The Bioscan 16(2): 101-105, 2021
AN INTERNATIONAL QUARTERLY JOURNAL OF LIFE SCIENCES
www.thebioscan.com

EFFECT OF ORGANIC SOURCE OF NUTRIENTS ON BLACK RICE (*Oryza sativa* L.) VARIETIES

B. SHEKHAR MAHANTA*,VIKRAM SINGH, DHANANJAY TIWARI, NAREDDY HINDUJA, KRISHNA KUMARI AND ABHISHEK MAHAPATRA
Department of Agronomy, Naini Agricultural Institute,
SHUATS, Prayagraj, Uttar Pradesh- 211007, INDIA.
e-mail :-bibudhendu1710@gmail.com

KEYWORDS
Organic
SRI
Black rice
Organic Manure
Jeevamrutham
Waste decomposer.

Received on :
29.11.2020

Accepted on :
04.04.2021

***Corresponding author**

ABSTRACT
The experiment was carried out during *Kharif* season 2019-20 at Crop Research Farm, SHIATS Model of Organic Farm (SMOF), Department of Agronomy, NAI, SHUATS, Prayagraj (U.P.) to study the "Effect of Organic Source of Nutrients on Black Rice (*Oryza sativa* L.) varieties". Considering T_{10} *Kalabhat*, Vermicompost (2.25 t/ha) and Jeevamrutha (500 l/ha)], performed significantly higher in plant height (163.02cm) and straw yield (26.57t/ha). Considering T_{15} Manipuri black, Vermicompost (2.25 t/ha) and Jeevamrutha (500 l/ha) performed significantly higher in dry weight (191.48 g/hill), length of panicle (29.95cm), no. of grains/panicle (219.33), test weight (30.18 g), grain yield (5.61 t/ha), grain protein (15.60%) and also maximum B:C ratio (1:6.7). It can be concluded from the below research that application of Vermicompost (2.25 t/ha) and Jeevamrutha (500 l/ha) found to be enhancing productivity and economy of organic Manipuri black rice. Also it is a very good and sustainable cultivation practice.

INTRODUCTION

Rice (*Oryza sativa* L.) is a major cereal crop in this developing world. It is consumed as a staple food by over one-half of the world's population with approximately 95% of production in Asia (Bhattacharjee *et al*., 2001). World rice production in 2018-19 was 782.00 million tonnes (GOI, 2020). India has 44.50 m ha area under rice and production of 172.58 million tonnes during 2018-19 (GOI, 2020). On accounting state wise Uttar Pradesh ranked second place after West Bengal. Black rice is a type of the rice species which is glutinous, packed with high level of nutrients and mainly cultivated in Asia. Supplementation of black scented rice in the diet will have a great impact on human health (Asem *et al*., 2015). Black rice is also known as purple rice, forbidden rice, heaven rice, imperial rice, king's rice and prized rice. A health benefit of black rice includes prevention of cancer, diabetes, heart diseases, Alzheimer's disease, gallstones *etc*. (Kong *et al*., 2008). In recent years there has been adverse effect of continuous and indiscriminate use of inorganic fertilizers on deterioration of soil structure, soil health and environmental pollution (Singh *et al*., 2011). Devakumar *et al*., 2011 reported Blue baby syndrome in West Godavari district of Andhra Pradesh attributed to indiscriminate application of nitrogen in agricultural fields especially for rice crop. This incident hints us that chemical farming is not only hazardous to the health of environment, soil and other flora and fauna but also human beings. Use of organic manures have been found to be promising in arresting the decline in productivity through correction of deficiency of secondary and micronutrients and inf1uence the physical and biological properties of soil (Pandey *et al*., 2007). The nutrients required by the plants can be supplied through organic sources such as farmyard manure, vermicompost, and organic foliar spray (Debbarma *et al*., 2015). These manures can help to prevent soil erosion and also improving the infiltration capacity of the soil. Vermicompost is a better source of plant nutrients (Nayak *et al*., 2014). It has potential in modifying the soil physical properties and improving crop yields (Mishra *et al*., 2015). Apart from using conventional farm-based products there is an increasing demand for improvised materials like Jeevamrutha, Panchagavya, *etc*. which not only enrich the soil with indigenous microorganisms but also decrease the incidence of diseases in many crops. Devakumar *et al*., 2008 and Srinivas *et al*., 2010 have reported the presence of many beneficial micro organisms *i.e*. nitrogen fixers, phosphorus solubilizers, actinomycetes and fungi in Jeevamrutha and beejamrutha.

Keeping all these things in view to improve organic black rice production the present investigation was undertaken on the basis of the objective is to assess the effect of organic sources of nutrients on growth, yield, quality and economics of black rice varieties.

MATERIALS AND METHODS

The experiment was carried out during *Kharif* season of 2019

at the SMOF (SHUATS Model Organic Farm), Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P.) India. The soil of the experimental plot was sandy loam in texture, low in available nitrogen, medium in available phosphorus and high in available potash with 8.0 soil pH. The experiment was laid out in randomized block, having three varieties of black rice *viz*. Burma black, *Kalabhat*, Manipuri black and five organic sources of organic nutrients *viz*. Control (water + Jeevamrutha 500 litres/ha), FYM (14 t/ ha), FYM (7 t/ha) + Jeevamrutha (500 litres/ha), VC (4.5 t/ha), VC (2.25 t/ha) + Jeevamrutha (500 litres/ha). The net plot size was 3 × 4 m and net experimental area 768.00 m_2. Before puddling at the time of first irrigation Waste decomposer was applied to soil, which is rich in beneficial microorganisms. It can control all types of soil-borne, foliar diseases/ insects and pests. It also works as Biofertilizer, Bio control and as well as soil health reviver. Seed tretment was also done with Waste decomposer by soaking the seeds over night. (NCOF, 2018) The transplanting was done on 31th July 2019 with SRI method (25x25 cm^2). FYM and VC were applied as basal dose. Jeevamrutha was prepared with a mixture of four components in the ratio of 10:5:2:2, *viz*., cow dung, cow urine, jaggery, pulse powder with 200 lit of water. Jeevamrutha is applied 3 times to field in every 20 days interval after transplanting to the field. The agronomic practices, *viz*., weeding with cono-weeder, hand weeding were done and irrigation was given according to the schedules for all treatments. The Meteorological data observation total rainfall was 1127.70 mm. Data on Plant height (cm), Dry weight (g/ hill), No. of panicles /hill, No. of grains/ panicle, Test weight (g), Grain yield (t/ha), Straw yield (t/ha), Harvest index (%), Grain Protein (%), B:C ratio. Data recorded on different aspects of crop, *viz*., growth, yield attributes, yield and quality were tabulated.

The qualitative parameter, *viz*., protein (%) in grains was evaluated. Nitrogen in grain was estimated by Kjeldahl method by using the KjelTRON equipment in the department's laboratory and converted into protein (%) by multiplying with the power factor 5.95.

Statistical Analysis

Experimental data collected was subjected to statistical analysis by adapting Fishers method of analysis of variance (ANOVA) as outlined by (Gomez and Gomez, 1984). Critical Differences (CD) were calculated with F-test was found significant at 5% level.

RESULTS AND DISCUSSION

Plant height (cm)

Highest plant height (153.cm) was observed in (Table-1) with application of T_{10} [*Kalabhat* + Vermicompost(2.25 t/ha) + Jeevamrutha (500 litres/ha)] whereas the T_5[Burma black +Vermicompost (2.25 t/ha) + Jeevamrutha (500 litres /ha)] and T_8[*Kalabhat* + FYM (7 t/ha) + Jeevamrutha (500 litres/ha)] was found statistically at par with the highest treatment. This finding corroborates earlier researchers and Borah *et al*., 2018 also reported that it is a genetic character in which black rice plants attain height (136-166 cm), which was comparatively higher than the other traditional non black rice varieties.

Table 1: Effect of organic sources of nutrients on growth, yield and economy of black rice varieties at harvest.

TREATMENTS	Plant height(cm)	Dry weight (g/hill)	No. of panicles /hill	No. of grains/ panicle(g)	Test weight	Grain yield (t/ha)	Straw yield (t/ha)	Harvest index (%)	Grain Protein (%)	B:C ratio*
T_1: Burma black + Jeevamrutha (control)	148.09	165.54	13.22	173.22	27.59	3.25	15.23	18.2	12.33	01:04.6
T_2: Burma black + FYM (14 t/ha)	140.06	166.98	11.22	160.77	25.68	3.88	15.81	19.91	10.23	01:04.6
T_3: Burma black + FYM (7 t/ha) + Jeevamrutha	154.28	176.19	20.67	182	28.03	4.72	21.54	18.04	13.7	01:06.4
T_4: Burma black + VC (4.5 t/ha)	146.03	172.38	14.44	180.33	26.55	4.23	15.49	21.91	10.17	01:03.9
T_5: Burma black + VC (2.25 t/ha) + Jeevamrutha	158.81	187.69	21.33	195.11	30.12	5.28	22.38	19.02	13.93	01:06.2
T_6: *Kalabhat* + Jeevamrutha (control)	141.38	159.55	16.89	158.33	26.76	3.25	16.84	16.45	13.17	01:04.6
T_7: *Kalabhat* + FYM (14 t/ha)	145.73	159.49	14.11	153.44	26.99	4.25	13.89	23.17	11.47	01:05.0
T_8: *Kalabhat* + FYM (7 t/ha) + Jeevamrutha	157.96	180.07	20.89	180.33	28.82	4.53	23.69	15.67	14.5	01:06.1
T_9: *Kalabhat* + VC (4.5 t/ha)	142.14	172.39	13.44	168.77	28.96	4.3	19.68	17.9	11.83	01:04.0
T_{10}: *Kalabhat* + VC (2.25 t/ha) + Jeevamrutha	163.02	188.87	20.44	200	30.08	5.3	26.57	15.59	14.97	01:06.4
T_{11}: Manipuri black + Jeevamrutha (control)	117.32	162.03	11.56	190.22	27.53	3.72	14.06	21.7	13.83	01:05.3
T_{12}: Manipuri black + FYM (14 t/ha)	132.34	168.13	11.11	187.33	26.85	3.15	11.61	18	12.07	01:03.5
T_{13}: Manipuri black + FYM (7 t/ha) + Jeevamrutha	133.98	177.87	16.11	195.88	29.03	4.22	20.93	16.79	15.17	01:05.6
T_{14}: Manipuri black+ VC (4.5 t/ha)	115.54	161.38	11.11	192.22	28.91	4.97	15.8	24.71	12.27	01:04.7
T_{15}: Manipuri black + VC (2.25 t/ha) + Jeevamrutha	153.96	191.48	19.22	219.33	30.18	5.61	24.31	18.71	15.6	01:06.7
F-test	S	S	S	S	S	S	S	NS	S	-
SEm+	2.8	1.68	1.09	3.76	0.45	0.46	1.75	2.37	0.21	-
CD (P = 0.05)	8.13	4.87	3.17	10.9	1.32	1.34	5.08	-	0.61	-

*BCR is not subjected to statistical analysis;N.B.-Jeevamrutha applied 500 l/ha. (FYM- Farm Yard Manure, VC- Vermicompost)

(Vijayram., 2018)

Dry weight (g/hill)

Highest dry weight(191.48 g/hill) was observed in (Table-1) with application of T_{15}[Manipuri black + Vermicompost (2.25 t/ha) + Jeevamrutha], whereas the T_5[Burma black + Vermicompost (2.25 t/ha) + Jeevamrutha (500 litres/ha)] and T_{10}[*Kalabhat* + Vermicompost (2.25 t/ha) + Jeevamrutha (500 litres/ha)] was found statistically at par with the highest treatment. Puli *et al*., 2016 reported that the increasing of dry matter was attributed due to the FYM and Vermicompost, which provide better growing conditions to plants by continuous supply of nutrients and improvement of soil properties. Similar findings were also reported (Bhattacharjee *et al*., 2001; Sunil *et al*., 2005).

Number of panicles/hill

Highest number of panicles/hill (21.33) was observed in (Table-1) with application of T_5[Burma black + Vermicompost (2.25 t/ha) + Jeevamrutha (500 litres/ha)] whereas T_3[Burma black + FYM (7 t/ha) + Jeevamrutha (500 litres/ha)], T_8[*Kalabhat* + FYM (7 t/ha) + Jeevamrutha (500 litres/ha)],T_{10}[*Kalabhat* + Vermicompost (2.25 t/ha) + Jeevamrutha (500 litres/ha)] and T_{15}[Manipuri black + Vermicompost(2.25 t/ha) + Jeevamrutha (500 litres/ha)] was found statistically at par with the highest treatment.

Gangmei and George, 2017 reported that tiller number and panicle number were positively and closely correlated and also reported that the number of panicles per unit area is determined by either stand density or tiller development during vegetative growth of rice.

Number of grains per panicle

The significant and Highest number of grains/panicles (219.33) was observed in (Table-1)with treatmentT_{15} [Manipuri black +Vermicompost (2.25 t/ha) + Jeevamrutha (500 l/ha)].The potential number of grains per panicle is determined at panicle initiation and it is influenced by the plants' nutritional status during vegetative growth (Gangmei and George, 2017).More micronutrient uptake by plants could enable to convert macronutrients more efficiently into the cells and tissues that constitute grain (Uphoff *et al*., 2009).

Test weight (g)

The significant and highest test weight (30.18 g) was observed in (Table-1) with application of the treatment T_{15} [Manipuri black + Vermicompost(2.25 t/ha) + Jeevamrutha (500 l/ha)]. However, treatment T_5[Burma black + Vermicompost(2.25 t/ha) + Jeevamrutha (500 l/ha)], T8[Kalabhat + FYM (7 t/ha) + Jeevamrutha (500 l/ha)], T_9[Kalabhat + Vermicompost (4.5 t/ha)], T_{10}= *Kalabhat* + Vermicompost (2.25 t/ha) + Jeevamrutha, T_{13}[Manipuri black + FYM (7 t/ha) + Jeevamrutha (500 l/ha)] and T_{14} [Manipuri black+ Vermicompost (4.5 t/ha)] were found to be statistically at par with the highest treatment. The increase in test weight in response to application of organic fertilizers is probably due to enhanced availability of nutrients from organic sources because of microbial action and improved physical condition of soil (Sarker *et al*., 2004). Siavoshi (2011) reported that application of organic fertilizer significantly increased test weight of rice.

Grain yield (t/ha)

The significant and highest grain yield (5.61 t/ha) was observed in (Table-1) with treatmentT_{15} [Manipuri black + Vermicompost(2.25 t/ha) + Jeevamrutha (500 l/ha)]. However, T_3 [Burma black + FYM (7 t/ha) + Jeevamrutha (500 l/ha)], T_5[Burma black + Vermicompost (2.25 t/ha) + Jeevamrutha (500 l/ha)], T8[*Kalabhat* + FYM (7 t/ha) + Jeevamrutha (500 l/ha)], T_9[*Kalabhat* + Vermicompost(4.5 t/ha)], T_{10}[Kalabhat + Vermicompost (2.25 t/ha) + Jeevamrutha (500 l/ha)], T_{13}[Manipuri black + FYM (7 t/ha) + Jeevamrutha (500 l/ha)], T_{14} [Manipuri black+ Vermicompost(4.5 t/ha)] were found to be statistically at par withT_{15} [Manipuri black + Vermicompost (2.25 t/ha) + Jeevamrutha (500 l/ha)].Higher grain yield may have contributed due to large root volume, profuse and strong tillers with big panicles, more and well filled spikelets with higher grain weight (Sreenivasa *et al*., 2010). Further the presence of micro-elements and plant growth regulators in organic liquid manure increased the yield of rice (Palekar, 2006; Neelima and Sreenivasa, 2011), This result has been corroborated by Layek *et al*., 2016.

Straw yield (t/ha)

The significant and highest straw yield (26.57 t/ha) was observed in (Table-1) with treatmentT_{10} [Kalabhat +Vermicompost (2.25 t/ha) + Jeevamrutha (500 l/ha)]. However, T_3[Burma black + FYM (7 t/ha) + Jeevamrutha (500 l/ha)], T_5[Burma black + Vermicompost (2.25 t/ha) + Jeevamrutha (500 l/ha)], T8[*Kalabhat* + FYM (7 t/ha) + Jeevamrutha (500 l/ha)], T15 [Manipuri black +Vermicompost (2.25 t/ha) + Jeevamrutha (500 l/ha)] were found to be statistically at par withT_{10} [Kalabhat + VC (2.25 t/ha) + Jeevamrutha (500 l/ha)]. The positive and synergetic effect of foliar feeding of organic liquid manure may have caused an enhancement of straw yield (Porpavai, 2009), ultimately increasing the chlorophyll production by boosting the photosynthetic process, thereby stimulating vegetative growth. The straw yield of rice was influenced by SRI management. Transplanting of seedlings from younger stage may have provided sufficient nutrients for vegetative growth and also for reproductive phase which ultimately led to increased straw yields (Pramanick *et al*., 2014).

Harvest Index (%)

Maximum value of 24.71% was recorded in (Table-1) with the applicationof treatment T_{14}[Manipuri black+ Vermicompost (4.5 t/ha)] and the minimum value of 15.59 % was recorded with the application of treatmentT_{10} [Kalabhat + Vermicompost(2.25 t/ha) + Jeevamrutha (500 l/ha)].

Grain protein content (%)

The significant and highest Grain protein content (15.60 %) was observed in (Table-1) with treatment T_{15} [Manipuri black + Vermicompost (2.25 t/ha) + Jeevamrutha (500 l/ha)]. However, treatment T_{13} [Manipuri black + FYM (7 t/ha) + Jeevamrutha (500 l/ha)] found to be statistically at par with T_{15} [Manipuri black + Vermicompost (2.25 t/ha) + Jeevamrutha (500 l/ha)].The protein content in grain is influenced with application of various organic manures (Layek *et al*., 2016). Also increase in protein content with the application of organic liquid manure; this might be because of promotive effects on root proliferation and higher uptake of N, P and sulphur needed for protein synthesis (Shah *et al*., 2013).

Effect of organic sources of nutrient s on economics of black rice varieties

The Height BCR in (Table-1) was under application of T_{15} [Manipuri black + VC (2.25 t/ha) + Jeevamrutha (500 l/ha)] was mainly owing to more grain yield and straw yield in this respective plots.

CONCLUSION

On the basis of one year experimentation, It can be concluded from the research that application of Vermicompost (2.25 t/ ha) and Jeevamrutha (500 l/ha) found to be enhancing productivity and economy of organic Manipuri black rice. Also it is a very good and sustainable cultivation practice. However, these results are only indicative and require further experimentation to arrive at more consistent and final conclusion.

ACKNOWLEDGEMENT

We are sincerely thankful to Department of Agronomy, Naini Agricultural Institute, SHUATS, Prayagraj, for providing field, facilities and assistance in conducting this research.

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