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# Effect of different organic manures and systems of planting on growth and yield of scented rice

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**Abstract**
A field research was carried out at crop research farm at the Maya College of Agriculture and Technology in Selaqui, Dehradun (Uttarakhand), during the 2016 *kharif* season. Combinations of six organic manure treatments (Green manuring with *Sesbania aculeata* + foliar spray of *Panchgavya* (3%), green manuring with *Sesbania aculeata* + foliar spray of fish amino acid (FAA 3%), green manuring with *Crotalaria juncea* + foliar spray of *Panchgavya* (3%), green manuring with *Crotalaria juncea* + foliar spray of fish amino acid (FAA 3%), basal application of FYM (12 t $ha^{-1}$) + foliar spray of *Panchgavya* (3%) and basal application of FYM (12 t $ha^{-1}$) + foliar spray of fish amino acid (FAA 3%)) in main plots and three systems of planting (System of Rice Intensification (SRI), Conventional Transplanted Rice (CTR) and Direct Seeded Rice (DSR)) in sub plots were used taken in split plot design with three replications in the experiment. Amongst organic manure treatments, maximum yield was recorded in basal application of FYM (12 t $ha^{-1}$) + foliar spray of *Panchgavya* (3%). Rice sown in SRI Method was obtained higher growth and yield.

**Keywords:** Rice, systems of planting, organic manure

## Introduction
Cereals are grasses which are members of the poaceae family and are grown for the edible parts of its grain, which consists of the endosperm, germ, and bran. More cereal grains than any other type of crop are farmed and offer more food energy globally. They include a wealth of vitamins, minerals, lipids, proteins, carbohydrates, and proteins in their natural state. According to Singh and Singh (2011) [10, 11], rice alone makes about 40% of India's production of food grains. India has the greatest area under rice cultivation, followed by China and Indonesia, with China producing the most. In terms of acreage, productivity, and consumer choice, it is among India's most significant staple food crops. Around the world, 164.19 million ha are used to grow rice, with 3105 kg $ha^{-1}$ and 509.87 million tonnes produced year, respectively. About 45 million hectares of land in India are used to grow rice, with yearly yields of 118.87 million tonnes and 2641.5 kg $ha^{-1}$, respectively. West Bengal, Bihar, Maharashtra, Uttar Pradesh, Panjab, Haryana, etc. are the major rice-producing states in India (FAO STAT 2020) [3].

Land, water, manpower, and other inputs like fertilisers, pesticides, and insecticides (which are heavy pollutants) are the main barriers to India's ability to produce rice. These barriers do not have an impact on the agricultural environment. The rapid adoption of farming systems centred on rice in India has had a negative impact on both the long-term viability and profitability of the soil as well as crop productivity. With increased worries about soil quality, human health, and environmental safety, it has become necessary to reconsider current agricultural practises, particularly fertiliser management. Furthermore, maintaining crop output at a high level, particularly in developing nations like India, is imperative if the population's demand for food grains is to be met. According to the findings of long-term research done on rice, this system's output is declining or stagnating. It is also clear that the amount of organic matter has decreased, and that this has changed both the soil's physical characteristics and its ability to hold onto nutrients. According to Yadav *et al*. (2009) [17], secondary nutrient deficits are also having an impact on how well rice is produced.

The rising prices of artificial fertilisers, along with the global energy crisis, have redirected the attention of agronomists and soil scientists to the search for alternative sources of nutrients. By combining inorganic fertilisers with organic fertilisers like FYM, green manure, and crop residues, Khan *et al*. (2006) [6] stated that it has become crucial to use the available organic manures efficiently through appropriate application methods, time of application, and integrated nutrient management practises.

In addition to being a significant source of secondary and micronutrients, FYM is dense organic manure that is a repository of important nutrients. Commonly utilised as farmyard manure are the wastes of cattle and goats. This manure contains modest amounts of all the nutrients that the plants need. Longer-lasting and producing well, they stay in the soil. Due to its in-situ production, quick decomposition in the soil, mobilisation of nutrients, and enhancement of the physical state of the soil, green manure has been determined to be the most suitable. The rice plant gets various nutrients from the soil from the day of seeding till harvest. As a result, it is crucial to replenish the nutrients that have been utilised and to maintain soil fertility for the crop that will be planted the following season.

The nutrients required by the plants can be obtained from organic sources such as farmyard manure, green manure, green leaf manure, and liquid formulations of organics such as cattle urine, botanicals, and so on. Both the soil's ability to infiltrate water and its ability to resist erosion are improved by these manures. They might also help improve the soil's biological qualities. The use of manures from wastes to boost soil productivity would be achieved through organic farming and recycling, which would reduce pollution. Food that is produced organically is anticipated to sell for more money, which can help make up for any losses caused by lower yields and create lucrative commercial opportunities on the global market.

According to an opinion expressed by Yadav and Lourduraj (2006) [16], organic farming could result in significant expenditure (23%) savings by using the effective/cheap *Panchgavya* foliar treatment method.

In the past 20 years or so, a novel strategy known as the System of Rice Intensification (SRI) has gained popularity due to its apparent success in raising rice productivity. The system of rice intensification (SRI), a practical rice growing option that increases yield while reducing inputs, was launched in India in the year 2000. Utilising organic manures like FYM and GM has been shown to be a successful INM for SRI component. However, there is a need for us to transition to organic farming wherever there is a chance of increasing productivity potential through this method (Uphoff *et al*., 2002) [15].

## Materials and Methods

A study was conducted at plot number 16 B of the crop research farm at the Maya College of Agriculture and Technology in Selaqui, Dehradun (Uttarakhand), during the 2016 *kharif* season. Selaqui receives 1040.4 mm of rainfall on average throughout the course of the experimental period. Selaqui is located at 25.28° N Latitude, 81.54° E Longitude, and 410 m above mean sea level. The average temperature for the maximum and minimum is 35.34°C and 12.94°C, respectively. The experimental site's soil had a sandy-loam with adequate drainage qualities and a reaction pH of 8.34. The soil was found to have low organic carbon (0.36%) and low levels of available nitrogen (0.028%) and medium in available phosphorus (13.05 kg ha$^{-1}$) and potassium (156.44 kg ha$^{-1}$). The treatments involved combinations of six organic manure treatments ($M_1$: green manuring with *Sesbania aculeata* + foliar spray of *Panchgavya* (3%), $M_2$: green manuring with *Sesbania aculeata* + foliar spray of fish amino acid (FAA 3%), $M_3$: green manuring with *Crotalaria juncea* + foliar spray of *Panchgavya* (3%), $M_4$: green manuring with *Crotalaria juncea* + foliar spray of fish amino acid (FAA 3%), $M_5$: basal application of FYM (12 t ha$^{-1}$) + foliar spray of *Panchgavya* (3%) and $M_6$: basal application of FYM (12 t ha$^{-1}$) + foliar spray of fish amino acid (FAA 3%)) in main plots and three systems of planting ($S_1$: System of Rice Intensification (SRI), $S_2$: Conventional Transplanted Rice (CTR) and $S_3$: Direct Seeded Rice (DSR)) in sub plots, taken in split plot design with three replications. 13-day-old rice seedlings were transplanted using SRI, while 22-day-old seedlings were transplanted using the traditional approach. Rice sprouting seed was planted in drums in the DSR. Manual puddling was done because there was no tractor with a puddler. *Sesbania aculeata* and *Crotalaria juncea*, two green manure crops, were grown in the field for up to 55 days on 30 June 2016, and then buried there with a tractor-drawn disc plough. 7 days prior to transplanting or sowing, well-decomposed FYM was applied at a rate of 12 t ha$^{-1}$.

*Panchgavya* was made with a 5:4:3:2:1 mixture of five ingredients, namely cow dung, cow urine, milk, curd, and ghee, and six ripe bananas, and fermented for 15 days. When applying as a foliar spray at 15, 30, 45, and 60 DAS/DAT according to the treatments, *Panchgavya* 3% solution was made by mixing 300ml of the prepared and filtered solution in 10 litres of water. Fish waste (2.5 kg) and jaggy (2.5 kg) were combined to create fish amino acid, which was then fermented for 15 days. A foliar spray of fish amino acid 3% solution was administered at 15, 30, 45 and 60 DAS/DAT in accordance with the treatments by mixing 300 prepared and filtered solution with 10 litres of water.

The experimental plot was ploughed with a tractor-drawn plough, then two harrowing passes were made, and finally planking. Following that, manual flooding and puddling procedures were carried out in experimental blocks. During the crop-growing season, the field was kept in a wet state and received eight irrigations as advised. With the aid of a cono weeder, weed control was performed twice at 22 and 36 DAS/DAT. Each plot's produce was picked separately based on the date of transplanting. Produce from the net plot was tied in individual bundles before being labelled.

Plant height was measured from the ground level up to the tip of growing point at 15, 30, 45, 60, 75 and 90 DAS/DAT in tagged plants and the averaged, expressed in cm. Number of tillers hill$^{-1}$ was counted from five tagged hill in each plot at 15, 30, 45, 60, 75 and 90 DAS/DAT. Number of primary branches on the main stem was counted in tagged plants at harvest and the mean was expressed as number of branches plant$^{-1}$. The tagged bundles were allowed for sun drying in field and after drying on the threshing floor, the weight of bundles was recorded for obtaining biological yield. Threshing of rice was done manually by beating panicles on the sheaf with wooden baton and then seeds were separated by winnowing and recorded grain yield as treatments wise and expressed as t ha$^{-1}$. Straw yield was calculated by subtracting grain yield from respective biological yield of each plot and expressed as t ha$^{-1}$. The ratio of economic yield (grain yield) to the biological yield (grain + straw yield) was worked out and expressed in percentage as advocated by Donald and Hamblin (1976) [2].

$$\text{Harvest index (\%)} = \frac{\text{Economic yield}}{\text{Biological yield}} \times 100$$

Data was statistically analyzed by following the method of analysis of variance as suggested by Panse and Sukhatme (1985) [8]. Critical difference was calculated wherever "F test" was found significant at 5 per cent probability level and the values were furnished. Treatment differences that were non–significant were denoted as 'NS'.

## Results and Discussion

### Organic manure

The results revealed that the growth attributes (plant height and number of tillers hill$^{-1}$) were significantly enhanced by organic manure of rice. The plant of rice at 45 and 60 DAS/DAT recorded significantly taller with basal application of FYM (12 t ha$^{-1}$) + foliar spray of fish amino acid (FAA 3%) and found at par with basal application of FYM (12 t ha$^{-1}$) + foliar spray of *Panchgavya* (3%) and green manuring with *Crotalaria juncea* + foliar spray of *Panchgavya* (3%). Increase in plant height may be due to synchronized availability of essential plants nutrients to the crop for a longer period during its growth stages (Deshpande and Devasenpathy, 2011) [1]. Foliar application of organic manures may have amplified hormonal effects in the receptive cells, tissues, organs leading to accelerated growth of rice plant (Frank and Ross, 1995) [4]. However, the plant height at 15, 30, 75, and 90 DAS/DAT and number of tillers hill$^{-1}$ at all growth stages was found to be significantly not affected by organic manure.

The grain yield was significantly influenced by the organic manure application (Table 1). The maximum grain yield, biological yield and harvest index was recorded with basal application of FYM (12 t ha$^{-1}$) + foliar spray of *Panchgavya* (3%). The corresponding increases in term of per cent 85.32, 00 and 43.39 as compared to green manuring with *Sesbania aculeata* + foliar spray of fish amino acid (FAA 3%). This might due to increased plant height and leaf area index may have helped in increasing the photosynthetic area for photosynthesis in plant. Foliar spray of Panchgavya showed beneficial effect on yield parameters. The easy transfer of nutrients through foliar spray of Panchgavya might be the reason for enhancement of yield attributes, and then increased yield ultimately (Yadav and Lourduraj, 2006) [16]. Better supply of micro and macro nutrients by organic manure might have helped for more enzymatic activity and physiological process of plant, which resulted into better translocation of the photosynthates and production of dry matter of the sink (grain). This might have helped in increasing the number of filled grains panicle$^{-1}$ and increased 1000- grain weight (Deshpande and Devasenapathy, 2011) [1]. The current and residual contribution of organic sources, *viz*., FYM and green manure may have carry-over effect, which in turn increased the availability of nutrients to plants, resulting in higher productivity of rice (Munda *et al*., 2008) [7].

### System of planting

The results revealed that the plant height was significantly enhanced by different system of planting of rice. The tallest plant height at 15, 30, 45 and 60 DAS/DAT was found in CRT system of planting treatment. However, later stage of growth (75 and 90 DAS/DAT) was recorded higher plant height under SRI system of planting treatment. The increase in plant height due to organic manure was to the magnitude of 53.53 & 80.74 per cent at 75 and 90 DAS/DAT, respectively over DSR system of planting. The younger seedlings in SRI when carefully transplanted by keeping the roots straight (assuring that the roots do not assume J shape) might have encouraged vigorous and deeper root system which in turn resulted into more vigorous and taller plants (Shekhar *et al*. 2009) [9]. The higher plant height realized with SRI method may be due to the use of younger seedlings which possesses a potential for more rooting. Also, wide planting, *i.e*. square pattern (25 cm x 25 cm) may have been helpful for better plant growth (Hugar *et al*. 2009) [5].

The significantly higher total number of tillers hill$^{-1}$ at 45, 60, 75 and 90 DAS/DAT observed in S1 treatment over rest of the treatments. Single plants starting as young (12-day) seedling with SRI practice were able to produce more tillers or panicles hill$^{-1}$. It may be due to greater number of large leaves, more open canopy structure with wider angles (Thakur *et al*. 2010) [14]. Increased plant height and leaf area index may have helped in increasing the photosynthetic area for photosynthesis in plant, which in turn helped in formation of new tillers. The higher number of tillers hill$^{-1}$ realized with SRI method may be due to adjusting mechanism of rice with regard tillering (Singh *et al*., 2011) [10, 11].

The grain yield was significantly influenced by the organic manure application (Table 2). The maximum grain yield, biological yield and harvest index was recorded with S1. The corresponding increases in term of per cent 85.32, 00 and 43.39 as compared to S3. SRI recorded an additional grain yield over CTR and DSR method which may be due more yield attributes and better partitioning. The increase in the test weight due to SRI method may be attributed to the larger root volume, profuse and stronger tillers and well filled spikelets with higher grain weight (Sowmya *et al*., 2011) [13]. Similar results were recorded by Sowmya *et al*. (2007) [12]. Higher grain yield realized with SRI method might be due to large root volume, strong tillers with big panicles as well as higher fertility of spikelet. Harvest index was considerably higher in plants grown at the spacing of 25 x 25 cm than in plants grown in other spacings. This indicates that differences in grain yield at the various spacing were attributable to differences in harvest index (Thakur *et al*., 2010) [14].

**Table 1:** Effect of different forms of organic manures and systems of planting on plant height and number of tillers hill$^{-1}$ of scented rice

| Treatments | Plant height | | | | | | Number of tillers hill$^{-1}$ | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 15 DAS/DAT | 30 DAS/DAT | 45 DAS/DAT | 60 DAS/DAT | 75 DAS/DAT | 90 DAS/DAT | 15 DAS/DAT | 30 DAS/DAT | 45 DAS/DAT | 60 DAS/DAT | 75 DAS/DAT | 90 DAS/DAT |
| **Organic manures** | | | | | | | | | | | | |
| $M_1$ | 8.19 | 11.73 | 13.58 | 18.61 | 34.35 | 56.83 | 1.71 | 3.13 | 5.44 | 6.40 | 8.08 | 8.17 |
| $M_2$ | 7.80 | 11.65 | 13.58 | 18.35 | 31.76 | 58.08 | 1.77 | 3.40 | 5.86 | 6.75 | 8.46 | 8.66 |
| $M_3$ | 8.02 | 12.34 | 14.79 | 19.37 | 36.43 | 60.32 | 1.64 | 3.60 | 6.26 | 6.88 | 8.75 | 8.97 |
| $M_4$ | 8.10 | 12.24 | 14.33 | 20.02 | 37.97 | 64.03 | 1.77 | 4.04 | 7.15 | 8.26 | 9.77 | 10.06 |
| $M_5$ | 7.75 | 12.64 | 15.11 | 20.97 | 37.73 | 65.19 | 1.75 | 3.31 | 6.42 | 6.97 | 8.48 | 9.13 |
| $M_6$ | 9.02 | 12.79 | 15.17 | 21.57 | 42.15 | 66.24 | 1.75 | 3.62 | 7.13 | 7.06 | 7.33 | 8.13 |
| SEd (±) | 0.32 | 0.40 | 0.37 | 0.91 | 2.81 | 4.07 | 0.04 | 0.39 | 0.57 | 0.64 | 0.64 | 0.80 |
| CD (P = 0.05) | NS | NS | 0.82 | 2.04 | NS | NS | NS | NS | NS | NS | NS | NS |
| System of planting | | | | | | | | | | | | |
| $S_1$ | 7.89 | 12.47 | 15.41 | 21.18 | 43.11 | 74.05 | 1.12 | 3.42 | 8.15 | 10.04 | 12.97 | 13.84 |
| $S_2$ | 8.78 | 13.34 | 15.07 | 21.58 | 41.96 | 69.51 | 3.08 | 5.13 | 7.88 | 8.00 | 9.04 | 9.04 |
| $S_3$ | 7.77 | 10.89 | 12.79 | 16.68 | 25.08 | 40.97 | 1.00 | 2.00 | 3.11 | 3.13 | 3.63 | 3.68 |
| SEd (±) | 0.32 | 0.33 | 0.32 | 0.77 | 2.12 | 2.22 | 0.06 | 0.32 | 0.35 | 0.32 | 0.44 | 0.49 |
| CD (P = 0.05) | 0.67 | 0.69 | 0.66 | 1.60 | 4.36 | 4.58 | 0.13 | 0.66 | 0.72 | 0.66 | 0.91 | 1.02 |

**Table 2:** Effect of different forms of organic manures and systems of planting on yield of scented rice

| Treatments | Grain yield (t ha$^{-1}$) | Straw yield (t ha$^{-1}$) | Biological yield (t ha$^{-1}$) | Harvest Index (%) |
|---|---|---|---|---|
| **Organic manures** | | | | |
| $M_1$ | 3.38 | 6.92 | 10.3 | 37.17 |
| $M_2$ | 2.99 | 8.05 | 11.04 | 71.06 |
| $M_3$ | 3.25 | 9.55 | 12.8 | 29.29 |
| $M_4$ | 3.06 | 7.48 | 10.54 | 33.92 |
| $M_5$ | 4.79 | 6.67 | 11.46 | 43.37 |
| $M_6$ | 3.99 | 10.51 | 14.5 | 27.54 |
| SEd (±) | 0.39 | 1.77 | 1.67 | 4.40 |
| CD (P = 0.05) | 0.88 | NS | 4.99 | 9.81 |
| **System of planting** | | | | |
| $S_1$ | 4.67 | 6.40 | 11.07 | 43.39 |
| $S_2$ | 3.56 | 8.90 | 12.46 | 33.24 |
| $S_3$ | 2.52 | 9.22 | 11.74 | 24.52 |
| SEd (±) | 0.37 | 1.57 | 1.94 | 5.64 |
| CD (P = 0.05) | 0.77 | NS | 5.78 | 11.63 |

## Conclusion

Basis on our findings, it can be concluded that growing of scented rice with basal application of FYM + *Panchgavya* is most efficient preposition, when judged in term of production. Among systems of planting significantly and higher yield of rice was recorded in SRI method over CTR and DSR methods.


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