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Effect of different organic nutrient management on yield and yield attributes of different aromatic rice varieties

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Abstract
A field experiment was carried out at Research cum Instructional Farm, IGKV, Raipur, during *kharif* season of 2011. The soil of experiment field was '*Vertisols*'. The soil was neutral (pH 7.12) in reaction and medium in fertility having 0.52% organic carbon, low N (205.5 kg ha^{-1}), medium P (17.0 kg ha^{-1}) and high K (345 kg ha^{-1}). The experiment was laid out in split plot design with 3 replications. The main plot consisting of four aromatic rice varieties *viz.* Jeeraphool, Kasturi Badshah Bhog and Sugandhamati with six organic nutrient management treatments as sub plot *viz.* T_1 (cowdung manure + composted crop residue + Vermicompost), T_2 (T_1 + BGA + PSB + *Azospirillum*), T_3 (T_1 + Rock Phosphate), T_4 (T_1 + Panchagavya), T_5 (T_2 + Rock Phosphate + Panchagavya) and T_6 (T_1 + Neemastra).The results revealed that between Among the four varieties, Sugandhamati recorded significantly higher grain yield (37.74 q ha^{-1}) and followed by Kasturi (33.5 q ha^{-1}) and Badshah Bhog (33.43 q ha^{-1}). Additional organics (BGA+PSB+*Azospirillum*) over and above of T_1 (CDM, CCR and VC) provided a balanced supply of all essential nutrients, which synchronized with crop needs and uptake and thus resulted in significantly higher grain yield (35.99 q ha^{-1}) in T_5 (T_2 + rockphosphate + panchagavya). Increased in yield over T_1 was ranged from 12.3 to as high as 24.8 per cent in T_2 and T_5 respectively. Interaction between Sugandhamati variety and application of T_2 + RP + Panchgavya mixture (T_5) recorded higher grain yield of 42.87 q ha^{-1} and was significantly superior over all other combination of varieties with organic nutrient management. Significantly the highest straw yield was recorded in Badshah Bhog (96.41 q ha^{-1}) over other varieties. Between the rice aromatic varieties, heaviest panicle was recorded under variety Badshah Bhog (3.45 g) and was found significantly superior over all other varieties. While, Variety Kasturi (20.73 g) recorded significantly highest test weight among all other varieties.

Keywords: Organic, management, nutrient, attributes, aromatic

Introduction
The slogan 'Rice is life' is most appropriate for India as this crop plays a vital role in our national food security and is a means of livelihood for millions of rural households. More than 90 perscent of world's rice is grown and consumed in Asia, where 60 perscent of the earth's people live. Rice accounts for 35 to 75 perscent of the calories consumed by more than 3 billion Asians (Kumar *et al.*, 2006) [4] and is planted to about 154 m ha annually or on about 11 perscent of the total world's cultivated land. India is the second largest producer after China and has an area of over 43.77 m ha under rice and produced 89.05 mt during 2010 (Anonymous, 2011a) [1].

In Chhattisgarh, rice occupies an area around 3.61 m ha with the production of 5.22 mt and productivity of 1619 kg ha^{-1} (Anonymous, 2011b) [2]. Out of which, the productivity of aromatic rice varieties are less than improved one.

The yields of scented rice varieties are comparatively less than high yielding non scented varieties. The farmers have switched over to high yielding coarse rice because of the higher yield from modern varieties, which compensates for the premium price of scented rice. It is therefore important to achieve high yield from scented rice varieties, while, maintaining its quality too. This objective cannot be achieved by chemical nutrients source only. Because it is considered that, the quality characteristics of aromatic rice are improved through organic sources of nutrient on sustainable yield basis. Farmers of the state have been practicing *in situ* green manuring and using organic manures for years and sustained variety aroma and special taste. FYM is very common source of nutrients to the farmers of Chhattisgarh, which is prepared easily and contains substantial amount of plant nutrients.

Introduction of high yielding improved semi dwarf varieties and their wide acceptability may be another cause for shrinking the area and preference over tall indigenous low productivity varieties. Therefore, there is a need for taking research experiments to revive the lost fragrance and taste of these varieties, to increase their productivity without losing their quality by using organic manure practices alone or in combination.

Sustainable agricultural productivity and improvement in soil health and soil physical properties can be achieved by the use of organic manures and biofertilizer etc. Using organic resources like, cow dung manure, compost crop residue, vermicompost, blue green algae, phosphorus solubilizing bacteria, rock phosphate and *Azospirillum* etc deserves priority for sustained production and better resource utilization in organic nutrient management.

The role of plant nutrient would be extremely important from sustainability point of view. different organic sources and inclusion of biofertilizers and organic preparations to develop the suitable nutrient management practices for better quality and high productive fine and fine scented rice varieties by organic sources of nutrients to increase the nutrient use efficiency as well as sustainability.

Materials and Methods

The field experiment was conducted during *Kharif* season of 2011 at the Research cum Instructional Farm of Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.). Raipur is situated in mid – eastern part of Chhattisgarh state and lies at 21^0 16' North Latitude and 81^0 36' East Longitude with an altitude of 314.15 m above the mean sea level. Raipur comes under the Chhattisgarh plains agro climatic sub zone and having dry moist to sub humid climatic condition. The region receives an average of 1200-1400 mm annual rainfall, out of which about 87 percent received during the rainy season (June to September) and the rest 13 percent during the winter season (October to February). January is the coolest and May is the hottest month. The maximum temperature ranges from 26.7 ^{0}C and 42.5 ^{0}C. Atmospheric humidity varies between 70 to 90 per cent from mid June to March and wind velocity is high from May to August with its peak in June to July months. Soil surface temperature of this region crosses 60 ^{0}C, air temperature to 48 ^{0}C and humidity drops down to 3 to 4 per cent during summer season.

The experiment was laid out in split plot design with 3 replication. The main plot consisting of four aromatic rice varieties *viz.* Jeeraphool, Kasturi Badshah Bhog and Sugandhamati with six organic nutrient management treatments as sub plot *viz.* T_1 (cowdung manure + composted crop residue + Vermicompost), T_2 (T_1 + BGA + PSB + *Azospirillum*), T_3 (T_1 + Rock Phosphate), T_4 (T_1 + Panchagavya), T_5 (T_2 + Rock Phosphate + Panchagavya) and T_6 (T_1 + Neemastra). Rice varieties were transplanted in rows with planting geometry of 20 X 10 cm on July 20, 2011 and harvested on November 05, 2011 and November 16, 2011 due to different duration of varieties. The crop received 1193.7 mm rainfall during the study period.

All the organic sources of nutrients and rock phosphate were applied as per the treatments in respective plots to fulfill the nutrient requirement of 50:50:30 kg N: P_2O_5: K_2O ha^{-1}. Entire quantity of all sources was applied 4 days before the transplanting. Blue green algae were applied 10 days after transplanting as top dressing. 3-5 cm water level was maintained to up 25-30 days for better growth of Blue green algae. All the three main sources- i.e. cow dung manure, compost crop residue, and vermicompost were applied on N basis (1/3 of each) 4 days before the transplanting. Accordingly, 2563 kg ha^{-1} cow dung manure, 3332 kg ha^{-1} compost crop residue, and 1041 kg ha^{-1} of vermicompost were required to fulfill the required N to the crop in each and every treatment. These quantities of all three nutrient sources supplied 21.53 kg ha^{-1} (6.92+7.33+7.28 respectively) of P and 37.71 kg ha^{-1} (12.30+15.00+10.41 respectively) of K.

Results and Discussion

Number of effective tillers m^{-2}

Number of effective tillers m^{-2} were counted at harvest and presented in Table 1. It was significantly influenced due to different aromatic rice varieties and organic nutrient management treatments. Different aromatic rice varieties have their significant response on the number of effective tillers. Significantly higher number of effective tillers (291 m^{-2}) was recorded in Sugandhamati over Jeeraphool, which have the lowest count (244 m^{-2}). Other two varieties namely Kasturi (285 m^{-2}) and Badshah Bhog (278 m^{-2}) have also recorded Significantly similar number of effective tillers.

The interaction between varieties and different organic nutrient management was also found significant (Table 2). Addition of more organics in successive growth stages of T_4 & T_5 treatments have helped in increasing the number of effective tillers m^{-2} irrespective of variety. This was mainly due to higher photosynthetic efficiency and net assimilation, which helped in increasing the overall growth of the plant. Rest of the nutrient management treatments had recorded relatively similar number of effective tillers with same variety, which might be due to limited availability of nutrients to the plants. Similar results have been also found by Murali and Setty (2001) [8], Ghosh *et al*. (2005) [3], Mhaskar *et al*. (2005) [7] and Lal *et al*. (2009) [5].

Panicle length (cm)

As far as length of panicle is concerned, significantly longest panicle (30.4 cm) was observed in Badshah Bhog to that of Kasturi and found at par with Jeeraphool and Sugandhamati. Panicle length was remained unaffected due to different organic nutrient management practices (Table 1). However, longer panicle was recorded with T_5 (T_2 + rock phosphate + panchagavya) followed by T_4 (T_1 + panchagavya), T_3 (T_1 + rock phosphate). The shortest panicle was measured under T_1 (CDM + CCR + Vermicompost).

Panicle weight (g)

On perusal of data presented in Table 1 it is evident that weight of panicle varied significantly due to different varieties, however, it was remained unaffected due to different organic nutrient management treatments. Among the aromatic rice varieties, heaviest panicles were obtained under variety Sugandhamati (3.45 g) which was found significantly superior over all other varieties. Among various organics used, application of BGA + PSB + *Azospirillum* + RP and panchagavya alongwith CDM + CCR + VC in T_5 ranked first in weigh scale followed by T_4 where only panchagavya was applied in addition to CDM + CCR + VC.

Table 1: Effect of organic nutrient management on effective tillers, panicle length, panicle weight and test weight of different aromatic rice varieties

Treatment	Effective tillers (No. m^{-2})	Panicle length (cm)	Panicle weight (g)	Test weight (1000 grain) (g)
Aromatic rice varieties				
V_1=Jeeraphool	244	29.5	2.29	17.24
V_2=Kasturi	285	27.4	2.75	20.73
V_3=Badshahbhog	278	30.4	2.29	17.79
V_4=Sugandhmati	291	28.1	3.45	19.95
S.Em+	9	0.8	0.13	0.80
CD (P = 0.05)	31	2.8	0.47	2.76
Organic nutrient management				
T_1= CDM+CCR+VC	253	28.1	2.66	18.31
T_2=T1+BGA+PSB+Azo	274	28.9	2.70	18.95
T_3=T1+RP	273	29.2	2.67	19.19
T_4=T1+ Panchagavya	292	29.4	2.73	19.22
T_5=T2+RP+ Panchagavya	294	29.5	2.76	19.54
T_6=T1+Neemastra	261	27.8	2.67	18.36
S.Em+	6	0.7	0.18	1.18
CD (P = 0.05)	17	NS	NS	NS

Test weight (g)

The data on test weight in Table 1. clearly shows that it was significantly influenced due to varieties. Among the varieties, Kasturi recorded significantly highest test weight (20.73 g) over the other varieties. However, it was at a with Sugandhamati (19.95 g). The lowest test weight was noted with Jeeraphool.

Although different organic nutrient management did not affect the test weight but highest weight was recorded with T_5 (T_2 + Rock Phosphate + Panchagavya) followed by T_4 (T_1 + Panchagavya), T_3 (T_1 + Rock Phosphate). The lowest was recorded under T_1 (CDM + CCR + Vermicompost).

Grain yield (q ha^{-1})

It was significantly influenced due to the varieties as well as organic nutrient management. Among the four varieties, Sugandhamati recorded significantly higher grain yield (37.74 q ha^{-1}) and followed by Kasturi (33.5 q ha^{-1}) and Badshah Bhog (33.43 q ha^{-1}). Growth and yield attributing characters as well as genetic behavior were responsible for higher grain yield of Sugandhamati rice. Organic application registered higher dry matter production and increased photosynthetic rate, rapid mineralization of N from green manure and absorption by rice crop and creating favorable microenvironment to improve the organic matter content in the soil and plant growth (Meisheri *et al.*, 2001) [6]. Organic nutrition has increased the plant vigour with higher absorption of nutrient resulted in higher productive tiller production (Nagarju and Krishnappa, 1995) [9] and ultimately higher grain yield.

Straw yield (q ha^{-1})

The straw yield of rice was also significantly affected due to different aromatic rice varieties but was found non significant with organic nutrient management practices. The interaction between varieties and organic nutrient management was also found to be non significant. Among varieties, significantly the highest straw yield was recorded with Badshah Bhog (96.41 q ha^{-1}) over other varieties. The lowest was recorded with Jeeraphool (57.78 q ha^{-1}).

Harvest Index (%)

Harvest index is the ratio of economic yield with biological yield. The results revealed that it was not influenced significantly due to the application of organic nutrients but vary significantly with different aromatic rice varieties. Among all four varieties, higher percent of harvest index was recorded under Kasturi (38.28). Sugandhamati (34.84) and Jeeraphool (30.00) were also comparable to that of Kasturi. The lowest value of harvest index was recorded under Badshah Bhog (25.72). Among different organic nutrient management, application of CDM+ CCR+ VC+ BGA+ PSB+ *Azospirillum* with rock phosphate and panchagavya (T_5) registered higher harvest index followed by T_3 (T_1 + Rock Phosphate) and T_4 (T_1 + panchagavya) with 32.81 and 32.26%, respectively. The lowest value of harvest index was obtained with T_1 (CDM +CCR+ Vermicompost) with 30.93%.

Table 2: Effect of organic nutrient management on grain yield, straw yield and harvest index of different aromatic rice varieties

Treatment	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})	Harvest index (%)
Aromatic rice varieties			
V_1=Jeeraphool	24.75	57.78	30.00
V_2=Kasturi	33.58	54.19	38.28
V_3=Badshahbhog	33.43	96.41	25.72
V_4=Sugandhmati	37.74	70.63	34.84
S.Em+	2.33	6.67	2.74
CD (P = 0.05)	8.07	23.08	9.48
Organic nutrient management			
T_1= CDM+CCR+VC	28.85	65.42	30.93
T_2=T1+BGA+PSB+Azo	32.39	70.03	32.26
T_3=T1+RP	33.34	70.26	32.81
T_4=T1+ Panchagavya	33.67	72.09	32.41
T_5=T2+RP+ Panchagavya	35.99	72.98	33.45
T_6=T1+Neemastra	30.00	67.72	31.41
S.Em+	2.18	5.85	2.07
CD (P = 0.05)	6.24	NS	NS

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