International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
www.chemijournal.com
IJCS 2020; 8(3): 2768-2770

Received: 12-03-2020
Accepted: 16-04-2020

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Nutrient management for higher rice productivity under different establishment methods

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DOI: https://doi.org/10.22271/chemi.2020.v8.i3an.9631

Abstract
A field experiment was conducted during *Kharif*, 2017 and 2018 at Department of Rice, Tamil Nadu Agricultural University, Coimbatore, to study the nutrient management for higher productivity in different rice establishment methods. Experimental trial was conducted in split plot design with three replications. In main plot, different rice establishment methods *viz.*, M_1: Machine transplanting method, M_2: Conventional method, M_3: System of Rice Intensification (SRI) method; where as in sub-plot, the nutrient management *viz.*, S_1: 100 % of recommended inorganic fertilizer (120:60:40 kg NPK/ha), S_2: 75 % inorganic + 25 % organic (equivalent of N dose), S_3: 150 % RDF (180:90:60 kg NPK/ha), S4: LCC based N application, S_5: Location specific fertilizer management (150:50:50 kg NPK/ha). Based on the two years of study, the results revealed that among the different methods of planting and nutrient sources, SRI method of planting with LCC based N application recorded higher grain yield (6114 kg/ha) which was followed by machine transplanting method. The net return (Rs.55,882/-) and BCR (2.54) was higher under SRI method with LCC based N application when compared to other methods.

Keywords: Rice, machine planting methods, system of rice intensification (SRI), conventional method, nutrient management, leaf Colour chart

Introduction
Rice is the most important food crop of the world providing major source of food and energy for more than half of the human population. More than 80 per cent of the rice is produced and consumed in Asia where rice is an integral part of culture and tradition. Countries food grain production largely depends on the production of rice over decade needs to be improved with adoption of the appropriate technologies to keep pace with growth rate in population. But the productivity growth of rice in India has either decelerated or remained stagnant (Javaid *et al.*, 2012) [5] for the last one decade. Thus, sustainability of growth rate for rice sector is of prime concern for the country to maintain food security and to support the growth in economy. To achieve the targeted rice production of about 140 million tonnes by 2030, the present approaches have to be transformed by roping in overarching agronomic management technologies that underpins sustainability of rice. Under this, the methods of planting and nutrient management practices are one of the important interventions to increase the productivity of rice.

Materials and Methods
A field experiment was conducted during *Kharif*, 2017 and 2018 at Department of Rice, Tamil Nadu Agricultural University, Coimbatore, to study the nutrient management for higher productivity in different rice establishment methods. Experimental trial was conducted in Split plot design with three replications. In main plot, different establishment methods *viz.*, M_1 - Machine transplanting method, M_2 - Conventional method, M_3 - System of Rice Intensification (SRI) method; where as in sub-plot the nutrient management *viz.*, S_1: 100 % of recommended dose of inorganic fertilizer (120:60:40 kg NPK/ha), S_2: 75 % inorganic fertilizer + 25 % organic (equivalent of N dose), S_3: 150 % of recommended dose of inorganic fertilizer (180:90:60 kg NPK/ha), S4: LCC based N application, S_5: Location specific fertilizer management (150:50:50 kg NPK/ha). All the recorded data were analysed statistically as per the method suggested by Gomez and Gomez (1984) [3].

Results and Discussion

Yield attributes: Pooled analysis of two years data of yield attributing characters were presented in Table.1. Among the methods of planting, System of Rice Intensification (SRI) method recorded higher total number of panicles per m^2 (379) and panicle weight (3.02) when compared to machine planting and conventional planting methods. In sub plot as different nutrient levels, the LCC based N application recorded higher total number of panicles per m^2 (376) and panicle weight (3.27) compared to other nutrient sources. Hossain (2018) [4] found that highest biological yield in SRI method when compared to the conventional planting method and application of the intermediate level of nitrogen is economical and environment-friendly. The better performance of the crop under SRI was the outcome of enhanced growth measured in terms of significantly higher plant height, number of tillers/hill, dry matter accumulation and leaf area index at different growth stages as compared to other methods of planting in rice.

Grain yield

Grain yield of two years data were pooled analysed and the results were presented in Table 2. Grain yield was recorded higher under System of Rice Intensification (SRI) method when compared to machine planting and conventional planting methods. In different nutrient levels, the LCC based N application recorded higher grain yield compared with other nutrient sources. In the interaction effect, System of Rice Intensification (SRI) method with LCC based N application recorded higher grain yield of 6114 kg/ha. This was followed by machine planting method with LCC based N application with a grain yield of 5726 kg/ha. This increase in yield could be attributed to profuse tillering, improved soil aeration achieved through the soil disturbance by cono weeder operation, in addition to effective weed suppression (Thiyagarajan *et al.*, 2002 and 2005) [6, 7]. Accordance to Debbarma, (2013) [2], reported that SRI (System of Rice Intensification) method produced rice yields of 7 to 8 t ha^{-1} against the normal 3 to 4 t ha^{-1}. SRI method of planting also saved nearly 25% irrigation water without any penalty on yield compared to conventional transplanting (Chowdhary *et al.*, 2018) [1]. Using intermittent irrigation, water saving of 50% in SRI over the traditional flooding without any adverse effect on grain yield (Thiyagarajan *et al.* (2002) [6].

Table 1: Influence of treatments on yield attributes of rice (Pooled analysis of two years data)

Treatments		Total No. panicles /m^2	Panicle. wt (g)	Test wt (g)
Main plot:				
M_1	Machine transplanting method	355	2.87	14.20
M_2	Normal planting method	334	2.89	14.26
M_3	SRI	379	3.02	14.29
Sub plot:				
S_1	100 % of RDF (120:60:40 kg NPK/ha)	315	2.75	14.23
S_2	75 % inorganic + 25 % (equi. of N dose) organic	334	2.85	14.19
S_3	150 % RDF (180:90:60 kg NPK/ha)	363	2.95	14.29
S_4	LCC based N application	376	3.27	14.35
S_5	Location spec. ferti. mgmt. (150:50:50 kg NPK/ha)	360	3.00	14.18

	Total No. panicles /m^2	M	S	M at S	S at M
S.Ed		8	6	15	13
CD (0.05)		15	12	27	24
	Panicle. wt (g)	M	S	M at S	S at M
S.Ed		0.03	0.06	0.10	0.10
CD (0.05)		0.09	0.12	0.22	0.22
	Test wt (g)	M	S	M at S	S at M
S.Ed		0.4	0.5	0.12	0.13
CD (0.05)		NS	NS	NS	NS

Table 2: Influence of treatments on grain yield (kg/ha) of rice (Pooled analysis of two years data)

Treatments	Grain yield (kg/ha)			
	Machine transplanting method	Normal planting method	System of Rice Intensification method	Mean
S_1 - 100 % of RDF (120:60:40 kg NPK/ha)	5218	4645	5248	5037
S_2 - 75 % inorganic + 25 % (equi. of N dose) organic	5403	4748	5327	5159
S_3 - 150 % RDF (180:90:60 kg NPK/ha)	5484	5122	5866	5491
S_4 - LCC based N application	5726	5236	6114	5692
S_5 - Location spec. ferti. mgmt. (150:50:50 kg NPK/ha)	5377	5174	5822	5458
Mean	5442	5012	5722	
	S.Ed			CD(0.05)
M	63			124
S	71			135
M at S	125			264
S at M	137			272

Table 3: Economics of different treatments on rice

Treatments	Machine transplanting method			Normal planting method			SRI method		
	GR (Rs./ha)	NR (Rs./ha)	BCR	GR (Rs./ha)	NR (Rs./ha)	BCR	GR (Rs./ha)	NR (Rs./ha)	BCR
S_1 - 100 % of RDF (120:60:40 kg NPK/ha)	78270	40418	1.93	69675	27411	1.65	78720	41952	2.14
S_2 - 75 % inorganic + 25 % (equi. of N dose) organic	81045	42367	1.91	71220	28879	1.68	79905	42652	2.15
S_3 - 150 % RDF (180:90:60 kg NPK/ha)	82245	42669	1.93	76830	33652	1.78	87990	48982	2.25
S_4 - LCC based N application	85890	48428	2.29	78540	38368	1.96	92160	55882	2.54
S_5 - Location spec. ferti. mgmt. (150:50:50 kg NPK/ha)	80655	41881	2.08	77610	34632	1.81	87330	49546	2.31

*GR – Gross return; NR – Net return; BCR – Benefit cost ratio

Economics

In economics, Gross return, Net return and benefit cost ratio was worked out and the results are presented in Table 3. The net return (Rs. 55882/-) and benefit cost ratio (2.54) was higher in System of Rice Intensification (SRI) method with LCC based N application when compared to others. SRI method shows higher economic returns when compared to other methods which are mainly due higher yield obtained and less cost of cultivation.

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