

RESEARCH ARTICLE

Studies on Integrated Nutrient Management Practices on Growth and Yield 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 (INM) on rice under System of Rice Intensification. The experiment was laid out in a randomized block design with three replications. Biometrics such as plant height, number of tillers hill ¹, dry matter production, number of panicles m⁻², number of grains panicle⁻¹, panicle length, grain yield and straw yield were recorded. Integrated Nutrient management significantly influenced the growth and yield of rice. Application of 100% RDF + Poultry manure (3 t ha⁻¹) + 3% Panchakavya foliar spray @ AT, PI & 50% flowering significantly influenced the growth parameters, yield characters and yield were recorded under 75% RDF alone. AT- Active Tillering, PI- Panicle Initiation

Key words: Rice, Integrated nutrient management, Poultry manure, FYM, Vermicompost, Yield

INTRODUCTION

Rice is the most prominent crop as it is the staple food for most of the people of the country. This crop is the backbone of livelihood for millions of rural households and plays vital role in the country's food security, so the term "rice is life" is most appropriate in Indian context. India occupies an important position both in area and production of rice.

In India rice is cultivated in an area of 44.38 million hectares with a production of 104.31 million tons (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). Every year, huge amount of chemical fertilizers are applied to achieve maximum production in rice to meet the food requirement of our country. Due to the indiscriminate and injudicious use of chemical fertilizers, pesticides and aberrant weather conditions, the production and productivity of rice in India is facing a sustainability problem. Use of chemical fertilizers without addition of organic manures has created problems such as environmental pollution, health hazards, interruption of natural ecology, destruction of biological communities that support crop production, the depletion of soil organic carbon and mineral nutrients (Sheeja Raj et al., 2013).

Continuous application of fertilizers at high doses may, have adverse effects on crop yield besides affecting soil physical, chemical and biological properties. The use of organic manures in combination with chemical fertilizers proved its significant long term consistent beneficial effect on soil properties and productivity. An integration of organic and inorganic fertilizer may be necessary to maintain the sustainability in crop production (Datta and Singh, 2010). Thus keeping in view the above consideration, present investigation was undertaken to study the effect of integrated nutrient management practices on growth and yield of rice under system of rice intensification.

MATERIAL AND METHODS

The field experiment was conducted during rabi 2017-18 at Agricultural Research Station, Thirupathisaram, Kanyakumari District to study the effect of integrated nutrient management practices on growth and yield of rice under system of rice intensification. The experiment was laid out in a randomized block design with three replications. The treatments structure comprised of 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. The variety TPS 5 was used as a test crop. Poultry manure, FYM, vermicompost and glyricidia 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 growth parameters, yield characters, grain yield and straw yield were recorded.

Table 1. Effect of INM or	n growth	characters	of rice
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RESULT AND DISCUSSION

Effect on crop growth

The growth of the plant is observed through plant height, number of tillers plant⁻¹, leaf area index (LAI) and dry matter production (DMP). Growth characters can be altered by crop management practices. Most of the plant growth and development process regulated by various nutrient management practices. Integrated nutrient management is one of the important factors, which is directly influences the plant by changing the ability of the plant to respond to the available nutrients and others.

	Treatments	Plant height (cm)		Number of tillers m ⁻²		DMP (kg ha ⁻¹)				
		AT	PI	Н	AT	PI	Н	AT	PI	Н
T ₁	100% RDF	25.4	46.5	85.8	142	455	431	1997	7120	9865
T_2	100% RDF + FYM 12.5 t ha^1 + 3% Panchagavya foliar spray @ AT, PI & 50% flowering	39.2	65.2	101.9	177	512	498	3004	8291	14024
Τ ₃	100% RDF + Vermicompost 5 t ha^{1} + 3% Panchagavya foliar spray @ AT, PI & 50% flowering	38.6	63.8	100.8	175	508	494	2890	8165	13526
T_4	100% RDF + Green leaf manure 6.25 t ha ¹ + 3% Panchagavya foliar spray @ AT, PI & 50% flowering	35.4	60.5	97.5	168	497	480	2704	7940	12718
T_5	100% RDF + Poultry manure 3 t ha1 + 3% Panchagavya foliar spray @ AT, PI & 50% flowering	42.6	68.8	104.8	184	524	512	3160	8508	14813
T_6	75% RDF	22.0	42.9	82.7	135	442	417	1840	6810	9169
T ₇	75% RDF + FYM 12.5 t ha1 + 3% Panchagavya foliar spray @ AT, PI & 50% flowering	31.9	54.2	93.6	160	484	464	2415	7620	11740
Т ₈	75% RDF + Vermicompost 5 t ha1 + 3% Panchagavya foliar spray @ AT, PI & 50% flowering	29.4	50.5	90.5	153	473	450	2254	7400	11045
T_9	75% RDF + Green leaf manure 6.25 t ha ¹ + 3% Panchagavya foliar spray @ AT, PI & 50% flowering	28.6	49.6	89.3	151	468	445	2152	7340	10556
T ₁₀	75% RDF + Poultry manure 3 t ha1 + 3% Panchagavya foliar spray @ AT, PI & 50% flowering	32.3	56.0	94.2	161	486	467	2548	7715	11900
	SEd	0.89	1.3	1.1	3.0	4.0	5.0	76.30	106	346
	CD(P=0.05)	1.8	2.7	2.4	6.0	10.0	12.0	154	215	693

In the present study also, growth characters were distinctly influenced by the integrated nutrient management practices, which have been elucidated through plant height, number of tillers plant⁻¹ and dry matter production of rice (Table 1). Data on growth attributes of rice viz., plant height, number of tillers hill⁻¹ and DMP were significantly influenced by the different integrated management practices. Plant height, number of tillers hill⁻¹ and DMP were recorded at active tillering, panicle initiation and harvest. Among the various integrated nutrient management practices tried, application of 100% RDF + Poultry manure (3 t ha⁻¹) + 3% Panchakavya foliar spray @ AT, PI & 50% flowering significantly recorded the maximum plant height (42.6, 68.8 and 104.8 cm), number of tillers hill-1 (184, 524 and 512) and DMP (3160, 8508 and 14813 kg ha-¹). The increase in plant height was mainly due to incorporation of poultry manure along with inorganic nutrients. These results are in accordance with the findings of Islam et al., (2014). This might be due

to enhanced level of nutrient available in the rhizoecosystem of the soil applied with basal application of fertilizers resulting in better plant growth and development. Application of nutrients would have resulted in better vegetative growth as observed by taller plants. The increase in plant height was mainly due to the reason of more availability of nutrients by poultry manure along with inorganic nutrients. These results are in accordance with the findings of Sarker *et al.*, (2015). The increase in number of tillers hill⁻¹ was perhaps due to the increased availability of inorganic nutrients added with poultry manure which promote nitrogen supply which is essential for vegetative growth. These findings are in confirmation with Khan *et al.*, (2007).

Dry matter accumulation is considered to be the reliable index of crop growth. The DMP was increased steadily with the advancement of the crop growth. The DMP was favorably increased in all stages due to integrated nutrient management practices. The probable reason might be attributed to the continuous slow release of nutrients from poultry manure plus inorganic fertilizer and foliar nutrition at later stages which might have enabled the leaf area duration to extend there by providing an opportunity for plants to increase the photosynthetic which could have led to higher accumulation of dry matter. The results are similar to the findings of Roy et al., (2015). In addition, when *Panchakavya* (3%) was sprayed to foliage, the absorption of nutrient would have been in the higher side, thus encouraging quick growth and increased plant height, tiller numbers and dry matter partioning as noticed in the treatments receiving poultry manure combine with inorganic nutrient and *Panchakavya* spray.

	Treatments	No. of	No. of	Panicle	Grain yield	Straw
		productive tillers m ⁻²	grains panicle ^{.1}	length (cm)	(kg ha¹)	yield (kg ha¹)
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
Τ ₃	100% RDF + Vermicompost 5 t ha $^{\rm 1}$ + 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
Т ₇	75% RDF + FYM 12.5 t ha1 + 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 ha¹+ 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

The lower value of DMP was observed in the application of 75% RDF alone clearly showed its inability to produce more DMP. The reason for the poor performance of the above plots was due to poor nutrient availability to meet out the crop demand at various growth stages. Similar views were expressed by Alagappan and Venkitasamy (2014).

Effect on yield attributes and yield

The trend observed in growth parameters was also observed in yield attributes. 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 2).

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 filled grains panicle (189). 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. 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 panicle¹ 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 vield 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 observed in straw yield also.

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 growth and yield of rice under system of rice intensification.

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