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Effect of Nitrogen Scheduling On Yield and Yield Attributing Characters in Rice under Different Establishment Methods

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ABSTRACT

A field experiment was conducted at Research Farm of Dr. Rajendra Prasad Central Agricultural University, Pusa- Bihar during kharif 2015 to assess the effect of nitrogen scheduling on yield and yield attributing characters in rice under different establishment methods in split plot design. The factors under study comprised the effect of nitrogen scheduling viz. LCC based and splitting of N along with slow release N fertilizer and crop establishment methods viz. transplanting, direct seeded rice (DSR) dry and wet. Among different rice establishment methods, transplanting method registered the maximum grain yield (39.11 q ha^{-1}) which remain comparable to DSR-wet. Under different nitrogen scheduling, LCC-4 recorded maximum grain yield (44.12 q ha^{-1}) and it was significantly superior to rest of the treatments except neem coated urea. However, an appraisal of data indicated that different rice establishment system didn't produced significant effect on yield attributing characters of rice. With regard to nitrogen scheduling yield attributing characters was significantly superior over the control. The maximum, test weight was recorded under N_5 – NCU (100% B) (21.63 g), harvest index N_5 – NCU (100% B) (43.01 %), number of panicles m^{-2} LCC-4 (252), number of grains panicle^{-1} N_2 – LCC-4 (117), panicle length N_2 – LCC-4 (27.83 cm), panicle weight N_2 – LCC-4 (2.82 g) and grain weight panicle^{-1} N_2 – LCC-4 (2.51 g) during the experiment.

Key words: *Nitrogen scheduling, Transplanting, Direct seeded rice, Neem coated urea, LCC.*

INTRODUCTION

Rice is traditionally grown by transplanting seedlings into puddled soil. Puddling benefits rice by reducing water percolation losses, controlling weeds, facilitating easy seedling establishment, and creating anaerobic conditions to enhance nutrient availability. But, repeated puddling adversely affects soil physical properties by destroying soil aggregates, reducing permeability in subsurface layers, and forming hard-pans at shallow depths1. Traditionally, transplanting seedlings entails lot of expenditure on raising nursery, uprooting and transplanting. Scarcity of labour during peak period of transplanting and rising labour cost necessitate the search for an alternative to conventional method of transplanting.

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Direct seeded rice (DSR), being a cost effective, consumes less water and labour saving crop establishment method, is becoming popular[2]. Direct seeding methods can be categorized as wet seeding (pre-germinated seeds) and dry seeding. In wet seeding, pre-germinated seeds are sown into puddled and levelled field which are free from standing water and in dry seeding; dry rice seeds are drilled or broadcast on unpuddled soil either after dry tillage or zero tillage or on a raised bed. DSR is efficient resource conservation technology which saves the labour to the extent of about 40% and water up to 60%[3].Nitrogen (N) is typically the nutrient that most often limits rice yields and hence the nutrient needed in largest quantity among the fertilizer. The fertilizer N recovery efficiency has been found to be around 30-40 % in rice with the current practices[4]. Low recovery is attributed to various losses *via.* ammonia volatilization, denitrification, run off and leaching. The main reason of low nitrogen use efficiency is inefficient splitting of N application, including the use of N in excess to the requirement[5]. Use of N fertilizer at higher dose as well as at wrong time makes plants succumb to lodging, and attractive to insect, pests and diseases. Several soil and agronomic approaches, such as split application of N, use of nitrification inhibitor, slow release N-fertilizer etc., has been evolved to reduce the losses and increase the recovery efficiency of N. Modification in fertilizer management practices can lead to reduced losses of N and increased fertilizer N use efficiency. Oil derived from seeds of neem (*Azadirachta indica*) contains melicians (generally known as neem bitters) of which *Epinimbin*, *Deacetyl*, *Salaninand* and *Azadirachtin* are the active ingredients, which showed nitrification inhibition action. The objective of using nitrification inhibitor is to control leaching of nitrate by keeping nitrogen in the ammonium-N form longer, to prevent denitrification of nitrate-N and to increase the efficiency of nitrogen applied. However, rice plant require sufficient N at early and mid-tillering stage to achieve an adequate yield attributes *viz.* number of panicles, grain numbers per panicle. There is need to measure N requirement of crop at different critical stages of growth. Real time corrective N management is based on periodic assessment of plant nitrogen status and the appearance of nitrogen deficiency symptoms especially on leaves. Thus, the key ingredient for real time N management is a method of rapid assessment of leaf nitrogen content that is closely related to the photosynthetic rate and biomass production and is a sensitive indicator of changes in crop nitrogen demand within a growing season. Recently, it has become possible to quickly and non-destructively quantify spectral characteristics of leaves, which can be used to diagnose plant N deficiency and in-directly, to correct N fertilization and improve N-use efficiency in rice crop. Thus, Leaf colour chart (LCC) has been found an effective, inexpensive and easy-to-use tool for monitoring the greenness of plant and providing a quick estimate of leaf N status and highly useful to synchronize fertilizer N application with crop demand[3]. Keeping above facts in view, the present investigation entitled Effect of nitrogen scheduling on yield and nitrogen use efficiency in rice under different establishment methods.

MATERIAL AND METHODS

A field experiment was carried out at the Research Farm of Dr. Rajendra Prasad Central University, Pusa, Samastipur, Bihar (India), during *kharif* season of 2015. The soil of experimental field was calcareous clay-loam alkaline in reaction with pH 8.6. It was moderately fertile being low in organic carbon (0.36%), available nitrogen (212 kg N ha^{-1}), phosphorous (17 kg P_2O_5 ha^{-1}) and potassium (103 kg K_2O ha^{-1}). The factors under study comprised of (A) Establishment methods (3 levels): M_1- Transplanting, M_2- DSR-dry and M_3- DSR-wet in main plot and (B) Nitrogen Scheduling (6 levels): N_1- LCC-3, N_2- LCC-4, N_3- LCC-5, N_4- RDN (120 kg N ha^{-1}) (50% B + 25% AT + 25% PI), N_5- Neem coated urea (100 % B) and N_6- Control in sub plot. The experiment was conducted in split plot design replicated thrice. 'Rajendra Suwasani' was taken as a test crop. 60 kg P_2O_5, 40 kg K_2O and 25 kg $ZnSO_4$ per hectare was used. Nitrogen was applied as per treatment. Whereas, full dose of P_2O_5 and $ZnSO_4$ was applied as basal at the time sowing/transplanting. K_2O was applied in two splits 75% as basal and 25% at panicle initiation stage.

RESULT AND DISCUSSION

Yield

The higher grain yield was recorded in transplanted method (39.11 q ha^{-1}) which was comparable to wet direct seeding (36.56 q ha^{-1}). This might be ascribed to the availability of more nutrients, light, space, moisture as puddling also restrict percolation losses. Lesser plant competition within row might be also the reason. This impact has made it possible to record more number of tillers m^{-2} with heavier panicles contributing to higher grain yield with transplanting method. Higher grain yield under transplanting method were also reported by Mallaredd and Padmaja[6]. The poor yield in dry direct seeded rice (35.79 q ha^{-1}) was because of higher loss of water by the way of seepage and percolation along with the leeching of nitrogen with percolating water resulting in poor growth. These results are in accordance with the findings of Ram *et al*.[7]. Application of nitrogen in split doses with LCC-4 (44.12 q ha^{-1}) up to late growth stages registered higher grain yield, however it was at par with grain yield with neem coated urea (43.94 q ha^{-1}). The increased availability of nitrogen at distinct physiological phases would have supported for better assimilation of photosynthates towards grain and also due to the favourable effect of accelerating the yield attributes. Similar finding have been reported by Sen *et al*.[8]. Straw yield is the amount of photosynthates not converted to economic yield. Like grain yield, straw yield also differed significantly due to different establishment methods. Transplanting method recorded higher straw yield (52.48 q ha^{-1}). This might be due to increased production of tillers m^{-2}, plant height and length of panicle which ultimately contributed to increased straw yield. Similar results were found by Mhaskar *et al.*[9] .In case of nitrogen scheduling higher straw yield (58.27 q ha^{-1}) was recorded with LCC-4 and it was comparable to neem coated urea (58.00 q ha^{-1}) due to its slowly and steady supply of nitrogen upto late growth phases. These results were in accordance with the results of Mahajan *et al.*[10].

Yield attributing characters

Yield attributing characters *viz*. panicles m^{-2}, number of grains $panicle^{-1}$, panicle length (cm), panicle weight (g), grain weight $panicle^{-1}$ (g) and 1000-grain weight (g) didn't reach to the level of significance due to different establishment method. Maximum values of yield attributes were recorded under M_1-Transplanting. This might be due to profused tillering and better availability of space, nutrients and light. These results are in accordance with the findings of Mallareddy and Padmaja[6].Yield attributing characters were positively influenced by different nitrogen scheduling during the year of experimentation. Maximum values of yield contributing characters except 1000-grain weight was registered with N_2- LCC-4 (21.58). This might be due to steady supply of nitrogen in split doses at different growth stages. The nitrogen absorbed by plant from tillering to panicle initiation helped to increase the number of panicle. Similar results was also notified by Budhar[11]. The number of grains $panicle^{-1}$, panicle weight and grain weight $panicle^{-1}$ were generally associated with panicle length, which has been favourably affected in present study. Number of grain $panicle^{-1}$, panicle weight and grain weight $panicle^{-1}$ depends on the efficient translocation of photosynthates from source (leaf) to sink. Higher the translocation of photosynthates more will be number of grain $panicle^{-1}$, panicle weight and grain weight $panicle^{-1}$. Significance difference in number of grain $panicle^{-1}$, panicle weight and grain weight $panicle^{-1}$ has been registered. This might be due to slow and steady availability of nitrogen to the plant. The adequate availability of nitrogen during the late growth stages (panicle initiation to flowering) increased the number of grain panicle^{-1}. Similar results were also reported by Satpute *et al.*[12] 1000-grain weight is partially a genetic character however, nutrient status and physiological conditions may affect. Although, nitrogen scheduling practices showed a tendency to increase 1000-grain weight significantly. This increase in 1000-grain weight may be due to better nutrition of spikelets with neem coated urea which was comparable to LCC-4. Similar results were also obtained by Jaiswal and Singh[13].

Table 1: Effect of nitrogen scheduling on yield and Yield attributes in rice under different establishment methods

Treatments	Straw yield (q ha^{-1})	Grain yield (q ha^{-1})	1000-grain weight (g)	Harvest index (%)	Panicles m^{-2}	Number of grains panicle^{-1}	Panicle length (cm)	Panicle weight (g)	Grain weight panicle^{-1} (g)
Establishment methods									
M_1 – Transplanting	52.48	39.11	21.12	42.62	235	108	27.01	2.65	2.30
M_2 - DSR-Dry	47.46	35.79	21.21	42.91	222	103	26.81	2.38	2.06
M_3 - DSR-Wet	48.94	36.56	21.24	42.74	225	106	29.90	2.47	2.13
SEm ±	0.90	0.98	0.36	0.29	6.08	2.34	0.31	0.13	0.13
CD $_{(P=0.05)}$	2.73	2.94	NS	NS	NS	NS	NS	NS	NS
Nitrogen scheduling									
N_1 – LCC-3	45.29	33.37	20.86	42.73	213	106	27.0	2.39	2.12
N_2 – LCC-4	58.27	44.12	21.58	43.09	252	117	27.83	2.82	2.51
N_3 – LCC-5	52.81	38.82	21.53	42.37	225	104	27.23	2.40	2.13
N_4 – RDN	54.41	41.11	21.50	43.04	239	114	27.49	2.75	2.3
N_5 – NCU	58.00	43.94	21.63	43.10	243	113	27.06	2.82	2.33
N_6 – Control	28.97	21.14	20.05	42.20	192	78	25.30	1.82	1.54
SEm ±	0.89	0.95	0.35	0.30	6.01	2.32	0.30	0.12	0.12
CD $_{(P=0.05)}$	2.67	2.80	1.01	0.87	17.65	6.74	0.89	0.37	0.34

CONCLUSION

Among different method of rice establishment, transplanting method recorded the maximum yield and yield attributing characters while remained comparable to wet direct seeding. However, Leaf colour chart (LCC) critical value 4 registered significantly maximum yield and yield attributing characters indicating better utilization of applied nitrogen compared with the other nitrogen management practices.

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