Chelonian Conservation And Biology

Vol. 19 No. 1 (2024) | https://www.acgpublishing.com/ | ISSN - 1071-8443

DOI: doi.org/10.18011/2024.01(1).2187-2196

COMBINATIONAL FYM AMENDMENT EFFECT IN PADDY SOIL

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ABSTRACT:

Adding organic amendments to the soil improves soil physical structures alertly, it rejuvenates soil from ill effect and builds- up a positive effect on growth parameters, crop production which equalizes the yield similarities as like as CF'$_S$ input without harming the agro-ecological chain. The main objective is to reduce the physical constraints of the soil to supply right fertilizer dosage level as nutrient input so that sustained organic farming vibrantly attracts furthermore for large scale application. Present paper deals with TKM-9 (Paddy variety) cultivation under Randomized Block Design (RBD) having 13 treatments with three replication. Organic compost mannure (FYM, VC and VWC) with different dosage additively with different combination levels are supplied to each plots except control plot (no mannure). From soil samples test data like soil p^H, N, P,K their inter relational effects is compared with control plot Viz its significance difference of N,P,K values are statistically analyzed using SPSS software version 26.

KEYWORD: **N**-Nitrogen, P –Phosphorus, **K-** Potassium, **FYM**-Farm yard mannure, **VC**-Vermicompost, **VWC**- Vegetable Waste compost, CF- Chemical fertilizer.

INTRODUCTION:

Agriculture in other words known as "farming" the art of giving back and getting from it is the beginning of civilization in India which started around 9000 B.C till now has integrated co -relation with climatic factors. The global food policy report 2022 warns that climate change might cause widespread famine in India by 2030, weakening the food supply chain and increasing the risk to human health [1]. Rice is the indigenous part of food in Asia largely cultivated in various region under varied atmospheric effect, less water resource by local, small –medium farmers.

Soil quality is the health function status, a storage source of soil that inhibit growth of plants water resources, supports human life. The soil quality as multifunction indicators which promotes biological boundary to sustain productivity, environment quality [2]. The monoculture practices for long time declines the soil nutrients which destroys the natural defense of the soil. Thus organic farming is graceful practice which maintain soil organic matter (SOM), less pest management its major concerns

rely on food quality consumed by human and other feeder animals.

The advancement of rice cultivation exhibited superior progress when employing a continuous organic farming approach as opposed to employing conventional farming methods [3]. The focus on organic fertilizers has garnered increasing attention, as concerns regarding the long-term viability of food production have prompted a resurgence in the utilization of organic inputs within contemporary agricultural practices. This resurgence is perceived as an apt means of upholding soil health through the provision of soil organic matter and micronutrients [4]. For centuries, FYM is being used as traditional fertilizer in Asian country for farming. Farm Yard Mannure compost is the most important and widely used bulk manures. They improve soil physical properties like structure, water holding capacity and saturated moisture. They increase the availability of nutrients and organic matter. Carbon dioxide released during decomposition act as a CO_2 fertilizer [5].It provides organic matter to microbes as a source of carbon, increase in microbial population degrades the usage of pesticides, heavy metals, less harmful compounds.

Thus the utilization of Farm Yard Manure compost is paramount and extensively employed for its bulk manurial properties. It enhances the physical attributes of the soil, such as its structure, capacity to retain water, and level of saturation. Nutrient availability depends highly on soil p^H [6,7].Macronutrients N are responsible for effective growth, high grain yield. P, K activates cell division, enzymatic activity and shoot growth. The SEM image illustrated in this paper helps to understand the soil microstructure by aiming on the role of compaction system and water content and composition.

MATERIALS AND METHODS:

The experimental field study analysis is carried out at farmer's field in Alwanneri village, Nanguneri Taluk, Tirunelveli district whose geographical co-ordinates matches at latitude 8.608˚, longitude 77.755˚and 141-m above the sea level during kharif season 2020. Primary investigation like soil texture analysis and its suitability is checked. The field soil is sandy clay loam in texture with no lime status is suitable for paddy cultivation. Three different organic compost mannure at different concentrations 4.5 t ha^{-1}, 11.5 t ha^{-1} and 17.5 t ha^{-1} at different combination level is supplied to each plot except the control plot (no mannure) with three replication under randomized block design method. Initially the water level in the field is maintained at minimum 2-3cm submergence level and it is raised after cropping. The chosen land is not vegetativly cultivated for past 15 years before the experimental period.

By using the direct transplantation method from the nursery bed, the juvenile young plantlets (<26 days) are moved to the main field. The nursery bed is maintained in the absence of any organic fertilizer and devoid of pesticides in order to investigate the significant impact of organic fertilizer amendments. TKM-9 crop variety growth duration is 110 days. The soil samples are collected from different area within the plots in order to cover the entire plot at before and after harvest separately. From each plot, samples are collected in separate bags for chemical analysis, such as measuring the soil's pH, N, P, and K levels and its significant difference is statistically analysed using SPSS software version 26.

SOIL PHYSICAL and PHYSICO-CHEMICAL PROPERTIES:

SOIL P^H and EC:

Soil pH serves as a non-climatic factor that provides information about the quality of the soil, indicating whether it is acidic, sodic, or saline. It is determined by the negative logarithmic decrease in the concentration of hydrogen ions. Additionally, electrical conduction (EC) is utilized to measure the soil's ability to conduct electricity, which is potentiometrically assessed in the supernatant suspension of a 1:2.5 solid: liquid mixture [8].

NITROGEN:

Nitrogen accelerates growth of crops, enhances the quality of grain yield, aids in the augmentation of tillers and leaf area index. The utilization of organic manures has the potential to diminish nitrogen losses and preserve soil Nitrogen through mineralization, thereby ensuring a consistent supply of nitrogen throughout the entire life cycle of the rice plant [9]. Nitrogen plays a vital role in numerous enzymatic reactions, and its concentration is determined by [10].

PHOSPHORUS:

Phosphorus acts as an activator, playing a crucial role as an elemental source for photosynthesis. The decrease in phosphorus level has a detrimental impact on the process of photosynthesis, which is responsible for converting sunlight into energy. It aids in the conversion of sunlight into energy, proper plant development, disease resistance, and the expansion of root systems. It also promotes flowering. Phosphorous is available in the form of phosphate ions (H_2PO_4 and HPO_4^-). Phosphorus availability was improved by organic acids generated during the breakdown of organic manures [11]. The organic material forms a protective coating on sesquioxide, which reduces soil phosphorus fixing capacity and hence increases soil phosphorous availability [12]. The approach framed by [13] is used to estimate phosphorus.

POTASSIUM:

Although potassium is often referred as a “quality nutrient,” its effects are more closely related to how it interacts with other nutrients, such nitrogen, than to absolute levels of K. Due to an increase in K ion interaction, increasing the K dose causes plants to absorb more K. Increased potassium levels cause plants to have more N, P, K, Ca, S, and Zn in their shoots. Decomposition of organic sources results in an increase in potassium availability [14]. The method [15] is used to estimate the potassium concentration.

RESEARCH FINDINGS AND ANALYSIS:

Soil sample analysis of combinations with FYM for after harvest is shown in Table-1

Plots	**Combinations**	**P^H**	**EC ds m^{-1}**	**N Kg/ha**	**P Kg/ha**	**K Kg/ha**
T1 A	FYM	6.50	0.416	109	30	120
T1 B	FYM	6.40	0.398	121	28	133
T1 C	FYM	6.40	0.406	113	32	128
T4 A	FYM+VC	6.50	0.409	110	28	117
T4 B	FYM+VC	6.40	0.406	105	28	111
T4 C	FYM+VC	6.60	0.396	113	30	128
T5 A	FYM+VWC	6.30	0.429	120	29	122
T5 B	FYM+VWC	6.60	0.418	114	33	124
T5 C	FYM+VWC	6.30	0.408	125	28	128
T7 A	FYM+VC+VWC	6.30	0.409	106	32	124
T7 B	FYM+VC+VWC	6.40	0.411	116	31	120
T7 C	FYM+VC+VWC	6.60	0.415	117	30	119
T8 (Control plot)	(No Manure)	6.70	0.477	99	28	93

FYM-Farm Yard Manure VC-Vermicompost VWC – Vegetable Waste Compost

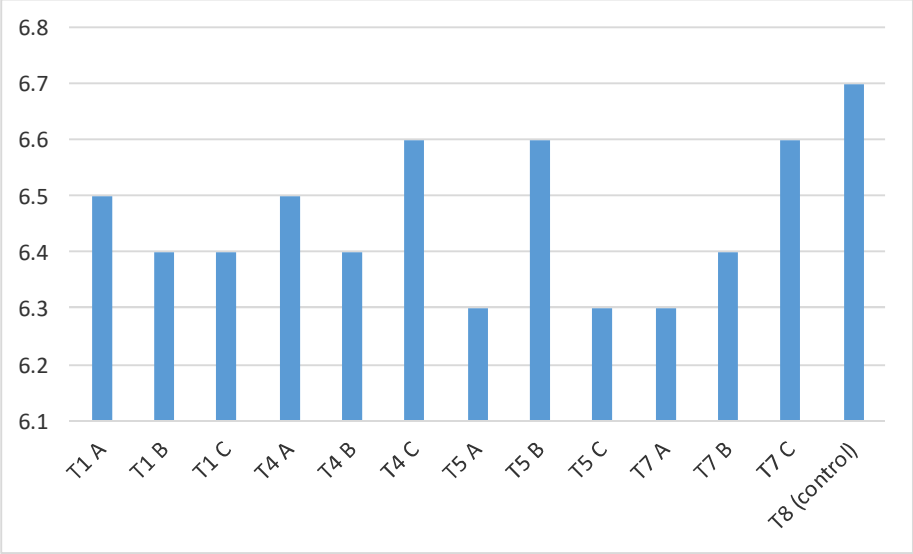
A- 4.5 t ha^{-1},B- 11.5 t ha^{-1},C- 17.5 t ha^{-1}, EC –Electrical conductivity, N-Nitrogen,P –Phosphorus

K- Potassium.

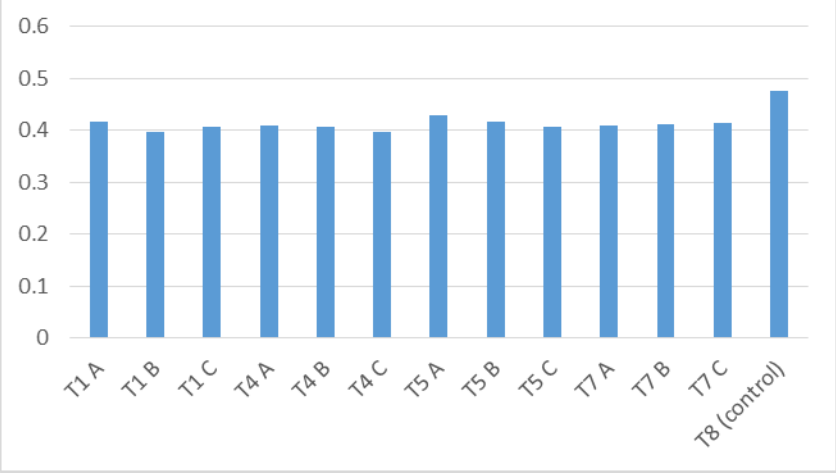
Physiochemical properties:

Figure 1-3

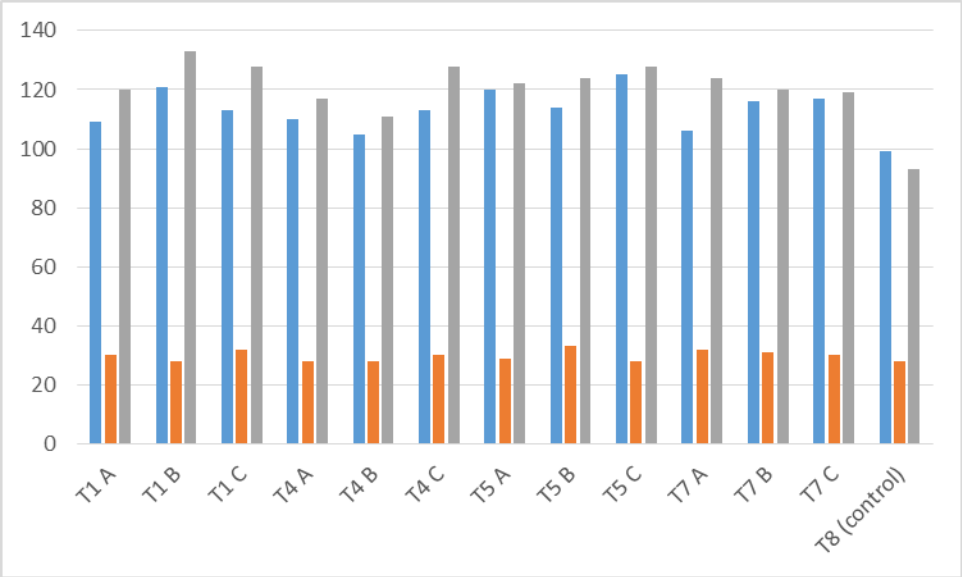
Soil P^H



EC ds m^{-1}



MACRONUTRIENTS (NPK Kg/ha)



(In figure 1-3: It specifies soil P^H (concentration of hydrogen ion) and electrical conductivity comparison with the control plot (with no manure condition) ,macronutrients Nitrogen, Phosphrous,Potassium is specified in kg/ha)

TABLE-2 One Sample t test statistical analysis:

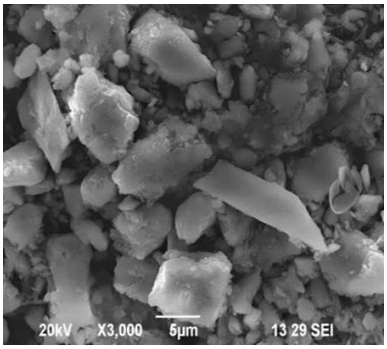
Parameters	t	df	Sig.(2-tailed)	Mean difference	Upper	Lower
Soil P^H	-7.685	11	.000	-.25833	-.3323	-.1843
EC ds m^{-1}	-26.142	11	.000	-.06692	-.0726	-.0613
N kg/ha	8.591	11	.000	15.08333	11.2189	18.9477
P kg/ha	3.727	11	.003	1.91667	.7847	3.0487
K kg/ha	17.319	11	.000	29.8333	26.0420	33.6246

The Table- 2 shows the one sample t test statistical analysis ($p<0.05$) for soil P^H, Electrical conductivity (EC ds m^{-1}) and Macronutrients NPK kg/ha individually compared with control plot using SPSS software version 26)

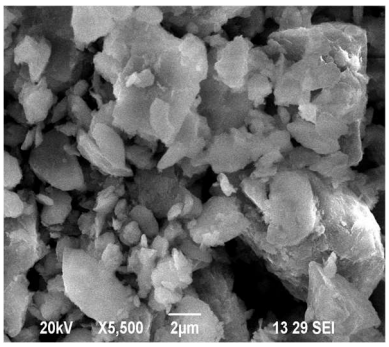
SEM ANALYSIS:

The microstructural SEM analysis provides magnified images of the size, shape, composition, crystalline structure, and other physical and chemical features of the soil samples, which can be used to understand soil mechanics. He [16] first emphasised the significance of microstructural analysis. They suggested that soil behaviour should be studied from the perspective of how micro particles shape soil behaviour because they play a significant role in this process. SEM is a surface morphological technique magnified many times to view the internal and external structure which helps to evaluate the difference on the surface of soil. Knowing the location is crucial because SEM makes it possible to detect secondary and back scattered electrons that result from the interaction of the electron beam with the material.

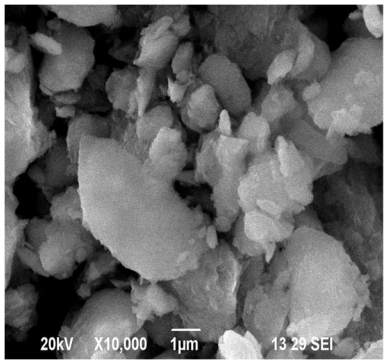
T4 A



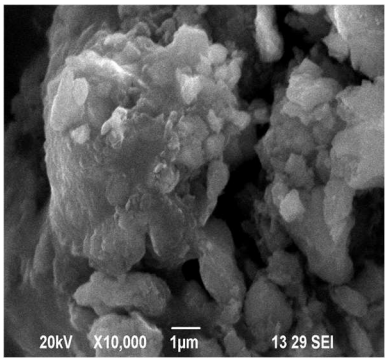
T5 B



T5 C



CONTROL PLOT



(Figures 4: shows the SEM image of best yield soil sample after harvest with control plot)

RESULT AND DISCUSSION:

This is the first reported paper on FYM combination with vermicompost and vegetable waste compost study on paddy.The excellent organic fertiliser source known as Farmyard manure (FYM) is easily available on all farms. According to [17], FYM improves soil structure by raising soil nitrogen

content availability of nutrients, and nutrient mobilisation as well as aeration and water retention FYM organic manure serves as a slow release nutrient like nitrogen, phosphorous and potassium, albeit in varying quantities it helps to stabilizes soil P^H, It improves soil structures, water retention capacity combining Farm Yard Manure (FYM) With Vermicompost and Vegetable waste compost it nourishes the soil and it gives complete balance in the soil available nutrients. Transitioning from synthetic fertilizers to organic options would further contribute to environmental preservation [18].

Soil P^H

Soil P^H describes about the soil reaction parameters which indicates the acidity and alkalinity of soil and its defined as the negative logarithm of the hydrogen ion concentration. From Table-1 choosing the values between treated and untreated plots with soil P^H a graph is drawn which is shown in figure 1,where The control plot exhibits a maximum soil p^H value of 6.70, whereas the combination of FYM+VWC shows the minimum value of 6.30 at the dosage level of 4.5 t ha^{-1}. This observation indicates that the manured plot experiences stabilization and a slight decrease in P^H compared to the control plot. Furthermore, this value is slightly lower than the reported value [19].

Electrical Conductivity (EC)

From the values of Table-1, Figure -2 represents, the plots with electrical conductivity obtained from the soil samples analysis In terms of the EC value, the control plot demonstrates a maximum of 0.477 ds m^{-1}, while the combination of FYM+VC shows the minimum value of 0.396 ds m^{-1} and FYM+VWC exhibits a value of 0.429 ds m^{-1} at a rate of 4.5 t ha^{-1}. This value is lower than that of the control plot and aligns with the reported value by [20] has the highest EC value is 0.421 ds m^{-1} and the lowest value is 0.391 ds m^{-1}.The observed effect can be attributed to the gradual release and buffering activity of the decomposition process of organic manure .The wide range of electric conductivity observed in the soil samples can be attributed to the low salt content, which is due to the inherent drainage capacity in the respective blocks.

Macronutrients (NPK kg/ha)

Micronutrients like Nitrogen helps good foliage more important reason for leaf greenly nature chlorophyll production in the crop, Phosphorus assists the root strength helps to survive under harsh climatic condition, environmental stress and Potassium helps in water retention, easy growth prevent from contracting plant diseases. From the Table-1 values Figure-3 represents the NPK graphical description, from the Table-1 the value of Nitrogen (N) is maximum in FYM+VWC plot @ 11.5 t ha^{-1} which is 121 kg /ha wherein control plot it is 99 kg /ha .For medium P and low K the value is maximum as 33 kg/ha, 128 kg /ha @11.5 t ha^{-1} for FYM +VWC and the P, K Value of control plot is 28 kg/ha 93 kg /ha. This value is agreeable with [21, 22] and statistically analysis showed that there is significant result with NPK using one sample t test. Soil texture varies because of supplement lost [23]. Pest control is also impacted by soil textures [24, 25].Using Table-1 individual parameters like soil PH, EC and NPK values a statistically analysis is Performed using one sample t –test analysis with control plot test value for ($p<0.05$) which is described in Table-2 showed there is a significant result in the manure amended plot than the control plot.

SEM analysis

They [26] provided a definition for the arrangement of elementary particles, particle assemblages, and pore space in the fabric model, specifically referring to sand, silt, and clay particles. The use of scanning electron microscopy (SEM) allows for the visualization of soil clusters and aids in the examination of surface morphology, grain observation, and mineral composition of soil and rock sections. For the purpose of this investigation, soil morphological analysis was conducted at three magnifications: 2500x, 3000x, and 10,000x. The figure above displays the SEM image of untreated soil, along with treated soil samples from a paddy field in Alwanneri village. The soil exhibits a well-structured and irregular surface, with sporadic round, triangular, and almost triangular, platy features. These characteristics confirm the presence of quartz, with varying crystal sizes, as well as small aggregates of clay minerals containing traces of kaolinite, titanium, oxygen, aluminium, and silica, whereas in the T8 control plot it seem to have large aggregates with composition of calcium,carbon,zinc,iron traces. He[27] identified Euhradral, linear, subhedral curvilinear, and euhedral types of quartz through their study. The microstructure shows a granular skeleton structure made of quartz and feldspar grains coated by clay particles after dynamic compaction at the ideal water content.

A rise in water content alters the arrangement of the micro pores between the grains that are covered and the micro pores connected to the clay particles. At higher water content, the clayey particles disperse between the quartz and feldspar grains, resulting in a decrease in porosity and hydraulic conductivity due to a significant reduction in macropores. Clay minerals have fine-grained and flakes-like shapes and are distinguished by their small particle size (<0.002 mm). These minerals differ from sand, gravel, and silt because of the positive electrical charge on the crystal faces and the negative electrical charge on the crystal edges. Kaolinite, composed of silica and alumina plates, exhibits exceptional stability. This observation [28][29] who looked into the connection between the geotechnical index characteristics and the distribution of pore sizes in compacted clayey silts. This is consistent with the result of [30].The SEM image reveals a dispersed structure in the compacted silt samples, indicating increased flocculation with the addition of clay. Temperature, soil pH, and surface-absorbed ions all have an impact on flocculation levels.

CONCLUSION:

Among thirteen combinational mannured plot of FYM, Soil P^H and EC shows slight significant changes but the plot supplied with double and triple dosage combination showed significant increase with N, P, K. This effect is attributable to pure organic amendments of combinational FYM with natural pesticides, and it is the best way to produce healthy soil and toxin-free food for people.

ACKNOWLEDGEMENT:

Myself, G.SELVALAKSHMI (Reg.No: 20222232132012) is thankful to authorities of the Department of Physics, Sarah Tucker College (Autonomous), Tirunelveli, Research Department of Physics, V.O.Chidambaram College, Tuticorin, affiliated to Manonmaniam Sundaranar University, Tirunelveli-12 for providing necessary research guidance and supporting facilities and I would like

to extend my sincere thanks to Centre for Research in Nanotechnology,Karunya Institute of Technology and Sciences for soil analysis.

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