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# Growth and yield performance of aromatic rice (*Oryza sativa* L.) varieties as affected by various nutrient management practices

**PS Rathiya, VK Singh and Ranjeet kumar**

**Abstract**
A field experiment was conducted during *kharif* 2015 at Raj Mohni Devi College of Agriculture and Research Station, Ambikapur, Chhattisgarh. The experiment was laid in split plot design replicated thrice to assess the performance of two aromatic rice varieties (Jeerafool and Pusa Basmati-1) in main plots and to find the best management practices with seven nutrient management practices ($N_1$- 20×10 cm with RDF (60:50:50 NPK kg $ha^{-1}$), $N_2$- 20×15 cm with RDF + 5t FYM $ha^{-1}$, $N_3$- 20×15 cm with RDF + 5t FYM $ha^{-1}$ + 5t GM (Green Manure) $ha^{-1}$, $N_4$- 20×15 cm with 75% RDF + 10t FYM $ha^{-1}$, $N_5$- 20×15 cm with 50% RDF +10t FYM $ha^{-1}$+ 10t GM $ha^{-1}$ + Mechanical weeding, $N_6$- 20×15 cm with 50% RDF + 10t FYM $ha^{-1}$ + 10t GM $ha^{-1}$ + Mechanical weeding + Silicon spray + ZnSo4, $N_7$- 20×15 cm with 150% N + 10t FYM $ha^{-1}$ + Staking) in sub- plots. The results revealed that aromatic rice Jeerafool recorded significantly higher plant height (137.4 cm), panicle length (26.71cm), number of grains $panicle^{-1}$ (276.14), panicle $weight^{-1}$ (2.31 g), grain yield (3.94 t $ha^{-1}$), straw yield (4.88 t $ha^{-1}$), biological yield (8.82 t $ha^{-1}$) and B:C ratio (1.65) whereas the number of total tillers (489.4 $m^2$), number of total panicle (396.3 $m^2$) and 1000-grains weight (25.31 g) was recorded in Pusa Basmati-1. Among the different nutrient management practices, 20×15 cm with 150 % N + 10 t FYM $ha^{-1}$ + Staking, resulted higher plant height (123.2 cm), number of total tillers (470.7 $m^2$), number of total panicle (383.3 $m^2$), panicle length (26.0 cm), number of grains $panicle^{-1}$(213.33), panicle $weight^{-1}$ (2.32g), 1000-grains weight (19.32 g), grain yield (4.3 t $ha^{-1}$), straw yield (4.86 t $ha^{-1}$), biological yield (9.16 t $ha^{-1}$) and B:C ratio (1.98).

**Keywords:** Growth and yield, aromatic rice, nutrient management.

## Introduction
Aromatic rice has great potential to attract rice consumer for its taste and deliciousness, and high price to boost up the economic condition of the rice grower in the country. Because of its natural chemical compounds which give it a distinctive scent or aroma when cooked, aromatic rice commands a higher price than non-aromatic rice. Increasing demand of quality rice calls for increasing the grain yield of available scented varieties without sacrifying the grain quality. Both grain yield and grain quality are mainly influenced by fertilizer management. The indigenous aromatic rice varieties are, poor yielders having poor response to fertilizer application (Singh *et al*. 2001) [10]. Presently adverse effects like decline in yield, soil fertility, and factor productivity are raising concerns about sustainability of the production system. Indiscriminate use of chemical fertilizers resulted in deterioration of soil physical, chemical and biological health in rice growing areas. The increasing land use intensity without balanced use of chemical fertilizers with little or no use of organic manure have caused severe fertility deterioration of soils resulting in stagnating or even declining crop productivity (Shormy *et al*., 2013) [9]. Increasing the productivity is a hard task due to emerging multi-nutrient deficiencies, imbalance use of fertilizers, and declining soil organic matter. (Bodruzzaman *et al*. 2002) [3] opined that the combined use of organic manures with inorganic fertilizers performed better than sole inorganic fertilizer to sustain the soil fertility and rice productivity. Therefore, a suitable combination of organic and inorganic source of nutrients is necessary for sustainable rice production that can ensure food production with high quality. Thus, a field experiment was conducted to improve production and profitability of Jeerafool and Pusa basmati-1 varieties with the use of organic manures and inorganic fertilizers.

## Materials and Methods
A field experiment was conducted during kharif 2015 at Research and Instructional Farm of Raj Mohani Devi College of Agriculture and Research Station, Ambikapur, Chhattisgarh. The soil of the experimental site was sandy loam with a pH of 5.8, available N- 233 kg $ha^{-1}$; $P_2O_5$- 10.5 kg $ha^{-1}$ and $K_2O$- 319 kg $ha^{-1}$. The experiment was laid in split plot design replicated thrice to assess the performance of two aromatic rice varieties (Jeerafool and Pusa Basmati-1)

in main plots with seven nutrient management practices ($N_1$- 20×10 cm with RDF (60:50:50 NPK kg $ha^{-1}$ ), $N_2$- 20×15 cm with RDF + 5t FYM $ha^{-1}$, $N_3$- 20×15 cm with RDF + 5t FYM $ha^{-1}$ + 5t GM (Green Manure) $ha^{-1}$, $N_4$- 20×15 cm with 75% RDF + 10t FYM $ha^{-1}$, $N_5$- 20×15 cm with 50% RDF +10t FYM $ha^{-1}$+ 10t GM $ha^{-1}$ + Mechanical weeding, $N_6$- 20×15 cm with 50% RDF + 10t FYM $ha^{-1}$ + 10t GM $ha^{-1}$ + Mechanical weeding + Silicon spray + ZnSo4, $N_7$- 20×15 cm with 150% N + 10t FYM $ha^{-1}$ + Staking) in sub- plots under different row spacing**.** The recommended dose was 60:50:50 kg N, $P_2O_5$, $K_2O$ $ha^{-1}$. FYM and green manure (green leaf of *Leucaena leucocephala*) was applied 2 days before transplanting of rice as per treatment. Entire dose of phosphorus and potassium and one third of nitrogen were applied basally. The remaining nitrogen was top dressed equally at tillering and panicle initiation stages. ZnSo4 (20 kg $ha^{-1}$) applied at the time of transplanting and micro nutrient silicon (3.0%) was applied at flowering stage as per the treatments. Observations on growth and yield parameters were recorded. The net returns and benefit cost ratio due to different treatments were calculated based on cost of cultivation at the prevailing market prices

## Results and Discussion

### Growth and yield attributes

Experimental results revealed that scented rice variety, Jeerafool recorded significantly higher plant height (137.4 cm), panicle length (26.71cm), number of grains $panicle^{-1}$ (276.14), panicle $weight^{-1}$ (2.31 g), as compared to Pusa basmati-1, whereas the maximum number of total tillers (489.4 $m^2$), number of total panicle (396.3 $m^2$) and 1000-grains weight (25.31 g) was recorded in Pusa Basmati-1 (Table. 1). Kharub and Chander (2008) [6] reported that application of chemical fertilizers improved 1000 grain weight of basmati rice compared to that of farm yard manure alone. Among the different nutrient management practices, 20×15 cm with 150% N + 10t FYM $ha^{-1}$ + Staking, producing higher plant height (123.2 cm), number of total tillers (470.7 $m^2$), number of total panicle (383.3 $m^2$), panicle length (26.0 cm), number of grains $panicle^{-1}$ (213.33), panicle $weight^{-1}$ (2.32g), 1000-grains weight (19.32 g), and also were at par with the treatment i. e 20×15 cm with 50% RDF + 10t FYM $ha^{-1}$ + 10t GM $ha^{-1}$ + mechanical weeding + silicon spray + ZnSo4 as compared to others (Table 1). Chaudary *et al.* (2011) [4] and Bahadur *et al.* (2013) [2] who reported increased plant height, effective tillers and length of panicle with increasing levels of nitrogen in combination with organic manures.

### Yield and Economics

The data on grain, straw, biological yield and economics of aromatic rice as influenced by varieties and nutrient management practices is presented in Tables 2. Among the varieties Jeerafool recorded significantly higher grain yield (3.94 t $ha^{-1}$), straw yield (4.88 t $ha^{-1}$), biological yield (8.82 t $ha^{-1}$) and B: C ratio (1.65) over the other cultivar Pusa basmati-1. This might be due to production of maximum number of grains $panicle^{-1}$ and panicle $weight^{-1}$. According to Gautam *et al.* (2005) [5], each successive increase in level of nitrogen significantly enhanced the grain yield of aromatic rice. Among the different nutrient management practices application of, 20×15 cm with 150% N + 10t FYM $ha^{-1}$ + Staking was recorded maximum grain yield (4.3 t $ha^{-1}$), straw yield (4.86 t $ha^{-1}$), biological yield (9.16 t $ha^{-1}$) and B:C ratio (1.98) respectively and also grain, straw and biological yield were at par with the treatment i. e 20×15 cm with 50% RDF + 10t FYM $ha^{-1}$ + 10t GM $ha^{-1}$ + mechanical weeding + silicon spray + ZnSo4 (Table.2). This 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) [7]. Adhikary and Majumdar (2002) [1] also suggested combined application of chemical fertilizers and organic manures for attaining higher grain yields. Higher yields under combined use of RFD and FYM could be attributed to well decomposition of FYM, which favoured better nutrient availability coupled with higher assimilation of nutrients. Murthy *et al.* (2012) [8] reported that increasing levels of nitrogen progressively enhanced the gross and net returns and benefit cost ratio up to 120 kg N $ha^{-1}$ and was significantly higher than with that of rest of nitrogen levels tried.

**Table 1:** Growth and yield attributes as influenced by aromatic rice varieties and nutrient management practices.

| Treatments | Plant height (cm) | Number of total tillers ($m^2$) | Number of total panicle ($m^2$) | Panicle length (cm) | Number of grains $panicle^{-1}$ | Panicle weight (g) | 1000-grains weight (g) |
|---|---|---|---|---|---|---|---|
| **Varieties** | | | | | | | |
| V1-Jeerafool | 137.4 | 371.9 | 296.8 | 26.71 | 276.14 | 2.31 | 12.17 |
| V2-Pusa Basmati-1 | 99.7 | 489.4 | 396.3 | 24.55 | 103.95 | 1.72 | 25.31 |
| SEm± | 2.2 | 13.2 | 19.0 | 0.36 | 15.14 | 0.12 | 0.28 |
| CD at 5% | 6.6 | 40.0 | 58.0 | 1.08 | 46.12 | 0.35 | 0.85 |
| **Nutrient Management** | | | | | | | |
| $N_1$- 20×10 cm with RDF (60:50:50 NPK kg $ha^{-1}$) | 112.7 | 369.7 | 308.8 | 24.95 | 151.67 | 1.61 | 18.77 |
| $N_2$- 20×15 cm with RDF + 5t FYM $ha^{-1}$ | 111.0 | 402.5 | 335.8 | 25.82 | 167.50 | 1.83 | 18.92 |
| $N_3$- 20×15 cm with RDF + 5t FYM $ha^{-1}$ + 5t GM $ha^{-1}$ | 117.7 | 414.0 | 320.3 | 25.70 | 193.50 | 2.06 | 18.65 |
| $N_4$- 20×15 cm with 75% RDF + 10t FYM $ha^{-1}$ | 117.5 | 433.3 | 345.8 | 25.62 | 192.83 | 2.03 | 18.28 |
| $N_5$- 20×15 cm with 50% RDF +10t FYM $ha^{-1}$ + 10t GM $ha^{-1}$ + mechanical weeding | 122.0 | 455.8 | 350.7 | 25.73 | 209.83 | 2.09 | 18.60 |
| $N_6$- 20×15 cm with 50% RDF + 10t FYM $ha^{-1}$ + 10t GM $ha^{-1}$ + mechanical weeding + silicon spray + ZnSo4 | 122.8 | 468.7 | 375.0 | 25.58 | 201.67 | 2.21 | 18.65 |
| $N_7$- 20×15 cm with 150% N + 10t FYM $ha^{-1}$ +Staking | 123.2 | 470.7 | 383.3 | 26.00 | 213.33 | 2.32 | 19.32 |
| SEm± | 2.4 | 8.5 | 13.9 | 0.49 | 9.08 | 0.10 | 0.28 |
| CD at 5 % | 7.0 | 24.8 | 40.5 | NS | 26.51 | 0.30 | NS |

GM- Green Manure

**Table 2:** Yield and economics as influenced by aromatic rice varieties and nutrient management practices.

| Treatments | Grain yield (t ha$^{-1}$) | Straw yield (t ha$^{-1}$) | Biological yield (t ha$^{-1}$) | Cost of cultivation (Rs./ha) | Net Income (Rs./ha) | B:C ratio |
|---|---|---|---|---|---|---|
| **Varieties** | | | | | | |
| V1-Jeerafool | 3.94 | 4.88 | 8.82 | 35079 | 57945 | 1.65 |
| V2-Pusa Basmati-1 | 3.52 | 4.20 | 7.72 | 35079 | 47821 | 1.36 |
| SEm± | 0.07 | - | 0.11 | - | - | - |
| CD | 0.20 | - | 0.33 | - | - | - |
| **Nutrient Management** | | | | | | |
| $N_1$- 20×10 cm with RDF (60:50:50 NPK kg ha$^{-1}$) | 2.9 | 3.99 | 6.90 | 32822 | 36385 | 1.11 |
| $N_2$- 20×15 cm with RDF + 5t FYM ha$^{-1}$ | 3.2 | 4.21 | 7.45 | 34822 | 41931 | 1.20 |
| $N_3$- 20×15 cm with RDF + 5t FYM ha$^{-1}$ + 5t GM ha$^{-1}$ | 3.6 | 4.46 | 8.10 | 36322 | 49556 | 1.36 |
| $N_4$- 20×15 cm with 75% RDF + 10t FYM ha$^{-1}$ | 3.7 | 4.38 | 8.10 | 34765 | 52769 | 1.52 |
| $N_5$- 20×15 cm with 50% RDF +10t FYM ha$^{-1}$ + 10t GM ha$^{-1}$ + mechanical weeding | 4.0 | 4.77 | 8.78 | 33207 | 61214 | 1.84 |
| $N_6$- 20×15 cm with 50% RDF + 10t FYM ha$^{-1}$ + 10t GM ha$^{-1}$ + mechanical weeding + silicon spray + ZnSo4 | 4.2 | 4.80 | 9.10 | 34181 | 66776 | 1.95 |
| $N_7$- 20×15 cm with 150% N + 10t FYM ha$^{-1}$ + Staking | 4.3 | 4.86 | 9.16 | 33761 | 67079 | 1.98 |
| SEm± | 0.1 | - | 0.23 | - | - | - |
| CD | 0.4 | - | 0.66 | - | - | - |

GM- Green Manure, Sale price of produce: Grain@ 22000/t and straw @ 1300/t

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