Effect of integrated nutrient management on yield and yield attributes in Scented Rice (*Oryza sativa* L.)

ABSTRACT

The current study was conducted at Barrister Thakur Chhedilal College of Agriculture and Research Station, Bilaspur, India, during the autumn season of 2019-20. The research focused on integrated nutrient management in scented rice, incorporating both organic and inorganic nutrient sources along with the recommended dose of fertilizers (RDF) at 100:60:40 NPK kg ha-1. The experimental design employed a randomized block layout (RBD) with ten treatments and three replications, utilizing the Chhattisgarh SugandhitBhog variety of scented rice. The findings revealed noteworthy outcomes among the various organic and inorganic treatments. Notably, Treatment 6 (75% RDF + 5 tonnes of Vermicompost ha-1 enriched with consortia) exhibited the highest grain yield of 35.78 q ha-1, signifying significant superiority over other treatments. Treatment 5 (75% RDF + 5 tonnes of FYM ha-1 enriched with consortia) closely followed with a grain yield of 34.24 q ha-1, demonstrating comparable performance. Additionally, Treatments 4, 3, 2, and 10 showed promising results in terms of yield attributes. The superior performance of Treatment 6 in terms of higher yield and yield attributes, including the highest number of panicles per m2 (349.36), underscores its effectiveness and significance in the context of integrated nutrient management for scented rice cultivation.

Keyword:Integrated nutrient management, scented rice,

INTRODUCTION

Rice (*Oryza sativa* L.) is the world's largest staple food crop. It is the rich energy source and contains reasonable protein (6-10 percent), carbohydrate (70-80 percent), minerals (1.2-20%) and vitamins (Riboflavin, Thiamine, Niacin and Vitamin E). (Anonymous 2014). This data shows that in the 2018 crop year about 167.13 million hectare. India covers more than 30% of total cultivated area and contributes more than 40% of total production. In India rice production for 2015-16 amounts to 104.41 million tonnes, 2400 kg ha^{-1} of production covering an area of 434.99 lakh hectares. The field size decreased to 431.94 lakh hectare in 2016-17 with an increase in 110.15 million tonnes of output and 2500 kg ha^{-1} productivity (Annual report of 2017-18). India has 42.95 million hectare acreage with 111.01 million tonnes of production. According this data published by Indian stat (Anonymous, 2018). The state leader in rice in India is Uttar Pradesh, the rice is cultivated in an area of 5.95 million hectare (mha) with gross output of 13.53 hectare. In rice responsible for its scent, 2-Acetyl-1 pyrroline (2-AP) is most common; almost every state in the country has its own set of aromatic rice that has a good performance in.

Chhattisgarh is historically known as an Indian bowl of rice. More than 23,250 rice varieties were reported in state. In Chhattisgarh, rice is grown in 3.79 million hectare (mha) area and covers 8.58 percent of India, with average yield of 6.91 million tonne. (Anonymous, 2018). In the state of Chhattisgarh, there are many scented rice varieties that are cultivated and popular for their cultivation. Rice varieties are being grown in Chhattisgarh *i.e*. Jeeraphool, Dubraj, Vishnubhog and Jawaphool. Indira Gandhi Krishi Vishwavidyalaya developed medium length and short height of scented rice "Chhattisgarh SugandhitBhog".Several studies have highlighted the role of integrated nutrient management activities to increase crop yields and improve soil quality in long term. The use of organic manures plays an significant role in the use of fertilizers performance, lower cost of supply of nutrients, increase production under rainfed conditions and require less capital investment, particularly under unfavourable weather conditions.

Organics supplies nutrients during peak adsorption and also supplies micro nutrients and alters soil physical behaviour and increase the performance of applied nutrients (Pandey *et al.*, 2018). Use of organic and inorganic fertilizers mixture which increases the nutrient use efficiency and minimum losses of nutrients. The nitrogen loss processes occur by leaching and de-nitrification. Reasonable and fertilizer use can increase markedly the yield and the rice quality improved. PSB (Phosphorus Solubilizing Bacteria) plays an important role amongst soil microorganisms in the solubilization of P for plants and use of phosphatic fertilizers.

MATERIALS AND METHODS

Field experiments were conducted at Barrister Thakur Chhedilal College of Agriculture and Research Station, Bilaspur (C.G.) during *Kharif*season 2019-20. The experimental plot soil has been classified as black group, known as clayey loam soil. pH in soil was 6.2, Electrical conductivity was recorded 0.25 dSm^{-1}, OC 0.64 and available nitrogen was 150 kg ha^{-1}, phosphorus and potassium was 13.88 kg ha^{-1} and 204.96 kg ha^{-1} respectively. The present experiment was laid out in Randomized Block Design (RBD) with ten treatments and three replications. Ten treatments of the experiment *viz*., T_1 – Control, T_2 – 100% RDF (100:60:40 kg NPK ha^{-1}), T_3 – 75% RDF + 5 tonne FYM ha^{-1}, T_4 – 75% RDF + 5 tonne Vermicompost ha^{-1}, T_5 – 75% RDF + 5 tonne FYM ha^{-1} enriched with consortia, T_6 – 755 RDF + 5 tonne Vermicompost ha^{-1} enriched with consortia, T_7 – 50% RDF + 5 tonne FYM ha^{-1}, T_8 – 50% RDF + 5 tonne Vermicompost ha^{-1}, T_9 – 50% RDF + 5 tonne FYM ha^{-1} enriched with consortia, T_{10} – 50% RDF + 5 tonne Vermicompost ha^{-1} enriched with consortia. Rice variety "Chhattisgarh sugandhitbhog" used as a experimental variety. Recommended dose of fertilizers for scented rice *i.e.*, 100:60:40kg NPK ha^{-1} was application as urea, single super phosphate (SSP) and murate of potash (MOP). Available nitrogen, phosphorus and potassium content sample was determined by Alkaline permanganate method (Subbaiah and Asija,1956), Olsen's method (Olsen, 1954)and Flame photometer (Jackson,1967). Data subjected was statistical analysis as prescribed by Gomez and Gomez, 2010.

RESULT AND DISCUSSION

Panicle Length

The data on the length of the panicles (cm) is shown in Table- 1 . Panicle length was at par with different treatment. However, the longest panicles (24.39 cm) were reported in the T_6 (75% RDF + 5 tonne Vermicompost ha^{-1} enriched with consortia) nearly followed by T_5 (75% RDF + 5 tonne FYM ha^{-1} enriched with consortia) (23.50 cm), T_4 and T_3. The shortest panicle length reported in T_1 (control) 20.29cm.

The data showed that the integrated nutrient management methods and the application on of only chemical fertilizers had a positive impact on the length of panicles but was statistically at par.however, the maximum plant height, highest grain yield and maximum panicle length observed in treatment T_6 but treatment T_2 is closely followed without the bio-fertilizer application which is totally inorganic fertilizers.

Number of Panicle per m^2

Data on various yield attributes are shown in Table- 1 and shown in Table It was clear from the data that there was a substantial difference in the number of ear-bearing panicles per square meter between different treatments. Results indicated that the highest number of effective panicles per square meter (349.36) was observed in T_6 (75% RDF + 5 tonne Vermicompost ha^{-1} enriched with consortia) which was significantly superior over other treatments but was at par with T_5 (75% RDF + 5 tonne FYM ha^{-1} enriched with consortia) 327.97. Minimum number of effective panicles observed in T_1 (Control) with 232.40.

Test Weight

Data on the weight of 1000grain as determined by different treatments are shown in Table- 1. The test weight of seed differed significantly between the different treatments. Result indicated that the highest test weight (24.84g) was observed in treatment T_6 (75%RDF + 5 tonne Vermicompost ha^{-1} enriched with consortia) which was significantly superior over other treatments but was at par with treatment T_5 (75%RDF + 5 tonne FYM ha^{-1} enriched with consortia) 24.54g recorded the minimum test weight of seed (20.18g) was reported in treatment T_1 (Control) which was significantly different from the other treatments.

In integrated nutrient management treatments, the number of panicles and test weight of seed nearly equal to the other significantly differed between single application of the required chemical or inorganic fertilizers. Its increase or decrease combination with FYM and Bio-fertilizers. Same results also found by Sahu *et al*.,(2017). Pandey *et al*.,(2018). Farooq *et al*.,(2018). Raj *et al*.,(2013). Sravan and singh*et al*.,(2019).

Table- 1 Effect of INM of Yield Attributing Characters

	Treatments	Length of panicles (cm)	No. of panicles/m^2	Test weight
T_1	Control	20.29	232.40	20.18
T_2	100% RDF (100:60:40 kg N:P:K ha^{-1})	22.34	293.30	21.76
T_3	75% RDF + 5 tonne FYM ha^{-1}	22.79	293.62	21.83
T_4	75% RDF + 5 tonne Vermicompost ha^{-1}	22.59	307.59	23.76
T_5	75% RDF + 5 tonne FYM ha^{-1} enriched with consortia	23.50	327.97	24.54
T_6	75% RDF + 5 tonne Vermicompost ha^{-1} enriched with consortia	24.39	349.36	24.84
T_7	50% RDF + 5 tonne FYM ha^{-1}	21.4	265.19	21.36
T_8	50% RDF + 5 tonne Vermicompost ha^{-1}	22.06	279.25	21.42
T_9	50% RDF + 5 tonne FYM ha^{-1} enriched with Consortia	22.15	282.76	21.51
T_{10}	50% RDF + 5 tonne Vermicompost ha^{-1} enriched with Consortia	22.29	286.51	21.58
SEm±		**0.71**	**12.54**	**0.64**
CD(0.05%)		**NS**	**37.26**	**1.89**

Grain Yield

Result indicated that the highest grain yield (35.78 qha^{-1}) was observed in treatment T_6 (75%RDF + 5 tonne FYM ha^{-1} enriched with consortia) which was significantly superior over other treatments but was at par with T_5 (75%RDF + 5 tonne FYM ha^{-1} enriched with consortia) with 34.24 qha^{-1}). Minimum grain yield observed in treatment T_1 (Control) 13.76 qha^{-1}.

In results indicated that the higher grain yield observed in treatment T_6 over other treatments but which was significantly at par with T_5 and followed by T_4, T_3. Organic sources such as vermicompost, bio-fertilizers and inorganic fertilizers have contributed to the constant supply of nutrients, hormones and related enzymes eventually reducing nutrient losses and increasing nutrient quality, yield and also increased the use efficiency. Same results also found by Rao *et al*.,(2013). Kumar *et at*.,(2014). Kandeshwari and Thavaprakash (2016). Sahu *et al*.,(2017). Harikesh *et al*.,(2017). Pandey *et al*.,(2018). Kumar *et al*.,(2018).

4.2.5. Straw Yield

In relation to grain yield, straw yield was also affected by various treatments, as shown in Table- 2. Result indicated that the highest straw yield (60.66 qha^{-1}) was observed in treatment T_6 (75% RDF + 5 tonne Vermicompost ha^{-1} enriched with consortia) which was significantly superior over other treatments but was at par with T_5 (75% RDF + 5 tonne FYM ha^{-1} enriched with consortia) 57.50 qha^{-1}. Minimum straw yield observed in treatment T_7 and T_1 38.57 and 24.70 qha^{-1} in descending order.

4.2.7. Harvest Index

The harvest index for various treatments is shown in Table- 2. Result indicated that the highest harvest index (39.77) was observed in treatment T_1 (Control) which was significantly superior over other treatments but was at par with T_9 (50% RDF + 5 tonne FYM ha^{-1} enriched with consortia) 39.07 followed by T_8, T_{10} and T_2. The minimum harvest index recorded in treatment T_7 (50% RDF + 5 tonne FYM ha^{-1}) 35.55.

The results indicated that the highest grain yield observed in T_6 and harvest index was observed in treatment T_{10} (50% RDF + 5 tonne Vermicompost ha^{-1}) which was significantly superior over other treatments. The use of organic nutrients with prescribed dose of fertilizer showed strong response for all characters.

Higher yields of grain and straw could be attributed to the combined use of organic and inorganic nutrients sources resulting in increased essential nutrients availability to the plant and improved soil quality which facilitated improved root spread this contributes to improved nutrient absorption and eventually to higher yields.

Each treatment was observed different harvest index but in treatment T_4 (75% RDF + 5 tonne Vermicompost ha^{-1}) was lower straw yield than other rest treatments and harvest index was increased. In results indicated that the higher grain yield observed in treatment T_6 over other treatments but which was significantly at par with T_5 and followed by T_4, T_3. Organic sources such as vermicompost, bio-fertilizers and inorganic fertilizers have contributed to the constant supply of nutrients, hormones and related enzymes eventually reducing nutrient losses and increasing nutrient quality, yield and also increased the use efficiency. Same results also found by Rao *et al*.,(2013). Kumar *et at*.,(2014). Kandeshwari and Thavaprakash (2016). Sahu *et al*.,(2017). Harikesh *et al*.,(2017). Pandey *et al*.,(2018). Kumar *et al*.,(2018).

Straw: Grain ratio

Straw: grain ratio data are presented in Table-2. Between the treatments, T_7 (50% RDF + 5 tonne FYM ha^{-1}) observed in highest straw: grain ratio (1.81) which was significantly superior over other treatments but was at par with T_1. The treatment T_9 (50% RDF + 5 tonne FYM ha^{-1} enriched with consortia) observed the minimum straw: grain ratio of 1.55.

Table- 2 Effect of integrated nutrient management Grain and Straw Yield

	Treatments	Grain Yields (qha^{-1})	Straw: Grain ratio	Straw Yield (qha^{-1})	Harvest Index (%)
T_1	Control	13.67	1.80	24.70	39.77
T_2	100% RDF (100:60:40 kg NPK ha^{-1})	28.35	1.66	45.71	38.27
T_3	75% RDF + 5 tonne FYM ha^{-1}	28.88	1.61	46.60	38.26
T_4	75% RDF + 5 tonne Vermicompost ha^{-1}	31.30	1.64	51.48	37.81
T_5	75% RDF + 5 tonne FYM ha^{-1} enriched with consortia	34.24	1.67	57.50	37.32
T_6	75% RDF + 5 tonne Vermicompost ha^{-1} enriched with consortia	35.78	1.69	60.66	37.10
T_7	50% RDF + 5 tonne FYM ha^{-1}	21.28	1.81	38.57	35.55
T_8	50% RDF + 5 tonne Vermicompost ha^{-1}	24.32	1.58	38.58	38.66
T_9	50% RDF + 5 tonne FYM ha^{-}	26.81	1.55	41.81	39.07

	[1]enriched with Consortia				
T_{10}	50% RDF + 5 tonne Vermicompost ha^{-1} enriched with Consortia	27.96	1.59	44.57	38.54
SEm±		**0.72**	**0.04**	**0.98**	
CD(0.05%)		**2.13**	**0.11**	**2.91**	

CONCLUSION

Based on the experimental findings, it is evident that the application of 75% RDF + 5 tonnes of vermicompost ha-1 enriched with consortia emerges as a favorable choice for achieving higher production under integrated nutrient management. In contrast, the control group yielded poor experimental results. Integrated nutrient management demonstrated consistently superior outcomes across all stages of the crop. The combination of organic and inorganic fertilizers not only had a positive impact on rice yield but also contributed to the sustainability of soil production capacity. Therefore, integrated nutrient management holds promise as a more successful and profitable approach for scented rice cultivation.

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