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Effect of organic manures on yield of scented rice (*Oryza sativa* L.)

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Abstract
A field experiment was conducted at the Instructional farm, Barrister Thakur Chhedilal College of Agriculture and Research Station, Bilaspur (C.G.), during *kharif* season of 2020-21, to evaluate the influence of "Effect of organic manures on yield of scented rice (*Oryza sativa*)''. Totally 09 different treatments consisting of different organic and inorganic and fertilizers, alone and in both combination have been tried. Among the different treatments, treatment T_8 (100% RDF (60:40:30) NPK kg ha^{-1}) recorded significantly enhanced yield parameters *viz.,* length of panicle plant^{-1} (cm), number of seed panicle^{-1}, test weight (1000 seed weight in g), grain yield (q ha^{-1}), straw yield (q ha^{-1}) & harvest index (%) which was at par with treatment T_5 (100% RDN through green leaf manure + Decomposed cow dung enriched with rock phosphate amendment (7.59q ha^{-1}), T_4 (100% RDN through Compost + Decomposed cow dung enriched with rock phosphate amendment (7.59q ha^{-1})) and T_7 (Decomposed cow dung enriched with rock phosphate @ (12qha^{-1})) and proved significantly superior over all other remaining treatments.

Keywords: organic, manures, scented rice, *Oryza sativa* L.

Introduction
Rice (*Oryza sativa* L.) is the second most widely consumed cereal in the world next to wheat. It is the most important and extensively cultivated food crop grown in tropical and sub tropical region which provides half of the daily food for one of every three person on the earth. About 70% of the world population takes rice as staple food while in Asia alone, more than 2 billion people 60-70% of their energy intake from rice and its derivatives (Kumari *et al.,* 2014) [6]. Rice is the major crop in India and occupies the largest cropped area of 43.19 million ha with annual production of 110.15 million tons and productivity of 2.55 tons/ha.
Chhattisgarh state rice occupies major area of 3.74 million ha (2016-17) out of 5.9 million ha area. Total production of rice in Chhattisgarh is 5749.07 million tons, productivity 1482/ha and total area under rice 43.79 ha with production of 109.70 million tons with productivity 2494kg/ha (Anonymous, 2017) [1]. The Chhattisgarh extends south east of Madhya Pradesh from 170 46'N to 240 5' N latitude and from 800 15' E to 840 20' E longitude. Chhattisgarh has a tremendous agricultural potential with a diversity of soil and climate, mountains, plateau, rivers, natural vegetation and forest. It is unique in sense in many ways. It has no seas and no connection with Himalaya and yet it has hilly and mountains with big rivers. The temperature goes down up to 1 ^{0}C in Chilpi and Surguja. The rainfall ranges from 800 mm to 1700 mm in different years. Diversified crops and cropping systems are the typical characteristics of Chhattisgarh. Aromatic or scented (fragrant) rice has occupied a prime position in Indian society not only because of its high quality, but also because it has been considered auspicious. The basmati type among them is accepted as the best scented, longest and slender rice in the world and the Indian subcontinent continues to be its home land. The area under scented rice varieties is increasing day by day with the opening of the world market as well as increased domestic consumption due to their premium quality (Singh *et al.*, 2008 and Basu *et al.*, 2022) [12, 3]. Although aromatic rice which is popular in world market is long grained, majority of the Indian indigenous aromatic rice are small and medium-grained. Aromatic rice constitutes a small but an important sub-group of rice. These are rated best in quality and fetch much higher price than high quality non-aromatic rice in international market. Chhattisgarh is famous for its diversity of rice. In every district of CG specific traditional rice is famous, which is locally grown by the farmers and very much popular among the local peoples for consumption in daily diet.

These varieties are locally adapted by farmers and grown as traditional rice by the farmers, such traditional aromatic varieties are very poor in yield due to low test weight, lodging losses, unawareness regarding fertilizer use, spacing and susceptibility to diseases and pests. And having poor response to fertilizer application (Singh *et al*., 2001) [11].

Vishnu bhog is one of the signature-aromatic rice of Chhattisgarh. This rice is Non- Basmati aromatic short to medium grain rice. These are traditional Indian cultivar with intermediate amylose and gelatinization temperature. These are most common in Madhya Pradesh and Chhattisgarh. It is one of the best variety of small grain rice which is used for every-day cooking. The subtle colour, fine texture and godly flavour speak of its supremacy. Vishnu bhog is nutrient rich and a great addition to your balanced diet. It has good amount of zinc and selenium that helps in weight-control. The staple food is rich in fiber and proteins. It has lesser carbohydrate and glycemic index and, hence good for diabetics. It provides fast and instant energy to the body, naturally gluten-free, no sugar, controls high blood pressure, no cholesterol good for the heart helps prevent constipation and excellent food for a balanced dirt etc. Farmers of Chhattisgarh usually keep Vishnu-bhog safe for festive seasons as they offer it as a Bhog (offering) to Deity and hence the name.

Organic farming in rice can maintain soil quality. The chemical use is hitting the sustainability in soil and decreasing its potency and also preferred because of increasing consumer demand for safe, high quality, ethical organic foods and good monetary returns. There is a great demand for high quality products and organically grown foods in the international market and can capitalize on its potential to go for organic farming on a large scale. India had the least percentage of cultivated area under organic farming. There is thus considerable scope to increase the area under organic farming in India. The total volume of export during 2015-16 was 263687 MT. The organic food export realization was around 298 million USD (APEDA, 2015). The area under scented rice varieties is increasing day by day with the opening of the world market as well as increased domestic consumption due to their premium quality (Singh *et al*., 2008) [12]. Scented rice occupies a pivotal position in world because of their high quality and therefore earns premium prices. In rice growing areas, organically produced scented rice has better scope to obtained better market price as well as good export opportunity.

Use of organic manures in present agriculture is increasing day by day, because of its utility not only improving the physical, chemical and biological properties of soil but also maintaining the good soil health and supplying almost all essential plant-nutrients for growth and development of crop plants. So, it is time to look for measures to stimulate sustainability in production of rice on long- term basis. Organic manures like FYM, poultry manure and vermin compost, green manure, bio fertilizer, plant compost etc. deserves priority for sustained production and better utilization in organic rice production (Dahiphale *et al.*, 2003) [4].

Globally, the agricultural soils are getting phosphorus (P) deficient after nitrogen (Vance *et al.*, 1987) [13] and hence, impairs the various physiological and biochemical processes within plants (Wu *et al.*, 2005) [14]. Generally, on dry weight basis, it constitutes ~ 0.2% of the plant biomass (Schachtman *et al.*, 1998) [15]. Phosphorus, being an immobile nutrient in soil necessitates the application of chemical phosphatic fertilizers as its available sources for optimum production of crop plants. However, nutrient availability from chemical fertilizers is not more than 20% and has forced the poor farmers to add two times more than the optimum application rate of P-fertilizers. The addition of extra P in the soil led to consume more resources for the crop production, and hence, the costs of production of crop plants per unit area increase (Aziz *et al*. 2006) [16]. Moreover, there is expected depletion of high quality rock phosphate (RP) which is the major sources of P-fertilizers by the year 2050 (Vance *et al*. 1987) [13]. These circumstances necessitate to find out an economical and eco-friendly way to increase the availability of P, and at the same time, reduce the losses of P, and RP enriched with compost and phosphate solubilizing microorganisms (PSMs) can be a good solution.

Rock phosphate (RP) is an important natural source of P and is used as raw material for the production of chemical phosphatic fertilizers (Reddy *et al.* 2002) [17]. The direct application of RP has been found suitable for acidic soils as low pH helps to solubilize the RP and increases available form of P to the plants. However, this approach does not work for alkaline/or calcareous soils due to high pH (Caravaca *et al.*, 2004) [18]. The application of enriched-RP with compost to alkaline/or calcareous soils could be a wise approach for the solubilization of RP. Furthermore, addition of organic fertilizers also improves the physicochemical as well as biological properties of soil (Adhami *et al*. 2014; Lim *et al*. 2015) [19]. This approach also had positive effects on crop because organic fertilizers contained plenty of macro and micro-nutrients (Gaur 1997; Kalaivanan and Hattab 2016) [20, 21]. Typically, most of the organic fertilizers are produced from biodegradable solid wastes using compost or/and vermicompost (Wu *et al*. 2014; Lim *et al*. 2016) [22, 23].

Materials and Methods

The field experiment was conducted at the Instructional cum farm, Barrister Thakur Chhedilal College of Agriculture and Research Station, Sarkanda, Bilaspur (C.G.). Geographically, the experimental site is located in central part of Chhattisgarh at latitude 22.0796° N, and longitude 82.1391° E and an altitude of 262.0 meters above the mean sea level. Climatologically, Bilaspur is characterized as slightly moist hot zone. An average annual rainfall of 1164.6 mm is generally appeared and mostly concentrated during the period from June to September. The major portion of the rainfall is received by South-Western monsoon. The May and December is the hottest and coolest month of the year respectively. In general, weekly maximum temperature goes upto 47°C during the summer season and minimum temperature falls upto 8°C during the winter season. The soil of the experimental site was sandy clay soil. The soil was neutral in reaction, medium in organic carbon, low in nitrogen and medium in phosphorus and potash content.

The experiment consisted of 7 treatments *viz*. T_1: 100% RDN through Compost, T_2: 100% RDN through Green leaf manure, T_3: Decomposed cow dung enriched with rock phosphate amendment (7.59q ha^{-1}), T_4: 100% RDN through Compost + Decomposed cow dung enriched with rock phosphate amendment (7.59q ha^{-1}), T_5: 100% RDN through green leaf manure + Decomposed cow dung enriched with rock phosphate amendment (7.59q ha^{-1}), T_6: 100% RDN through FYM enriched with consortia, T_7: Decomposed cow dung enriched with rock phosphate @ (12q ha^{-1}), T_8: 100% RDF (60:40:30) NPK kg ha^{-1} and T_9: Control plot which was arranged in Randomized Block Design with three replications. The crop variety Vishnubhog was sown on 9 July 2020. Full dose of P and K along with one third of N was applied as basal dose at the time of sowing through inorganic sources of nutrients *viz*. Urea, DAP and MOP, respectively and remaining two third was applied in two equal splits. Data was collected regarding yield and yield attributes of rice grains. Data recorded on various parameters of the experiment was subjected to analysis by using Fisher's method of analysis of variance (ANOVA) and interpreted as outlined by Gomez and Gomez (1984) [24]. The level of significance used in „F" and „t" test was p = 0.05. Critical difference values were calculated where F test was found significant.

Results and Discussion

Yield attributes

The data on various yield attributes *viz*. length of panicle $plant^{-1}$ (cm), number of seed $panicle^{-1}$ and test weight (g) as influenced by the effect of organic manures were recorded and presented in Table 1. Data indicated that among the applied treatments, T_8 (100% RDF (60:40:30) NPK kg ha^{-1}) though at par with the treatment T_5 (100% RDN through green leaf manure + Decomposed cow dung enriched with rock phosphate amendment (7.59q ha^{-1}), T_4 (100% RDN through Compost + Decomposed cow dung enriched with rock phosphate amendment (7.59q ha^{-1})) and T_7 (Decomposed cow dung enriched with rock phosphate @ (12q ha^{-1})) recorded significantly higher length of panicle $plant^{-1}$ (24.41 cm), number of seed $panicle^{-1}$ (250.61) and test weight (13.70 g), than the control and other treatments in comparison. However, treatment T_9 (Control plot) recorded significantly lowest length of panicle $plant^{-1}$ (16.86 cm), number of seed $panicle^{-1}$ (201.17) and test weight (10.10 g). Also similar result found by Moe *et al.*, (2019) [7], Murali and Setty *et al.*, (2001) [9] and Sharma *et al*. (2018) [25].

Grain and straw yield

The effect of organic manure had significant effect on the grain yield and straw yield of scented rice. The data presented in Table 2 and Figure 1 depicts that treatment T_8 (100% RDF (60:40:30) NPK kg ha^{-1}) recorded significantly maximum grain yield (33.48 q ha^{-1}) and straw yield (49.08 q ha^{-1}) which was however, statistically at par with the treatment T_5 (100% RDN through green leaf manure + Decomposed cow dung enriched with rock phosphate amendment (7.59q ha^{-1}), T_4 (100% RDN through Compost + Decomposed cow dung enriched with rock phosphate amendment (7.59q ha^{-1})) and T_7 (Decomposed cow dung enriched with rock phosphate @ (12q ha^{-1})). The significantly minimum grain yield (14.95 q ha^{-1}) and straw yield (23.14 q ha^{-1}) was recorded in treatment T_9 (Control plot). Also, similar result found by Rautaray *et al*. (1995) [10], Gowda *et al.*, (2001) [5] and Rabindra *et al.*, (1986) [26].

Harvest index (%)

The data pertinent to the harvest index in Table 2 reveals that the effect of organic manures on harvest index was found to be non-significant.

Table 1: Effect of organic manures on yield attributes of scented rice

Tr. No.	Treatment details	Yield attributes		
		Length of panicle $plant^{-1}$ (cm)	Number of seed $panicle^{-1}$	Test weight (1000 seed weight in g)
T_1	100% RDN through Compost	20.67	208.14	11.50
T_2	100% RDN through Green leaf manure	22.03	215.12	11.79
T_3	Decomposed cow dung enriched with rock phosphate amendment (7.59q ha^{-1})	22.19	219.03	12.00
T_4	100% RDN through Compost + Decomposed cow dung enriched with rock phosphate amendment (7.59q ha^{-1})	23.52	237.45	12.90
T_5	100% RDN through green leaf manure + Decomposed cow dung enriched with rock phosphate amendment (7.59q ha^{-1})	23.82	242.34	13.35
T_6	100% RDN through FYM enriched with consortia	22.23	224.33	12.33
T_7	Decomposed cow dung enriched with rock phosphate @ (12q ha^{-1})	22.92	231.28	12.65
T_8	100% RDF (60:40:30) NPK kg ha^{-1}	24.41	250.61	13.70
T_9	Control plot	16.86	201.17	10.10
S.Em (±)		1.36	10.14	1.02
CD (5%) =		4.08	30.41	NS
CV (%) =		10.68	7.79	14.52

Table 2: Effect of organic manures on grain yield, straw yield and harvest index of scented rice

Tr. No.	Treatment details	Production parameters		
		Grain yield (q ha^{-1})	Straw yield (q ha^{-1})	Harvest index (%)
T_1	100% RDN through Compost	21.19	32.76	39.28
T_2	100% RDN through Green leaf manure	22.90	35.22	39.40
T_3	Decomposed cow dung enriched with rock phosphate amendment (7.59q ha^{-1})	25.82	38.25	40.28
T_4	100% RDN through Compost + Decomposed cow dung enriched with rock phosphate amendment (7.59q ha^{-1})	29.59	46.24	38.98
T_5	100% RDN through green leaf manure + Decomposed cow dung enriched with rock phosphate amendment (7.59q ha^{-1})	30.62	46.58	39.80
T_6	100% RDN through FYM enriched with consortia	26.88	42.47	38.74
T_7	Decomposed cow dung enriched with rock phosphate @ (12q ha^{-1})	27.18	44.26	38.02
T_8	100% RDF (60:40:30) NPK kg ha^{-1}	33.48	49.08	40.59
T_9	Control plot	14.95	23.14	40.23
S.Em (±)		1.49	2.41	2.77
CD (5%) =		4.47	7.24	NS
CV (%) =		10.00	10.52	12.15

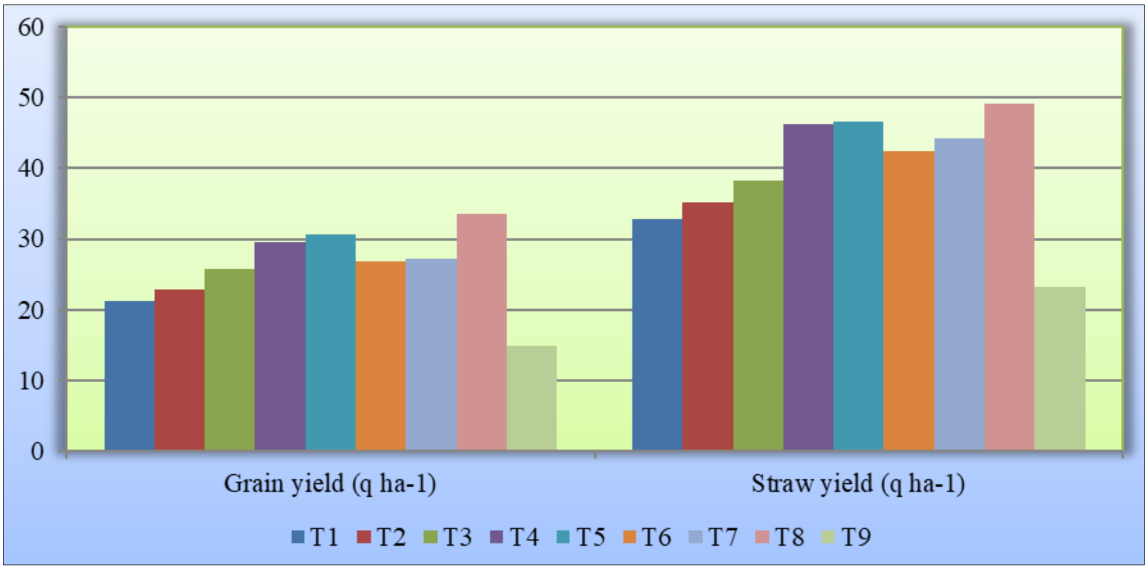

Fig 1: Effect of organic manures on grain yield and straw yield of scented rice

Conclusion

On the basis of the study, it is concluded that among the different treatments, treatment T_8 (100% RDF (60:40:30) NPK kg ha^{-1}) was found to be the best treatment in increasing the crop yield and yield attributes of scented rice.

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