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Effect of different establishment methods and nutrient management practices on growth, productivity and profitability of rice (*Oryza sativa* L.)

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Abstract
A field experiment was conducted at Zonal Agricultural Research Station, V.C. Farm, Mandya, University of Agricultural Sciences, Bengaluru during the *Kharif* season of 2015 and 2016 to study the response of nutrient management practices under different rice establishment methods. The experiment was laid out in split plot design with three replications consisting of twenty treatment combinations. Four establishment methods of rice such as Manual transplanted, Mechanized transplanted, Dibbling of seeds followed by SRI principles, and Wet direct seeded rice by broadcasting were followed in main plots and five nutrient management practices such as 100 per cent RDF, 150 per cent RDF, 75 per cent inorganic + 25 per cent Organic, LCC based N application and UASB POP recommended dose of manure and fertilizers, in sub plot. Among the different establishment methods (mean of two years), Dibbling of seeds followed by SRI principles significantly influenced the growth, yield attributes and yield and was on par with Mechanized transplanted significantly superior over manual transplanted method and wet direct seeded rice by broadcasting method and among different nutrient management practices application of 150% RDF was recorded significantly higher growth, yield attributes and yield and which was on par with LCC based N application found superior over 100% RDF, UASB package of practices (FYM 10 t ha^{-1} + 100: 50: 50: kg NPK ha^{-1} + 20 kg $ZnSO_4$ ha^{-1}) and 75% inorganic + 25% Organic (N equivalent basis).

Keywords: Machine planting, rice establishment methods, nutrient management, LCC SRI method

Introduction
Rice (*Oryza sativa* L.) is considered as the “Global Grain” and is the most staple food crop in Asia. It is a means of livelihood for millions of rural households and plays a vital role in our national food security and hence the slogan “Rice is Life” is most appropriate. Rice is commonly grown by transplanting seedling into the puddled soil, which is labour, water-, energy intensive and is becoming less reliable to the resource-poor farmers. Also, repeated puddling deteriorates soil quality thus farmers are shifting the puddled transplanting method (TPR) to direct seeding method (DSR) as this method has emerged as feasible alternative establishment method to deal with the water and labour shortages. Though DSR method of rice cultivation suffers from lower grain yield compared to traditional transplanting method, the grain yield can be increased through proper weed control and crop management practices. Farmers can be benefitted by the less cost, higher yield, lower drudgery of transplanting and the quick maturity of DSR as they can plant succeeding crops early. System of Rice Intensification (SRI), a method emerged from Madagascar uses single and young seedlings at wider spacing and is one of the water-saving rice production technology which yield is nearly twice to that of conventional transplanting method. The productivity and sustainability of rice depends on these three factors of production, especially nutrient, water and labour could be the most limiting factors in achieving target production. The nutrient management provides an approach for feeding the plants with nutrients as and when required. Integrated use of organic manures and chemical fertilizers has advantages over use of only organic manures or chemical fertilizers. Since sourcing of organic manure is difficult and the crop response to them during initial stages is not as spectacular, compared to the chemical fertilizers, an integrated approach of plant nutrition involving the judicious use of organic, chemical and microbial sources could be helpful to sustain optimum yield and to restore the residual soil fertility.

Material and Methods

The investigation was carried out in the Zonal Agricultural Research Station, Vishweshwaraiah Canal Farm, Mandya, University of Agricultural Sciences, Bengaluru during the *Kharif* season of 2015 and 2016. The experimental farm is located at an altitude of 704 m above mean sea level with the geographical location at 12º 34' North latitude and 76º 49' East longitudes comes under Southern dry zone of Karnataka (Zone-VI). The climate of the experimental field is classified as semi-arid tropical with high humidity, moderate temperature and medium rainfall. The soil of the experimental plot was sandy loam in texture and well drained with acidic reaction (pH 5.1). Organic carbon content of the soil was found to be medium while available nitrogen was found to be low, phosphorous and potassium were found to be medium. The experiment was laid out in split plot design with three replications consisted of twenty treatment combinations. Four establishment methods of rice such as manual transplanted (M_1), mechanized transplanted (M_2), dibbling of seeds with SRI principles (M_3), and wet direct seeded rice by broadcasting (M_4) were grown in main plots and five nutrient management treatments of rice such as 100% RDF (F_1), 150% RDF (F_2), 75% inorganic + 25% Organic (F_3), LCC based N application (F_4) and UASB POP recommended dose of manure and fertilizers (F_5), in sub plot. Treatment F_5 UAS package of practices (10 t FYM/ha + 100: 50: 50: kg NPK/ha + 20 kg ZnSo4). The variety IR-30864 was studied as test crop during *kharif*, in manual transplanted 18-20 days old seedlings are transplanted, With respect to mechanized transplanted fourteen days old seedlings of mat nursery were transplanted with a spacing of 25 x 25 cm, were in dibbling of seeds with SRI principles seeds were soaked in water for 24 hours and incubated in dark for 12 hours to induce sprouting which are placed 2-3 seeds per corners of square, marked ropes were used for square planting and for wet direct seeded rice by broadcasting the seeds are broadcasted the at 25 kg/ha seed rate to maintain optimum plant population respectively. Intercultural operations such as gap filling, irrigation and plant protection were carried out as required. The crop was harvested at four different dates depending on the maturity of the varieties harvesting was done manually and grain yield was recorded at 16% moisture level. Data were collected from five hills per plot and then averaged. Observations on growth and yield characters were recorded during harvesting stage. Data recorded for different growth and yield parameters were compiled and tabulated in proper form for statistical analysis. Statistical analysis was performed following the method of Gomez and Gomez (1984).

Results and Discussion

Effect of establishment methods and nutrient management practices of rice on growth parameters (Table 1)

Among different establishment practices significantly higher plant height (92.67 cm), number of green leaves (69.10 Hill^{-1}), number of tillers (24.85 Hill^{-1}), leaf area (1658.40 cm^2 hill^{-1}), total dry matter (72.39 g), root length (24.85 cm), root weight (12.1 g), was recorded under dibbling of seeds followed by SRI principles method of rice cultivation and significantly superior over mechanized transplanted method of rice cultivation plant height (91.73 cm), number of green leaves (65.37 Hill^{-1}), number of tillers (21.86 Hill^{-1}), leaf area (1470.75 cm^2 hill^{-1}), total dry matter (64.48 g), root length (23.78 cm), root weight (11.1 g), manual transplanted method of rice cultivation plant height (87.85 cm), number of green leaves (62.67 Hill^{-1}), number of tillers (19.38 Hill^{-1}), leaf area (1316.00 cm^2 hill^{-1}), total dry matter (60.78 g), root length (21.90 cm), root weight (9.9 g), and lower was recorded under wet direct seeded rice by broadcasting plant height (86.53 cm), number of green leaves (61.60 Hill^{-1}), number of tillers (16.78 Hill^{-1}), leaf area (1201.20 cm^2 hill^{-1}), total dry matter (52.86 g), root length (20.37 cm), root weight (9.3 g), this might be due to dibbling of seeds in SRI principles method which is an important index to strengthen the source–sink relationship because wider plant spacing produced more number of green leaves with greater size. It is in accordance with the findings of Yadav *et al*. (2010) [5] in rice.

Among different nutrient management practices application of 150% RDF was recorded significantly higher plant height (91.96 cm), number of green leaves (69.42 Hill^{-1}), number of tillers (22.72 Hill^{-1}), leaf area (1517.50 cm^2 hill^{-1}), total dry matter (72.25 g), root length (24.73 cm), root weight (11.7 g), and which was on par with LCC based N application plant height (89.92 cm), number of green leaves (66.29 Hill^{-1}), number of tillers (21.68 Hill^{-1}), leaf area (1450.06 cm^2 hill^{-1}), total dry matter (66.75 g), root length (23.77 cm), root weight (11.3 g), found superior over other treatments. Lower was recorded with application of 100% RDF plant height (88.38 cm), number of green leaves (60.83 Hill^{-1}), number of tillers (18.935 Hill^{-1}), leaf area (1327.310 cm^2 hill^{-1}), total dry matter (52.10 g), root length (21.08 cm), root weight (9.6 g). This might be due to application of higher rate of N at 150% RDF fact that inorganic fertilization has quick, adequate and easy nutrient supplying capacity to the crop and application of nutrients as per crop requirement at various growth stages eventually leads to better utilization of nitrogen for growth and development, might be attributed to more growth. This is in harmony with Pandey *et al*. (2001) [4].

Interaction effect between establishment methods and nutrient management practices with respect to growth parameters was found non-significant.

Effect of establishment methods and nutrient management practices of rice on yield attributes and yield of rice. (Table 2)

Among different establishment practices significantly influence on days taken to 50 per cent flowering (92.7 days), days taken to maturity (119 days), number of panicles m^{-2} (455 m^{-2}), panicle weight (3.1 g), thousand grain weight (23.6 g), panicle length (20.1 cm), total number of grains per panicle (162 panicle^{-1}), grain yield (5553 kg ha^{-1}) and straw yield (6810 kg ha^{-1}) was recorded under dibbling of seeds followed by SRI principles method of rice cultivation and on par with mechanized transplanted method of rice cultivation days taken to 50 per cent flowering (89.1 days), days taken to maturity (120 days), number of panicles m^{-2} (436 m^{-2}), panicle weight (3.0 g), thousand grain weight (23.2 g), panicle length (19.6 cm), total number of grains per panicle (159 panicle^{-1}), grain yield (5308 kg ha^{-1}) and straw yield (6577 kg ha^{-1}) significantly superior over manual transplanted method of rice cultivation days taken to 50 per cent flowering (91.2 days), days taken to maturity (126 days), number of panicles m^{-2} (394 m^{-2}), panicle weight (2.6 g), thousand grain weight (22.5 g), panicle length (18.6 cm), total number of grains per panicle (154 panicle^{-1}), grain yield (4733 kg ha^{-1}) and straw yield (6044 kg ha^{-1}) and lower was recorded under wet direct seeded rice by broadcasting days taken to 50 per cent flowering (82.3 days), days taken to maturity (116 days), number of panicles m^{-2} (333 m^{-2}), panicle weight (2.2 g), thousand grain weight (21.6 g), panicle length (16.6 cm), total number of grains per panicle (149 $panicle^{-1}$), grain yield (4152 kg ha^{-1}) and straw yield (5602 kg ha^{-1}) this might be due to yield advantage due to SRI over direct seeded rice by broadcasting and manual transplanting method was mainly due to more number of tillers production per unit area accompanied by maximum panicle bearing tillers with low spikelet sterility. Since planting of young seedlings of 14 days in main field with immediate establishment have facilitated early initiation of tillers. It is evident that highest tillers production was observed with SRI planting. Controlled irrigation also augmented the fresh root production till flowering stage and helped in supplementation of nutrient required for supporting of filling capacity of panicles. Similar reported by Duttarganvi *et al.* (2014).

Among different nutrient management practices application of 150% RDF was recorded significantly influence on days taken to 50 per cent flowering (92.7 days), days taken to maturity (119 days), number of panicles m^{-2} (455 m^{-2}), panicle weight (3.1 g), thousand grain weight (23.6 g), panicle length (20.1 cm), total number of grains per panicle (162 $panicle^{-1}$), grain yield (5553 kg ha^{-1}) and straw yield (6810 kg ha^{-1}) and which was on par with LCC based N application influence on days taken to 50 per cent flowering (92.7 days), days taken to maturity (119 days), number of panicles m^{-2} (455 m^{-2}), panicle weight (3.1 g), thousand grain weight (23.6 g), panicle length (20.1 cm), total number of grains per panicle (162 $panicle^{-1}$), grain yield (5553 kg ha^{-1}) and straw yield (6810 kg ha^{-1}) found superior over other treatments. Lower was recorded with application of 100% RDF on days taken to 50 per cent flowering (92.7 days), days taken to maturity (119 days), number of panicles m^{-2} (455 m^{-2}), panicle weight (3.1 g), thousand grain weight (23.6 g), panicle length (20.1 cm), total number of grains per panicle (162 $panicle^{-1}$), grain yield (5553 kg ha^{-1}) and straw yield (6810 kg ha^{-1}). This might be due to the adequate N availability, which facilitates tillering, and develops more and heavier grains in rice crop. Furthermore, cell elongation, cell enlargement and cell division due to proper utilization of nitrogenous fertilizer application under SRI, activates meristematic tissues which remain functional for longer periods resulting in better expression of yield and yield attributes and converting more yield of the crop. This result is in close agreement with those reported earlier by (Mohanty *et al*., 2014) [3].

Interaction effect between establishment methods and nutrient management practices with respect to yield attributes and yield was found significant.

Effect of establishment methods and nutrient management practices of rice on economics. (Table 3)

Establishment methods had influence on the cost of cultivation. Manual transplanted rice cultivation recorded higher cost of cultivation (41936 ₹ ha^{-1}) followed by mechanized transplanted rice cultivation (39316 ₹ ha^{-1}), wet direct seeded rice by broadcasting (DSR) method of cultivation (35966 ₹ ha^{-1}) and dibbling of seeds followed by SRI principles method cultivation (35866 ₹ ha^{-1}). Increased in cost of cultivation at preparation of nursery and transplanting by machine and labours which in turn increased the number of labours required and higher labours cost and nursery treys.

Among different nutrient management practices 75% inorganic + 25% Organic (N equivalent basis) recorded higher cost of cultivation with application of 150% RDF recorded significantly higher cost of cultivation (56247 ₹ ha^{-1}), followed by UASB package of practices (FYM 10 t ha^{-1} + 100: 50: 50: kg NPK ha^{-1} + 20 kg $ZnSo_4$) (37716 ₹ ha^{-1}). Lower cost of cultivation was recorded with application of 100% RDF (31556 ₹ ha^{-1}). This was mainly due to application of large quantity of FYM and which contains very less quantity of nutrients and application cost by labours which ultimately increased the cost of cultivation.

Gross returns (₹ ha^{-1})

Establishment methods had influence on gross returns, dibbling of seeds followed by SRI principles method cultivation recorded higher gross returns (102289 ₹ ha^{-1}) followed by manual transplanted rice cultivation (97591 ₹ ha^{-1}) and mechanized transplanted rice cultivation (94312 ₹ ha^{-1}). Lower gross returns were recorded wet direct seeded rice by broadcasting (DSR) method (90762 ₹ ha^{-1}) and the same may be due to higher grain and straw yield.

Among different nutrient management practices application of 150% RDF was recorded higher gross returns (105112 ₹ ha^{-1}), followed by LCC based N application (101293 ₹ ha^{-1}). Lower gross returns were recorded with application of 100% RDF (88695 ₹ ha^{-1}) and the same may be due to higher grain and straw yield.

Net returns (₹ ha^{-1})

Establishment methods had influence on net returns, dibbling of seeds followed by SRI principles method cultivation recorded higher net returns (66423 ₹ ha^{-1}) followed by manual transplanted rice cultivation (55655 ₹ ha^{-1}) and mechanized transplanted rice cultivation (54996 ₹ ha^{-1}). Lower net returns were recorded wet direct seeded rice by broadcasting (DSR) method (54796 ₹ ha^{-1}) and the same may be due to higher grain and straw yield. This was mainly due to higher grain and straw yield obtained the higher net returns in SRI over other establishment methods. Similar results were also observed earlier by Jayadeva and Prabhakara Setty, (2008) [1], Manjunatha *et al*. (2009) [2].

Among different nutrient management practices application of 150% RDF was recorded higher net returns (71142 ₹ ha^{-1}), followed by LCC based N application (68204 ₹ ha^{-1}). Lower net returns were recorded with application of 75% inorganic + 25% Organic (N equivalent basis) (33716 ₹ ha^{-1}) and the same may be due to higher grain and straw yield. This was mainly due to higher cost of cultivation in 75% inorganic + 25% Organic (N equivalent basis) through organic practice.

B:C ratio

Establishment methods had influence on benefit cost ratio, dibbling of seeds followed by SRI principles method recorded higher benefit cost ratio (2.85) followed by wet direct seeded rice by broadcasting (DSR) method (2.52) and mechanized transplanted rice cultivation (2.40). Lower benefit cost ratio were recorded manual transplanted rice cultivation (2.33). Both the establishment methods performed equally better with respect to B:C ratio. The higher benefit: cost ratio was attributed to higher grain yield and net returns in SRI. This was supported by Manjunatha *et al*. (2009) [2]. Though grain yield is higher in SRI and lesser cost of cultivation by avoiding preparation of nursery in dibbling of seeds followed by SRI principles method and wet direct seeded rice by broadcasting (DSR) method made SRI equal to wet direct seeded rice by broadcasting (DSR) method in respect of benefit cost ratio.

Table 1: Growth of rice as influenced by response of nutrient management practices under rice establishment methods during *Kharif* 2015 and 2016. (Mean of two years)

Treatments	Plant height (cm)	Number of green leaves (Hill^{-1})	Number of tillers (Hill^{-1})	Leaf area (cm^2 hill^{-1})	Total dry matter (g)	Root length (cm)	Root weight (g)
EST Methods	Pooled	Pooled	Pooled	Pooled	Pooled	Pooled	Pooled
M_1	87.85	62.67	19.38	1316.00	60.78	21.90	9.9
M_2	91.73	65.37	21.86	1470.75	64.48	23.78	11.1
M_3	92.67	69.10	24.85	1658.40	72.39	24.85	12.1
M_4	86.53	61.60	16.78	1201.20	52.86	20.37	9.3
S.Em±	0.62	0.56	0.62	13.55	1.38	0.66	0.5
CD at 5%	2.14	1.93	2.15	46.90	4.79	2.30	1.8
NMP							
F_1	88.38	60.83	18.93	1327.31	52.10	21.08	9.6
F_2	91.96	69.42	22.72	1517.50	72.25	24.73	11.7
F_3	88.60	62.79	19.94	1368.56	60.38	21.90	10.1
F_4	89.92	66.29	21.68	1450.06	66.75	23.77	11.3
F_5	89.63	64.08	20.31	1396.50	61.65	22.00	10.4
S.Em±	0.65	1.05	0.72	23.69	1.70	0.59	0.2
CD at 5%	1.89	3.01	2.06	68.24	4.90	1.71	0.7
Interaction							
S.Em±	1.31	2.09	1.43	47.38	3.40	1.19	0.5
CD at 5%	NS	NS	NS	NS	NS	NS	NS

Methods of crop establishment (04)
M1: Manual transplanted rice
M2: Mechanized transplanted rice
M3: Dibbling of seeds followed by SRI principles
M4: Wet direct seeded rice by broad casting (DSR)
DAS/T: Days after sowing/transplanting

Subplot: Nutrient management practices (05)
F1: 100% RDF
F1: 100% RDF
F1: 100% RDF
F2: 150% RDF
F3: 75% inorganic + 25% Organic (N equivalent basis)
F4: LCC based N application
F5: UASB package of practices (FYM 10 t/ha + 100: 50: 50: kg NPK/ha + 20 kg ZnSo4)
NS: Non significant

Table 2: Growth of rice as influenced by response of nutrient management practices under rice establishment methods during *Kharif* 2015 and 2016. (Mean of two years)

Treatments	Days taken to 50 per cent flowering	Days taken to maturity	Number of panicles/m^2	Panicle weight (g)	Thousand grain weight (g)	Panicle length (cm)	Grains panicle^{-1}	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})
EST Methods	Pooled	Pooled	Pooled	Pooled	Pooled	Pooled	Pooled	Pooled	Pooled
M_1	93.4	126	394	2.6	22.5	18.6	154	4733	6044
M_2	89.1	120	436	3.0	23.2	19.6	159	5308	6577
M_3	92.7	119	455	3.1	23.6	20.1	162	5553	6810
M_4	82.3	116	333	2.2	21.6	16.6	149	4152	5602
S.Em±	0.6	2	6	0.0	0.2	0.3	2	74	70
CD at 5%	2.2	6	21	0.1	0.8	1.1	5	256	241
NMP									
F_1	89.1	117	385	2.5	21.5	18.1	150	4364	5585
F_2	89.8	122	430	3.0	23.9	19.8	165	5519	6864
F_3	88.9	119	398	2.6	22.2	18.2	150	4665	5902
F_4	89.9	120	416	2.9	23.5	19.4	160	5326	6748
F_5	89.2	121	393	2.7	22.4	18.1	155	4807	6190
S.Em±	0.4	1	6	0.0	0.3	0.2	2	83	56
CD at 5%	NS	3	16	0.1	0.9	0.7	6	240	161
Interaction									
S.Em±	0.8	2	11	0.1	0.6	0.4	4	167	112
CD at 5%	NS	NS	33	NS	NS	1.4	12	480	323

Methods of crop establishment (04)
M_1: Manual transplanted rice
M_2: Mechanized transplanted rice
M_3: Dibbling of seeds followed by SRI principles
M_4: Wet direct seeded rice by broad casting (DSR)
DAS/T: Days after sowing/transplanting

Subplot: Nutrient management practices (05)
F_1: 100% RDF
F_2: 150% RDF
F_3: 75% inorganic + 25% Organic (N equivalent basis)
F_4: LCC based N application
F_5: UASB package of practices (FYM 10 t/ha + 100: 50: 50: kg NPK/ha + 20 kg $ZnSo_4$)
NS: Non significant

Table 3: Effect of establishment methods and nutrient management practices of rice on economics during *Kharif* 2015 and 2016. (Mean of two years)

Treatments	Cost of cultivation (₹ha^{-1})	Gross returns (₹ha^{-1})	Net returns (₹ha^{-1})	B:C
EST Methods	Pooled	Pooled	Pooled	Pooled
M_1	41936	97591	55655	2.33
M_2	39316	94312	54996	2.40
M_3	35866	102289	66423	2.85
M_4	35966	90762	54796	2.52
NMP				
F_1	31556	88695	57139	2.81
F_2	33970	105112	71142	3.09
F_3	56247	89963	33716	1.60
F_4	33089	101293	68204	3.06
F_5	37716	96130	58414	2.55

Methods of crop establishment (04)
M_1: Manual transplanted rice
M_2: Mechanized transplanted rice
M_3: Dibbling of seeds followed by SRI principles
M_4: Wet direct seeded rice by broad casting (DSR)
DAS/T: Days after sowing/transplanting

Subplot: Nutrient management practices (05)
F_1: 100% RDF
F_2: 150% RDF
F_3: 75% inorganic + 25% Organic (N equivalent basis)
F_4: LCC based N application
F_5: UASB package of practices (FYM 10 t/ha + 100: 50: 50: kg NPK/ha + 20 kg $ZnSo_4$)
NS: Non significant

Among different nutrient management practices application of 150% RDF was recorded higher benefit: cost ratio (3.09), followed by LCC based N application (3.06). Lower benefit cost ratio was recorded with application of 75% inorganic + 25% Organic (N equivalent basis) (1.60). Higher B:C ratio may be attributed to lesser cost of cultivation and higher net returns and it was in accordance with results of Jayadeva and Prabhakara Setty, (2008) [1].

References

1. Jayadeva HM, Prabhakara Shetty TK. Influence of crop establishment techniques and sources of nutrients on productivity, 245nergetic and economics of rice. *Oryza.* 2008;45(2):165-168.
2. Manjunatha MV, Masthana Reddy BG, Shashidhar SD, Joshi VR. Studies on the performance of self-propelled rice transplanter and its effect on crop yield. Karnataka J. Agric. Sci. 2009;22(2):385-387.
3. Mohanty TR, Maity SK, Roul PK. Response of rice to establishment methods and nutrient management practices in medium land. *Oryza.* 2014;51(2):136-142.
4. Pandey N, Upadhyay SK, Joshi BS, Tripathi RS. Integrated use of organic manures and inorganic N fertilizers for the cultivation of low land rice in vertisol. Ind. J Agricl. Res. 2001;35(2):112-114.
5. Yadav AS, Jaidev RAM H, Upadhyay MK. Effect of nitrogen levels and plant geometry on growth, yield and root characteristics of hybrid rice (*Oryza sativa*). Crop Res. 2010;40(3):16-19.