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Influence of organic manures and organic sprays on growth and yield of rice (*Oryza sativa* L.)

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Abstract
The investigation entitled, "Influence of organic manures and organic sprays on growth and yield of rice (*Oryza sativa* L.)" was conducted during *Kharif* 2019 and 2020 at Agronomy Department Farm, College of Agriculture, Dapoli (M.S.). The field experiment was laid out in a strip plot design comprising sixteen treatment combinations replicated thrice during *Kharif* season. The vertical strips comprised four organic manures *viz*., Farm yard manure (M_1), Vermicompost (M_2), Poultry manure (M_3) and Glyricidia leaf manure (M_4) and horizontal strips consisted of four organic spray treatments *viz*., Control (S_0), Jeevamrut (5% spray) (S_1), Vermiwash (5% Spray) (S_2) and Cow urine (5% Spray) (S_3) to rice in *Kharif* season. The results revealed that the application of poultry manure along with foliar application of 5% jeevamrut (M_3S_1) increased the growth and yield of rice.

Keywords: Rice, organic manures, organic sprays, growth, yield

1. Introduction
Rice (*Oryza sativa* L.) belonging to the family poaceae which constitutes the principle food for about 60 per cent of the world's population. Rice is grown in 114 countries across the globe, with a total harvested area of approximately 162.06 million hectares. Rice is cultivated in India, China, Japan, Korea, Thailand and several other countries of the world. India is the world's second largest rice producer and consumer next to China. Rice occupies a pivotal place in Indian agriculture as it is a staple food of India. Globally, it stands first in rice area and second in rice production, after China. India contributes 21.5 percent of global rice production. Within the country, rice occupies one-quarter of the total cropped area, contributes about 40 to 43 percent of total food grain production and continues to play a vital role in the national food and livelihood security system. The area grown to rice in India was about 43.79 million hectares in 2019, which was the largest among all the rice-growing countries. Annual production of rice in India is about 117.94 million tones (Anonymous 2019-2020) [2]. It is higher by 10.14 million tones than the last five years' average production of 107.80 million tones. Rice contributes 43 per cent of total food grain production and 46 per cent of total cereal production in India. It contributes an annual production of 104.32 million tonne from an area of 43.39 million hectares with average productivity of 2.40 t ha^{-1} (Anonymous, 2016) [1].
Application of imbalanced and/or excessive nutrients led to declining nutrient-use efficiency making fertilizer consumption uneconomical and producing adverse effects on the atmosphere (Aulakh and Adhya, 2005) [3] and groundwater quality (Aulakh *et al.* 2009) [4] causing health hazards and climate change. On the other hand, nutrient mining has occurred in many soils due to lack of affordable fertilizer sources and where fewer or no organic residues are returned to the soils. Therefore, to overcome these problems there is a need to develop organic nutrient management which conserve land, water, plant and animal genetic resources that are environmentally non-degrading, technically appropriate, economically viable and socially acceptable system. Sustainable agricultural productivity and improvement in soil health and soil physical properties by using organic manures and organic sprays are other important issues in the present context. Organic resources like cow dung manure, vermicompost, poultry manure, *gliricidia* leaf manure, Jeevamrut, vermiwash, cow urine etc. deserve priority in organic nutrient management. Nitrogen is the key nutrient element limiting the yield of rice. Fertilizer N use efficiency varies from 18 to 40 per cent only in different soils, because of rapid loss of inorganic N from the soil through ammonia volatilization and denitrification. Organic materials minimize N loss and increase N use efficiency.

Keeping this point in the view, the proposed research entitled "Influence of organic manures and organic sprays on growth and yield of rice (*Oryza sativa* L.)" is planned to be conducted with the objective to study the effect of organic manures and organic sprays on growth and yield of *Kharif* rice.

2. Material and Methods

The investigation entitled, "Influence of organic manures and organic sprays on growth and yield of rice (*Oryza sativa* L.)" was conducted during the *Kharif* seasons of 2019-20 and 2020-21 at Agronomy Department Farm, College of Agriculture, Dapoli (M.S.). The soil of the experimental plot was sandy clay loam in texture, high in organic carbon (0.94%) and low in available nitrogen (215.16 kg ha^{-1}), low in phosphorus (11.42 Kg ha^{-1}) and medium in potassium (251.15 kg ha^{-1}). The soil was slightly acidic (pH 5.80) in reaction.

The field experiment was laid out in a strip plot design comprising of sixteen treatment combinations replicated thrice. The vertical strips comprised four organic manures *viz*., Farm yard manure (M_1), Vermicompost (M_2), Poultry manure (M_3) and Glyricidia leaf manure (M_4). The horizontal strips consisted four organic spray treatments *viz*., Control (S_0), Jeevamrut (5% spray) (S_1), Vermiwash (5% Spray) (S_2) and Cow urine (5% Spray) (S_3) to rice in *Kharif* season.

The rice transplanting was done by using conventional method on puddled field in which 21 days old seedlings were used during both *Kharif* seasons. Organic manures were applied as per the treatments. The organic sprays were applied at 15, 30 and 45 DAT of rice. The other usual common packages of practices were followed from time to time and periodical growth observations were recorded at an interval of 30 DAS for *Kharif* rice. Crops were harvested at physiological maturity and data on yield attributes and yield were recorded for both seasons.

3. Results and Discussion

3.1 Effect on growth attributes

3.1.1 Effect of organic manures

It is evident from the data presented in Table 1 that a marked effect of organic manures was observed on growth characters of rice throughout the crop growth period during both the years of experimentation. At all growth stages poultry manure recorded significantly higher plant height, number of functional leaves $hill^{-1}$, number of tillers $hill^{-1}$ and dry matter accumulation $hill^{-1}$. This might be due to more availability of nutrients from poultry manure throughout the growing season and the fact that in poultry manure, mineralization is rapid. Similar findings were also reported by Channabasangowda *et al.* (2008) [5], Farhad *et al.* (2009) [7] and Siavoshi *et al.* (2010) [14].

Table 1: Effect of organic manures and organic sprays on growth of rice at harvest during *Kharif* 2019 and 2020.

Treatment	Plant height (cm)		Number of functional leaves $hill^{-1}$		Number of tillers $hill^{-1}$		Dry matter accumulation $hill^{-1}$ (g)	
	2019	2020	2019	2020	2019	2020	2019	2020
Organic manures (M)								
M_1: Farm yard manure	69.23	67.93	7.35	7.76	6.06	6.29	50.04	53.14
M_2: Vermicompost	66.91	65.47	7.26	7.66	5.89	6.06	48.97	51.95
M_3: Poultry manure	72.51	70.63	7.85	8.28	6.12	6.37	52.48	55.90
M_4: Glyricidia leaf manure	66.57	64.64	6.99	7.50	5.08	5.33	43.50	46.21
S.Em. ±	0.79	0.77	0.10	0.09	0.13	0.13	1.09	1.17
C.D. at 5%	2.73	2.69	0.35	0.33	0.48	0.47	3.79	4.07
Organic sprays (S)								
S_0: Control	65.93	64.48	7.10	7.49	5.36	5.61	47.57	50.27
S_1: Jeevamrut (5 % Spray)	71.88	70.00	7.61	8.14	6.30	6.45	50.54	53.84
S_2: Vermiwash (5 % Spray)	69.10	67.34	7.44	7.97	5.93	6.19	48.77	51.79
S_3: Cow urine (5 % Spray)	68.30	66.85	7.30	7.60	5.55	5.80	48.12	51.32
S.Em. ±	0.70	0.65	0.06	0.08	0.12	0.10	0.37	0.43
C.D. at 5%	2.45	2.26	0.21	0.30	0.41	0.37	1.28	1.49
Interaction								
S.Em. ±	0.52	0.73	0.20	0.26	0.14	0.16	0.27	0.37
C.D. at 5%	NS	NS	NS	NS	NS	NS	NS	NS
General mean	68.80	67.17	7.36	7.80	5.78	6.01	48.75	51.80

3.1.2 Effect of organic sprays

It is evident from the data presented in Table 1 that the remarkable influence of different organic spray treatments on growth characters of rice was observed during all growth stages of rice in the year 2019 and 2020. During growing period, growth parameters of rice, *viz*., plant height, number of functional leaves m^{-2}, number of tillers m^{-2} and dry matter accumulation (g) m^{-2} recorded a maximum under 5% foliar application of jeevamrut over rest of the treatments and was at par with 5% foliar application of vermiwash during both the years. Plant height was observed higher by foliar application of jeevamrut might be due to greater potential of growth promoting substances in jeevamrut which helps to enhance carbohydrate synthesis and effective translocation of photosynthates which contributed in improvement of the growth attributes. The foliar application of 5% jeevamrut produced significantly higher dry matter accumulation in rice which might be due to availability of significant quantity of vitamins and natural phyto-regulators in jeevamrut in a balanced form resulting in increased dry matter production of rice. Similar findings have also been reported by Ramesh *et al*. (2015) [10], Sahare and Mahapatra (2015) [12] and Vedagiri *et al.* (2022) [16].

3.1.3 Interaction effect

The interaction effect between organic manures and organic sprays with respect to plant height, number of functional leaves $hill^{-1}$, number of tillers $hill^{-1}$ and dry matter accumulation $hill^{-1}$ was found to be non- significant during both the years.

3.2 Effect on yield attributes and yield

3.2.1 Effect of organic manures

Data pertaining in Table 2 revealed that **t**he number of panicles hill^{-1} and the weight of panicle was significantly higher in treatment of poultry manure and it was at par with farm yard manure and vermicompost. While, length of panicle and number of filled grains panicle^{-1} were higher under poultry manure treatment which was at par with farm yard manure. This might be due to higher concentration of macro and micro nutrients in poultry manure and higher and steady nutrient release compare to other organic manures. Further, the poultry waste had both urinary and fecal excretion, hence the fertilizer value was nearly three times higher than FYM. The enhanced and continuous supply of nutrient by the enriched organics might have led to better tiller production, enhanced panicle length and filled grains of rice. These results are in accordance with the findings of Channabasangowda *et al.* (2008) [5], Farhad *et al.* (2009) [7], Hammad *et al.* (2010) [8], Siavoshi *et al.* (2010) [14] and Meena *et al.* (2012) [9].

Grain and straw yield of rice were significantly higher under poultry manure treatment over rest of the treatments. The increase in yield attributes and yield in poultry manure might be due to increased growth and development parameters which ultimately resulted in increase in yield contributing characters and eventually the grain yield. The supremacy of poultry manure lies in the fact that it can supply the nutrients in soluble forms for a quite longer period by not allowing the entire soluble form into solution, to come in contact with soil and other inorganic constituents, thereby minimizing fixation and precipitation from the poultry manure, the plant roots can very well compete with loss mechanisms and absorb more nutrients leading to better yield. These results fall in line with the findings of Siavoshi et al. (2010) [14], Sangeetha et al. (2010) [13] and Choudhary (2013) [6].

3.2.2 Effect of organic sprays

The results revealed that foliar application of 5% jeevamrut remained at par with foliar application of 5% vermiwash and both the treatments significantly increased almost all the yield attributes (Table 2) as compared to other organic spray treatments during both the years. This might be due to higher availability of growth promoting substances such as IAA, GA, cytokinin, kinetin, essential plant nutrients, effective microorganisms present in jeevamrut that directly influenced leaf area index, increased photosynthetic activity and assimilate partitioning from source to sink might be attributed to increase the yield attributes in this treatment. These results were in agreement with the findings of Sahare and Mahapatra (2015) [12], Ramesh *et al.* (2018) [11], and Vedagiri *et al.* (2022) [16].

Foliar application of 5% jeevamrut remained at par with foliar application of 5% vermiwash in rice and both the treatments recorded significantly higher grain yield (Table 2) over other treatments during both the years as well as in pooled analysis. Foliar spraying with jeevamrut could have created stimuli in the plant system which in turns increase the production of growth regulators in cell system and the action of growth regulators in plant system stimulated the necessary growth and development, leading to better yield. Besides the easy transfer of nutrients and growth stimulants to plants through foliar spray of optimum dose of jeevamrut might be the reason for enhancement in grain yield of rice. The results confirm the findings of Sahare and Mahapatra (2015) [12], Ramesh *et al.* (2018) [11], and Vedagiri *et al.* (2022) [16].

Foliar application of 5% jeevamrut remained at par with foliar application of 5% vermiwash in rice and both the treatments recorded significantly higher grain yield (Table 2) over other treatments during both the years as well as in pooled analysis. Foliar spraying with jeevamrut could have created stimuli in the plant system which in turns increase the production of growth regulators in cell system and the action of growth regulators in plant system stimulated the necessary growth and development, leading to better yield. Besides the easy transfer of nutrients and growth stimulants to plants through foliar spray of optimum dose of jeevamrut might be the reason for enhancement in grain yield of rice. The results confirm the findings of Sahare and Mahapatra (2015) [12], Ramesh *et al.* (2018) [11], and Vedagiri *et al.* (2022) [16].

Table 2. Effect of organic manures and organic sprays on yield attributes and yield of rice at harvest during *Kharif* 2019 and 2020

Treatment	Number of panicles hill^{-1}		Length of panicle (cm)		Weight of panicle^{-1} (g)		Number of filled grains panicle^{-1}		Number of unfilled grains panicle^{-1}		Test weight (g)		Grain yield (q ha^{-1})			Straw yield (q ha^{-1})		
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020	Pooled	2019	2020	Pooled
Organic manures (M)																		
M_1: Farm yard manure	6.06	6.29	23.30	23.80	4.44	4.80	233.00	256.25	44.83	39.50	15.41	15.73	47.84	49.36	48.60	70.61	72.41	71.51
M_2: Vermicompost	5.89	6.06	22.84	23.05	4.35	4.69	230.58	249.42	52.42	44.42	15.33	15.65	46.13	47.72	46.92	69.35	71.11	70.23
M_3: Poultry manure	6.12	6.37	23.41	24.11	4.57	4.95	241.67	261.25	41.92	34.33	15.51	15.83	50.28	51.81	51.04	72.97	74.93	73.95
M_4: Glyricidia leaf manure	5.08	5.33	21.97	22.58	3.91	4.09	227.58	248.75	56.83	47.50	15.13	15.45	45.32	46.72	46.02	68.00	69.79	68.89
S.Em. ±	0.13	0.13	0.18	0.20	0.08	0.10	1.74	1.71	1.976	1.66	0.04	0.04	0.63	0.64	0.63	0.61	0.63	0.62
C.D. at 5%	0.48	0.47	0.65	0.69	0.28	0.37	6.05	5.94	6.837	5.76	NS	NS	2.19	2.21	2.20	2.11	2.19	2.15
Organic sprays (S)																		
S_0: Control	5.36	5.61	22.37	22.63	4.05	4.39	225.17	244.17	59.17	51.00	15.22	15.54	45.37	46.74	46.05	68.64	70.23	69.43
S_1: Jeevamrut (5 % Spray)	6.30	6.45	23.20	23.86	4.62	4.94	242.75	262.75	40.42	30.25	15.48	15.81	49.01	50.38	49.69	71.67	73.55	72.61
S_2: Vermiwash (5 % Spray)	5.93	6.19	23.07	23.71	4.44	4.75	235.00	256.75	48.17	40.50	15.44	15.77	47.88	49.53	48.70	70.65	72.58	71.61
S_3: Cow urine (5 % Spray)	5.55	5.80	22.88	23.35	4.16	4.46	229.92	252.00	48.25	44.00	15.23	15.55	47.32	48.96	48.14	69.97	71.88	70.93

S.Em. ±	0.12	0.10	0.10	0.15	0.07	0.07	2.17	2.26	2.22	2.49	0.04	0.04	0.43	0.44	0.44	0.36	0.40	0.38
C.D. at 5%	0.41	0.37	0.36	0.55	0.25	0.25	7.51	7.83	7.70	8.63	NS	NS	1.51	1.55	1.53	1.27	1.39	1.33
Interaction																		
S.Em. ±	0.14	0.16	0.24	0.27	0.16	0.10	2.15	3.21	2.15	2.64	0.12	0.12	0.65	0.67	0.65	0.49	0.52	0.50
C.D. at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
General mean	5.78	6.01	22.88	23.39	4.32	4.63	233.21	253.92	49.00	41.44	15.34	15.67	47.39	48.90	48.15	70.23	72.06	71.15

The foliar spray of 5% jeevamrut and vermiwash recorded identical and significantly higher straw yield (Table 2) over rest of the treatments during both the years as well as in pooled analysis. This might be due to increased morphological characters *viz*., plant height, number of leaves hill^{-1}, number of tillers hill^{-1} and dry matter accumulation hill^{-1} observed under foliar spray of jeevamrut and vermiwash. Similar findings were also reported by Sahare and Mahapatra (2015) [12], Ramesh *et al.* (2018) [11] and Shridhara et al. (2022) [15].

3.2.3 Interaction effect

The interaction effect between organic manures and organic sprays with respect to number of panicles hill^{-1}, length of panicle (cm), weight of panicle^{-1} (g), number of filled grains panicle^{-1}, number of unfilled grains panicle^{-1}, test weight (g), grain and straw yield (q ha^{-1}) was found to be non- significant during both the years.

4. Conclusion

From the above findings, it can be concluded that the application of 100% RDN through poultry manure along with 5% foliar application of jeevamrut recorded significantly higher growth, yield attributes and yield of rice.

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