

## Influence of organic manure on soil's physical, chemical properties and yield of Onion

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### Abstract

Repeated cultivation of crops makes the soil infertile and deficient in minerals. Organic manure enhances the texture, structure and fertility of the soil thereby increases the crop yield. Organic manure produces positive impact on soil and creates pollution free environment. Because of organic farming people also get good health and nutrients. A field experiment was conducted during early Kharif season of 2020 at Alangulam, Tenkasi district of Tamil Nadu, India. The main objective of this study is to analyse the impact of organic manure on the growth, yield of onion and soil physical properties. In this study Farm Yard Manure (FYM), Goat Manure (GM) and Charcoal Manure (CM) are used as organic manures. Highest onion yield (4758 kg ha<sup>-1</sup>) was recorded in the treatment FYM+GM+CM @ 12.5 t ha<sup>-1</sup>. Lowest yield (1500 kg ha<sup>-1</sup>) was recorded in the control plot (does not receive any manure). Results of this study revealed that soil treated with organic manure produced high onion yield compared to control. Organic manure also improved Soil Organic Carbon (SOC) level in the soil, thereby increased Water Holding Capacity (WHC) and Porosity (PO).

**Key words :** Farm Yard Manure (FYM), Goat Manure (GM) and Charcoal Manure (CM), Soil Organic Carbon (SOC), Physical properties and Onion yield.

**I**n India, Onion is the important vegetable that plays vital role in every dishes. Onions are famous for its pungency and nutrient content. Onion plays inevitable role in medical field. It reduces blood sugar level and platelet aggregation. Organic onions contain high level of antioxidants because they are produced from the soil that is rich in

nutrients and free from synthetic chemicals. Onions are fresher and tastes good when they grow using sustainable organic farming practices. When it comes to production, China got the first place followed by India and United States. In order to increase the production rate use of chemical fertilizers increased. Excess use of Fertilizers deteriorate soil health and

fertility. By opting suitable farming practices, farmers obtain better profits in organic onion growing. Not only that people also benefitted by getting healthy, dietary fiber onion. People of India now-a-days focusing towards organic products which improves their health and make them fit. Organic manure enhances essential plant nutrients such as nitrogen, phosphorous and potassium. It also contains organic matter that improves soil structure and aeration. Organic matter in turn releases the plant food in available form for the use of crops. Organic manure is sustainable and environmental friendly to the soil. Organic manuring is the most natural and chemical free substance to increase the yield of crops and to soil<sup>12</sup>. Organic manure reduces the evaporation of excess water and balances soil fertility and the ratio of carbon and nitrogen as well as increasing the activity of roots. The rapid growth is a master piece<sup>10</sup>. The Best alternative method of improve production rate and soil health is organic manuring.

#### *Experimental :*

A field experiment was conducted at Alangulam, Tenkasi district of Tamil Nadu, India to examine the effect of organic manure on soil physical, chemical properties and onion productivity. The field was located at 8.8646° N latitude and 77.4960° E longitude. The experiment was conducted in a completely Randomized Block Design (CRBD) with three replications. Each plot size was 8m x 5m. The experiment consists of thirteen treatments. In the first three treatments FYM was applied @ 8.5, 12.5, 16.5 t ha<sup>-1</sup> concentration respectively. In the next six treatments were applied with FYM+GM, FYM+CM in equal combination in the above said concentration. FYM+GM+CM

in equal combination used in next three treatments with the above concentration. A Control treatment does not receive any manure. The land was prepared properly before manure application. Ploughing was done by tractor to loosen the soil and also provide good aeration to the roots of the crops. Organic manure was applied before 30 days of cultivation. Onion seedlings were transplanted after 30 days of manure application. Springler irrigation was used twice a week. Weeds removal done manually after 15 days of seedling transplanting. Onion was harvested after it reaches maturity. Onion yield on every treatments were measured.

#### *Soil Sampling and analysis :*

Soil samples were collected from the thirteen treatments after harvesting Onion. Soil samples were analysed for soil pH, Electrical conductivity (EC), Soil Organic Carbon (SOC), Soil Organic Matter (SOM), C/N ratio, soil physical and chemical properties. Soil pH was measured using Blackman's glass electrode pH meter. Chemical Properties such as Soil Organic Carbon (SOC) and Soil Organic Matter (SOM) were analyzed using Walkey and Black<sup>14</sup> wet oxidation method. Nitrogen was determined using Kjeldhal's method. Phosphorous was measured using Olsen's method. Pottasium content in the soil was measured using flame photometer method. Electrical conductivity was measured using conductivity meter. Soil physical properties such as Bulk Density (BD) , Particle Density (PD) density, Water Holding Capacity (WHC), Porosity(PO), Pore Space (PS), Water Content (WC) and Saturated Moisture (SM) were determined using KEEN-RACZKOWSKI box method<sup>9</sup>.

*Statistical analysis :*

In the current study statistical analysis was done for soil data using analysis of variance test (ANOVA) as applicable to Completely Randomized Block Design (CRBD) according to Statistical Software Package SPSS (Version 16.0). Least Significant Difference (LSD) at  $P=0.05$  was used to compare treatment means<sup>8</sup>.

*NPK :*

NPK are macronutrients, essential for all the crops to achieve optimum yield and supporting plant growth. The NPK supplied to the soil by FYM, GM and CM during Onion cropping in this experiment. Better onion yield found at the plots treated with organic manure relative to control. Organic manure increased the nutrient uptake by the onion plant. The level of nitrogen (N) content was maximum as  $190 \text{ kg ha}^{-1}$  for FYM+GM plot @  $8.5 \text{ t ha}^{-1}$  which was 18.42 % more than the control ( $155 \text{ kg ha}^{-1}$ ) after adding organic manure. Soil P and K values were increased significantly by Organic manure application.  $123 \text{ kg ha}^{-1}$  High P value observed as in the soil added with FYM+CM @  $8.5$  and  $16.5 \text{ t ha}^{-1}$ . FYM+GM has P value as 113 @  $8.5 \text{ t ha}^{-1}$ . Organic manure addition increased P value by increasing soil moisture content<sup>1</sup>. Organic manure produced organic legends in soil by increased microbial activity, that leads to the desorption of P from mineral compounds<sup>11</sup>. Organic manure after decomposition release  $\text{CO}_2$  increased P bioavailability<sup>11</sup>. Adding farmyard manure and goat manure improves soil chemical properties. The value of K was high for plots treated with FYM+GM +CM @  $8.5 \text{ t/ha}^{-1}$  as  $743 \text{ kg ha}^{-1}$  which was 67.69% higher than control ( $240 \text{ kg ha}^{-1}$ ). Minimum

value of K was observed in control plot as  $240 \text{ kg ha}^{-1}$ . CM treated plot retained the highest K value as  $340 \text{ t ha}^{-1}$  which was 80.88 % greater than control plot ( $65 \text{ kg ha}^{-1}$ ). The acid or acid forming compounds are added in the form of compost to the soil it affects potassium availability<sup>7</sup>. From this study onion has need more potassium for its growth.

*EC & pH :*

Initial soil characteristics are given in table-1. The result of the soil analysis data of the experimental site presented in Table-1. Addition of organic manure decreased soil pH slightly compared to control. pH Value of the control was 7.9. Other plots treated with manure having a little bit lower pH value as 7.7 and 7.8. Highest EC (0.36) was observed under FYM treatment @  $16.5 \text{ t ha}^{-1}$  and FYM+GM treated plot @  $16.5 \text{ t ha}^{-1}$ . Lowest value of EC (0.22) was observed under (FYM+GM) treated plot @  $8.5$  and  $12.5 \text{ t ha}^{-1}$ . Increase in EC was due to the addition of organic manure. This increase caused by the amount of dissolved salts in the organic manure<sup>3,5,6</sup>.

*SOC and SOM :*

The highest SOC values were observed under FYM application (0.93%) which was significantly higher than control (67.7%; 0.3%), FYM+CM+GM (61% higher; 0.78%). FYM+GM+CM (60% higher; 0.76%) FYM+CM (58% higher; 0.73%). The application of organic manure increased SOC in all the treatments because the organic manure having more carbon content<sup>5</sup>. Especially FYM application increases the SOC in the soil tremendously. Similar results were reported by several researchers<sup>4,15</sup>.

*C/N ratio :*

All the soils treated with organic manure has high carbon to nitrogen ratio relative to control. Highest C/N ratio (0.695) was observed in FYM+GM+CM plot @ 16.5  $\text{tha}^{-1}$ . Lowest C/N ratio was observed in control plot as (0.194).

*BD and PD :*

The result of the soil analysis data of the experimental site presented in Table. The highest bulk density 1.830  $\text{g cm}^{-3}$  was recorded in the plot treated with FYM @ 12.5  $\text{tha}^{-1}$ . The lowest bulk density was recorded in FYM+GM was recorded in FYM+GM treated plot as

1.347 @ 12.5  $\text{tha}^{-1}$  Compared to control all the plots having lowest bulk density. Particle density ranges between 2.1358–3.5564  $\text{g cm}^{-3}$ . Particle density of the plots treated with organic manure decreased relative to control. Addition of organic amendments into soil reduces BD and increases porosity<sup>2</sup>. The value of PD ranged from 2.136  $\text{gm cm}^{-3}$  to 3.5564  $\text{gm cm}^{-3}$ . Decrease in Particle density were observed with the addition of FYM ,GM and CM. A perusal of the data shows that significantly lowest particle density (2.136  $\text{gm cm}^{-3}$ ) was observed in FYM+GM+CM amenended plot @ 8.5  $\text{t ha}^{-1}$  over control. PD recorded in control plots<sup>3</sup> was 2.723  $\text{gm cm}^{-3}$ .

Table-1. Effect of organic manure on soil Chemical properties

S. No	Manure	Plots	N ( $\text{kg ha}^{-1}$ )	P ( $\text{kg ha}^{-1}$ )	K ( $\text{kg ha}^{-1}$ )	EC ( $\text{dS/m}$ )	pH	OC %	OM %	C/N
1	FYM	T <sub>1</sub> A	135	95	375	0.3	7.8	0.93	1.603	0.689
2	FYM	T <sub>1</sub> B	133	95	480	0.27	7.8	0.55	0.948	0.415
3	FYM	T <sub>1</sub> C	155	70	493	0.36	7.8	0.49	0.845	0.316
4	FYM+GM	T <sub>2</sub> A	190	113	480	0.3	7.7	0.51	0.879	0.268
5	FYM+GM	T <sub>2</sub> B	143	108	358	0.22	7.7	0.54	0.931	0.379
6	FYM+GM	T <sub>2</sub> C	155	93	365	0.22	7.7	0.44	0.759	0.284
7	FYM+CM	T <sub>3</sub> A	138	123	555	0.24	7.9	0.71	1.224	0.516
8	FYM+CM	T <sub>3</sub> B	150	80	390	0.27	7.8	0.49	0.845	0.327
9	FYM+CM	T <sub>3</sub> C	130	123	593	0.36	7.8	0.68	1.172	0.523
10	FYM+GM+CM	T <sub>4</sub> A	123	88	315	0.35	7.7	0.78	1.345	0.637
11	FYM+GM+CM	T <sub>4</sub> B	140	98	743	0.35	7.8	0.76	1.310	0.543
12	FYM+GM+CM	T <sub>4</sub> C	105	80	440	0.29	7.9	0.73	1.259	0.695
13	CONTROL	T <sub>5</sub>	155	108	240	0.3	7.9	0.3	0.517	0.194
		Mean	142.31	97.69	448.08	0.295	7.792	0.608	1.049	0.445
		SE	5.622	4.515	36.504	0.014	0.021	0.048	0.082	0.046
		S.D	20.271	16.281	131.617	0.050	0.076	0.172	0.297	0.167
		Variance	410.89	265.06	17323.07	0.003	0.006	0.03	0.088	0.028
		Sig	NS	NS	NS	NS	NS	NS	NS	NS
		F test	2.226	1.194	1.021	1.227	3.192	2.774	2.774	3.672

EC-Electrical conductivity OC-organic Carbon OM-Organic Matter C/N-Carbon to Nitrogen Ratio  
 FYM- Farm Yard Manure GM-Goat Manure CM-Charcoal Manure S.E-Standard Error  
 S.D-Standard Deviation A-8.5  $\text{t ha}^{-1}$  B-12.5  $\text{t ha}^{-1}$  C-16.5  $\text{t ha}^{-1}$  NS-Not significant

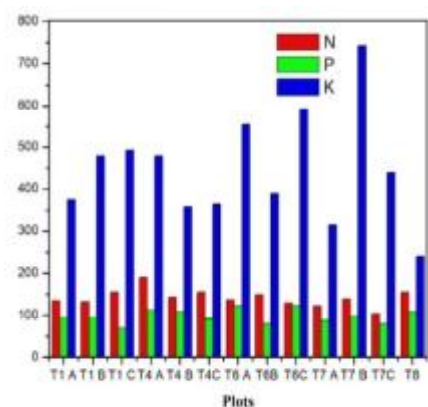


Figure 1. Influence of organic manure on NPK

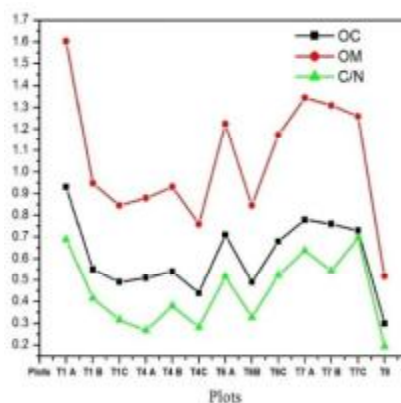


Figure 2. Influence of organic manure on OC, OM and C/N Ratio

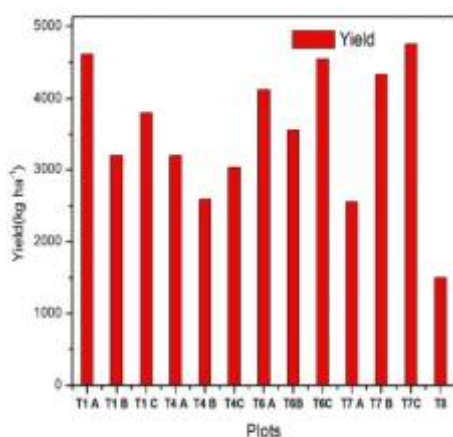


Fig. 3. Yield of Onion

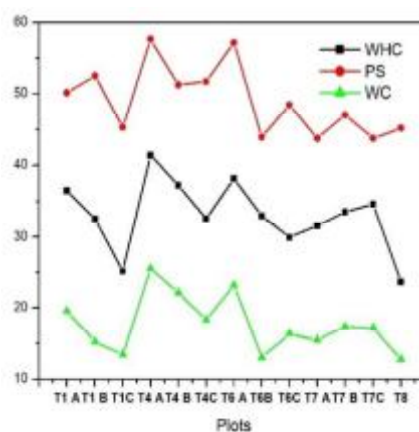


Fig. 4. Influence of organic manure on WHC, PS and WC

*C/N Ratio :*

All the soils treated with organic manure has high carbon to nitrogen ratio relative to control. Highest C/N ratio (0.695) was observed in FYM+GM+CM plot @ 16.5 tha<sup>-1</sup>. Lowest C/N ratio was observed in control plot as (0.194).

*BD and PD :*

The result of the soil analysis data of

the experimental site presented in Table. The highest bulk density 1.830 g cm<sup>-3</sup> was recorded in the plot treated with FYM @ 12.5tha<sup>-1</sup>. The lowest bulk density was recorded in FYM+GM treated plot as 1.347 @ 12.5 tha<sup>-1</sup> Compared to control all the plots having lowest bulk density. Particle density ranges between 2.1358 – 3.5564 g cm<sup>-3</sup>. Particle density of the plots treated with organic manure decreased relative to control.

Table-2. Effect of organic manure on soil Physical Properties

S. No	Manure	Plots	BD (gm/cm <sup>3</sup> )	PD (gm/cm <sup>3</sup> )	WHC %	PS %	WC %	SM %	PO %	VR %	YIELD (kg ha <sup>-1</sup> )
1	FYM	T <sub>1</sub> A	1.537	2.827	36.484	50.152	19.542	35.383	45.620	0.839	4618
2	FYM	T <sub>1</sub> B	1.830	3.437	32.536	52.495	15.206	32.085	46.767	0.879	3200
3	FYM	T <sub>1</sub> C	1.594	2.537	25.196	45.308	13.413	29.251	37.179	0.592	3800
4	FYM+GM	T <sub>2</sub> A	1.551	3.556	41.390	57.651	25.506	37.109	56.377	1.292	3196
5	FYM+GM	T <sub>2</sub> B	1.347	2.496	37.239	51.245	22.132	42.702	46.051	0.854	2590
6	FYM+GM	T <sub>2</sub> C	1.725	3.300	32.609	51.714	18.283	31.892	47.738	0.913	3030
7	FYM+CM	T <sub>3</sub> A	1.420	2.981	38.174	57.182	23.161	40.022	52.361	1.099	4129
8	FYM+CM	T <sub>3</sub> B	1.586	2.468	33.005	43.902	13.025	34.195	35.735	0.556	3550
9	FYM+CM	T <sub>3</sub> C	1.514	2.569	29.928	48.433	16.321	32.806	41.075	0.697	4548
10	FYM+GM+CM	T <sub>4</sub> A	1.386	2.136	31.567	43.746	15.443	32.765	35.114	0.541	2553
11	FYM+GM+CM	T <sub>4</sub> B	1.547	2.646	33.535	47.027	17.362	35.312	41.535	0.710	4335
12	FYM+GM+CM	T <sub>4</sub> C	1.494	2.427	34.623	43.746	17.158	33.506	38.468	0.625	4758
13	CONTROL	T <sub>5</sub>	1.697	2.723	23.665	45.152	12.771	27.178	37.694	0.605	1500
		Mean	1.556	2.777	33.073	49.058	17.640	34.170	43.209	0.785	3523.56
		S.E	0.038	0.118	1.363	1.343	1.110	1.147	1.830	0.063	268.39
		S.D	0.136	0.427	4.916	4.844	4.003	4.137	6.597	0.225	929.72
		Variance	0.019	0.182	24.168	23.462	16.021	17.113	43.519	0.051	936401
		Sig	NS	NS	NS	NS	NS	NS	NS	NS	NS
		F test	1.032	1.336	2.035	1.737	1.781	1.732	1.718	1.642	0.023
	FYM- Farm Yard Manure	GM-Goat Manure	CM-Charcoal Manure	BD-Bulk Density							
	PD -Particle Density	WHC-Water Holding Capacity	PS-Pore Space								
	SM-Saturated Moisture	PO-Porosity	WC-Water Content	VR-Void Ratio							

Addition of organic amendments into soil reduces BD and increases porosity<sup>1</sup>. The value of PD ranged from 2.136 gm cm<sup>-3</sup> to 3.5564 gm cm<sup>-3</sup>. Decrease in Particle density were observed with the addition of FYM, GM and CM. A perusal of the data shows that significantly lowest particle density (2.136 gm cm<sup>-3</sup>) was observed in FYM+GM+CM amended plot @ 8.5 t ha<sup>-1</sup> over control. PD recorded in control plots<sup>3</sup> was 2.723 gm cm<sup>-3</sup>.

*Pore space (PS) :*

Data revealed that Pore Space of the manure amended plots increased relative to control. Perusal of data on Pore Space indicated that there is a significant difference in the Pore Space values and value range was between 43.746 to 57.651 %. After harvesting FYM+CM and FYM +GM treated plot @ 8.5 t ha<sup>-1</sup> resulted in the highest values in Pore Space (57.182%) and (57.651 %) when compared to control soil. Control has the lowest value 45.152%.

*Water holding capacity (WHC) and Saturated moisture (SM) :*

Present data showed that, after harvesting Onion crop the WHC of soil varied from 23.66 to 41.39 % in different treatments. The highest WHC (41.39 %) was observed under the treatment FYM+GM @ 8.5 t ha<sup>-1</sup>. However control has lowest WHC 23.65 %. Water holding capacity values of soil were significantly increased by the amendments<sup>4</sup>. SM Value increased due to the application of organic manure. SM was maximum as 42.702% in FYM+GM amended plot @ 12.5 t ha<sup>-1</sup>

which was 36% higher than control. Control has the lowest value 27.17%. Addition of organic manure increased phosphorous content in the soil due to that saturated moisture increased.

*Yield :*

Onion yield was found statistically significant under different organic treatments. It was ranged from 1500 to 4758 t ha<sup>-1</sup>. Significantly highest yield (4758 t ha<sup>-1</sup>) was recorded in the treatment FYM @ 12.5 t ha<sup>-1</sup>. Significantly lowest yield (1500 t ha<sup>-1</sup>) was recorded in the control.

From the results, it can be concluded that, the application of FYM, GM, CM and their combination in various concentrations impacted soil PH, EC, SOC, SOM, C/N ratio, BD, PD, WHC, WC, PO, SOM and yield. On an average, organic manure application to the soil increased SOC, SOM, WHC, WC, SM, PO in a significant manner addition manure decreased the BD, PD values compared to control. Highest yield was obtained in the manure treated plots compared to control. This study revealed FYM+GM+CM @ 12.5 t ha<sup>-1</sup> concentration improved soil fertility, soil physical parameters and onion yield. So farmers can use the combination of FYM, GM and CM in 12.5 t ha<sup>-1</sup> to get good yield and sustain the soil health.

I, M.C. Subha (20121072132006) research scholar thankful to the authorities of Department of Physics and Research centre Sarah Tucker College (Autonomous), Tirunelveli, The MDT Hindu College, PG and Research department of Physics, Tirunelveli and

Manonmanium Sundaranar University, Tirunelveli -12, Tamil Nadu, India for providing necessary research facilities.

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