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Influence of nitrogen levels and varieties on growth, yield and quality of rice (*Oryza sativa* L.)

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Abstract
An experiment was conducted at Instructional Farm, Department of Agronomy, Faculty of Agriculture, AKS University, Sherganj, Satna (M.P.) during *kharif* season of 2017-2018. The experiment consisted of randomize block design having Factorial arrangement in three replications. In this experiment, 12 treatment combinations including three varieties (MTU-1010, IR-64 and JR-201) and four levels of nitrogen (0, 60, 120 and 180 kg/ha). The treatments comprised three varieties (MTU-1010, IR-64 and JR-201) and four levels of nitrogen (0, 60, 120 and 180 kg/ha). It was found that variety and nitrogen significantly affected plant height, number of tillers per plant, number of tillers per plant, number of grains/panicle, thousand grain weight, grain and Stover yield of rice. The plant height, number of branches per plant were, in general, increased in all the treatments with the successive growth and development stages of crop i.e. 30, 60 and at 90 DAT stages of plant growth. Among these vegetative growth parameters, plant height, in general, enhanced at the faster between 30 days up to the 60 days stage of observations. At 90 DAT stage, plant height ranged from 85.22 to 92.57 cm and tillers 9.26 to 11.97/plant as well as effective tillers 11.26 to 12.23/plant at 65 DAT stage under different treatments. Similarly, the factor which are directly responsible for ultimate grain production *viz*. number of panicles/plant, number of filled grains/panicle and seed yield/plant were augmented almost significantly due to rice variety JR 201 as against IR-64 and MTU-1010. Thus, the maximum number of panicles were 10.36/plant, number of filled grain 10.40/panicle and 31.69 g seed yield/plant in case of JR-201.

Keywords: Rice, plant, grains/panicle, grain weight, test weight, stover yield

Introduction
Rice is one of the most important food crop of India and belongs to the family poaceae. Major share of rice is cultivated during *kharif* season. The small share of rice is grown in *rabi* and summer season under assured irrigation. In India rice production is totally dependent upon rainy season. Rice contains high concentration of CHO (78.2 g), calcium (10 g), protein (6.8 g), fat (0.5 g), minerals (0.6 g) fiber (0.2 g) and energy 365 kg calorie. In Madhya Pradesh, rice is grown on 15.59 lac/ha areas with production of 14.62 lac tonnes and productivity of 989 kg/ha. It's productivity can be raised by applying appropriate fertilized-N and adopting new varieties.

Nitrogen is an essential plant nutrient being a component of amino acid, nucleic acid, nucleotides, chlorophyll and enzymes which promotes rapid plant growth and improves grain yield and grain quality through higher tillering, leaf area development, grain formation, grain filling, and protein synthesis. Nitrogen is the most limiting elements in all types of soil. Thus proper application of N fertilizer is vital to improve crop and grain yield of rice.

Varieties play an important role in enhancing the production as well as improve the quality of the grains like other crops. Rice varieties are also influenced by genotypic, phenotypic, environmental and physiological interactions. Day-by-day different varieties are being developed with desirable characters to suit under a particular environmental and agro-climatic conditions.

Genetic character of a variety limits the expression of yield. Rice cultivars differ in their potential to respond to high fertility conditions. Selection of suitable varieties and their nutrient requirements have great relevance in boosting up productivity of low land rice. Selection of proper variety suitable to the specific ecological situation may prove to be a boon to the farmer.

In recent years, the development of HY rice varieties have shown better yield potential than the existing varieties mainly due to presence of larger sink. Nutrient management of improved rice differs considerably from the conventional varieties. It is, therefore, essential to evaluate the location-specific nutrient management to restore the nutrient balance in soil and to sustain the crop productivity.

Materials and Methods

The experiment was conducted at the Instructional plot of department of Agronomy, Faculty of Agriculture sciences and technology AKS University, Sherganj, Satna (M.P.) during the year 2017-18. The experiment was conducted in randomize block design with Factorial concept with three replications. This experiment, 12 treatment combinations including three varieties (MTU-1010, IR-64 and JR-201) and four levels of nitrogen (0, 60, 120 and 180 kg/ha). The gross and net plot size was 5.0 m x 3.0 m and 4.0 m x 3.0 m, respectively. The experimental plots were fertilizers as per recommended dose.

Results and Discussion

The result shows that plant height, number of tillers per plant, number of leaves per plant number of grains/panicle, thousand grains weight, grain and stover yield was influenced significantly due to different variety and nitrogen levels.

Amongst the varieties, JR-201 resulted in significantly higher all these growth parameters at every stage. Accordingly the maximum plant height was 89.31 cm, tillers 11.12/plant at 90 DAT stage and effective tillers 12.23/plant at 65 DAT stage of JR-201. The variety MTU-1010 recorded the lowest values of all these parameters. The variety IR-64 attained the intermediate position with respect to these growth parameters.

In fact vegetative growth parameters comprising plant height and formation of number of tillers and effective tillers/plant are mainly governed genetically because such traits inherited in the newly introduced high-yielding varieties are likely to be variable owing to the variability in their parental origin. The variations in height and tiller formations among the different rice varieties have also been reported by many workers (Singh, 2014; Sowmya Latha *et al.,* 2013; Tripathi *et al.,* 2014 and Prafull Kumar *et al.,* 2015) [3, 4, 6, 2].

The growth response of rice varieties towards applied nitrogen levels was found to be significantly different. The increasing levels of nitrogen up to 180 kg/ha resulted in increase in the growth parameters significantly. Accordingly N_{180} enhanced the plant height upto 92.57 cm as against only 85.22 cm under without nitrogen at 90 DAT stage. Similarly tillers were 11.97/plant over 9.26/plant under N_0. Effective tillers were 12.02/plant at 65 DAT.

Among the commonly applied major nutrients, nitrogen is the key element in rice production, which is structural components of protein molecules, amino acids, chlorophyll and other constituents. Its adequate supply promotes higher photosynthesis activity and vigorous vegetative growth. A higher nitrogen supply favours the conversion of carbohydrates in to protein. In fact, nitrogen encourages the plant foliage and boosted plant growth at every stage, because it is an integral part of chlorophyll, all proteins, enzymes and structural materials. Nitrogen functions as stover of energy. It is also responsible for the dark-green colour of the leaves, vigorous growth, branching or tillering, leaf production and enlargement of leaf surface. The tremendous increase in growth parameters due to increased supply of nitrogen of rice has also been reported by many workers (Vinod Kumar *et al.,* 2011; Bhanu Prakash *et al.,* 2013; Tiwari *et al.,* 2015; Pandey and Namdeo, 2016) [7, 1, 5].

The variety JR-201 recorded maximum panicles (10.36/plant), filled grains (1040/panicle) and seed yield (31.69 g/plant). Whereas MTU-1010 recorded significantly lowest number of panicles (9.18/plant), filled grains (884/panicle) and seed yield (27.90 g/plant).

The variety JR-201 gave significantly higher seed yield (51.90 q/ha) and stover yield (96.10 q/ha) but harvest index was found significantly lowest (34.78%). Whereas the variety MTU-1010 produced significantly lowest seed (50.65 q/ha) and stover (80.11 q/ha), but the harvest index was found significantly highest (38.78%). The variety IR-64 attained the intermediate position for all these parameters.

The nitrogen application up to N_{180} resulted in significantly higher seed yield (56.37 q/ha) and stover yield (110.0 q/ha), but harvest index was significantly lowest (35.89%). The position under without nitrogen was significantly lowest seed yield (46.35 q/ha) and stover yield (77.17 q/ha), but harvest index was found significantly higher (37.57%).

The grain and straw yield was found exactly in accordance with the vegetative growth and yield-attributing parameters under different levels of nitrogen. The plants adequately supplied with nitrogen might have synthesized more photosynthates which were translocated and stored in seed thus resulting higher seed yield. The increase in seed yield of rice due to nitrogen has also been reported by several researchers (Vinod Kumar *et al.* 2015; Tiwari *et al.* 2015) [7, 5].

Table 1: Growth parameters of rice as influenced by N-levels and varieties

Treatments	Plant height (cm)			Number of tillers/plant		
	30	60	90 DAT	30	60	90 DAT
N-levels(kg/ha)						
0	25.63	64.94	85.22	5.30	6.37	9.26
60	27.97	67.41	87.34	6.55	8.50	10.19
120	30.39	68.74	91.07	7.71	10.88	11.18
180	31.52	69.33	92.57	7.97	12.04	11.97
S.Em+	0.15	0.26	0.065	0.137	0.592	0.121
C.D.(P=0.05)	0.45	1.06	0.190	0.403	1.74	0.356
Varieties						
MTU-1010	27.93	65.58	88.88	6.31	8.78	10.12
IR-64	28.90	68.18	88.95	6.93	9.16	10.72
JR-201	29.80	69.06	89.31	7.41	10.40	11.12
S.Em+	0.134	0.31	0.056	0.119	0.513	0.105
C.D.(P=0.05)	0.39	0.91	0.165	0.349	NS	0.309

Table 2: Yield-attributes from rice as influenced by N-levels and varieties

Treatments	Number of panicles/plant	Number of filled grains/panicle	Number of chaffy grains/panicle	Seed yield/plant (g)	Seed yield (q/ha)	Stover yield (q/ha)	Harvest index (%)
N-levels(kg/ha)							
0	8.27	826	64	28.44	46.35	77.17	37.57
60	9.54	924	76	29.35	48.51	82.94	36.96
120	10.57	1023	88	30.49	52.29	91.51	36.43
180	10.75	1064	90	31.00	56.37	110.01	35.89
S.Em+	0.196	12.01	1.06	0.332	0.055	0.79	0.196
C.D.(P=0.05)	0.574	35.23	3.10	0.973	0.163	2.32	0.575
Varieties							
MTU-1010	9.18	884	71	27.90	50.65	80.11	38.78
IR-64	9.81	954	80	29.86	50.90	88.25	36.56
JR-201	10.36	1040	86	31.69	51.09	96.10	34.78
S.Em+	0.169	10.40	0.91	0.287	0.048	0.68	0.170
C.D.(P=0.05)	0.497	30.51	2.68	0.842	0.141	2.01	0.500

Summary and Conclusion

Based on experimental data, it is concluded that among the rice varieties, JR-201 recorded significantly higher growth, yield-attributes, grain yield and its nutritional quality. Thus, the maximum grain yield was 51.09 q/ha, net income up to Rs.74070/ha with 2.96 B:C ratio as well as carbohydrate content 76.20%. Amongst the nitrogen levels, 180 kg N/ha resulted in maximum grain yield up to 56.37 q/ha, net income Rs.83551/ha with 3.12 B:C ratio as well as 77.47% carbohydrate content in grain. The treatment interactions were found to be non-significant. However, grain yield was further slightly augmented up to 56.60 q/ha with net income of Rs.85083/ha, but the carbohydrate content was significantly higher (77.81%).

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