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Standardization of Nitrogen Dose to the Popular *Kharif* Rice (*Oryza sativa* L.) Varieties in Central Telangana Region of Andhra Pradesh

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ABSTRACT

A field experiment was conducted at Regional Agricultural Research Station, Warangal during *kharif* season of 2008 and 2009 to validate and optimize the nitrogen dose to the popular *kharif* rice varieties in Central Telangana Zone of Andhra Pradesh. Among the varieties, MTU-1001 performed superior to WGL-32100, WGL-14 and Keshava in yield attributes, yield, nitrogen uptake and net returns. WGL-32100 and WGL-14 were at par with each other. All the rice varieties responded up to 180 kg N ha^{-1}(150 % of the recommended N) which was found to be optimum dose for the Central Telangana region of Andhra Pradesh.

Key words : High Yielding Variety, Net returns, Nitrogen, Rice, SPAD reading.

Andhra Pradesh is one of the rice bowl states of India contributing to 12 % of the total rice production, grown in 4.4 M ha with a production of 14.2 M t and productivity of 3.2 t ha^{-1} (CMIE, 2010). Rice yield depends on its genetic potential, agro climatic condition and management practices. Varieties play a unique role in maximizing of yield by improving the input use efficiency. It has been estimated that improved varieties contributed to increase the yield to the extent of 10-30% in India. Fertilizer is one of the most efficient means of increasing rice yield. Nitrogen is called 'Kingpin' in rice fertilization. HYV's are highly responsive to nitrogen fertilizer. It is essential to investigate the differential response of promising varieties to nitrogen levels in irrigated condition. Of late, many studies indicated the response of rice varieties to nitrogen above the recommended dose (Saoji *et al*., 2008 and Prasada Rao *et al*., 2011). Hence, the present study was conducted for standardization of nitrogen dose to different popular *kharif* rice varieties in Central Telangana region of Andhra Pradesh.

MATERIAL AND METHODS

Field experiments were conducted during *kharif* season of 2008 and 2009 at Regional Agricultural Research Station, Warangal, Andhra Pradesh. The soil was sandy clay loam with a p^H of 8.1 and EC of 0.35 d S m^{-1}, medium in organic carbon (0.44%) and low in available nitrogen (227 kg/ha), medium in available P_2O_5 (24.8 kg/ha) and low in available K_2O (234 kg/ha). The experiment was laid out in randomized block design with factorial concept consisting of four varieties (V) i.e.V_1: MTU-1001, V_2: WGL-32100, V_3: WGL-14 and V_4: Keshava and three nitrogen doses (N) i.e. N_1: 120 (Recommended dose), N_2: 180 (150 % of the recommended dose) and N_3: 240 kg ha^{-1} (200 % of the recommended N) replicated thrice.

A range of mean minimum temperature of 22.3 – 26.2°C and 21.2 – 27.4°C and mean maximum temperature of 29.1 – 32.2°C and 29.7 – 38.1°C were recorded during 2008 and 2009, respectively (Table 1). A rainfall of 739.1 and 399.3 mm was received during the crop growth period in 35 and 30 rainy days during 2008 and 2009, respectively. The rice varieties were transplanted at a spacing of 20 x 15 cm. The plot size was 4.5 x 4.0 m. The calendar of operations taken up during the crop growth period and rainfall details is furnished in Table 1. Nitrogen was applied as per treatments in three splits (½ as basal, ¼ at maximum tillering and ¼ at panicle initiation). A recommended dose of 60 kg P_2O_5 and 50 kg K_2O ha^{-1} was applied uniformly to all plots as basal in the form of single super phosphate and muriate of potash, respectively. All the other recommended practices were

Table 1. Calendar of operations taken up during the study period and rainfall details.

Variety	Date of nursery sowing		Date of transplanting		Date of harvesting		Duration (days)		Rainfall (mm)		Rainy days	
	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009
MTU-1001	04.07.2008	28.06.2009	05-08-2008	28-07-2009	24.11.2008	16.11.2009	140	138	739.1	399.3	35	30
WGL-32100	04.07.2008	28.06.2009	05-08-2008	28-07-2009	18.11.2008	11.11.2009	134	133	739.1	399.3	35	30
WGL-14	04.07.2008	28.06.2009	05-08-2008	28-07-2009	24.11.2008	17.11.2009	140	139	739.1	399.3	35	30
Keshava	04.07.2008	28.06.2009	05-08-2008	28-07-2009	11.11.2008	04.11.2009	127	126	739.1	399.3	35	30

followed. Pre and post-harvest observations in respect of both growth and yield parameters were recorded following standard procedures. Net returns (Rs. ha^{-1}) were calculated by deducting the cost of cultivation (Rs. ha^{-1}) from the gross returns (Rs. ha^{-1}). Nitrogen uptake (kg ha^{-1}) was calculated by considering nitrogen content (%) in grain / straw at harvest. Available nitrogen in the soil after harvest of the rice crop in each year is presented in Table 6.

RESULTS AND DISCUSSION

Varieties

Varieties differed significantly for tillersm^{-2}, SPAD reading, yield attributes, yield and nitrogen uptake during both the years (Table 2, 3, & 4). Among the four varieties, MTU–1001 produced significantly more number of tillers at 30 DAT compared to other three varieties but it was superior to Keshava only at 60 DAT during 2009. The differences in tillering of different varieties were not significant at 30 and 60 DAT during 2008. The SPAD reading recorded at 60 DAT was significantly higher with MTU–1001 than all the three varieties during both the years and they were at par with each other. The number of panicles/m^2 recorded was also higher with MTU–1001, even though the difference among the varieties during 2008 was not significant. WGL–32100 and WGL - 14 were at par with each other. During 2008, the number of filled grains/panicle was more with WGL–32100, significantly superior to MTU–1001 and Keshava but at par with WGL–14. During 2009, it was MTU–1001 in which highest number of filled grains/panicle was recorded and it was at par with WGL–14. Highest number of chaffy grains/ panicle was found with keshava during both the years. The chaffyness was the least with MTU–1001. The varieties differed significantly for 1000-grain weight. The test weight of MTU–1001 was significantly higher than all the three varieties during 2008 and WGL–32100 and WGL–14 during 2009. The superior performance of MTU–1001 in yield attributes is reflected in grain and straw yield also (Table 4). During both the years of study, significantly higher grain and straw yield was recorded with MTU-1001 than the other varieties. WGL–32100 and WGL–14 were at par with each other with respect to grain and straw yield. Keshava recorded the lowest grain and straw yield among the varieties. Similar trend was observed in nitrogen uptake by the grain as well as straw. The net returns

Table 2. Tillers and SPAD meter reading of different rice varieties as influenced by nitrogen doses under transplanted condition

Treatment	Tillers/m^2				SPAD meter reading at 60 DAT	
	30 DAT		60 DAT			
	2008	2009	2008	2009	2008	2009
Varieties						
MTU-1001	484	443	343	314	43	41
WGL-32100	518	413	355	305	40	38
WGL-14	500	418	355	309	41	39
Keshava	512	374	327	277	39	37
SEm±	16.9	7.6	13.6	6.5	0.9	0.7
CD (P=0.05)	NS	22.2	NS	19.1	2.6	2.0
Nitrogen doses						
120 kg ha^{-1}	456	396	315	293	40	38
180 kg ha^{-1}	517	414	349	302	41	39
240 kg ha^{-1}	537	427	372	310	42	40
SEm±	14.6	6.6	11.8	5.7	0.8	0.6
CD (P=0.05)	42.9	19.3	34.5	NS	NS	NS
Interaction (VxN)						
SEm±	29.3	13.1	23.5	11.3	1.2	1.2
CD (P=0.05)	NS	NS	NS	NS	NS	NS

Table 3. Yield attributes of different rice varieties as influenced by nitrogen doses under transplanted condition.

Treatment	Panicles/m^2		Filled grains / panicle		Chaffy grains / panicle		1000 grain weight (g)	
	2008	2009	2008	2009	2008	2009	2008	2009
Varieties								
MTU-1001	277	235	208	185	15	17	29.33	28.00
WGL-32100	263	214	309	163	21	26	19.33	18.00
WGL-14	272	213	288	167	16	25	20.00	19.00
Keshava	257	193	219	144	26	34	28.00	27.00
SEm±	8.4	4.8	11.2	6.4	1.1	1.4	0.35	0.54
CD (P=0.05)	NS	13.9	32.7	18.7	3.3	4.1	1.02	1.58
Nitrogen doses								
120 kg ha^{-1}	243	206	245	157	22	25	23.50	23.00
180 kg ha^{-1}	265	215	256	165	19	25	24.00	23.00
240 kg ha^{-1}	294	221	267	172	19	26	25.00	24.00
SEm±	7.3	4.1	9.7	5.5	1.0	1.2	0.30	0.46
CD (P=0.05)	21.3	12.1	NS	NS	NS	NS	0.88	NS
Interaction (VxN)								
SEm±	14.6	8.2	19.3	11.1	2.0	2.4	0.60	0.92
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS

Table 4. Yield and nitrogen uptake of different rice varieties as influenced by nitrogen doses under transplanted condition.

Treatment	Nitrogen uptake (kg/ha)				Grain yield (kg/ha)		Straw yield (kg/ha)	
	Grain		Straw					
	2008	2009	2008	2009	2008	2009	2008	2009
Varieties								
MTU-1001	70.21	51.79	44.58	34.60	6782	5104	8336	6596
WGL-32100	46.30	40.03	32.12	27.67	5014	4431	6749	5922
WGL-14	45.55	40.19	28.76	25.97	5039	4546	6532	6038
Keshava	41.54	32.14	25.68	20.99	4753	3759	6259	5252
SEm±	1.01	0.77	1.41	0.62	105.0	76.2	271	106
CD (P=0.05)	2.96	2.26	4.13	1.82	307.0	223.4	794	310
Nitrogen doses								
120 kg ha^{-1}	46.90	37.51	30.01	25.11	5144	4219	6641	5713
180 kg ha^{-1}	51.13	41.53	32.85	27.38	5383	4486	7005	5977
240 kg ha^{-1}	54.67	44.08	35.50	29.44	5664	4676	7261	6167
SEm±	0.88	0.67	1.22	0.54	91.0	66.0	235	91.5
CD (P=0.05)	2.58	1.96	3.57	1.58	266.0	193.4	NS	268.3
Interaction (VxN)								
SEm±	1.76	1.33	2.44	1.07	181.5	131.9	470	183.0
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS

Table 5. Economics of different rice varieties as influenced by nitrogen doses under transplanted condition.

Treatment	Net returns (Rs./ha)		B:C ratio	
	2008	2009	2008	2009
Varieties				
MTU-1001	40734	34613	1.42	1.36
WGL-32100	25012	26721	0.87	1.04
WGL-14	22370	28025	0.76	1.09
Keshava	20193	19130	0.70	0.75
SEm±	-	-	-	-
CD (P=0.05)	-	-	-	-
Nitrogen doses				
120 kg ha^{-1}	24420	25159	0.86	1.01
180 kg ha^{-1}	27601	27391	0.96	1.07
240 kg ha^{-1}	29214	28818	0.99	1.09
SEm±	-	-	-	-
CD (P=0.05)	-	-	-	-
Interaction (VxN)				
SEm±	-	-	-	-
CD (P=0.05)	-	-	-	-

Price (Rs. /kg) : Grain : 9.0 (2008), 9.8 (9009); Straw : 1.0 (2008), 1.5 (2009)

Table 6. Soil available nitrogen (kg/ha) after harvest of *kharif* rice under transplanted condition.

Treatment	After *kharif* 2008	After *kharif* 2009
Varieties (V)		
MTU-1001	226.3	227.4
WGL-32100	228.2	230.3
WGL-14	227.4	229.2
Keshava	229.5	231.4
Nitrogen doses (N)		
120 kg ha^{-1}	227.2	228.1
180 kg ha^{-1}	230.4	231.9
240 kg ha^{-1}	231.7	234.5

and B: C ratio was more in MTU–1001 due to higher yield of the same over the other varieties. The B: C ratio was below one with keshava variety (Table 5). The differences among the varieties might be due to difference in their genetic make-up. Similar results with different varieties were noticed earlier by Saoji *et al*. (2008) and Prasada Rao *et al*. (2011).

Nitrogen

The nitrogen doses had significant influence on tiller production, yield attributes, yield, nitrogen uptake and returns (Table 2, 3, 4 & 5). Application of 240 kg N ha^{-1} produced significantly more number of tillers than 120 kg at 30 and 60 DAT (Table 2) during 2008 and at 30 DAT only during 2009. It was at par with 180 kg N ha^{-1} at both the stages of observation. The difference in SPAD reading was not significant due to different nitrogen doses. Significantly higher number of panicles/m^2 and filled grains/panicle were produced with 240 kg over 120 kg N ha^{-1}. The test weight increased significantly at 240 kg N ha^{-1} over the other two lower doses of nitrogen. The grain and straw yield obtained with 240 kg N ha^{-1} was at par with 180 kg N ha^{-1} but not superior to 120 kg N ha^{-1}. But, the uptake of nitrogen by the grain and straw were significantly higher with 240 kg N ha^{-1} over the other two doses of nitrogen. Increased yield under higher nitrogen dose might be due to adequate nutrient supply which would have occurred due to increased growth and yield components. The response of the popular rice varieties to the higher doses of nitrogen above the recommended might be due to their high yielding genetic potential, high uptake, depletion of native soil fertility due to increased cropping intensity and low organic matter in the soil due to non addition of organic manures. Marginally higher net returns (Rs. /ha) and B: C ratio were recorded with 240 kg N ha^{-1} over 180 kg which in turn with 120 kg N ha^{-1} (Table 5). Similar results were reported by Raju and Suneetha Devi (2005), Saoji *et al*., 2008, Chaudhary *et al*., 2008, Ramana *et al*., 2008 and Prasada Rao *et al*., 2011).The interaction between the varieties and nitrogen doses was not significant for the growth, yield attributes, yield and nitrogen uptake.

Available nitrogen in the soil after harvest of the crop

The difference in the soil available nitrogen after the harvest of rice crop was meager among the treatments (Table 6). However, the available nitrogen was increased in 240 kg N applied plots (7.5 kg ha^{-1}) followed by 180 (4.9 kg ha^{-1}) and 120 kg N applied plots (1.1 kg ha^{-1}) compared to initial status after second year of study. Similarly, higher available nitrogen was recorded in Keshava variety (4.4 kg ha^{-1}) followed by WGL–32100 (3.3 kg ha^{-1}) compared to initial status.

Thus it could be inferred that 180 kg N ha^{-1} (150 % of the recommended dose) need to be applied to exploit the full genetic potential of high yielding popular rice varieties (MTU-1001,WGL-32100,WGL-14 and Keshava) in sandy clay loam soils of Central Telangana region of Andhra Pradesh. Among these varieties, MTU-1001 performed better than others.

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