

Influence of organic and inorganic sources on enhancing the growth and yield of Rice

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Abstract

In order to evaluate the effects of organic and inorganic sources which enhancing the growth and yield of rice. The field experiment was conducted in farmer's field at Varagurpettai Village, Chidambaram (TK), Cuddalore (DT). The experiment with factorial randomized block design with three replications using rice variety ASD-16 in the season's kharif 2022. The treatment details namely, two factors F & S. F₀ - Control, F₁- 50 % RDF, F₂- 100% RDF, F₃-150% RDF, S₀ - Control, S₁-Vermicompost @ 5 t ha⁻¹, S₂-Press mud @ 5 t ha⁻¹, S₃-Green leaf manures @ 6.25 t ha⁻¹, S₄-Poultry manure @ 5 t ha⁻¹. The initial pH and EC of the soil status was registered 7.9 and 1.7 d Sm⁻¹. The initial status of available N (137 kg ha⁻¹), P (8.6 kg ha⁻¹) and K (175 kg ha⁻¹) was recorded. The micronutrients such as DTPA-Zn, Fe, Cu and Mn content of the soil which recorded 0.64, 12.2, 0.48 and 9.1 mg kg⁻¹. The results showed that growth, yield and yield attributes of rice was superiorly increased by the application of 100% RDF (F₂) with S₄-Poultry manure at 5 t ha⁻¹ compare to control (F₀S₀).

Key words : Rice, RDF, Poultry manure, Vermicompost, Press mud, growth and yield.

Rice is the most cultivated cereal crop worldwide and is pronounced to be target food to the lives of billions of people around the world. Rice is being stable food for 65 per cent of the total population in India is consumed about 41.5 per cent of the total grain production and 55 per cent of total cereal production. India stands second in rice production next to China

with an area of 44.40 m ha. Indian rice production has been 112.91 mt during the year 2017-18 (DAC & FW, 2019).

Organic manures are being utilised more frequently in modern agriculture due to their importance in maintaining good soil health, delivering nearly all necessary plant nutrients

for crop plant growth and development and enhancing the physical, chemical, and biological features of soil¹⁷. Poultry manures are an excellent fertilizer containing nitrogen, phosphorus, potassium and micronutrients for healthy growth of plants. Poultry manure such as poultry manure increases the organic matter (OM) content of soil and in turn releases the plant nutrients in available form for the use of the plants. It contained essential nutrient elements association with high photosynthetic activities and thus promotes root and vegetable growth. The present studies have shown that the integration of inorganic fertilizer and poultry manure has also been report to be more beneficial than the use of either mineral fertilizer in intensive agricultural production.

The current study, which used the rice, was carried out on a farmer's field. The field experiments were conducted in Varagurpettai Village, Chidambaram (TK), Cuddalore (DT). in the farmer's holding geographically situated at latitude 11.39° N and of longitude of 79.72°E. The experimental soil belongs to clay loamy soil. The experiment with factorial randomized block design (FRBD) with three replications using rice variety ASD-16 in the season's kharif 2022. The treatment details namely, two factors F & S. F₀ - Control, F₁- 50 % RDF, F₂- 100% RDF, F₃ -150% RDF, S₀ - Control, S₁ - Vermicompost @ 5 t ha⁻¹, S₂-Press mud @ 5 t ha⁻¹, S₃-Green leaf manures @ 6.25 t ha⁻¹, S₄- Poultry manure @ 5 t ha⁻¹. The initial pH and EC of the soil status was registered 7.9 and 1.7 d Sm⁻¹. The initial status of available N (137 kg ha⁻¹), P (8.6 kg ha⁻¹) and K (175 kg ha⁻¹) was recorded. The micronutrients such as DTPA-Zn, Fe, Cu and Mn content of the soil which recorded 0.64, 12.2, 0.48 and 9.1

mg kg⁻¹. The application of 100% RDF(F₂) with S₄-Poultry manure @ 5 t ha⁻¹ increases the growth characters, yield and yield attributes of rice.

Growth attributes :

Plant height (cm) (Table-1) :

Among the various factors, utilization of F₂ with S₄ *i.e.*, 100% RDF + Poultry manure at 5 t ha⁻¹ compared to control and other treatments, increased plant heights were observed at the 30 days (43.94 cm), 60 days (80.59 cm), and 90 days (110.57 cm). The continuous availability of major and trace minerals may be the cause of the rise in plant height in response to the beneficial effect of poultry manure on plant height and micro nutrients with different growth hormones like gibberellins, NAA and cytokinin, which led to a rise in plant height. Similar findings were obtained by Farid *et al.*,⁷ Kshetrimayum Ellena Devi *et al.*,¹⁰ and Boreddy Narendra Kumar Reddy *et al.*,⁴. In control plots, the lowest plant height was recorded.

Number of tillers hill⁻¹ (Table-2) :

Utilization of F₂ with S₄ *i.e.*, 100% RDF + Poultry manure at 5 t ha⁻¹ compared to control and other treatments, which produced the highest number of tillers at 17.56 at 30 days, 19.96 at 60 days and 18.75 at harvest stage outperformed other treatments by a significant margin. This may be due to better growth and enhanced photosynthesis in presence of required nutrients in sufficient amount and also owing to better translocation of photosynthesis to sink because of balance nutrients of NPK

Table-1. Effect of inorganic fertilizer and organic manures on plant height (cm) of rice in clay loam soil

	Plant height - 30 Days					Plant height - 60 Days					Plant height (cm) - at harvest							
	S0	S1	S2	S3	S4	Mean	S0	S1	S2	S3	S4	Mean	S0	S1	S2	S3	S4	Mean
F0	29.27	32.21	32.12	31.97	34.26	31.97	38.72	46.11	45.89	45.52	51.51	45.55	67.30	75.39	75.17	74.80	80.79	74.69
F1	32.05	34.54	34.65	34.37	36.70	34.46	45.70	53.44	54.44	51.94	59.91	53.09	74.98	82.72	83.72	81.22	89.19	82.37
F2	36.96	41.64	41.45	41.16	43.94	41.03	60.65	74.59	73.69	72.24	80.59	72.35	89.93	103.87	102.97	101.52	110.57	101.77
F3	34.45	39.12	38.98	36.82	41.29	38.13	52.63	66.89	66.04	60.25	72.94	63.75	81.91	96.17	95.32	89.53	102.22	93.03
Mean	33.18	36.88	36.80	36.08	39.05		49.43	60.26	60.02	57.49	66.24		78.53	89.54	89.30	86.77	95.69	
	SED			CD (0.05)			SED			CD (0.05)			SED			CD (0.05)		
F	0.688			1.684			1.107			2.710			1.659			4.060		
S	0.298			0.607			0.479			0.977			0.718			1.463		
F x S	0.870			1.996			1.401			3.213			2.098			4.813		

Table-2. Effect of inorganic fertilizer and organic manures on No. of Tillers hill⁻¹ of rice in clay loam soil

	No. of Tillers hill ⁻¹ - 30 Days					No. of Tillers hill ⁻¹ - 60 Days					No. of Tillers hill ⁻¹ - at harvest							
	S0	S1	S2	S3	S4	Mean	S0	S1	S2	S3	S4	Mean	S0	S1	S2	S3	S4	Mean
F0	8.10	10.47	10.40	10.30	11.65	10.18	10.11	12.58	12.51	12.41	13.88	12.30	9.23	11.68	11.61	11.51	12.94	11.39
F1	10.35	11.83	11.91	11.70	13.12	11.78	12.46	14.06	14.06	13.93	15.45	14.01	11.56	13.12	13.20	12.99	14.47	13.07
F2	13.24	15.86	15.78	15.69	17.56	15.63	15.57	18.36	18.28	18.19	19.96	18.07	14.59	17.25	17.17	17.08	18.75	16.97
F3	11.76	14.49	14.43	13.17	15.73	13.92	13.99	16.90	16.84	15.50	18.23	16.29	13.05	15.87	15.81	14.52	17.12	15.27
Mean	10.86	13.16	13.13	12.72	14.52		13.03	15.48	15.44	15.01	16.88		12.11	14.48	14.45	14.03	15.82	
	SED			CD (0.05)			SED			CD (0.05)			SED			CD (0.05)		
F	0.245			0.599			0.287			0.703			0.26			0.657		
S	0.106			0.216			0.124			0.253			0.116			0.237		
F x S	0.310			0.711			0.363			0.834			0.339			0.779		

Table-3. Effect of inorganic fertilizer and organic manures on leaf area index of rice in clay loam soil

LAI-30 days							LAI-60 days					
	S0	S1	S2	S3	S4	Mean	S0	S1	S2	S3	S4	Mean
F0	1.86	233	226	216	250	2.22	2.07	2.75	2.70	2.65	3.09	2.65
F1	2.21	268	276	255	294	2.63	2.67	3.18	3.23	3.11	3.58	3.15
F2	3.06	368	360	351	397	3.56	3.65	4.51	4.46	4.41	4.99	4.40
F3	2.61	331	325	299	355	3.14	3.14	4.05	4.00	3.61	4.43	3.85
Mean	2.44	3.00	2.97	2.80	3.24		2.88	3.62	3.60	3.45	4.02	
	SED		CD (0.05)				SED		CD (0.05)			
F	0056		0.138				0.066		0.161			
S	0024		0.049				0.028		0.058			
F x S	0071		0.164				0.083		0.191			

Table-4. Effect of inorganic fertilizer and organic manures on Dry matter production (kg ha⁻¹) of rice in clay loam soil

DMP - 30 days							DMP - 60days					
	S0	S1	S2	S3	S4	Mean	S0	S1	S2	S3	S4	Mean
F0	1833	2250	2234	2213	2512	2208	3405	3967	3951	3930	4278	3906
F1	2222	2541	2560	2519	2828	2534	3939	4307	4326	4285	4639	4299
F2	2853	3465	3440	3411	3775	3389	4664	5376	5351	5322	5778	5298
F3	2528	3146	3123	2838	3422	3011	4294	5002	4979	4649	5333	4851
Mean	2359	2851	2839	2745	3134		4076	4663	4652	4547	5007	
	SED		CD (0.05)				SED		CD (0.05)			
F	52528		128538				865263		211.731			
S	22.745		46.3324				37.4669		76.3197			
F x S	66.444		152.373				109.448		250.992			

Table-5. Effect of inorganic fertilizer and organic manures on yield attributes of rice in clay loam soil

No. of Panicles m ⁻²							No. of grains / panicle m ⁻¹					
	S0	S1	S2	S3	S4	Mean	S0	S1	S2	S3	S4	Mean
F0	123.00	176.00	174.00	171.00	195.00	167.80	65.95	74.72	72.76	68.85	76.91	71.84
F1	173.00	199.00	201.00	197.00	220.00	198.00	70.8	82.82	84.8	78.87	86.97	80.85
F2	223.00	269.00	267.00	266.00	314.00	267.80	90.9	103.1	101.12	97.19	106.1	99.68
F3	197.00	246.00	242.00	221.00	266.00	234.40	80.84	95.04	93.06	88.93	99.15	91.40
Mean	179.00	222.50	221.00	213.75	248.75		77.12	88.92	87.94	83.46	92.28	
	SED		CD (0.05)				SED		CD (0.05)			
F	4.09		10.01				1.62		3.97			
S	1.77		3.61				0.70		1.43			
F x S	5.18		11.87				2.05		4.70			

Table-6. Effect of inorganic fertilizer and organic manures on panicle length (cm) of rice in clay loam soil

Panicle length (cm)						
	S0	S1	S2	S3	S4	Mean
F0	16.50	16.91	16.91	16.90	17.82	17.01
F1	16.90	17.83	17.83	17.82	17.86	17.65
F2	17.87	17.95	17.94	17.93	18.30	18.00
F3	17.83	17.90	17.90	17.87	17.94	17.89
Mean	16.06	16.98	16.95	16.77	17.50	
	SED			CD (0.05)		
F	0.160			0.392		
S	0.069			0.141		
F x S	0.202			0.464		

Table-7. Effect of inorganic fertilizer and organic manures on grain and straw yield of rice in clay loam soil

Grain yield kg ha ⁻¹							Straw yield kg ha ⁻¹					
	S0	S1	S2	S3	S4	Mean	S0	S1	S2	S3	S4	Mean
F0	1208	2607	2591	2425	2980	2362	1591	3028	3009	2816	3461	2781
F1	2606	3128	3225	3051	3443	3090	3027	3632	3746	3543	3999	3589
F2	3501	4440	4340	4214	5483	4396	4067	5156	5040	4894	6394	5110
F3	3086	3892	3816	3479	4312	3717	3585	4521	4432	4041	5008	4317
Mean	2600	3517	3493	3292	4054		3067	4084	4057	3824	4715	
	SED			CD (0.05)			SED			CD (0.05)		
F	90.96			194.65			103.88			222.31		
S	101.69			217.62			116.14			248.55		
F x S	203.38			435.24			232.29			497.11		

in poultry manure. Higher tiller count might be ascribed to adequate supply of zinc that might have increased the uptake and availability of other essential nutrients which resulted in improvement of plant metabolic process. This result is in accordance with the reports of Yadav *et al.*,¹⁸ and Boreddy Narendra Kumar Reddy *et al.*, (2023). The control had the lowest number of tillers.

Leaf area index (Table-3) :

The treatment with the highest leaf

area index of 3.97 at 30 days and 4.99 at 60 days out of all the combinations tested was F₂ with S₄ *i.e.*, 100% RDF + Poultry manure at 5 t ha⁻¹ compared to control and other treatments. This result is in accordance with the reports of Arif *et al.*,¹. The control has the lowest leaf area index ever observed.

Higher LAI could be attributed to increase of plant metabolism that might have encouraged meristematic activity and led to apical development. Hence, as a result of the

application of poultry manure, plants are using more nitrogen, which increases photosynthesis and, ultimately, the leaf area index¹⁴. These findings are similar to the result of Kumar and Singh¹¹, Panhwar and Othman¹² and Satsangi and Yadav¹⁵.

Dry matter production (kg ha⁻¹) (Table-4):

Utilization of F₂ with S₄ *i.e.*, 100% RDF + Poultry manure at 5 t ha⁻¹ registered the maximum dry matter production was notably recorded of 3775 kg ha⁻¹ at 30 days and 5778 at 60 days. This result is in accordance with the reports of Hussain *et al.*,⁹. The absolute control had the lowest dry matter production.

The increased leaf area caused by the sustained and improved availability of nutrients from the combination of poultry manure and inorganic fertiliser up until maturity, which would have improved better biomass production, may be the cause of the higher DMP. This is in concurrence with the findings of Gupta *et al.*,⁸, Shanmugam and Veeraputhiran¹⁶ and Elayakumar⁶.

Number of panicles m⁻² (Table-5) :

The treatment F₂ with S₄ *i.e.*, 100% RDF + Poultry manure at 5 t ha⁻¹ had the highest number of panicles m⁻² of 314 out of all the combinations tested. Highest number of panicle m⁻² may be due to enhanced and continuous supply of nutrients by the poultry manure. This was also confirmed by Devi *et al.*,⁵ and Boreddy Narendra Kumar Reddy *et al.*,⁴. The control plot which was the least number.

Number of grains panicle⁻¹ :

The treatment that produced the most grains panicle⁻¹, out of all the combinations tested F₂ with S₄ *i.e.*, 100% RDF + Poultry manure at 5 t ha⁻¹ of 106.1. Enhanced and continuous supply of nutrients by the addition of poultry manure leading to better number of grains panicle⁻¹. This result is in accordance with the reports of Yumnam *et al.*,¹⁹ and Boreddy Narendra Kumar Reddy *et al.*,⁴. The control which was the fewest number ever recorded.

Panicle length (cm) (Table-6) :

The treatment F₂ with S₄ *i.e.*, 100% RDF + Poultry manure at 5 t ha⁻¹ had the highest panicle length of 18.70 cm out of all the combinations tested. Poultry manure stimulates the plant growth possibly through supplying nutrients and increasing panicle length. This was also confirmed by Borah *et al.*,³ and Farid *et al.*,⁷. The control plot which was the least number.

Grain yield and straw yield (kg ha⁻¹) (Table-7):

Utilization of F₂ with S₄ *i.e.*, 100% RDF + Poultry manure at 5 t ha⁻¹ significantly recorded significantly highest value of 5483 kg ha⁻¹ and 6394 kg ha⁻¹. This may be because additional nutrients were added to the soil through poultry manure and inorganic fertiliser, increasing the amount of nutrients available for plant absorption and increasing photosynthetic efficiency as measured by increased, which in turn enhanced grain yield and straw yield. This outcome is consistent with the

reports of Farid *et al.*,⁷ Hussain *et al.*,⁹ and Boreddy Narendra Kumar Reddy *et al.*,⁴. The least amount of grain and straw was produced on the control plot.

Based on the aforementioned experimental findings, it could be concluded that a F₂ combination of S₄ *i.e.*, 100% RDF + Poultry manure at 5 t ha⁻¹ that promote plant growth and yield as well as to enable rice crops to reach their maximum yield potential.

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