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Influence of Integrated Nutrient Management Practices on Yield and Nutrient Uptake of Rice under System of Rice Intensification

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Abstract: Field experiment was conducted at Agricultural Research Station, Thirupathisaram during rabi 2017-18 to study the effect of integrated nutrient management practices on rice under system of rice intensification. The experiment was laid out in a randomized block design with three replications. Biometrics such as number of panicles m-^{2}, number of grains panicle^{-1}, panicle length, grain yield, straw yield and nutrient uptake were recorded. Integrated Nutrient management significantly influenced the yield and nutrient uptake of rice. Application of 100% RDF + Poultry manure (3 t ha^{-1}) + 3% Panchakavya foliar spray @ AT, PI & 50% flowering significantly influenced the yield and nutrient uptake of rice under system of rice intensification. The lowest yield characters, yield and nutrient uptake were recorded under 75% RDF alone.
Keywords: Rice, Poultry manure, FYM, Vermicompost, INM, yield

Introduction:

Rice (Oryza sativa L.) is an important and extensively cultivated food crop which feeds more than half of the world's population. In Asia alone, more than 2 billion people obtain 60 to 70 per cent of their energy intake from rice and its derivatives. India has the largest area among rice growing countries and it stands second in production next to China (Udhyakumar and Ramasamy, 2016). It produces 104.31 million tons of rice in an area of 44.38 million hectares (Agriculture Statistical year book, India 2017). The country has to produce about 130 million tons of rice by 2025 to meet the food requirement of the growing population (Hugar *et al.*, 2009). In Tamil nadu, rice is cultivated in a area of 20.37 lakh hectare with an annual production of 79.83 lakh tones (Agriculture Statistical year book, India 2017).

Even though the area under rice cultivation is large; the productivity is low due to various interaction factors. The imbalance usage of fertilizers is one of the main factors responsible for the low productivity and also the continuous use of inorganic fertilizers resulted in declining of soil fertility. Swaminathan (2002) opined that the

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green revolution had gradually turned into a 'greedy revolution' as evident in the indiscriminate use of inorganic inputs to attain higher productivity. The increasing demand for rice grain production has to be achieved by using limited available resources in a sustainable manner. In India, about 40 per cent of the total plant nutrients are consumed by rice crop alone. Though the use of fertilizers per unit area of rice is higher, the fertilizer use efficiency (FUE) is generally low. Importance of organics is increasingly felt these days in sustainable crop production systems. To achieve higher and sustainable rice yields, use of organic manures is a must (Gill *et al*., 2008). It is, however, difficult to meet the crop nutrient requirements with bulky organic manure alone and there is a need for integrated application of different sources of nutrients for sustaining the desired crop productivity. Though there are many findings indicating the importance of INM, comprehensive study of appropriate combination or blending of INM practices are lacking in rice under system of rice intensification.

Materials and Methods:

The field experiment was conducted during *rabi* 2017-18 at Agricultural Research Station, Thirupathisaram, Kanyakumari District to study the influence of integrated nutrient management practices on yield and nutrient uptake of rice under system of rice intensification. The experiment was laid out in a randomized block design with three replications. The experiment consisted of ten treatments *viz*., 100% RDF, 100% RDF + FYM (12.5 t ha^{-1}) + 3% Panchakavya foliar spray @ AT, PI & 50% flowering, 100% RDF + Vermicompost (5 t ha^{-1}) + 3% Panchakavya foliar spray @ AT, PI & 50% flowering, 100% RDF + Green leaf manure (6.25 t ha^{-1}) + 3% Panchakavya foliar spray @ AT, PI & 50% flowering, 100% RDF + Poultry manure (3 t ha^{-1}) + 3% Panchakavya foliar spray @ AT, PI & 50% flowering, 75% RDF, 75% RDF + FYM (12.5 t ha^{-1}) + 3% Panchakavya foliar spray @ AT, PI & 50% flowering, 75% RDF + Vermicompost (5 t ha^{-1}) + 3% Panchakavya foliar spray @ AT, PI & 50% flowering, 75% RDF + Green leaf manure (6.25 t ha^{-1}) + 3% Panchakavya foliar spray @ AT, PI & 50% flowering, 75% RDF+ Poultry manure (3 t ha^{-1}) + 3% Panchakavya foliar spray @ AT, PI & 50% flowering. Rice variety TPS 5 was used as a test variety. Poultry manure, FYM, vermicompost and glyricidia (GLM) were applied as a source of organic manure one week before transplanting of crop as per the treatment. The recommended dose of NPK @ 150:50:50 kg ha^{-1} was applied as inorganic sources. Observations on yield characters, grain yield, straw yield and nutrient uptake were recorded. The data were subjected to statistical analysis as prescribed by Gomez and Gomez, (2010).

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Results and Discussion:

Effect of INM on yield attributes and yield

The yield contributing characters such as number of productive tillers m^{-2}, total number of grains $panicle^{-1}$ and panicle length were influenced significantly due to application of poultry manure, FYM, vermicompost and GLM (glyricidia) and NPK fertilizers along with foliar spray of panchakavya (Table 1).

In the present study, application of 100% RDF + Poultry manure (3 t ha^{-1}) + 3% Panchakavya foliar spray @ AT, PI & 50% flowering significantly exhibited its superiority to increase the productive tillers m^{-2} (482), total number of grains $panicle^{-1}$ (220) and panicle length (23.5 cm). It was followed by the application of 100% RDF + FYM (12.5 t ha^{-1}) + 3% Panchakavya foliar spray @ AT, PI & 50% flowering recorded the above yield attributes which was comparable with 100% RDF + Vermicompost (5 t ha^{-1}) + 3% Panchakavya foliar spray @ AT, PI & 50% flowering. The application of inorganic fertilizers in combination with poultry manure and foliar nutrition by panchakavya at critical stages might have showed better performance of yield attributing characters than other organic and inorganic nutrients applied. The result is in agreement with the findings of Miah *et al.* (2006). The increased might be due to the balanced supply of nutrients from poultry manure and chemical fertilizer which enhanced the yield attributes. Malika (2011) and Parvez *et al.* (2008) reported that inorganic fertilizers in association with poultry manure was found to be more effective in producing maximum panicle length, more productive tillers and filled grains $panicle^{-1}$ in rice.

The grain yield significantly varied due to various integrated nutrient management practices. Among the various organic and inorganic nutrients tested, application of 100% RDF + Poultry manure (3 t ha^{-1}) + 3% Panchakavya foliar spray @ AT, PI & 50% flowering significantly recorded the higher grain yield. The increase in grain yield over 100% RDF and 75% RDF were 61 and 77 %, respectively. Next to this treatment, the higher grain yield were recorded with the application of 100% RDF + FYM (12.5 t ha^{-1}) + 3% Panchakavya foliar spray @ AT, PI & 50% flowering and it is on par with 100% RDF + Vermicompost (5 t ha^{-1}) + 3% Panchakavya foliar spray @ AT, PI & 50% flowering. The higher yield achieved in the above promising inorganic nutrient application was a combined effect of applied major nutrients (N,P and K) and poultry manure might have supplies continuous slow release and increased more available nutrients, which aided in better growth parameters. The favorable growth parameters greatly influenced the yield attributes, ultimately increased the grain yield in the application of 100% RDF NPK with Poultry manure as soil and foliar application of Panchakavya. Similar results have been reported by Dhaka *et al.* (2012) and Amanullah *et al.* (2006). The lesser grain yield was recorded in 75% RDF alone treatment which registered 3771 kg ha^{-1}. This might be due to unavailability of required quantity of nutrient present in soil during crop period. This is in conformation with earlier finding of Ali *et al*. (2009). Similar trend was also observed in straw yield.

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Effect of INM on nutrient uptake of rice

The nutrient uptake was increased with the crop growth. Significant impact on N, P and K uptake was observed due to the various nutrient management practices (Table 2.). The nutrient uptake of the crop depicted a steep increase with the advancement of crop growth stage**.** Higher uptake of N, P and K (105.4, 38.7 and 118.5 kg ha^{-1} at harvest) was recorded with application of 100% RDF + Poultry manure (3 t ha^{-1}) + 3% Panchakavya foliar spray @ AT, PI & 50% flowering significantly superior to the rest of the all treatments. Next to that higher N,P and K uptake was recorded with the application of 100% RDF + FYM (12.5 t ha^{-1}) + 3% Panchakavya foliar spray @ AT, PI & 50% flowering and it is on par with 100% RDF + Vermicompost (5 t ha^{-1}) + 3% Panchakavya foliar spray @ AT, PI & 50% flowering. The N, P and K uptake was lesser in 75% RDF (55.6, 19.0 and 64.9 kg ha^{-1}) at harvest as compared to other treatments.

The higher nutrient application might have increased nutrient content in soil solution, which reflected in terms of increased nutrient content in grain and straw (Parvez *et al.*, 2008). Similar results were also observed by Islam *et al.* (2013).

Moreover presence of macro (N, P, K and Ca) and micro (Zn, Fe, Cu, Mn) nutrients besides total reducing sugars (glucose) were observed in panchagavya. Chemolithotrops and autotropicnitrifiers (ammonifers and nitrifers) present in panchagavya colonize in the leaves increase the ammonia uptake and enhance the total N supply (Papen *et al.*, 2002). The fact that organic manures producing favourable changes in soil, which might have resulted in loose and friable soil condition and enabled better root formation. The organic manures were found to reduce nutrient losses and conserve soil nutrients to form organo-mineral complex, maintained supply of nutrients to rice plant and increased total N, P and k uptake (Pandey *et al*., 2001). Moreover, positive influence of these treatments might be due to slow and steady availability of nutrients throughout the crop growth period.

Conclusion:

From this study, it can be concluded that combined application of 100 % RDF + poultry manure (3 t ha^{-1}) + 3% Panchakavya foliar spray @ AT, PI & 50% flowering can be recommended as the best integrated nutrient management practice for higher yield and nutrient uptake of rice under system of rice intensification.

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Table 1: Effect of integrated nutrient management practices on yield attributes and yield of rice under SRI

	Treatments	No. of productive tillers m^{-2}	No. of grains $panicle^{-1}$	Panicle length (cm)	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})
T_1	100% RDF	367	146	16.2	4132	5003
T_2	100% RDF + FYM 12.5 t ha^{-1} + 3% Panchakavya foliar spray @ AT, PI & 50% flowering	464	207	22.0	6329	7210
T_3	100% RDF + Vermicompost 5 t ha^{-1} + 3% Panchakavya foliar spray @ AT, PI & 50% flowering	455	201	21.9	6031	6989
T_4	100% RDF + Green leaf manure 6.25 t ha^{-1}+ 3% Panchakavya foliar spray @ AT, PI & 50% flowering	436	189	20.5	5670	6559
T_5	100% RDF + Poultry manure 3 t ha^{-1} + 3% Panchakavya foliar spray @ AT, PI & 50% flowering	482	220	23.5	6690	7633
T_6	75% RDF	343	134	14.9	3771	4578
T_7	75% RDF + FYM 12.5 t ha^{-1} + 3% Panchakavya foliar spray @ AT, PI & 50% flowering	410	173	19.1	5170	5986
T_8	75% RDF + Vermicompost 5 t ha^{-1} + 3% Panchakavya foliar spray @ AT, PI & 50% flowering	389	162	17.8	4809	5618
T_9	75% RDF + Green leaf manure 6.25 t ha^{-1}+ 3% Panchakavya foliar spray @ AT, PI & 50% flowering	385	158	17.5	4639	5427
T_{10}	75% RDF + Poultry manure 3 t ha^{-1} + 3% Panchakavya foliar spray @ AT, PI & 50% flowering	416	176	19.2	5309	6136
	SEd	8.0	5.0	0.57	176	209
	CD(p= 0.05)	16.5	10.4	1.18	360	412

RDF- Recommended Dose of Fertilizer, AT- Active tillering, PI- Panicle initiation

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Table 2: Effect of integrated nutrient management practices on nutrient uptake (kg ha^{-1}) of rice under SRI

	Treatments	N	P	K
T_1	100% RDF	68.0	22.0	76.5
T_2	100% RDF + FYM 12.5 t ha^{-1} + 3% Panchakavya foliar spray @ AT, PI & 50% flowering	99.0	35.4	111.7
T_3	100% RDF + Vermicompost 5 t ha^{-1} + 3% Panchakavya foliar spray @ AT, PI & 50% flowering	97.2	34.2	107.9
T_4	100% RDF + Green leaf manure 6.25 t ha^{-1}+ 3% Panchakavya foliar spray @ AT, PI & 50% flowering	91.0	31.3	101.1
T_5	100% RDF + Poultry manure 3 t ha^{-1} + 3% Panchakavya foliar spray @ AT, PI & 50% flowering	105.4	38.7	118.5
T_6	75% RDF	55.6	19.0	64.9
T_7	75% RDF + FYM 12.5 t ha^{-1} + 3% Panchakavya foliar spray @ AT, PI & 50% flowering	82.0	28.3	91.7
T_8	75% RDF + Vermicompost 5 t ha^{-1} + 3% Panchakavya foliar spray @ AT, PI & 50% flowering	76.1	25.4	85.0
T_9	75% RDF + Green leaf manure 6.25 t ha^{-1}+ 3% Panchakavya foliar spray @ AT, PI & 50% flowering	74.2	24.3	83.2
T_{10}	75% RDF + Poultry manure 3 t ha^{-1} + 3% Panchakavya foliar spray @ AT, PI & 50% flowering	84.1	29.0	94.0
	SEd	2.5	0.9	2.6
	CD(p=0.05)	5.4	1.9	5.7

RDF- Recommended Dose of Fertilizer, AT- Active tillering, PI- Panicle initiation

