

Effect of nitrogen levels on yield, N uptake and nitrogen use efficiency of hybrid rice

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ABSTRACT

The effect of nitrogen doses viz. 0, 50, 100 and 150 Kg Nha⁻¹ on growth, yield and N use efficiency (NUE) of hybrid rice (PHB-71, KRH-2, NDRH-2), and inbred check NDR-359 was studied. The highest grain and straw yield, N uptake, agronomic efficiency and physiological efficiency were observed with PHB-71 followed by NDRH-2 whereas lowest values were observed with inbred check NDR-359. N application resulted in significant increase in grain yield, straw yield, nitrogen uptake, panicles m⁻² and panicle weight with every increase in dose of nitrogen upto 150kg N ha⁻¹ while agronomic efficiency (AE) was highest with 100Kg Nha⁻¹ and physiological efficiency (PE) with 50Kg Nha⁻¹. Any variation in dose caused significant reduction in AE and PE.

Key words: Nitrogen fertilization, hybrid rice, N use efficiency

For exploiting the full heterotic potential of hybrids it is necessary to assess the performance of promising hybrids at graded levels of nitrogen. Effective nitrogen management plays an important role in increasing the response of the plant to fertilizers. Inadequate N application adversely affects the grain production, while excess nitrogen may lead to excess vegetative crop growth, favourable conditions for insect pests and diseases (Ohm *et al.*, 1996). Therefore, the present investigation was undertaken to study the effect of levels of nitrogen on growth, yield and nitrogen use efficiency (NUE) of hybrids in Inceptisols of Eastern Uttar Pradesh.

Field experiment was conducted at Crop Research Station, N.D. University of Agriculture and Technology, Masodha, Faizabad (U.P.) during three consecutive wet seasons 2001-2003. The soil of experimental field was sandy loam in texture having pH 7.5, Organic C 0.47%, E.C. 1.02 dsm⁻¹, C.E.C 13.6 C mol (P⁺) kg⁻¹, available nutrients 205 kg N ha⁻¹, 25kg P₂O₅ ha⁻¹ and 230 kg K₂O ha⁻¹. Sixteen treatments comprised of four nitrogen levels (0, 50, 100 and 150 Kg N ha⁻¹) and four rice varieties PHB-71, KRH-2 and NDRH-2 (hybrids) and NDR-359 (Local check) were arranged in split plot design keeping

nitrogen levels in main plots and rice cultivars in subplots. There were four replications having a net plot size of 20m². A uniform basal dose of 60kg ha⁻¹ each of P₂O₅ and K₂O were applied to all the plots through single superphosphate and muriate of potash. Nitrogen was applied as per treatment in three splits, 50% as basal, 25% at maximum tillering and 25% at panicle initiation stage. Twenty five day old seedlings were transplanted in first fortnight of July using 1-2 seedlings hill⁻¹ at a spacing of 20cm x 15cm. Yield attributes and grain yield at 14% moisture were recorded from each plot. Nitrogen concentration in grain and straw were estimated by modified Micro Kjeldhal method suggested by Jackson (1973). N uptake was computed by multiplying the N contents and their respective yields of grain and straw. The NUE Agronomic efficiency (AE) and Physiological efficiency (PE) were calculated.

$$AE = \frac{(\text{Grain yield (kg) with N}) - (\text{grain yield (kg) with no N [control]})}{\text{kg N applied}}$$

$$PE = \frac{\text{Grain yield (kg)}}{\text{Total N uptake by crop (kg)}}$$

The average of three years data revealed that, PHB-71 produced highest grain yield of 4.86 t ha⁻¹ being at par with NDRH-2 (4.81 t ha⁻¹). The hybrid PHB-71 showed yield increase of 0.36 and 0.82 t ha⁻¹ over KRH-2 and NDR-359, respectively Table 1. The increase in yield with PHB-71 and NDRH-2 may be attributed to higher values of yield attributing characters panicles m⁻² and panicle weight. The results are in agreement with those of earlier studies. (Anonymous, 2003).

There was significant increase in grain and straw yield with every increase in the dose of nitrogen upto 150 kg N ha⁻¹ during all the three years. On an average, the highest grain yield of 6.30 t ha⁻¹ was recorded with 150 Kg ha⁻¹. The N response was found to be linear as well as quadric ($Y=23.565 + 0.325N - 0.001N^2$). The optimum dose of N was worked out to be 153.8kg N ha⁻¹. The increase in yield was positively associated with increase in panicles m⁻² and panicle weight (Table 1). Ramiah *et al*, (1987) and Subbiah *et al*, (2001) have also reported significant increase in grain yield and yield attributes with increase in dose of nitrogen.

Rice hybrid PHB-71, NDRH-2 and KRH-2 recorded significantly higher N uptake (96.36 and 96.08 and 84.58 kg N ha⁻¹, respectively) than KRH-2 and NDR-359 (check). The higher uptake was mainly due to higher grain and straw yield of the hybrids than inbred check.

Nitrogen application resulted in significant increase in total N uptake with an increase in the dose upto 150 kg N ha⁻¹ during all the three years. On an average, the highest total N uptake of 123.11 kg ha⁻¹ was recorded with application of 150 kg N ha⁻¹ showing additional uptake of 78.46, 34.42 and 22.95 Kg N ha⁻¹ over 0, 50 and 100 Kg N ha⁻¹, respectively. The increase in N-uptake was mainly due to significant increase in grain and straw yield with every increase in nitrogen dose. Ramiah *et al*, (1987) have also reported significant increase in N uptake with increase in nitrogen doses.

The differences in AE due to genotypes were found significant. All the three hybrids being at par, were found significantly better than inbred NDR-359 which recorded lowest AE of 21.90 Kg grain Kg N⁻¹ applied. Amongst hybrids PHB-71 and KRH-2 proved slightly better than NDRH-2. Similar observations have also been recorded at Hyderabad and Kanpur (Anonymous-2003).

Agronomical efficiency increased significantly with increase in the dose of N upto 100 Kg N ha⁻¹ and further increase in the dose registered significant reduction in AE. The highest AE of 26.54 Kg grain Kg N⁻¹ applied was recorded with 100 Kg N ha⁻¹ which showed an increase of 2.39 Kg grain Kg N⁻¹ applied over 50 and 150 Kg N ha⁻¹. Similar results have been reported by Gunri *et al*, (2004).

Table1. Effect of nitrogen levels and hybrids on grain yield, yield attributes N-use efficiency and N-uptake of rice (Mean of 2001, 2002 and 2003)

Treatment	Grain yield	Straw yield (t ha ⁻¹)	Agronomic (t ha ⁻¹) (kg grain kg N ⁻¹)	Physiological efficiency (kg grain kg N uptake)	N-uptake efficiency (kg ha ⁻¹)	Panicles m ⁻²	Panicle wt. (g)
N - Levels							
N ₁ : No (control)	2.47	3.89	-	55.32	44.65	284	2.54
N ₂ : 50 Kg N ha ⁻¹	3.75	5.62	24.15	54.50	68.69	294	2.88
N ₃ : 100 Kg N ha ⁻¹	5.61	8.15	26.54	54.38	103.16	306	3.02
N ₄ : 150 Kg N ha ⁻¹	6.30	9.48	24.15	51.17	123.11	299	3.13
CD (P=0.05)	0.14	0.45	1.20	2.14	1.77	9.0	0.10
Varieties							
V ₁ : PHB-71	4.86	7.27	26.10	50.44	96.36	314	2.98
V ₂ : KRH-2	4.50	6.84	26.04	53.20	84.58	305	2.96
V ₃ : NDRH-2	4.81	7.46	25.67	50.06	96.08	322	3.24
V ₄ : NDR-359	4.04	6.24	21.90	57.66	70.07	269	2.60
CD (P=0.05)	0.13	0.37	2.50	3.45	1.89	7.0	0.13

Physiological efficiency (PE) which summarises the effect of plant factor/genotypic variation, is an important factor to screen the genotypes for their better N utilization. The local check NDR-359 recorded significantly higher PE (57.66 kg grain Kg⁻¹ N uptake) than all the three hybrids with remained at par. N application decreased the PE which increase in the dose of nitrogen upto 150Kg N ha⁻¹ but the differences were significant beyond 100 Kg N ha⁻¹.

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