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Studies on Effect of Various Proportions of Vermicompost and Fertilizers on Physiological Parameters, Growth, Yield and Yield Components of Scented Rice

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A B S T R A C T

Field experiment was conducted during rainy (*Kharif*) season 2008 at Jabalpur, M.P. to study the effect of various proportions of vermicompost and fertilizers on physiological parameters, growth, yield and yield components of scented rice. Total seven treatments viz., T_1 = Control (no application of manure and fertilizers), T_2 = 100% N through VC, T_3 = 100% NPK through fertilizers, T_4 = 20% N through VC+ 80% NPK, T_5 = 40% N through VC+60% NPK, T_6 = 60% N through VC+ 40% NPK, T_7 = 80% N through VC+ 20% NPK. The experiment was laid out in Randomized Block Design (RBD) with four replications. The results revealed that applications of inorganic sources of nutrients remarkably increased growth, yield, yield attributes and physiological parameters of rice than application of organic sources of nutrients alone and different combination of organic and inorganic sources of nutrients. 100% NPK through fertilizers recorded significantly higher growth, yield, yield components and physiological parameters in comparison to other treatments and this was followed by substitution of proportion of NPK proportions (20% and 40% N with vermicompost). Application of 100% NPK through fertilizers was increased values of Leaf Area Index, Crop growth Rate, RGR, Net assimilation rate and dry matter production (g/m^2), effective tillers/m^2 (283.63), panicle length (23.59 cm), grains/panicle (86.90), test wt.(25.94 gm), grain yield (42.24 q/ha), straw yield (84.60 q/ha) over control. The lower physiological parameters, growth, yield and yield attributed was recorded in control.

Introduction

Rice (*Oryza sativa L.*) is the most important crop in India and is also the hub of food security of the global population. The adoption of modern farming practices and integrated nutrient management are essential to produce crops in line with the observed global standards of quantity and quality. Owing to high grain yield, wetland rice

removes a substantial amount of major and minor nutrients from the soil, and deficiency of either nutrient reduces its grain yield. But with the present day high yielding cultivars, which have higher nutrient requirements, the use of inorganic fertilizers has increased considerably leading to decline in the use of organic materials (Hossain and Singh, 2000). It is widely recognized that neither use of organic manures alone nor chemical fertilizers can achieve the sustainability of yield under the modern intensive farming. Contrary to detrimental effects of inorganic fertilizers, organic manures are available indigenously which improves soil health resulting in enhanced crop yield. However, the use of organic manures alone might not meet the plant requirement due to presence of relatively low level of nutrients. Therefore, in order to make the soil well supplied with all the plant nutrients in the readily available form and to maintain good soil health, it is necessary to use organic manures in conjunction with inorganic fertilizes to obtain optimum yields (Ramalakshmi *et al.,* 2012). The efficacy of nutrient use may be raised by the combined use of organic and inorganic fertilizers. Organic fertilizers not only act as the source of nutrients, but also provide micronutrient and modify soil-physical behavior as well as increased the efficiency of applied nutrients (Pandey *et al.,* 2007).

In rice growing areas, organically produced scented rice has better scope to obtain better market price as well as good export opportunity. But the productivity of organically grown rice is quite less than that of rice grown with the use of improved production technologies including agro-chemicals viz., fertilizers, herbicides and pesticides. Under such circumstances, it is essential to assess the ability of vermicompost to replace certain proportions of fertilizers to be applied in scented rice without declining the yields.

Materials and Methods

The experiment comprises on seven treatments combination was conducted at Research Farm of Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur during *Kharif* season of 2008 under edaphic and climatic conditions of Jabalpur (M.P.). The climate of this locality is sub-tropical with cool winter and hot summers and mean annual rainfall of Jabalpur is 1350 mm. Jabalpur belongs to "Kymore Plateau and Satpura Hills'' agro-climatic zone as per norms of National Agricultural Research Programme. As per recent concept, developed by National Bureau of Soil Science and Land Use Planning, Nagpur, this area belongs to agro-ecological sub-region No. 10.1 named as sub humid (dry) eco-region (Malwa plateau, Vindhyan Scrap Land and Narmada Valley). The maximum temperature rises to the extreme of 45^0C and minimum temperature falls as low as to the limit of 4^0C. The soil of experimental field was sandy clay loam in texture, netural (pH 7.35) in reaction, normal in EC (0.48 dS/m) with medium OC (0.68%) content and analyzing low in available N (215 kg/ha) and P (9.20kg/ha), S (9.3kg/ha) and Zn (1.5kg/ha) and medium in available K (318 kg/ha) contents. Seven treatments viz., T_1 – absolute control (no application of any manure and fertilizers), T_2 – 100% N through vermicompost, T_3 – 100% NPK through fertilizers, T_4 – 20% N through vermicompost + 80% NPK, T_5 – 40% N through vermicompost + 60% NPK, T_6 – 60% N through vermicompost + 40% NPK,T_7 – 80% N through vermicompost + 20% NPK were tested in randomized block design with 4 replications. The recommended dose of N 120 kg/ha as urea was applied in 3 equal splits at transplanting, tillering and panicle-initiation stages. In vermicompost treatments, well prepared vermicompost was incorporated before transplanting as per the treatments. Application of P_2O_5 and K_2O were uniform @

60 kg and 40 Kg/ha as single super phosphate and murate of potash respectively and all were applied as per treatments. Rice cv. Pusa Basmati was grown by transplanting method and rice seedlings were raised in nursery bed for this purpose. Twenty five old days seedlings of rice were transplanted with 20 × 20 cm planting geometry in 7.0 × 6.0 m sized plots. Plant observations such as functional leaf/hill, number of tillers/m^2, dry weight of plant/hill, LAI, CGR, RGR, NAR were recorded at 30, 60 and 90 DAS and at harvest. Different growth and physiological parameters such as LAI, CGR, RGR and NAR were calculated by following standard formula as shown below:

Crop Growth Rate

Crop growth Rate of different treatments was determined by using following formula and express in terms of g/m^2/day. Formula proposed by Watson (1952).

$$CGR = W_2\text{-}W_1 / P(t_2\text{-}t_1)$$

Where, P = Ground area,W_1 = dry weight per unit area at t_1, W_2 = dry weight per unit area at t_2, t_1 = time of first sampling, t_2 = time of second sampling

Relative growth rate

Relative growth rate of different treatments was determined by using following formula and express in terms of g/g/day. Formula proposed by Watson (1952).

$$RGR = \log_e W_2 - \log_e W_1 / t_2\text{-}t_1$$

Where,

W_1 = dry weight per unit area at t_1, W_2 = dry weight per unit area at t_2, t_1 = time of first sampling, t_2 = time of second sampling, $\log_e$ = Natural log

Leaf Area Index

LAI is the ratio of leaf area to the area of ground cover. It is also determine by using following formula. Formula proposed by Watson (1952).

$$LAI = \frac{\text{Leaf area/plant (cm}^2\text{)}}{\text{Land area occupied/plant (cm}^2\text{)}}$$

Net Assimilation Rate

It is increase in dry wt. of plant per unit leaf area per unit time. NAR is calculated from the following formula. Formula proposed by Blackman (1968).

$$NAR = \frac{(W_2\text{-}W_1)(\text{Log } L_2 - \text{Log } L_1)}{(t_2 - t_1)(L_2\text{-}L_1)}$$

Where,

L_1= Total Leaf area of plant at t_1, L_2 = Total Leaf area of plant at t_2, W_1 = dry weight of plant at t_1, W_2 = dry weight of plant at t_2, $\log_e$ = Natural log

Results and Discussion

Growth parameters

Result revealed (Table 1) that the among the organic and inorganic sources of nutrient management, at maturity application of inorganic sources of nutrient recorded maximum dry matter/m^2(1685.25 gm) closely followed by application of 20% N through VC+80% NPK through fertilizer than other combinations and significantly superior over control and vermicompost alone.

Vermicompost contain nutrients in organic form which mineralized into available form after a particular time.

Table.1 Effect of different proportions of vermicompost and fertilizers on growth analytical parameters viz., LAI, CGR, RGR and NAR in scented rice

Treatment	Leaf Area Index			Crop Growth rate ((g/m^2/day)			Relative Growth Rate (g/g/day/m^2)			Net Assimilation Rate (g/m^2/day)	
	30 DAS	60DAS	90 DAS	30 DAS	60DAS	90 DAS	30 DAS	60DAS	90 DAS	30 DAS-60 DAS	60DAS-90 DAS
T_1	2.28	4.25	3.95	7.88	11.56	15.48	0.0630	0.0269	0.0194	0.0249	0.0282
T_2	2.47	4.64	4.35	10.74	11.79	21.44	0.0645	0.0220	0.0222	0.0312	0.0262
T_3	2.97	5.40	4.95	15.86	14.65	28.94	0.0664	0.0195	0.0221	0.0390	0.0283
T_4	2.75	5.07	4.77	15.36	14.10	27.81	0.0660	0.0194	0.0220	0.0405	0.0286
T_5	2.71	4.80	4.52	14.52	13.25	26.10	0.0656	0.0193	0.0219	0.0396	0.0284
T_6	2.65	4.72	4.41	13.43	12.26	24.03	0.0648	0.0192	0.0218	0.0374	0.0268
T_7	2.60	4.69	4.38	12.89	11.73	22.96	0.0647	0.0192	0.0217	0.0364	0.0258
SEm±	0.098	0.21	0.16	0.57	0.61	0.98	0.0003	0.0019	0.0006	0.0004	0.0001
CD at 5%	0.29	0.62	0.48	1.70	1.82	2.91	0.001	NS	NS	0.0012	0.0003

Table.2 Effect of different proportions of vermicompost and fertilizers on growth, yield and yield attributes of scented rice

Treatment	Dry matter Production (g/m^2)				Effective tillers/m^2	Panicle length (cm)	Grains /panicle	Test Wt. (g)	Grain yield (q/ha)	Straw yield (q/ha)	Harvest index (%)
	30DAS	60DAS	90 DAS	Maturity							
T_1	42.00	278.60	625.50	997.10	239.24	21.48	72.95	24.02	26.45	52.25	33.59
T_2	54.25	376.50	730.25	1245.00	258.71	22.63	82.40	24.16	35.41	69.02	33.90
T_3	75.00	550.90	990.50	1685.25	283.63	23.59	86.90	25.94	42.24	84.60	33.30
T_4	73.75	534.84	958.00	1625.55	276.38	23.44	84.75	25.72	40.03	80.06	33.33
T_5	70.85	506.20	903.80	1530.28	269.85	23.30	84.09	24.86	38.24	75.28	33.68
T_6	67.21	470.38	838.20	1415.00	266.15	23.12	83.53	24.64	36.35	72.80	33.30
T_7	64.75	451.65	803.75	1355.00	263.42	22.78	83.06	24.38	36.01	72.08	33.31
SEm±	1.74	6.93	10.99	21.30	4.80	0.33	1.52	0.64	1.37	3.86	0.28
CD at 5%	5.17	20.61	32.66	63.27	14.25	0.99	4.52	NS	4.07	11.46	NS

The conversion of nutrients from organic form to inorganic form is unavailable to fulfill the timely needs of crop. This may be the reason for the poor growth of plant nutrition. The reduction of proportion of NPK through vermicompost equivalent to N correspondingly reduced the food accumulation in plants in terms of DMP/m^2. These results were collaborated with the findings of Murali (2001) and Singh *et al.*, (2007).

The Leaf area index (LAI) values were maximum in inorganic sources of nutrients at 30,60 and 90 DAS being at par with 20% N through VC and 80% NPK through fertilizers and 40% N through VC+60% NPK through fertilizers. Minimum LAI was recorded under control. The highest LAI which is correlated with photosynthesis and ultimately indicates that increase in dry matter is associated with increase in produced more dry matter per unit leaf area.

Crop Growth Rate (CGR) indicates that the rate of increment per unit area. CGR increased with advancement of plant stage but decreased at maturity stage. Maximum CGR recorded maximum under 100% NPK through fertilizers and minimum in control.

The photosynthates synthesized in plants were utilized for improvement in vegetative growth of plants. Therefore CGR in crop plants were slow in early growth and all photosynthates is converted into development of grain at maturity.

Relative growth rate (RGR) expresses the dry weight increase in time interval in relation to initial weight. The maximum RGR was registered under application of inorganic sources of nutrients at 30 DAS which was at par with 20% N through VC and 80% NPK through fertilizers and 40% N through VC and 60% NPK through fertilizers.

Higher value of net photosynthesis was recorded in application of inorganic sources of nutrients at 30-60 DAS which was at par with 20% N through VC and 80% NPK through fertilizers and 40% N through VC and 60% NPK through fertilizers and minimum value under control. The crop yields depend upon both the rate and duration of photosynthesis and increased photosynthesis potential is considered to be a possible approach in improving yield. These findings are in close agreement with those of Shivangi and Reddy (2000) and Barisan (2002).

Yield attributes

In rice, yield attributes viz., effective tillers/m^2 (283.63), length of panicle (23.55 cm), grains/panicle (86.90) and test weight (25.94 gm) was recorded higher under application of inorganic sources of nutrient closely followed by application of 20% N through VC+80% NPK through fertilizer than other combination and significantly superior over control and vermicompost alone. The minimum yield attributes viz., effective tillers/m^2 (239.24), length of panicle (21.48 cm), grains/panicle (72.95) and test weight (24.02 gm) were recorded in control (Table 2). Application of inorganic sources of nutrients was recorded 18.55%, 9.82%, 19.12% and 7.82% more tillers/m^2, length of panicle, grains/panicle and 1000 grain weight respectively. Similar findings were also reported by Ramalakshmi *et al.*, (2012), Alim, (2012). The higher yield attributes is might be due to higher levels of inorganic fertilizers have been increases the activity of photosynthesis and enzymes which responsible for transformation of energy, carbohydrates, fat metabolism and respiration of plant. Organic manures acting as slow release source of N are expected to more closely match with the N and supply of other nutrients with demand of rice crop and this

could reduce the N losses and also improved nutrient use efficiency particularly nitrogen.(Becker *et al.,* 1994). The yield attributes were markedly superior with inorganic nutrient management as a result of optimum supply of nutrients through fertilizers than combined application of vermicompost and inorganic fertilizers in different proportions and organic nutrient management (Guo *et al.,* 2001).

Grain and straw yield

Significantly higher grain yield (42.24 q ha^{-1}) and straw yield (84.60 q ha^{-1}) were recorded under application of inorganic sources of nutrients than control. This was closely followed by application of 20% N through VC + 80% NPK through fertilizers and 40% N through VC + 60% NPK through fertilizers. Minimum grain yield (26.45 q ha^{-1}) and straw yield (52.25 q ha^{-1}) were recorded under control. The application of 100% NPK through fertilizers increased the grain yield (59.73%) and straw yield (61.91%) over control. The inorganic nutrient management gave higher grain yield. The nutrient availability to the crop might be lesser under combined application of VC and inorganic fertilizers resulting significantly inferior growth parameters, ultimately lesser grain yields as compared to application of NPK through fertilizers.

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