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STUDIES ON THE INTEGRATED NUTRIENT AND WEED MANAGEMENT PRACTICES ON GROWTH , YIELD AND ECONOMICS OF RICE (*ORYZA SATIVA* L.)

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Abstract

A comprehensive study was made in irrigated rice to optimise the integrated nutrient and weed management practices for augmenting rice productivity, at Annamalai University, Experimental Farm, Annamalai Nagar, Tamil Nadu, India. The experiment was laid out in split plot design with three replications. The details of the treatment in main plots are M_1 – Un weeded control, M_2- Hand weeding (HW) twice at 20 and 40 DAT (Farmers practice), M_3 - Butachlor 1.25 kg a.i ha^{-1} + one hand weeding (25 DAT), M_4 – Pretilachlor 0.75 kg a.i ha^{-1} + one hand weeding (25 DAT) and the sub plots S0 – Absolute control (no organic and inorganics), S_1 – RDF through inorganic fertilizers (150 : 50 : 50 kg N, P_2O_5, K_2O), S_2 – 75% recommended dose of N + recommended dose of P and K + 25 % N on equivalent basis of composted vermicompost, S_3 - 75% recommended dose of N + recommended dose of P and K + 25 % N on equivalent basis of composted pressmud, S_4 – 75% recommended dose of N + recommended dose of P and K + 25 % N on equivalent basis of water hyacinth compost. The results of the study evidently proved that application of pre- emergence herbicide of pretilachlor 0.75 kg a.i. ha^{-1} + one hand weeding at 25 DAT along with application of 75% recommended dose of N + recommended dose of P and K (112.5 : 50 :50 kg N, P_2O_5 and K_2O ha^{-1}) + 25% N on equivalent basis of vermicompost (1400 kg ha^{-1}) as an agronomically efficient , eco friendly and economically viable technology for improving growth, yield and economics of rice . The lowest values for plant height, LAI at flowering, No. of tillers hill^{-1}, and DMP and yield attributes and yield was observed in the treatment M_1S_0 (unweeded control x no organic / inorganics) at all the stages of observation However, in both the crops treatment M_2 S_0 was statistically on par with M_1S_0 at 20 DAT.

***Key Words*:** Integrated nutrient and weed management, Rice, Growth ,yield attributes, yield and economics.

Introduction

"Rice is life" is the theme of United Nations for the "International year of Rice 2004 (IYR 2004)" for the second time (first in 1966) in the history of a single crop because it is the most predominant stable food crop of more than half of the world's population. . It provides about 27 per cent of the dietary energy and 20 per cent of dietary protein for the world population. World demand for rice by the year 2025 is estimated to be about 765 million tonnes as against the present production of 556 million tonnes (Ravichandran and Singh, 2005). At global level, rice is grown in an area of 158.10 million hectares with a production of 447.42 million tonnes and having the productivity of 4.22tha^{-1} (USDA, 2010). India has the largest acreage under rice of 44 million hectares with a production of about 141 million tonnes. However, the national productivity of rice is 3.21 t ha^{-1}. In Tamil Nadu, it is cultivated in an area of 21 lakh hectares with the production and productivity of 50.40 lakh tonnes and 2.82 t ha^{-1}, respectively (Anonymous, 2010). The reasons for low rice yields are many and diverse in nature, inefficient utilization of applied nitrogen, ill effects of cloudy weather on photosynthetic activity of rice in monsoon season, heavy infestation of weeds (Subramanian, 2003). To meet the food demand of ever increasing human population, it is imperative to maximize the productivity of rice, the staple food, as land and water are limited for extending

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the area under rice (Siddiq, 2000). The green revolution had gradually turned into a "greedy revolution" (Swaminathan, 2002) as evident from the indiscriminate use of inorganic inputs to attain higher productivity. Excessive use of high analysis synthetic inputs, such as chemical fertilizers and pesticides in the intensive rice bowls, will likely be resulted in resource degradation and environmental pollution with adverse effects on human health, biotic and abiotic ecosystem (IRRI, 2003). Nitrogen is the kingpin for any fertilizer management programme in rice cultivation and is the universal key element for realizing the yield potential of high yielding rice varieties in Indian soils. Fertilizer N use efficiency various 18 to 40 percent in different soils, because applied inorganic N hurriedly lost from soil by ammonia volatilization, de nitrification and runoff (Natarajan and Pusphavalli, 1994) Therefore, there is a felt necessity to evaluate suitable agronomic strategies with emphasis on eco friendliness to accomplish the twin objectives of achieving the sustained production and maintaing the soil fertility over a longer period. One of the major practices to achieve sustainability is to partially substitute the chemical N fertilizers with suitable organic manures. They are considered as the promising renewable nutrient rich sources and can be served as substitute to cut down the cost of chemical fertilizer inputs and to increase the productivity of rice. Weeds constitute a serious biotic stress in rice cultivation and they compete with rice for nutrients, water, light and space and inhibit crop growth, ultimately reduced grain yield. In India, the rice yield losses due to weeds have been put on a range of 10 per cent to as high as 90 per cent (Janardhan and Maniyappa, 1992) which amount to 15 million tonnes of rice). This is particularly unfortunate because weeds deprive not only the yield potential of crops but also 40 per cent of the fertilizers, the costliest input for Indian farmers. Hence, weed management technology becomes necessary to increase the productivity of rice. Although, hand weeding is widely practiced for effective weed control in rice, it is time consuming, expensive and laborious. Moreover, weeding during critical growth stages is not possible in several times due to scarcity of labour during the peak season. Therefore, controlling weeds by using herbicides is one of the best alternatives to hand weeding for increasing the rice yield. The continuous use of herbicides often affects the soil health and pollutes the environment (Singh *et al.,* 2005).). However, adoption of any single method of weed control is not satisfactory to control all type of weeds. Therefore, integrated approach involving chemical, cultural methods, etc. is vital to maximize the weed control efficiency. Integration of different methods of weed control may result in effective control of weeds and result in increasing the productivity of transplanted rice (Brar and Walia, 1995). Keeping in view the problems like heavy weed infestation and low nitrogen use efficiency was encountered by the farmers in rice cultivation. The present investigation was proposed to evolve an integrated efficient and eco friendly nutrient and weed management packages for augmenting the productivity of transplanted rice.

Materials and methods

The field experiments were conducted in wetland block of Experimental Farm, Department of Agronomy, Faculty of Agriculture, Annamalai University, Annamalainagar, Tamil Nadu, India. . The soil of the experimental field is clay loam in texture. The nutrient status of the experimental soil was low in available nitrogen (204 Kg ha^{-1}), medium in available phosphorus (21.4 Kgha^{-1}) and high in available potassium (281 Kgha^{-1}). The pH and E.C were 7.3 and 0.45 dsm^{-1} respectively. The experiment was laid out in a split plot design with three applications by taking the integrated weed management in the main plots viz., unweeded control, hand weeding twice at 20 and 40 DAT , pre emergence application of butachlor 1.25 kg a.i. ha^{-1} + one hand weeding at 25 DAT and pre emergence application of pretilachlor 0.75 kg a.i. ha^{-1} + one hand weeding at 25 DAT and nutrient management practices in the subplots treatments *viz.*, absolute control (No organic and inorganic), recommended dose of (RDF) NPK through inorganic fertilizers, 75% recommended dose of N+ recommended dose of P and K+ 25% N on equivalent basis of vermicompost, 75% recommended dose of N + recommended dose of P and K+ 25% N on equivalent basis of enriched pressmud and 75% recommended dose of N + recommended dose of P and K+ 25% N on equivalent basis of water hyacinth compost. Based on the nitrogen content, required quantities of vermicompost, composted pressmud, *Ipomoea* compost and water hyacinth compost were incorporated into the soil 10 days before transplanting of rice as per treatment schedule. Recommended dose of 150:50:50 kg N, P_2O_5 and K_2O ha^{-1}, respectively was applied to *cv.* CO 43 rice crop. Nitrogen was applied in the form of prilled urea (46% N), phosphorus as single superphosphate (16 % P_2O_5) and potash as muriate of potash (60 % K_2O). Nitrogen was applied as per the treatment schedule in four equal splits at 20 DAS, active tillering, panicle initiation and at flowering. The entire dose of phosphorus was applied basally before planting. Potassium was applied all along with nitrogen in four equal splits (20 DAS basal, active tillering, panicle initiation and flowering stages). The required quantity of herbicides was calculated except oxadiargyl and were mixed with sand @ 50 kg ha^{-1} and broadcasted uniformly at 5 DAT as pre-emergence application as per the treatment schedule. The required quantity of oxadiargyl herbicide was dissolved in little quantity of water, then mixed with dry sand and broadcasted. A spray volume of 500 litres of water was used per hectare.

Results and Discussion

Crop Growth Attributes

Growth characters *viz*., plant height, number of tillers hill^{-1}, leaf area index and dry matter production are the indicators of effective utilization of resources in a better crop production environment. The treatment M_4 (pretilachlor 0.75 kg a.i. ha^{-1}+ one hand weeding at 25 DAT) recorded the maximum plant height (59.86,95.32 and 60.30 , 95.67 cm) at tillering and flowering, LAI at flowering (5.12,5.21) , No. of tillers hill-1 (19.40,19.70), and DMP(13.15, 13.30 Kgha^{-1}) at harvest in the first and second crop, respectively. The plant height increased progressively with time and reached the maximum at harvest. The leaf area index determines the total photosynthetic area available to the plant and quantum of sink that would be produced for transformation. Singh *et al.*, (2004). The taller plants, more number of tillers and higher leaf area of the crop could be the cause for accumulation of higher plant dry matter consistently at all the growth stages of rice. Better weed control with favourable soil environment might have resulted in reduced crop-weed competition for the growth factors such as light, space and nutrients which in turn helped in producing healthier and tallest plants. Application of pretilachlor at early stage helped to effectively suppress the weeds which could have favoured the crop for efficient utilization of all available resources from early crop establishment onwards and resulted in more number of tillers hill^{-1} and greater LAI. This finding of the present study in corroborates with the reports of Ravisankar *et al.*, (2008). The minimum plant height, LAI, No. of tillers hill-1, and DMP were recorded in the treatment M_1 (unweeded control) which registered the values of plant height (49.28, 78.29 and 53.93, 78.66 cm), LAI at flowering (3.92, 4.02), No. of tillers hill^{-1} (15.60, 15.50), and DMP (8.00, 8.23 Kgha^{-1}), at tillering and flowering in the first and second crop, respectively. This was also statistically on par with M_2 at 20 DAT in both the crops.

Among the integrated nutrient management practices, application of 75% recommended dose of N + recommended dose of P and K +25% N on equivalent basis of vermicompost (S_2) recorded the maximum plant height (59.84, 97.76 and 60.02, 97.95 cm) at tillering and flowering, LAI at flowering (5.32, 5.45), No. of tillers hill-1 (20.00, 20.20), and DMP (13.24,13.47 Kgha^{-1}) at harvest in the first and second crop, respectively. Incorporation of vermicompost to soil influences soil enzymatic activities since the added material contains intra and extracellular enzymes with higher fulvic acid content that ultimately stimulate the microbial activity in the soil (Tejada and Gonzalez, 2009) and N supplied through labile fraction of organic matter in a sustained manner (Roy and Singh, 2006), acting as an immediate energy source for growing plants. The least values were recorded in S_0 (absolute control - no organic and inorganics) in both the crops at all the growth stages.

The interaction effect between the integrated weed and nutrient management treatment on plant height, LAI

Table 1: Effect of Integrated nutrient and weed management practices on growth attributes of rice.

Treatment	Plant height (cm)				LAI		DMP (Kgha^{-1})		No. of tillers / hill	
	Tillering	Flowering	Tillering	Flowering	I Crop	II Crop	I Crop	II Crop	I Crop	II Crop
M_1	49.28	78.29	53.93	78.66	3.92	4.05	8.00	8.23	15.60	15.50
M_{-2}	54.57	87.65	53.82	87.23	4.89	4.90	12.24	12.40	17.30	17.20
M_3	54.16	89.16	55.17	89.62	5.01	5.08	12.53	12.91	18.20	18.40
M_4	59.86	95.32	60.30	95.67	5.12	5.21	13.15	13.30	19.40	19.70
SEd	0.52	0.89	0.50	0.96	0.07	0.05	0.08	0.087	0.24	0.21
CD	1.28	2.18	1.22	2.34	0.14	0.12	0.19	0.212	0.29	0.52
S_o	47.92	76.17	50.80	76.29	3.64	3.67	6.85	7.37	14.90	14.80
S_1	52.79	82.97	55.78	83.27	4.69	4.80	12.13	12.15	16.93	17.00
S_2	59.84	97.76	60.02	97.95	5.32	5.45	13.24	13.47	20.00	20.20
S_3	57.12	92.99	57.41	93.11	5.13	5.18	12.80	13.01	18.70	18.70
S_4	54.66	88.14	55.06	88.34	4.90	5.03	12.39	12.55	17.70	17.80
SEd	0.72	1.37	0.70	1.44	0.07	0.07	0.19	0.171	0.32	0.42
CD	1.47	2.79	1.43	2.93	0.14	0.14	0.38	0.355	0.66	0.86

at flowering, No. of tillers hill-1, and DMP at tillering and flowering in the first and second crop, was significant. . The treatment combinations of pre-emergence application pretilachlor 0.75 kg a.i. ha^{-1} + one hand weeding at 25 DAT (M_4) with 75% recommended dose of N + recommended dose of P and K + 25% N on equivalent basis of vermicompost (S_2) recorded maximum plant height (64.98, 105.98 cm) at tillering and flowering, LAI at flowering (5.69, 5.82), No. of tillers $hill^{-1}$ (21.90, 22.30), and DMP (15.18, 15.48 $Kgha^{-1}$) at harvest in the first and second crop, respectively. The results are in agreement with these facts of Arancon *et al.,* (2006) who found an increase in enzymatic activities after the addition of vermicompost in the soil. Besides, there is a significant quantity of vitamins, humic acid and natural phytoregulators such as gibberellins, cytokinin and auxin in balanced form (Madan, 1993). The lowest values for plant height LAI at flowering, No. of tillers hill-1, and DMP was observed in the treatment M_1S_0 (unweeded control × no organic/inorganics) at all the stages of observation However, in both the crops treatment M_2 S_0 was statistically on par with M_1S_0 at 20 DAT.

Crop yield and yield attributes

Yield attributes

Among the integrated weed management practices, M_4 (pretilachlor 0.75 kg a.i. ha^{-1} + one hand weeding at 25 DAT) registered the highest Number of productive tillers m-^{2} (432,439), Number of filled grains $panicle^{-1}$ (107.93, 108.35), first and second crop, respectively. Efficient weed control throughout the critical periods of competition resulted in higher LAI and sustained nutrient availability extending up to the reproductive phase. This could have resulted in higher post flowering photosynthesis and assimilate partitioning to the sink which ultimately contributed for higher tiller synchronization and spikelet formation, leading to higher number of panicles m^{-2} and filled grains $panicle^{-1}$ (Ravisankar *et al.,* (2008). The treatment M_1 (unweeded control) registered the lowest number of productive tiller m^{-2} (282, 248), Number of filled grains $panicle^{-1}$ (71.46, 71.90) in both the crops. The reduction in tiller number and filled grain number was recorded by Mahmoudi *et al.,* (2011) due to the competition offered by unchecked weeds in rice field.

Among the integrated nutrient management treatment tested, S_2 (75% recommended dose of N + recommended dose of P and K + 25% N on equivalent basis of vermicompost) registered the maximum number of Number of productive tillers m^{-2} (425, 429), Number of filled grains $panicle^{-1}$ (106.06, 106.49), first and second crop, respectively. The better performance of integrated application was also due to the counteraction of the adverse effects of inorganic fertilizers by the organic manures and the continuous liberal supply of nutrients satisfying the demand of the rice crop at every phenophase as opined by Babu Mathew (2001), thus helping in accelerating the photosynthetic efficiency as evident from increased LAI values and better translocation of photosynthates from source to sink which resulted in higher number of filled grains $panicle^{-1}$. The minimum Number of productive tillers m^{-2} (327, 331), Number of filled grains $panicle^{-1}$ (83.35, 83.87), in first and second crop, respectively was registered in S_0 (no organic and inorganics).

Integrated nutrient and weed management practices had significant influence on productive tillers. The treatment M_4 (pretilachlor 0.75 kg a.i. ha^{-1} + one hand weeding at 25 DAT) along with S_2 (75% recommended dose of N + recommended dose of P and K + 25% N on equivalent basis of vermicompost) registered the maximum Number of productive tillers m^{-2} (476, 485), Number of filled grains $panicle^{-1}$ (117.26, 117.84), first and second crop, respectively. These results are in line with the findings of Subramanian (2003) and Stalin and Vaiyapuri (2009). The minimum number of Number of productive tillers m^{-2} (217, 225), Number of filled grains $panicle^{-1}$ (57.92, 58.51), first and second crop, respective was recorded in M_1S_0 (unweeded control × no organic and inorganics).

Yield

A significant difference in grain yield was noticed among the integrated weed management treatments. The treatment M_4 (pretilachlor 0.75 kg a.i. ha^{-1} + one hand

Table 2: Effect of Integrated nutrient and weed management practices on yield attributes of rice.

Treat-ment	No of productive tillers /m^2		No. of filled grains		Test weight cs	
	I Crop	II Crop	I Crop	II Crop	I Crop	II Crop
M_1	282	248	71.46	71.90	22.12	22.31
M_{2-}	418	410	105.82	106.46	23.13	23.21
M_3	394	397	101.12	101.67	22.78	22.87
M_4	432	439	107.93	108.35	23.52	23.59
SEd	3.92	4.13	0.76	0.78	0.17	0.13
CD	9.60	10.11	1.86	1.92	NS	NS
So	327	331	83.35	83.87	22.31	22.49
S_1	371	375	94.65	95.23	22.68	22.73
S_2	425	429	106.06	106.49	23.38	23.46
S_3	402	409	101.39	101.83	23.14	23.25
S_4	383	388	97.49	97.96	22.94	23.04
SEd	5.65	6.19	1.42	1.51	0.32	0.28
CD	11.50	12.60	2.89	3.08	NS	NS

weeding at 25 DAT) recorded maximum grain yield (5455 and 5502 kg ha^{-1}) and straw yield of (9207 and 9318kg ha^{-1}) in the first and second crop, respectively. This was followed by M_3 (butachlor 1.25 kg ha^{-1} + one hand weeding at 25 DAT) in both the crops. The yield increase under M_4 was 81.10 and 75.83 percent in the first and second crop, respectively over control (M_1). The increase in grain yield is due to effective suppression of weeds throughout the critical period of weed competition offered by integrated weed control treatments and consequently reduced nutrient depletion, which resulted in effective uptake of nutrients. This ultimately resulted in higher leaf area index, yield attributes, pre and post flowering photosynthesis which ultimately increased the source and sink capacities and all these facts reflected on enhanced grain and straw yield. Similar results were also observed by Subramanian (2003).The unchecked weed growth (M_1) resulted in lowest grain and straw yield of 2985and 3067 and 5938 and 6103 kg ha^{-1} in the first and second crop, respectively.

Among the integrated nutrient management treatments, the treatment S_2 (75% recommended dose of N + recommended dose of P and K + 25% N on equivalent basis of vermicompost) excelled over all other treatments by recording the highest grain yield of 5451 and 6513 kg ha^{-1} and straw yield of 9307 and 9397 kg ha^{-1} in the first and second crop, respectively. This was due to the fact that vermicompost offered a balanced nutritional release pattern to plants, providing nutrients such as available N, soluble K, exchangeable Ca, Mg and P that could be readily taken by plants (Edwards and Arancon, 2004) and greater microbial diversity and activity which resulted in higher grain and straw production (Vinay Singh, 2006).This was followed by treatment S_3 (75% recommended dose of N+ recommended dose of P and K + 25% N on equivalent basis of composted pressmud) which recorded a yield of 5149 and 5280 kg ha^{-1} in the first and second crop, respectively. Yield increase in S_2 was 112.92 and 137.41 percent in the first and second crop, respectively over S_0. The lowest grain yield of 2560 and 2740 kg ha^{-1} in the first and second crop, respectively was recorded in the treatment S_0 (no organic and inorganics).

The interaction effect between the integrated weed and nutrient management treatment on grain yield of rice was significant in both the years. The treatment combination of pretilachlor 0.75 kg a.i. ha^{-1} + one hand weeding at 25 DAT × 75% recommended dose of N + recommended dose of P and K + 25% N on equivalent basis of vermicompost recorded (M_4S_2) recorded the highest grain yield of 6528 and 6685 kg ha^{-1} and straw yield of 10397 and 10569 kg ha^{-1} in the first and second crop respectively. The increase in yield could be attributed to significant reduction in weed dry matter thereby reduction in crop weed competition which provided congenial growing environment to the crop, better expression of vegetative and reproductive potential. Moreover, the integration of organic N with vermicompost provided higher nutrient availability and consequently higher uptake of nutrient by crop which would have helped in development of higher yield attributing characters which ultimately reflected on higher yield. These results are in line with the findings of Neeta Tripathi and Verma (2008) and Adeosun *et al.,* (2009).

Table 3: Effect of Integrated nutrient and weed management practices on yield of rice.

Treat-ments	Grain Yield (Kg ha^{-1})		Straw Yield (Kg ha^{-1})		Harvest Index	
	I Crop	II Crop	I Crop	II Crop	I Crop	II Crop
M_1	2985	3067	5938	6103	33.25	33.33
M_{2-}	4732	4945	8951	9209	35.69	35.78
M_3	5016	5188	8907	8878	34.55	35.53
M_4	5455	5502	9207	9318	36.93	36.85
SEd	34.54	40.13	0.08	0.06	0.08	0.063
CD	84.51	98.20	0.18	0.13	0.18	0.13
So	2560	2740	5075	5471	33.43	33.29
S_1	4694	4729	8822	8814	34.29	34.71
S_2	5451	6513	9307	9397	36.65	37.15
S_3	5149	5280	9116	9217	35.85	36.18
S_4	4881	5005	8935	8987	35.11	35.53
SEd	57.36	89.18	0.13	0.16	0.13	0.16
CD	167.85	181.65	0.26	0.33	0.26	0.33

Economics

In general, the combination of vermicompost with inorganic fertilizers treatment had proved it economical superiority by realizing higher net return, return rupee^{-1} invested. The treatment combinations of M_4S_2 (pretilachlor 0.75 kg a.i. ha^{-1} +one hand weeding at 25 DAT X 75 % recommended dose of N + recommended dose of P and K + 25 % N on equivalent basis of vermicompost) recorded the maximum net return of Rs 29104.86 and 32470.88 ha^{-1} and return rupee^{-1} invested of 2.50 and 2.73 in the first and second crop, respectively. This was closely followed by M_4S_3 (pretilachlor 0.75 kg a.i. ha^{-1} + one hand weeding at 25 DAT × 75% recommended dose of N + recommended dose of P and K + 25 % N on equivalent basis of pressmud) which recorded the return rupee^{-1} invest of 2.42 and 2.60 in the first and second crop, respectively. Increased profitability in this treatment combination could be attributed to the

Table 4: Effect of Integrated Nutrient and weed management on Economics of Rice in I Crop.

Treat-ments	Cost of Cultivation (Rs ha^{-1})	Gross income (Rs ha^{-1})	Net income (Rs ha^{-1})	Return per rupee invested
$M_1 S_0$	104 96.1	13928.97	3432.26	1.17
$M_1 S_1$	12838.64	20663.20	7824.56	1.42
$M_1 S_2$	14357.78	24034.32	9676.54	1.47
$M_1 S_3$	13991.08	22770.80	8779.72	1.43
$M_1 S_4$	13674.11	21570.43	7896.33	1.39
$M_2 S_0$	12278.71	16662.99	4384.28	1.19
$M_2 S_1$	14620.64	34127.10	19506.47	2.05
$M_2 S_2$	16139.78	39503.29	23363.51	2.15
$M_2 S_3$	15773.08	37474.78	21701.69	2.09
$M_2 S_4$	15456.11	35357.62	19901.51	2.01
$M_3 S_0$	11772.71	19292.74	7520.03	1.44
$M_3 S_1$	14114.64	35541.84	21427.20	2.22
$M_3 S_2$	15633.78	41667.12	26033.34	2.35
$M_3 S_3$	15267.08	39183.40	23916.31	2.26
$M_3 S_4$	14950.11	37092.51	22142.40	2.18
$M_4 S_0$	11944.31	20769.02	8824.71	1.53
$M_4 S_1$	14286.24	39115.82	24829.58	2.41
$M_4 S_2$	15805.38	44910.24	29104.86	2.50
$M_4 S_3$	15438.68	42447.02	27008.33	2.42
$M_4 S_4$	15121.71	40522.82	25401.11	2.36

Table 5: Effect of Integrated Nutrient and weed management on Economics of Rice in II Crop.

Treat-ments	Cost of Cultivation (Rs ha^{-1})	Gross income (Rs ha^{-1})	Net income (Rs ha^{-1})	Return per rupee invested
$M_1 S_0$	10973.83	15786.66	4812.82	1.32
$M_1 S_1$	13422.21	22195.57	8773.36	1.52
$M_1 S_2$	15010.41	26133.07	11122.66	1.60
$M_1 S_3$	14627.04	25172.92	10545.88	1.58
$M_1 S_4$	14295.66	23409.07	911.341	1.51
$M_2 S_0$	12836.83	20329.24	7492.41	1.46
$M_2 S_1$	15285.21	36935.12	21649.91	2.22
$M_2 S_2$	16873.41	43975.57	27102.16	2.40
$M_2 S_3$	16490.04	41231.57	24741.52	2.30
$M_2 S_4$	16158.66	39108.67	22950.02	2.23
$M_3 S_0$	12307.83	21481.78	9173.94	1.61
$M_3 S_1$	14756.21	38744.22	23988.01	2.42
$M_3 S_2$	16344.41	45857.5	29513.10	2.58
$M_3 S_3$	15961.04	42988.42	27027.38	2.48
$M_3 S_4$	15629.66	41198.06	25568.40	2.43
$M_4 S_0$	12487.23	22985.55	10498.32	1.69
$M_4 S_1$	14935.61	41036.04	26100.43	2.53
$M_4 S_2$	16523.81	48994.69	32470.88	2.73
$M_4 S_3$	16140.44	45563.24	29422.80	2.60
$M_4 S_4$	15809.06	43226.51	27417.45	2.52

highest economical yields of rice crop as a result of favourable neutron - physiological condition offered by integrated weed and nutrient management. These findings are in conformity with the study of Ramesh and Vaiyapuri (2008) and Sangeetha *et al.*, (2009) by integrated weed management. The least net return and return rupee^{-1} invested was realized in the treatment combination of M_1S_0 (unweeded control and no organics and inorganics).

Conclusion

In the light of above said facts, it can be concluded that adoption of pre-emergence application of pretilachlor 0.75 kg a.i. ha^{-1} + one hand weeding at 25 DAT along with application of 75% recommended dose of N + recommended dose of P and K (112.5 : 50 :50 kg N, P_2O_5 and K_2O ha^{-1}) + 25% N on equivalent basis of vermicompost (1400 kg ha^{-1} holds promise as an agronomically sound, ecologically safe and economically viable technology for enhancing the yield of transplanted low land rice.

References

Adeosun, J.O., C.K. Daudu, A. Mando, A.C. Odunze, I. Yamapu and T. Kudi (2009). On farm weed management in upland rice in three villages of Katsina state of Nigeria. *African Crop Science Conference Proceedings*, **9:** 625-629.

Anonymous (2010). Tamil Nadu at a glance. Statistical Hand Book, Dept. Economics and Statistics, Tamil Nadu, Chennai, India.

Arancon, N.Q., C.A. Edwards and P. Bierman (2006). Influences of vermicomposts on field strawberries: Part 2. Effects on soil microbiological and chemical properties. *Bioresource Tech.*, **97:** 831-840.

Babu Mathew, P. (2001). Energetics and nutrient balance studies on sustainable rice based cropping system of southern Kerala. Ph.D. Thesis, Annamalai Univ., Annamalainagar, India.

Brar, L.S. and U.S. Walia (1995). Time of application of herbicides against *Echinochloa crusgalli* in transplanted rice. In: Abstr.VI Biennial Conf. 1994. Indian Soc. Weed Sci., Annamalai Univ., Annamalainagar, Feb 9-10, p.2.

Edwards, C.A. and N.Q. Arancon (2004). The use of earthworms in the breakdown of organic wastes to produce vermicomposts and animal feed protein. In C.A. Edwards (ed.) Earthworm Ecology. CRC Press, Boca Raton, FL, pp. 345-438.

*IRRI. (2003). IRRI's environmental agenda. Unpublished draft document.

Janardhan, G.J. and T.M. Maniyappa (1992). Effect of pre emergence herbicides on weed control in transplanted rice. In: Abstr. Annual conf. Indian Soc. Weed Sci., HAU. Hissar, 10-11, Mar. p. 50.

Madan, M. (1993). Organic waste recycling with earth worms. Potential source for energy conservation in Indian biogas slurry utilization. Consortium on Rural Technology. New Delhi, pp. 83-91.

Mahmoudi, M., R. Rahnemaie, S. Soufizadeh, M.J. Malakouti and A. Eshaghi (2011). Residual effect of thiobencarb and oxadiargyl on spinach and lettuce in rotation with rice. *J. Agri. Sci. Tech.,* **13:** 785-794.

Neeta Tripathi and R.S. Verma (2008). Performance of basmati rice under organic sources of nutrition. *Intl. J. Agric. Sci.,* **4(1):** 301-305.

Ramesh, S. and V. Vaiyapuri (2008). Agronomic Strategies for rice- cotton cropping sequence. Ph.D. Thesis, Annamalai Univ., Annamalai Nagar, India.

Ravisankar, N., B. Chandrasekaran, R. Raja Dini and S. Ghoshal Chaudhuri (2008). Influence of integrated weed management practices on productivity and profitability of wet-seeded rice (*Oryza sativa* L.). *Indian J. Agron.,* **53(1):** 57-61.

Roy, D.K. and B.P. Singh (2006). Effect of level and time of nitrogen application with and without vermicompost on yield, yield attributes and quality of malt barley (*Hordeum vulgare*). *Indian J. Agron.,* **51(1):** 40-42.

Sangeetha, M., R. Jayakumar and C. Bharathi (2009). Effect of slow release formulations of pretilachlor on growth and yield of low land transplanted rice (*Oryza sativa* L.) *Green farming,* **2(14):** 997-999.

Siddiq, E.A. (2000). Yawning productivity gaps. The Hindu Survey of Indian Agriculture, The Hindu Publication, Chennai, pp. 39-44.

Singh, U.P., Y. Singh and V. Kumar (2004). Effect of weed management and cultivars on boro rice (*Oryza sativa* L.) and weeds. *Indian J. Weed Sci.,* **36(1&2):** 57-59.

Singh, V.P., G. Singh, R.K. Singh, S.P. Singh, A. Kumar, V.C. Dhyani, M. Kumar and G. Sharma (2005). Effect of herbicide alone and in combination on direct seeded rice. *Indian J. Weed Sci.,* **37(3&4):** 197-201.

Stalin, P. and V. Vaiyapuri (2009). Studies on integrated plant nutrient supply system on yield maximization and economic analysis in rice for Cauvery delta region. *Plant Archives,* **9(1):** 47-49.

Subramanian, E. (2003). Studies on integrated nitrogen and weed management practices and optimization of nitrogen dose for wet seeded rice. Ph.D. Thesis Tamil Nadu Agric. Univ., Coimbatore, India.

Swaminathan, M.S. 2002. Green revolution is now greed revolution. The Hindu, p. 5.

Tejada, M. and J.L. Gonzalez (2009). Application of two vermicompost on a rice crop: Effects on soil biological properties and rice quality and yield. *Agron. J.,* **101(2):** 336-344.

Vinay Singh (2006). Productivity and economics of rice (*Oryzasativa*) - wheat (*Triticumaestivum*) cropping system under integrated nutrient supply system in recently reclaimed sodic soil. *Indian J. Agron.,* **51(2):** 81-84.

USDA (2010). Rice; Area, yield and production. United States Department of Agriculture, *World Agricultural Production,* **3(10):** 1-25.