Original Research Article

Effect of Organic Nutrient Management on Growth and Yield Attributes of Different Varieties of Rice

ABSTRACT

A field experiment was conducted during *kharif* season 2018 at the Research Farm of Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (MP) to evaluate the "Effect of organic nutrient management on growth and yield attributes of different varieties of rice". The experiment was laid out in RBD involving twelve rice varieties in triplicate. A uniform dose of organic manures *i.e.* 1/3rd Nitrogen through each of farm yard manure, neem cake and vermicompost were applied to all the varieties. Results of the study revealed that Pusa Sugandha 3 has recorded significantly higher growth parameters *viz.,* plant height (69.80 cm), number of tillers per hill (13.53) and dry matter production per hill (43.39 g) among all the varieties. Among yield attributes significantly higher number of effective tillers per hill (11.40), total number of grains per panicle (164.67), panicle length (25.33 cm), grain yield (3298 kg ha^{-1}) and straw yield (5463 kg ha^{-1}) were recorded under Pusa Sugandha 3 variety of rice. However Sahyadri and MTU 1010 reported the highest sterility percentage (17.62) and test weight (24.45g) respectively.

Keywords: Organic nutrient management, panicle length, grain yield, harvest index

1. INTRODUCTION

Rice (*Oryza sativa L.*) is the staple food for about half of the global population. In India, out of 141 mha of net cultivated area, rice occupies the maximum *i.e.,* about 43 mha [1]. The requirement will about 1121 Tg by 2025 [2] and by 2050 it will be 137.3 Tg [3]. The adoption of conventional farming methods or agriculture based on synthetic chemicals has enhanced productivity, but it has also damaged some ecosystem services and put the sustainability of the production system in jeopardy [4]. The use of excessively high yielding rice cultivars in intensive agriculture has resulted in a significant loss of nutrients from the

soil, and the imbalanced and selective application of chemical fertilizers has worsened the condition of the soil [5]. Because rice was grown continuously for extended periods of time and frequently under poor soil and crop management techniques, soil fertility was lost, as seen by the establishment of multi-nutrient deficits [6]. This deterioration in soil quality lowers factor production and overall crop productivity. Before the introduction of inorganic fertilizers, organic materials were essentially the only external supply of nutrients for crops. One is forced to consider the usage of organic manures due to the numerous negative effects of commercial fertilizer, especially the reduction of soil fertility and productivity and the rising expense of chemical fertilizers [7]. Organic farming is gaining momentum during recent times due to awareness of people towards environment and food safety. Production of high quality organic aromatic rice by the farmers for domestic as well as export purpose is a major concern of future agricultural strategy [8]. To maximize the farming system under organic farming, there is a constant search for agronomic improvement, and it requires suitable variety to reach its potential [9]. Through agricultural intensification, India became able to produce enough food, feed, ~~bio-energy~~bioenergy, and fiber to satisfy the requirements of its burgeoning population. The augment of synthetic agrochemicals and ~~nutrient responsive high yielding~~nutrient-responsive high-yielding crop varieties made us self sufficient in the sector of food production [10]. Despite the potential advantages of organic farming, such as improved soil health and crop quality, maintaining high yields is a significant issue in organic agricultural systems [11]. According to studies, regulating nutrient cycles through organic nutrition could preserve yields without increasing nutrient inputs [12]. For the cultivation of organic rice, proper variety selection and nutrition management are crucial [13]. Organic manures have the ability to appropriately meet the nutrient needs of crops and encourage the activity of macro and micro flora in the soil [14].

2. MATERIALS AND METHODS

The field experiment was conducted during *kharif* season of 2018 at Research Farm of Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, India. The soil of the experimental site was neutral in reaction with normal EC, medium in OC contents and low available nitrogen, medium phosphorus, and medium potassium. The average rainfall of the area was 1092.10 mm with normal weather conditions for better growth and development of the crop. The experiment was laid out in randomized block design in triplicate. The treatments consisted of twelve varieties of rice *viz.,* Pusa Sugandha 5, Sahyadri, Pusa Sugandha 4, BVD 109, JR 201, Dhanteshwari, Madhumati, IR 36, MTU 1010, IR 64, Pusa Basmati 1 and Pusa Sugandha 3. A uniform dose of organic manures *i.e.* 1/3rd N through each of FYM, neem cake and vermicompost remaining phosphorus through rock phosphate were applied

to all varieties. Organic manures were applied based on their nutrient content and incorporated two weeks before planting. Twenty days old seedlings were transplanted on 10th July 2018 by using of two seedlings per hill with the planting geometry of 20 cm x 20 cm. Weeds were controlled by two hands weeding at 20 and 40 days after transplanting (DAT). All necessary precautions were taken to maintain uniform plant population in each treatment per replication.

For all the growth and development studies during the crop growth period, five plants were selected randomly and tagged in net plot area of each plot. Initially the growth parameters were recorded at 30 days after transplanting and subsequent observations were taken at an interval of 30 days. Plant height of each marked plant was measured with the help of meter scale from ground level to the base of fully emerged last leaf. Yield and yield attributing characters were determined using standard procedures. Finally yield was expressed in terms of kg ha^{-1}. Data collected and recorded from various observations were tabulated and subjected to their statistical analysis as per the procedure suggested by Panse and Sukhatme (1967) [15].

3. RESULTS AND DISCUSSION

3.1 Growth and physiological attributes

3.1.1 Plant height

The data presented in the Table 1 revealed that there were significant variations in plant height of different varieties at all the growth stages due to their genetic ability. At maturity stage, Pusa Sugandha 3 (T_{12}) noted significantly tallest plant (69.80 cm) while, Madhumati attained the dwarfed height (59.47 cm).The height of other varieties was almost ceased or slightly declined at maturity. The varieties reached to their reproductive phase on or after 60 DAT. Mankotia *et al.* (2008)[16] reported that rapid rate of increment in plant height is during the period between 30 to 60 DAT and increases successively with the advancement of growth stages up to 90 DAT. At maturity the crop growth gets almost stopped and food materials starts diverting for grain development, therefore the elongation of plant height get ceased at maturity.

3.1.2 Number of tillers per hill

Among different varieties, Pusa Sugandha 3 (T_{12}) recorded maximum number of tillers (13.53) hill^{-1} found at par with Pusa Sugandha 5 (12.53) and Pusa Sugandha 4 (12.33) while, Madhumati recorded minimum (8.73) number of tillers hill^{-1} at harvest. Positive response of organic manures on number of tillers hill^{-1} was also reported by Prajapati ~~(2005)~~[17]. The number of tillers hill^{-1} gradually increased with the advancement in growth stages up to 90 DAT reported declining during 60 to 90 DAT (Table 1).

3.1.3 Dry matter production (DMP)

The dry matter production hill^{-1} in different rice varieties (Table 1) increased linearly with the advancement of growth stages till maturity. The rapid rate of increment during the period between 30 DAT to 60 DAT in all varieties was reported. At maturity, Pusa Sugandha 3 recorded highest (43.39 g) DMP hill^{-1} followed by Pusa Sugandha 5 (41.36 g) however; Madhumati (30.77 g) had least DMP hill^{-1}. These results were in close conformity with the findings of [18, 19, 20].

3.2 Yield and yield attributes

3.2.1 Number of ear bearing tillers hill^{-1}

Among different varieties Pusa Sugandha 3 recorded maximum (11.40) number of ear bearing tillers hill^{-1}. However, Pusa Sugandha 5, Pusa Sugandha 4, IR 64 and Pusa Basmati 1 were at par with Pusa Sugandha 3 produced 10.73, 10.40, 9.87 and 9.73 number of ear bearing tillers hill^{-1} respectively. Better growth of plants *i.e.* superiority in plant height, tillers hill^{-1} and DMP hill^{-1} were noticed with Pusa Sugandha 3, Pusa Sugandha 5 and Pusa Sugandha 4 which attributed to ~~produce~~ producing a significantly greater number of effective tillers hill^{-1} than the other varieties (Table 2).

3.2.2 Length of panicle and total grains panicle^{-1}

The length of panicle had significant variations among different cultivars of rice. Pusa Sugandha 3 gained maximum panicle length of 25.33 cm while Madhumati only attained 17.33 cm of length. Pusa Sugandha 3 was at par with Pusa Sugandha 5, Pusa Sugandha 4 and BVD 109 with respective values of 24.00, 23.33 and 22.00 (Table 2).

It was also noted that varieties having large sized panicles also beared more number of grains panicle^{-1}. Maximum number of total grains panicle^{-1} was recorded in Pusa Sugandha 3 (164.67) which was at par with Pusa Sugandha 5 (157.67) and Pusa Sugandha 4 (150.67). Madhumati had the minimum (125.33) number of total grains panicle^{-1} (Table 2).

3.2.3 Sterility Percentage (%)

The varietal treatments had no significant variations on sterility percentage. Among different treatments under study treatment T_2 (Sahyadri) calculated highest (17.62) sterility percentage followed by treatment T_8 (IR 36) with 17.20 % sterility. The best performance among varieties was of Pusa Sugandha 3 (T_{12}) (Table 2).

3.2.3 Test weight

The test weight of different varieties differed significantly due to their genetic ability. The test weight was highest in the variety MTU 1010 (24.45 g) due to its bold seeds. The

fine seed variety Pusa Sugandha 5 was found to have lowest 21.48 g of test weight (Table 2). Similar findings on yield attributes were also reported by [18, 21, 22].

3.2.4 Grain and straw yield

The grain yields of varieties are the final product for which varieties had been evolved (Table 3). Variety Pusa Sugandha 3 (T_{12}) with grain yields of 3298.66 kg ha^{-1} excelled to all, but it was statistically comparable to Pusa Sugandha 5 (T_1), Pusa Sugandha 4 (T_3) and BVD 109 (T_4) yielded 3082.26 kg ha^{-1}, 2986.61 kg ha^{-1} and 2916.07 kg ha^{-1} respectively. These varieties had superior growth parameters and yield attributing characters produced significantly higher grain yields than others. Treatment T_7 (Madhumati) was found lowest yielder with grain yield of 2535.87 kg ha^{-1}(Table 3). Treatment (T_{12}) Pusa Sugandha 3 produced maximum straw yields (5463.65 kg ha^{-1}) followed by treatment T_6 (Dhanteshwari), T_4 (BVD 109) and T_5 (JR 201). The varieties had significantly superior plant height and tillers $hill^{-1}$ than other varieties, hence they produced the higher straw yields (Table 3).

3.2.5 Harvesting Index (%)

The results were found no significant harvesting index value for varieties under study. Treatment T_{12} (Pusa Sugandha 3) obtained max harvesting index (37.65 %) followed by T_1 (Pusa Sugandha 5) and T_3 (Pusa Sugandha 4), T_8 (IR 36) and T_9 (MTU 1010) with 37.53%, 37.32%, 37.27% and 37.24% respectively (Table 3).

The candidate manuscript does not have a robust scientific discussion, I suggest the authors incorporate the suggested paragraphs, in this way it would improve the scientific quality of the manuscript:

Numerous publications emphasize the use of organic fertilizers to maintain and improve the availability of nutrients in the soil and obtain higher yields in the cultivation of crops in tropical territories [23, 24, 25]. Organic fertilizers are highly variable in their physical characteristics and chemical composition, mainly in their nutrient content; the constant application of them, over time, improves the physical, chemical, biological, and sanitary characteristics of the soil. Before chemical fertilizers appeared in their different forms, the only way to supply nutrients to plants and replace those extracted from the soil by crops was using organic fertilizers. The use of chemical fertilizers favored increases in crop yields [26].

This change in the use of organic fertilizers for chemical fertilizers in the fertilization of crops is currently causing the soil to suffer from an accelerated depletion of organic matter and a nutritional imbalance, and over time it loses its fertility and productive capacity. In addition, the inappropriate use of chemical fertilizers or their abuse, without considering

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the lack of other nutrients that limit crop productivity, leads to the emergence of environmental problems and the deterioration of other natural resources [27, 28].

There are studies that establish that organic fertilizers, due to their own characteristics in their composition, are humus formers and enrich the soil with this component, modifying gaps in the properties and characteristics of the soil such as its reaction (pH), variable loads, exchange capacity ionic, chelation of elements, availability of phosphorus, calcium, magnesium, and potassium, and of course the microbial population, making it more appropriate for the good development and yield of crops [29, 30]. Organic fertilizers can also lower the exchangeable acidity (Al^{3+} and H^{+}) and extractable Al and Fe in acid soils that influence the retention of phosphates and other anions, reducing their availability.

Due to the favorable effects that organic fertilizers provide to the soil, it could be said that they must be essential in the use and management of this resource to improve and maintain its organic component, its characteristics of a living entity, its physical, chemical, and biological fertility [30, 31, 32] and finally their productivity [33, 34, 35].

4. CONCLUSION

From the present study, it can be inferred that nutrient management system through organic manures along with suitable varieties can play a key role in improving crop productivity. Among different cultivars of rice Pusa Sugandha 3 was found superior. Growth as well as yield attributes of Pusa Sugandha 3 found superior followed by Pusa Sugandha 5 and Pusa Sugandha 4 under different organic nutrient management practices.

Table1: Growth parameters of different varieties of rice under organic nutrient management

Varieties	Treatment	Plant height (cm)	Tillers hill^{-1}	DMP hill^{-1} (g)
		At harvest	At harvest	At harvest
Pusa Sugandha 5	T_1	67.67	12.53	41.36
Sahyadri	T_2	64.93	10.67	38.33

Pusa Sugandha 4	T_3	67.47	12.33	41.19
BVD 109	T_4	65.20	10.37	34.20
JR 201	T_5	61.50	9.33	30.84
Dhanteshwari	T_6	62.13	9.90	32.68
Madhumati	T_7	59.47	8.73	30.77
IR 36	T_8	62.53	11.13	36.17
MTU 1010	T_9	64.47	11.00	36.89
IR 64	T_{10}	63.13	10.80	34.96
Pusa Basmati 1	T_{11}	63.53	11.20	35.86
Pusa Sugandha 3	T_{12}	69.80	13.53	43.39
SEm±		**0.50**	**0.71**	**0.61**
CD (P=0.05)		**1.46**	**2.09**	**1.80**

Table2: Yield attributing characters of different varieties of rice under organic nutrient management

Varieties	Treatment	Effective tillers hill^{-1}	Length of panicle (cm)	Total grains panicle^{-1}	Sterility Percentage (%)	Test weight (g)
Pusa Sugandha 5	T_1	10.73	24.00	157.67	12.48	21.48
Sahyadri	T_2	9.00	19.67	128.67	17.62	24.32
Pusa Sugandha 4	T_3	10.40	23.33	153.33	14.20	21.70
BVD 109	T_4	9.20	22.00	150.67	12.74	23.66
JR 201	T_5	8.20	21.67	148.00	13.01	24.40
Dhanteshwari	T_6	8.73	20.67	141.67	15.28	23.45

Madhumati	T_7	7.80	17.33	125.33	15.67	22.29
IR 36	T_8	9.33	20.33	131.67	17.20	24.15
MTU 1010	T_9	9.60	21.33	142.67	14.52	24.45
IR 64	T_{10}	9.87	20.67	130.67	15.81	23.97
Pusa Basmati 1	T_{11}	9.73	20.67	137.67	13.87	22.79
Pusa Sugandha 3	T_{12}	11.40	25.33	164.67	12.14	22.05
SEm±		**0.59**	**0.85**	**5.87**	**1.72**	**0.53**
CD (P=0.05)		**1.75**	**2.50**	**17.29**	**NS**	**1.56**

Table 3: Grain yield, Straw yield and Harvest index of different varieties of rice under organic nutrient management

Varieties	Treatment	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Harvesting Index (%)
Pusa Sugandha 5	T_1	3082.26	5129.12	37.53
Sahyadri	T_2	2691.30	4686.99	36.48
Pusa Sugandha 4	T_3	2986.61	5022.00	37.32
BVD 109	T_4	2916.07	5339.31	35.32
JR 201	T_5	2750.48	5333.69	34.02
Dhanteshwari	T_6	2796.51	5434.96	33.97
Madhumati	T_7	2535.87	5220.23	32.70
IR 36	T_8	2774.99	4670.25	37.27

MTU 1010	T_9	2845.17	4824.65	37.10
IR 64	T_{10}	2786.23	4694.98	37.24
Pusa Basmati 1	T_{11}	2823.65	5135.99	35.48
Pusa Sugandha 3	T_{12}	3298.66	5463.65	37.65
SEm±		**37.23**	**86.56**	**-**
CD (P=0.05)		**109.74**	**255.12**	**-**

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