The Pharma Innovation Journal 2023; 12(5): 2836-2839

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(5): 2836-2839

www.thepharmajournal.com
Received: 12-03-2023
Accepted: 22-04-2023

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Performance of traditional scented rice varieties grown under organic system in a *vertisol*

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Abstract
A study was conducted during *kharif* 2020 to evaluate "Performance of traditional scented rice varieties grown under organic system in a *Vertisol*" at Indira Gandhi Krishi Vishwavidyalaya's Research cum Instructional Farm in Raipur (C.G.), India. The treatment composed of fifteen traditional scented rice genotypes and laid out in Randomized Block Design (RBD) with three replications. Varieties was given a recommended dose @80:50:30 N:P:K kg ha^{-1} via FYM, vermicompost, neem cake (1/3 part each) and Rock Phosphate. The results showed that the CG Sugandhit Bhog, Sugandhmati and Kaarigilas varieties were performed better among all the traditional scented rice varieties in terms of grain yield and lowest grain yield was recorded in variety Tarun Bhog Selection 1. The harvest index of varieties CG Sugandhi tBhog and Sugandhmati were found maximum among all the treatments. All the morphological characters were better found in variety CG Sugandhit Bhog.

Keywords: Vermicompost, FYM, Neem cake, soil physico-chemical properties

Introduction
Rice is the major cereal crop playing significant role in diet, culture and economy of millions of people across the world. It is the leading food source in terms of calories being consumed for mankind and feeds about 60% of the world's population (FAO 2007) [4]. It is estimated that in India alone the demand for rice in 2010 will be 100 million tones and by 2025, it will be around 140 million tones (Murali 2005) [9]. India has to produce 170 to 180 million tonnes of rice (115-120 million tonnes of milled rice) by 2020 with an average productivity of 4.03 t ha-1 to maintain present level of self-sufficiency (Mishra *et al*., 2006) [8]. Chemical fertilizers are well known for their effects on the yield increment whereas organic nutrients enhance the quality and aroma (Prakash *et al*., 2002) [10]. Organic farming systems aim at the resilience and buffering capacity in the farm eco-system, by stimulating internal self-regulation through functional agro-biodiversity in and above the soil, instead of external regulation through chemical protectors (Bueren *et al*., 2002) [2]. Many breeding programs took yield potential as the primary target. However, with the increasing living standards and the improvements in cooking, the eating and appearance quality of the rice grain has become a priority (Zhang, 2007). Rice (*Oryza sativa* L.) is India's most imported crop, as well as global population's food security hub. Rice is grown an estimated 155.62 million hectares worldwide, with production and productivity of 461 million tonnes and 4.09 tonnes ha^{-1} respectively. Only after China, India is first in terms of area (44.50 million ha) second in terms of production (102.75 million tone), however rice productivity is quite poor (2.20 t ha^{-1}) (Anonymous, 2012) [1]. Rice is the important crop of the Chhattisgarh state occupies nearly 77% of the cultivated land. India is well known for its aromatic Rices which are distributed in almost all the corners of the country.

Organic manures improve the soil fertility and health of tropical soils by providing humus and plant nutrient. Organic farming practices have been shown to maintain and increase soil health by increasing the activity of soil organisms (Yadav *et al.*, 2013) [11]. Organic sources like green manures, crop residues, vermicompost and farm yard manure as well as their proper management, have shown promise in productivity and soil health while also fulfilling a portion of crop nutrient requirements (Choudhary *et al*., 2011; Khursheed *et al.*, 2012, 2013) [3, 6]. The economic elements of aromatic rice were explored by Aromatic rice holds a unique place in the global due to its exceptional quality, and as a result, it commands a premium price.

Organically produced fragrant rice has a better chance of obtaining a better market price as well as good export opportunity in rice-growing locations.

Materials and Methods

A field experimental was carried out during *kharif*season 2020 at the Instructionalcum Research Farm, Indira Gandhi KrishiVishwavidyalaya, Raipur (C.G.), India under ongoing AICRP on NPOF Experimental trial on rice-chickpea cropping sequence. Raipur is situated central - east of Chhattisgarh and lies at 21º 16' Latitude and 81º 36' E Longitude with an altitude of 34.15 m above the mean sea level.The soil of the experimental soil is locally known as "*Kanhar*" soil. With organic management approaches, the experiment was set up in a randomise block design. T_{13} (Sugandhmati), T_{15} (Lalu 14), T_{10} (Gangabaru), T_8 (Dubraj Selection 1), T_{11} (Kaarigilas), T_1 (BadshahBhog Selection 1), T_{14} (CR SugandhaDhan 907), T_3 (Vishnu Bhog Selection 1), T_7 (KubriMohar), T_2 (GopalBhog), T_9(Lohandi), T_4 (CG SugandhitBhog), T_5 (Shyamjeera), T_6 (IndiraSugandhitDhan), and T_{12} (TarunBhog Selection 1). Twenty one days old seedlings of rice were transplanted on July 16, 2020 at the distance of 20 cm between rows and 10 cm between hills by using 2-3 seedlings per hill. Green manuring with *Sesbania aculeate* was done prior to rice cultivation. The recommended dose of fertilizers for rice crop was 80 kg N + 50 kg P_2O_5+ 30 kg K_2O ha^{-1}. The 100% Nitrogen application used as supplemented *via* 1/3rd each of FYM, Vermicompost and Neemcake. The major requirement of Phosphorus was also supplemented *via* the organic manures application and the remaining requirement was fulfilled by applying Rock phosphate on the basis hectare. All organic manures and Rock phosphate were supplied as basal after final layout of field. In addition to these, Azospirillum and PSB culture have been used for treating the rice seedlings and BGA were applied 10 days after transplanting as top dressing in all the experimental plots. To inhibit the infestation of gall midge/gall fly (*Orseoliaoryzae*) and stem borer (*Scirpophagaincertula*) a broad spectrum bio pesticide namely Neemastra @ 3% liquid ha^{-1} was applied two times after tillering stage at 15 days interval. After that in the experimental plots the water levels were maintained at 5±2cm during the entire crop growth and development phases by providing sufficient irrigations. First hand weeding was done at 35 days after transplanting and second weeding, was carried out at 60 days for weed free crop field throughout its growth period for avoiding crop weed competition. The matured crops of rice harvested on 127 DAT Grain and straw yield was recorded plot–wise and calculated on hectare basis.

Results and Discussion

Growth attributes of plant

The plant height was observed by applying recommended organic nutrients. At harvest, Gagabaru (194.27 cm) had the highest plant height, which was significantly higher than two taller types, Badshah Bhog Selection 1 (188.31 cm) and CR Sugandha Dhan-907 (186.29 cm). The variety Lalu-14 (131.22 cm) had the shortest plant height, followed by Indira Sugandhit Dhan (131.63 cm) at harvest among all the 15 traditional scented rice cultivars. The number of effective tillers/hill is very important factor to determine the yield potential of a variety. The number of tillers/hill was significantly varied among all the traditional scented rice varieties due to different genotypes. The maximum number of tiller/hill was observed in variety Dubraj Selection1 and Sugandhmati at harvest (14.67) followed by CG SugandhitBhog (14.33) while, lower number of tillers/hill recorded in variety Lalu-14 (10.67) followed by CR sugandhadhan-907 (11). It was observed that Gopal Bhog (32.52 cm) had the longest panicle length, which was comparable to the panicle length of Badshah Bhog Selection 1 (31.99 cm), but differed significantly from the rest of the rice varieties tested. An application of organic nutrient with chemical fertilizer increase in number of tillers in rice varieties similar finding was also reported by Lodh *et al.* (2017) [7].

Yield and yield attributing characters

Different growth and yield characteristics are thought to contribute to the greater yield in CG SugandhitBhog, such as higher plant height approximately (132.40 cm) and effective tillers/hill (14.33) that leads to more photosynthetic product and also contribution of more number of grains/panicle (200), Whereas, Gagabaru (166) and Sugandhmati (166) among all the 15 traditional scented rice varieties. Variety GopalBhog (32.52 cm) had the longest panicle length and KubriMohar (5.9 g) had the largest panicle weight, followed by Kaarigilas (4.97 g).

Table 1: Yield attribute characteristics of different scented rice varieties grown by applying recommended organic nutrients.

Treatment	Plant height (cm) at harvest	No. of Tillers per hill at harvest	Panicle length (cm)	Panicle Weight (g)	Total no of grains / Panicle	Test weight (g)
T1-BadshahBhog Selection 1	188.31	12.33	31.99	3.90	140	16.04
T2GopalBhog	176.76	11.33	32.52	3.13	144	19.10
T3 - Vishnu Bhog Selection 1	181.79	13.67	26.48	4.20	152	16.27
T4 - CG Sugandhit Bhog	132.40	14.33	28.76	4.17	200	20.06
T5 – Shyam Jeera	167.48	11.67	27.59	3.50	156	15.56
T6- Indira Sugandhit Dhan	131.63	13.33	27.05	4.73	161	20.67
T7 - KubriMohar	165.31	13.00	26.77	5.90	120	16.51
T8 - Dubraj Selection 1	142.96	14.67	26.81	4.77	149	20.63
T9 - Lohandi	177.47	12.33	27.70	3.03	122	19.86
T10-Gagabaru	194.27	12.00	24.82	4.47	166	15.60
T11-Kaarigilas	184.54	12.67	27.41	4.97	150	33.17
T12-Tarun Bhog Selection 1	179.60	12.00	24.80	4.10	148	15.71
T13-Sugandhmati	142.90	14.67	27.08	3.67	163	23.47
T14-CRSugandha Dhan-907	186.29	11.00	25.47	3.83	147	18.53
T15-Lalu-14	131.22	10.67	19.88	3.30	88	15.98
S.Em ±	3.06	0.69	0.99	0.29	4.12	0.48
CD (P = 0.05)	8.87	2.01	2.88	0.86	11.95	1.41

The CG variety Sugandhit Bhog had the highest harvest index value (31.37%), and Sugandhmati had a promising harvest index value as well (28.94%). The highest test weight value was recorded under Kaarigilas (33.17 g), while the lowest test weight was recorded under ShyamJeera (15.56 g).

The findings indicated that the grain yield (q ha^{-1}) of all the scented varieties varies substantially.CG SugandhitBhog (51.51 q ha^{-1}) had the highest grain production, followed by sugandhmati (50.25 q ha^{-1}), Kaarigilas (42.03 q ha^{-1}), Indira Sugandhit Dhan (35.50 q ha^{-1}), and Dubraj Selection 1 (35.17 q ha^{-1}). While, among all the scented rice varieties Lalu -14 (10.89 q ha^{-1}) produced the lowest yield followed by Lohandi (24.78 q ha^{-1}). The lowest grain yield was observed in treatment Lalu-14 due to genotype of the variety. The highest harvest index was recorded in treatment CG Sugandhit Bhog because of better yield potential. Organic nutrient management influenced the straw yield of different scented rice varieties. In comparison to the other scented rice varieties, Tarun Bhog Selection 1 produced the maximum amount of straw yield (158.69 q ha^{-1}). Lalu-14 (37.57 q ha^{-1}) had the lowest straw yield, followed by Indira Sugandhit Dhan (91.21 q ha^{-1}), CG Sugandhitbhog (113.82 q ha^{-1}), and Shyam Jeera (116.32 q ha^{-1}). The incorporation of FYM and green manure were also recorded maximum straw yield of rice crop (Ganpathi *et al.* 2014) [5].

Table 2: Yield, protein content and harvest index of different scented rice varieties grown by applying recommended organic nutrients.

Treatment	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})	Harvest index (%)
T1 - BadshahBhog Selection 1	29.22	123.28	19.17
T2 - GopalBhog	30.54	121.29	20.11
T3 - Vishnu Bhog Selection 1	34.21	127.45	21.19
T4 - CG SugandhitBhog	51.51	113.82	31.37
T5 - ShyamJeera	34.86	116.32	23.24
T6 - IndiraSugandhitDhan	35.50	91.21	28.04
T7 - KubriMohar	26.64	124.40	17.89
T8 - Dubraj Selection 1	35.17	133.24	20.76
T9 - Lohandi	24.78	125.74	16.48
T10-Gagabaru	33.73	137.03	19.87
T11-Kaarigilas	42.03	132.14	24.13
T12-Tarun Bhog Selection 1	31.19	158.69	16.37
T13-Sugandhmati	50.25	123.37	28.94
T14-CR Sugandha Dhan-907	32.49	137.10	20.95
T15-Lalu-14	10.89	37.57	22.59
S Em ±	1.19	4.27	1.31
CD (P = 0.05)	5.76	12.39	3.80

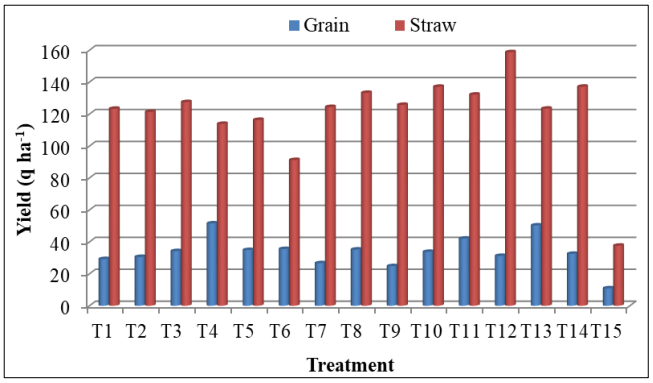

Fig 1: Grain and straw yield of different scented rice varieties grown by applying recommended organic nutrients.

Conclusions

CG SugandhitBhog, Sugandhmati and Kaarigilas varieties were performed better among all the traditional scented rice varieties in terms of grain yield. The harvest index of varieties CG SugandhitBhog and Sugandhmati were found maximum among all the treatments. Among all the varieties studied, variety Kaarigilas outperforms the others in terms of growth (Panicle weight) and test weight (1000 seed weight).

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