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Response of levels and split application of nitrogen on yield and economics in pre-monsoon established rice (*Oryza sativa* L.)

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Abstract
Direct seeded rice is a system of cultivation gaining importance under water constraint situations and research on optimum dose and time of nitrogen application is timely warranted. In the present study, the research results concluded that direct seeded rice responded up to 150 kg ha^{-1} nitrogen with five splitting of nitrogen. The highest grain yield (38.73 q ha^{-1}), cost of cultivation (23410 Rs. ha^{-1}), gross return (Rs. 56603 ha^{-1}), net return (Rs. 33193 ha^{-1}) and B:C ratio (2.42) was obtained from 150 kg ha^{-1}. Similarly in case of splitting of nitrogen, highest grain yield (39.59 q ha^{-1}), cost of cultivation (23272 Rs. ha^{-1}), gross return (Rs. 57798 ha^{-1}), net return (Rs. 34526 ha^{-1}) and B:C ratio (2.48) was recorded under five splitting of nitrogen i.e. S_6 (20:20:20:30:10 at 10-12, 20, 40, 60, DAS & flowering). Rate of nitrogen @ 100 kg N ha^{-1} with three splitting i.e. S_1-3 Splits (20:50:30 at 0, 30, 60 DAS) gives lower results as compare to other treatments. Application of nitrogen at 10 DAS observed higher grain yield as compared to basal application at respective levels of splitting. Thus, nitrogen application of 150 kg N ha^{-1} in six splits - (20:20:20:30:10 at 10-12, 20, 40, 60, DAS & flowering) is considered a suitable nitrogen management technique in direct seeded rice cultivation at Raipur (C.G.).

Keywords: pre-monsoon, *Oryza sativa* L

Introduction
Rice is the staple food for about 50 per cent of the world's population that live in Asia. On a global basis, rice ranks second only to wheat in terms of area harvested, but in terms of its importance as a food crop, rice provides more calories ha^{-1} than any other cereal food. Recently, there is an increasing scarcity of fresh water for agriculture particularly for rice cultivation due to decline in water levels in one hand and the demand of water to industries and other sectors on the other hand threatens the sustainability of the irrigated rice ecosystem. In this context the system of "direct-seeding" of rice has several advantages over transplanting rice system.

Nitrogen is the key element in the production of rice and gives by far the largest response. It is also a fact that improper use of nitrogenous fertilizer, decreasing the yield advantage. Again different time of splitting may have varying responses to N-fertilizer depending on their agronomic traits. Required optimum N rate varies with soil type, yield potential of cultivar, levels of phosphorus (P) and K in the soil, water management practices, and intensity of diseases, insects, and weeds. However, rate of fertilizer application is also governed by socio-economic factors. Such factors are production cost, economic situation of the farmers, efficiency of extension service, and availability of credit to the growers. Use of adequate N rate is important not only for obtaining maximum economic return, but also to reduce environmental pollution (Fageria and Baligar 2003) [2].

For maximization of rice yield agronomic management is highly important. Among the management practices, soil fertilization, particularly nitrogen management is the most important. The scientific information on option for nitrogen management in pre-monsoon established rice under irrigated condition needs to be workout for higher productivity and efficiently utilization of nitrogen, which will be helpful to lower the cost of cultivation.

Materials and Methods
An experiment was conducted at the Agronomy Field Laboratory, Indira Gandhi Agricultural University, Raipur (C.G.) during *kharif* season of 2015. To determine the different levels and splitting of nitrogen on the yield and economics of direct seeded rice.

The plot was ploughed and prepared well by using MB plough, plankar and leveler. Phosphorus and Potassium were applied as per recommendation in each plot at the time of final land preparation and were mixed thoroughly with soil. The treatments comprised of three levels of nitrogen under factor- i.e. 100 kg ha^{-1}, 125 kg ha^{-1} and 150 kg ha^{-1} and six levels of time of application of nitrogen under factor-II i.e. S_1-3 Splits (20:50:30 at 0, 30, 60 DAS), S_2-3 Splits (20:50:30 at 10-12, 30, 60 DAS), S_3-4 Splits (20:25:25:30 at 0, 20, 40, 60 DAS), S_4-4 Splits (20:25:25:30 at 10-12, 20, 40, 60 DAS), S_5-5 Splits (20:20:20:30:10 at 0, 20, 40, 60, DAS & flowering) and S_6–5 Splits (20:20:20:30:10 at 10-12, 20, 40, 60, DAS & flowering). The experiment was conducted using split-plot design with three replications. Rice variety "Rajeshwari (IGKV-R1)" was grown as a test crop. Test crop was sown on June 14, 2015. The crop was harvested when 90% of the seeds became golden yellow in color. Grains were sun dried and moisture content of 14% was adjusted to estimate in grain yield. The cost of cultivation (Rs.ha^{-1}) of each treatment was calculated considering the current charges of agricultural operations and market price of inputs involved. Gross returns, net returns and B:C ratio were obtained by converting the harvest (grain and straw) into monetary terms at the prevailing market price during the course of studies for each treatments.

Net return (Rs. ha^{-1}) = Gross return (Rs. ha^{-1}) – Cost of cultivation (Rs. ha^{-1})

Benefit: cost ratio = Gross returns (Rs. ha^{-1}) / Cost of cultivation (Rs. ha^{-1})

Results and Discussion

The yield of pre-monsoon established rice was significantly affected by levels and splitting of nitrogen. Interaction effect of levels and splitting of nitrogen was found non-significant. Increasing levels of nitrogen increased the grain yield of rice. Application of 150 kg N ha^{-1} produced the highest grain yield (38.73 q ha^{-1}), cost of cultivation (23410 Rs. ha^{-1}), gross return (Rs. 56603 ha^{-1}), net return (Rs. 33193 ha^{-1}) and B:C Ratio (2.42) followed by 125 kg N ha^{-1}. The lowest grain yield (36.76 q ha^{-1}), cost of cultivation (22758 Rs. ha^{-1}), gross return (Rs. 53592 ha^{-1}), net return (Rs. 30834 ha^{-1}) and B:C Ratio (2.35) was recorded under 100 kg N ha^{-1}. Higher grain yield was increased due to dose of nitrogen this was mainly improvement by yield contributing characters like number of panicles m^{-2}, number of grains panicle^{-1} and test weight through better availability of nitrogen to rice plant. Similar results was also found by Reddy *et al.* (2010) [6], Fatehjeet Singh *et al.* (2015) [3] and Prabhakar *et al.* (2010) [5].

The comparison of nitrogen splitting found that nitrogen applied in five splits (S6-20:20:20:30:10 at 10-12, 20, 40, 60, DAS & flowering) produced higher grain yield (39.59 q ha^{-1}), cost of cultivation (23272 Rs. ha^{-1}), gross return (Rs. 57798 ha^{-1}), net return (Rs. 34526 ha^{-1}) and B:C Ratio (2.48) as compared to all other split applications of nitrogen. The lowest grain yield (36.76 q ha^{-1}), cost of cultivation (22897 Rs. ha^{-1}), gross return (Rs. 53637 ha^{-1}), net return (Rs. 30740 ha^{-1}) and B:C Ratio (2.34) was observed under three splitting of nitrogen (S1-20:50:30 at 0, 30, 60 DAS).

Application of nitrogen in splits according to crop requirement caused not only decreased the loss of nitrogen but also increased the nitrogen absorption and better utilization of applied nitrogen leads to higher yield attributes and finally resulted in higher grain yield and this may causes of found higher gross return, net return and B:C ratio. This was in accordance with findings of Balasubramanian *et al.* (2002) [1], Singh and Thakur (2007) [7] and Nair *et al*. (2000) [4].

Table 1: Effect of nitrogen levels and splitting on grain yield and economics of pre- monsoon established rice

Treatments	**Rice**				
	Grain yield (q ha^{-1})	**Cost of cultivation (Rs. ha^{-1})**	**Gross return (Rs. ha^{-1})**	**Net return (Rs. ha^{-1})**	**B:C ratio**
Nitrogen levels (kg ha^{-1})					
N1-100	36.76	22758	53592	30834	2.35
N2-125	37.79	23084	55124	32040	2.39
N3-150	38.73	23410	56603	33193	2.42
SEm±	0.30				
CD (P=0.05)	1.18				
Nitrogen splitting					
S1 – 3 Splits (20:50:30 at 0, 30, 60 DAS)	36.76	22897	53637	30740	2.34
S2 – 3 Splits (20:50:30 at 10-12, 30, 60 DAS)	37.53	23022	54758	31736	2.38
S3 – 4 Splits (20:25:25:30 at 0, 20, 40, 60 DAS)	36.94	23022	53899	30877	2.34
S4 – 4 Splits (20:25:25:30 at 10-12, 20, 40, 60 DAS)	37.74	23147	55084	31937	2.38
S5 – 5 Splits (20:20:20:30:10 at 0, 20, 40, 60, DAS & FL)	37.99	23147	55463	32316	2.40
S6 – 5 Splits (20:20:20:30:10 at 10-12, 20, 40, 60, DAS & FL)	39.59	23272	57798	34526	2.48
SEm±	0.62				
CD (P=0.05)	1.79				

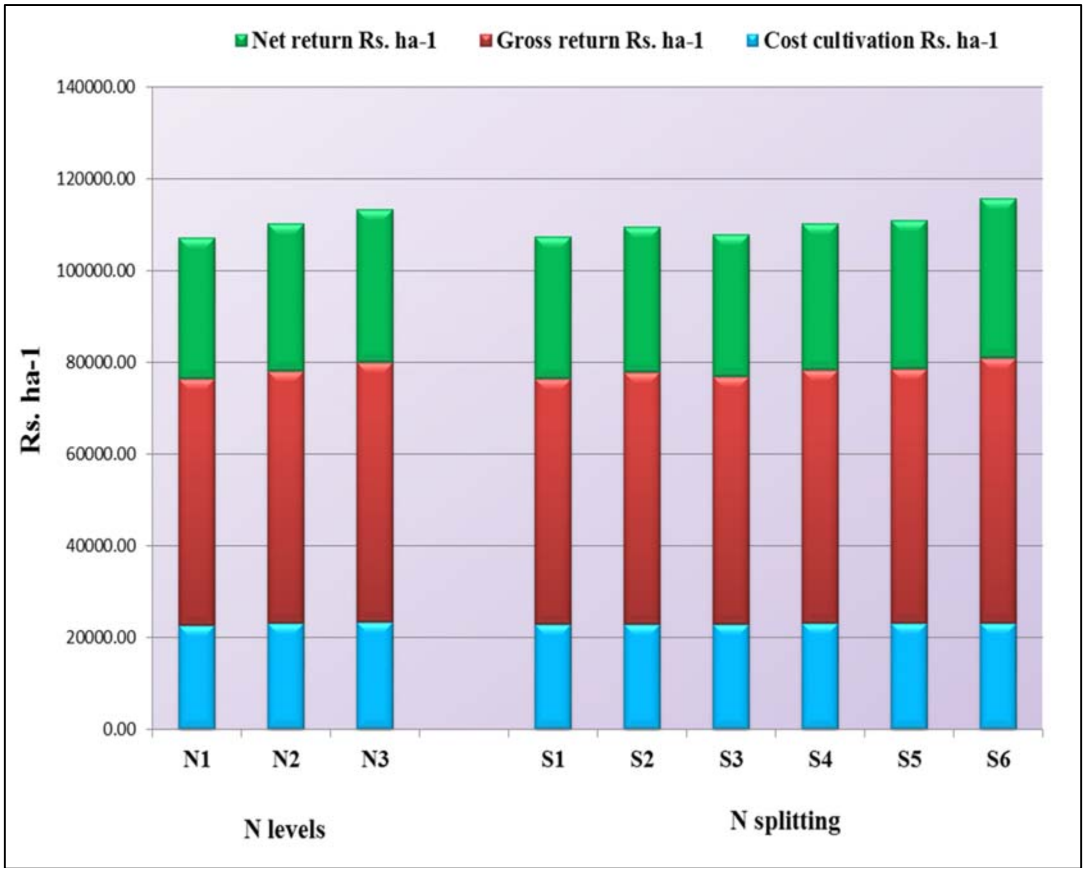

Fig 1: Effect of nitrogen levels and splitting on economics of pre-monsoon established rice.

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