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Evaluating Time of First Split of N Application on the Performance of Transplanted Rice

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Abstract: *Application of first split of nitrogen after one or two weeks after transplanting in transplanted rice can increase the yield and nitrogen use efficiency (NUE.) A field experiment was conducted during kharif 2014 and 2015 at two locations at PAU, Ludhiana (sandy loam) and at RRS Gurdaspur (clay loam) to evaluate the timing of first split of urea application to transplanted rice. In all there were four treatments with different timings of first split of urea application. In first three treatments (T1: First split of nitrogen applied at transplanting, T2: First split of nitrogen applied 1 week after transplanting and T3 first split of nitrogen applied two weeks after transplanting and second and third split of nitrogen was applied at 3 and 6 weeks after transplanting in all the three treatments. In the fourth treatment T4, the three splits (first, second and third) were applied two, three and seven weeks, respectively after transplanting rice. The results revealed that grain yields or N uptake obtained at both the sites were statistically similar. However, there was a yield advantage at both the sites when first split of nitrogen was applied after one or two weeks of transplanting. Likewise the numerical values of number of tillers, panicle length and 1000 grain weight were higher in the corresponding treatments from which higher grain yields were obtained.*

INTRODUCTION

In highly permeable alkaline soils of Punjab, alternating aerobic and anaerobic soil conditions under riceapplied N is readily converted to NO_3 which is prone to leaching lossesand nitrification-denitrification (Aulakh and Bijay Singh 1997; Bijay Singh *et al* 2001). In North-western India, fertilizer N to rice is generally applied in three equal split doses (Bijay-Singh *et al* 2002). Application of first dose of N is recommended to be applied at transplanting and the other two splits at 3 and 6 weeks after transplanting. However, its synchronization with the crop demand needs to be understood thoroughly so as to minimize the N losses from the soil-plant system and thus increasing nitrogen fertilizer use efficiency. Despite considerable research to increase N use efficiency in rice, the recovery efficiency of N fertilizer achieved by rice farmers remained between 30 and 40 % (Bijay-Singh and Yadvinder-Singh 2003).

Improving efficiency of fertilizer N use is vital to sustain high crop yields, achieve high NUE and reduce environmental pollution. Appropriate modification in fertilizer management practices can help in reducing N losses and increase the N use efficiency. Meelu and Gupta (1980) showed that rice seedlings take about 7 days to recover from transplanting shock and it is very likely that most N applied within 7 days after transplanting is not used by plants and is prone to losses. Therefore, excessive N application during early crop growth stages may be avoided and needs to be applied at later stages when the plant requires it most. Peng and Cassman (1998) demonstrated that RE of top

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dressed urea during panicle initiation stage would be as high as78%. These studies reveal that proper time of application of fertilizers can markedly increase the yield, NUE and improve the quality of rice. Given the importance of nitrogen fertilization on the grain yield from the rice plant, it is necessary to know the best time of fertilizer N for maximizing yield and N use efficiency. Present investigation was undertaken to evaluate that how the proper timing of N alters the nitrogen transformations in soil and hence the usefulness of applying first split of fertilizer of N at about 7 to 14 DAT.

MATERIALS AND METHODS

Field experiments were conducted for two years in kharif 2014 and 2015 at Ludhiana on a Typic Ustipsamment (Fatehpur sandy loam) at the experimental farm of the Punjab Agricultural University and at Gurdaspur on a clay loam soil at experimental area of PAU Regional Station in kharif 2015. The climate of Ludhiana is subtropical, semi-arid with an annual rainfall of 750 mm, of which about 80% is received during June to September with mean monthly temperature varying from 29.3 to 33.8°C.

Table 1
Soil analysis

Parameter	*Ludhiana*	*Gurdaspur*
Texture	Sandy loam	Clay loam
pH	7.5	7.3
EC(dS m^{-1})	0.103	0.300
OC (%)	0.52	0.58
Avail. P (kg/ha)	16.0	17.0
Avail. K(kg/ha)	163	240

The climate of Gurdaspur is sub-humid, semi-arid with annual rainfall of 890 mm, of which about 80% is received during June to September with mean monthly temperature varied from 28.1.3 to 33.0°C. The physico-chemical characteristics of two soils (0-15 cm) under study are given in Table 1. The experiments were laid out in a randomized complete block design.

TREATMENTS

During First Year at Ludhiana, Three Treatments

T1: First split of nitrogen applied at transplanting, T2: First split of nitrogen applied 1 week after transplanting and T3 first split of nitrogen applied two weeks after transplanting. The second and third split of N was applied after 3 and 6 weeks after transplanting in all the three treatments. During second year at both the sites, one additional treatment (T4) was kept in which first, second and third split of nitrogen was applied after 2, 3 and 7 weeks after transplanting of rice. The treatments were replicated thrice with a plot size of 30 sq. m. In each treatment a total of 120 kg N ha^{-1} was applied in three equal of 40 kg ha^{-1} each. A basal dose consisting of 26 kg P, 50 kg K and 10 kg $ZnSO_4$ ha^{-1} was applied at the time of puddling.

Thirty five days old seedlings of cultivar PR121 were transplanted at 20 × 15 cm spacing in the fourth week of June. Recommended agronomic practices were followed to grow the crop.

Agronomic parameters like number of tillers per hill, panicle length and 1000 grain weight were recorded and grain and straw yield were recorded at maturity. The grain yield is reported at 14%

Table 2
Effect of time of N application on the performance of transplanted rice during 2014 at Ludhiana

	N application (weeks after transplanting of rice)			*Grain Yield (t ha^{-1})*	*% increase over T1*
Treatment No.	*Ist split*	*2nd split*	*3rd split*		
T1 (Recommended)	At transplanting	3	6	5.70	–
T2	1	3	6	6.17	8.25
T3	2	3	6	6.41	12.4

Table 3
Effect of time of application of urea-N on the grain yield of transplanted rice during 2015

	N application (weeks after transplanting of rice)			Ludhiana		Gurdaspur		Pooled data
Treatment No.	I^{st} split	2^{nd} split	3^{rd} split	Grain yield (t ha^{-1})	Total N uptake (kg ha^{-1})	Grain yield (t ha^{-1})	Total N uptake (kg ha^{-1})	Grain yield (t ha^{-1})
T1	At transplanting	3	6	6.62	123.5	6.46	132.3	6.54
T2	1	3	6	6.90	132.0	7.02	135.1	6.96
T3	2	3	6	6.99	133.4	6.83	129.4	6.91
T4	2	3	7	6.82	137.1	7.03	139.5	6.93
LSD (0.05)	NS	NS	NS	NS	NS			

T1: Recommended dose-120 kg N/ha

moisture content and straw yield on oven dry basis. Oven dried grain and straw samples were analysed for N content. Analysis of variance (ANOVA) was carried out by using CPCS1, software developed by Department of Mathematics and Statistics, PAU, Ludhiana based on the procedure of Cochran and Cox (1966).Least significance difference (LSD) at a 0.05 level of probability was used to test the significance of differences among treatment means.

RESULTS AND DISCUSSIONS

Ludhiana

Year 2014

In 2014, first split of nitrogen (one third of urea) application one and two weeks after transplanting rice produced 8.3 and 12.4 % higher grain yield as compared to application of 1^{st} split of urea at transplanting, respectively (Table 2).

Year 2015

Table 3 indicated that the grain yield obtained in the treatments T2, T3 and T4 was statistically on a par with T1 (recommended practice of applying nitrogen in three equal splits at transplanting, 3 and 6 week after transplanting of rice). Total N uptake by rice in all the treatments was also statistically similar. It suggested that first split of nitrogen can be applied up to 2 weeks after transplanting of rice without any adverse effect on yield and N uptake over the recommended practice.

Gurdaspur site

Like Ludhiana, grain yield and total N uptake of rice obtained in all the treatments were statistically on a par with T1 (Table 3).

Pooled analysis of data showed that grain yield obtained under all the treatments was statistically similar suggesting that first split of nitrogen can be

Table 4
Effect of different treatments on plant parameters during 2015 at Gurdaspur

	N application (weeks after transplanting of rice)			No. of tillers per hill	Panicle length (cm)	1000 grain wt. (g)
Treatment No.	I^{st} split	2^{nd} split	3^{rd} split			
T1	At transplanting	3	6	14.5	21.3	26.4
T2	1	3	6	15.3	22.7	27.0
T3	2	3	6	14.7	21.8	26.6
T4	2	3	7	15.3	22.6	28.3
LSD (0.05)				NS	NS	NS

T1: Recommended dose-120 kg N/ha

applied up to 2 weeks after transplanting of rice. Grain yield was 6.42 % higher under T2 (N applied one week after transplanting) treatment as compared to T1.

Agronomical parameters

There was no significant effect of different treatments on any of the three agronomic parameters (Table 4). There was an increasing trend in panicle length, number of tillers per hill and 1000 grain weight in the treatments where first split of urea was applied at one or two weeks after transplanting as compared to T1.

CONCLUSIONS

First split of nitrogen to transplanted rice can be applied on any day between 0 to 14 days after transplanting. The second and third dose should be applied at 3 and 6 weeks after transplanting, irrespective of the timings of first split of urea applied either at transplanting or on any day up to 14 days of transplanting.

References

Aulakh MS and Bijay-Singh (1997), Nitrogen losses and N-use efficiency in porous soils. *Nutr Cycling Agrosyst*. 47: 197-212.

Bijay-Singh, Bronson KF, Yadvinder-Singh, Khera TS and Pasuquin E (2001), Nitrogen-15 balance as effected by rice straw management in a rice-wheat rotation in northern India. *Nutr Cycl Agroecosyst* 52: 227-37.

Bijay-Singh, Yadwinder Singh, Ladha JK, Bronson KF, Ballasubramanian V, Singh J and khind CS (2002), Chlorophyll chart and leaf colour chart based nitrogen management for rice and wheat in north western India. *Agron J* 94: 821-29.

Bijay-Singh and Yadvinder Singh (2003), Efficient nitrogen management in rice-wheat system in the Indo-Gangetic plains. In: Yadvinder-Singh, Bijay-Singh, Nayyar VK, Jagmohan singh (eds) Nutrient management for sustainable rice-wheat cropping system. National Agricultural Technology Project, Indian Council of Agricultural Research, New Delhi and Punjab Agricultural University, Ludhiana, pp 99-114.

Cochran WG and Cox M (1963), *Experimental Designs.* Asia Publishing House, New Delhi.

Meelu OP, and Gupta RK (1980), Time of fertilizer N application in rice culture. *Int Rice res Newsl.* 5(3): 20-21.

Peng S and Cassman KG (1998), Upper threshold of nitrogen uptake rates and associated nitrogen fertilizer efficiencies in irrigated rice. *Agron J* 90:178-85.