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Study of Performance of Short Grain Aromatic Rice (*Oryza sativa* L.) Varieties under Various Nutrient Management Options

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ABSTRACT: *The experiment was carried out at Raipur during season of 2012, at college of agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur to study the effect of combination of organic and inorganic fertilizers on growth, soil nutrient status, quality, economics and yield. The experiment revealed that the performance of* Dubraj *was comparatively better than that of* badshahbhog, vishnubhog *and* bisni *in terms of grain yield and growth characters, with good quality and yield too. The treatments receiving both organic and inorganic fertilizers has improved the soil fertility level along with highest plant height, tillers hill^{-1}, dry matter accumulation with good quality and yield in lower input cost.*

Keywords: *Organic and Inorganic Fertilizers, Integrated Nutrient Management, Soil Fertility, Yield and Aromatic Rice.*

INTRODUCTION

Rice is considered as the gift of god, and it is treated with reverence, and its cultivation is tied to elaborate rituals. Tradition holds that "the precious things are not pearls and jade but the five grains", of which rice is the first. Rice is only cereal that is eaten as whole grain and human selection down the ages has given preference to quality to cater to the needs of diverse rice based preparations. Rice is intimately involved in the culture as well as the food ways and economy of many societies. In world the total production of rice is 463.3 million tonnes (milled basis) in 2011–12 (Anonymous, 2012a). India is second largest producer after china and has an area of over 42.2 million hectares and production of 104.32 million tonnes with productivity of 2372 kg ha^{-1}. Rice production in India has shown a steady upward trend during the period 2005–06 to 2008–09 reaching a record level of 99.18 million tonnes in 2008–09. Production declined to 89.09 million tonnes in 2009–10 due to a severe drought gripping in most parts of the country but rebounded to 96 million tonnes in 2010–11 and further with a record production of 103.4 million tonnes in 2011–12 (Anonymous, 2012b). In India, supply of fine and fine scented rice is very less; therefore its market is comparatively high. In India, supply of fine and fine scented rice is very less; therefore its market is comparatively high. Most of the fine scented traditional varieties are tall, low productive, low input responsive, long duration and susceptible towards the insect, pest and diseases. Due to this, farmers are unable to make their cultivation a profitable enterprise in this region. It is therefore important to achieve high yield with good quality from scented rice varieties through proper nutrient management and use of good variety. Chhattisgarh has traditionally been known as the bowl of scented rice in central India, particularly due to several varieties of its aromatic rice. Grain quality of rice is determined by the factors such as grain appearance, nutritional value, cooking and eating quality (Juliano *et al.* 1990). Specialty rice is a term used to distinguish cultivars of rice that have unique properties like flavor, color, nutrition and chemical composition. Today, the consumers prefer to eat organically produced products because of the nutrient value and their reputation for nutritional excellence. Therefore the demands for good quality of scented rice are increasing among the populations. Farmers cannot afford to much high cost of cultivation so we have to develop some technique for the improve production in less cost of cultivation which enable the farmers to adopt the cultivation of scented rice.

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MATERIAL AND METHOD

A field experiment was carried out at the Instructional Farm I.G.K.V., Raipur (C.G.) during *kharif* season of 2012. The experiment was performed on '*Inceptisols*' (sandy loam) which is locally known as '*Matasi*'. The soil was neutral in reaction and medium in fertility having low N, medium P and high K. The experiment was laid out in split plot design with four varieties namely Dubraj, Badshah Bhog, Vishnu Bhog and Bisni in main plot and six nutrient management treatments *i.e.* ($N_{1)}$ 60:40:30 Kg N: P_2O_5: K_2O ha^{-1} (Inorganic), (N_2) 80:50:40 Kg N: P_2O_5: K_2O ha^{-1} (Inorganic), (N_3) 60:40:30 Kg N: P_2O_5: K_2O ha^{-1} (50%Inorganic+50% Organic), (N_4) 80:50:40 Kg N: P_2O_5: K_2O ha^{-1} (50%Inorganic+50% Organic), (N_5) 60:40:30 Kg N: P_2O_5: K_2O ha^{-1} (Organic – FYM) and (N_6) 80:50:40 Kg N: P_2O_5: K_2O ha^{-1} (Organic – FYM) in sub- plot and the treatments were replicated thrice.

Quantity of the nutrient was applied as per the treatments. The one third dose of inorganic nitrogen and whole amount of organic nitrogen, phosphorus and potassium was applied as basal dressing. Where as remaining dose of inorganic nitrogen was applied in two equal splits at 25-30 and 55-60 DAT of the crop. The source of organic nutrient was FYM and remaining nitrogen through urea, phosphorus through single super phosphate, and potassium through murate of potash the potash present were applied, in case of organic nutrient management treatment, amount of FYM was calculated as per the level of nitrogen only, However , the amount of phosphorus and potash present in the calculated FYM had decided the levels of P_2O_5 ad K_2O ha^{-1} in the treatments. Rice varieties are translated in rows with spacing of 20 cm whereas; the plant to plant spacing was 10 cm, using seed rate of 40 kg ha^{-1} for Dubraj, Vishnu Bhog, Bisni and 35 kg ha^{-1} for Badshah Bhog. Crop was transpanted on July 27, 2012 and harvested on December 2, 2012.

The plants of outer row and the extreme ends of the middle rows were excluded to avoid border effect. Five hills were randomly selected from each unit plot prior to harvest for recording data on plant height, total tillers/hill, bearing tillers/hill, non-baring tillers/hill, panicle length, grains/panicle, sterile spikelets/panicle, and 1000-grain weight. Grain yield, straw yield, and harvest index were recorded at harvest. The straws were sun dried and the yield of grain and straw/plot were converted to t/ha. Collected data were analyzed statistically following ANOVA technique and the mean differences were adjudged by Duncan's multiple Range lest (Gomez and Gomez, 1984).

Cost of production for all treatments was worked out on the basis of the prevailing input and market price of the produce. The net return ha^{-1} was calculated by deducting the cost of production ha^{-1} from the gross return ha^{-1}. Ultimately, net return per rupees (cost: benefit ratio) invested was calculated treatment wise to assess the economic impact of the treatments by dividing the net return ha^{-1} by the cost of production. The benefit: cost ratio was calculated with the help of following formula:

$$Benefit:cost\ ratio = \frac{Net\ return\ (Rs\ ha^{-1})}{Total\ cost\ of\ cultivation\ (Rs\ ha^{-1})}$$

RESULT AND DISCUSSION

Effect of Various Nutrient Management Options on Growth Characters

It is obvious from the data of plant height progressively increased with advancement of the age of crop. When organic sources of nutrients were applied and supplemented with inorganic sources of nutrients enhanced the nutrient availability and helped in increasing the plant height. Plant height varied significantly due to their genetic behavior and different growth habits of four varieties. Among the four varieties, *Badshah Bhog* had taller plants. Data on plant height of rice (Table 1.1) revealed that plant height increased progressively with increase in the age of the crop. The application of 80:50:40 kg N:P_2O_5:K_2O ha^{-1} (50% Inorganic + 50% Organic) was found to be at par with 80:50:40 kg N:P_2O_5:K_2O ha^{-1} (Inorganic). This result is in accordance with of Mahaptra *et al.* (2004), this indicated that supply of nutrients under these treatments were sufficient to meet the demand of the crop and thereby maintained the similar plant height. The positive role of nitrogen, phosphorus and potassium for cell division and enlargement has been already established. The increase in plant height is may be due to the greater availability and steady supply of essential plant nutrients during the entire period of crop growth.

Data related to number of tillers $hill^{-1}$ are presented in table 1.1. In general, tillers $hill^{-1}$ increased with crop age upto 90 DAT but, the number of tillers at maturity were slightly reduced. *Badshah Bhog* recorded significantly higher number of tillers $hill^{-1}$, which were at par with *Dubraj*. The application of 80:50:40 kg N:P_2O_5:K_2O ha^{-1} (50% Inorganic + 50% Organic) recorded higher number of tillers which were comparable with application of 80:50:40 kg N:P_2O_5:K_2O ha^{-1} (Inorganic). The results are also in

Table 1.1
Effect of Various Nutrient Management Options on Growth of Short Grain Aromatic Rice Varieties

Treatment	*Growth characters*		
	Plant height (cm)	*Number of tillers hill^{-1}*	*Dry matter accumulation (g hill^{-1})*
Varieties			
V_1 –Dubraj	131.38	6.87	36.55
V_2 –Badshah Bhog	136.26	7.01	36.29
V_3 –Vishnu Bhog	131.05	6.63	35.11
V_4 –Bisni	132.54	6.60	35.44
SEm±	0.93	0.10	1.43
CD (P=0.05)	3.22	0.34	NS
Nutrient management			
N_1- 60:40:30 Kg N: P_2O_5: K_2O ha^{-1} (Inorganic)	133.75	6.72	34.80
N_2- 80:50:40 Kg N: P_2O_5: K_2O ha^{-1} (Inorganic)	142.13	7.33	43.20
N_3 - 60:40:30 Kg N: P_2O_5: K_2O ha^{-1} (50%Inorganic+50% Organic)	132.54	6.92	37.57
N_4 - 80:50:40 Kg N: P_2O_5: K_2O ha^{-1} (50%Inorganic+50% Organic)	138.49	7.70	47.28
N_5 - 60:30:60 Kg N: P_2O_5: K_2O ha^{-1} (Organic – FYM)	122.57	5.82	22.67
N_6 - 80:40:80 Kg N: P_2O_5: K_2O ha^{-1} (Organic – FYM)	127.35	6.18	29.57
SEm±	1.91	0.09	0.46
CD (P=0.05)	5.48	0.27	1.37

consonance with the findings of Sarawgi and Sarawgi (2004[a]). it might be due to the fact that application of organic sources of nutrients and their combination with inorganic sources of a nutrient leads to greater availability of nutrients to the plants at all the stages of crop growth. Increased plant height also help in better photosynthesis in plant, which in turn helped in formation of new tillers. Similar results were also obtained by Jha *et al.* (2006).

The higher value of dry matter accumulation might be due to higher availability and translocation of nutrients during growth and development stages. The dry matter accumulation depends upon the photosynthesis and respiration rate, which finally increase the plant growth with respect to increased plant height, tillers etc by Mandal *et al.*, (2004). Application of different sources of nutrients influenced the dry matter accumulation of the crop significantly at all the stages of crop growth. The application of 80:50:40 kg N:P_2O_5:K_2O ha^{-1} (50% Inorganic + 50% Organic) recorded the highest dry matter accumulation as compared to other treatments. The application of inorganic sources in combination with organic sources of nutrients helped to mitigate crop requirement and thus this treatment assisted in increasing dry matter accumulation. These treatments provided sufficient nutrients for proper growth. the highest dry matter accumulation is due to higher length and weight of panicle and filled grains. Dry matter accumulation increased with the advancement of crop age as given in table 1.1. *Badshah Bhog* and *Vishnu Bhog* recorded the higher dry matter accumulation. The results have also been confirmed by Murali and Setty (2001). Similarly as dry matter accumulation, number of tillers and plant height was higher in integrated nutrient management of 80:50:40 kg N:P_2O_5:K_2O ha^{-1} (50% Inorganic + 50% Organic) followed by similar level of inorganic fertilizer.

Effect of Various Nutrient Management Options on Quality Characters

Quality parameters *viz.* hulling, milling and head rice recovery percentage is presented in table 1.2. Hulling, milling and head rice recovery percentage varied significantly due to genetic traits of the varieties and nutrient management practices. Among the varieties *Badshah Bhog* recorded significantly higher value of hulling, milling and head rice recovery percentage than others. Whereas *Dubraj* showed consistently lower values of hulling, milling and head rice recovery percentage. Similar result was reported by Kumar *et al.* (1996).

In case of integrated nutrient management practices, application of 80:50:40 kg N:P_2O_5:K_2O ha^{-1} (50%Inorganic+50%Organic) gave higher values of hulling, milling and head rice recovery percentage.

This was due to the combination of organic manure and inorganic fertilizers, which released nutrients for a longer period and increased the quality of scented rice this result also have been reported by have also been reported by Pandey *et al.* (1999).On the other hand lowest values of hulling, milling and head rice recovery percentage was recorded with the application of 60:30:60 kg N:P_2O_5:K_2O ha^{-1} (Organic-FYM). Similar finding was observed by Murali and Setty (2006).

In case of varieties, difference in hulling, milling and head rice recovery might be due to the fact that varieties bear different genetic characters. Similar results were also found by Dahiphale *et al.* (2004) and Rao *et al.* (1994).

Grain Yield and Straw Yield

The grain and straw yield as well as harvest index were significantly influenced due to nutrient management options and varieties (Table 1.3). Among the varieties *Dubraj* produced relatively higher grain yield. However highest straw yield was produced by the variety *Badshah Bhog*. While the highest harvest index was produced by the variety *Vishnu Bhog*. The application of 80:50:40 Kg N:P_2O_5:K_2O ha^{-1}(50%Inorganic+50% Organic) produced the significantly highest grain yield, which was at par with 80:50:40 Kg N: P_2O_5:K_2O ha^{-1} (Inorganic). The 80:50:40 kg N:P_2O_5: K_2O ha^{-1} (Inorganic) produced the highest straw yield, which was comparable to that of 80:50:40 Kg N:P_2O_5: K_2O ha^{-1} (50%Inorganic +50%Organic). Similar result was found by Paraye *et al.*, (2006). The increase in yield attributes significantly increased the grain yield. The higher grain yield was achieved under integrated nutrient management system especially with 80:50:40 kg N:P_2O_5:K_2O ha^{-1}(50% Inorganic+50% Organic) might be due to higher availability of essential nutrients and application of organic source(FYM) also helped in improving the physical condition of the soil for better root proliferation leading to higher absorption of water and nutrients and ultimately resulting in higher yield. Similar results have also been reported by, Mahapatra *et al.* (2004).

CONCLUSION

From the results it is clear that all cultivars showed better performance under combination of inorganic and organic than sole organic management. Moreover, based on sustainable agriculture concept use of organic fertilizer in combination with organic fertilizers for fine rice cultivation is must. Among the different nutrient management practices, application of 80:50:40 kg N:P_2O_5:K_2O ha^{-1} (50% Inorganic+50% Organic) gave better performance. It is revealed that the variety *Dubraj* fertilized with 80:50:40 kg N:P_2O_5:K_2O ha^{-1} (50% Inorganic+50% Organic) gave the highest grain yield. In case of variety the performance of *Dubraj* was comparatively better than that of *badshahbhog, vishnubhog* and *bisni* in terms of grain yield along with highest plant height, dry matter accumulation, leaf area and leaf area index with good yield attributing characters.

Table 1.2
Effect of Various Nutrient Management Options on Quality of Short Grain Aromatic Rice Varieties

Treatment	*Hulling*	*HRR*
Varieties		
V_1 –Dubraj	76.25	53.38
V_2 –Badshah Bhog	78.68	61.19
V_3 –Vishnu Bhog	76.55	56.16
V_4 –Bisni	76.42	57.02
SEm±	0.072	0.04
CD	0.251	0.14
Nutrient management		
N_1- 60:40:30 Kg N: P_2O_5: K_2O ha^{-1} (Inorganic)	76.61	56.25
N_2- 80:50:40 Kg N: P_2O_5: K_2O ha^{-1} (Inorganic)	77.84	58.04
N_3- 60:40:30 Kg N: P_2O_5: K_2O ha^{-1} (50%Inorganic+50% Organic)	77.73	57.11
N_4- 80:50:40 Kg N: P_2O_5: K_2O ha^{-1} (50%Inorganic+50% Organic)	78.09	58.76
N_5- 60:30:60 Kg N: P_2O_5: K_2O ha^{-1} (Organic – FYM)	75.60	55.38
N_6- 80:40:80 Kg N: P_2O_5: K_2O ha^{-1} (Organic – FYM)	76.53	56.10
SEm+	0.08	0.09
CD	0.25	0.27

Table 1.3
Effect of Various Nutrient Management Options on Grain Yield (q ha^{-1}), Straw Yield (q ha^{-1}) and Harvest Index (%) of Short Grain Aromatic Rice Varieties

Treatment	*Grain Yield (q ha^{-1})*	*Straw Yield (q ha^{-1})*	*Harvest Index (%)*
Varieties			
V_1 –Dubraj	29.22	55.1	35.6
V_2 –Badshah Bhog	26.78	59.59	30.9
V_3 –Vishnu Bhog	23.68	52.31	30.4
V_4 –Bisni	24.17	52.05	32.00
SEm±	0.71	1.67	0.6
CD (P=0.05)	2.47	6.79	2.1
Nutrient management			
N_1- 60:40:30 Kg N: P_2O_5: K_2O ha^{-1} (Inorganic)	26.2	59.46	30.4
N_2- 80:50:40 Kg N: P_2O_5: K_2O ha^{-1} (Inorganic)	29.3	66	30.8
N_3 - 60:40:30 Kg N: P_2O_5: K_2O ha^{-1} (50%Inorganic+50% Organic)	27.49	62.44	30.2
N_4 - 80:50:40 Kg N: P_2O_5: K_2O ha^{-1} (50%Inorganic+50% Organic)	30.62	64.08	31.5
N_5 - 60:30:60 Kg N: P_2O_5: K_2O ha^{-1} (Organic – FYM)	20.04	37.8	34.6
N_6 - 80:40:80 Kg N: P_2O_5: K_2O ha^{-1} (Organic – FYM)	21.22	38.76	35.7
SEm±	0.6	1.23	0.57
CD (P=0.05)	1.71	3.51	1.63

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