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EFFECT OF ORGANIC AND INORGANIC AMMENDMENTS ON YIELD AND ECONOMICS OF RICE

E.T. Vignesh and G.B. Sudhgar Rao

Department of Agronomy, Faculty of Agriculture, Annamalai University, Cidambaram, Cuddalaore, Tamilnadu, India - 608002.

Abstract

A field experiment was carried out during kharif season 2018 at Vallalarpuram, Sankarapalayam, Anthiyur, Erode, Tamil Nadu to study the effect of organic and inorganic ammendments on yield and economics of rice. Application of organic and inorganic sources of nutrient in combination remarkably increased yield and economics of rice than alone. 75% N + 25% N through vermicompost + $ZnSO_4$ (25 Kg/ha) + 100% PK through inorganic fertilizer + microbial consortium (T_7) recorded significantly higher yield and economics in comparison to other treatments and this was followed by 75% N + 25% N through poultry manure + $ZnSO_4$ (25 Kg/ha) + 100% PK through inorganic fertilizer + microbial consortium (T_9). 75% N + 25% N through vermicompost + $ZnSO_4$ (25 Kg/ha) + 100% PK through inorganic fertilizer + microbial consortium was increased plant height, Dry matter production, number of productive tiller/m^2, number of filled grains/panicle, test weight, grain yield, straw yield, net return and benefit cost ratio. The lower yield and economics was recorded in control.

Key words: Rice, Vermicompost, Pressmud, Poultry manure, Microbial consortium, Zinc.

Introduction

Due to different agro-climatic conditions in the India, a large number of crops are grown. Rice (*Oryza sativa*) stands first among all food grain crops of the world and is staple food for more than half of world's population. Almost 90% of the total rice is produced and consumed in Asia. Rice plays an important role in Indian agriculture and is staple food for more than 60% of the population. According to 2016-2017 statistics, rice is grown in 114 countries across the global in an area of 161 million hectares with an annual production of around 600 million tonnes with an average productivity of 4.44 tonnes ha^{-1}. In India, rice is cultivated in an area of 43.39 million hectares with a production of 104.32 million tonnes and an average productivity of 2.4 tonnes ha^{-1} (Directorate of Economics and Statistics, 2016). In Tamilnadu, rice is cultivated in an area of 18.30 lakh hectares with a production of 79.49 lakh tonnes and an average productivity of 4.4 tonnes ha^{-1} (Department of Economics and Statistics, 2016). In Erode district, rice is cultivated in a total area of 34,339 hectares with a production of 1,46,570 metric tonnes and the productivity is 4.26 t/ha (Deputy Director of Statistics, 2016).

Rice requires high quantity of nutrients to harness their potential yield. Sustainable production could be achieved only when factors leading to continued maintenance of soil health are taken care of. Hence, the complimentary role of organics as supplements to chemical fertilizers is important for keeping the soil health in order to harness the potential yield in rice (Lency, 2001). To explore the potentiality of integrated use of organic and inorganic nutrient sources, the urgent need is to test easily available alternative sources of energy such as vermicompost, pressmud and poultry manure for increasing rice production and soil health as well.

Vermicompost has been recognized as an ecofriendly technology for converting organic wastes into high value organic manure rich in nitrates, available form of phosphorus, calcium, vitamins, natural phyto regulators and micro flora in balanced form which helps in

reestablishment of the natural fertility of soil (K. Chiranjeevi *et al.*, 2018).

Pressmud is one of the important by product obtained from sugar factory and rich in organic matter, Ca, P, some organic nitrogen and trace elements. It has been used as a soil conditioner, soil ameliorant and source of nutrients for crop growth. This might be due to improvement in nutrient supply with more organics, which improves soil physico-chemical and biological properties by providing essential food to microbes (Debiprasad Dash *et al*., 2010).

Poultry manure is the feces of chickens used as an organic fertilizer, especially for soil which are low in nitrogen. Of all animal manures, it has the highest amount of nitrogen, phosphorus and potassium. The fertility status of the soil to benefit from poultry manure application since the manure is to improve soil organic matter and micronutrient status and micronutrient qualities of the soil (Soremi *et al.,* 2017). The objective of this study to find out the effect of inorganic and organic amendments on agronomic performance of rice.

Materials and Method

A field experiment was conducted during kharif season 2018 at Vallalarpuram, Sankarapalayam, Anthiyur, Erode, Tamil Nadu to study the response of lowland rice to effective use of organic and inorganic ammendments. The farm lies in the western zone (11°61' N, 77°58' E) at +251 m above the mean sea-level. The soil was red loam having pH (7.6), electrical conductivity (0.34 dS/m), organic carbon (0.39%), available N (222.50 kg/ha), P (17.25 kg/ha), K (272.50 kg/ha). The N, P, K and Zn were applied through urea, diammonium phosphate (DAP), muriate of potash (MOP) and zinc sulphate respectively. Half dose of N and full dose of $P2O_5$, K_2O and Zn were applied as basal. Remaining N was applied in 2 equal splits at 30 and 60 days after transplanting (DAT) rice. The soil samples were analysed for pH (Jackson, 1973) and EC also as per method of Jackson (1973). For analysis of organic carbon, Wet digestion method of Walkley and Black (1934), available N was estimated by Alkaline KMnO4 method (Subbiah and Asija 1956), P by Olsen's method (Olsen *et al.,* 1954) and K by Flame Photometer method (Stanford and English, 1949).

Nine treatments were laid out in randomized block design with three replications consisting of three organic sources of nutrients (vermicompost, pressmud and poultry manure) along with fertilizers, microbial consortium (*Pseudomonas, Azospirillum* and *Cyanobacteria*) and one micronutrient (zinc). vermicompost (3.3 t ha^{-1} on dry weight basis), pressmud (3.8 t ha^{-1} on dry weight basis), poultry manure (3.6 t ha^{-1} on dry weight basis) were incorporated during last plough as per the treatments. Microbial consortium was applied at the rate of 800g ha^{-1}. The Slurry can be prepared by mixing microbial consortium at 800 g/ha in 40 litres of water and rice seedlings are dipped in the suspension for 15-30 minutes before transplanting. Zinc was applied in the form of zinc sulphate ($ZnSO_4$. H_2O). Treatments of the experiment were T_1 - Absolute control, T_2 - Recommended dose of fertilizers, T_3 - Farmers practices (87:45:30), T_4 - 25% N +75% N through vermicompost + 100% P + 100% K through inorganic manures + $ZnSO_4$ (25Kg/ha), T_5 - 25% N +75% N through pressmud +100 P + 100% K through inorganic manures + $ZnSO_4$ (25Kg/ha), T_6 - 25% N +75% N through Poultry manure + 100 P + 100% K through inorganic manures + $ZnSO_4$ (25Kg/ha), T_7 - 25% N +75% N through vermicompost + 100% P + 100% K through inorganic manures + $ZnSO_4$ (25Kg/ha) + microbial consortium, T_8 - 25% N +75% N through pressmud + 100% P + 100% K through inorganic manures + $ZnSO_4$ (25Kg/ha) + microbial consortium, T_9 - 25% N +75% N through poultry manure + 100% P + 100% K through inorganic manures + $ZnSO_4$ (25Kg/ha) + microbial consortium. Rice variety ADT-45 was used, nursery for transplanting was raised at the seed rate 60 kg ha^{-1}, transplanted on 21st day, at a spacing of 12.5 cm x 10 cm, manually.

Harvest Index (HI) was suggested by Donold and Humblin (1976), using formula,

$$\text{Harvest Index} = \frac{Economic\,Yield}{Biological\,Yield} \times 100$$

Results and Discussion

Plant height and Dry matter production of rice

Plant height and dry matter production (DMP) of rice increased significantly, the maximum was in T_7 - 25% N +75% N through vermicompost + 100% P + 100% K through inorganic manures + $ZnSO_4$ (25Kg/ha) + microbial consortium, with a plant height (cm) of 55.45, 86.49 and 97.12 on 30, 60 and 90 DAT, and with a DMP (Kg/ha) of 8524, 10335 and 12237 on 30, 60 and 90 DAT (Table 1). Integrated application of vermicompost which contains high amount of macro and micro nutrients enhanced the nutritional status of soil when applied to the soil in combination with inorganic fertilizers primarily NO_3, PO_4, Ca, K, Mg, S and other essential nutrients in the forms that are readily taken up by the plants which led to higher number of tillers and leaf area index of rice thereby providing an opportunity for the plants to increase the photosynthetic rate which in turn resulted in higher

Table 1: Effect of organic and inorganic manure on yield and economics on Plant height and Dry matter production of rice

S.No.	Treatments	Plant height (cm)			DMP (Kg/ha)		
		30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT
1.	T_1 - Absolute control	40.10	67.19	78.17	4617	5230	6417
2.	T_2 - Recommended dose of fertilizer	45.68	82.58	86.72	7285	8152	9921
3.	T_3 - Farmers practice	44.02	81.92	84.98	7065	7773	9526
4.	T_4 - 75% N + 25% N through vermicompost + $ZnSO_4$ (25 Kg/ha) + 100% PK through inorganic fertilizer	50.58	84.56	91.94	7940	9278	11140
5.	T_5 - 75% N + 25% N through pressmud + $ZnSO_4$ (25 Kg/ha) + 100% PK through inorganic fertilizer	47.33	83.25	88.47	7510	8531	10357
6.	T_6 - 75% N + 25% N through poultry manure + $ZnSO_4$ (25Kg/ha) +100% PK through inorganic fertilizer	48.95	83.90	90.20	7720	8901	10742
7.	T_7 - 75% N + 25% N through vermicompost + $ZnSO_4$ (25 Kg/ha) + 100% PK through inorganic fertilizer + microbial consortium	55.45	86.49	97.12	8524	10335	12237
8.	T_8 - 75% N + 25% N through pressmud + $ZnSO_4$ (25 Kg/ha) + 100% PK through inorganic fertilizer + microbial consortium	52.23	85.23	93.69	8165	9669	11545
9.	T_9 - 75% N + 25% N through poultry manure + $ZnSO_4$ (25 Kg/ha) 100% PK through inorganic fertilizer + microbial consortium	53.81	85.83	95.38	8340	9961	11845
	SEd	0.81	0.32	0.86	102.5	183.5	193
	CD (p=0.05)	1.62	0.64	1.72	205	367	386

Table 2: Effect of organic and inorganic manure on yield and economics on Number of productive tillers m^{-2}, number of filled grain $panicle^{-1}$ and test weight (g) of rice

S.No.	Treatments	No. of productive tillers m^{-2}	No. of filled grain $panicle^{-1}$	test weight (g)
1.	T_1 - Absolute control	235.0	66.0	18.10
2.	T_2 - Recommended dose of fertilizer	307.2	85.0	18,35
3.	T_3 - Farmers practice	297.6	83.5	18.34
4.	T_4 - 75% N + 25% N through vermicompost + $ZnSO_4$ (25 Kg/ha) + 100% PK through inorganic fertilizer	333.6	89.8	18.40
5.	T_5 - 75% N + 25% N through pressmud + $ZnSO_4$ (25 Kg/ha) + 100% PK through inorganic fertilizer	316.8	86.7	18.37
6.	T_6 - 75% N + 25% N through poultry manure + $ZnSO_4$ (25Kg/ha) +100% PK through inorganic fertilizer	325.6	88.2	18.38
7.	T_7 - 75% N + 25% N through vermicompost + $ZnSO_4$ (25 Kg/ha) + 100% PK through inorganic fertilizer + microbial consortium	355.2	94.0	18.50
8.	T_8 - 75% N + 25% N through pressmud + $ZnSO_4$ (25 Kg/ha) + 100% PK through inorganic fertilizer + microbial consortium	341.6	91.5	18.44
9.	T_9 - 75% N + 25% N through poultry manure + $ZnSO_4$ (25 Kg/ha) 100% PK through inorganic fertilizer + microbial consortium	347.2	92.4	18.46
	SEd	0.56	0.7	0.02
	CD (p=0.05)	1.12	1.4	NS

NS- Non Significance

accumulation of dry matter. The findings are in close conformity with those of Amit Kumar *et al.,* (2017) and Priyanka Anand (2010).

Number of productive tillers m^{-2}, number of filled grain $panicle^{-1}$ and test weight of rice

The interaction effect of vermicompost and inorganic fertilizer T_7 - 25% N +75% N through vermicompost + 100% P + 100% K through inorganic manures + $ZnSO_4$ (25Kg/ha) + microbial consortium had significant impact on the number of productive tillers per m^2, test weight, and the number of filled grains per panicle. The highest productive tiller number of 355.2 m^{-2}, the highest filled

grain number of 94.0 and with the highest test weight of 18.50 g (Table 2). The combined application of inorganic fertilizers and vermicompost could have helped in balanced availability of nutrients at all the growth stages of rice. Further, this might have improved in higher uptake of nutrients which ultimately led to better translocation of photosynthesis from source to sink resulting in maximum number of productive tillers, test weight, higher number of filled grains panicle^{-1}. These findings are in conformity with the earlier reports of Balasubramanian and Wahab, (2012) and Md. Kashedul *et al.,* (2015) in rice.

Grain, Straw yield and Harvest Index of rice

Application of 25% N +75% N through vermicompost

Table 3: Effect of organic and inorganic manure on yield and economics on Grain yield (Kg/ha), Straw yield (Kg/ha) and Harvest Index (%) on rice

S.No.	Treatments	Grain yield (Kg/ha)	Straw yield (Kg/ha)	Harvest Index (%)
1.	T_1 - Absolute control	2807	5915	32.18
2.	T_2 - Recommended dose of fertilizer	4790	8958	34.84
3.	T_3 - Farmers practice	4550	8906	33.81
4.	T_4 - 75% N + 25% N through vermicompost + $ZnSO_4$ (25 Kg/ha) + 100% PK through inorganic fertilizer	5520	9112	37.72
5.	T_5 - 75% N + 25% N through pressmud + $ZnSO_4$ (25 Kg/ha) + 100% PK through inorganic fertilizer	5040	9013	35.86
6.	T_6 - 75% N + 25% N through poultry manure + $ZnSO_4$ (25Kg/ha) +100% PK through inorganic fertilizer	5280	9060	36.82
7.	T_7 - 75% N + 25% N through vermicompost + $ZnSO_4$ (25 Kg/ha) + 100% PK through inorganic fertilizer + microbial consortium	6180	9257	40.00
8.	T_8 - 75% N + 25% N through pressmud + $ZnSO_4$ (25 Kg/ha) + 100% PK through inorganic fertilizer + microbial consortium	5770	9167	38.62
9.	T_9 - 75% N + 25% N through poultry manure + $ZnSO_4$ (25 Kg/ha) 100% PK through inorganic fertilizer + microbial consortium	5930	9205	39.18
	SEd	110	172.5	0.41
	CD (p=0.05)	220	345	0.79

Table 4: Effect use of organic and inorganic amendments on yield and economics of rice

S.No.	Treatments	Cost of treatments in Rs.ha^{-1}		Total Cost of cultivation in Rs. ha^{-1}	Gross income in Rs. ha^{-1}	Net income in Rs. ha^{-1}	BCR
		organic sources	others				
1.	T_1 - Absolute control	-	21900	21,900	45,514	23,614	2.07
2.	T_2 - Recommended dose of fertilizer	1000	25938	26,938	75,396	48458	2.79
3.	T_3 - Farmers practice	300	26324	26,624	72,412	45788	2.71
4.	T_4 - 75% N + 25% N through vermicompost + $ZnSO_4$ (25 Kg/ha) + 100% PK through inorganic fertilizer	1980	26540	28,520	80,864	52344	2.83
5.	T_5 - 75% N + 25% N through pressmud + $ZnSO_4$ (25 Kg/ha) + 100% PK through inorganic fertilizer	3800	26582	30,382	78,506	48124	2.58
6.	T_6 - 75% N + 25% N through poultry manure + $ZnSO_4$ (25 Kg/ha) + 100% PK through inorganic fertilizer	3060	26564	29,624	81,480	51858	2.75
7.	T_7 - 75% N + 25% N through vermicompost + $ZnSO_4$ (25 Kg/ha) + 100% PK through inorganic fertilizer + microbial consortium	2580	26550	29,130	92,674	63,544	3.18
8.	T_8 - 75% N + 25% N through pressmud + $ZnSO_4$ (25 Kg/ha) + 100% PK through inorganic fertilizer + microbial consortium	4400	26595	30,995	87,574	56,579	2.82
9.	T_9 - 75% N + 25% N through poultry manure + $ZnSO_4$ (25 Kg/ha) + 100% PK through inorganic fertilizer + microbial consortium	3660	26578	30,238	89,570	59,332	2.96

+ 100% P + 100% K through inorganic manures + $ZnSO_4$ (25Kg/ha) + microbial consortium (T_7) recorded the highest grain, straw yield and Harvest Index (HI %). The highest grain yield of 6180 kg ha^{-1}, straw yield of 9257 Kg ha^{-1} and HI% of 40.00% (Table 3). This might be due to the slow and steady release of nutrients by vermicompost that provided nutrients such as available N, soluble K, exchangeable Ca, Mg and P that could be readily taken by the plants in balanced manner and subsequent conversion of assimilates into yield attributes in larger fraction which ultimately resulted in higher grain straw yield and Harvest Index. Similar findings of balanced supply of nutrients by integrating organics with inorganics for better growth, yield attributes and yield of rice were consonant with the results of the study of (E. Taheri Ramhimabadi *et al.*, 2017).

Economics

The total cost of cultivation was highest in case of pressmud fertilization i.e. in T_8 - 75% N + 25% N through pressmud + $ZnSO_4$ (25 Kg/ha) + 100% PK through inorganic fertilizer + microbial consortium (Rs. 30,995/). Whereas, the lowest cost of cultivation was associated with (Rs. 21,900/-) absolute control. Maximum gross return and net return (Rs. 92,674/- and Rs. 63,544/-) was recorded in 25% N + 75% N through vermicompost + 100% P + 100% K through inorganic manures + $ZnSO_4$ (25Kg/ha) + microbial consortium (T_7) and lowest gross return and net return was in absolute control. The highest benefit cost ratio (3.18) was also found with T_7 - 75% N + 25% N through vermicompost + $ZnSO_4$ (25 Kg/ha) + 100% PK through inorganic fertilizer + microbial consortium (Table 4). Higher yield and less cost of cultivation was found in vermicompost fertilization. This is in agreement with the findings of Gowdhaman (2014) and Shalini *et al.,* (2017).

Conclusion

Based on the results of the experiments it can be concluded that application of 75% N + 25% N through vermicompost + $ZnSO_4$ (25 Kg/ha) + 100% PK through inorganic fertilizer + Microbial consortium was highly impressive and appears to be more promising as an efficient integrated nutrient management system for not only enhancing crop yields in rice but also maintaining soil fertility and eco system, a felt need of present day agriculture. Though vermicompost has a high potential to sustain rice production, further research is required to find out the long-term effects of the application of vermin-composts derived from plant and animal residue. Hence, this nutrient management practice can be recommended for adoption by the farmers in the Western zone of Tamilnadu.

Reference

Kumar, Amit, B.P. Dhyani, Ashish Rai and Vipin Kumar (2017). Effect of timing of vermicompost application and different level of NPK on growth, yield attributing characters and yield of rice in rice-wheat cropping system. *Intl. J. Chem. Stud.* **5(5):** 2034-2038.

Balasubramanian, A. and K. Wahab (2012). Integrated nutrient management in rice for Cauvery deltaic zone of Tamilnadu, India. *Plant Archives* **12(1):** 95-97.

Chiranjeevi, K., M. Yakadri and Mahender Kumar (2018). Response of rice varieties to integrated nutrient management practices on yield nutrient uptake and economics of rice. *J. Pharma. Phytochem.* **7(2):** 2559-2561.

Dash, Debiprasad, Hrusikesh Patro, Ramesh C. Tiwari and Mohammad Shahid (2010). Effect of organic and inorganic sources of nitrogen on Fe, Mn, Cu and Zn uptake and content of rice grain at harvest and straw at different stages of rice (*Oryza sativa*) crop growth. *Adv. Appl. Sci. Res.* **1(3):** 36-49.

Department of Economics and Statistics (2016). Statistical Hand Book 2016, Government of Tamil Nadu. P.119. *http://www.tn.gov.in/deptst/agriculture.pdf.*

Deputy Director of Statistics (2016). District statistical handbook 2016-2017, Erode District. P.9. *https://cdn.s3waas.gov.ins3bca82e41ee7b0833588399b1fcd177c7/uploads/2018/06/2018062116.pdf*

Directorate of Economics and Statistics (2016). Agricultural Statistics for 2015-16 agricultural crop year at a glance, Ministry of Agriculture. p.89. *https://eands.dacnet.nic.in/PDF/Glance-2016.pdf.*

Donold, C.M. and J. Humblin (1976). The biological yield and harvest index of cereals as agronomic and plant breeding criteria. *Adv. Agron.* **28:** 361-405.

Gowdhaman, L. (2014). Effect of integrated nutrient management in increasing the production of rice. M.Sc., (Ag) Thesis, Annamalai University, Tamilnadu.

Jackson, M.V. (1973). Soil Chemical analysis. Prentice Hall of India Pvt., Ltd., New Delhi.

Kashedul, Md., S. Shahriar, A.S.M. Fazle Bari, Mst. Sharmin Sultana and H. Mehraj (2015). Growth and yield performance of nerica rice in aus season under integrated nitrogenous nutrient management system. *American-Eurasian J. Scientific Res.* **10(6):** 352-356.

Lency, T. (2001). Formulation and evaluation of organic meals from KCPL effluent slurry. Ph.D Thesis. Kerala Agril. Univ. Vellayanikkara, Thrissur.

Olsen, S.R., C.V. Cole, F.S. Watanabe and A.L. Dean (1954). Estimation of available phosphorus in soils by extraction with sodium carbonate, *U.S.D.A. circ.* **939:** 1-19.

Palanisamy, K.M. and K.A. Gomez (1974). Length width method for estimating leaf area for rice. *Agron J.* **66:** 430-433.

Anand, Priyanka (2010). Management of water hyacinth biomass along with industrial effluents through Mushroom culturing and vermicomposting. M. Tech. Thesis, Thapar Univ., Patiala, India.

Shalini, Virendra Pratap Singh and Brijbhooshan Jangid (2017). Yield and economics in direct seeded rice using organic manures and micronutrients. *Intl. J. Chem. Stud.* **5(3):** 105-109.

Soremi, A.O., M.T. Adetunji, C.O. Adejuyigbe, J.G. Bodunde and J.O. Azeez (2017). Effects of poultry manure on some soil chemical properties and nutrient bioavailability to soybean. *J. Agri. Eco. Res. Intl.* **11(3):** 1-10.

Stanford, S. and L. English (1949). Use of flame photometer in rapid soil test for K and Ca. *Agron. J.* **41:** 446-447.

Subbiah, B.V. and G.L. Asija (1956). A rapid procedure for the estimation of available nitrogen in soils. *Curr. Sci.* **25:** 259-260.

Taheri rahimabadi, E., M. H. Ansari and A. Razavi nematollahi (2017). Influence of cow manure and its vermicomposting on the improvement of grain yield and quality of rice (*Oryza sativa* L.) in field conditions. *App. Eco. Environ. Res.,* **16(1):** 97-110.

Walkley, A. and C.A. Black (1934). An examination of degtjareff method for determining soil organic matter and a proposed modification of the chromic and titration method. *Soil Sci.* **40:** 233-243.