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Influence of Target Yield-based Nutrient Management Using Rice Crop Manager on Growth and Productivity of Rice Cultivars

SHRIJA BHUNIYA, LALICHETTI SAGAR*, SONIA PANIGRAHI, RANJEET SINGH BOCHALYA[1], SAVIRIGANA PRASANTH AND DEBANJAN GUCHHAIT

Department of Agronomy and Agroforestry, M. S. Swaminathan School of Agriculture, Centurion University of Technology and Management, Odisha-761 211, India
**(e-mail: lalichetti.sagar@cutm.ac.in; Mobile:70065 05360)*

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ABSTRACT

Rice productivity in Odisha, particularly in districts like Gajapati, remains low due to abiotic stresses and inefficient fertilizer use. To address this, site-specific nutrient management (SSNM) and tools like the Rice Crop Manager (RCM) have been introduced to optimize nutrient application based on field-specific conditions. In the light of above facts, the present study was laid out in split plot design with three main plot treatments (cultivars) viz., Bina Dhan 11, MTU 1010 and MTU 1156 as well as three subplot treatments (target yield based nutrient management) viz., RDF, RCM-based nutrient management for a target yield of 6 t/ha and RCM-based nutrient management for a target yield of 7 t/ha which were replicated thrice. The results revealed that MTU 1156 recorded the highest tiller number, dry matter accumulation, grain and straw yield, performing significantly better than Bina Dhan 11. RCM-based nutrient management targeting 7 t/ha resulted in superior growth and yield attributes compared to RDF, highlighting its effectiveness in enhancing productivity. Therefore, it can be concluded that the MTU 1156 with RCM-based nutrient management for a target yield of 7 t/ha is recommended for maximizing growth and productivity of rice.

Key words: Cultivars, nutrient management, rice, rice crop manager, target yield

INTRODUCTION

Odisha is one of the leading contributors to rice cultivation, covering 3.94 million hectares and producing 9.14 million tonnes of rice. However, the state's average productivity remains relatively low at 2318 kg/ha. In the Gajapati district of Odisha, rice is a major crop grown on 40.46 thousand hectares, yielding 71.7 thousand tonnes with an even lower productivity of 1772 kg/ha (GoO, 2023).

Rice production in eastern India, including Odisha, is constrained by multiple abiotic stresses such as drought, flooding, salinity and low soil fertility. These natural constraints are further intensified by inefficient fertilizer management practices (Kumar *et al.,* 2021). Farmers in the region often apply fertilizers in uniform quantities, without assessing the actual nutrient status of their fields or the specific requirements of the rice crop (Sharma *et al.,* 2019). This approach results in either under-application or over-application of fertilizers, both of which are economically and environmentally unsustainable.

In response to the limitations of general recommendations of fertilizers for a large area and the growing need for efficient nutrient use in rice cultivation, Site-Specific Nutrient Management (SSNM) was developed during the 1990s as a scientific approach to optimize fertilizer use in a more targeted and effective manner (Patil *et al.,* 2020). SSNM recognizes that nutrient needs vary considerably across different fields and even within a single field due to differences in soil fertility, crop varieties, water availability and management practices. Rather than applying the same amount of fertilizer everywhere, SSNM promotes customized nutrient application tailored to the specific needs of the crop and field conditions. The concept of target yield is crucial in SSNM, as it allows nutrient recommendations to be scaled precisely to the

[1]Department of Agronomy, Maharishi Markendeshwar (Deemed to be University), Mullana, Ambala-133 203 (Harayana), India.

yield potential of a field, taking into account genetic potential of the cultivar, management practices and resource availability (Sarma *et al.,* 2024). This helps to avoid both nutrient overuse in low-potential environments and underuse in high-potential ones, thereby improving both productivity and input-use efficiency.

In this scenario, the Rice Crop Manager (RCM), an ICT-based tool developed by IRRI and adapted for Odisha, is gaining popularity for optimizing nutrient management in rice. Since different rice cultivars respond differently to nutrient levels and yield targets, this study was conducted to evaluate RCM across various cultivars and yield scenarios to develop genotype-specific nutrient strategies.

MATERIALS AND METHODS

A field experiment was conducted at the PG Research Farm of the M. S. Swaminathan School of Agriculture in Paralakhemundi, Odisha, which is part of Centurion University of Technology and Management. The site is located in Odisha, India's sub-humid and sub-tropical North-Eastern Ghat Zone, with coordinates of 18°80'49" N latitude and 84°17'90" E longitude with an altitude of 88 m above the mean sea level.

The maximum temperature varied from 31°C to 34°C and minimum temperature ranged from 21°C to 27°C during the cropping period. There was total 799 mm of rainfall throughout this period. The highest relative humidity recorded in morning was 87.2%, while the highest relative humidity recorded in afternoon was 81.8%. Sunshine hours ranged from 4 h/day to 9 h/day during the cropping season.

The soil of the experimental field was sandy loam in texture with slightly acidic in pH, low organic carbon content, low available nitrogen, medium available phosphorus and low in available potassium.

The experiment was laid out in split plot design with three cultivars in main plot viz., Bina Dhan 11, MTU 1010 and MTU 1156, and three target yield-based nutrient recommendations in sub-plots viz., recommended dose of fertilizers (RDF), RCM-based nutrient management (Target yield 6 t/ha), RCM-based nutrient management (Target yield 7 t/ha) which were replicated thrice. The treatment details and fertilizer application schedule are presented in Tables 1 and 2, respectively.

Table 1. Treatment details

Main plot	Cultivars
C_1	Bina Dhan 11
C_2	MTU 1010
C_3	MTU 1156
Sub plot	Nutrient management
N_1	RDF (80-40-40 kg N-P_2O_5-K_2O/ha)
N_2	RCM (Target yield 6 t/ha)
N_3	RCM (Target yield 7 t/ha)

Table 2. Fertilizer application schedule during crop growing season of 2024

Nutrient management	N (kg/ha)	P_2O_5 (kg/ha)	K_2O (kg/ha)
RDF	80	40	40
RCM-based nutrient management (Target yield 6 t/ha)	139	38	65
RCM-based nutrient management (Target yield 7 t/ha)	156	43	80

The collected experimental data for different parameters were subjected to statistical analysis using analysis of variance (ANOVA). The standard error of means (S. Em±) and the critical difference at a significance level of P = 0.05 were calculated for the analysis.

RESULTS AND DISCUSSION

The data presented in Table 3 reveal that at harvest, apart from plant height all other parameters viz., number of tillers per square metre and dry matter accumulation per square metre were significantly influenced by cultivars. Among cultivars, MTU 1156 recorded the highest number of tillers/m^2 and dry matter accumulation (g/m^2) which was at par with MTU 1010. Further, the former treatment significantly outperformed Bina Dhan 11 in terms of number of tillers/m^2 and dry matter accumulation (g/m^2) by 27.1 and 23.3%, respectively. This might be attributed to genetic makeup of the cultivar in the given agroclimatic region. This discussion was is close conformity with the findings of Dileep *et al*. (2018). However, plant height was not influenced significantly due to stabilization of vegetative growth.

Among target yield-based nutrient management, RCM-based nutrient management for a target yield of 7 t/ha recorded the highest

Table 3. Influence of target yield based nutrient management using rice crop manager on growth parameters at harvest of rice cultivars

Treatment	Plant height (cm)	No. of tillers/m^2	Dry matter accumulation (g/m^2)
Cultivars			
Bina Dhan 11	105	217	1135
MTU 1010	114	271	1368
MTU 1156	119	276	1399
S. Em. (±)	4	11	32
C. D. (P=0.05)	NS	45	125
Target yield-based nutrient management			
RDF	107	235	1193
RCM-based nutrient management (Target yield 6 t/ha)	115	265	1342
RCM-based nutrient management (Target yield 7 t/ha)	115	265	1367
S. Em. (±)	3	6	30
C. D. (P=0.05)	NS	18	93

NS–Not Significant.

number of tillers per square metre and dry matter accumulation per square metre which was at par with RCM-based nutrient management for a target yield of 6 t/ha and significantly superior over RDF (Table 3). This might be due to adequate and balanced application of nutrients to the rice crop. These results are in close conformity with the findings of Pujari *et al.* (2022) and Lalichetti *et al.* (2024). However, the target yield-based nutrient management did not influence the plant height of rice at harvest significantly.

The perusal of data in Table 4 reveals that among cultivars MTU 1156 recorded the highest grain yield which was at par with MTU 1010. Moreover, the former treatment was significantly superior over Bina Dhan 11 by 28.3% which recorded the lowest grain yield. This was mainly attributed to number of effective tillers per square metre, number of filled spikelets per panicle and 1000-grain weight likely due to better assimilate partitioning capacity of the cultivar when cultivated under the given agroclimatic conditions. The result is in close conformity with the findings of Singh *et al.* (2020) and Pujari *et al.* (2022). Moreover, the highest straw yield was also noted by MTU 1156 which was statistically comparable with MTU 1010 and the former significantly outperformed Bina Dhan 11 by 18%. This might be due to limited vegetative phase and smaller canopy size, which restricted dry matter accumulation leading to lower straw yield of rice. It was in close conformity with the findings of Sampath and Srinivas (2017).

Table 4. Influence of target yield-based nutrient management using rice crop manager on yield and yield attributes of rice cultivars

Treatment	No. of effective tillers/m^2	No. of filled spikelets/ panicle	1000-grain weight (g)	Grain yield (kg/ha)	Straw yield (kg/ha)
Cultivars					
Bina Dhan 11	211	132	16.94	4654	7225
MTU 1010	258	141	19.59	5245	8395
MTU 1156	262	152	21.75	5697	8497
S. Em. (±)	6	4	0.79	177	206
C. D. (P=0.05)	25	15	3.10	697	809
RDF	228	130	18.37	4544	7391
Target yield-based nutrient management					
RCM-based nutrient management (Target yield 6 t/ha)	252	137	19.86	5477	8301
RCM-based nutrient management (Target yield 7 t/ha)	254	159	20.04	5576	8425
S. Em.(±)	4	4	0.94	157	210
C. D. (P=0.05)	12	12	NS	482	648

NS–Not Significant.

Among target yield-based nutrient management, RCM-based nutrient management for a target yield of 7 t/ha recorded the grain yield of rice which was on par with RCM-based nutrient management for a target yield of 6 t/ha which was significantly superior over RDF by 22.7% (Table 4). This was mainly attributed to total number of spikelets per square metre which is a function of number of effective tillers per square metre and number of filled spikelets per panicle. The maximum number of effective tillers per square metre and number of filled spikelets per panicle were noted by RCM-based nutrient management for a target yield of 7 t/ha, which was at par with RCM-based nutrient management, for a target yield of 6 t/ha. However, the former treatment significantly outperformed latter treatment in terms of number spikelets per panicle. This discussion was in close conformity with the findings of Mannade *et al.* (2017) and Goudra *et al.* (2019).

CONCLUSION

The study evaluated the impact of target yield-based nutrient management using rice crop manager on rice cultivar growth and productivity and concluded that MTU 1156 with RCM-based nutrient management for a target yield of 7 t/ha, which was recommended for maximizing growth and productivity of rice.

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