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SUPERIMPOSITION OF ORGANIC SOURCES OF MANURES TO ENHANCE YIELD AND QUALITY PARAMETERS OF SCENTED RICE (*ORYZA SATIVA* L.) IN INDO-GANGETIC PLAIN ZONE

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Abstract

An experiment was conducted during *kharif* 2012 and 2013 at Chandra Shekhar Azad University of Agriculture and Technology, Kanpur (U.P.), India; in scented rice (*Oryza sativa* L.). Data revealed that superimposition of organic sources of neem cake @ 3 t ha^{-1} over RDF produced significantly higher grain (53.60 and 54.76 q ha^{-1}) and straw (83.33 and 84.20 q ha^{-1}) yield than all other treatments except T_8 (RDF + FYM @ 12 t ha^{-1}) and T_9 (RDF + Vermicompost @ 6 t ha^{-1}) where it showed at par with each others during both the years. The magnitude of increase in yield an average as assess to 53 percent over the control. The superimposition of organic sources of manures significantly enhanced quality parameters *viz*., kernel length, kernel breadth, length and breadth ratio and hulling (%), milling (%) and head rice recovery (%) than the control. The physical quality of rice grain such as hulling (77%) milling (74.33%) and head rice recovery (54.28%), length of kernel (9.55 mm), breadth of kernel (1.79 mm) and length and breadth ratio (5.33 mm) responsible for high quality was improved by application of RDF + neem cake @ 3 tonnes ha^{-1} along with higher production The aroma was not estimated owing to non-availability of such sophisticated tactic.

Key words : Scented rice, superimposition, FYM, vermicompost neem cake, yield, grain quality.

Introduction

Rice is a major cereal crop of India occupied an area of 42.41 million hectare and production of 105.24 million tonnes with average productivity of 2480 kg ha^{-1}. In Uttar Pradesh, rice is cultivated in an area of 5.63 million hectare with an annual production of 11.90 million tonnes with average productivity of 2136 kg ha^{-1} (Anonymous, 2013). Scented rice is grown in several Asian countries and on the American continent and has high commercial value. In India alone, scented (Indian Basmati) rice is being cultivated on about 1.6 million hectares and its production, on rough rice basis, is about 6.6 million tonnes in the year of 2013-14. Rice export from India constitutes the major share of Basmati rice. Nearly two-third of Basmati rice produced in India is exported. Basmati rice is the leading aromatic fine quality rice of the world trade and it fetches good export price in the international markets. Infact, Basmati rice is a gift from "Mother Nature" to the Indian sub-continent and grows in the Indo-Gangetic plain only. The production of aromatic rice is declining fast even in the native areas of adaptation due to poor yield and quality traits including aroma. As regards to the rice grain quality, different properties are important to different target groups. For example, high total and head rice yield are critical for rice millers while physical appearance, cooking and eating qualities are important to the rice eaters (Zhou *et al*., 2002).

Basmati, the unique aromatic quality rice is a nature's gift to Indian sub-continent. Epicureans acclaimed its delightful fragrance, taste and texture which makes it the best among the aromatic rice of the world. Scented rice emit specific aroma in fields, at harvestings, in storage, during milling, cooking and eating (Efferson, 1985). Aroma development is influenced by both genetic and environment factors. It is known that aroma is best developed when aromatic rice is grown in areas where temperature is cooler during fruiting/maturity. Aroma is due to certain chemical present in the endosperm. The biochemical basis of aroma was identified as '2-acetyl-1-pyrroline' (Itani *et al*., 2004). It is cultivated on the foot hills of the Himalayas including Saharanpur, Bijnaur,

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Dehradun, Massurie, Haridawar etc. and nearby area of Indo-Gangetic plains. Keeping these views, the present investigation was undertaken to study the effect of superimposition of organic sources of manures on yield and quality parameters of scented rice in Indo-Gangetic plain zone.

Materials and Methods

An experiment was conducted during the *kharif* seasons of 2012 and 2013 at Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh, India. The soil was sandy loam, slightly alkaline (pH 8.2 and 7.9), low in available nitrogen (215 and 220 kg ha^{-1}), medium in available phosphorus (20.5 and 21.5 kg ha^{-1}) and available potassium (158 and 159 kg ha^{-1}), during 2012-13 and 2013-14, respectively. The experiment with ten treatments was laid out in Randomized Block Design with three replications with gross and net plot size of 5.00 × 3.60 m^2 and 4.20 x 3.0 m^2, respectively. The ten treatments consisted of i) recommended dose of fertilizer (RDF: 100: 40: 30 ha^{-1}), ii) RDF + FYM @ 6 t ha^{-1}, iii) RDF + vermicompost @ 2 t ha^{-1}, iv) RDF + neem cake @ 1 t ha^{-1}, v) RDF + FYM @ 9 t ha^{-1}, vi) RDF + vermicompost @ 4 t ha^{-1}, vii) RDF + neem cake @ 3 t ha^{-1} viii) RDF + FYM @ 12 t ha^{-1}, ix) RDF + vermicompost @ 6 t ha^{-1} and x) RDF + neem cake @ 3 t ha^{-1}. Scented rice variety Pusa Basmati 1121 was transplanted at spacing 20 × 10 cm^2 during both the years. As per treatments superimposition of organic sources (FYM, vermincompost and neem cake), phosphorus and potassium were applied as a basal application. The nitrogen was applied two in split doses, ¼ at transplanting, ¼ at 30 DAT and ¼ at 60 DAT (days after transplanting).

At maturity, a net plot area (4.2 × 3.0 m) leaving border rows was harvested and air-dried and the produce was threshed and cleaned. Final grain yield (at 14% moisture content) and straw yield were recorded in terms of kg per plot and converted to quintals per hectare. For milling quality evaluation of rice, 200 g paddy was dehulled in a dehuller machine. The husk as well as brown rice was weighed and the percent yield of brown rice and hulls was calculated. The brown rice was polished for a standardized optimum polishing time of 80 sec in a laboratory polisher. The polished rice was separated into broken rice and head rice by sieving and separately weighed. The percentage milling yield, percentage yield of head rice based on paddy as well as on brown rice and the percentage broken kernels were calculated. Rice quality tests such as kernel length, breadth and length to breadth (L:B) ratio were recorded (Kaul, 1970). Average kernel length, breadth and length to breadth (L:B) ratio was determined by closely placing the 20 randomly selected grains on a graph paper which had 10 divisions in 1 cm. All data were analyzed statistically as suggested by Panse and Sukhatme (1978).

Results and Discussion

Grain and straw yield

As shown in table 1, the superimposition of organic sources of manures with recommended dose of fertilizers (N_{100}:P_{40}:K_{30}) significantly increased grain and straw yields of scented rice over control in both the years. It could be seen from the table 1 that the grain and straw yield was maximize with the application of neem cake @ 3 t ha^{-1} along with recommended dose of fertilizer to 53.60 q ha^{-1} and 83.33 q ha^{-1} in first year and 54.76 q ha^{-1} and 84.20 q ha^{-1} in second year followed by as same RDF added with vermicompost @ 6 t ha^{-1} and FYM @ 12 t ha^{-1}. The magnitude of increase in yield an average as assess to 53 percent over the control. Whereas, those plot receiving lower amount of organic sources of manures with RDF produced significantly lower grain yield than RDF + neem cake @ 3 t ha^{-1}, but it was significantly superior to RDF only (control). However, treatment T_1 observed significantly lowest grain and straw yield as compared to all other superimposing treatments under study during both the years.

The increase in grain and straw yield might be due to superimposition of organic sources with combination of recommended dose of fertilizer provides higher availability of both the native and applied nutrients and better source

Table 1 : Mean grain and straw yield (q ha^{-1}) of scented rice as influenced by superimposition of organic sources of manures.

Treatment	Year-2012		Year-2013	
	Grain (q ha^{-1})	Straw (q ha^{-1})	Grain (q ha^{-1})	Straw (q ha^{-1})
T_1 RDF (100:40:30 NPK)	35.18	58.76	35.72	59.48
T_2 RDF + FYM @ 6 t ha^{-1}	41.93	66.20	43.10	67.86
T_3 RDF + VC @ 2 t ha^{-1}	42.95	70.50	42.28	69.83
T_4 RDF + NC @ 1 t ha^{-1}	45.18	73.23	46.18	74.28
T_5 RDF + FYM @ 9 t ha^{-1}	45.98	75.80	46.98	76.70
T_6 RDF + VC @ 4 t ha^{-1}	47.93	78.56	48.60	79.63
T_7 RDF + NC @ 2 t ha^{-1}	48.42	80.63	49.07	81.16
T_8 RDF + FYM@12 t ha^{-1}	50.33	81.96	51.34	82.63
T_9 RDF + VC @ 6 t ha^{-1}	51.86	82.30	52.90	83.00
T_{10} RDF + NC @ 3 t ha^{-1}	53.60	83.33	54.76	84.20
S.Em. ±	1.74	2.39	1.71	2.26
CD (P= 0.05)	5.18	7.12	5.10	6.72

Table 2 : Mean hulling (%), milling (%) and head rice recovery (%) of scented rice as influenced by superimposition of organic sources of manures.

Treatment	Year-2012			Year-2013		
	Hulling (%)	Milling (%)	Head rice recovery (%)	Hulling (%)	Milling (%)	Head rice recovery (%)
T_1 - RDF (100:40:30 NPK)	71.96	67.80	48.13	72.40	68.23	48.50
T_2 -RDF + FYM @ 6 t ha^{-1}	73.73	69.20	50.30	74.26	69.83	50.96
T_3 -RDF + VC @ 2 t ha^{-1}	74.10	69.50	50.57	74.43	70.06	51.23
T_4 -RDF + NC @ 1 t ha^{-1}	74.73	69.60	51.70	75.35	70.20	52.13
T_5 -RDF + FYM @ 9 t ha^{-1}	74.50	70.70	51.50	75.10	71.36	52.06
T_6 -RDF + VC @ 4 t ha^{-1}	74.86	70.83	51.90	75.36	71.26	52.40
T_7 -RDF + NC @ 2 t ha^{-1}	75.20	71.26	52.13	75.43	71.80	52.70
T_8 -RDF + FYM@12 t ha^{-1}	75.24	72.20	53.06	75.70	73.06	53.43
T_9 -RDF + VC @ 6 t ha^{-1}	76.06	72.33	53.23	76.40	73.46	53.86
T_{10} -RDF + NC @ 3 t ha^{-1}	76.60	73.80	53.86	77.40	74.86	54.70
S.Em.±	0.62	0.58	0.57	0.64	0.62	0.61
CD (P = 0.05)	1.86	1.74	1.70	1.90	1.84	1.83

Table 3: Mean length of kernel (mm), breadth of kernel (mm) and L/B ratio of scented rice as influenced by superimposition of organic sources of manures.

Treatment	Year-2012			Year-2013		
	Kernel length (mm)	Kernel breadth (mm)	L/B ratio	Kernel length (mm)	Kernel breadth (mm)	L/B ratio
T_1 -RDF (100:40:30 NPK)	7.63	1.60	4.75	7.66	1.61	4.77
T_2 -RDF + FYM @ 6 t ha^{-1}	8.15	1.65	4.94	8.22	1.66	4.95
T_3 -RDF + VC @ 2 t ha^{-1}	8.31	1.68	4.95	8.40	1.70	4.94
T_4 -RDF + NC @ 1 t ha^{-1}	8.43	1.72	4.90	8.64	1.76	5.00
T_5 -RDF + FYM @ 9 t ha^{-1}	8.56	1.69	5.06	8.75	1.71	5.12
T_6 -RDF + VC @ 4 t ha^{-1}	8.76	1.75	5.04	8.80	1.76	5.02
T_7 -RDF + NC @ 2 t ha^{-1}	8.93	1.76	5.11	9.08	1.78	5.10
T_8 -RDF + FYM@12 t ha^{-1}	9.26	1.77	5.22	9.37	1.79	5.24
T_9 -RDF + VC @ 6 t ha^{-1}	9.31	1.78	5.24	9.41	1.79	5.30
T_{10} -RDF + NC @ 3 t ha^{-1}	9.43	1.79	5.30	9.67	1.80	5.37
S.Em.±	0.16	0.02	0.09	0.16	0.03	0.07
CD (P= 0.05)	0.47	0.06	0.27	0.49	0.08	0.21

and sink relationship, which contributed better dry matter production which ultimately increased the grain and straw yield. Neem cake also acts as nitrification inhibitor which regulates slow release of organic fertilizers and thus reduces the loss of nitrogen and increased nitrogen use efficiency. Kumar *et al.* (2003) also observed that application of nutrient as organic and inorganic sources has ensured the continuous release of nutrients, synchronizing with crop requirement at different phenophases, which has resulted higher grain and straw yield, thus, suggesting that application of RDF along with organic sources of manures were more advantageous. The results are in close conformity with the finding of Singh *et al.* (2006), Mahajan and Dongra (2012), Murthy (2012) and Kumar *et al.* (2014).

Quality parameters

Quality parameters of scented rice in considered a very important aspects and it is a genetical characters. Superimposition of organic sources like FYM, vermicompost and neem cake brought significant improvement on the quality parameters of scented rice viz., hulling (%), milling (%), head rice recovery (table 2), kernel breadth and length: breath ratio (table 3).

Application of recommended dose of fertilizers with combination of neem cake @ 3 t ha^{-1} recorded higher value of hulling (77%) followed by $\mathbf{T_9}$, $\mathbf{T_8}$, $\mathbf{T_7}$ and $\mathbf{T_6}$ during both the years. Pandey *et al*. (2001) reported application of chemical fertilizers with organic manures increased hulling (%) of rice.

The significantly higher values of milling (74%) recorded by RDF + NC @ 3 t ha^{-1} during both the years and it were significantly higher than all other treatments except $\mathbf{T_9}$ and $\mathbf{T_8}$ where, it shown at par with each others. However, lowest values of milling (68%) recorded with $\mathbf{T_1}$ during both the years.

Head rice recovery (%) also followed similar trends as that of milling (%), the increase in head rice recovery may be due to increase in kernel length by superimposition of organic sources. Paakash *et al.* (2002) reported that organic manures was improving milling and cooking quality and enhance head rice recovery of rice.

The aroma development is governed by edaphic condition as well as low temperature during the reproductive phase. Natural habitat of adaptation in Pakistan and foot hills of Himalayan regions where aroma is highly developed for scented rice. Since, the present investigation was conducted at place, where not natural habitat of aroma producing rice. However, some aroma developed in scented rice but could not study due to non-availability of such facilities for assessing aroma.

Conclusion

Superimposition of neem cake @ 3 tonnes ha^{-1} along with RDF not only maximize the grain yields (53.60 and 54.76 q ha^{-1}), but also improved the quality parameters *viz*., hulling, milling and head rice recovery (%), kernel length, kernel breadth and length and breadth ratio. However, the aroma development could not be studied as a result of non availability of facility.

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