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Promising rice establishment methods and N management for rice-greengram system

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ABSTRACT

Field experiments were conducted during two consecutive *Kharif* and *Rabi* season of 2014-15 and 2015-16 on sandy clay loam soils at agricultural research station Ragolu. The trial was conducted in split plot design with three replications. Main plots consists four crop establishment methods viz., dry direct sown rice, sowing by Drum Seeder, machine planting, and normal transplanting. Sub plots consists four N management practices viz., N @80 kg ha^{-1}, N @120 kg ha^{-1}, N @120 kg ha^{-1} (66% fertilizer+33% thro' organic), N @120 kg ha^{-1} + FYM @ 10 t ha^{-1}. Results revealed that, among different crop establishment methods, machine transplanting proved as productive, Dry direct seeding emerged as remunerative and water productive method for rice. Regarding nutrient management, application of 120 kg N ha^{-1} +FYM @ 10 t ha^{-1} proved to be effective N management option for realizing higher yield in rice and fallow green gram. Regarding system yield and system profits, dry direct sown rice-Green gram system and machine planted rice-greengram systems with application of 120 kg N ha^{-1} + FYM @10 t ha^{-1} proved superior.

Key words: *Rice establishment methods, N management, Greengram, Economics, Water productivity*

Introduction

Rice is grown to the extent of 43.9 m ha with a production of 108 mt of rice with a productivity of 2494 kg ha^{-1} in India. In Andhra Pradesh, it is grown in an area of 2.152 m ha with a production of 8.05 m t and productivity of 3741 kg ha^{-1} (Ministry of Agriculture, Govt of India, 2018-19). Further, there is an urgent need to produce 42% more rice by 2025 to assure self sufficiency of rice availability in India with the diminishing resources and reduced factor productivity of rice cultivation. Growing more rice with reduced cost of production and maintaining soil health are the major concerns of rice farming.

Promising method of crop establishment is essential for efficient use of resources and attaining desired level of productivity in rice. Rice establishment through manual transplanting is laborious involving drudgery, requires lot of energy and becoming costly affair due to increasing cost and shortage of labour for performing field operations bedsides it influences the soil aeration, farm operations and reduce yields and profits of rice based cropping systems. Searching for alternative methods of rice establishment is imperative to improve productivity and returns of rice based cropping systems. Direct sowing of dry seed, sowing of sprouted seed on to the prepared seed bed using drum seeder and machine transplanting are some of the emerging alternative methods of crop establishment which require less labour and water with less time and energy requirement compared to conventional practice of manual transplanting.

As nitrogen is considered as the king pin of rice

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nutrition, optimum nitrogen management is highly essential to realize the full potential of improved methods of crop establishment because of variations in N dynamics under different establishment methods. Rice – greengram (cereal – legume) sequence is an age old and the best cropping sequence followed in Andhra Pradesh. Therefore a study was under taken to find out productive and remunerative and less water required rice establishment system with optimum N management to make rice based cropping more profitable and sustainable.

Materials and Methods

Field experiments were conducted during two consecutive *Kharif* and *Rabi* season of 2014-15 and 2015-16 at agricultural research station Ragolu, which is geographically situated at 18.24°N latitude, 83.84 °E longitude and at an altitude of 27 meters above mean sea level in North Coastal Zone of Andhra Pradesh, India. The soil was sandy clay loam having pH 7.2, organic carbon 0.45%, available N of 237 kg ha^{-1}, available P_2O_5 34 kg ha^{-1} and available K_2O of 264 kg ha^{-1}. The trial was conducted in split plot design with three replications. Main plots consists four crop establishment methods *viz.*, dry direct sown rice (DDS), Sowing by Drum Seeder, machine planting, and normal transplanting. Sub plots consists four N management practices viz., N@80kg ha^{-1}, N@120kg ha^{-1}, N@120kg ha^{-1} (66% fertilizer+33% through organic), N@120kg ha^{-1} +FYM @10t $ha^{-1.}$ Cultivars used in the study for rice and greengram were MTU 1001 and LGG 460 respectively. Standard and recommended cultural and plant protection measures followed for respective establishment methods as per the treatments. 24-day old seedlings were planted at a spacing of 15 X 15 cm with 2-3 seedlings per hill. Weed control measure were taken up by application of pre emergence herbicide pretilachlore @ 0.75 kg *a.i* per hectare followed by one hand weeding at 40 days after transplanting. Water level in the crop was maintained at a depth of 2 cm up to panicle initiation and 5 cm thereafter up to one week before harvest. The field was drained before application of fertilizers and one week before harvest. Fertilizers were applied as per the treatment through Urea, single super phosphate (SSP), Muriate of potash (MOP). Entire P & K and 1/3 recommended N was applied as basal, remaining N was applied in two splits at active tillering and panicle initiation. Zinc Sulphate @ 50 kg ha^{-1} was applied as basal dressing. Greengram pre-germinated seed sown as fallow crop in standing rice at one week before harvest. The experiments received uniform plant protection and cultural management practices throughout the period of crop growth. Data on growth, yield attributes and yield were collected following standard procedures from 10 randomly marked hills. Economic parameters like gross returns, net returns and rupee returned per rupee invested were worked out treatment–wise taking prevailing market rates for different inputs and out puts. Water was measured using Water meters and Parshall flume Data were analyzed using ANOVA and the significance was tested by Fisher's least significance difference (p= 0.05) by pooling two years data.

Results and Discussion

Crop establishment Methods

The two years pooled data revealed that, among different crop establishment methods of rice during *kharif*, drum seeding produced more number of tillers as well as panicles m^{-2} followed machine planting. The increase in number of panicles m^{-2} under drum seeding might be due to greater plant population rather than tillers $plant^{-1}$. Whereas machine planting recorded significantly higher number of filled grains per panicle, 1000 grain weight, grain yield and straw yield over other methods of crop establishment and the grain yield was 8.44 percent higher compared to drum seeding. Uniform depth of planting with younger seedlings at optimum spacing might have provided optimum growing conditions ultimately resulted into higher yield structure and grain yield. Rao *et al.* (2015) also reported similar results of superior performance of machine planting in terms of yield over rest of the crop establishment methods. There was no measurable difference in grain yield among machine planting, dry direct sowing and transplanting. While among different establishment methods direct sowing by drum seeder resulted lesser grain yield. However, it was at par to dry direct sowing and transplanting. Days to maturity was conspicuously lesser in dry directs own rice followed by drum seeding is a very important result here as it facilitates timely and early sowing of subsequent pulse crop, where time of sowing is very crucial parameter for realizing higher yield and profits. Better root establish-

ment from the day of germination and lack of transplanting shock in direct sowing leads to early maturity than transplanted rice. The growth duration of manual transplanted rice was 8-10 days more than direct-seeded rice, while, it was 4-5 days more in mechanical transplanting than DSR treatments Guruprem *et al.* (2017).

Economics of rice showed that, though the gross returns were higher with machine planting, net returns and B: C ratio was higher with DDS system due to conspicuously lesser cost of cultivation of DDS compared to other establishment systems. The higher gross returns in machine transplanted rice might be due to higher grain and straw yields. These results are in line to the observations of *Rao et al.* (2016). Guru Prem *et al*. (2017) also observed similar findings and found significantly higher net returns and B: C ratio under direct sown rice than manual and mechanical transplanting.

Regarding water requirement and water productivity, DDS method took about 21% lesser water and highly Water productive compared to transplanting. As DDS avoids puddling, more or less rainfed crop up to 45 DAS and reduced duration at the end by a

Table 1. Effect of rice establishment methods and N management on yield attributes and yield of rice

Treatments	Number of tillers m^{-2}	Number of panicles m^{-2}	Filled spikelets/	1000 grain wt.(g) panicle	Grain yield	Straw yield (kg/ha)	Days to maturity (kg/ha)
Crop Establishment methods							
Dry direct sowning	615	445	112	24.68	6162	7137	136
Drum seeding	695	475	112	24.44	5945	6861	137
Machine planting	662	452	122	25.36	6447	7588	143
Transplanted	586	392	120	25.01	6225	7102	142
SE m±	12.66	11.15	2.64	0.39	143	203	1.51
CD(5%)	43.63	42.78	8.24	1.28	492	698	5.2
N management practices							
80kg ha^{-1}	549	411	106	24.34	5444	6267	138
120kgN ha^{-1}	623	450	116	24.93	6280	7242	138
120kgN ha^{-1} (INM)	602	435	118	24.89	6279	7292	140
120kgN ha^{-1} +FYM	656	464	121	25.28	6425	7445	141
SE m±	13.28	10.86	2.09	0.4	199	297	1.92
CD(5%)	38.74	34	6.095	NS	581	868	NS

INM=66% fertilizer+33% thro' organics

Table 2. Effect of rice establishment methods and N management on profitability and water requirement of rice

Treatment	Cost of cultivation (Rs/ha)	Gross Returns (Rs/ha)	Net Returns (Rs/ha)	BCR*	Water Requirement (mm)	Water productivity (Kg ha^{-1} mm^{-1})
Crop Establishment methods						
Dry direct sowning	35849	92362	56513	1.58	983	6.27
Drum seeding	42687	89207	46520	1.09	1001	5.94
Machine planting	46587	96751	50164	1.08	1047	6.16
Transplanted	49737	93123	43386	0.87	1238	5.03
SE m±	1208	2289	1081	0.02	24.13	—
CD(5%)	4168	7896	3728	0.08	83.0	—
N management practices						
80kg ha^{-1}	49150	81561	32411	0.66	—	—
120kgN ha^{-1}	49737	94000	44263	0.89	—	—
120kgN ha^{-1} (INM)	55335	94133	38798	0.70	—	—
120kgN ha^{-1} +FYM	58496	96233	37737	0.65	—	—
SE m±	603	1584	981	0.021	—	—
CD(5%)	1761	4625	2864	0.06	—	—

INM=66% fertilizer+33% thro' organics

week days over transplanting resulted into reduced water requirement of the method. These findings are well supported by the results of Rao *et al.*, (2016) who reported that higher water productivity with dry direct sown rice compared to machine planting and transplanting.

Residual effect of different establishment methods showed marked variation on all yield attributes and yield of succeeding Greengram. Plant height, number of branches and pods plant^{-1}, number of seeds pod^{-1} , 1000 seed weight and seed yield was the highest when sown as rice fallow pulse after *kharif* dry direct sown rice and it was significantly superior over other crop establishment methods of rice. As crop established on non puddle soil and a bit early with dry direct sown method of rice establishment might have resulted in favourable conditions for greengram. These findings are in corroboration with the results of Amara jyothi *et al.* (2020).

Regarding system yield and system profits, DDS rice- Green gram system and machine planted rice-greengram systems proved superior. Murthy *et al.* (2015) reported similar findings of superior performance of alternate systems of rice establishment on productivity of rice pulse system. Similarfindings of superior performance of DDS rice- greengram system and machine planted rice-greengram systems over other rice establishment methods has been reported by Rao *et al.* (2016).

N management

Among N management practices studied, application of 120 kgN ha^{-1} +FYM @10t ha^{-1} recorded significantly more number of tillers as well as panicles m^{-2}, higher number of filled grains per panicle, 1000 grain weight, grain yield and straw yield of rice over N @ 80 kg ha^{-1} however, it was found on par to N @ 120 kgN ha^{-1} and 120 kgN ha^{-1} (66% thro' fertilizer+33% through organic). The increase in growth and yield structure with increasing level and integrated use of nitrogen might be due to continuous supply of adequate nitrogen to the crop which could suggest that nitrogen nutrition is important for both source and sink development. These results are in confirmation with the findings of Amarajyothi *et al.*2018 in rice.

Though the application of N@120 kgha^{-1} +FYM @10t ha^{-1} resulted higher gross returns of *kharif* rice and system as well, application of N@120 kgha^{-1} recorded markedly higher net returns and B: C ratio. Incremental dose of nitrogen possibly with integrated approach has resulted in a steady and progressive increase in grain and straw yields with consequent increase in gross and net returns as well as B:C ratio, indicating the potential advantage of nitrogen application to rice crop to the level of adequacy. These results are in agreement with Amarajyothi *et al.*, 2018.

Residual effect of N application revealed that, application of N@120kgha^{-1} +FYM @10t ha^{-1} recorded significantly higher plant height, number of branches and pods plant^{-1}, number of seeds pod^{-1}, 1000 seed weight and the highest seed yield of greengram followed by integrated use of 120kgN

Table 3. Effect of rice establishment methods and N management of rice on yield attributes and yield of succeeding Greengram.

Treatment	Plant height (cm)	No of branches plant^{-1}	Pods plant^{-1}	Seeds pod^{-1}	1000 seed Wt (g)	Seed Yield (Kg/ha)	Days to maturity
Crop Establishment methods							
Dry direct sowning	48.55	5.00	16.04	11.32	40.65	794	62
Drum seeding	46.75	4.35	14.37	9.9	39.87	704	64
Machine planting	47.15	4.40	14.72	10.27	39.84	728	65
Transplanted	45.87	4.10	14.06	9.77	39.42	686	65
SE m+	1.03	0.21	0.36	0.28	0.73	19.97	1.57
CD(5%)	NS	0.72	1.26	0.96	NS	59	NS
N management practices							
80kg ha^{-1}	45.83	3.83	13.39	9.49	38.57	644	63
120kgN ha^{-1}	46.95	4.53	14.50	10.01	39.83	711	63
120kgN ha^{-1} (INM)	47.51	4.67	15.01	10.49	40.39	747	65
120kgN ha^{-1} +FYM	47.97	4.79	16.28	11.26	40.99	811	65
SE m+	1.11	0.23	0.47	0.345	0.795	22.75	1.61
CD(5%)	NS	0.66	1.375	1.005	2.33	66.3	NS

INM=66% fertilizer+33% thro' organics REY=Rice equivalent yield

Table 5. Effect of methods of rice establishment and N management on performance of rice-greengram system

Treatment	REY of Greengram (kg/ha)	System yield (kg/ha)	Gross Returns (Rs/ha)	Net Returns (Rs/ha)	BCR*	Systm duration
Crop Establishment methods						
Dry direct sowning		3403	9565	140002	76402	1.20
198						
Drum seeding	3017	8962	131447	61009	0.87	201
Machine planting	3118	9563	140401	66064	0.89	208
Transplanted	2940	9165	134283	56796	0.73	207
SE m±	86	169	2164	1226	0.02	3.11
CD(5%)	252	582	7487	4231	0.07	NS
N management practices						
80kg ha^{-1}	2760	8204	120201	43301	0.56	201
120kgN ha^{-1}	3045	9325	136630	59143	0.76	203
120kgN ha^{-1} (INM)	3199	9478	138923	55838	0.67	205
120kgN ha^{-1} +FYM	3474	9898	144863	58616	0.68	205
SE m±	98	297	2309	1182	0.017	3.03
CD(5%)	284	866	6743	3450	0.05	NS

INM=66% fertilizer+33% thro' organics REY=Rice equivalent yield

ha^{-1} (66% thro'fertilizer+33% through organic). Though the application of N@120kgha^{-1} +FYM @10t ha^{-1} resulted higher gross returns of *kharif* rice and system as well, application of N@120kg ha^{-1} recorded markedly higher net returns and BC ratio. The favourable performance of residual effect of fertilisers might be due to prolonged availability of nutrients in such treatments. Similar results are also reported by Prathibhasree *et al.* (2016) and Amarajyothi *et al.*, 2020.

Conclusion

Among different crop establishment methods, machine transplanting proved as productive, dry direct seeding (DDS) emerged as remunerative and water productive method for rice and rice-greengram system. Regarding nutrient management application of 120kgN ha^{-1} +FYM @10t ha^{-1} proved to be effective N management option for realizing higher rice and fallow green gram.

References

Amara Jyothi, P., Martin Luther, M., Upendra Rao, A., Narasimha Rao, K.L. and Ratna Prasad, P. 2018. Evaluation of Crop Establishment Techniques and N Levels on Growth and Yield of Rice. *The Andhra Agric. J.* 65 (2) : 290-296.

Amara Jyothi, P., Martin Luther, M., Upendra Rao, A. and Mounika, B. 2020. Effect of Crop Establishment Techniques and N Levels of Rice on SYSTEM Productivity and Economics of Rice- Greengram System. *Int. J. Curr. Microbiol. App. Sci*. 9(6): 487-493.

Guru Prem, Rakesh Choudhary, Amit Kumar, Ramesh Jhorar and Singh, V.D. 2017. Recent production technologies of rice (*Oryza sativa* L.) for its sustainable cultivation in Haryana. *International Journal of Agricultural Sciences.* 13(1): 83-92.

Ministry of Agriculture, Government of India. 2018-19 https://www.indiastat.com/default.aspx.

Murthy, K.V.R., Rao, A.U. and Visalakshmi,V. 2015. Influence of rice establishment systems on the productivity of rice-pulse system in North Coastal Zone of Andhra Pradesh. (In) Abstract of papers *International Rice Symposium held* From 18-20 November 2015 at Hyderabad.pp.443.

Prathibha Sree, S., Raghavaiah, R.V., Subbaiah, G., Ashoka Rani, Y. and Sreenivasa Rao, V. 2016**.** Growth, yield attributes, yield and nutrient uptake of rice (*Oryza sativa*) as influence by organic manures and zinc supplementation at different nitrogen levels. *The Andhra Agricultural Journal.* 63(1) : 34-39.

Rao, A.U., Murthy, K.V.R., Visalakshmi, V., Kumar, K.M. and Rao, N.V.G. 2015. Evaluation of establishment methods for productivity and profitability of rice cultivation. (In) Abstract of papers *International Rice Symposium held* From 18-20 November 2015 at Hyderabad.pp.58

Rao, A.U., Visalakashmi, V., Kumar, K.M. and Rao, N.V.G. 2016. Evaluation of establishment methods and N management in rice. In: Extended summaries of *4th International Agronomy Congress*, held during Nov, 22-26, 2016, at New Delhi, India. PP.1188.