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Integration of different organic manures and nitrogenous fertilizer and its effect on the growth and yield of rice

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Abstract
Field experiment was conducted at Agricultural College and Research Institute, Killikulam during *Pishanam* season (November- March) of 2015 – 2016. Higher Plant height, dry matter production, yield attributes and grain yield was realised with application of 75% N as inorganic fertilizer and 25% N as poultry manure (7160 kg/ha) comparable with 25% N as vermicompost (6920 kg/ha) and was followed 25% N as green leaf manure (6710 kg/ha). Higher physiological efficiency was attained when substituting 25% N as poultry manure and was followed by the same proportion of vermicompost. The highest net return with B: C ratio of 3.12 was attained by 25% N substitution as poultry manure while green leaf manure fetched highest B: C ratio of 3.26. From the above results, it could be indoctrinated that application of 75% of recommended N as inorganic fertilizer and substitution of 25% N either as poultry manure or green leaf manure is the desirable integrated nutrient management practice for achieving higher productivity and profitability under transplanted condition.

Keywords: organic fertiliser, poultry manure, vermicompost, green leaf manure, physiological efficiency

Introduction
Rice is an important and extensively cultivated food crop and feeds more than half of the world's population. The slogan “Rice is life” is most appropriate for India; as this crop plays a vital role in our national food security and is a means of livelihood for millions of rural households. Even though the area under rice cultivation is large, the productivity is low due to various interaction factors. The imbalance in usage of fertilizers is one of the main factors responsible for low productivity and also the continuous use of inorganic fertilizers resulted in declining of soil fertility. To obtain better yield, farmers have used more and more fertilizers year after year causing decline in soil fertility (Abrol and Katyal, 1990) [1].
High cost of fertilizer and the low purchasing capacity of the small and marginal peasants of the country, restrict the use of fertilizer inputs (Reddy, 1988) [8]. The increasing demand for rice grain production has to be achieved by using limited available resources in a sustainable manner. Though the use of fertilizers per unit area of rice is higher, the fertilizer use efficiency is generally low (Somasundaram, 1991) [10]. Use of organic manure, green manuring, crop residues along with inorganic fertilizers not only reduce the demand for inorganic fertilizers but also increases the efficiency of applied nutrients due to their favourable effect on physical, chemical and biological properties of soil (Prasad *et. al.,* 1992) [7]
An integrated approach involving organic manures and chemical fertilizers will go a long way in building up of the soil fertility on a permanent basis and the system will supply most of the nutrients in a judicious way and nutrients uptake by the crop will be enhanced. The INM concept if properly designed, not only meets the nutrient requirement of component crops of a system, but keeps the system intact (Dutta and Bandyopadhyaya, 2003) [2].
The INM practices not only maintain soil health but also reduce input cost thereby raising the sustainability in productivity. The effectiveness of integrated nutrient management practice can depend on season, soil type, climate, water management, variety and cropping pattern. Probably, there will be no universally best integrated nutrient management practice. Thus, more efforts are needed to improve nutrient management strategy for a particular target environment.

Materials and Methods
A field experiment was conducted at Agricultural College and Research Institute, Killikulam during Pishanam season (November – March) of 2015-2016, to study the integration of different sources of organic manures and nitrogenous fertilizer and its effect on the growth and

yield of rice. The treatments consisted of T_1 - Control (without any nutrients), T_2 - 100% N as inorganic fertiliser, T_3 - 75% N as inorganic fertilizer + 25% N as farmyard manure, T_4 - 50% N as inorganic fertilizer + 50% N as farm yard manure, T5 - 75% N as inorganic fertilizer + 25% N as green leaf manure, T_6 - 50% N as inorganic fertilizer + 50% N as green leaf manure, T_7 - 75% N as inorganic fertilizer + 25% N as vermicompost, T_8 - 50% N as inorganic fertilizer + 50% N as vermicompost, T_9 - 75% N as inorganic fertilizer + 25% N as poultry manure, T_{10} - 50% N as inorganic fertilizer + 50% N as poultry manure. The recommended dose of nitrogen was applied at 50% and 75% through inorganic source to the respective treatments and the balance N (25 & 50% N) was substituted through organic manures. Based on N equivalent basis, required quantities of organic manures were worked out and incorporated into the soil before transplanting of rice as per treatment schedule (table1). Well decomposed and powdered farmyard manure, Poultry manure and vermicompost were collected and applied as basal two days before transplanting of rice. Green leaf manure *Glyricidia maculata* leaves were incorporated in the respective plots at 15 days before transplanting of rice for proper decomposition within the field.

A seed rate of 60 kg/ha was used after treating with Carbendazim @ 2g/ kg of seeds followed by *Azospirillum* and *Phosphobacteria* each 600 g ha^{-1} of seeds for raising nursery. The seeds were soaked in water for 10 hours and incubated. The sprouted seeds were used for raising nursery. Seedbeds were formed by marking plots of 2.5 m breadth with channels 30 cm wide all around with length of 10 m. Well puddled soil from the channel was collected and spread on the seedbeds, so that the seed bed is at a higher level. Surface of the seedbed was levelled in order to drain water into the channel. Then sprouted seeds were sown uniformly on the seedbed, having thin film of water in the nursery. The seedlings were maintained in the nursery bed up to 21 days from sowing. Transplanting was done in the main field with a spacing of 25 × 25 cm with two seedlings per hill. The age of the seedling used for transplanting was 21 days.

The recommended dose of 150:50:50 kg/ha of NPK was applied to the crop. Nitrogen (Urea) was applied at 50% and 75% through inorganic source to the respective treatments. The phosphatic (SSP) and potash (MOP) fertilisers are also applied to the crop at 25% and 50% substitution as these organic sources of manures contain phosphorus and potash nutrients. The inorganic fertiliser N was applied either two splits (panicle initiation and heading) or three splits (active tillering, panicle initiation and heading) for 50% and 25% N substitution respectively. 100% N was applied in equal 4 splits with each 25% as basal, active tillering, panicle initiation and heading stages. Entire phosphatic fertiliser was applied at basal and potash fertiliser applied at two times at basal and panicle initiation stage.

Physiological efficiency (PE) was calculated using the following formula (Yoshida, 1981) [11]:

$$PE = \frac{Y_f - Y_{uf}}{N_f - N_{uf}}$$

Where, Y_f = yield in fertilised plot (kg/ha); Y_{uf} = yield in unfertilised plot (kg/ha); N_f = Nitrogen uptake in fertilised plot (kg/ha); N_{uf} = Nitrogen uptake in unfertilised plot (kg/ha).

Statistical Analysis of variance (ANOVA) was performed using the Fischer's method as described by Gomez and Gomez (1984). Critical difference (CD) at 5% level of probability and LSD values were calculated wherever 'F' test was significant. Non significant comparisons were indicated as NS.

Results and Discussion

Plant growth

The plant height is a direct index to measure the growth and vigour of plant and was measured at active tillering, flowering and at harvest stages (Table 2). It was observed that, application of 25% N as poultry manure and 75% N as inorganic fertilizer recorded higher plant height of 109.4 cm and it was on par with the application of 25% N as vermicompost (103.8 cm). Increase in the growth and physiological parameters of rice by application of poultry manure might be due to the presence of uric acids in poultry manure that hastens the release of nutrients from poultry manure which could have attributed to steadier and greater root development, greater response of the crop to available nutrients and rapid conversion of synthesized photosynthates into protein to form more protoplasm, thus increasing the number and size of the cell, which might have increased the plant height. Similar results were reported by Islam *et al*. (2014) [3]. Dry matter accumulation is considered to be reliable index of crop growth and was significantly influenced by INM practices (Table 2). Application of 75% N as inorganic fertilizer and 25% N as poultry manure significantly recorded higher dry matter registering 15435 kg/ha and was comparable with 25% N as vermicompost 15010 kg/ha. The increase in plant height in response to combined application of organic manure and inorganic fertilizer was probably due to enhanced availability of N, which significantly enhanced more leaf area resulting in higher photo assimilates and thereby resulted in more dry matter production. Similar findings were observed by Maiti *et al.* (2006) [5].

Yield Attributes

The analysis of components help to understand better on the physiological basis and source – sink relationship of the crop due to the effect of different nutrient treatments adopted. The trend observed in growth parameters were also observed in yield attributes (Table 2). Physiologically, proper partitioning might have occurred from source to sink, as a result improved the yield attributes (Kumar and Singh. 2006) [12]. The filling of grains with photosynthates is likely to occur due to steady and continuous supply of N throughout the crop growth period due to gradual transformation and mineralization of organics, solubilisation of water insoluble P compounds by organic acids released while decomposition of organic manures, resulting in greater P availability to crop coupled with higher native K availability which might have played a key role in ensuring superior yield attributes in INM practice. The continuous supply of nutrients by the organic manures led to better tiller production, enhanced panicle length and development of filled grain in rice. This is in accordance to the findings of Mohandas *et al.* (2008) [13]

Grain and Straw yield

Application of organic manures in conjunction with inorganic fertilizers significantly improved the grain yield of rice due to their positive influence on growth and yield attributes (Table 3). Application of 75% of N as inorganic fertilizer and 25% of N through organic manures significantly recorded higher

grain yield of rice in the range of 6580 to 7160 kg/ha compared to application of 100% N as inorganic fertilizer (6270 kg/ha). The variation could have been due to better nutrient supply from organic manure leading to better utilization of applied nutrients through improved micro environmental conditions and the transport of nutrients from different sources of organic manure that influenced the nutrient availability to the crop plant enhancing its potential for higher production. Similar findings were reported by Singh *et al.* (2006) [14].

Among the combination of 75% N as inorganic source of fertilizer, 25% of N as poultry manure significantly recorded higher grain yield of 7160 kg/ha and was on par with 25% of N through vermicompost (6920 kg/ha). This may be due to the fact that in lowland rice soils, organic manure incorporation undergoes decomposition at a steady rate resulting in the release of NH_4^+–N into soil solution for a longer period and restored humus status of the soil ecosystem to hold its fertility and productivity, thus resulting in higher N uptake of rice which is readily available to rice plant. These are similar to the findings of Kumar *et al*. (2010) [4].

Next to the above treatments, substitution of 25% of N through FYM and GLM recorded the grain yield of 6580 and 6710 kg/ha and were on par with each other. The yield increase due to 25% N substitution through poultry manure or vermicompost were 14 and 10 per cent compared to application of 100% N as inorganic fertilizer. The judicious use of organic and inorganic fertilizer enabled rice plant to assimilate sufficient photosynthesis resulting in increased dry matter production and these together produced more productive tillers and filled grains leading to higher grain yield. Better performance of combined use of organic manures with chemical fertilizers might be due to synergistic effect of inorganic fertilizer and organic manures, as well as the slow release of nutrients throughout the crop growth, thus helping to form more photosynthates and translocating the same from source to sink and also the immediate release of N and improved soil physical properties due to application of organic manures and inorganic fertilizer enhanced the crop growth and in turn yield attributes of rice. This was evidenced by Mondal *et al.* (2003) [6] and Singh and Singh (2008) [9].

Application of 50% of N as inorganic fertilizer and 50% N as organic sources recorded lesser grain yield ranging from 5445 – 6130 kg/ha. The control plot significantly resulted in lesser grain yield of 3250 kg/ha. This was quite natural that the soil available nutrients were not sufficient to meet the crop demand since there were no additional applications of nutrients from any means. Taller plants, higher quantity of biomass accumulation, better yield attributes and yield due to better nutrient uptake might have resulted in higher straw yield (Table 3). This is in accordance with the results obtained by Yadav and Lourduraj (2006).

Physiological efficiency

The physiological use efficiency indicated the quantity of rice production per unit quantity of N uptake is often expressed as the product of efficiency of absorption and efficiency of utilization (Table 3). Physiological use efficiency was improved with application 75% N as inorganic fertilizer + 25% N as poultry manure followed by substitution of 25% N through various combination of organic manures such as vermicompost, green leaf manure and farmyard manure. This might be due to the considerable quantity of N mineralization making more N available to the plants leading to increased N use efficiency. Similar results were reported by Seshadri *et al*. (2005) [16].

Table 1: Nutrient content of organic manures based on their dry weight

S. No	Organic manure	Nutrient content (%)		
		N	P	K
1.	Farmyard manure	0.52	0.21	0.51
2.	*Glyricidia maculate*	2.10	0.25	1.80
3.	Vermicompost	2.05	0.78	0.60
4.	Poultry manure	3.05	2.59	1.45

Table 2: Effect of INM on plant height, DMP, number filled grains per panicle, fertility percentage and test weight of rice

Treatments	Plant height (cm)	DMP (Kg/ha)	Filled grains panicle^{-1}	Fertility percentage	Test weight (g)
T_1- Control	77.2	7065	98	71.0	17.23
T_2- 100% N as inorganic fertiliser (IF)	93.1	13605	139	79.1	17.55
T_3- 75% N as IF + 25% N as FYM	97.6	14300	143	79.9	17.62
T_4- 50% N as IF + 50% N as FYM	89.8	11795	130	78.2	17.47
T_5- 75% N as IF + 25% N as GLM	99.4	14550	147	80.1	17.63
T_6- 50% N as IF + 50% N as GLM	91.3	12750	133	78.6	17.53
T_7- 75% N as IF + 25% N as VC	103.8	15010	150	80.6	17.68
T_8- 50% N as IF + 50% N as VC	91.9	13135	136	78.7	17.52
T_9- 75% N as IF + 25% N as PM	109.4	15435	155	81.2	17.71
T_{10}- 50% N as IF + 50% N as PM	92.6	13345	137	78.9	17.53
Sem ±	1.98	273	2.33	1.49	0.40
CD (P=0.05)	5.9	813	7.0	4.5	NS

DMP= Dry matter production, IF=Inorganic fertilizer, FYM=Farmyard manure, GLM=Green leaf manure, VC= Vermicompost, PM=Poultry manure,

Table 3: Effect of INM on grain yield, straw yield, harvest index and physiological efficiency of rice

Treatments	Grain yield (Kg/ha)	Straw yield (Kg/ha)	Harvest index	Physiological Efficiency
T_1- Control	3250	3710	0.467	-
T_2- 100% N as inorganic fertiliser (IF)	6270	7110	0.469	69.27
T_3- 75% N as IF + 25% N as FYM	6580	7510	0.467	68.94
T_4- 50% N as IF + 50% N as FYM	5445	6210	0.467	69.24
T_5- 75% N as IF + 25% N as GLM	6710	7580	0.470	69.20
T_6- 50% N as IF + 50% N as GLM	5870	6690	0.467	69.13
T_7- 75% N as IF + 25% N as VC	6920	7840	0.469	69.51
T_8- 50% N as IF + 50% N as VC	6050	6890	0.468	69.14

T_9- 75% N as IF + 25% N as PM	7160	8090	0.470	70.32
T_{10}- 50% N as IF + 50% N as PM	6130	6980	0.468	68.74
Sem ±	113	130	0.011	-
CD (P=0.05)	337	387	NS	-

IF=Inorganic fertilizer, FYM=Farmyard manure, GLM=Green leaf manure, VC= Vermicompost, PM=Poultry manure,

Conclusion

From the above results, it could be enlightened that application of 75% of recommended N as inorganic fertilizer and substitution of 25% N as organic manure increases the growth and yield of rice. Organic manure either poultry manure or vermicompost could be selected as desirable for integrated nutrient management in order to achieve higher productivity and profitability under transplanted condition. The major criteria in the selection of kind of organic manure should be based on the availability of the resource, since procurement from outside the farm may eventually decrease the economics due to higher cost.

References

1. Abrol LP and Katyal JC. Managing soil fertility for sustained agriculture. In: Proceedings of first International Symposium on Natural Resource Management for a Sustainable Agriculture. Singh, R.P. (Ed.) Indian Society of Agronomy, 6-10th February New Delhi, 1990, 235-263.
2. Dutta D and Bandyopadhyaya P. Integrated nutrient management for rice and mustard cropping system. Madras Agriculture Journal. 2003; 90(4-6):340-344.
3. Islam MR, Shaikh MS, Siddique AB and Sumon MHJ. Yield and nutrient uptake by wheat as influenced by integrated use of manures and fertilizers. Bangladesh Agricultural University. 2014; 12(1):73-78.
4. Kumar N, Chandra KK and Singh R. IPNS on growth, yield and economics of rice. Indian Journal of Fertiizers. 2010; 6(2):25-28.
5. Maiti S, Saha M, Banerjee H and Pal S. Integrated nutrient management under hybrid rice- (*Oryza sativa*) hybrid rice cropping sequence. Indian Journal Agronomy. 2006; 51(3):157-159.
6. Mondal SS, Sitamgshu Sarkar, Aruoghosh and Das J. Response of summer rice (*Oryza sativa* L.) to different organic and inorganic sources of nutrients. Crop Research. 2003; 25:219-222.
7. Prasad R, Sharma SN, Singh S and Lakshmanan R. Agronomic practices for increasing nitrogen use efficiency and sustained crop production. In: National Symposium for Resource Management for Sustained Production, Indian society of Agronomy, Rajasthan Agricultural University. 1992; 1(1):8.
8. Reddy DS. Integrated nutrient management in a rice based cropping system. International Journal of Agricultural Research. 1988; 2(8):701-711.
9. Singh B and Singh RV. Effect of nutrient management on productivity and economics of transplanted rice crop. International Journal of Agricultural Sciences. 2008; 4(2):408-410.
10. Somasundaram E. Studies on the direct and residual effect of applied and intercropped *Sesbania rostrata* on rice. Asian Journal of Plant Sciences 1991, 6(2): 282-287.
11. Yoshida S. Fundamentals of Rice Crop Science. IRRI, Los Banos, Philippines. 1981; 1(1):269.
12. Kumar V and Singh OP. Productivity and economics of rice-wheat cropping system as influenced by organic manures and fertilizer management under irrigated conditions. International Journal of Agricultural Sciences. 2006; 2(2):629-632.
13. Mohandas S, Paramasivam V and Sakthivel N. Phosphorus and zinc enriched organics for enhancing the yield of transplanted rice in new Cauvery delta, Tamil Nadu. Journal of Ecobiolology 2008, 23(1):73-76.
14. Singh RP, Yadav PK, Singh RK, Singh SN, Bisen MK and Singh J. Effect of chemical fertilizer, FYM and biofertilizer on performance of rice and soil properties. Crop Research. 2006; 32(3):283-285.
15. Yadav BK and Christopher Lourduraj A. Effect of organic manures and panchagavya spray on rice (*Oryza sativa* L.) quality. Crop Research. 2006; 31(1):6-10.
16. Seshadri RS, Shivaraj B, Reddy VC and Ananda MG. Direct effect of fertilizers and residual effect of organic manures on yield and nutrient uptake of maize (*Zea mays* L.) in groundnut-maize cropping system. Crop Research. 2005; 29(3):390-395.