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PRODUCTION POTENTIAL OF TRADITIONAL RICE (*ORYZA SATIVA*) VARIETIES AS INFLUENCED BY EM COMPOST UNDER CAUVERY DELTA ZONE OF TAMIL NADU

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Abstract

Field experiment was carried out at the Experimental farm, Annamalai University, Annamalai Nagar to study the production potential of traditional rice (*Oryza sativa*) varieties as influenced by EM compost under Cauvery delta zone of Tamil Nadu during August 2017 to January 2018 (samba season). The experiment comprised of three main treatments *viz.,* Mapillai samba, Illupai poo samba and Seeraga samba (traditional rice varieties) and six sub treatments namely., Control, Recommended dose of nitrogen (RDN), 75 % RDN + FYM @ 12.5 t ha^{-1}, 75% RDN + EM (effective microorganisms) compost @ 5 t ha^{-1}, 75% RDN + pressmud @ 10 t ha^{-1}, 75% RDN + Green manure @ 6.25 t ha^{-1}. The treatments were replicated thrice and adopting split plot design. From the results of field trail, among the varieties, Mapillai samba significantly recorded higher values of growth attributes *viz.,* plant height, leaf area index, dry matter production and yield attributes like thousand grain weight. However, Seeraga samba registered significantly higher number of tiller $hill^{-1}$, productive tillers m^{-2} and filled grains $panicle^{-1}$. In respect of INM treatments, plots received with 75% RDN along with EM compost @ 5 t ha^{-1} significantly recorded higher growth, yield attributes, grain and straw yields. The least growth and yield attributes and grain yield of rice registered under control (No organic manure and fertilizer).

Key words: Traditional rice, growth attributes, yield attributes, grain yield, nitrogen, organic manures and EM compost

Introduction

Rice (*Oryza sativa*) is one of the most ancient crops being cultivated in 117 countries, hence called as "Global Grain". Rice is the staple food for two thirds of the world's population (Kumari *et al*., 2014). In India, it is grown over an area of 44 million hectares with a total production of 105 million tonnes and the productivity of 2.4 t ha^{-1} (*Directorate* of Economics and *Statistics, 2017- 2018*). 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). The traditional rice varieties in India and across Asia are under serious threat of extinction due to arrival of modern rice varieties, like the so-called high yielding varieties (HYV), hybrids and genetically engineered rice being developed, an outcome of corporate - centered technology. It has many significant role on the human health not only in terms of food but also as a medicine. Literature on the influence of nitrogen on the growth and yield of modern rice across ecosystems abound. However, similar information's on the traditional varieties are scanty. After the attainment of self-sufficiency in food grains, there has been increasing demand for quality rice, particularly of traditional varieties. Against this background information on the magnitude of nitrogen response in traditional rice varieties are essential. Even though poor response of nitrogen by traditional rice cultivar the optimum dose of nitrogen to traditional rice varieties is still not clear. The recommendation of nitrogen use thus needs attention. Indiscriminate use of chemical fertilizers has led to environmental pollution and deterioration of soil health. Balanced use of nutrients through different organic manures like FYM, green manure, vermicompost and pressmud and inorganic fertilizers is the prerequisites to sustain soil fertility and

to provide maximum crop yield (Ramesh and Vaipuri, 2008). EM compost leads to the sustained release of nutrients during the entire crop growing period and minimize the nutrient losses due to increased absorption of nutrients. (Jaffer basha *et al*., 2016). Although research work on organic wastes 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 investigation was planned to develop a sustainable nutrient management concept to achieve a highly productive of traditional rice crop under tail end area of Cauvery deltaic zone of Tamil Nadu.

Materials and Methods

Field experiment was conducted at the Experimental Farm, Department of Agronomy, Annamalai University, Annamalai Nagar, Tamil Nadu during August 2017 - January 2018 (samba season) to study the production potential of traditional rice (*Oryza sativa*) varieties as influenced by EM compost under Cauvery delta zone of Tamil Nadu. The Experimental Farm is situated at 11°24' N latitude and 79°44' E longitude at an altitude of +5.79 m above mean sea level. 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 comprised of three main treatments (traditional rice varieties) *viz.,* Mapillai samba, Illupai poo samba and Seeraga samba and six sub treatments namely., 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. The treatments were replicated thrice and adopting split plot design. The following organic manures were used in this study *viz.,* FYM, pressmud and EM compost and green manure. EM compost prepared with following procedure, FYM was inoculated with activated effective microorganisms (AEM) solution @ 5 lit / tonne of FYM and heaped. Daily sprinkle water and maintain 60 percent moisture in the compost. After 45 days the compost was ready to apply in mainfield. As per treatment schedule all the organic manures were applied as basal one week before transplanting. Thirty days old paddy seedlings were transplanted @ two seedlings $hill^{-1}$ for all three rice varieties with a spacing of 20 × 15 cm. A fertilizer schedule of 100 kg N, 50 kg P_2O_5 and 50 kg K_2O ha^{-1} was applied. Five hills of rice plants were chosen at random from each net plot area and tagged for recording biometric observations at various crop growth stages. Harvesting was done in each plot separately from the net plot area leaving the border rows. Grains were separated, cleaned and grain yield was recorded plot wise at 14 percent moisture content. The data on various characters studied during the course of investigation were statistically analyzed as suggested by Gomez and Gomez (1984).

Results and Discussion

Effect of INM practices on growth attributes

Among the main plot treatments, Mapillai samba rice variety (M_1) recorded significantly maximum plant height of 129.30 cm, LAI of 7.84 and DMP of 6195 kg ha^{-1}. However the maximum number of tillers $hill^{-1}$ of 16.90 registered under Seeraga samba. The variation of the plant height, tillers number and LAI among the varieties may be the ability of the variety with response to nutrient supply. The findings were in accordance with Ranabhat and Amgain (2016). The higher plant height and LAI of Mapillai samba might be due to better utilization of available growth resources like light and temperature which may result in more nitrogen absorption for the synthesis of protoplasm responsible for rapid cell division consequently increasing the plant in shape and size or may be due to vigour of the variety. Similar findings have also been reported by Awasthe *et al*., (2011). The least values of plant height of 98.71cm in Seeraga samba (M_3), number of 11.83 tillers $hill^{-1}$ in Mapillai samba (M_1) and LAI of 6.80 cm and DMP of 5370 kg ha^{-1} registered under Illupai poo samba (M_2). In respect of INM practices, plots received with 75% RDN along with EM compost @ 5 t ha^{-1} (S_4) registered significantly maximum plant height of 133.48 cm, number of tillers $hill^{-1}$ of 15.88, LAI of 8.68 and DMP of 6946 kg ha^{-1}. This is mainly due to EM compost, which contains nutrients in forms that are readily taken up by the plants such as nitrates, exchangeable phosphorus and soluble potassium, calcium and magnesium (Harikesh *et al.,* 2017). Besides, there is a significant quantity of vitamins and natural phytoregulators in a balanced form. It was followed by 75% RDN + pressmud @ 10 t ha^{-1} (S_5). The least plant height of 87.74 cm, number of tillers $hill^{-1}$ of 9.86, LAI of 4.25 and DMP of 2960 kg ha^{-1} 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 plant height of 147.33 cm, LAI of 9.21 and DMP of 7367 kg ha^{-1} was recorded. However maximum number of tillers $hill^{-1}$ of 19.22 registered under treatment

Table 1: Effect of INM practices on growth attributes in traditional rice varieties.

Treatments	Plant height				Number of tillers hill^{-1}				LAI			
	M_1	M_2	M_3	MEAN	M_1	M_2	M_3	MEAN	M_1	M_2	M_3	MEAN
S_1	97.22	90.76	75.24	87.74	8.03	9.48	12.05	9.86	4.66	3.85	4.25	4.25
S_2	116.52	106.62	85.12	102.75	11.36	12.48	16.08	13.31	7.28	6.08	6.66	6.68
S_3	133.57	124.47	101.78	119.94	12.24	13.46	17.36	14.35	8.35	7.27	7.78	7.80
S_4	147.33	138.72	114.38	133.48	13.49	14.93	19.22	15.88	9.21	8.17	8.67	8.68
S_5	141.86	133.10	109.11	128.02	13.05	14.42	18.53	15.34	8.87	7.79	8.32	8.33
S_6	139.30	130.28	106.61	125.40	12.80	14.14	18.17	15.04	8.71	7.62	8.14	8.15
MEAN	129.30	120.66	98.71		11.83	13.15	16.90		7.84	6.80	7.31	
	Main	Sub	M at S	S at M	Main	Sub	M at S	S at M	Main	Sub	M at S	S at M
$S.E_d$	3.88	2.36	7.46	5.62	0.48	0.18	1.12	0.33	0.21	0.15	0.38	0.27
CD(p=0.05)	7.92	4.72	15.08	11.03	0.97	0.37	2.31	0.68	0.44	0.31	0.79	0.58

Treatment details:

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

Table 2: Effect of INM on DMP, number of productive tillers m^{-2} and number of filled grains panicle^{-1} in traditional rice varieties

Treatments	DMP (Kg ha^{-1})				Number of productive tillers m^{-2}				Number of filled grains panicle^{-1}			
	M_1	M_2	M_3	MEAN	M_1	M_2	M_3	MEAN	M_1	M_2	M_3	MEAN
S_1	3241	2675	2964	2960	206.53	243.12	309.41	253.02	44.29	49.59	53.15	49.01
S_2	5826	4864	5331	5340	291.74	320.97	412.55	341.75	61.17	65.28	70.93	65.79
S_3	6678	5816	6223	6239	314.11	345.43	445.73	368.42	65.92	70.38	76.57	70.96
S_4	7367	6536	6936	6946	346.79	383.95	493.81	408.18	72.66	78.11	84.74	78.50
S_5	7093	6235	6655	6661	335.63	370.27	475.62	393.84	70.28	75.45	81.74	75.82
S_6	6965	6092	6514	6524	328.48	363.14	466.87	386.16	68.94	73.95	80.15	74.34
MEAN	6195	5370	5771		303.88	337.81	433.99		70.68	68.79	74.55	
	Main	**Sub**	**M at S**	**S at M**	**Main**	**Sub**	**M at S**	**S at M**	**Main**	**Sub**	**M at S**	**S at M**
$S.E_d$	132	124	265	244	06.51	05.11	13.18	09.69	0.89	0.83	2.12	1.56
CD(p=0.05)	268	252	536	493	13.12	10.23	26.41	19.46	1.79	1.68	4.29	3.17

Treatment details:

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

combination of Seeraga samba along with 75% RDN + EM compost @ 5 t ha^{-1} (M_3S_4).

Effect of INM practices on yield attributes

Among the traditional rice varieties, maximum number of productive tillers of 433.99 M^{-2} and number of filled grains panicle^{-1} of 74.55 significantly registered under Seeraga samba (M_3). However, higher thousand grain weight of 25.39 g registered under Mappilai samba (M_1). The wide variations in yield attributing parameters persisted among the varieties obtained from the different parental origin. Attainments of particularly higher or lower yield attributing character among verities are the genetically controlled phenomenon. These were in line with findings of Otung (2014). The least values of yield attributes registered under following rice varieties *viz.*, number of productive tillers hill^{-1} of 303.88 in Mappilai samba (M_1), number of filled grains panicle^{-1} of 68.79 under Illupai poo samba (M_2) and thousand grain weight of 13.36 g in Seeraga samba (M_3). Plots receives with 75% RDN + EM compost @ 5 t ha^{-1} (S_4) registered significantly maximum number of productive tillers m^{-2} of 408.18, number of filled grains panicle^{-1} of 78.50 and thousand grain weight of 18.93 g. This might be due to higher concentration of macro and micronutrients in the EM compost, higher and steady nutrient release compared to other organic manures. Besides, the enhanced and continuous supply of nutrients by the enriched organics lead to better productive tillers m^{-2} and filled grains panicle^{-1}. This result coincides with the work of Snehlata *et al.,*

Table 3: Effect of INM practices on thousand grain weight grain and straw yields in traditional rice varieties

Treatments	Thousand grain weight (g)				Grain yield (kg ha^{-1})				Straw yield (kg ha^{-1})			
	M_1	M_2	M_3	MEAN	M_1	M_2	M_3	MEAN	M_1	M_2	M_3	MEAN
S_1	25.09	17.03	13.18	18.43	1176	0922	1047	1048	1975	1631	1802	1803
S_2	25.18	17.10	13.24	18.50	2198	1749	1965	1971	3446	2920	3202	3189
S_3	25.29	17.18	13.30	18.59	2804	2215	2487	2502	4174	3635	3890	3900
S_4	25.73	17.50	13.57	18.93	3247	2698	2955	2967	4604	4085	4335	4341
S_5	25.56	17.38	13.47	18.80	3052	2484	2746	2761	4433	3897	4159	4163
S_6	25.48	17.31	13.42	18.74	2967	2389	2652	2669	4353	3808	4071	4077
MEAN	25.39	17.25	13.36		2574	2076	2309		3831	3329	3577	
	Main	Sub	M at S	S at M	Main	Sub	M at S	S at M	Main	Sub	M at S	S at M
$S.E_d$	1.59	0.04	3.06	0.26	096	067	191	137	104	073	207	144
CD(p=0.05)	3.24	0.08	NS	NS	195	136	382	278	212	149	418	293

Treatment details:

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

(2017). It was followed by S_5 (75% RDN + Pressmud @ 10 t ha^{-1}). The least number of productive tillers m^{-2} of 253.02, number of filled grains panicle^{-1} of 49.01 and thousand rain weight of 18.43 g recorded under S_1 (No fertilizer and no organic manure). The interaction effect between main and sub plots were significant. The treatment combination of Seeraga samba along with 75% RDN + EM compost @ 5 t ha^{-1} (M_3S_4) registered the maximum number of productive tillers m^{-2} of 493.81 and number of filled grains panicle^{-1} of 84.74. However, Mapillai samba registered higher thousand grain weight of 25.73 g.

Effect of INM practices on 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} and straw yield of 3831 kg ha^{-1}. 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. Especially thousand grain weight was higher under Mapillai samba (Ghimire *et al*., 2016). The least grain yield of 2076 kg ha^{-1} and straw yield of 3329 kg ha^{-1} was recorded under Illupai poo samba (M_2). Among the INM treatments, plots received with 75% RDN + EM compost @ 5 t ha^{-1} (S_4) registered significantly maximum grain yield of 2967 kg ha^{-1} and straw yield of 4341 kg ha^{-1}. The aforesaid increased yield attributes and simultaneous enhanced yield due to inorganic fertilizer along with EM compost might be due to higher nutrient uptake and increased photosynthetic efficiency as evident from increased LAI values. 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 S_5 (75% RDN + pressmud @ 10 t ha^{-1}). The least grain yield of 1048 kg ha^{-1} and straw yield of 1803 kg ha^{-1} 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}.

Conclusion

Adoption of the integrated nutrient management practices to traditional rice, consisting of Mappilai samba traditional rice variety along with 75% RDN + EM compost @ 5 t ha^{-1} will hold an ecofriendly and agronomically sound viable practice for farmers in tail end areas of Cauvery Deltaic Zone of Tamil Nadu.

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