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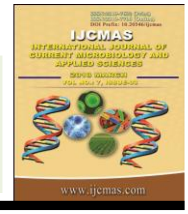

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Evaluation of Different Nutrient Management Practices for Enhancement of the Productivity in Different Rice Establishments Methods

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A B S T R A C T

In crop nutrient management, crop yields can be increased by minimizing nutrient losses in the environment by managing nutrient supply to the root zone within a reasonable range which realizes the biological need of crops to match N requirement high-yielding crop, and controls nutrient losses. Minimal Nutrient supply and nutrient requirements in high yielding cropping systems must be matched in quantity and synchronized in time and space. To achieves this goal, to identify the optimum and cost effective nutrient management practices in different crop establishment methods, a study was conducted during 2015-16 and 2016-17, experiment was laid out in split plot design with 3 main plots {M1:Mechanical transplanting method (all the principles as per SRI), M2: Direct Seeding with SRI principles saturation method of water management weeding with cono weeder and fertilizer management and M3:Normal transplanting (20 x 15 cm with flood water management, 3-4 seedlings transplanted at 25 to30 days old seedlings and 5 subplots (S1-100% RD, S2-75% inorganic + 25% organic equivalent N dose, S3-150% RDF, S4-LCC based N application and S5-Location specific fertilizer management. Among the crop establishments methods, use of mechanical transplanting and adopting all the principles as per SRI, performed excellently by registering higher yield attributes and grain yield of 5910 and 5767 kg ha^{-1} during Kharif 2015 and 2016, respectively. While comparing the method of nutrient management practices LCC based N application registered higher grain yield of 6430 and 6635 kg ha^{-1} during Kharif 2015 and 2016, respectively, which is also economically feasible besides higher net return due to reduce the cost of production particularly in edging out higher inorganic fertilizers without affecting the grain yield.

Introduction

India, many challenges are faced in our quest to overcome food scarcity with limited resource available for agriculture. Though India tops the list in terms of area constituting 28 percent of world's rice, the productivity is very low compared to leading rice growing countries. The major constraint in rice production is lack of suitable crop management practices and sufficient irrigation facilities. The recommended water management practice for rice is to provide irrigation up to 5 cm depth, one day after disappearance of ponded water. However, many farmers keep their fields under flooded condition during the entire growing period, which is a wasteful practice. The total water input in rice fields varies widely between 500 and 3000 mm depending on the environmental conditions and the length of the growing period. Considering the future food requirements, competition from non-agricultural uses for fresh water, and more amount of water currently used in rice cropping, new methods of rice cultivation must be identified aiming at less water requirement and higher crop productivity. Earlier studies revealed that rice can come up very well under semi aquatic conditions with little or no major reduction in yield and it has the self-adjusting nature which will have synergetic effect on rice growth and yield. This system is composed of a package of agronomic measures that should be applied simultaneously to realize a yield increase. The components of SRI include transplanting of young seedlings, usually 8-12days and not more than 15 days old.

Transplanting of seedlings with wider spacing in a square pattern which facilitates better weeding operations using mechanical weeder and consequent aeration of the soil. This gives more room for better root and canopy growth. The soil is kept moist but not inundated during vegetative growth phase, so that the soil is aerated and never become hypoxic. Early and frequent weeding is essential because otherwise weed growth will become a problem. The practice of SRI is not only aiming at maximum yield but rather to promote the higher productivity of land, labour, capital, and water in ways that benefit the farmer especially poor one. Many countries like Indonesia, Madagascar, and Bangladesh etc. reported double or triple fold increase in rice grain yield with less water consumption. It was against this background that the field investigation was carried out to study the effect of system of rice intensification (SRI) practices on yield attributes, yield, and water productivity of rice (*Oryza sativa* L.). In crop nutrient management, crop yields can be increased by minimizing nutrient losses in the environment by managing nutrient supply to the root zone within a reasonable range which realizes the biological need of crops to match N requirement high-yielding crop, and controls nutrient losses. Minimal Nutrient supply and nutrient requirements in high yielding cropping systems must be matched in quantity and synchronized in time and space (Uphoff, 2002).

Materials and Methods

In order to achieve this goal, to identify the optimum and cost effective nutrient management practices in different crop establishment methods, a study was conducted during 2015-16 and 2016-17at Perunthalaivar Kamaraj Krishi Vigyen Kendra (PKKVK), Puducherry State experimental farm with three replication., The rice variety was taken CO 51 during both Kharif 2015 and Kharif 2016. The soil type was clay loam in texture and Acidic in reaction (pH 6.91), acidic having electrical conductivity (EC) of 0.23 dSm^{-1} and available N, P, K content were 134.4 kg ha^{-1}, 26.5 kg $ha^{-1}$and 91 kg ha^{-1} in Kharif 2015 and the soil type was clay loam in texture and Acidic in reaction (pH 4.99), acidic having electrical conductivity (EC) of 0.1 dSm^{-1} and available N, P, K content were 145.6 kg ha^{-1}, 11.85 kg $ha^{-1}$and 102 kg ha^{-1} in Kharif 2016 with field duration of 110 days, was used in the trial. The selected packages of treatment details are as follows: experiment was laid out in split plot design with 3 main plots M1:Mechanical transplanting method (all the principles as per SRI), M2: Direct Seeding with SRI principles saturation method of water management weeding with cono weeder and fertilizer management and M3:Normal transplanting (20 x 15 cm with flood water management, 3-4 seedlings transplanted at 25 to30 days old seedling sand 5 subplots (S1- 100% RD, S2- 75% inorganic + 25% organic equivalent N dose, S3-150% RDF, S4-LCC based N application and S5-Location specific fertilizer management that were tested. The result of experiment-I and II revealed that younger seedlings (14 days old) from tray nursery recorded higher yield than conventional seedlings. In Leaf Color Chart (LCC) based N management the nitrogen requirement was 140 kg N ha-1 whereas it was only 120 kg N ha-1 in recommended practice. Moreover there was no significant difference in yield between LCC and traditional fertilization.

The cost of fertilization was also higher in LCC than traditional fertilization. So it was decided to include both younger seedlings (14 days old) from tray nursery and aged seedlings (21 days) from conventional nursery and also excludes the LCC treatment. Nitrogen is the most limiting nutrient in almost all the soils. Blanket fertilizer recommendations over large areas are not efficient as it does not consider variability of soil N supply and changes in crop demand. It is more beneficial if N inputs could be adjusted to actual crop conditions and nutrient requirements.

Demonstrated that leaf color chart (LCC) is reliable, quite simple, and useful tool to assist farmers in decision making regarding top- dress N application to crops. Multi- location field experiments were conducted on rice to determine the appropriate LCC value for rice for getting the optimum cost effective yield. Various LCC values were evaluated. The LCC value 4 was found to be the most effective for getting the optimum yield and to achieve higher nitrogen use efficiency.

Saving of urea is 30 kg ha^{-1} by using LCC. Substantial amounts of urea can be saved if half of the rice growing farmers will adopt this technology. It will not only increase the profit of farmers but also reduce the environmental pollution.

Results and Discussion

Most of the yield components were significantly improved under the combination of younger seedlings which are transplanted before the growth of the 4th phyllochron starts (14 days old), wider spacing with a plant density of 16 seedlings m^{-2} (25 × 25 cm), either conventional irrigation or limited irrigation and mechanical weeding. Under younger seedlings combination, increased leaf area and subsequent increase in photosynthetic activity were exhibited through increased biomass production as a major portion of photosynthesis accounted for dry matter and all these factors favored the yield components under SRI practices. Wider spacing was the reason for less below and above ground competitions for better grain filling, higher grain weight and more number of filled grains per panicle. Optimum supply of irrigation water with mechanical weeding resulted in higher nutrient availability subsequently resulting in better source to sink conversion and in turn enhanced the production of more total number of seeds and filled seeds panicle -1. The findings of two seasons, among the crop establishments methods, use of mechanical transplanting and adopting all the principles as per SRI, performed excellently by registering higher yield attributes and grain yield of 5910 and 5767 kg ha^{-1} during Kharif 2015 and 2016, respectively (Table 1 and Fig. 1). While comparing the method of nutrient management practices LCC based N application registered higher grain yield of 6430 and 6635 kg ha^{-1} during Kharif 2015 and 2016, respectively (Table 1 and Fig. 2), which is also economically feasible besides higher net return due to reduce the cost of production particularly in edging out higher inorganic fertilizers without affecting the grain yield (Table 2 and 3).

Table.1 Evaluation of different nutrient management practices for enhancement of the productivity in different rice establishments methods on grain yield (kg/ha)

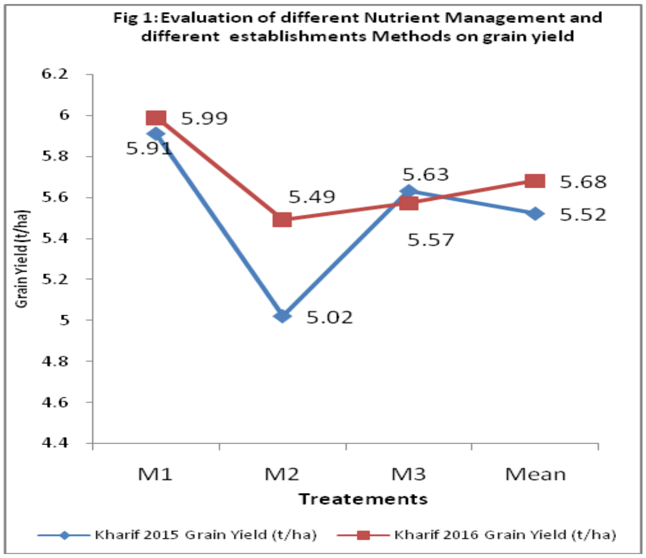
Method of crop establishment / Nitrogen splits	Kharif 2015 (Variety Co-51)				Kharif 2016 (Variety Co-51)			
	M1	**M2**	**M3**	**Mean**	**M1**	**M2**	**M3**	**Mean**
S1 -100% recommended inorganic fertilizers (120:60:40 kg NPK/ha)	5.21	4.67	5.66	**5.15**	6.13	5.11	5.21	**5.48**
S2 -75% inorganic + 25% (equivalent of N dose) organic	5.99	4.95	6.01	**5.53**	5.95	5.45	5.66	**5.69**
S3 -150% recommended fertilizer dose	6.42	5.24	6.40	**5.89**	6.61	6.05	5.95	**6.20**
S4 -LCC based N application	6.95	5.94	4.51	**6.43**	6.21	6.27	5.97	**6.15**
S5 -Location specific fertilizer management	4.97	4.29	5.66	**4.59**	5.05	4.56	5.05	**4.89**
Mean	**5.91**	**5.02**	**5.63**	**5.52**	**5.99**	**5.49**	**5.57**	**5.68**
	M	**S**	**MXS**		**M**	**S**	**MXS**	
CD (0.05)	0.13	0.29	NS		0.14	0.30	NS	
C.V.(%)	3.59	5.43	NS		3.74	5.35	NS	

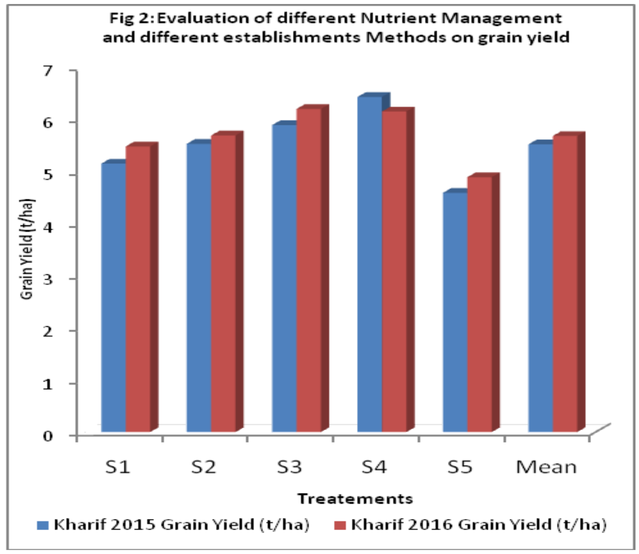
Table.2 Evaluation of different nutrient management practices for enhancement of the productivity in different rice establishments methods on panicle No. /m^2

Method of crop establishment / Nitrogen splits	Kharif 2015 (Variety Co-51)				Kharif 2016 (Variety Co-51)			
	M1	**M2**	**M3**	**Mean**	**M1**	**M2**	**M3**	**Mean**
S1 -100% recommended inorganic fertilizers (120:60:40 kg NPK/ha)	335	314	330	327	344	322	325	330
S2 -75% inorganic + 25% (equivalent of N dose) organic	347	328	343	339	365	334	339	346
S3 -150% recommended fertilizer dose	369	339	356	355	406	352	360	373
S4 -LCC based N application	389	357	376	374	437	380	385	400
S5 -Location specific fertilizer management	310	279	298	296	330	288	306	308
Mean	350	323	341	**338**	376	335	343	351
	M	**S**	**MXS**		**M**	**S**	**MXS**	
CD (0.05)	NS	14.63	NS		17.37	14.37	NS	
C.V. (%)	10.67	6.54	NS		7.62	4.2	NS	

Table.3 Evaluation of different nutrient management practices for enhancement of the productivity in different rice establishments methods on panicle weight (g)

Method of crop establishment / Nitrogen splits	Kharif 2015 (Variety Co-51)				Kharif 2016 (Variety Co-51)			
	M1	**M2**	**M3**	**Mean**	**M1**	**M2**	**M3**	**Mean**
S1 -100% recommended inorganic fertilizers (120:60:40 kg NPK/ha)	3.50	3.00	3.13	3.21	3.51	3.13	3.12	3.25
S2 -75% inorganic + 25% (equivalent of N dose) organic	3.66	3.25	3.45	3.45	3.59	3.45	3.26	3.43
S3 -150% recommended fertilizer dose	3.73	3.33	3.62	3.56	3.86	3.62	3.54	3.67
S4 -LCC based N application	3.95	3.74	3.89	3.86	4.10	3.90	3.87	3.96
S5 -Location specific fertilizer management	3.01	2.60	2.65	2.75	3.15	2.65	2.81	2.87
Mean	3.57	3.18	3.35	**3.37**	3.64	3.35	3.32	**3.44**
	M	**S**	**MXS**		**M**	**S**	**MXS**	
CD (0.05)	0.02	0.21	NS		0.04	0.22	NS	
C.V. (%)	1.13	6.54	NS		2.02	6.56	NS	





SRI method provided the plants better growth conditions (such as wider spacing, better aeration and better utilization of resources), which enabled them to grow vigorously.

This has been exhibited in terms of higher leaf area and ultimately higher dry matter production. These enhanced growth parameters might have helped in better filling of spikelets. These results are in agreement with findings of Nayak *et al.,* (1998) and Barison (2002).

This result is in confirmation with result obtained by Pandian (2010). The results supported the findings of Vijayakumar *et al.*, (2006). An increased conversion of tillers into productive tillers per flowering panicles with the adoption of SRI management. This favourable influence might be due to efficient utilization of resources and less inter-and-intra-space competition under SRI management, which may be assigned as the reason for superiority in such yield attributes of rice and consequently increased yield (Gani *et al.*, 2002). This observation was confirmed by the earlier findings of Tao *et al.*, (2002), Radhamani *et al.*, (2012), Meyyappan *et al.*, (2013) and Senthil Kumar (2015).
It may be concluded that in the Evaluation of different Nutrient Management Practices for Enhancement of the Productivity in different rice establishments Methods, the crop establishments methods, use of mechanical transplanting and adopting all the principles as per SRI, performed excellently by registering higher yield attributes and grain yield of 5910 and 5767 kg ha^{-1} during Kharif 2015 and 2016 (M1) was performed excellent by registering higher yield attributes and grain yield.

While comparing the method of nutrient management practices LCC based N application (S4) registered higher grain yield of 6430 and 6635 kg ha^{-1} during Kharif 2015 and 2016. All the yield parameters and grain yield were favourably influenced when N was applied under LCC guidance especially at higher rate i.e., 20 or 30 kg Nha^{-1} per application. Adequate N supply during reproductive growth phase was probably responsible in enhancing yield parameters and in turn the yield. Kenchaiah *et al.*, (2000) also found higher grain yield under LCC based N management than the blanket recommendation. Considering the influence of LCC based nitrogen application on growth and yield of rice and saving of fertilizer N, application of nitrogen to syncronise it with the crop demand as determined by LCC observations appears to be a better method of N management in rice.

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