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Effect of different sources of organic manures and inorganic nutrients on growth and yield seeragasamba rice

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Abstract
Field experiments were conducted during samba seasons of 2017-18 and 2018-19 at Madurai, Tamil nadu to find out the effect of organic and inorganic nutrients on growth and yield of Seeragasamba rice (local land race). Fourteen treatments were replicated thrice in a randomized block design. The treatments are as follows: T_1- 100%N through Green Manure, T_2-75%N through Green Manure+25%N through RDF, T_3 - 50%N through Green Manure+50% N through RDF, T_4 -100%N through FYM, T_5-75% N through FYM+25% N through RDF, T_6-50% N through FYM+50% N through RDF, T_7-100% N through Composted Poultry Manure, T_8-75%N through Composted Poultry Manure+25%N through RDF, T_9-50% N through Composted Poultry Manure+50%N through RDF, T_{10}-100%N through Vermicomposted Pressmud, T_{11}- 75% N through Vermicomposted Pressmud+25% N through RDF, T_{12}-50% N through Vermicomposted Pressmud+50% N, T_{13}-RDF @ 56:37:37 NPK Kg/ha through inorganic and T_{14} - Control (No Nitrogen). The results revealed that the application of 50% N through green manure + 50% N through RDF recorded the highest grain yield of 4573 kg/ha 2017-18 and 4619 kg/ha in 2018-19 experiments. It was followed by T_{12} *viz*. application of 50% N through vermi composted pressmud + 50% N through RDF which registered the grain yield of 4436 kg/ha in 2017-18 and 4481 kg/ha in 2018-19. These two treatments were found to be significantly superior to the rest of the treatments. However, T_3 and T_{12} were found to be on par not only in yield but also in other growth and yield components. Similarly T_3 and T_{12} were recorded significantly higher B:C ratio of 1.86 and 1.84 in 2017-18, 1.88 and 1.85 in 2018-19 respectively.

Keywords: Seeragasamba rice, organic manure, leaf area index, cgr, yield components in b:c ratio

Introduction
The organic fertilizer is traditionally an important source for supplying nutrient for rice in India but use of inorganic fertilizers is increased dramatically, whereas utilization of organic fertilizer decreased. The application of farmyard manure meets nitrogen requirement provides micronutrients and modifies soil physical behavior (Larson and Clapp, 1984) [7] and thus favours rice production and probably it may affect the grain quality of aromatic rice. Moreover, use of farmyard manure not only acts as a source of nitrogen and other nutrients but also increases the efficiency of applied nitrogen (Saravanan *et al*., 1987) [10]. Green manure prepared from Sesbania *spp.* is a cheaper and feasible alternative to other organic sources like cow-dung and crop residues. Green manuring *spp*. such as *Sesbaina rostata* can fix sufficient amounts of nitrogen for optimum rice yield without any inorganic nitrogen input (Becker *et al.*, 1990; Meelu *et al*., 1992) [2, 8].

Aromatic rice is rated best in quality and fetches much higher price than high quality non aromatic rice in the domestic and international market. The demand of aromatic rice for internal consumption and also for export is increasing day by day (Das and Baqui, 2000) [3]. Due to low yield and limited market facilities farmers seems to have little interest to continue growing these aromatic rice cultivars. Nature of sensitivity of aroma is the genetic factor, which is highly affected by the environmental conditions (Singh *et al.*, 1998) [15]. Farmer's observation at present day is that aromatic rice gradually losing their aroma and qualities due to lack of organic matter in the soil and huge use of chemical fertilizers. Use of judicious combination of organic and inorganic fertilizer is very important for tropical country (Khan *et al*., 1986) [6] like in India. This will ultimately economize fertilizer use and maintain soil productivity and grain quality. Seergasamba a medium duration rice variety and is being cultivated during samba season. Through the Seeragasamba possess higher market demand with excellent price but its production potential is low under varied agro climates. Further, the

information is limited on varietals response to different organic and inorganic fertilizers with their interactions particularly in respect of growth and yield of Seeragasamba. Therefore, the present investigation was aimed to study the effect of different organic and inorganic sources of nutrient on growth and yield of Seeragasamba.

Materials and Methods

The study was undertaken on sandy clay loamy soils of Madurai district during the period samba seasons of 2017-18 and 2018-19. The experimental field is located in Southern agro climatic zones of Tamil Nadu at 9.54ºN latitude and 78.80ºE longitude at an altitude of 147 m above MSL. During the 2017-18, a total of 278.1 mm rainfall was received in 12 rainy days and in 2018-19, a total of 377.8 mm was received in 11 days. Two field experiments were conducted during 2017-18 and 2018-19 under RBD replicated thrice with fourteen treatments *viz*. T_1- 100%N through Green Manure, T_2-75%N through Green Manure+25%N through RDF,
T_3 - 50%N through Green Manure+50% N through RDF, T_4 - 100%N through FYM, T_5-75% N through FYM+25% N through RDF, T_6-50% N through FYM+50% N through RDF, T_7-100% N through Composted Poultry Manure, T_8-75%N through Composted Poultry Manure+25%N through RDF, T_9-50% N through Composted Poultry Manure+50%N through RDF, T_{10}-100%N through Vermicomposted Pressmud, T_{11}-75% N through Vermicomposted Pressmud+25% N through RDF, T_{12}-50% N through Vermicomposted Pressmud+50% N, T_{13}-RDF @ 56:37:37 NPK Kg/ha through In organic and T_{14}- Control (No Nitrogen). The growth parameters *viz*, plant height at harvest, LAI at flowering, CGR between flowering and harvest and DMP at harvest were measured in randomly selected five plants in each replication. The number of productive tillers, filled grains (per cent), 1000 grain weight, grain and straw yield were recorded at harvest stage. In addition to the above, B:C ratio was also worked out. The data were statistically analyzed as per the method suggested by Gomez and Gomez (1984) [4].

Results and Discussion

Growth attributes

The plant height was significantly influenced by the application of different sources of organic manures and inorganic nutrients in samba seasons of both 2017-18 and 2018-19. (Table 1). Among the treatments, application of 50% N through green manure + 50% N through RDF (T_3) significantly recorded the highest plant height of 150.8 cm in 2017-18 and 149.4 cm in 2018-19 followed by T_{12} application of 50% N through vermicomposted pressmud + 50% N through RDF 147.8 cm in 2017-18 and 145.3 and in 2018-19. However T_3 and T_{12} were found to be an par with each other. The lowest plant height 113.4 cm in 2017-18 and 128.7 cm in 2018-19 was recorded in T_{14}.

Leaf area index is one of the important growth parameters which decides the photosynthetic surface and subsequently on yield. Similar to the plant height, the leaf area index observed at flowering stage revealed that the LAI of 4.51 in 2017-18 and 4.95 in 2018-19 were observed in the application of 50% N through green manure + 50% N through RDF (T_3). The lowest LAI of 3.22 in 2017-18 and 3.39 in 2018-19 were recorded in control T_{14} (without nitrogen).

The crop growth rate, as a measure of unit productivity was significantly increased due to the application of organic manure and inorganic nutrients. Here again, a trend is similar to that of other growth parameters. Application of 50% N through green manure + 50% N through RDF (T_3) recorded the highest CGR 9.10 g/m^2 day in 2017-18 and 9.33 g/m^2/day in 2018-2019. It was followed by T_{12} which recorded 8.60 g/m^2/day in 2017-18 and 8.83 g/m^2/day in 2018-19 and both were found to be on par. The lowest CGR 3.41 g/m^2/day in 2017-18 and 4.05 g/m^2/day in 2018-19 was observed in control (T_{14}).

The plant height, LAI and CGR were reflected in total dry matter production. In the present investigation, application of 50% N through green manure + 50% N through RDF (T_3) recorded the highest TDMP (9554 kg/ha in 2017-18 and 9690 kg/ha in 2018-19) and was followed by (T_{12}) application of 50% N through Vermi composted pressmud + 50% N through RDF (9263 kg/ha in 2017-18 and 9444 kg/ha in 2018-2019). The lowest TDMP (4301 kg/ha in 2017-18 and 4383 kg/ha in 2018-19) was recorded in control (T_{14}).

The higher TDMP in T_3 and T_{12} could be attributed to the better performance of these treatments in enhancing the plant height, LAI and CGR. The release of organic matter during the decomposition of green manure and vermicomposted pressmud could be the probable reason for the higher plant height, LAI and CGR (Singaravel *et al.*, 2001 [14] and Ramanathan, 1995) [9]. Similar results in rice were also reported by (Sharma and Kuhad, 1993 [12] and Satheesh, 1998) [11].

Yield and yield components

The most important yield components of rice *viz*, no of productive tillers, filled grains (per cent) 1000-grain weight, grain yield and B:C ratio were observed at harvest stage in samba seasons of both 2017-18 and 2018-19 (Table 2 and 3). The data revealed that application of different sources of organic manures and inorganic nutrients significantly increased the yield components. Among the treatments, (T_3) application of 50% N through green manure + 50% N through RDF recorded significantly the highest number of productive tillers (12.5 in 2017-18 and 12.8 in 2018-19) and was followed by (T_{12}) application of 50% N through vermicomposted pressmud + 50% N through RDF (12.2 in 2017-18 and 12.5 in 2018-19). These two treatments were found to be on par with each other. The (T_{14}) control (without nitrogen) registered the lowest number of productive tillers (7.5 in 2017-18 and 8.0 in 2018-19).

The filled grains (per cent) in 2017-18 and 2018-2019 followed a trend similar to that of number of productive tillers per hill. The highest filled grains (78.5 per cent in 2017-18 and 80.9 per cent in 2018-19) was recorded in T_3 followed by T_{12} which registered 70.2 per cent in 2017-18 and 78.5 per cent in 2018-19 and T_3 and T_{12} were found to be on par. However, the lowest percent of filled grains of 57.6 in 2017-2018 and 57.1 in 2018-2019 were registered in control (T_{14}).

The 1000 grain weight, as of measure of size of the grains was significantly influenced by the treatments. The highest 1000- grain weight (12.99 g in 2017-18 and 12.5 g in 2018-2019) was recorded in T_3, it was followed by T_{12} which registered 11.8 g in 2017-2018 and 12.1 g in 2018-2019. These two treatments were found to be on par with each other. The control (T_{14}) recorded the lowest 1000-grain weight (9.1 g in 2017-18 and 9.3 g in 2018-2019).

The highest grain yield of 4573 kg/ha in 2017-2018 and 4619 kg/ha in 2018-2019 were recorded due to the application of 50% N through green manure +50% N through RDF and it was followed by (T_{12}) application of 50% N through

vermicomposted pressmud + 50% N through RDF which recorded the grain yield of 4436 kg/ha and 4481 kg/ha respectively in 2017-18 and 2018-2019. The lowest grain yield of 2084 kg/ha and 2105 kg/ha were recorded respectively in 2017-2018 and 2018-2019 in T_{14}.

With respect to the straw yield, T_3 registered the highest straw yield of 7363 kg/ha and 7510 kg/ha during 2017-18 and 2018-19 repsectively. T_3 was followed by T_{12} which recorded 7142 kg/ha in 2017-18 and 7285 kg/ha in 2018-2019. Similar to the grain yield, T_3 and T_{12} were found to be on par with each other.

The higher grain yield in T_3 and T_{12} might be due to the fact that the important yield components *viz*, number of productive tillers, filled grains (per cent) and 1000-grain weight were found to be higher in these two treatments as compared to others. The better performance of these two treatments in enhancing the grain yield through yield components is due to the higher solubility of phosphorus and slow release of nitrogen through the mineralization and decomposition of green manure and vermicomposted pressmud (Babu *et al.*, 2001) [1]. These results are supported by the findings of Gunaseena and Ahmed (1961) [5] who reported that the use of organic manure in combination with the mineral fertilizers maximized the plant growth and yield of rice.

Benefit: Cost Ratio

The benefit: cost ratio in both experiments were significantly influenced by the treatments. Among the treatments, (T_3) application of 50% N through green manure + 50% N through RDF registered the highest B:C ratio of 1.86 in 2017-18 and 1.88 in 2018-2019. It was followed by T_{12} *viz*, application of 50% N through vermicomposted pressmud + 50% N through RDF which recorded the B:C ratio of 1.84 in 2017-18 and 1.85 in 2018-2019. The lowest B:C ratio of 1.58 in 2017-2018 and 1.62 in 2018-2019 were recorded in control (T_{14}). The highest B:C ratio in T_{12} and T_{12} might be due to the low cost involved in the green manure as well as the pressmud. These results are also in line to the findings of Usman *et al*. 2003 [16] and Siavoshi *et al.* (2011) [13].

Table 1: Effect of different organic manures and inorganic nutrients on growth attributes of Seeragasamba rice

Treatments	2017-18				2018-19			
	Plant height at harvest	LAI at flowering	CGR ($g/m^2/day$)	DMP (kg/ha)	Plant height at harvest	LAI at flowering	CGR ($g/m^2/day$)	DMP (kg/ha)
T_1 - 100% N through green manure	111.0	3.62	5.22	5530	133.2	3.96	5.37	5638
T_2 - 75% N through green manure+25% N through RDF	135.9	3.94	6.90	7246	138.6	4.33	7.04	7391
T_3 - 50% N through green manure+50% N through RDF	150.8	4.51	9.10	9554	149.4	4.95	9.33	9690
T_4 - 100% N through FYM	119.9	3.42	4.43	4621	129.6	3.52	4.52	4712
T_5 - 75% N through FYM+25% N through RDF	134.3	3.67	5.62	6077	134.1	4.07	5.71	6196
T_6 - 50% N through FYM+50% N through RDF	138.9	4.12	7.40	8120	141.5	4.37	7.53	8281
T_7 - 100% N through composted poultry manure	134.5	3.48	4.73	5033	131.0	3.67	4.80	5131
T_8 - 75% N through composted poultry manure+25% N through RDF	135.3	3.78	6.11	6582	136.9	4.10	6.37	6712
T_9 - 50% N through composted poultry manure+50% N through RDF	141.2	4.21	8.20	8783	143.2	4.71	8.34	8952
T_{10} - 100% N through Vermicomposted pressmud	123.0	3.59	5.09	5366	130.2	3.84	5.15	5474
T_{11} - 75% N through Vermicomposted pressmud+25% N through RDF	132.8	3.87	6.54	7002	135.2	4.24	6.72	7141
T_{12} - 50% N through Vermicomposted pressmud+50% N through RDF	147.8	4.36	8.60	9263	145.3	4.63	8.83	9444
T_{13} - RDF @ 56:37:37 NPK kg/ha through inorganic	137.5	4.03	7.43	7969	140.4	4.25	7.54	8127
T_{14} - Control (No nitrogen)	113.4	3.22	3.41	4301	128.2	3.39	4.05	4383
SEd	8.36	0.135	0.31	467.5	5.76	0.285	0.51	519.6
CD (P=0.05)	17.18	0.279	0.64	961.0	11.84	0.585	1.04	1068.0

Table 2: Effect of different organic manures and inorganic nutrients on yield components of Seeragasamba rice

Treatments	No. of productive tillers per hill		Filled grains (per cent)		1000-grain weight (g)	
	2017-18	2018-19	2017-18	2018-19	2017-18	2018-19
T_1 - 100% N through green manure	9.4	9.1	62.3	64.2	10.4	10.5
T_2 - 75% N through green manure+25% N through RDF	9.6	10.2	70.6	72.7	10.6	10.7
T_3 - 50% N through green manure+50% N through RDF	12.5	12.8	78.5	80.9	12.9	12.5
T_4 - 100% N through FYM	7.9	8.3	58.1	59.8	10.2	10.3
T_5 - 75% N through FYM+25% N through RDF	9.1	9.3	65.7	67.7	10.4	10.5
T_6 - 50% N through FYM+50% N through RDF	10.6	11.1	72.1	72.5	10.7	10.8
T_7 - 100% N through composted poultry manure	9.1	9.3	59.8	61.6	10.3	11.4
T_8 - 75% N through composted poultry manure+25% N through RDF	9.2	9.5	68.2	70.2	10.5	10.6
T_9 - 50% N through composted poultry manure+50% N through RDF	11.3	11.6	73.9	76.1	11.6	11.7
T_{10} - 100% N through Vermicomposted pressmud	8.9	8.8	61.6	63.5	10.4	10.5
T_{11} - 75% N through Vermicomposted pressmud+25% N through RDF	9.4	9.6	70.1	71.5	10.6	10.7
T_{12} - 50% N through Vermicomposted pressmud+50% N through RDF	12.2	12.5	76.2	78.5	11.8	12.1
T_{13} - RDF @ 56:37:37 NPK kg/ha through inorganic	10.1	10.4	71.8	72.2	10.7	10.8
T_{14} - Control (No nitrogen)	7.5	8.0	57.6	57.1	9.1	9.3
SEd	0.53	0.34	4.71	4.29	0.55	0.52
CD (P=0.05)	1.10	0.71	8.58	8.82	1.13	1.08

Table 3: Effect of different organic manures and inorganic nutrients on grain and straw yield and B:C ratio of Seeragasamba rice

Treatments		Grain yield (kg ha^{-1})		Straw yield (kg h^{-1})		B:C ratio	
		2017-18	2018-19	2017-18	2018-19	2017-18	2018-19
T_1	100% N through green manure	2701	2754	4212	4296	1.61	1.59
T_2	75% N through green manure+25% N through RDF	3497	3567	5560	5671	1.71	1.72
T_3	50% N through green manure+50% N through RDF	4573	4619	7363	7510	1.86	1.88
T_4	100% N through FYM	2265	2288	3511	3581	1.52	1.53
T_5	75% N through FYM+25% N through RDF	2934	2963	4606	4698	1.62	1.63
T_6	50% N through FYM+50% N through RDF	3836	3875	6176	6300	1.74	1.75
T_7	100% N through composted poultry manure	2562	2488	3936	3892	1.53	1.54
T_8	75% N through composted poultry manure+25% N through RDF	3189	3222	5039	5140	1.63	1.64
T_9	50% N through composted poultry manure+50% N through RDF	4070	4212	6594	6889	1.73	1.75
T_{10}	100% N through Vermicomposted pressmud	2620	2673	4087	4169	1.55	1.56
T_{11}	75% N through Vermicomposted pressmud+25% N through RDF	3392	3426	5360	5466	1.65	1.66
T_{12}	50% N through Vermicomposted pressmud+50% N through RDF	4436	4481	7142	7285	1.84	1.85
T_{13}	RDF @ 56:37:37 NPK kg/ha through inorganic	3760	3800	6054	6175	1.76	1.77
T_{14}	Control (No nitrogen)	2084	2105	3272	3338	1.58	1.62
SEd		201.2	181.0	338.7	231.1	0.086	0.034
CD (P=0.05)		413.5	372.0	696.3	475.0	0.176	0.070

Conclusion

From the present study, it could be concluded that (T_3) the application of 50% N through green manure + 50% N through RDF recorded the highest growth and yield of rice. It was found to be on par with T_{12} *viz*, application of 50% N through vermicomposted pressmud + 50% N through RDF in all aspects of growth and yield. The higher B:C ratios was also obtained with above treatments.

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