



# Response of foliar feeding of nitrogen at different stages of plant on growth and yield of transplanted rice (*Oryza sativa* L.)

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## ABSTRACT

A field experiment entitled “Response of foliar feeding of nitrogen at different stages of plant on growth and yield of transplanted rice (*Oryza sativa* L.)” conducted during Kharif, 2021-22 at the Research farm of the Department of Agronomy, School of Agriculture Science, Technology & Research, Sardar Patel University, Balaghat (M.P.) A Factorial randomized block design consisted of two factors four levels of nitrogen to foliar spray and three crop growth stages to foliar spray of urea and was replicated three times. The paddy variety, MTU-1010 were tested for this experiment along with these treatments. The treatments were four levels of nitrogen to foliar spray were tested N<sub>0</sub>- control, N<sub>1</sub>= 2.0% urea, N<sub>2</sub>- 3.0% urea and N<sub>3</sub>- 4.0% urea while three crop growth stages viz., S<sub>1</sub>- Seedling stage, S<sub>2</sub>- Tillering stage and S<sub>3</sub>- Panicle initiation stage. The gross and net plot size was 4.40 m x 3.2 m and 4.0 m x 3.0 m, respectively. Recommended doses of 80 kg P<sub>2</sub>O<sub>5</sub> and 60 kg K<sub>2</sub>O per ha were applied in the form of urea, single superphosphate and muriate of potash, respectively. Nitrogen was applied as per treatment. Based upon this experiment it is concluded that the treatment combination consisting of the application of foliar spray of nitrogen through urea @ 4.0 % at the tillering stage recorded the maximum grain yield 48.47 q/ha with total cost of cultivation of Rs. 30076. The treatment combination consisting, application of foliar spray of nitrogen through urea @ 4.0 % at tillering stage recorded the maximum and significantly higher net monetary returns (Rs 83256/ha) and B: C ratio (2.45:1). Hence, application of this treatment combination can be adopted in Eastern plateau and hills Region of India. However, these results are only indicative and require further experimentation to arrive at a more consistent and final conclusion to be passed on to farmers.

**Keywords:** transplanted, rice, tillering, factorial, randomized, panicle.

## INTRODUCTION

Rice (*Oryza sativa* L.) belongs to the family graminaceae is the stable food for nearly three billion people all over the world. In India, rice is the most important and extensively grown food crop, occupying about 40 million tons of rough rice. It is life for more than half of humanity and about 90 % of the world's rice is produced as well as consumed in Asia. About 90% of the all rice grown in the world is produced and consumed in the Asian region. India is the world's second largest rice producer and consumer next to China. To sustain present food self- sufficiency and to meet future food requirements, India has to increase its rice productivity by 3 per cent per annum but the possibility of expanding the area under rice in near future is limited.

Management of nitrogen in paddy, however, needs special care on account of its lower use efficiency under submerged conditions. Though, nitrogen is the most limiting nutrient over the vast rice tracts, yet this has remained the most neglected production factor in rice culture. Nitrogen plays a key role in rice production as it is required in huge amount. Nitrogen (N) is an essential element and a constituent of protoplasm, proteins and chlorophyll. It plays an important role in many physiological and biochemical activities of plant such as the synthesis of nucleotides, phosphatides, enzymes, hormones, and vitamins (Tiwari *et al.*, 2015). Nitrogenous fertilizers applied to soil undergo physical, chemical and biological transformation by enzymes and microbial activity and ultimately become available to crops. Rice plants prefer an ammonical form of nitrogen during the early stage and also utilise nitrate form with equal efficiency during later stage of growth period irrespective of the source *viz.* ammonical, nitrate, amide or organic form (Yawalkar *et al.*, 1996). N is a constituent of numerous important compounds, including amino acids, proteins (enzymes), nucleic acids, chlorophyll, and several plant hormones.

Nitrogen, the key nutrient of rice production is a limiting factor in crop production and accounts for 67 per cent of total nutrients applied to rice (Jayanthi *et al.*, 2007). Nitrogen fertilization a major agronomic practice affects the yield and quality of rice crop. It is required in adequate quantities at early and mid-tillering stages to maximize panicle number and during the reproductive stage to produce optimum spikelets per panicle and to increase the percentage of filled spikelets (Murthy *et al.*, 1992). Nitrogen supply must be available according to the needs of the plant for optimal yield (Fageria and Baligar, 2005). So, managing the application time and rate of nitrogen fertilizer is very important.

If nitrogenous fertilizers are applied in  $\text{NH}_4^+$  form in the lowland rice field then the biological oxidation of  $\text{NH}_4^+$  to  $\text{NH}_3^-$  takes place in the surface aerobic layer. Nitrogen losses from top dressing of fertilizer at 10 days after transplanting may be as high as 20% with most of the ammonium lost in 3 days after application (De Datta, 1981).

Among the alternate methods of plant nutrient application, foliar nutrition of macronutrients is one of the possibilities of improving productivity and increasing fertilizer use efficiency and reduces environmental

hazards. Foliar application of fertilizer is a convenient and effective method of nutrient application for many crops. Foliar feeding targets the growth stages where declining rates of photosynthesis and leveling off of root growth and nutrient absorption occur, in attempts to aid translocation of nutrients into seed, fruit, tuber or vegetative production. Early foliar applications can make an already good crop better, either by stimulating more vigorous regrowth or maximizing the yield potential growth stage period.

A series of work has been done by the several workers of fertilizer trials with a view to determination of fertilizer dose, time of application and methods of application of different chemical fertilizers in different vegetative growth of rice crop. But few works have been done by the research workers on post-flowering nutritional management of rice crop. Several workers reported that foliar application of nitrogen gives higher yield as compared to soil application (Bhowmik, 1968). To overcome losses and promote efficiency, foliar spray is considered and advocated as one of the best alternatives. Application of different nutrients as foliar is economic and minimize the nutritional loss and easy to supply plant nutrients at different stages as per demand of crop.

Combining foliar nitrogen fertilization with reduced rates of soil nitrogen during the growing season can reduce the total nitrogen inputs and the amount of nitrogen runoff during production. Reduced rates of soil nitrogen can lessen excessive vegetative growth, resulting in reduced water requirement, lesser disease insect infestation and hardy plants. Reduced nitrogen in the growing medium during the growing season can also increase root growth relative to shoot growth. Foliar nitrogen fertilization can reduce plant dependence on frequent soil nitrogen application. In many growing regions, fertilizers applied in soil are inefficiently taken up due to low temperatures and high rainfall. Combining foliar nitrogen fertilization with defoliant can increase stored nitrogen and improve plant quality.

## MATERIALS AND METHODS

The experiment was carried out at the Research farm of the Department of Agronomy, School of Agriculture Science, Technology & Research, Sardar Patel University, Balaghat (M.P.). A Factorial randomized block design consisted two factors whereas four levels of nitrogen to foliar spray and three crop growth stages to foliar spray of urea and replicated for three times. The paddy variety, MTU-1010 were tested for this experiment along with these treatments. The treatments were four levels of nitrogen to foliar spray were tested are N<sub>0</sub>- control 0.0%, N<sub>1</sub>= 2.0% urea, N<sub>2</sub>- 3.0% urea and N<sub>3</sub>- 4.0% urea while, three crop growth stages *viz.*, S<sub>1</sub>- Seedling stage, S<sub>2</sub>- Tillering stage and S<sub>3</sub>- Panicle initiation stage. The gross and net plot size was 4.40 m x 3.2 m and 4.0 m x 3.0 m, respectively. Recommended dose of 80 kg P<sub>2</sub>O<sub>5</sub> and 60 kg K<sub>2</sub>O per ha were applied in the form of urea, single superphosphate and muriate of potash, respectively. Nitrogen applied as per treatment.

## RESULTS AND DISCUSSION

The interactive effect of foliar feeding of nitrogen through urea at different crop growth stages were found to be significantly improve plant height at all the growth stages. The significantly higher plant height

of rice was recorded under the treatment combination consisting of the application of foliar spray of nitrogen through urea @ 4.0 % at the tillering stage with the respective values of 55.46, 71.46 and 99.09 cm at the growth stages of 30, 60 and 90 DAT, respectively.

The interactive effect of foliar feeding of nitrogen through urea at different crop growth stages were found to be significantly improve number of tillers per hill at all the growth stages. The significantly higher number of tillers per hill of rice was recorded under the treatment combination consisting of application of foliar spray of nitrogen through urea @ 4.0 % at tillering stage with the respective values of 16.53, 17.87 and 24.87 at growth stage of 30, 60 and 90 DAT, respectively.

So much variations in growth parameters in different growth stages owing to variations probably due to enhanced availability of N in optimum time which resulted in more leaf area that in turn enhanced photo assimilates and thereby resulted in more dry matter accumulation. Such type of observations among the growth stages for nitrogen application have also been reported by Ram *et al.* (2014), Shivay *et al.* (2015), Anand *et al.* (2017), Kumawat *et al.* (2017), Ashvin *et al.* (2018) and Giri *et al.* (2019).

The interactive effect of foliar feeding of nitrogen through urea at different crop growth stages were found to be significantly improve days taken to 50 % flowering. The significant maximum days taken to 50 % flowering of rice was recorded under the treatment combination consisting of application of foliar spray of nitrogen through urea @ 4.0 % at the tillering stage with the respective value of 97.73

Thus, out of these four nitrogen levels, more supply of N (@ 4.0% urea) took significantly more period to reach into 50% flowering as compared to the decreased supply of nitrogen. The main reason was the decreased vegetative growth period under the decreased supply of nitrogen and vice-versa. The fundamental truth has also been supported by Nawlake and Mankar (2009), Sharma (2015), Sudhakara *et al.* (2017) and Para *et al.* (2018).

The interactive effect of foliar feeding of nitrogen through urea at different crop growth stages was found to significantly improve grain yield per hectare. The significantly highest grain yield per hectare of rice was recorded under the treatment combination consisting of the application of foliar spray of nitrogen through urea @ 4.0 % at tillering stage with the respective values of 48.47 q/ha.

The interactive effect of foliar feeding of nitrogen through urea at different crop growth stages was found to be significantly improve straw yield per hectare. The significantly highest straw yield per hectare of rice was recorded under the treatment combination consisting of the application of foliar spray of nitrogen through urea @ 4.0 % at tillering stage with the respective values of 95.01 q/ha. These results confirm the findings of Ghosh *et al.* (2020).

The significantly highest GMR (Rs. 113332.00) and NMR (Rs. 83256.00) as well as B: C ratio (2.45:1) of rice was recorded under the treatment combination consisting of application of foliar spray of

nitrogen through urea @ 4.0 % at tillering stage, respectively proved significantly superior to rest of the treatments.

The net economic gain was secured in accordance with the per hectare yield as well as higher market value with the sale rate of rice variety of the fertility levels with crop growth stages and thereby gross income. Whereas the increasing levels of fertilizer increase the input costs and reduce the net monetary return and Benefit-cost ratio. Similar results reported by Rahman *et al.*, (2017), Hashem (2019) and Jothi *et al.* (2019).

## CONCLUSION

Based upon this experiment it is concluded that the treatment combination consisting of the application of foliar spray of nitrogen through urea @ 4.0 % at the tillering stage recorded the maximum grain yield of 48.47 q/ha with the total cost of cultivation of Rs. 30076. The treatment combination consisting, of the application of foliar spray of nitrogen through urea @ 4.0 % at tillering stage recorded the maximum and significantly higher net monetary returns (Rs 83256 /ha) and B: C ratio (2.45:1). Hence, the application of this treatment combination can be adopted in Eastern plateau and hills Region of India. However, these results are only indicative and require further experimentation to arrive at a more consistent and final conclusion to be passed on to farmers.

## Reference

- Anand Mohan, Ankit Tiwari, Manoj Kumar, Deepak Pandey, Ajay Singh and Bhagwan Singh, 2017. Effect of foliar spray of various nutrients on performance of rainfed rice (*Oryza sativa* L.). *Journal of Pharmacognosy and Phytochemistry*, 6 (5): 2252-2256.
- Ashvin Kumar Meena, DK Singh, PC Pandey and Gangadhar Nanda, 2018. Growth, yield, economics, and nitrogen use efficiency of transplanted rice (*Oryza sativa* L.) as influenced by different nitrogen management practices through neem (*Azadirachta indica*) coated urea. *International Journal of Chemical Studies*, 6 (3): 1388-1395.
- Bhowmik, H.D. 1968. Foliar application of urea for higher crop yield. *Fert. News*, 11 (8): 20-24.
- Datta De, S.K., Mooraw, J.C. and Daysit, R.S. 1981. Nitrogen response and yield potential of some varietal types in the tropical. *Int. Rice Common Newsletter*, 15 (3): 11-23.
- Fageria, N. K. and Baligar, V. C. 2005. Enhancing nitrogen use efficiency in crop plants. *Advances in Agronomy* .88: 97- 185.
- Ghosh Mainak, Dillip Kumar Swain, Madan Kumar Jha, Virendra Kumar Tewari and Abhishek Bohra, 2020. Optimizing chlorophyll meter (SPAD) reading to allow efficient nitrogen use in rice and wheat under rice-wheat cropping system in eastern India. *Plant Production Science*, DOI: 10.1080/ 1343943X. 2020. 1717970.

- Giri Kumar Sambhav, L Nabachandra Singh, Prakash Kumar Sarangi, Priyanka Irungbam, Tabuiliu Abonmai and NurinaShahni, 2019. Effect of nitrogen on growth and yield of direct seeded black aromatic rice (*Oryza sativa* L.). *International Journal of Chemical Studies*, 7 (3): 3494-3496.
- Hashem, I. M. 2019. Studies on the Effect of Foliar Fertilizer Application in Combination with Conventional Fertilizers on Rice Production. *J. Plant Production, Mansoura Univ.* 10 (6): 447 – 452.
- Jayanthi, T., Gali, S.K., Angadi, V.V. and Chimmads, V.P. 2007. Effect of leaf colour chart-based nitrogen management on growth and yield parameters of rainfed rice. *Karnataka Journal of Agricultural Sciences*, 20 (2): 272- 275.
- Jothi, M., P Keerthana, S Gomathi, B Priya, T Ramesh and Rathika, S. 2019. Effect of foliar spray of potassium on rice under sodic soil. *The Pharma Innovation Journal*, 8 (8): 244-247.
- Kumawat, A., Seema, S., Kumar, D., Singh, S., Jinger, D., Bamboriya, S.D. and Verma, A.K. 2017. Effect of irrigation scheduling and nitrogen application on yield, grain quality and soil microbial activities in direct-seeded rice. *International Journal of Current Microbiology and Applied Sciences*, 6 (5): 2855-2860.
- Murthy, P.S.S., Ramesh, K.S., Rao, G.V.H. and Narayanan, A. 1992. Influence of nitrogen on grain-filling potential and yield of rice (*Oryza sativa*) varieties. *Indian J. Agron.* 37 (1): 17-18.
- Nawlakhe, S.M. and Mankar, D.D. (2009). Nitrogen management of scented floe (*Oryza sativa* L.) in Eastern Vidharba Zone of Maharashtra. *Research on Crops*, 10 (3): 481-483.
- Para, P.K. (2018). Performance of rice varieties at different levels of nitrogen under direct-seeded upland conditions. M.Sc. (Ag.) Thesis (Agronomy), JNKVV College of Agriculture, Rewa (M.P.).
- Rahman Mohammad Rashedur, Mohammad Arif Hossain Khan and Iffat Ara Mahzabin, 2017. Efficacy and Economics of Urea Spray Technology for a Locally Discovered Rice Cultivar. *American Journal of Plant Biology*, 2 (4): 136-141.
- Ram, Hardev, Singh, J.P., Bohra, J.S., Singh, Rajiv K. and Sutaliya, J.M. 2014. Effect of seedlings age and plant spacing on growth, yield, nutrient uptake and economics of rice (*Oryza sativa*) genotypes under system of rice intensification. *Indian Journal of Agronomy*, 59 (2): 256-260.
- Sharma, R. (2015). Response of rice genotypes to nitrogen management. *Annals of Plant and Soil Research*, 17 (4): 423-424.
- Shivay, Y. S., Prasad, R. and Pal, M. 2015. Effect of Nitrogen Levels and Coated Urea on Growth, Yields and Nitrogen Use Efficiency in Aromatic Rice. *J. Plant Nutr.* 1532-4087.

Sudhakara, T.M., Srinvas, A., Kumar, R. M., Ram Prakash, T. and Mote Kishore, J. (2017). Productivity of rice as influenced by irrigation regimes and nitrogen management practices under SRI. *Annals of Plant and Soil Research*, 19 (3): 253-259.

Tiwari Sandeep, Kumar Suresh, Zaidi, S.F.A. and Ved Prakash (2015). Response of rice to integrated nitrogen management under SRI method of cultivation. *Annals of Plant and Soil Research*, 17 (1): 106-108.

Yawalhar, K. S., Agrawal, J. P. and Bokde, S. 1996. Commercial nitrogenous fertilizers. *Manure and fertilizers*, 8 (4): 96-97.

**Table 1: Response of foliar feeding of nitrogen at different stages of plant on growth and yield of transplanted rice (*Oryza sativa* L.)**

Treatment	Plant height (cm)	Number of tillers/Hills	Number of leaves/plant	Days taken to 50% flowering	Number of grains/Panicle	Test weight (g)	Grain yield per plot (kg)	B: C ratio
N <sub>0</sub> S <sub>1</sub>	57.11	9.40	18.13	86.93	84.20	19.88	2.81	0.71
N <sub>0</sub> S <sub>2</sub>	60.18	10.87	24.93	88.40	98.47	22.18	3.52	1.09
N <sub>0</sub> S <sub>3</sub>	58.22	9.73	20.60	87.27	85.33	21.20	3.01	0.81
N <sub>1</sub> S <sub>1</sub>	63.61	14.73	28.60	91.13	116.47	23.29	4.16	1.48
N <sub>1</sub> S <sub>2</sub>	67.63	16.33	32.13	92.93	125.67	24.33	4.35	1.64
N <sub>1</sub> S <sub>3</sub>	61.55	11.47	25.00	89.47	102.87	22.57	3.57	1.09
N <sub>2</sub> S <sub>1</sub>	65.44	16.27	29.60	91.87	118.40	23.55	4.19	1.54
N <sub>2</sub> S <sub>2</sub>	68.22	17.07	32.73	94.80	130.27	24.61	5.32	2.19
N <sub>2</sub> S <sub>3</sub>	62.15	11.73	25.67	89.73	110.60	22.79	4.04	1.33
N <sub>3</sub> S <sub>1</sub>	66.67	15.27	31.00	92.67	123.80	22.85	4.28	1.59
N <sub>3</sub> S <sub>2</sub>	71.46	17.87	35.87	97.73	138.73	26.21	5.82	2.45
N <sub>3</sub> S <sub>3</sub>	63.13	12.80	26.60	90.40	112.53	23.03	4.09	1.36
<b>SEm±</b>	<b>0.80</b>	<b>0.38</b>	<b>0.86</b>	<b>0.62</b>	<b>2.14</b>	<b>0.42</b>	<b>0.21</b>	<b>0.12</b>
<b>CD</b>	<b>1.66</b>	<b>0.79</b>	<b>1.78</b>	<b>1.28</b>	<b>4.34</b>	<b>1.18</b>	<b>0.43</b>	<b>0.24</b>