Production Potential of Rice (*Oryza Sativa L.*) Varieties under Different Nitrogen Levels

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Abstract

Production potential of rice varieties under different nitrogen levels was studied for four consecutive seasons i.e., *kharif* 2007 and 2008 and *rabi* seasons of 2007 and 2008 at Jagtial. Results revealed that during *Kharif* 2007, varieties JGL-1798, JGL-11470 and JGL-3855 were equally superior in terms of grain and straw yields and nitrogen uptake. During *kharif* 2008, varieties JGL-11470 and JGL-3855 recorded significantly superior grain, straw yield and N uptake over other varieties tested. During *rabi* 2007-08, variety JGL-3855 recorded significantly superior grain yield and nitrogen uptake over other varieties. While during 2008-09 *rabi,* there were no significant differences in grain and straw yields and N uptake among varieties. The response to applied nitrogen was observed up to 100 % RDN (100 kg N ha^{-1}) during *Kharif* 2008 and up to 150% RDN (180 kg N ha^{-1}) during *rabi* seasons of 2007-08 and 2008-09, respectively. Soil available nitrogen status was significant only during *rabi* 2008-09. Lower soil nitrogen values were recorded in plots fertilized with 150% RDN.

Key words: Rice varieties, nitrogen levels, yield and nitrogen uptake.

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Rice (*Oryza sativa* L.) is the principal cereal crop of India and world. Andhra Pradesh is considered as rice granary and enjoys a pride place among rice growing states of India. With ever increasing population, demand for rice will continue to increase. In this endeavour, in addition to high yielding rice varieties, efficient use of nutrients play an important role. Among the major plant nutrients, nitrogen is most important for augmenting rice yield. Rice is the major consumer of fertilizer nitrogen and accounts for one third of the total nitrogen consumption in the country.

Application of optimum dose of nitrogen to rice is gaining importance because nitrogen is a key nutrient in crop production that it can never be ignored. It is crucial for individual farmer as well as to the country to get the maximum economic benefit out of a huge recurring expenditure.

Identification and use of high yielding potential cultivars, though ensures higher yields, the actual yield advantage depends on the agronomic management including that of nitrogen management. Yield potential of a cultivar could be exploited to a maximum extent by judicious management of applied nitrogen.

As nitrogen deficiency is universal, significant yield increase due to nitrogen use is common. In general, about 10-12 kg of rice is obtained per every kg of applied nitrogen. Magnitude of response varies with season, soil characteristics, variety and cultural practices (Pillai *et al*., 1976).

Identification of location specific cultivar and optimum nitrogen dose are essential for increasing the productivity of rice. Such information is lacking for the newly developed rice cultivars *viz;* JGL 1798, JGL 3844, JGL 3855 and JGL 11470 under Northern Telangana region during *kharif* and *rabi* seasons. Keeping these points in view, the present investigation was initiated during *kharif* and *rabi* seasons on sandy clay soils of Jagtial.

Material and Methods

Field experiments were carried out for four consecutive seasons of k*harif* 2007 and 2008 and *rabi* 2007 and 2008 at Regional Agricultural Research Station, Jagtial, Karimnagar, Acharya N.G. Ranga Agricultural University, Andhra Pradesh. The soil of the experimental site was sandy clay in texture, low in organic carbon (0.42%) and available nitrogen (198 kg ha^{-1}) medium in available phosphorus (18.6 kg ha^{-1}) and high in available potassium (384 kg ha^{-1}). The treatments consisted of four rice varieties *viz*., JGL 1798, JGL 3844, JGL 3855 and JGL 11470 and four nitrogen levels 100% RDN (RDN-100 kg N ha^{-1} during *kharif* and 120 kg N ha^{-1} during *rabi*) 125, 150 and 175% RDN, The experiment was laid out in randomized block design with factorial replicated thrice. Seedlings of 30 days old were transplanted at 15 cm x 15 cm spacing @ two seedlings per hill. Nitrogen (Urea) was applied as per treatments in three equal splits (1/3 as basal, 1/3 at maximum tillering and 1/3 at panicle initiation stage). Phosphorus (50 and 60 kg ha^{-1}) and potassium (40 kg ha^{-1}) were supplied through single super phosphate and muriate of potash and were uniformly applied to all plots as basal during *kharif* and *rabi* seasons. Recommended agronomic practices and plant protection measures were followed. Concentration (%) of N was estimated in plant samples as per Jackson (1973). The uptake of nitrogen (N) was calculated as a product of concentration and total biomass.

Results and Discussion

Grain Yield

Effect of varieties

It is evident from the data (Table 1) that during *kharif* 2007, among the rice varieties tested, JGL-1798 recorded significantly higher grain yield (7102 kg ha^{-1}) over JGL-3844 (6052 kg ha^{-1}) and was statistically comparable with JGL-11470 and JGL-3855.

During *Kharif* 2008, varieties JGL-11470 and JGL-3855 recorded significantly superior grain yield over rest of the varieties tested. Similar to *Kharif* 2007, variety JGL-3844 recorded significantly lower yield (6182 kg ha^{-1}) over rest of the varieties.

During *rabi* 2007-08, JGL-3855 out yielded (7054 kg ha^{-1}) other varieties and was significantly superior to rest of the varieties tested. The varieties JGL-11470, JGL-3844 and JGL-1798 were at par with each other in terms

of grain yield. However, during *rabi* 2008-09, there were no significant differences among varieties in terms of grain yield.

The variation in grain yield among different varieties was due to the differential efficiency of these varieties in converting dry matter into grain. Similar findings were also reported regarding varietal performance under different nitrogen levels in rice by Priydarshini and Prasad (2003) and Srilaxmi *et al*. (2005).

Effect of Nitrogen levels

Among the nitrogen levels tested, there was no significant improvement in grain yield due to incremental N application over 100% RDN during *Kharif* season of 2007. During *Kharif* 2008, linear and significant increase in grain yield was recorded with 175% RDN over 100% RDN. However, the grain yield at 175, 150 and 125% RDN was comparable to each other (Table 1).

During *rabi* 2007-08 and 2008-09, crop applied with 175% RDN recorded significantly higher grain yield over 100, 125% RDN but was comparable to 150% RDN. The increase in grain yield due to 175% RDN was to a tune of 8.0 and 10.0 % over 100% RDN during *rabi* 2007-08 and 2008-09.

Application of higher level of nitrogen might have helped in the maintenance of optimum nutrient level in the plant, enabling quick establishment with good root development. Thus, wider spread of roots, might have resulted in absorption of more amount of nutrients due to greater exploration from the soil as evident from the nutrient uptake data (Table 2). Further, adequate nutrient availability might have resulted in enhanced amount of protoplasm and chlorophyll which play vital role in increased assimilation of photosynthates, dry matter production, number of productive tillers which finally reflected in higher grain yields (Singh *et al*., 2000). During *rabi*, the response to higher nitrogen level was due to the favourable weather conditions (bright sunshine hours) coupled with improved nutrient availability due to minimal losses under controlled irrigation over *kharif* season (Kavitha *et al*., 2009).

The interaction effect of varieties and nitrogen levels on grain yield was found to be non-significant during both the seasons and years.

Straw Yield
Effect of varieties

During *kharif* 2008, varieties JGL-3855, JGL-11470 and JGL-1798 recorded significantly higher straw yield over JGL-3844 and were comparable which each other in terms of straw yield. However, during *Kharif* 2009, varieties JGL–11470 and JGL-3855 were at par with each other and were significantly superior over JGL –1798 and JGL-3844 in terms of straw yield. The varieties JGL–1798 and JGL-3844 recorded comparable straw yield.

Effect of Nitrogen levels

Application of higher level of nitrogen over 100% RDN had no significant effect on straw yield during *kharif* 2008 and r*abi* 2007 –08 and 2008 –09, respectively.

The interaction effect of varieties and nitrogen levels on straw yield was found to be non significant during both the seasons and years.

Nitrogen Uptake

Effect of varieties

Similar to the grain yield, variety JGL-11470 recorded significantly higher total N uptake and was comparable to varieties JGL-3855 and JGL-1798 in terms of N uptake. Lowest N uptake was recorded with JGL-3844 (92 kg ha^{-1}) during *kharif*, 2007. During *Kharif* 2008, JGL-3855 and JGL-11470 recorded significantly higher N uptake over other rice varieties tested.

During *rabi* 2007-08 highest nitrogen uptake (86 kg ha^{-1}) was recorded with JGL-11470, while JGL-3855 accumulated significantly lower nitrogen (64 kg ha^{-1}) over rest of the varieties tested. However, during *rabi* 2008-09, similar to the grain yield, there were no significant differences among different varieties in terms of total N uptake.

Effect of N levels

During *kharif* 2007, there were no significant differences in total N uptake due to increased application of N over 100% RDN. During *kharif* 2008, there was linear increase in N uptake with each increase in N level above 100% RDN. However, N uptake at 125, 150 and 175% RDN was comparable with each other.

During *rabi* 2007-08, application of 175% RDN recorded significantly higher N uptake over 100, 125 and 150% RDN while lowest N uptake was observed in crop fertilized with 100% RDN. However, during *rabi* 2008-09, there were no significant differences in N uptake due to different N levels.

The interaction effect of varieties and nitrogen levels on N uptake by crop was found to be non significant during both the seasons and years.

Application of nitrogen increases the root cation exchange capacity and root surface area which enhance nitrogen absorption. Further, increased absorption of N increases leaf area and ultimately results in increased biomass production (Neelima and Bhanu Murthy, 2009). Nutrient uptake is the product of nutrient content and dry matter production and increased N uptake by crop at higher levels of N (Table 3) might be due to increased grain and straw yields as evident from Table 1 and 2.

The interaction effect due to varieties and N levels was found to be non-significant on Nitrogen uptake.

Post Harvest Soil Nitrogen Status

A perusal of data (Table 4) indicated that there were no significant differences in post harvest soil available N status during wet seasons of 2007, 2008 and *rabi* 2007-08.

However, during *rabi* 2008-09, the soil available N status was significantly lower in plots applied with 150 % RDN. The available soil N status in plots supplied with 100, 125 and 175% RDN was significantly higher over 150% RDN and was comparable with each other. Lower values associated with this treatment were due to higher grain and straw yield recorded as evident from Table 1 and 2. The

variation in soil available N status was due to the variation in N uptake by crop under different N levels coupled with low initial soil N status. The effect of different rice varieties and the interaction effect of varieties and N levels was found to be non-significant on available soil N status.

Conclusion

The results indicated that under Northern Telangana Zone, varieties JGL-3855 and JGL-11470 recorded significantly superior grain and straw yields and higher total N uptake during *kharif* season and application of 100% RDN (100 kg N ha^{-1}) was optimum during this season for realizing profitable yields. During *rabi* season, variety JGL – 3855 out yielded other varieties and the response in terms of grain yield was observed up to 150% RDN (180 kg N ha^{-1}).

References

Jackson, M. L. 1967. Soil chemical analysis. Prentice Hall of India Private limited, New Delhi.

Kavitha, M.P, Balasubramanian, R. and Shobana, R. 2009. Studies on nitrogen and potassium management in maximizing hybrid rice productivity. *Indian Journal of Agricultural Research* 43 (3):230-232.

Neelima, T. L. and Bhanu Murthy, V. B. 2009. Growth and yield attributes of rice as influenced by nitrogen fertiliser and differential incorporation of sunhemp green manure. *Journal of Rice Research* 1 (2): 45-50.

Pillai, K. G. Rao. A.V. Sharma and Rao N.S 1976. Economics of Nitrogen fertilization for dwarf rice varieties. *Fertiliser News* 21: 34-36.

Priyadarsini, J. and Prasad P. V. N. 2003. Evaluation of nitrogen use efficiency of different rice varieties supplied with organic and inorganic sources of nitrogen. The *Andhra Agricultural Journal* 50 (3&4): 207-210.

Singh, M. K. Thakur, R. Verma, V. N. Upasani, R. R and Pal, S. K. 2000. Effect of planting time and nitrogen on production potential of basmati rice (*Oryza sativa*) cultivar in Bihar plateau. *Indian Journal of Agronom*y 45 (2): 300-302.

Srilaxmi, G., Subbaiah, G. and Chandra Sekhar, K. 2005. Performance of direct seeded rice as affected by variety and nitrogen level. *The Andhra Agricultural Journal* 52 (3&4): 326-329.

Table 1: Grain and straw yield (kg ha^{-1}) of different rice varieties as influenced by nitrogen levels

	Grain yield				**Straw yield**			
	Kharif		***Rabi***		***Kharif***		***Rabi***	
	2007	**2008**	**2007-08**	**2008-09**	**2007**	**2008**	**2007-08**	**2008-09**
Variety								
JGL 1798	7102	6442	6708	6883	6568	5942	6670	5509
JGL 3844	6052	6182	6760	6700	5952	5781	6679	5570
JGL 3855	6821	6630	7054	6618	6913	6371	7010	5400
JGL 11470	6965	6678	6798	6949	6875	6454	6716	5658
CD (0.05)	**435**	**221**	**255**	**NS**	**410**	**341**	**NS**	**NS**
N level								
100 % RDN	6696	6321	6530	6437	6495	5700	6623	5291

125 % RDN	6802	6450	6803	6779	6561	6007	6705	5478
150% RDN	6799	6520	7094	7083	6591	6423	6983	5791
175% RDN	6643	6643	6894	6851	6660	6418	6764	5571
CD (0.05)	**NS**	**221**	**255**	**402**	**NS**	**341**	**NS**	**NS**

Table 2: Nitrogen uptake (kg ha^{-1}) by different rice varieties as influenced by nitrogen levels

Nitrogen uptake (kg ha^{-1})				
	Kharif		***Rabi***	
	2007	**2008**	**2007-08**	**2008-09**
Variety				
JGL 1798	100	95	75	99
JGL 3844	92	98	74	93
JGL 3855	107	110	64	96
JGL 11470	112	105	86	94
CD (0.05)	**14**	**9**	**6**	**NS**
100 % RDN	100	95	70	91
125 % RDN	105	100	82	96
150% RDN	110	106	90	101
175% RDN	95	107	102	94
CD (0.05)	**NS**	**9**	**6**	**NS**

Table 3: Post harvest soil nitrogen status (kg ha^{-1}) under different nitrogen levels

	Kharif		***Rabi***	
	2007	**2008**	**2007-08**	**2008-09**
100 % RDN	91	101	104	197
125 % RDN	94	100	104	193
150% RDN	93	101	97	164
175% RDN	91	101	105	171
CD (0.05)	**NS**	**NS**	**NS**	**26**