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***Research Article** (Open Access)*

ENHANCEMENT OF PHYSICO-CHEMICAL AND CHEMICAL PROPERTIES OF SOIL USING ORGANIC AMENDMENTS AND ON ONION PRODUCTION

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ABSTRACT
Modern agricultural practices degrade soil fertility to a large extent by using huge quantities of inorganic fertilizer which increases the crop yield and but produces harmful effect on soil and microorganisms. It affects chemical, biological properties of soil and adding hazardous chemicals into human food chain from soil. Organic farming has emerged as a reliable method for producing healthy crops. Optimum yield obtained by maintaining the soil fertility properly. The objectives of this study were to assess the impact of organic amendments on soil physico-chemical and chemical properties of sandy clay loam soil and the resultant impact on onion yield. The field experiment was conducted on an uncultivated land at Alangulam, Tenkasi district, Tamil Nadu, South India in 2020.The organic amendments used in this study were charcoal manure (CM), goat manure (GM) and farm yard manure (FYM) at three different concentrations such as 8.5, 12.5 and 16.5 t ha^{-1}. The study consisted of eight treatments: (1) T_1-CM; (2) T_2-FYM; (3) T_3-GM; (4) T_4-CM+FYM; (5) T_5-CM+GM; (6) T_6-FYM+GM; (7) T_7- CM+FYM+GM; (8) T_8-CO (control-didn't receive any manure). The onion yield varied from 1500 to 4618 kg ha^{-1}. Combination CM+GM+FYM resulted in the highest onion yield (4618 kg ha^{-1}) over control (1500 kg ha^{-1}). Onion yield was significantly higher in all the treatments added with manure relative to control. Hence added organic amendments positively affected the yield of Onion and also reduced the particle size of soil. By comparing these amendments' impacts, this research seeks to inform sustainable soil management practices for sandy clay loam soil and onion production. Therefore, this paper mainly focuses on improving onion production by opting better organic amendments and its future progress.

***Keywords**: Organic Amendments, Nitrogen, Phosphorous, Potassium, Soil organic carbon, Soil Organic Matter*

INTRODUCTION
Soil is the foundation of agricultural production, providing essential nutrients, water, and physical support for plants. It is a limited and vulnerable resource that is critical for ensuring food security and environmental sustainability (Bagnall *et al.,* 2021). Soil health and quality are essential for maintaining high agricultural productivity and supporting a range of ecosystem services, from carbon sequestration to water filtration (Zhao *et al.,* 2021). Unfortunately, soil has been rapidly degraded at a global scale due to a range of invasive anthropic activities in intensive agriculture (Yang *et al.,* 2020). Organic amendments are important for agriculture which improves soil fertility, enhance crop productivity and promote sustainable farming practices (Utami *et al.,* 2020). Organic amendments have become increasingly important in sustainable agriculture due to their ability to improve soil health and fertility (Bhardwaj *et al.,* 2014). They are seen as a promising alternative to conventional inorganic fertilizers, which can have detrimental effects on the environment over time (Kumar *et al.,* 2018). Traditional practices favoring organic amendments not only enrich the soil with essential nutrients but also improve its structure, water retention, and biological activity, thereby enhancing long-term soil productivity. These amendments can

play a crucial role in improving soil nutrient levels, organic carbon content, and overall soil health, thereby contributing to more productive and environmentally-friendly farming systems. Major elements such as nitrogen, phosphorous and potassium have to be supplied into the soil for plant growth. Most of the nutrients exist in mineral and organic matter are insoluble and unavailable to plants. The nutrients are absorbed from the soil given to the plant through diffusion, ion exchange and carrier hypothesis. Carbon is the fundamental building of block of all life on Earth and plays important role in living systems. Soil is an ideal reservoir for storage of organic C since soil organic C has been depleted due to land misuse and inappropriate management. Many agricultural management global practices are emerging to sequestering soil organic carbon by increasing carbon inputs to the soil and enhancing various soil processes that protect carbon from microbial turnover. As the world population grows, the demand for food has increased, leading to the overexploitation of soil resources and the adoption of unsustainable farming practices. Soil productivity decline, deforestation, water scarcity, and climate change are all problems associated with many of today's farming systems (Sulaiman & Misnan, 2022). Excessive use of agricultural inputs such as fertilizers and pesticides, as well as heavy machinery use, has caused soil degradation through loss of organic matter, heavy metal and agrochemical pollution, compaction, and erosion. The escalating prices of synthetic fertilizers have also prompted greater interest in the utilization of organic manures. (Verma *et al.,* 2017). Onions are a staple kitchen ingredient, commonly used as a vegetable, condiment, and in salads. With a high-income elasticity of demand, onion consumption is expected to rise alongside economic development and urbanization. Additionally, as the population grows, the demand for onions is likely to increase further. Onions are an important commercial crop in the study area, making their increased cultivation a priority.

MATERIALS AND METHODS

The study was carried out at Alangulam (N 8.8646^{o} and E 77.4960$^{o)}$ in Tenkasi district, Tamil Nadu on farmer's land. The experiment was laid out in a randomized block design (RBD) with three replicates. Main plot size was 8 m x 5 m. The experimental soil was having sandy clay loam texture. The experimental field was plowed and harrowed properly. The experimental soil was obtained as a fine tilth without stubbles and weeds. Organic manures such as farm yard manure , goat manure and charcoal manure were added to the soil and mixed well uniformly and irrigated properly. After 30 days of manure application soil samples were collected from depth of 0-30 cm for analyzing physical and chemical properties. Crop selected for cultivation was onion (*Allium cepa* L.).Onion seedlings of 45 days were transplanted on 21 march 2020 in the treated soil and control. Optimum spacing of 15 cm between rows and 10 cm between onion plants used. Irrigation was given at an interval of 3 days depending upon soil moisture.Weeds were removed every 15 days after transplanting onion crop by hand-pulling. Onion was ready after 3 months of transplanting. Onion harvested after it reaches physiological maturity. After harvesting onion, soil samples were collected, air dried, sieved through 2 mm sieve for analyzing. Physico-chemical and chemical properties of experimental soil were analyzed by following standard protocols. Soil pH was measured using blackman's glass electrode pH meter. Organic carbon (OC) was determined using using walkey and black wet oxidation method (1934) .Nitrogen was measured using kjeldhal's method. Phosphorous was measured using olsen's method. Potassium (K) was measured using flame photometer. Electrical conductivity was measured using conductivity meter.

RESULTS AND DISCUSSION

PHYSICO-CHEMICAL AND CHEMICAL PROPERTIES

The experimental soil was sandy clay loam in texture and having N 95 kg ha^{-1},P 65 kg ha^{-1},K 240 kg ha^{-1}, pH 8.1, EC 0.38 dSm^{-1} SOM 0.517 and SOC 0.30 .Data with respect to physico-chemical and chemical properties of soil treated with and without manure (control) after harvest of the onion crop are presented in table 1.

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EC and pH

The data depicts the incorporation of organic manure into the soil has resulted in marginal decrease in soil pH and electrical conductivity. Soil pH of the collected samples was alkaline and neutral, ranged from 7.7 to 8.0 and application of organic manure reduced soil pH compared to control.Soil EC ranged from 0.22 to 0.38 dSm^{-1}.Highest EC value was observed in control (0.38 dSm^{-1}).

Table1: Effect of organic manure on soil physico-chemical and Chemical properties @ 8.5 t ha^{-1}.

S.No	Manure	Plots	N (kg ha^{-1})	P (kg ha^{-1})	K (kg ha^{-1})	EC (ds/m)	pH	SOC %	SOM %	C/N	YIELD (kg ha^{-1})
1	CM	T'1 A	190	95	465	0.31	7.8	0.76	1.310	0.400	3003
2	FYM	T'2 A	135	95	375	0.30	7.8	0.55	0.948	0.407	4618
3	GM	T'3A	113	115	440	0.34	7.8	0.55	0.948	0.489	2971
4	CM+FYM	T'4A	138	123	555	0.24	7.9	0.71	1.224	0.516	4129
5	CM+GM	T'5 A	165	120	555	0.33	7.8	0.65	1.121	0.394	4363
6	FYM+GM	T'6 A	155	93	365	0.22	7.7	0.44	0.759	0.284	3196
7	CM+FYM+GM	T'7 A	123	88	315	0.35	7.7	0.38	0.655	0.310	2553
8	CONTROL	T'8	95	65	240	0.38	8.0	0.30	0.517	0.194	1500
		Mean	139.063	99.063	413.750	0.309	7.813	0.543	0.935	0.374	3291
		S.E	10.742	6.829	39.424	0.019	0.035	0.057	0.098	0.038	367
		S.D	30.383	19.316	111.508	0.055	0.099	0.162	0.279	0.107	1039

FYM-Farm Yard Manure GM-Goat Manure CM-Charcoal manure N-Nitrogen P-Phosphorous K-Potassium SOC- Soil Organic carbon SOM-Soil Organic matter

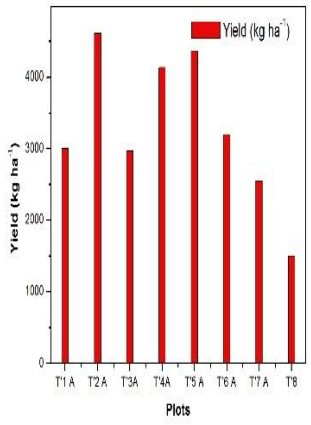


Fig 1: Plots Vs Yield

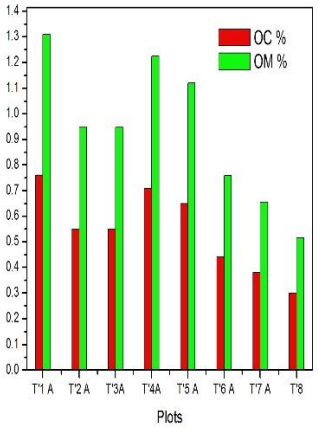


Fig 2: Plots Vs OC and OM

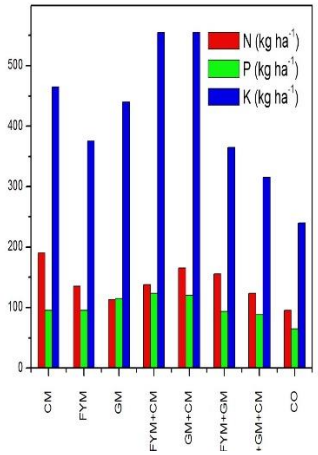


Fig 3: Plots Vs NPK

Available Nitrogen

The available Nitrogen content of the collected soil sample ranged from 95 to 190 kg ha^{-1}. The maximum available Nitrogen recorded was 190 kg ha^{-1} in CM amended plot which was followed by 165 kg ha^{-1} in GM+CM amended plot. The minimum available Nitrogen content was recorded with 95 kg ha^{-1} in control. As available Nitrogen directly correlated with soil organic carbon,sufficient nitrogen content shows the adequate availability of organic matter due to the addition of organic manure.Increase in nitrogen content helped plant growth through chlorophyll synthesis and photosynthesis.

Available Phosphorus

The available Phosphorus content of the collected soil sample ranged from 65 to 155 kg ha^{-1}The maximum available phosphorus content was recorded as 155 kg ha^{-1} in GM+CM plot which was followed

by123 kg ha^{-1} in FYM+GM amended plot. Lowest value was recorded in control as 65 kg ha^{-1}.Data depicts that organic amendments increased phosphorous content which supported root development and energy transfer within plants.

Available Potassium

Available Potassium content of collected soil sample ranged from 240 to 555 kg ha^{-1}. The highest available potassium content was recorded as 555 kg ha^{-1} in FYM+GM and GM+CM amended plot. Results reveal that potassium content of soil treated with organic manure was increased. Increase in potassium plays a vital role in regulating water movement, enzyme activation, and overall plant resilience. The use of organic amendments, such as farmyard manure, goat manure, and charcoal, can have significant impacts on the soil's physicochemical properties, including nitrogen (N), phosphorus (P), potassium and soil organic carbon and sulfur (Koushika *et al.*, 2024).

SOC and SOM

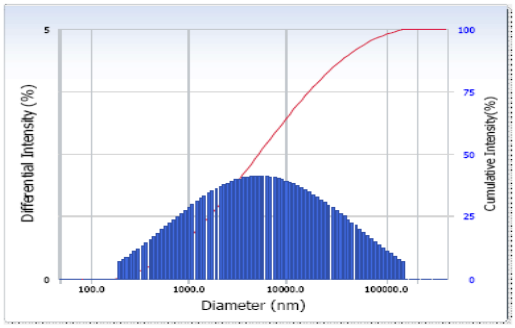
Soil organic carbon content ranged from 0.30 % to 0.76 % and the soil organic matter ranged from 0.517 % to 1.310 %.There was substantial increase in soil organic carbon content and Organic matter content values were remarkably higher in all organic manure added soil compared to control.Continuous cultivation leads to the significant loss of soil organic matter (SOM) and emit CO2 from soil to the atmosphere.CO_2 increase in the atmosphere leads to global warming. Organic matter content promotes soil aggregation leads to lower the bulk density.Organic matter regulate soil temperature and reduces evapo transpiration losses of water organic matter. Farmyard manure and goat manure and charcoal rich and in SOC and SOM provides essential nutrients such as nitrogen, phosphorus, and potassium which can positively impact soil fertility and the carbon-nitrogen ratio. Charcoal has a high carbon content and is known for its ability to enhance soil's water retention and microbial activity.Therefore FYM,GM and CM improved the soil health and onion yield.

C/N Ratio

Carbon nitrogen ratio ranged from 0.194 to 0.516.Control has low C/N ratio because it has low amount of nitrogen and organic carbon content.This increases the decomposition rates of added manure and increases nutrients in the soil. All the soils treated with organic manure had higher C/N ratio compared to control.

Particle size analysis

Particle size analysis of soil treated with organic manure provides valuable insights into the effects of organic amendments on soil texture, structure, and fertility. Fig 4 and 5 shows the Intensity distribution of CM+FYM+GM plot and Control.The addition of organic manure reduced particle size distribution of soil, potentially increasing the proportion of finer particles(silt and clay).Organic manure enhanced the formation of stable aggregates, improving soil structure and porosity, which is beneficial for water retention and root penetration.Changes in particle size distribution enhanced the soil's ability to retain nutrients, leads to improved fertility and crop productivity.



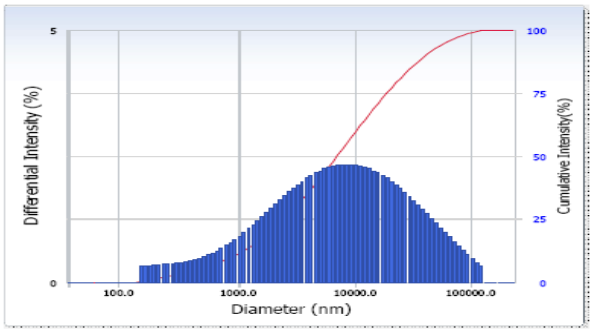


Fig 4: Intensity distribution of CM+FYM+GM plot Fig 5:Intensity distribution of Control

CONCLUSION

Thus, from the current research, it can be concluded that onion crop was produced successfully using organic manure. Organic manures such as FYM, GM and CM supplied the essential nutrients needed for the onion crop. The results also proved that organic amendments added to the soil improved the storage life of onion and enhanced soil fertility and nutrient availability. Application of organic manure decreased EC, pH and increased available nitrogen, phosphorus, potassium ,SOC and SOM in the soil, ultimately resulting luxuriant growth and high yield from the onion crops .Enhanced physical ,physico-chemical and chemical properties helped to achieve optimum crop production. These findings offer practical insights for farmers seeking to balance nutrient availability, organic matter, and soil structure for sustainable crop production. By understanding these effects, farmers and land managers can make informed decisions about soil management. Continued research in this area is essential to develop best practices for the application of organic manure and improve sustainable agricultural practices.

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