

Response of different duration varieties of rice (*Oryza sativa*) on growth, yield attributes and yield under varied levels of nutrient application

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ABSTRACT

A field experiment was conducted during the rainy season (*kharif*) 2017 on clay soils, of the ICAR–Indian Institute of Rice Research, Hyderabad, Telangana, to study the response of different duration rice (*Oryza sativa* L.) varieties as influenced by varied levels of nutrients under irrigated ecology. The experiment comprised rice varieties of 3 different durations where under each duration there were 2 varieties, viz. short duration of 110 days ('DRR-Dhan 44' and 'DRR-Dhan 46'), medium duration of 125 days ('MTU 1010' and 'Vardhan') and long duration of about 145 days ('Sugandhamati' and 'Swarnadhan') with 3 nutrient levels [50%, 100% and 150% recommended dose of fertilizer (RDF)] were tested in split-plot design with 3 replications. The variety 'Swarnadhan' produced significantly higher number of tillers, total dry matter and leaf-area index; however, the plant height was highest with the variety 'Sugandhamati' but it was at par with 'Swarnadhan'. The variety 'Varadhan' produced significantly higher number of grains/panicle, 1,000-grain weight, weight of the panicle and produced lower sterility percentage. Thus, it gave the highest grain yield (6.49 t/ha). The plant height, number of tillers/plant, leaf-area index and dry matter accumulation increased significantly with the application of 150% RDF (N : P₂O₅ : K₂O 180 : 90 : 60 kg/ha) as compared to 100% or 50% RDF. The results showed, increased rate of nutrients application that increased growth and yield of improved varieties.

Key words : Different durations, Fertilizers, Nutrient management, Rice, Varieties

Rice is an important cereal crop grown extensively in tropical and sub-tropical regions of the world. About 90% of all rice grown in the world is produced and consumed in the Asian region with China leading in production followed by India. The low productivity of rice in India is due to use of traditional varieties in some rice-growing areas, erratic behaviour of rainfall, low fertile soils and climate change from the past few years (Khush, 2003).

Among the production factors varietal selection and nutrient management play an important role in increasing the production and productivity. The varieties play a vital role in maximizing yield by improving the input-use efficiency. Growth and yield characteristics of cultivars depend on genetic and environmental factors. Nutrient management is another important factor that can increase the

yield (Alam *et al.*, 2009). Most of the research studies on rice showed that nitrogen and phosphorus together with potassium fertilizer are the major essential plant nutrients for increasing crop yield (Bo Nguyen Van *et al.*, 2003). It is observed that high-yielding varieties are responsive to higher levels of nitrogen, phosphorus and potassium than what is recommended (Rahale *et al.*, 2019). Along with varieties and nutrient management, the duration of the varieties is also a critical factor in obtaining higher yields due to the changing environmental conditions of India. Therefore, the investigation was undertaken to study the response of short, medium and long-duration rice varieties to different doses of fertilizers under irrigated condition.

MATERIALS AND METHODS

To evaluate the performance of rice cultivars with the application of different nutrient levels, the present investigation was conducted during the rainy season (*kharif*) 2017 at the ICAR–Indian Institute of Rice Research (IIRR) farm, Rajendranagar, Hyderabad, Telangana. The soil of the experimental field was clayey in texture (Vertisols). The soil was neutral in reaction and available nitrogen, phosphorus and potassium contents were low, high and

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medium (241 : 35 : 200 kg N : P₂O₅ : K₂O/ha) respectively. The climate of the region is semi-arid, with an average rainfall of 900 mm where during crop growth period 722.3 mm total rainfall was received.

In experiment, treatments comprising 3 nutrient levels, viz. 50% recommended dose of fertilizer (RDF), 100% RDF and 150% RDF is at the rate of 120 : 60 : 40 kg N : P₂O₅ : K₂O/ha), were applied in main plots and in subplots with the 6 different duration rice varieties, viz. 'DRR-Dhan 44' and 'DRR Dhan 46' with the duration of 110 days, 'MTU 1010' and 'Varadhan' having 125 days duration and 'Sugandhamati' and 'Swarnadhan' with 145 days duration were tested in split-plot design with 3 replications. DRR-stat software was used for statistical analysis.

RESULTS AND DISCUSSION

Fertilisers

The findings on growth parameters of rice, viz. plant height, number of tillers/plant, leaf-area index and dry matter accumulation, were significantly increased with the application of 150% RDF as compared to 100% or 50% RDF. Similarly, application of 100% RDF was found significantly superior to that of 50% RDF (Table 1). With regard to yield attributes and yield, application of 150% RDF resulted in highest yield attributes like effective tillers, number of filled grains and 1,000-grain weight, which result in increased yield of rice crop (Table 2). The variety having duration of 110 days had better yield potential

which might be owing to its ability to utilize higher doses of fertilizers and thereby provide yield that is close to varieties having longer duration with the same RDF. The increase in grain and straw yield of rice crop was found to be significant with the application, from 50 to 100% RDF as compared to application of nutrients from 100 to 150% RDF, but higher yields were recorded with the 150% RDF application. Similar trend was observed in harvest index also, as reported by Krishnaveni *et al.* (2002) and Singh *et al.* (2002). The improvement of these parameters by application of higher nutrient levels may be due to more efficient utilization of nutrients and their uptake by improved varieties and thereby increased growth as well as yield. Similar results have been also reported by Ranjha *et al.* (2001), Bahmaniar *et al.* (2007) and Paramasivan *et al.* (2016).

Varieties

The results of rice varieties with respect to growth parameters showed that the variety 'Swarnadhan' produced significantly higher number of tillers, total dry matter and leaf-area index, but the plant height was recorded highest with the variety 'Sugandhamati' being at par with 'Swarnadhan' as shown in Table 1. The variety 'Varadhan' produced significantly higher number of grains/panicle, 1,000-grain weight, weight of the panicle and exhibited lower sterility percentage. Thus, it gave highest grain yield. Similar trend was followed in harvest index also where the

Table 1. Growth parameters of different duration rice varieties as influenced by varied levels of nutrient application

Treatment	Growth parameters			
	Plant height (cm)	No. of tillers/m ²	Leaf-area index	Dry-matter accumulation (g/m ²)
<i>Nutrient levels</i>				
50% RDF	121.6	274	3.24	1,559
100% RDF	128.3	291	4.50	1,724
150%RDF	132.7	306	5.83	2,036
SEm±	0.58	4.7	0.14	53.1
CD (P=0.05)	1.5	18.8	0.58	133.4
<i>Rice varieties</i>				
'DRR Dhan 44'	125.8	291	4.05	1,567
'DRR Dhan 46'	129.3	295	5.11	1,784
'MTU 1010'	119.8	289	3.87	1,684
'Varadhan'	127.4	295	4.37	1,910
'Sugandhamati'	133.7	273	3.49	1,558
'Swarnadhan'	129.3	297	6.26	2133
SEm±	1.0	4.4	0.24	99.6
CD (P=0.05)	3.0	12.9	0.70	287.5
<i>Interaction (F × V)</i>				
SEm±	1.7	8.4	0.41	166.2
CD (P=0.05)	NS	NS	NS	NS

RDF, Recommended dose of fertilizer.

Table 2. Yield attributes yields and harvest index of rice as influenced by rice varieties and levels of nutrient application

Treatment	Effective tillers/m ² (Nos.)	Panicle length (cm)	Weight of panicle (g)	Grains/panicle (Nos.)	Sterility (%)	1,000-grain weight (g)	Grain yield (t/ha)	Straw yield (t/ha)	Harvest index (%)
<i>Nutrient levels</i>									
50% RDF	246	23.8	4.7	135	19.5	24.9	4.1	5.4	44.0
100% RDF	272	26.7	5.5	160	15.3	26.1	5.6	8.0	41.0
150% RDF	281	26.8	6.2	177	14.0	26.9	6.0	8.9	40.0
SEm±	1.7	0.09	0.14	4.3	0.24	0.36	0.12	0.23	1.5
CD (P=0.05)	6.8	0.23	0.57	17.2	0.95	0.90	0.31	0.93	NS
<i>Rice varieties</i>									
‘DRR Dhan 44’	257	25.2	5.8	146	20.9	25.7	4.7	7.1	40.1
‘DRR Dhan 46’	269	26.3	5.6	158	16.0	27.5	5.4	7.2	43.3
‘MTU 1010’	261	25.0	4.7	168	13.3	25.7	5.3	7.9	40.8
‘Varadhan’	277	25.2	6.1	177	11.4	27.0	6.5	7.5	46.9
‘Sugandhamati’	253	27.4	4.6	123	19.9	24.6	3.8	6.2	38.8
‘Swarnadhan’	282	25.5	5.9	171	16.1	25.3	5.7	8.9	39.1
SEm±	3.9	0.33	0.15	5.0	1.3	0.48	0.16	0.49	1.1
CD (P=0.05)	11.2	0.95	0.44	14.6	3.1	1.4	0.5	1.5	3.9
<i>Interaction</i>									
SEm±	6.3	0.53	0.28	9.0	2.1	0.84	0.29	0.85	2.9
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS

RDF, Recommended dose of fertilizer.

variety ‘Vardhan’ produced significant harvest index (Table 2). The variety ‘Swarnadhan’ gave higher straw yield, as it produced more number of tillers and accumulated more of dry matter. The results are similar with the finding of Saha and Mittra (1984), Ghosh and Mrit-y-unjays (2001) and Sabir *et al.* (2007).

The medium-duration rice variety ‘Varadhan’ gave the highest grain yield owing to the high yield potential than other varieties, which was followed by ‘Swarnadhan’. The higher grain yield was mainly owing to increase in growth and yield components of the rice. Among the nutrient levels, application of 150% RDF (N : P₂O₅ : K₂O 180 : 90 : 60 kg/ha) showed the highest growth, yield attributes and yields in rice.

The above results indicated that improved rice varieties respond well to nutrient application because of both genetic variability and nutrient-utilization efficiency as compared to that of conventional varieties. On this basis, we may conclude that for getting the higher yields, it is required to apply higher dose of fertilizers to supplement the nutritional requirement of modern or improved rice varieties.

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