Influence of various organic sources of nutrients on productivity enhancement in rice (O*ryza sativa* L.)

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ABSTRACT *Field investigation were carried out at the Annamalai University Experimental farm, Department of Agronomy, Annamalai Nagar to study the Influence of various organic sources of nutrients on productivity enhancement in rice (Oryza sativa L.) during Navarai season 2016 (January-April) and Kuruvai season 2016 (June-September). The experiments comprised of ten treatments viz., T_1- control (no fertilizer and no organic manure), T_2 - recommended dose of nitrogen (RDN), T_3 - 50 % N through urea + 50% N through sewage sludge compost, T_4 – 50 % N through urea + 50% N through pressmud, T_5 - 50 % N through urea + 50% N through FYM, T_6 – 50 % N through urea + 50% N through water hyacinth compost , T_7 – 50 % N through urea + 50% N through sewage sludge vermicompost, T_8 – 50 % N through urea + 50% N through pressmud vermicompost, T_9 – 50% N through FYM vermicompost, T_{10} – 50 % N through urea + 50% N through water hyacinth vermicompost and uniform dose of phosphorus and potassium as per fertilizer schedule was given to all the treatments except control. The treatments were replicated thrice adopting randomized block design. The effect of integrated nutrient management (INM) practices on growth attributes, yield attributes and yield of crop was critically studied under rice.The growth and yield components of rice viz., plant height, number of tillers hill^{-1}, leaf area index, dry matter production, root biomass and yield attributes like productive tillers m^{-2}, panicle length and filled grains panicle^{-1} were strikingly impressive by 50% N through urea + 50% N through pressmud vermicompost (T_8) in both seasons.*

Significantly recorded the higher grain yield of 5.81 t ha^{-1} and 5.98 t ha^{-1} during first crop and second crop, respectively was under plots received with 50% N through urea + 50% N through pressmud vermicompost (T_8).From the result of the field trials, it can be concluded that application of 50% N through urea + 50% N through pressmud vermicompost (T_8) to rice crop was found to be an agronomically sound, ecologically safe and economically viable practice for augmenting higher productivity in rice of tail end area of Cauvery deltaic zone of Tamil Nadu.

Keywords: *Rice, Recommended Dose Of Nitrogen, sewage sludge compost, Pressmud, FYM , water hyacinth compost and Vermicompost*

INTRODUCTION

Rice occupies a pride place among the food crops cultivated and it has not only meets most of the needs on earth but also symbolizes revolution, industrialization, calorie and earth. It is the cause of revolution on earth in nutrition as well as on food security front (Pradhan and Moharana, 2015). Rice is cultivated world-wide over an area of about 160.68 million ha^{-1} with an annual production of about 650.19 million tonnes. In India rice is cultivated over an area of about 39.16 million hectares with an annual production of about 85.59 million tonnes and the productivity of 2.20 tonnes ha^{-1}. (Anonymous, 2015) In Tamil nadu, rice is grown predominantly among the states in India, which is cultivated in an area of 1.90 million hectares and production of 5.79 million tonnes with productivity of 3.04 t ha^{-1}. However, yield is still lower when compared to the average productivity of rice producing countries such as Japan (6.50 t ha^{-1}), China (6.70 t ha^{-1}), Egypt (7.50 t ha^{-1}) and Israel (5.50 t ha^{-1}). In India, during the past three decades, intensive agriculture involving high yielding varieties of rice has lead to heavy withdrawal of nutrients from the soil. Further, imbalanced use of chemical fertilizers by farmers has also deteriorated soil health and declines soil organic carbon content, which is threat to sustainability. Nitrogen is commonly the most limiting nutrient for crop production in the major world's agricultural areas and therefore, adoption of good N management strategies often results in large economic benefits to farmers. Use of organic manures in present agriculture is increasing day by day, because of its utility not only improving the physical, chemical and biological properties of soil but also maintaining the good soil health and supplying almost all essential plant-nutrients for growth and development of crop plants. So, it is time to look for measures to stimulate sustainability in production of rice on long- term basis. In this context, vermicomposting of different organic wastes shows promising results in enriching the soil with organic matter, nutrients, etc., thereby maintaining soil fertility. Vermicomposting is a simple process of composting with certain species of earthworms to accelerate the process of waste conversion and to get a better end product. (Shweta *et al*., 2010).

Research evidences clearly show that vermicompost is a potential organic input which would impart consistent environment and soil physico-chemical properties, biological activity, nutrient availability which ultimately improves nutrient uptake, growth and yield components and yields of cereal crops.

Although research work on organic wastes with inorganic fertilizer on rice crop was in plenty, different vermicompost made from various organic sources in rice is almost meager. Therefore, the present investigation was planned to develop a sustainable nutrient management concept to achieve a highly productive and remunerative rice crop under tail end area of Cauvery deltaic zone of Tamil Nadu.

MATERIAL AND METHODS

Field experiments were conducted at Experimental Farm, Annamalai University, Annamalainagar, during Navarai season 2016 (January-April) and Kuruvai season 2016 (June-September). Study the Influence of various organic sources of nutrients on productivity enhancement in rice (O*ryza sativa* L.). The average annual rainfall of Annamalainagar is 1250 mm, distributed over 51 rainy days. The mean maximum and minimum temperature are 30.8°C and 24.7°C, respectively. Relative humidity ranges from 76 to 94 per cent. The experimental soil was deep clay, low in available soil nitrogen (193 kg ha^{-1}), medium in available soil phosphorus (21.3 kg ha^{-1}) and high in available soil potassium (274 kg ha^{-1}). The experiment was laid out in randomized block design and replicated thrice. The experiment comprised of ten treatments *viz.,* T_1- control (no fertilizer and no organic manure), T_2- recommended dose of nitrogen (RDN), T_3- 50 % N through urea + 50% N through sewage sludge compost, T_4 – 50 % N through urea + 50% N through pressmud, T_5 - 50 % N through urea + 50% N through FYM, T_6 – 50 % N through urea + 50% N through water hyacinth compost , T_7 – 50 % N through urea + 50% N through sewage sludge vermicompost, T_8 – 50 % N through urea + 50% N through pressmud vermicompost, T_9 – 50 % N through urea + 50% N through FYM vermicompost, T_{10} – 50 % N through urea + 50% N through water hyacinth vermicompost. A fertilizer schedule of 120 kg N, 38 kg P_2O_5 and 38 kg K_2O ha^{-1} was applied. N and K_2O were applied as per the treatment schedule in four equal splits *viz.,* basal, tillering, panicle initiation and heading stages of rice. The entire dose of P_2O_5 was applied basally before transplanting. N, P_2O_5 and K_2O were supplied through urea (46 per cent N), single super phosphate (16 per cent P_2O_5) and muriate of potash (60 per cent K_2O) respectively. The collected organic manures were turned over manually for 15 days in order to pre-compost it, so that it becomes palatable to earthworms. The earthworms used for composting was *Eisenia fetida* and vermicompost was prepared under pot method. After three months, matured vermicompost was applied to the experimental plots as per the treatment schedule. Twenty four days old paddy seedlings were planted with a spacing of 15 × 10 cm. Care was taken to fill the gap within 10 days after transplanting in order to maintain optimum population in both the seasons. Efforts were taken to maintain a water level of 2.5 and 5 cm in the early and later stages of crop growth period respectively. Irrigation was withheld 10 days before harvesting. Need based plant protection measures were taken up based on the economic threshold level of pest and diseases. All necessary management practices were carried out as per standard recommendation for rice crop. Five plants were selected from each plot at random. Each plant marked with a small plastic white coloured ring and with wooden peg nearby for demarcation. The same five plants were observed at various stages of crop growth up to harvest for biometric observations. These five plants were harvested separately for post harvest observations. The grain yield was assessed at 14 % moisture level.

Statistical analysis

The data on observations and characters studied were statistically analysed by adopting the procedure of Panse and Sukhatme (1978) and for the results that were significant, the critical differences were calculated at 5 per cent probability level to draw statistical conclusion.

RESULTS AND DISCUSSION

Effect of vermicompost and fertilizer nitrogen on growth attributes

In both the years, there was perceptible difference observed in rice growth attributes due to effect of INM treatments. Among the INM treatments, 50 % N through urea + 50% N through pressmud vermicompost (T_8) registered the maximum plant height of 95.39 and 98.21 cm, tillers number 12.61 and 12.98 $hill^{-1}$, LAI of 6.27 and 6.46, DMP of 12491 and 12857 kg ha^{-1} (Table 1) during first and second season, respectively. Favourable effect of vermicompost on plant height and tiller number $hill^{-1}$ could be attributed to sustained availability of major and micronutrients with different growth hormones like gibberellins resulting in increased plant height and tiller number $hill^{-1}$ which in turn increases LAI and DMP. These results coincide with the work of Subehia, Sepehya (2012). Besides, when LAI is optimum the

plants would become photosynthetically more active which would contribute to improvement in growth attributes (Kumar *et al.,* 2012).The lowest values were obtained in control (T_1).

Table 1. Effect of vermicompost and fertilizer nitrogen on growth attributes of rice

	Plant height		Number of tillers hill^{-1}		LAI		DMP (kg ha^{-1})		Root biomass (kg ha^{-1})	
Treatments	First crop	Second crop	First crop	Second crop	First crop	Second crop	First crop	Second crop	First crop	Second crop
T_1	52.64	53.18	4.49	4.88	2.24	2.43	4450	4837	382	416
T_2	62.82	65.52	7.57	7.90	3.77	3.93	7503	7826	645	673
T_3	78.48	82.08	9.46	9.90	4.71	4.92	9374	9804	806	843
T_4	85.32	88.56	10.29	10.68	5.12	5.31	10191	10578	876	910
T_5	79.56	82.98	9.59	10.00	4.77	4.98	9503	9911	817	852
T_6	73.44	76.32	8.85	9.20	4.41	4.58	8772	9116	754	784
T_7	97.02	100.62	11.70	12.13	5.82	6.04	11588	12018	997	1034
T_8	104.58	107.64	12.61	12.98	6.27	6.46	12491	12857	1074	1106
T_9	99.36	102.06	11.98	12.30	5.96	6.12	11868	12190	1021	1048
T_{10}	91.08	94.50	10.98	11.39	5.46	5.67	10879	11287	936	971
SEd	2.47	2.58	0.28	0.32	0.14	0.15	305	325	23.79	26.12
CD(p=0.05)	4.98	5.26	0.59	0.67	0.29	0.32	611	652	49.88	55.28

Effect of vermicompost and fertilizer nitrogen on yield attributes

The yield potential of rice is determined by yield attributes and the values of yield attributes are in accordance with that of growth parameters. Plots received with 50 % N through urea + 50% N through pressmud vermicompost (T_8) significantly registered higher number of productive tillers of 546.14 and 562.12 m^{-2}, panicle length of 21.50 and 22.13 cm, filled grains of 92.96 and 95.68 panicle^{-1} during first and second crop, respectively. It could be attributed due to vermicompost, which contains essential plant nutrients, steady supply of macro and micro nutrients during entire crop period, leading to better growth and development of filled grains panclie^{-1}. The results corroborate with the findings of Murthy (2012). Besides, greater availability of nutrients and microbial stimulation effects of organic manures and gradual mineralization of N (Pradhan and Moharana . 2015) and might also be due to greater availability of nutrients from combined application of organics which increasing the N level and sink capacity, which ultimately resulted in increasing the yield attributes of rice. The least productive tillers hill^{-1} and filled grains panicle^{-1} was recorded under control (T_1).

Effect of vermicompost and fertilizer nitrogen on grain and straw yields

Integration of 50% N through urea + 50% N through pressmud vermicompost (T_8) recorded significantly higher grain yield of 5.81and 5.98 t ha^{-1} (Table 2), which was 180.67 and 165.77 per cent higher than T_1 (No fertilizer and no organic manure) and 66.47 and 64.28 per cent over 100% RDN (T_2) during first and second crop, respectively. Similar trend was noticed in straw yield also. This might be due to the fact that vermicompost offer a balanced nutritional release pattern to plants, providing nutrients such as available N, soluble K, exchangeable Ca, Mg and P that can be taken readily by plants (Edwards and Fletcher, 1988) and greater microbial diversity and activity resulting in higher grain and straw production (Edwards, 2004). The variation in yield due to different organic manures was due to variation in availability of nutrients and their release pattern of nutrient (Rao *et al.,* 2013) The least yield was registered under T_1 (No fertilizer and no organic manure).

Table 2. Effect of vermicompost and fertilizer nitrogen on yield attributes, grain and straw yields in rice

	Productive tillers m^{-2}		Panicle length (cm)		Filled grains panicle^{-1}		Grain yield (t ha^{-1})		Straw yield (t ha^{-1})	
Treatments	First crop	Second crop	First crop	Second crop	First crop	Second crop	First crop	Second crop	First crop	Second crop
T_1	302.68	310.87	7.66	8.33	45.17	49.57	2.07	2.25	2.81	2.88
T_2	394.75	402.79	12.91	13.47	58.42	60.15	3.49	3.64	4.46	4.54
T_3	409.84	428.64	16.13	16.87	69.76	72.96	4.36	4.56	5.44	5.58

T_4	445.56	462.48	17.54	18.20	75.84	78.72	4.74	4.92	5.84	5.94
T_5	415.48	433.34	16.35	17.06	70.72	73.76	4.42	4.61	5.50	5.61
T_6	383.52	398.56	15.10	15.69	65.28	67.84	4.08	4.24	5.14	5.20
T_7	506.66	525.46	19.94	20.68	86.24	89.44	5.39	5.59	6.53	6.65
T_8	546.14	562.12	21.50	22.13	92.96	95.68	5.81	5.98	6.96	7.04
T_9	518.88	532.98	20.42	20.98	88.32	90.72	5.52	5.67	6.66	6.72
T_{10}	475.64	493.50	18.72	19.43	80.96	84.00	5.06	5.25	6.19	6.29
SEd	12.12	12.89	0.49	0.54	2.15	2.30	0.13	0.14	0.14	0.15
CD(p=0.05)	24.28	25.98	1.02	1.13	4.32	4.64	0.26	0.28	0.28	0.30

CONCLUSION

Thus, it can be concluded that application of 50 % N through urea along with 50% N through pressmud vermicompost can be an effective integrated nitrogen management practices that can be recommended to the farmers of coastal tracts of Tamil Nadu for higher productivity and sustainability in rice.

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