International Journal of Botany Studies
www.botanyjournals.com
ISSN: 2455-541X
Received: 16-11-2021, Accepted: 02-12-2021, Published: 17-12-2021
Volume 6, Issue 6, 2021, Page No. 1169-1172

Productivity, profitability and agronomic efficiency of traditional rice varieties as influenced by EM compost and fertilizer nitrogen under Cauvery delta zone of Tamil Nadu

S Ramesh[1*], S Keerthana[3], S Manimaran[1], K Arivukkarasu[2], G B Sudhgar Rao[2], S Anbarasan[4]

[1] Associate Professor, Scholar, Department of Agronomy, Annamalai University, Annamalainagar, Tamil Nadu, India
[2] Assistant Professor, Scholar, Department of Agronomy, Annamalai University, Annamalainagar, Tamil Nadu, India
[3] Assistant professor, Adhiyamaan College of Agriculture and Research, Hosur, Tamil Nadu, India
[4] Scholar, Department of Agronomy, Annamalai University, Annamalainagar, Tamil Nadu, India

Abstract
Field experiment was carried out at the Experimental farm, Annamalai University, Annamalai Nagar to study the productivity, profitability and agronomic efficiency of traditional rice varieties as influenced by EM compost and fertilizer nitrogen under Cauvery delta zone of Tamil Nadu (August 2017 to January 2018). The experiment conducted in split-plot design and treatments were replicated thrice, the three traditional rice varieties were assigned as main plot treatments *viz.*, Mapillai samba, Illupai poo samba and Seeraga samba, and integrated nutrient management were assigned as sub plot treatments, it include control, graded dose of nitrogen alone ant it combination with FYM, EM (effective microorganisms) compost, pressmud, green manure. From the results of field study, among the rice varieties, Mapillai samba significantly recorded higher grain yield of 2574 kg ha^{-1}, straw yield of 3831 kg ha^{-1} and harvest index of 39.85 and nitrogen use efficiency of 36.58 (NUE) agronomic efficiency of 21.68 (AE) and apparent N recovery (%) of 56.93 (ANR). The aforesaid parameters were least under Illupai poo samba rice variety. In respect of INM treatments, plots received with 75% RDN along with EM compost @ 5 t ha^{-1} significantly recorded maximum grain yield of 2967 kg ha^{-1}, straw yield of 4341 kg ha^{-1} and harvest index of 40.56. Also the same treatment recorded higher values of nitrogen use efficiency of 39.56 (NUE), agronomic efficiency of 25.58 (AE) and apparent N recovery (%) of 66.44 (ANR). The lowest grain yield, straw yield and harvest index of rice were registered under control. But lowest values of nitrogen use efficiency (NUE), agronomic efficiency (AE) and apparent N recovery (%) (ANR) were recorded under 100% recommended dose of nitrogen (RDN). In respect of economics, among the treatment combination seeraga samba rice variety received with 75% RDN + EM compost @ 5 t ha^{-1} registered higher gross return, net return and return per rupee invested.

Keywords: traditional rice varieties, grain and straw yields, harvest index, nitrogen use efficiency (NUE) agronomic efficiency and apparent N recovery (%) (ANR) and economic efficiency

Introduction

Rice (*Oryza sativa L.*) is an important and extensively cultivated food crop which feeds more than fifty percent of the world's population. In Asia alone, more than 2 billion people obtain 60 to 70 per cent of their energy intake from rice and its derivatives. In India, it is grown in an area of 44 million hectares with production of 105 million tonnes and the productivity of 2.4 t ha^{-1}. In Tamil Nadu, rice is grown in an area of 1.93 million hectare with the production of 7.63 million tonnes and the productivity is 3.9 t ha^{-1} (Annual report on Agriculture 2016-2017). Introduction of high yielding varieties and hybrids leads to reducing the area of cultivation of traditional rice varieties. It has many significant role on the human health not only in terms of food but also as a medicine. Even though poor response of nitrogen by traditional rice cultivar the optimum dose of nitrogen to traditional rice varieties is still not clear. Therefore, urgent need for optimize the dose nitrogenous fertilizer for traditional rice cultivation. Apply plenty of chemical fertilizers in the crop cultivation has led to environmental pollution and deterioration of soil health. To achieve higher and sustainable rice yields, use of bulky organic manures or compost is a must (Gill *et al.*, 2008) [8]. It is, however, difficult to meet the crop nutrient requirements with organic manure alone and there is a need for combined application of different sources of nutrients for sustaining the expected crop productivity. Integrated application of organic manures like FYM, green manure, vermicompost and pressmud and inorganic fertilizers is the prerequisites to sustain soil health and to provide higher crop yield (Ramesh and Vaipuri, 2008). EM compost leads to the constant release of nutrients during the throughout the crop growing period and check the nutrient losses due to increased absorption of nutrients. (Jaffer basha *et al.*, 2016) [5]. Even though research work on organic manure with inorganic fertilizer on rice crop was in plenty, EM compost and other organic manures *viz.*, FYM, green manure and pressmud in traditional rice is almost meager. Therefore, the present experiment was conducted to evaluate the influence of organic and fertilizer nitrogen on grain yield, agronomic and economic efficiency of traditional rice varieties under Cauvery delta zone of Tamil Nadu.

Materials and Methods

Field experiment was conducted at the Experimental Farm, Department of Agronomy, Annamalai University, Annamalai Nagar, Tamil Nadu (August 2017 - January 2018) to study the Productivity, Profitability and agronomic

efficiency of traditional rice varieties as influenced by different sources of nitrogen under Cauvery delta zone of Tamil Nadu. The experimental soil is low in available nitrogen (217.50 kg ha^{-1}), medium in available phosphorus (20.67 kg ha^{-1}) and high in available potassium (280.73 kg ha^{-1}. The experiment conducted in a split-plot design and treatments were replicated thrice, the three traditional rice varieties were assigned as main plot treatments *viz.*, Mapillai samba, Illupai poo samba and Seeraga samba, and integrated nutrient management were assigned as sub plot treatments, it include control (S_1), Recommended dose of nitrogen (RDN) (S_2), 75 % RDN + FYM @ 12.5 t ha^{-1} (S_3), 75% RDN + EM (effective microorganisms) compost @ 5 t ha^{-1} (S_4), 75% RDN + pressmud @ 10 t ha^{-1} (S_5), 75% RDN + green manure @ 6.25 t ha^{-1} (S_6) and uniform dose of phosphorus and potassium as per fertilizer schedule was given to all the treatments except control. EM compost prepared at the experimental farm with recommended procedure, the activated effective microorganisms (AEM) solution @ 5 lit inoculated to per tonne of FYM. Daily sprinkle water and maintain sixty per cent moisture in the compost. After forty-five days the EM compost was ready to apply in experimental plots. As per treatment schedule all the organic manures were applied as basal seven days before transplanting. Thirty days old rice seedlings were transplanted @ two seedlings $hill^{-1}$ with a spacing of 20 × 15 cm for all three rice varieties. A fertilizer schedule of 100 kg N, 50 kg P_2O_5 and 50 kg K_2O ha^{-1} was applied. Observation on grain yield and straw yield were recorded.

Agronomic Efficiency (AE)

In this approach, agronomic efficiency was calculated in terms of seed yield obtain from fertilized plot and unfertilized plot to kg^{-1} of nitrogen applied. It was computed using the formula as given below:

$$AE = \frac{\text{Grain yield in fertilizer Plot (kg ha}^{-1}\text{)} - \text{Grain yield in unfertilizer Plot (kg ha}^{-1}\text{)}}{\text{Amount of nitrogen applied (kg ha}^{-1}\text{)}}$$

Apparent N Recovery (ANR)

Apparent N recovery efficiency is defined as the quantity of nitrogen absorbed per unit of nitrogen applied. It was computed as per the formula suggested by Pillai and Varmadevan (1978) [6] and expressed in percentage.

$$ANR = \frac{\text{Uptake of N in fertilizer Plot (kg ha}^{-1}\text{)} - \text{Uptake of N in unfertilizer Plot (kg ha}^{-1}\text{)}}{\text{Amount of nitrogen applied (kg ha}^{-1}\text{)}} \times 100$$

Statistical analysis

The data on various characters studied during the course of investigation were statistically analyzed as suggested by Gomez and gomez (1984) [4].

Result and Discussion

Grain and straw yields

In respect of grain and straw yields, Mapillai samba (M_1) recorded significantly maximum grain yield of 2574 kg ha^{-1}, straw yield of 3831 kg ha^{-1} and harvest index of 39.85. This might be due to higher photosynthetic machineries, photosynthetic pigments and photosynthetic rate which could have contributed for greater assimilate supply from source to sink which would have helped in higher yield attributes which in turn registered higher yield of rice. In addition, the aforesaid positive parameters are also governed by genetic makeup of rice cultivar. (Ghimire *et al.*, 2016) [2]. The lowest grain yield of 2076 kg ha^{-1} and straw yield of 3329 kg ha^{-1} and harvest index of 38.12 were recorded under Illupai poo samba (M_2). In respect of INM practices, plots received with 75% RDN + EM compost @ 5 t ha^{-1} (S_4) registered significantly maximum grain yield of 2967 kg ha^{-1}, straw yield of 4341 kg ha^{-1} and harvest index of 40.56. Higher grain yield might be due to higher nutrient uptake and increased photosynthetic efficiency as evident from increased LAI values, which leads higher grain yield from plots received with inorganic fertilizer along with EM compost. Besides, the constant release of N from organic manure, particularly from EM compost supplemented with NPK fertilizers might have satisfied the demand at every phenophase of rice crop as opined by Sharma *et al.*, (2014). It was followed by 75% RDN + pressmud @ 10 t ha^{-1} (S_5). The least grain yield of 1048 kg ha^{-1}, straw yield of 1803 kg ha^{-1} and harvest index of 36.73 was recorded under S_1 (No fertilizer and no organic manure). The interaction effect between main and sub plots were significant. The treatment combination of M_1S_4 (Mapillai samba along with 75% RDN + EM compost @ 5 t ha^{-1} registered the maximum grain yield of 3247 kg ha^{-1} and straw yield of 4604 kg ha^{-1} and harvest index of 41.36.

Nitrogen use Efficiency, Agronomic Efficiency and Apparent N Recovery (%)

In respect of the different rice varieties, M_1 (Mapillai samba) recorded the maximum nitrogen use efficiency of 36.58, agronomic efficiency of 21.69 and apparent nitrogen recovery percentage of 56.93. This might be attributed to better growth and establishment of Mapillai samba rice variety, which in turn higher DMP and grain yield resulting in higher NUE and ANR. (Sampath *et al.*, 2017) [8]. This treatment was followed by Seeraga samba (M_3). The least nitrogen use efficiency of 29.59, agronomic efficiency of 17.92 and apparent nitrogen recovery of 52.06. Was recorded under Illupai poo samba (M_2).

With regard to nutrient management practices, 75% RDN + EM compost @ 5 t ha^{-1} (S_4) registered significantly maximum nitrogen use efficiency of 39.56, agronomic efficiency of 25.58 and apparent nitrogen recovery percentage of 66.44. This might be due to combined application of organic manures and along with chemical fertilizer checks nitrogen losses, conservation of soil N by forming organic minerals complex thus ensure continuous N availability to rice. Which would have helped in higher grain yield, uptake of N, which in turn higher NUE, agronomic efficiency and ANR (Shobit singh *et al.*, 2017) [10]. It was followed by 75% RDN + pressmud @ 10 t ha^{-1} (S_5). The least values of nitrogen use efficiency of 19.71, agronomic efficiency of 09.22 and apparent nitrogen recovery of 29.76 recorded under 100 RDN (S_2). The interaction effect was not significant.

Economics

Higher gross return of Rs. 1, 02,638 ha^{-1}, net return of Rs. 63,583 ha^{-1} and return per rupee invested Rs. 2.63 were

obtained under Seeraga samba rice variety received with 75% RDN along with EM compost @ 5 t ha^{-1}. Increased profitability under Seeraga samba traditional rice variety raised with 75% RDN + EM compost @ 5 t ha^{-1} could be attributed to lower cost of cultivation, higher gross returns and better premium price of Seeraga samba rice variety. The lowest gross return of Rs. 31,262 ha^{-1}, net return of Rs. 1586. ha^{-1} and return per rupee invested of Rs.1.05 were recorded under Illupai poo samba rice variety raised without fertilizer and organic manure.

Conclusion

From the results of the field trail, it can be concluded that cultivation of Mapillai samba traditional rice variety along with 75% RDN + EM compost @ 5 t ha^{-1} recorded higher grain and straw yields, nitrogen use efficiency, agronomic efficiency and apparent nitrogen recover percentage. However gross return, net return and return per rupee invested were obtained under seeraga samba rice variety applied with 75% RDN + EM compost @ 5 t ha^{-1}.

Table 1: Effect of INM practices on grain yield, straw yield and harvest index in traditional rice varieties

Treatments	Grain yield (kg ha^{-1})				Straw yield (kg ha^{-1})				Harvest index			
	M_1	M_1	M_1	M_1	M_1	M_2	M_3	MEAN	M_1	M_2	M_3	MEAN
S_1	1176	922	1047	1048	1975	1631	1802	1803	37.32	36.11	36.75	36.73
S_2	2198	1749	1965	1971	3446	2920	3202	3189	38.94	37.46	38.03	38.14
S_3	2804	2215	2487	2502	4174	3635	3890	3900	40.18	37.86	39.00	39.02
S_4	3247	2698	2955	2967	4604	4085	4335	4341	41.36	39.78	40.53	40.56
S_5	3052	2484	2746	2761	4433	3897	4159	4163	40.77	38.93	39.77	39.82
S_6	2967	2389	2652	2669	4353	3808	4071	4077	40.53	38.55	39.44	39.51
MEAN	2574	2076	2309		3831	3329	3577		39.85	38.12	38.92	
	Main	Main	Main	Main	Main	Sub	M at S	S at M	Main	Sub	M at S	S at M
$S.E_d$	096	096	096	096	104	073	207	144	0.24	0.32	0.49	0.59
CD(p=0.05)	195	195	195	195	212	149	418	293	0.51	0.63	1.02	1.21

Treatment details

M_1 – Mapillai samba		M_2 – Illupai poo samba		M_3 – Seeraga samba	
S_1 – Control	S_2- Recommended dose of nitrogen	S_3 - 75% RDN + FYM @12.5 t ha^{-1}	S_4 - 75% RDN +EM compost @ 5 t ha^{-1}	S_5 - 75% RDN + pressmud @ 10 t ha^{-1}	S_6 - 75% RDN + green manure @ 6.25 t ha^{-1}

Table 2: Effect of INM practices on nitrogen use efficiency, agronomic efficiency and apparent nitrogen recovery in traditional rice varieties

Treatments	Nitrogen use efficiency*				Agronomic efficiency *				Apparent nitrogen recovery (%)*			
	M_1	M_2	M_3	MEAN	M_1	M_2	M_3	MEAN	M_1	M_2	M_3	MEAN
S_1	-	-	-	-	-	-	-	-	-	-	-	-
S_2	21.98	17.49	19.65	19.71	10.22	8.27	9.18	9.22	32.31	27.36	29.60	29.76
S_3	37.39	29.53	33.16	33.36	21.71	17.24	19.20	19.38	57.29	52.35	54.33	54.66
S_4	43.29	35.97	39.40	39.56	27.61	23.68	25.44	25.58	68.76	64.35	66.21	66.44
S_5	40.69	33.12	36.61	36.81	25.01	20.83	22.65	22.83	64.20	59.32	61.53	61.68
S_6	39.56	31.85	35.36	35.59	23.88	19.56	21.40	21.61	62.08	56.95	59.19	59.40
Mean	36.58	29.59	32.84		21.69	17.92	19.57		56.93	52.06	54.17	
*Not Analyzed					*Not Analyzed				*Not Analyzed			

Treatment details

M_1 – Mapillai samba		M_2 – Illupai poo samba		M_3 – Seeraga samba	
S_1 – Control	S_2- Recommended dose of nitrogen	S_3 - 75% RDN + FYM @12.5 t ha^{-1}	S_4 - 75% RDN +EM compost @ 5 t ha^{-1}	S_5 - 75% RDN + pressmud @ 10 t ha^{-1}	S_6 - 75% RDN + green manure @ 6.25 t ha^{-1}

Table 3: Economics of traditional rice varieties cultivation

Treatments	Cost of Cultivation (Rs. ha^{-1})	Gross return (Rs. ha^{-1})	Net return (Rs. ha^{-1})	B:C ratio
M1S1	30726.00	36291.00	5565.00	1.18
M1S2	35776.00	67761.00	31985.00	1.89
M1S3	40456.00	86207.00	45751.00	2.13
M1S4	39255.00	99712.00	60457.00	2.54
M1S5	39755.00	93777.00	54022.00	2.36
M1S6	40656.00	91187.00	50531.00	2.24
M2S1	29676.00	31262.00	1586.00	1.05
M2S2	34726.00	59233.00	24507.00	1.71
M2S3	39406.00	74918.00	35512.00	1.90
M2S4	38205.00	91089.00	52884.00	2.38
M2S5	38705.00	83923.00	45218.00	2.17
M2S6	38705.00	80744.00	42039.00	2.09
M3S1	30526.00	35485.00	4959.00	1.16
M3S2	35576.00	68476.00	32900.00	1.92

M3S3	40256.00	86503.00	46247.00	2.15
M3S4	39055.00	102638.00	63583.00	2.63
M3S5	39555.00	95444.00	55889.00	2.41
M3S6	40456.00	92204.00	51748.00	2.28

M_1 – Mapillai samba	M_2 – Illupai poo samba	M_3 – Seeraga samba
S_1 – Control, S_2- Recommended dose of nitrogen, S_3 - 75% RDN + FYM @12.5 t ha^{-1}, S_4 - 75% RDN +EM compost @ 5 t ha^{-1}, S_5 - 75% RDN + pressmud @ 10 t ha^{-1}, S_6 - 75% RDN + green manure @ 6.25 t ha^{-1}		

References

1. Annual report on Agriculture Department of Agriculture. Cooperation and Farmers Welfare. Ministry of Agriculture and Farmers Welfare. Govt. of India, 2016-2017.
2. Ghimire S, Sherchan DP, Andersen P, Pokhrel C, Ghimire S, Khanal D. Effect of Variety and Practice of Cultivation on Yield of Spring Maize in Terai of Nepal. Agrotech,2016:5(2):1-6.
3. Gill MS, Pal SS, Ahlawat IPS. Approaches for sustainability of rice (Oryza Sativa) - wheat (Triticum aestivum) cropping system in Indo – gangetic plains of India – A Review. Indian J. Agron,2008:53(2):81-96.
4. Gomez KA, Gomez AA. Statistical procedures for agricultural research. A Willey Inter Science Publication, New York, 1984, 76-83.
5. Jaffer Basha S, Basavarajappa R, Babalad HB. Influence of organic and inorganic nutrient management practices on yield, economics and quality parameters of aerobic rice. Res. on Crops,2016:17(2):178-187.
6. Pillai KG, Varmadevan VK. Studies on integrated nutrient supply system. Fert. News,1978:23(3):11-14.
7. Ramesh S, Vaiyapuri V. Yield potential and economic efficiency of rice (*Oryza Sativa*) As in influenced by organic nutrition under Cauvery deltaic region of tamil nadu. Plant Archives,2008:8:621-622.
8. Sampath O, Srinivas A, Ramprakash T, Avil Kumar K. Nutrient uptake of rice varieties as influenced by combination of plant density and fertilizer levels under late sown conditions. Int. J. Curr. Microbiol. App. Sci,2017:6(6):1337-1346.
9. Sharma RP, Pathak SK, Jha RN, Raman KR. Effect of integrated nutrient management on productivity, nutrient uptake and changes in soil fertility in rice-wheat cropping system. Ann. Agric. Res, series,2014:28(3-4):219-225.
10. Shobit Singh, Bohra JS, SinghYV, Amit Kumar Upadhyay, Shiv Shanker Verma, Pankaj Kumar Mishra, Raghuveer M. Effect of Integrated Nutrient Management on Growth and Development Stages of Rice under Rice–Wheat Ecosystem. Int. J. Curr. Microbiol. App. Sci,2017:6(7):2032-2042.