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INFLUENCE OF PLANTING METHODS AND DIFFERENT VERMICOMPOSTS ON THE GROWTH ATTRIBUTES, YIELD AND NUTRIENT UPTAKE IN RICE

Balamurugan, R and Sudhakar, P

Department of Agronomy, Annamalai University, Chidambaram-608 002 (Tamil Nadu), India.

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ABSTRACT

Field experiments were conducted at Annamalai University, Experimental Farm, Annamalainagar, Chidambaram during two seasons namely Navarai of 2009-2010 and late samba of 2010- 2011 to identify the influence of different cultivation systems and various vermicomposts on productivity of rice. The experiment was laid out in a split plot design. The crop planting methods was assigned to main plot and different vermicomposts to sub plot. Three planting methods *viz*., M_1 (puddle direct sowing), M_2 (conventional transplanting), and M_3 (System of Rice Intensification) in main plot and different vermicompost *viz*., S_1 (Sewage sludge based vermicompost), S_2 (FYM based vermicompost), S_3 (Sugarcane trash based vermicompost), S_4 (Pressmud based vermicompost) and S_5 (No vermicompost-control) under sub plot were evaluated. The treatments were replicated thrice. Observations were taken for plant height, DMP, grain & straw yields and nutrient uptake in rice. The results of the study revealed that the SRI method of establishment enhanced the growth parameters, dry matter production, grain and straw yield and nutrient uptake in rice. Among vermicomposts, pressmud based vermicompost recorded better growth attributes and yield compared to other source of vermicompost. This treatment also recorded the highest nutrient uptake followed by conventional method of planting. Based on the above experimental results, it could be concluded that cultivation of rice with SRI method along with application of pressmud based vermicompost @ 3.0 t ha^{-1} will be a promising combination which resulted in higher yields and economic returns.

INTRODUCTION

In India, rice occupies pivotal place and is the staple food of more than70 per cent population. It accounts for about 45 per cent of total food grain production and 55 per cent of cereals production. It occupies about 44.6 million hectares with a production of 86.0 million tonnes and it continues to hold the key to sustain food production by contributing 20 to 25 per cent of agriculture GDP and assures food security in India for more than half of the total population. To feed the exploding population, projection of India's rice production target for 2025 AD is 140 millon tonnes, which can be achieved only by increasing the rice production by over 2.0 million tonnes per year in the coming decade (Subbiah, 2006). In contrast, recent slow down or plateauing of yield in irrigated rice was noticed as a result of soil health and decline in productivity level (IRCN, 2001). In recent years different combination of organic manures are used along with inorganics for sustaining the rice production and vermicompost was one among them which excels most. Vermicompost has been recognized as an eco friendly technology for converting organic wastes into high value organic manure rich in nitrates, available from of phosphorus, calcium, vitamins, natural phyto-regulators and micro flora in balanced from which help in reestablishment of the natural fertility of soil (Purakayastha and Bhatnagar, 1997).

In order to test the potential of vermicompost and different planting methods on the growth, yield attributes and to determine the nutrient balance of the soil of rice, the present investigation was under taken.

MATERIALS AND METHODS

Field experiments were conducted at Experimental Farm, Annamalai University, Annamalainagar, during Navarai 2009-2010 and Late samba 2010- 2011 to identify and formulate a suitable combination of vermicompost derived from different sources of raw materials under different cultivation systems of rice on growth and yield

*Corresponding author: +91
Email: rajabala85@gmail.com

components, of rice varieties ADT 43 & BPT 5204. The experimental soil was deep clay, low in available soil nitrogen (192 ha^{-1}), medium in available soil phosphorus (21.9 ha^{-1}) and high in available soil potassium (273 kg ha^{-1}). Short duration rice cv ADT 43 was used for the I season and rice cv BPT 5204 for II season, respectively.

The experiment was laid out in split plot design with three replication. The crop planting methods was assigned to main plot and different vermicomposts to sub plot. Three planting methods *viz*., M_1 (puddle direct sowing), M_2 (conventional transplanting), and M_3 (System of Rice Intensification) in main plot and different vermicompost *viz*., S_1 (Sewage sludge based vermicompost), S_2 (FYM based vermicompost), S_3 (Sugarcane trash based vermicompost), S_4 (Pressmud based vermicompost) and S_5 (No vermicompost-control) under sub plot were evaluated. The treatments were replicated thrice. Various observations on growth parameters viz. plant height, DMP and gain and straw yields during harvest were recorded. Plants were also analysed for N, P and K uptake after harvest. The data on various studies recorded during the investigation were subjected to statistical scrutiny as suggested by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Results of the field experiment revealed that SRI method of planting exhibited a salutary effect which was evident in terms of growth of rice *viz*., plant height and dry matter production. The least plant height was observed in puddle direct sowing (M_1) at tillering, flowering and harvest stages, respectively. This might be due to the fact that young seedlings in SRI had high vigour, more root growth and less transplant shock during the initial growth stages, which stimulated plant height. Similar findings were reported by Kimsangsu *et al*. (1999). The difference in plant height due to different organic based vermicompost was significantly superior than the control. Among the different organic based vermicompost treatments, pressmud based vermicompost application (S_4) recorded significantly the highest plant height of 86.7 cm for season I and 88.4 cm for season II at harvest stages, respectively. This was followed by sewage sludge based vermicompost (S_1) and FYM based vermicompost (S_2). The least plant height was recorded in S_5 *viz*., no vermicompost for season II at harvest.

The interaction effect between methods of planting and different organic based vermicompost was significant I year higher for plant height crop growth. Crop raised from SRI (M_3) along with application of pressmud based vermicompost (S_4) registered the highest plant for season I and II, respectively. The lowest plant height was recorded in puddle direct sowing with no vermicompost (M_1S_1) in general, dry matter production of rice plant was increased from sowing to harvest. The effect of different methods of planting and different vermicompost on DMP was significant at harvest stages of the crop. SRI (M_3) registered higher DMP of 13,441 kg ha^{-1} for season I and 13,702 kg $ha^{-1}$for season II at harvest stage, followed by conventional method (M_2). The lowest DMP was recorded in puddle direct sowing (M_1). Among various organic manures, Pressmud based vermicompost (S_4) recorded the highest DMP followed by sewage sludge based vermicompost (S_1), FYM based vermicompost (S_2) and sugarcane thrash based vermicompost (S_3) at both season of study. Plots without vermicompost (S_5) recorded the least DMP of season II at harvest stage. The grain and straw yields were registered significantly higher in plots with SRI method of planting when compared to other methods of planting. This could be attributed to optimum supply of irrigation water with mechanical weeding resulted in higher nutrient availability, subsequently resulting in better source to sink conversion which in turn enhanced grain and straw yield. The higher microbial population in the rhizosphere also mobilizes more nutrients which in turn reflected in higher grain & straw yield. The results are in line with those of Sinclair and Sheety, (1999).

Among the various vermicompost treatments, substantial increase in grain and straw yields number was realized in pressmud based vermicompost applied plots. Increased grain and straw yields of 55.23 and 25.63 per cent for season I and 66.24 and 42.11 per cent for season II, was recorded in pressmud based vermicomost applied plots over control. Sewage sludge based vermicompost and FYM based vermicompost follows the line in respect of grain and straw yields. The aforesaid increased yield attributes due to pressmud based vermicompost might be due to higher nutrient uptake and increased photosynthetic efficiency.

This adequate biomass production and better nutrient uptake have resulted in higher yield in pressmud based vermicompost plot. The control plot (without vermicompost) recorded low grain and straw yield. These results evidently indicated that integration of different planting methods along with different pressmud based vermicompost gave higher yields than control. Rajesh and Thanunathan (2003) observed that the roots of rice plants have least competition under wider spacing (SRI method) so that growth was stimulated by sunlight and space for the canopy expansion thereby increasing the yield attributes and yield of rice.

Crop nutrient uptake/ Resource utilization

Rice crop with SRI method registered higher nutrient uptake and was significantly superior to conventional method and puddle direct sowing methods.

Nitrogen uptake was higher in SRI compared to conventional transplanting and puddle direct sowing. Joeli Barison (2002) reported that greater nutrient uptake might be due to some increase of available N in the soil as a result of higher mineralization of organic-N in a soil environment that alternates aerobic and anaerobic conditions. Furthermore, greater activity of N-fixing bacteria such as N_2-fixing endophytes within the root cells and in the root rhizosphere might also be present in the SRI plant-soil environment.Phosphorus and potassium uptake was also higher with SRI which might be due to enhanced root activity, allowing the plants to access the sub soil nutrients similar results was reported by Moorthy *et al*. (1985). Higher nutrient uptake in SRI, was also attributed to better root activity and increased DMP

Table 1 Effect of planting methods and different vermicompost application on plant height (cm) and DMP (kg ha^{-1}) of rice

	Plant height (cm)								DMP (kg ha)							
	Season I				Season II				Season I				Season II			
Treatments	**M$_1$**	**M$_2$**	**M$_3$**	**Mean**	**M$_1$**	**M$_2$**	**M$_3$**	**Mean**	**M$_1$**	**M$_2$**	**M$_3$**	**Mean**	**M$_1$**	**M$_2$**	**M$_3$**	**Mean**
S$_1$	80.75	85.43	89.28	85.2	82.53	87.21	91.06	86.9	10479	12928	14469	12625	10678	13188	14895	12920
S$_2$	78.84	84.14	87.99	83.7	80.62	85.92	89.77	85.4	10176	12641	14126	12314	10278	12854	14504	12545
S$_3$	76.9	82.85	86.7	82.2	78.7	84.63	88.48	83.9	9902	12310	13791	12001	9943	12510	14125	12193
S$_4$	82.66	86.72	90.57	86.7	84.44	88.5	92.35	88.4	10700	13213	14733	12882	10996	13482	15204	13227
S$_5$	73.24	77.66	81.2	77.4	75.01	79.43	82.97	79.1	7856	8795	9954	8868	8118	9084	10255	9153
Mean	78.5	83.4	87.1		80.3	85.1	88.9		9875	12035	13475		9950	12166	13736	
	Main	**Sub**	**M at S**	**S at M**	**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	1.8	0.6	1.62	3.42	1.8	0.6	1.74	3.42	600	40	120	1260	650	60	180	1235
CD (p=0.05)	3.8	1.2	3.36	7.22	3.8	1.2	3.36	6.84	1200	90	252	2280	1400	120	312	2660

M$_1$ – Puddle direct sowing, M$_2$ – Conventional method, M$_3$ – SRI method
S$_1$ – Sewage based vermicompost, S$_2$ – FYM based vermicompost, S$_3$ – Sugar cane trash based vermicompost, S$_4$ – Pressmud based vermicompost, S$_5$ – Control

Table 2 Effect of planting methods and different vermicompost application on Grain yield (kg ha^{-1}) and Straw yield (kg ha^{-1})

	Grain yield (kg ha^{-1})								Straw yield (kg ha^{-1})							
	Season I				Season II				Season I				Season II			
Treatments	**M$_1$**	**M$_2$**	**M$_3$**	**Mean**	**M$_1$**	**M$_2$**	**M$_3$**	**Mean**	**M$_1$**	**M$_2$**	**M$_3$**	**Mean**	**M$_1$**	**M$_2$**	**M$_3$**	**Mean**
S$_1$	4299	5581	6524	5468	4382	5707	6733	5607	5655	6823	7420	6633	5771	6958	7638	6789
S$_2$	4129	5410	6346	5295	4171	5516	6528	5405	5524	6707	7256	6495	5583	6814	7452	6616
S$_3$	3964	5238	6174	5125	3965	5331	6329	5208	5415	6548	7094	6352	5454	6655	7271	6460
S$_4$	4470	5765	6710	5649	4598	5897	6941	5812	5705	6923	7500	6710	5873	7061	7739	6891
S$_5$	3053	3603	4261	3639	2948	3472	4066	3496	4542	4957	5471	4990	4383	4798	5364	4849
Mean	3983	5120	6003		4013	5185	6119		5368	6392	6948		5413	6457	7093	
	Main	**Sub**	**M at S**	**S at M**	**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	450	80	232	855	500	100	290	950	250	25	72.5	475	300	40	112	570
CD (p=0.05)	900	160	448	1710	1000	200	560	1900	500	50	135	950	600	80	232	1140

Table 3 Effect of planting methods and different vermicompost application on Nitrogen uptake (kg/ha^{-1}) and Phosphorus uptake by rice (kg/ha^{-1})

	Nitrogen uptake by rice (kg/ha^{-1})								Phosphorus uptake by rice (kg/ha^{-1})							
	Season I				Season II				Season I				Season II			
Treatments	**M$_1$**	**M$_2$**	**M$_3$**	**Mean**	**M$_1$**	**M$_2$**	**M$_3$**	**Mean**	**M$_1$**	**M$_2$**	**M$_3$**	**Mean**	**M$_1$**	**M$_2$**	**M$_3$**	**Mean**
S$_1$	121.99	129.38	135.61	128.99	127.30	134.69	140.92	134.30	22.43	24.58	26.39	24.47	25.87	28.02	29.83	27.91
S$_2$	119.28	126.65	132.97	126.30	124.59	131.96	138.28	131.61	21.68	23.84	25.66	23.73	25.12	27.28	29.10	27.17
S$_3$	116.57	123.92	130.33	123.61	121.88	129.23	135.64	128.92	20.93	23.10	24.93	22.99	24.37	26.54	28.37	26.43
S$_4$	124.70	132.11	138.25	131.69	130.01	137.42	143.56	137.00	23.18	25.32	27.12	25.21	26.62	28.76	30.56	28.65
S$_5$	95.32	102.74	109.25	102.44	102.30	108.41	114.52	108.41	16.69	18.30	19.91	18.30	18.34	19.95	21.56	19.95
Mean	115.57	122.96	129.28		121.22	128.34	134.58		20.98	23.03	24.80		24.06	26.11	27.88	
	Main	**Sub**	**M at S**	**S at M**	**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	3	1.2	3.24	5.7	3	1.3	3.64	5.7	0.8	0.3	0.87	1.52	0.8	0.3	0.84	1.6
CD (p=0.05)	6	2.5	7.25	11.4	6	2.6	7.28	11.4	1.8	0.8	2.16	3.42	1.8	0.6	1.74	3.42

M$_1$ – Puddle direct sowing, M$_2$ – Conventional method, M$_3$ – SRI method
S$_1$ – Sewage based vermicompost, S$_2$ – FYM based vermicompost, S$_3$ – Sugar cane trash based vermicompost, S$_4$ – Pressmud based vermicompost, S$_5$ – Control

Table 4 Effect of planting methods and different vermicompost application on Available Potassium (kg ha^{-1})

Potassium uptake by rice (kg/ha^{-1})								
	Season I				Season II			
Treatments	**M_1**	**M_2**	**M_3**	**Mean**	**M_1**	**M_2**	**M_3**	**Mean**
S_1	122.12	130.94	138.06	130.37	125.54	133.69	141.50	133.58
S_2	118.27	127.49	134.61	126.79	121.79	129.95	137.77	129.84
S_3	114.42	124.04	131.16	123.21	118.04	126.21	134.04	126.10
S_4	125.97	134.39	141.51	133.96	129.29	137.43	145.23	137.32
S_5	97.94	101.89	105.84	101.89	104.72	108.59	112.00	108.44
Mean	115.74	123.75	130.24		119.88	127.17	134.11	
	Main	**Sub**	**M at S**	**S at M**	**Main**	**Sub**	**M at S**	**S at M**
S.E	3	1.6	4.48	5.7	3.2	1.6	4.32	6.08
CD (p=0.05)	6	3.2	8.9	12.6	6.5	3.4	9.86	13.6

besides less competition among plants because of single seedling planting. Similar findings were made by Anupama Kumari and Ajay Kumar (2006).

The date on the effect of different organic manures show that pressmud based vermicompost @ 3 t ha^{-1} (s_4) resulted in the highest N, P & K uptake by rice, 28.55, 37.75 and 23.46 per cent and 26.37,43.60 and 26.53 per cent higher than control(S_5) in season I and season II, respectively. Higher uptake of nutrients in composted pressmud based vermicompost might be due to increased availability of nutrients. Increase in available N due to application of pressmud based vermicompost and FYM was reported by Rayar (1984). The application of pressmud based vermicompost decreased the adsorption capacity and increased the soluble P and P desorption and this lends support to the higher uptake of P in pressmud based vermicompost treatments (Reddy *et al*., 1980). The increased uptake of K due to composted pressmud based vermicompost might also be due to the increased availability of K and also due to its higher K content in the compost.

Thus it could be concluded that for relealising higher yields in rice, farmers are recommended to take up SRI method of planting along with application of 3 t/ha of vermicompost based vermicompost. In the absence of vermicompost and if sewage sludge was available, then sewage sludge based vermicompost can be substituted in place of pressmud based vermicompost for achieving higher yields in rice.

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