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Influence of Plant Densities and Nitrogen Levels on Yield of Transplanted Rice

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ABSTRACT

A field experiment was conducted to study the influence of different plant densities and nitrogen levels on rice performance at Agricultural Research Station, Ghantasala, Krishna District, Andhra Pradesh during the *kharif* seasons of 2009 and 2010. There were three plant densities (spacing); 16 hills/m^2 (25 x 25 cm), 25 hills/m^2 (20 x 20 cm) and 33 hills/m^2 (20 x 15 cm) as main treatments and four nitrogen levels; 80, 120, 160 and 200 kg N ha^{-1} as sub treatments in split plot design replicated thrice. The results indicated that planting patterns with different plant densities had no significant influence on yield attributing characters and yield. But the application of nitrogen at 120 kg/ha resulted in optimum grain yield of the rice crop.

Key words : Rice, Plant Densities and Nitrogen Levels.

Rice (*Oryza sativa* L.) is the most important food crop grown in *kharif* covering an area of around 40 l. ha in Andhra Pradesh annually. Crop plants depend largely on temperature, solar radiation, moisture and soil fertility for their growth and nutritional requirements. Thick population of crop may limit the availability of these factors, while manual transplanting of paddy on contract basis often results in establishment of sub optimal plant population. Hence, it is necessary to have optimum plant population per unit area for obtaining maximum yields (Baloch *et al*., 2002). Nitrogen is an inevitable component for the rice crop as it occupies prime position among the plant nutrients in realizing the yield potential of rice varieties. It is needed in high quantity particularly upto panicle initiation stage (Padmavathi *et al*., 2012). Therefore, a balance has to be brought between the plant density per unit area and nitrogen requirement for obtaining optimum yields. Keeping this in view, the present investigation was carried out to determine a suitable planting pattern and optimum nitrogen level for getting the maximum yield in rice.

MATERIAL AND METHODS

An experiment was conducted at Agricultural Research Station, Ghantasala during *kharif* 2009 and 2010 with three plant densities (spacing) *viz*., 16 hills/m^2 (25 x 25 cm), 25 hills/m^2 (20 x 20 cm) and 33 hills/m^2 (20 x 15 cm) as main plots and four nitrogen levels; 80, 120, 160 and 200 kg N ha^{-1} as sub plots in split plot design replicated thrice. The soil was clay loam in texture and low in organic carbon content and available nitrogen, medium in available phosphorus and high in available potassium. Paddy variety, MTU 1061 was sown during both the years and a single seedling of 15 and 21 days old were transplanted per hill during 2009 and 2010 respectively. The crop was fertilized with a uniform dose of 40 kg ha^{-1} of phosphorus (P_2O_5) and potassium (K_2O) each. The entire P_2O_5 (in the form of Single Super Phosphate) and half of K_2O (in the form of Muriate of Potash) dose were applied as basal at sowing. Nitrogen was applied in the form of urea in three equal splits at basal, tillering and panicle initiation stages. Another half of K_2O dose was applied along with third split dose of nitrogen. Recommended agronomic practices and plant protection measures were followed. In the delta region of Krishna, rice crop is grown under canal irrigation system taking the advantage of intermittent rains. During the crop period of *kharif* 2009, a total of 380 mm rainfall was received from 28 rainy days. Whereas during *kharif* 2010 the rainfall received was 1250 mm from 57 days, which was excess to the normal. Hence, 2009 was considered as normal and 2010 as wet season. Observations on plant growth, yield attributes, grain and straw yields were recorded

Table 1. Growth and yield attributes of rice as influenced by plant density and nitrogen levels.

Treatments	Plant height (cm)			Effective tillers/hill			No. of filled grains/panicle			1000 grain weight (g)		
	2009	2010	Mean	2009	2010	Mean	2009	2010	Mean	2009	2010	Mean
Main plots: Plant density (Spacing)												
16 hills/m^2 (25 x 25 cm)	140.8	137.1	138.9	15.6	13.0	14.3	195.8	139.8	167.8	19.8	20.8	20.3
25 hills/m^2 (20 x 20 cm)	140.2	132.0	136.0	11.6	9.5	10.5	194.2	141.5	167.9	19.7	20.0	19.9
33 hills/m^2 (20 x 15 cm)	139.0	130.5	134.8	9.1	8.6	8.8	186.3	122.8	154.6	19.4	20.0	19.7
SE m±	0.9	1.2	0.4	0.5	0.9	0.4	7.0	10.2	6.8	0.3	0.3	0.1
CD at 5%	NS	4.9	1.6	1.9	3.4	1.6	NS	NS	NS	NS	NS	0.3
Sub- plots (N – levels)												
80 kg ha^{-1}	134.4	128.4	131.4	11.4	9.8	10.6	184.0	149.5	166.7	19.4	20.5	19.9
120 kg ha^{-1}	137.3	129.8	133.5	12.2	10.4	11.3	191.9	134.0	162.9	19.5	20.5	20.1
160 kg ha^{-1}	142.3	135.7	139.0	12.7	10.4	11.5	196.4	124.8	160.6	19.7	19.8	19.7
200 kg ha^{-1}	146.1	138.9	142.5	12.1	10.7	11.4	196.2	130.5	163.3	20.0	20.3	20.2
SE m±	1.9	2.1	1.6	0.8	0.5	0.5	8.3	10.8	7.0	0.2	0.3	0.2
CD at 5%	5.7	6.2	4.7	NS	NS	NS	NS	NS	NS	NS	0.8	NS
Interaction												
SE m±	2.3	2.6	1.9	0.9	0.7	0.6	10.2	13.2	8.5	0.3	0.3	0.2
CD at 5%	6.9	7.6	5.7	NS	NS	NS	30.3	39.3	25.3	NS	NS	NS

Table 2. Grain and straw yields of rice as influenced by plant density and nitrogen levels.

Treatments	Grain yield (kg ha^{-1})			Straw yield (kg ha^{-1})		
	2009	2010	Mean	2009	2010	Mean
Main plots: Plant density (Spacing)						
16 hills/m^2 (25 x 25 cm)	7262	4587	5925	8619	7139	7879
25 hills/m^2 (20 x 20 cm)	7422	4369	5896	9076	7224	8150
33 hills/m^2 (20 x 15 cm)	7331	4091	5711	9014	7047	8031
SE m±	315	179	239	261	523	341
CD at 5%	NS	NS	NS	NS	NS	NS
Sub- plots: (N – levels)						
80 kg ha^{-1}	6871	4397	5634	7883	6288	7085
120 kg ha^{-1}	7505	4701	6103	8782	6937	7859
160 kg ha^{-1}	7488	4533	6011	9150	8090	8620
200 kg ha^{-1}	7490	3765	5628	9798	7232	8515
SE m±	178	285	142	201	477	255
CD at 5%	527	847	421	596	1418	757
Interaction						
SE m±	217	349	173	246	584	312
CD at 5%	NS	NS	NS	NS	NS	NS

following standard procedures. The data was statistically analyzed and mean values were compared by DMR test.

RESULTS AND DISCUSSION

The statistical analysis resolved that rice planted at different densities had no significant influence on plant height, number of filled grains/ panicle and 1000 grain weight except effective tillers per hill during 2009 (Table 1). Significantly more number of effective tillers per hill (15.6 and 13.0 during 2009 and 2010 respectively) were produced with the plant density of 16 hills/m^2 compared to the other two plant densities. During 2009, though number of effective tillers and filled grains/panicle were increased with increase in nitrogen level the difference was not significant. Different nitrogen levels could not influence 1000 grain weight significantly during both the years. Plant height was increased with lower plant density and higher nitrogen. Grain and straw yields were not significantly influenced by different plant densities. However, application of different levels of nitrogen had significant influence on grain and straw yields. During 2009, grain yield of 7505 kg ha^{-1} was recorded with nitrogen application of 120 kg ha^{-1} which was significantly superior over the grain yield (6871 kg ha^{-1}) obtained with the application of 80 kg N ha^{-1} (Table 2). Further increase in nitrogen upto 200 kg ha^{-1} did not influence grain yield significantly. Viswanath *et al.*, (2010) obtained better grain yield, straw yield and harvest index with the application of 125% recommended dose of fertilizers (120-60-40 N-P_2O_5-K_2O ha^{-1}) along with 5 t or 10 t FYM ha^{-1} on sandy clay soils of Bapatla. Prabhakar *et al.*, (2012) also found that the application of 160 kg N ha^{-1} was superior to 80 and 120 kg N ha^{-1} with respect to growth, yield attributes and grain yield of aerobic rice. Similarly, application of N as high as 240 kg ha^{-1} showed higher growth and yield components and yield in sandy soils of Bapatla (Prasada Rao *et al.*, 2011).

During 2010, though similar increase was noticed with application of 80 kg N ha^{-1} (4700 kg ha^{-1}) to 120 kg ha^{-1} (4397 kg ha^{-1}), further increase in nitrogen dose to 160 kg ha^{-1} and 200 kg ha^{-1} decreased the grain yield (4533 kg ha^{-1} and 3654 kg ha^{-1} respectively). Due to continuous rains and cloudy weather which prevailed during *kharif*, 2010 overall yields were low compared to the previous year. Further, crop lodging at milky stage due to heavy rain (225.8 mm) received from five rainy days during the 44th standard week (29th October to 4th November) reduced the grain yields in the treatments that received higher nitrogen (160 and 200 kg N ha^{-1}). Straw yield recorded in different plant densities was found to be on par. Highest straw yield (9798 kg ha^{-1}) was recorded with application of 200 kg N ha^{-1} during 2009 while the straw was damaged due to lodging of crop during 2010. Although, the interaction between plant densities and nitrogen levels was significant for the parameters; plant height and number of filled grains per panicle, the interaction effect was not significant for both grain and straw yields in both the years.

On the basis of these results, even though plant density had no significant influence on yield attributing characters and yield, it can be concluded that application of N at 120 kg/ha^{-1} is most suitable for obtaining optimum grain yield in rice and further increase in nitrogen may cause lodging of the crop in cyclone prone coastal areas of Krishna district.

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