gains increased significance and also it raises the food standards of resource-poor farmers and generates worthwhile employment while reducing pesticide use and environmental harm and maintaining sustainability. Additionally, it raises the food standards of resource-poor farmers and generates worthwhile employment while reducing pesticide use and environmental harm (Kathiresan et al., 2001; Gunasekaran and Kathiresan, 2003).

MATERIALS AND METHODS

The present study was carried out during *Navarai* 2021 (January 2021-April 2021) in Chidambaram Sathamamgalam, Cuddalore district of Tamil Nadu on the evaluation of yield and yield parameters in different rice farming systems and weed management practices. The experiment has done in split plot design with two different rice farming systems *viz.,* Rice monocropping (M_1) and Annamalai rice + fish + poultry (M_2) as main plots and with three weed management strategies sub plot with unwedded control (S_1), twice hand weeding on 20 and 40 DAT (S_2) and pre emergence(PE) application through tank mix of butachlor 50 % EC @ 1.25 kg a.i. ha^{-1} and 2,4-DEE 38 % EC @ 0.6 kg a.i. ha^{-1} (S_3). As a test variety, ADT 36 is long duration rice cultivar, was ccultivated. A plotted layout with irrigation and drainage systems was done after the field was levelled. Field trenches of 20 x 1 x 1 m dimensions in an area of 20

m^2 were dug in the Annamalai rice + fish + poultry farming system for fish shelter in the various treatments, which represents roughly 10 % of the plot. In each plot, 6 x4x2 feet with the dimensions of poultry cages were erected, supported by 8 feet concrete poles, 4 feet were buried in the ground. The formula Donald (1962) provided was used to determine the harvest index for each treatment. The agricultural systems' economics of production were also calculated and reported. Following an analysis of variance, the experimental results were statistically examined, and the least significant difference was calculated at a probability level of 5%.

RESULTS AND DISCUSSION

Effect on no. of panicles and no. of filled grains

The findings in **Table 1** demonstrated, among the different farming systems evaluated, Among the different farming systems practices, Annamalai rice+ fish + poultry (M_2) has registered the highest number of panicles of 295 m^{-2} and no. of filled grains 93 $panicle^{-1}$ and the lowest number of panicles of 277 m^{-2} and no. of filled grains 81 $panicle^{-1}$ during *Navara 2021* as recorded in rice monocropping system (M_1).

Among the weed management practices investigated, two hand weedings on 20 and 40 DAT (S_2) recorded the highest number of panicles and no. of filled grains panicle were recorded as 336 m^{-2} and 94 $panicle^{-1}$ respectively during *Navarai* 2020. This was followed by PE application through tank mix of butachlor (50 % EC) @ 1.25 kg a.i. ha^{-1} + 2,4-DEE (38 % EC) @ 0.6 kg a.i. ha^{-1} (S_3) registered number of panicles and no. of filled grains $panicle^{-1}$ were recorded as 315 m^{-2} and 89 $panicle^{-1}$ respectively during the cropping season. Regardless of the stages of crop growth the unweeded control (S_1) resulted with the lowest number of panicles of 207 m^{-2} and no. of filled grains 78 $panicle^{-1}$ during *Navarai* 2021. With respect to the interactions, the highest number of panicles and no. of filled grains $panicle^{-1}$ were record of 346 m^{-2} and 102 $panicle^{-1}$ during *Navarai* 2021 were resulted with Annamalai rice+ fish + poultry farming system with two hand weedings on 20 and 40 DAT (M_2S_2) during *Navarai* 2021. This was followed by Annamalai rice+ fish + poultry farming system along with PE application through tank mix of butachlor (50 % EC) @ 1.25 kg a.i. ha^{-1} + 2,4-DEE (38 % EC) @ 0.6 kg a.i. ha^{-1} (M_2S_3). With rice monocropping under unweeded control, this season's lowest numbers of panicles (199 m^{-2}) and full grains (77 $panicle^{-1}$) were recorded (M_1S_1). The test weight did not significantly differ across the treatments. Less competition between crop and weeds may account for the increased production in weed control treatments i.e. in treated plots where weeds were significantly reduced, hand weeding at 20 and 40 DAT (Lhungdim et al., 2019). Kuotsu and Singh (2020) it was found that regardless of the agricultural practices employed, the crop's yield can be enhanced by twice as much by weeding at 20 and 40 DAT.

Grain yield and Straw yield

Among the different farming systems practices, Annamalai rice + fish + poultry (M_2) registered significantly highest grain yield, straw yield of 4,447 kg ha^{-1}, 6,944 kg ha^{-1} respectively

during *Navarai* 2021. The lowest grain yield of 3,653 kg ha^{-1} and straw yield of 6,433 kg ha^{-1} during cropping season was recorded under rice monocropping system (M_1).

Among the weed management practices investigated, two hand weedings on 20 and 40 recorded the highest grain yield of 5,267 kg ha^{-1} and straw yield 7,751 kg ha^{-1} during *Navarai* and this was followed by PE application through tank mix of butachlor (50 % EC) @ 1.25kg a.i. ha^{-1} + 2,4-DEE (38 % EC) @ 0.6 kg a.i. ha^{-1} (S_3). The lowest grain yield and straw of 2,348 kg ha^{-1}, 5,059 kg ha^{-1} during *Samba* 2020 respectively were recorded under unweeded control (S_1).

With respect to the interactions, Annamalai rice+ fish + poultry farming system with two handweedings on 20 and 40 DAT (M_2S_2) recorded the highest grain yield of 5,962 kg ha^{-1} and 8,049 kg ha^{-1} of straw yield during *Navarai* 2021 and this was followed by Annamalai rice + fish + poultry farming system along with PE application through tank mix of butachlor (50 % EC) @ 1.25 kg a.i. ha^{-1} + 2,4-DEE (38 % EC) @ 0.6 kg a.i. ha^{-1} (M_2S_3). The lowest grain yield and straw yield of 2,289 kg ha^{-1} and 4,834 kg ha^{-1} were respectively recorded during *Navarai* 2021 under rice monocropping under unweeded control (M_1S_1). The harvest index indicates no discernible change between the treatments when compared.

The Annamalai rice+ fish+ poultry (M_2) farming system outperformed other arming systems in terms of maximum grain yield, straw yield, biological yield, number of panicles, and number of full grains. This may be due to the use of fish and poultry in agricultural practices, which may result in regular nutrient additions to the crop, enhancing crop output and productivity. (Dwivedi et al., 2017; Kathiresan, 2021).

Table 1. Effect of farming systems and weed management on yield parameters

Treatment	No. panicles m^{-2}	No. of filled grains $panicle^{-1}$	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Harvest index
Main treatment					
M_1	277	81	3653	6433	36.93
M_2	295	93	4447	6944	39.69
S.Ed	1.97	0.61	43.69	46.19	-
CD (p=0.05)	6.27	1.93	139.04	46.19	-
Sub treatment					
S_1	207	78	2348	5059	35.09
S_2	336	94	5267	7751	40.58
S_3	315	89	4534	7256	39.26
S.Ed	2.09	0.50	39.54	46.04	-
CD (p=0.05)	4.54	1.09	86.15	100.31	-

(Figures in parenthesis indicates original values)

Economics

Among the main treatments Annamalai rice+ fish+ poultry farming systems recorded the highest net income and BCR *viz.*, ₹ 8,28,750 and 1.85 and it was followed by ice monocropping.It might be because crop fertilisers are added, weeds are controlled, and fish and poultry products

bring in more money. The Annamalai integrated farming system efficiently uses the land to produce more money than rice monoculture, according to the economics of agricultural systems (Kathiresan, 2020). Additionally, Jayathi et al. (2000) studied on the integrated farming system supports it.

Among the weed management practices, twice hand weeding on 20 and 40 DAT results the higher net income and BCR of ₹ 4,49,316 and 1.70 and it was followed by PE application through tank mix of butachlor (50 % EC) @ 1.25 kg a.i. ha^{-1} + 2,4-DEE (38 % EC) @ 0.6 kg a.i. ha^{-1} (S_3). The lowest net income and BCR of 52,138 and 1.22 during *Navari* 2021 respectively were recorded under unweeded control (S_1). With respect to interactions, Annamalai rice+ fish + poultry farming system with two handweedings on 20 and 40 DAT (M_2S_2) recorded the highest net income and BCR of ₹ 12,73,415 and 1.85 and it was followed by Annamalai rice + fish + poultry farming system along with PE application through tank mix of butachlor (50 % EC) @ 1.25 kg a.i. ha^{-1} + 2,4-DEE (38 % EC) @ 0.6 kg a.i. ha^{-1} (M_2S_3). The net income and BCR of ₹ 27,957 and 0.70 were respectively recorded during *Navarai* 2021 under rice monocropping under unweeded control (M_1S_1).

The harvest index reveals no noticeable change between the treatments. By recycling by-products and leftovers from various system components, IFS was able to boost net profitability and cut production costs. Implementing IFS can reduce input costs by encouraging resource flow and integrated pest and nutrient management, especially for the use of essential inputs like fertilizers, insecticides, and herbicides. A daily income backed by components may be provided to small and marginal farmers by the improved product diversity in IFS (Reddy and Biddappa, 2000). According to research conducted by Deepthi Kiran and Subramnyam (2010) two hand weedings are superior than one because they eradicate weeds from the field more regularly and lessen weed competition.

Table 3. Effect of treatments on economics

Treatment	Gross income (₹)	Net income (₹)	Benefit-Cost ratio
M_1S_1	67,677	27,957	0.70
M_1S_2	1,16,658	71,538	1.59
M_1S_3	1,06,203	64,653	1.56
M_2S_1	11,99,713	7,58,328	1.72
M_2S_2	12,73,415	8,26,630	1.85
M_2S_3	12,38,618	7,95,404	1.79

Conclusion

The study found that Annamalai's rice growing methods offer greater economic advantages because they produce higher yield metrics than rice monoculture. The yield

parameters or financial returns produced by pre-emergence herbicides are not comparable to twice-manual weeding on 20 and 40 DAT.

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