

Effect of Different Levels of Organic Manures on Physico-Chemical Properties of Soil Under Cowpea Crop in an Inceptisol of Prayagraj, Uttar Pradesh, India

Abstract

An experiment was conducted on “Effect of Different Levels of Organic Manures on Physico-Chemical Properties of Soil Under Cowpea Crop in an Inceptisol of Prayagraj, Uttar Pradesh, India” to observe the combined effect of farmyard manure (FYM), Vermi Compost and Neem Cake on soil health and yield. The results showed that the application of FYM, Vermi Compost and Neem Cake had a significant and non-significant effect on soil Physico-chemical properties, respectively. The maximum bulk density (1.32 Mg m^{-3} and 1.35 Mg m^{-3}), particle density (2.46 Mg m^{-3} and 2.48 Mg m^{-3}), pH (7.47 and 7.49) and EC (0.251 dS m^{-1} and 0.248 dS m^{-1}) were recorded in T_1 (absolute control) at 0-15 cm and 15-30 cm depth. Similarly, the maximum percentage pore space (48.92 % and 45.47 %), water holding capacity (43.96 % and 40.38 %), organic Carbon (0.49 % and 0.47 %), Available Nitrogen ($301.14 \text{ kg ha}^{-1}$ and $294.97 \text{ kg ha}^{-1}$), Available Phosphorus (30.96 kg ha^{-1} and 27.50 kg ha^{-1}), Available Potassium ($196.58 \text{ kg ha}^{-1}$ and $188.41 \text{ kg ha}^{-1}$) were recorded in T_9 (vermicompost @ 2 t ha^{-1} and FYM @ 2.5 t ha^{-1}).

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Keywords: Soil nutrients, FYM, Vermicompost, Neem cake and Cowpea.

1. Introduction

Cowpea is one of the important legume vegetable crops grown in India. It is also known as black eye pea, southern pea and Crowder pea, well adapted to many areas of the humid tropics and subtropical zones. It is grown throughout India for its long, green vegetable pods, seeds and foliage for fodder. There is world-wide consensus that sole dependence on chemical input-based agriculture is not suitable in long run and only integrated plant nutrients system (IPNS) involving a combination of fertilizer, organic manures and bio-fertilizers are essential to sustain crop production, preserve soil health and biodiversity. In addition to this, the organic manures help in improving the use efficiency of inorganic fertilizers (Singh and Biswas [13]).

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Crop residues are a potential source of organic matter in soils. Essentially, the presence of organic matter in soils is responsible for improved chemical and Integrated use of vermi compost and

bio fertilizers increases the nutrient status of soil at harvest stage. Available P and micronutrient level increases with combine use of bio fertilizers and vermi compost. Organic compost is a very important method of providing the plants with their nutritional requirements without having an undesirable impact on the environment Adeoye *et al.*, [1].

Organic manures viz., [farmyard manure](#)(FYM), vermicompost, poultry manure and oilcakes help in the improvement of soil structure, aeration and water holding capacity of soil. Further, it stimulates the activity of microorganisms that make the plant to get the macro and micro-nutrients through enhanced biological processes, increase nutrient solubility, alter soil salinity, sodicity and pH Alabadan *et al.*, [2].

Incorporation of FYM or organic manure alone or integration with chemical fertilizers improves not only the nutrient use efficiency, but also increases available nutrient status of soil with enhanced soil biological activity which in turn provides a congenial physical condition and improved availability of nutrient in the rhizosphere Kanwar *et al.*, [7].

Neem Cakes are more cost efficient because the fertilizer in them lasts longer. The Neem Cake remains effective until the next crop is planted because of its long sustaining organic fertilizer compounds too. This, in turn, cuts the cost of having to add extra nutrients; always a bonus. This soil amendment is twofold. It will provide a better crop yield because it will provide the nutrients that crops need. And secondly, it helps to cure diseases and will control the growth of nematodes and harmful plant pathogens. Plus, the crop yield is 15-25% higher when using Neem Cakes than with any other fertilizer. Neem Cakes can also improve the organic content of the soil by providing lots of micro and macro nutrients. This also improves the fertility of the soil in which your plants or crops are planted. The use of Neem Cakes too will increase the water holding capability of the soil and improve soil structure. With the soil improvement there will be an increase in beneficial organisms like earthworms also. Additionally, Neem Cake will help improve the texture of your soil, the organic content and water holding capacity as stated as well as helping to keep the soil aerated for root development Kaur *et al.*, [5].

2. Materials and Methods:

2.1 Experimental Site and Location

The experiment was conducted at the Research Farm of Soil Science at Sam Higginbottom University of Agriculture, Technology Sciences, Prayagraj which is located at 25°24'30" N latitude, 81° 51'10" E longitude and 98 m above the mean sea level and is situated 6 km away on the right bank of Yamuna river. Representing the Agro-Ecological Sub Region [North Alluvium plain zone (0-1% slope)] and Agro-Climatic Zone (Upper Gangetic Plain Region).

Table 1. Details of treatment combination

S.No.	Treatment combination	Symbol
T ₁	Absolute Control,	
T ₂	Vermicompost @ 50% and Neem cake @ 50%	V ₁ N ₁
T ₃	Vermicompost @ 50% and Neem cake @ 100%	V ₁ N ₂
T ₄	Vermicompost @ 50% and FYM @ 50%	V ₁ F ₁
T ₅	Vermicompost @ 50% and FYM @ 100%	V ₁ F ₂
T ₆	Vermicompost @ 100% and Neem cake @ 50%	V ₂ N ₁
T ₇	Vermicompost @ 100% and Neem cake @ 100%	V ₂ N ₂
T ₈	Vermicompost @ 100% and FYM @ 50%	V ₂ F ₁
T ₉	Vermicompost @ 100% and FYM @ 100%	V ₂ F ₂

Note: Recommended dose of fertilizer was applied at the time of sowing (P = @ 20 Kg ha⁻¹, K = @ 20 Kg ha⁻¹) (N was applied in two different doses @ 40 kg ha⁻¹), FYM @ 5 t ha⁻¹, Vermicompost @ 2 t ha⁻¹ and Neem cake @ 2.64 t ha⁻¹.

2.2 Climate Condition

The area of Prayagraj district comes under subtropical belt in the South east of Uttar Pradesh, which experience extremely hot summer and cold winter. The maximum temperature of the location reaches up to 46°C – 48°C and seldom falls as low as 4°C – 5°C. The relative humidity ranged between 20 to 94 percent. The average rainfall in this area is around 1100 mm annually. Prayagraj has a sub-tropical and semi-arid climate with rain mostly during July- September.

2.3 Experimental Design

The experiment was conducted in randomized block design (RBD) having nine treatment combination which is replicated thrice, randomly allocated in each replication, dividing into 27 plots. In the study, Organic manures like FYM, Vermicompost and Neem Cake was applied in two different doses. Sowing of the cow pea crop was carried out on the 15th of March, 2022 respectively, by hand. The seed variety kashi Nidhi was sown at a rate of 25 kg ha⁻¹ and at a row to row spacing of 30 cm and plant to plant spacing of 15 cm.

2.4 Soil Analysis

The soils from each plot were separately collected, air-dried, ground, and passed through a 2-mm-size sieve for laboratory analysis. Soil samples were analyzed for bulk density, particle density, Percentage pore space, and waterholding capacity (Muthuvel *et al.*, 1992) [9], pH (Jackson, 1967) [4], EC (Wilcox, 1950) [17], Percentage Organic Carbon (Walkley and Black, 1934) [16], Available Nitrogen (Subbiah and Asiija, 1956) [14], Available Phosphorus (Olsen *et al.*, 1954) [10] and Available Potassium (Toth and Prince, 1949) [15] before sowing and after harvest of the crop.

2.5 Statistical analysis

The statistical analysis of the data was carried out using STATISTICA (7.0) software.

3. Results and Discussion

3.1 Effect of different levels of organic manures on physical properties of soil after harvest of cowpea

The result observed in treatment T₁ non-significantly higher bulk density (1.32 Mg m⁻³ and 1.35 Mg m⁻³), particle density (2.46 Mg m⁻³ and 2.48 Mg m⁻³) and significantly higher percentage pore space (48.92 % and 45.47 %) and Water holding capacity (43.96 % and 40.38 %) were recorded in T₉ (absolute control) at 0-15 cm and 15-30 cm depth. This corroborates with the findings of Pradeepa *et al.*, [12], Kumar *et al.*, [8] and Babaji *et al.*, [3].

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3.2 Effect of different levels of organic manures on soil chemical properties of soil after harvest of cowpea

The result observed in treatment T₁ non-significantly higher soil pH (7.47 and 7.49) and significantly higher Electrical conductivity (0.251 dS m⁻¹ and 0.248 dS m⁻¹) at 0-15 cm and 15-30 cm. There was significantly higher percentage Organic Carbon (0.49 % and 0.47 %), Available Nitrogen (301.14 kg ha⁻¹ and 294.97 kg ha⁻¹), Available Phosphorus (30.96 kg ha⁻¹ and 27.50 kg ha⁻¹),

Available Potassium ($196.58 \text{ kg ha}^{-1}$ and $188.41 \text{ kg ha}^{-1}$) were recorded in T₉ at 0-15 cm and 15-30 cm depth. This corroborates with the findings of Khandelwal *et al.*, [6], Adeoye *et al.*, [1] and Pandey *et al.*, [11].

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Table No.2: Effect of different levels of organic manures on bulk density, particle density, pore space, water holding capacity and pH

S. No.	Treatment combination	Bulk Density (Mg m ⁻³)		Particle Density (Mg m ⁻³)		Pore space (%)		Water holding Capacity (%)		pH	
		0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm
T ₁	Absolute Control	1.32	1.35	2.46	2.48	42.22	39.12	38.21	33.37	7.47	7.49
T ₂	Vermicompost 50 % and Neem cake 50 %	1.29	1.32	2.44	2.47	43.38	41.25	39.32	33.67	7.45	7.48
T ₃	Vermicompost 50% and Neem cake 100%	1.25	1.27	2.41	2.43	44.53	41.34	40.38	37.94	7.36	7.39
T ₄	Vermicompost 50% and FYM 50 %	1.27	1.30	2.43	2.45	43.98	40.31	39.98	35.44	7.43	7.46
T ₅	Vermicompost 50 % and FYM 100 %	1.22	1.24	2.38	2.39	46.32	43.16	41.37	38.31	7.31	7.33
T ₆	Vermicompost 100 % and Neem cake 50 %	1.24	1.26	2.40	2.42	45.84	41.37	40.91	36.26	7.34	7.38
T ₇	Vermicompost 100 % and Neem cake 100 %	1.19	1.20	2.30	2.35	48.36	43.33	43.28	39.87	7.23	7.24
T ₈	Vermicompost 100 % and FYM 50 %	1.20	1.23	2.36	2.39	47.64	43.28	42.84	36.35	7.27	7.26
T ₉	Vermicompost 100 % and FYM 100%	1.17	1.19	2.27	2.29	48.92	45.47	43.96	40.38	7.20	7.22
F(test)		NS	NS	NS	NS	S	S	S	S	NS	NS
S.Em. ±						0.82	0.44	0.66	0.62		
C.D. at 5%						2.48	1.32	1.99	1.88		

Table No.3:Effectofdifferent levels of organicmanureon Electrical Conductivity, Organic Carbon, Available Nitrogen, Available Phosphorus and Available Potassium

S. No.	Treatment combination	EC (dS m ⁻¹)		Organic Carbon (%)		Available Nitrogen (kg ha ⁻¹)		Available Phosphorus (kg ha ⁻¹)		Available Potassium (kg ha ⁻¹)	
		0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm
T ₁	Absolute Control	0.251	0.248	0.35	0.31	245.88	236.80	16.38	14.35	138.25	130.32
T ₂	Vermicompost 50 % and Neem cake 50 %	0.248	0.244	0.38	0.35	253.73	248.34	17.47	15.64	140.59	132.77
T ₃	Vermicompost 50% and Neem cake 100%	0.242	0.239	0.42	0.41	273.80	265.66	22.34	20.79	148.88	137.87
T ₄	Vermicompost 50% and FYM 50 %	0.244	0.242	0.40	0.38	265.52	257.91	20.37	17.92	146.59	139.05
T ₅	Vermicompost 50 % and FYM 100 %	0.231	0.227	0.44	0.42	285.45	276.94	23.47	22.55	166.72	156.11
T ₆	Vermicompost 100 % and Neem cake 50 %	0.237	0.232	0.42	0.40	278.99	270.40	23.52	21.43	158.33	138.62
T ₇	Vermicompost 100 % and Neem cake 100 %	0.220	0.218	0.47	0.45	298.95	283.48	28.12	24.68	187.17	171.95
T ₈	Vermicompost 100 % and FYM 50 %	0.229	0.225	0.46	0.43	294.28	286.50	25.08	23.75	176.32	162.02
T ₉	Vermicompost 100 % and FYM 100%	0.216	0.213	0.49	0.47	301.14	294.97	30.96	27.50	196.58	188.41
F(test)		S	S	S	S	S	S	S	S	S	S
S.Em. ±		0.004	0.004	0.006	0.006	3.17	3.80	0.33	0.33	2.79	2.03
C.D. at 5%		0.011	0.011	0.019	0.02	9.54	11.45	1.01	0.99	8.42	6.13

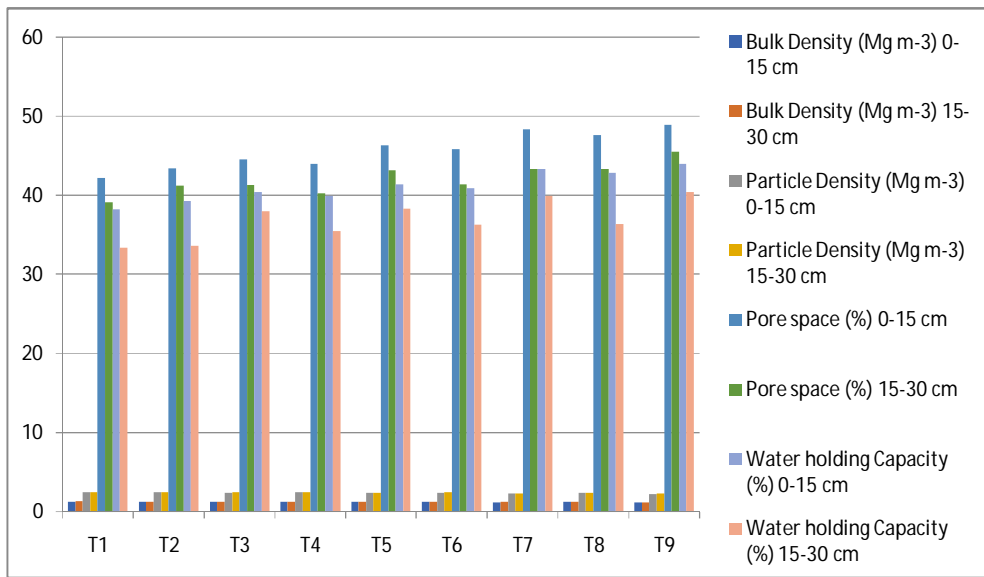


Fig No.1:Effect of different levels of organic manures on bulk density, particle density, pore space and water holding capacity

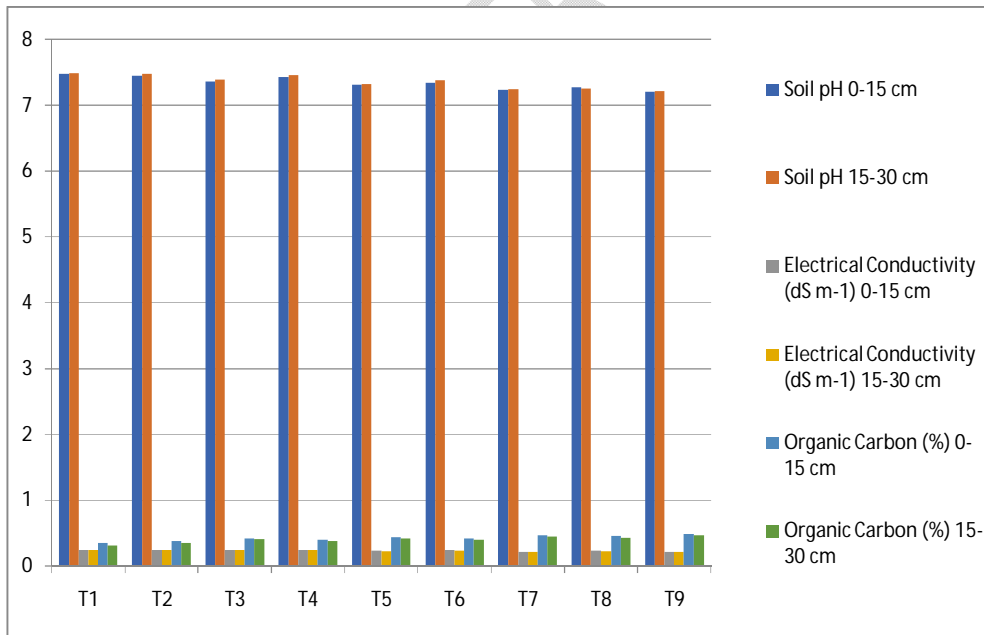


Fig No.2:Effect of different levels of organic manures on soil pH and Electrical Conductivity and Organic Carbon

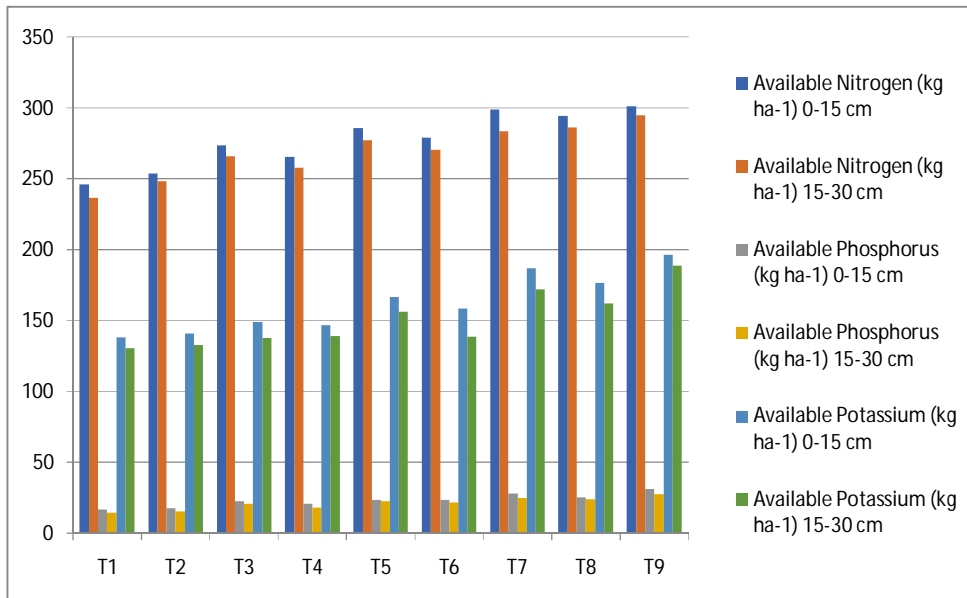


Fig No.3:Effect of different levels of organic manures on Available Nitrogen, Available Phosphorus and Available Potassium

Conclusion

Conclusion based on the results; the application of organic manures was found to improve the soil health in reference to cowpea. Application of T₉ (Vermicompost @ 2 t ha⁻¹ and FYM @ 5 t ha⁻¹) was found optimal for improving soil properties like pore space, water holding capacity, Available Nitrogen, Available phosphorus and Available potassium.

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