THE EFFECT OF FARM YARD MANURE COMBINATIONS WITH GOAT MANURE AND COMPOST MANURE ON YIELD AND NUTRIENT UPTAKE OF RICE

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ABSTRACT

Organic farming often has to deal with a scarcity of readily available nutrients and this is in contra to chemical farming which lies on soluble fertilizers. The present study was conducted on the effects of three concentrations (8.5, 12.5 & 16.5 t ha^{-1}) of Farm Yard Manure (FYM), Goat Manure (GM) and Compost Manure (CM) from household wastes on the chemical and physical characteristics of soil. The field experiment was carried out at Keelakadayam, Tenkasi District in 2020. The yield measurement of rice was done for sandy loam clay soil which is situated at 8.72º latitude and 77.68º longitude. Treatment consisted of a control plot (no manure) and three manure treatments with different combinations and concentrations. The combinations of FYM+GM+CM @ 16.5 t ha^{-1} resulted in the increased growth and highest yield. This combination was significantly superior to all other combinations for all the growth, yield and nutrients uptake by grain. The present study indicates that a combination of FYM+GM+CM holds enhanced physical & chemical parameters and grain quality of rice. The result of the study shows that FYM+GM+CM @ 16.5 t ha^{-1} was the most productive treatment and this combination resulted in improved grain quality a promise for excellent organic farming.

Keywords: Farm Yard Manure, Goat Manure, Compost Manure, Nutrients.

INTRODUCTION

Rice is the most important cereal crop in India, both in terms of area and production. Organic farming often has to deal with a scarcity of readily available nutrients in contrast to inorganic farming which relies on widely available on soluble fertilizers. The aim of the management in organic systems is to optimize the use of farm resources and minimize losses[1]. Physical and chemical properties of the soil can be improved by using organic manure, which may ultimately increase crop yields, physical properties like bulk density, hydraulic conductivity [2]. When FYM+GM+CM @ 16.5 t ha^{-1} were applied in combination with organic amendments, resulting in enhanced rice yields in sandy loam clay soil. The tillering plant height and paddy yield were significantly increased [3]. Grain and straw yields of rice were significantly higher in treatments that received one of the manures of FYM, GM or CM bounds Nitrogen (N), Phosphorus (P), Potassium (K) than no manure. Overall, grain and straw yields of rice and uptake of N, P and K showed that a manure schedule with one of the manures of FYM, GM and CM with the recommended of N, P and K would maximize the rice yield and uptake of nutrients than the recommended results of fertilizers alone without any manure [4].Therefore, the present study intended to evaluate the influence of organic amendments (FYM, GM and CM) on physical properties of the soil and yield of the rice.

MATERIALS AND METHODS

Farm yard manure and goat manure was prepared at the campus of the farm and compost manure was prepared from wastes of the houses and was subsequently applied to the normal field (pH = 7.7, EC = 0.38 ds m^{-1}). Randomized complete block design with three concentrations of 8.5 t ha^{-1}, 12.5 t ha^{-1} and 16.5 t ha^{-1} of thirteen treatments viz., (i) Control plot without manure (ii) For single manure application, 100% of manure is applied (iii) For double manure combinations, 50% of manure for each plot is applied (iv) For triple manure combinations, 33% of manure for each plot is applied. The experiment started from ploughing the field, sowing seeds for raisingrice crop. The manures were incorporated before transplanting rice seedlings in the field. Soil samples were collected from each plot after 30 days of manure application and before transplanting the rice seedlings. Rice crop was harvested after 104 days from transplanting at the time of maturity. After harvesting rice, soil samples were collected from all the treated plots and brought to the laboratory prepared and analyzed systematically.

EXPERIMENTALWORK

Experimental fieldwork was performed at Keelakadayam in Ambai block, Tenkasi District of Tamilnadu. The field was prepared by selected manure combinations and tilth before one month of cultivation. Thirteen combinations were chosen with different concentrations and combinations of farm yard manure. In that control plot no organic manure was applied. In the first four plots FYM, FYM+GM, FYM+CM, FYM+GM+CM combinations of manure were applied with 8.5 t ha^{-1} in a similar way the manure combinations were applied with 12.5 t $ha^{-1}$and 16.5 t $ha^{-1}$for the next 8 plots. The related soil is made-up of sandy loam clay soil structure. The electrical conductivity of the soil was calculated with potentiometry method. The propagation of heat in soil is governed by its thermal characteristics. The ability to monitor soil thermal conductivity is an important tool in managing the soil temperature regime to affect seed germination and crop growth. Thermal conductivity was increased with increasing soil density and moisture content [5]. Thermal conductivity was measured by Lees disc method. SEM and EDAX analysis gave the surface morphology and mineral combination of the sample.

RESULT AND DISCUSSION

GROWTH AND YIELD PARAMETERS

Among the different organic manure treatments, application of FYM+GM+CM@

16.5 t ha^{-1} performed better than the other treatments through improved plant characteristics viz., plant height (59.6 cm) and yield (7538 t ha^{-1}) though all the organic manure treatment showed positive effect for growth and yield characteristics. The chlorophyll content in the leaves has been significantly increased with the application of organic source of nutrients [6]. The increased application of FYM, which contain appreciable quantities of magnesium, might have helped in chlorophyll synthesis which in turn increased the rate of photosynthesis. Higher yield response due to organics is described for improvement in physical and chemical properties of soil resulted in better supply of nutrients lead to better crop growth and yield [7]. The reason for increased rice yield could be attributed to solubilization effect of plant nutrients by the addition of FYM+GM+CM leading to increased uptake of NPK. Further FYM would have helped the soil to improve the nutrients status and water holding capacity. The significance of organic farming in sustainable agriculture, the application of different organic manures showed a significant increase in plant height and yield [8]. This significant influence on growth characters might have been due to the enhancement of uptake of nutrients favored by the application of organic manures.

The better efficiency of organic manures might be due to the fact that the organic manures especially FYM+GM+CM would have provided the micronutrients such as Zn, Cu, Fe, Mn, Ca, K and Mg in an optimum level. Copper and manganese are the important co-enzymes for certain respiratory reaction. Iron and Magnesium is involved in chlorophyll synthesis which increases the rate of photo synthesis [9]. Application of organic manures thus would have helped in the plant metabolic activity through the supply of such important micro nutrients in the early vigorous growth.

ECONOMICS

The economics of cultivation in the present investigation showed that among the treatments, application of FYM+GM+CM @ 16.5 t ha^{-1} resulted in a higher benefit in rice. This might be due to the highest yield obtained under this treatment.

YIELD

The yield was very high in the triple manure combination of FYM+GM+CM plot @

16.5 t ha^{-1}concentration as 7538 t ha^{-1}as shown in Table – 1. Similarly the next maximum yield was obtained by using FYM @ 16.5 t ha^{-1} as 6663 t ha^{-1} and 5825 t ha^{-1} for FYM+GM+CM @ 12.5 t ha^{-1} respectively. The yield produced by the soil also increases due to the addition of organic manure.

Table – 1: Yield of Crop

Plot	Yield t ha^{-1}	Manure combination
T1-A	5250	FYM
T2-A	4338	FYM + GM
T3-A	3788	CM + FYM
T4-A	2813	FYM + GM + CM
T1-B	3875	FYM
T2-B	4325	FYM + GM
T3-B	3763	CM + FYM
T4-B	5825	FYM + GM + CM
T1-C	6663	FYM
T2-C	4550	FYM + GM
T3-C	3025	CM + FYM
T4-C	7538	FYM + GM + CM
T5	800	Without manure

A - 8.5 t ha^{-1}; B - 12.5 t ha^{-1}; C - 16.5 t ha^{-1}

ELECTRICAL CONDUCTIVITY (EC)

The Electrical Conductivity (EC) of a soil is a measure of the ability of soil to conduct electricity. When ions (salts) are present, the EC of the soil increases. The EC value indicates the presence or absence of salts but does not indicate which salts might be present. For example, the EC of the soil sample may be considered relatively high. The electricalconductivity plays a significant role in the soil to produce electricity. The addition of FYM+GM+CM to the soils leads to slightly decrease in EC values compared with control plot [10]. The soils amended with FYM+GM+CM had lower EC value than the untreated soil. The soil EC decreased with increasing the application rate of FYM in soil. Table to shows that before harvest and after harvest EC values are compared with one another. The soil particle with a high value of EC leads to instability of soil structure [11]. Sandy loam clay soil has little water at high water potentials.

Table - 2

Variations in soil pH and EC before harvest and after harvest of rice as affected by different levels of FYM combinations with GM and CM in Sandy loam clay soil

Concentration	Treatments	Before Harvest		After Harvest	
	Manure Combinations	pH	EC ds m^{-1}	pH	EC ds m^{-1}
8.5 t ha^{-1}	FYM	7.2	0.22	7.1	0.15
	FYM+GM	7.6	0.32	7.1	0.28
	FYM+CM	7.5	0.22	7.3	0.16
	FYM+GM+CM	7.4	0.36	7.0	0.29
12.5 t ha^{-1}	FYM	7.2	0.23	7.3	0.18
	FYM+GM	7.4	0.33	7.2	0.24
	FYM+CM	7.5	0.32	7.2	0.23
	FYM+GM+CM	7.2	0.37	7.1	0.32
16.5 t ha^{-1}	FYM	7.6	0.38	7.4	0.29
	FYM+GM	7.4	0.36	7.3	0.36
	FYM+CM	7.5	0.33	7.4	0.23
	FYM+GM+CM	7.4	0.47	7.3	0.35
Without Manure	Control Plot	7.7	0.38	7.5	0.38

THERMAL CONDUCTIVITY ANALYSIS

Heat is transmitted into or from the soil by conduction or convection due to thermal gradients within the soil mass. The main thermal characteristics of the soil is thermal conductivity. A soil thermal conductivity measurement explains the soil properties which show the flow of heat through the soil. The thermal conductivity is defined as the quantity of heat that flows through unit area in unit time under unit temperature gradient. The capacity of soil heat transfer is playing a vital role to maintain the soil temperature gradient which affects germination and growth of the crop [12]. Using Lee's disc method, the thermal conductivity of the soil of best three yields were determined in contrast to the control plot without manure. Lee's disc experiment apparatus consists of a steam chamber and a metal disc with thermometer for each. The steam was produced by heating the water until the steady temperature was reached. Then the disc was allowed to cool to the room temperature, while the temperature was recorded with respect to time. Then the thermal conductivity of sandy loam clay soil was calculated. By the application of organic manure, the thermal conductivity decreases when compared to the control plot as shown in Table - 3. Low thermal conductivity of the soil produces good crop productivity and increasing water holding capacity [13].

Table – 3: Soil Analysis Result for Thermal Conductivity (K)

Manure Concentration	Combinations of Manure	Thermal Conductivity (k) $wm^{-1}k^{-1}$	
		Before Harvest	After Harvest
16.5 t ha^{-1}	FYM+GM+CM	0.1360	0.1181
	FYM	0.2890	0.1489
12.5 t ha^{-1}	FYM+GM+CM	0.2184	0.1244
Without Manure	Control Plot	0.1660	0.1375

SEM and EDAX ANALYSIS

SEM is a surface imaging method in which the incident electron beam scans across the sample surface and interacts with the sample to generate backscattered and secondary electrons that are used to create an image of the sample [14]. The SEM can be used to determine the elemental composition of soil samples as well as for the characterization of particle sizes and external and internal morphology. SEM was used to find the composition and element distribution in the soil surface samples [15].

The presence of heavy metals was analyzed using an energy dispersive X- ray spectrometer. The particle size of the sample soil can be observed to be heterogeneous. Energy Dispersive X-Ray Analysis (EDX), referred to as EDS or EDAX, is an x-ray technique used to identify the elemental composition of materials [16]. The data generated by EDX analysis consists of spectra showing peaks corresponding to the elements making up the true composition of the soil sample being analyzed. From the EDAX spectrum, the elements such as Fe, Cu, Mn, Zn, Ca, Si, Al and k are observed in the experimental soil samples. The presence of silicon mineral shows the semi conducting nature of the soil and it helps to generate electricity [17]. The presence of elements intensity and atomic weights are compared with the controlplot.

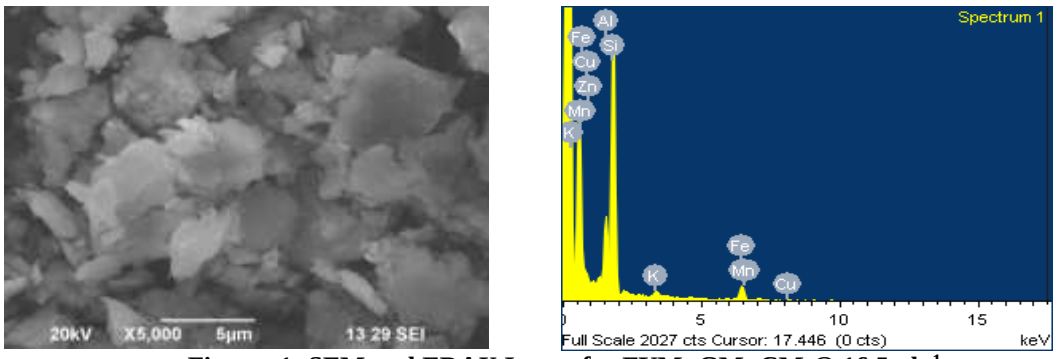

Figure -1: SEM and EDAX Image for FYM+GM+CM @ 16.5 t h^{-1}

The morphological appearance of FYM+GM+CM @ 16.5 t h^{-1} added to the sandy loam clay soil shown in figure 1 reveals that the SEM image appears to be small cylindrical shaped. The elemental composition such as Al, Si, K, Mn, Fe, Cu and Zn can be seen in the EDAX spectrum. It possesses intensity ranges at 1.0609 nm, 0.9020 nm, 0.9095 nm, 0.8405 nm, 0.8645 nm, 0.8305 nm and 0.8337 nm respectively.

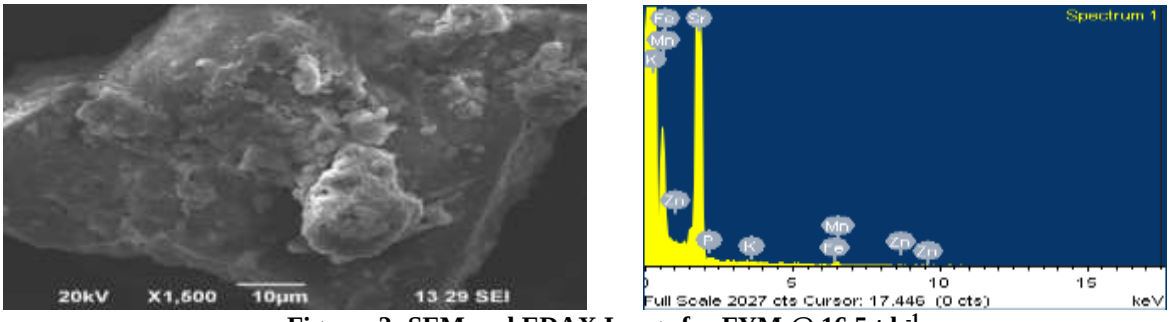

Figure -2: SEM and EDAX Image for FYM @ 16.5 t h^{-1}

The morphological appearance of FYM @ 16.5 t h^{-1} added to the sandy loam clay soil shown in figure 2 contains SEM image appearing to be irregular fragments. The EDAX spectrum reveals the presence of elements composition such as P, K, Mn, Fe, Zn

and Sr possess intensity ranges at 0.6520nm, 0.9124nm, 0.9939nm, 1.0368nm, 1.0478nm and 1.0028nm.

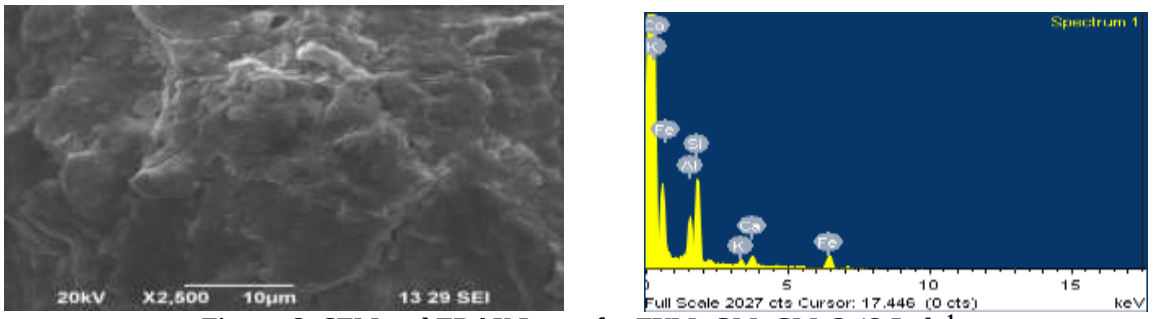

Figure -3: SEM and EDAX Image for FYM+GM+CM @ 12.5 t h^{-1}

The morphological appearance of FYM+GM+CM @ 12.5 t h^{-1}added to the sandy loam clay soil shown in figure 3. contains the SEM image appears to be small cylindrical shape with a polished surface. The EDAX spectrum indicates the presence of elemental composition such as Al, SI, k, CA and Fe possesses the intensity ranges of 0.9301nm, 0.7958nm, 0.9695nm,0.9391nm and0.8726nm.

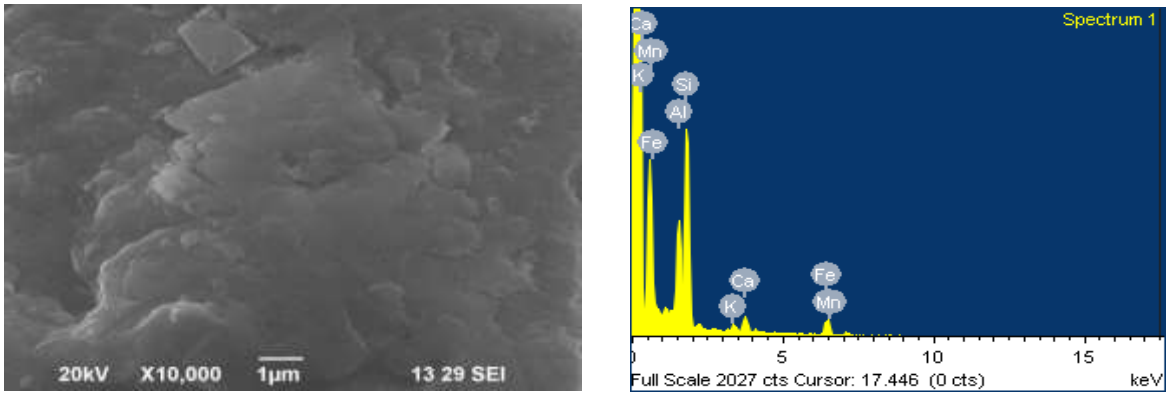

Figure -4: SEM and EDAX Image for without Organic Manure

The SEM image appears to be large for the control plot without organic manure. The EDAX spectrum shows the presence of elemental composition such as Al, Si,K,Ca, Mn and Fe possesses the intensity ranges at 1.0134nm, 0.8154nm, 0.9412nm, 0.9245nm, 0.8407nm and 0.8653nm.

CONCLUSION

The physical properties such as electrical conductivity (EC) and thermal conductivity (K) of the soil samples were determined viz., before and after harvest. The observed values were compared with the control plot. Before harvest the control plot had the maximum value of EC as 0.38 ds m^{-1}after harvest the control plot had the maximum valueof

0.32 ds m^{-1}. Before harvest the thermal conductivitycalculated was 0.1360 $wm^{-1}k^{-1}$ for FYM+GM+CM @ 16.5 t ha^{-1} lower than the control plot value as 0.1660 $wm^{-1}k^{-1}$. After harvest the value of thermal conductivity was found to be 0.1244 $wm^{-1}k^{-1}$ for FYM @ 12.5 t ha^{-1}lower than the control plot. All the treatment plots shows that the electrical conductivity and thermal conductivity values decreased when compared to the control plot. Low thermal conductivity of the soil with different combination of organic manure produced good crop productivity and higher water holdingcapacity.

Soil chemical properties and nutrient availability were substantially improved in soils receiving organic amendments. Compared with the unamended soil, soil treated with organic amendments showed apparent increase of total N and available macro elements P, K, Ca, Fe, Al and Mg.

FYM+GM+CM application increases the soil organic content. The results revealed that among the different organic manure treatments, rice responded well to the application of FYM+GM+CM @ 16.5 t ha^{-1}. The organic manures prepared will not only supplant the organic fertilizers but also reduces the environmentalpollution.

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REFERENCES

1. Prem sekhar,M. and Raja Shree,V. (2009), Influence of Organic Manures On Growth,Yield and Quality of Okra: *Am-Eurasian J.Sustain.Agric.,* **3(1)**:6-8.
2. Indra NoerHamdhan and Barry G.Clarke, (2010). Determination of Thermal Conductivity of Coarse and Fine Sand Soils. *World Geo ther. Cong,* **13**:192- 195.
3. Angelova. V. R and Akova. V.I. (2013). The effect of organic amendments in soil chemical characteristics. *Blug.J.Agric.Sci.,***19(5)**: 958- 971.
4. Uwah, D. F. and Eyo, V. E. (2014). Effects of number and rate of goat manure application on soil properties, growth and yield of sweet maize. *Sustain. Agri. Res.* **3(4)**:75-83.
5. Wade W. McCall, (1980) Use of Soil Amendments to Improve Physical Properties of Soil, *University of Hawali* **17:** 56-5*8.*
6. Zebarth. B.J and Nelson. D, (1999). Influence of Organic Waste Amendments on Selected Soil Physical and Chemical Properties. *Can. J. Soil Sci.* **79**: 501-504.
7. Bouajila. K, Sanaa. M. (2011), The Effects of Organic Amendments on Soil Physico-Chemical and Biological Properties. *J. Mater. Environ. Sci.* **2:**485-490.
8. Rekha, G. S., Kaleena, P. K. and Elumalai, D. (2018). Effects of vermicompost and plant growth enhancers on the exo-morphological features of Capsicum annum (Linn.) Hepper. *Int. J.Recycling of Org. Waste in Agri.***7:**17-191.
9. Jeyamangalam. F and Jeyalakashmi. P, (2018). Short term effect on composted coir pith, FarmYard Manure and vermin compost on physical chemical properties of the soil with the yield of pearl millet. *J. Mod. Sci.,* **8(1)**, 33- 39.
10. Rop, K., Karuku, G. N. and Mbui. D,(2019). Evaluating the effects of formulated nano-NPK slow release fertilizer composite on the performance and yield of maize, kale and capsicum. *Annals of Agri. Sci.***12**:1-11.
11. Samavatean, N., Rafiee, S., Mobil, H. & Mohammadi, A. (2011). An analysis ofenergy use and relation between energy inputs and yield, costs and income of garlic production in Iran. *Renewable Energy*, **36**:1808 –1813.
12. Somnmez, S and Sevil, C. (2016). Effect of vermicompost on chemical and biological properties of an alkaline soil with high lime content during celery (Apiumgraveolens L. var. dulce Mill.). *Bot. Horti Agrobo,* **44(1):**280-290.
13. Jeyaseeli. P, Jeyamangalam. F, Selvaraj. S and Vella Durai. S.C, (2021). Conductivity and Particle size Measurement in Sandy Loam Soil Using Organic Amendment, *Rasayan J. Chem.,* **14(1)**: 74-81.
14. Sovovo, M. and Sova, P. (2004). Pharmaceutical importance of garlic (Allium sativumL) *Hypolipemic effects in vitro and in vivo. Ceskaslov Farm,***53(3)**:117-123.
15. Surindra, S. (2009). Impact of vermi compost and composted farm yard manure on growth and yield of garlic (Allium stivum L). *Int. J.Plant Prod.,***3**:1735-6814.
16. Suthar, S. (2009). Impact of vermicompost and composted farmyard manure on growth and yield of garlic (Allium sativum L.) field crop. *Int. J.Plant Prod.,* **3(1)**:27-38.
17. Tadesse, A. A. (2015). Growth and yield response of garlic (Allium sativum L.) varieties to nitrogen fertilizers rates at Gantaafeshum, *Northern Ethiopia.MSc Thesis, Haramaya University.*