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Effect of Vermicompost and Zn on Physico-Chemical Properties of Soil in Cultivation of Okra (*Abelmoschus esculentus* L.) var. Supper Green

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The objective of the experiment was to evaluate the effect of vermicompost and zinc as form of ZnSO4.7H20 on soil health and yield attributes of okra. The design applied was 3x3 randomized block design having three levels of vermicompost @ 0, 50 and 100% ha^{-1}, three levels of Zn @ 0, 50 and 100% ha^{-1} respectively. It was observed that treatment T9 (Vermicompost @ 100% + Zn @ 100%) improved the soil WHC, OC, available N, P, and K, resulted in a slight chenge in soil pH 7.28, EC 0.388 dS m^{-1} and bulk density 1.40 Mg m^{-3} and particle density 2.64 Mg m^{-3}. In post-harvest soil of fertilizers observations were resulted in significant increase in pore space 48.20%, water holding capacity 43.22 %, organic carbon 0.52 %, and available N 307.14kg ha^{-1}, P 34.14 kg

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ha^{-1}, K 186.58 kg ha^{-1} and Zn 0.57 mg kg^{-1}, significant increase in case of Nitrogen kg ha^{-1}, Phosphorus kg ha^{-1}, Potassium kg ha^{-1} and Zinc mg kg^{-1} was found to be significant among other treatments in okra cultivation and soilquality improvement. The maximum yield regarding, gave the best results with respect to plant height 120.70 cm, number of leaves plant^{-1} 49.31, number of fruit plant^{-1} 24.22, and yield of fruits 135.59 q ha^{-1}. It gave highest yield 135.59 q ha^{-1}. It was also revealed that the application of Zinc with organic manures was excellent source for fertilizer.

Keywords: Okra; vermicompost; zinc; physico-chemical properties of soil; growth and yield etc.

1. INTRODUCTION

"Okra is a popular vegetable which is cultivated in the tropical and sub-tropical region of the world. Okra belongs to the Malvaceae family and semi pollinated in nature which plays an important role to the demand of vegetables in the country where they are scanty in the market. The nutritional constituents of okra include calcium, protein, oil and carbohydrates; others are Ferrous, Magnesium and Phosphorus. Okra is eaten in cooked or processed form. Young fruits may be eaten raw, the oil could be as high as in poultry eggs and soyabean" Adesida et al., [1].

"Use of Vermicompost has been advocated in integrated nutrient management (INM) system in vegetable crops. Vermicompost helps in reducing C:N ratio, increased humic acid content, cation exchange capacity and water-soluble carbohydrate. Vermicompost is a source of micro and macro nutrients and acts as a chelating agent. Vermicompost is greatly humified through the fragmentation of parent organic materials by earthworms and colonization by micro-organisms" Singh et al., [2].

"Vermicompost is a mixture of worm castings, undigested organic wastes, microbes, vitamins, enzymes, hormones and antibiotics. It has less soluble salts, neutral pH, greater ion exchange capacity, humic acid content, nitrates, calcium and magnesium. It improves water holding capacity of the soil. It contains plant hormones like auxins and gibberellins and enzymes which believed to stimulate plant growth and discourage plant pathogens. It also enriches the soil with useful microorganisms which add different 4 enzymes like phosphatases and cellulases to the soil. It enhances germination, plant growth and thus over all crop yield, It is rich in NPK and retain the nutrients for long time" Tensingh et al., [3].

"Zinc mainly functions as the metal component of a series of enzymes. The most important enzymes activate by this element are carbonic anhydrase. Zinc deficiency is thought to restrict RNA synthesis, which in turn inhibits protein synthesis. Zinc is also involved in auxinproduction as well as flower and fruit setting. Shoots and buds of zinc deficient plants contain very low auxin, which causes dwarfism and growth reproduction" Nusrat et al., [4].

2. METHODOLOGY

The field experiment is to be conducted out during the Zaid season 2022 central research farm of department of soil science and agricultural chemistry, Naini Agricultural Institute, Prayagraj (Allahabad) 211 007, (U.P.), located at 25°24'30'' North latitude 81°51'10'' East longitude and 98 m above mean sea level. Representing the Agro-ecological sub region [North Alluvium plain zone (0-1% slop)] and Agro-climatic zone (Upper gangetic plain region).

Argo Climatically, Prayagraj district represents the subtropical belt of the South East of (U.P.), and is endowed with extremely hot summer and fairly cold winter. The maximum temperature of the location ranges between 46°C and seldom falls below 4°C-5°C. The relative humidity ranges between 20-94%. The average rainfall of this area is around 1100mm annually.

The soil samples were randomly collected from one site in the experiment plot prior to tillage operation from a depth of 0-15 cm and 15-30 cm. The volume of the soil sample will be reduced by conning and quartering the composites soil sample will be air dried and passed through a 2 mm sieve by way of preparing the sample for physical anlysis, bulk density, particle density, pore space %, water holding capacity % [5] and chemical analysis, pH [6], EC [7], organic carbon [8], available nitrogen [9], phosphorus [10], potassium [11], and zinc [12].

Table 1. Treatment combination of Okra var. Supper green

S. No.	Treatment combination
T_1	Absolute Control,
T_2	(Vermicompost @ 0 t ha^{-1} and Zinc @ 2.5kg ha^{-1}),
T_3	(Vermicompost @ 0 t ha^{-1} and Zinc @ 5kg ha^{-1}),
T_4	(Vermicompost @ 2.5 t ha^{-1} and Zinc @ 0kg ha^{-1}),
T_5	(Vermicompost @ 2.5 t ha^{-1} and Zinc @ 2.5kg ha^{-1}),
T_6	(Vermicompost @ 2.5 t ha^{-1} and Zinc @ 5kg ha^{-1}),
T_7	(Vermicompost @ 5 t ha^{-1} and Zinc @ 0kg ha^{-1}),
T_8	(Vermicompost @ 5 t ha^{-1} and Zinc @ 2.5kg ha^{-1}),
T_9	(Vermicompost @ 5 t ha^{-1} and Zinc @ 5kg ha^{-1}).

3. RESULTS AND DISCUSSION

3.1 Soil Parameters

The composition of vermicompost and Zn have significant increasement on the soil parameters. The increasement of pore space %, water holding capacity %, organic carbon, available nitrogen, phosphorus, potassium, and zinc with the improvement of soil parameters, Table 2 revealed that application of different levels of vermicompost and Zn have following roll, on soil. In treatment T1 lowest data observed particle density 2.61 and 2.63 Mg m^{-3}, pore space 42.34 and 40.12%, water holding capacity 38.35 and 36.16% and T9 shows the highest particle density 2.64 and 2.66 Mg m^{-3}, pore space 48.20% and 46.96%, water holding capacity 43.22% and 41.98% respectively in 0-15cm and 15-30cm depth of soil. Also in Table 2 shown bulk density with highest in T1 1.48 and 1.50 with lowest in T9 1.40 and 1.43 respectively in 0-15cm and 15-30 cm depth of soil. Fig. 1 shown that the verbal diagram of the proper rising depending upon Table 2 [13,14].

Table 3 shown that in Treatment T1 have lowest pH 7.20 and 7.21, EC 0.213 and 0.228 dS m^{-1}, organic carbon 0.37 and 0.30%, nitrogen 252.13 and 243.96 kg ha^{-1}, phosphorus 22.10 and 20.37 kg ha^{-1}, potassium 140.25 and 132.08 kg ha^{-1}, zinc 0.39 and 0.18 mg kg^{-1} and T9 have highest pH 7.28 and 7.29, EC 0.388 and 0.391 dS m^{-1}, organic carbon 0.52% and 0.45%, nitrogen 307.14 and 298.97 kg ha^{-1}, phosphorus 34.14 and 32,23 kg ha^{-1}, potassium 186.57 and 178.41 kg ha^{-1}, zinc 0.57 and 0.35 mg kg^{-1} respectively in 0-15cm and 15-30cm depth of soil. Fig. 2 revealed that the chemical properties details rising of Table 3.

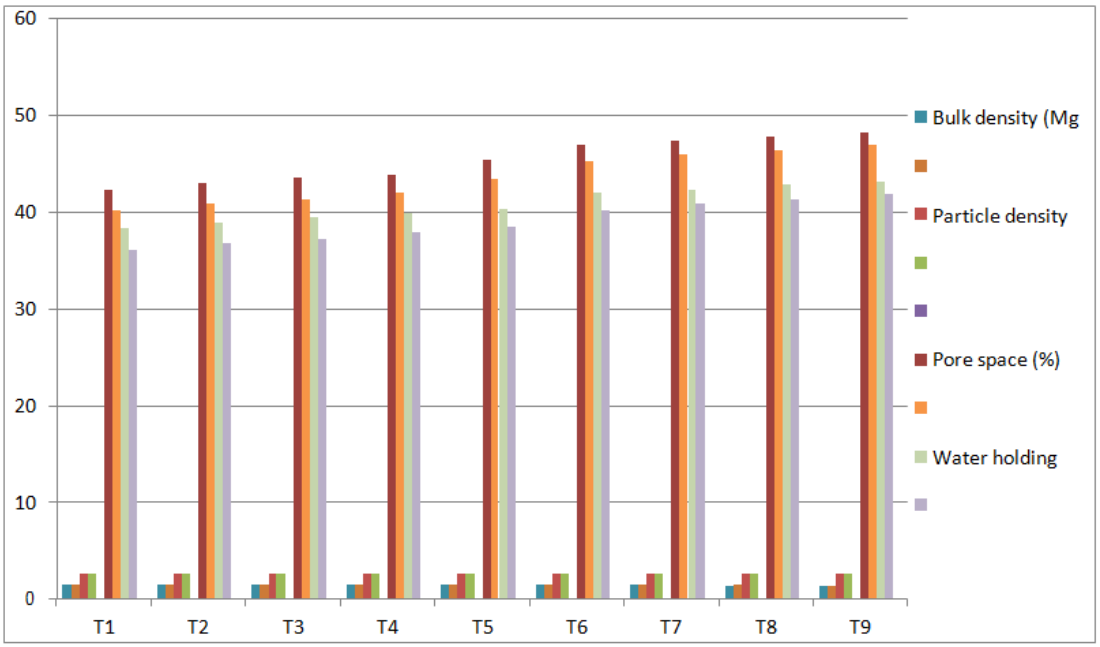

Fig. 1. Effect of different levels of Vermicompost and Zn on physical properties of soil

Table 2. Effect of different levels of Vermicompost and Zn on physical properties of soil

Treatments	Bulk density (Mg m^{-3})		Particle density (Mg m^{-3})		Pore space (%)		Water holding capacity (%)	
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	1.48	1.50	2.61	2.63	42.34	40.12	38.35	36.16
T_2	1.47	1.48	2.62	2.64	42.99	40.86	38.99	36.87
T_3	1.46	1.47	2.61	2.63	43.53	41.28	39.51	37.23
T_4	1.47	1.49	2.63	2.64	43.87	41.98	39.87	37.95
T_5	1.46	1.48	2.62	2.64	45.38	43.51	40.33	38.52
T_6	1.45	1.47	2.63	2.66	46.95	45.22	41.96	40.26
T_7	1.44	1.45	2.62	2.65	47.35	45.98	42.32	40.93
T_8	1.42	1.44	2.64	2.66	47.86	46.37	42.84	41.31
T_9	1.40	1.43	2.64	2.66	48.20	46.96	43.22	41.98
F-test	NS	NS	NS	NS	S	S	S	S
S.Em. (±)	-	-	-	-	0.03	0.09	0.87	0.76
C.D.@5%	-	-	-	-	2.59	1.98	1.87	1.62

Table 3. Effect of different levels of Vermicompost and Zn on chemical properties of soil

Treatments	pH		EC (dS m^{-1})		Organic Carbon (%)		Nitrogen (kg ha^{-1})		Phosphorus (kg ha^{-1})		Potassium (kg ha^{-1})		Zinc (mg kg^{-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	0-15 cm	15-30 cm	0-15 cm	15-30 cm
T_1	7.20	7.21	0.213	0.228	0.37	0.30	252.13	243.96	22.10	20.37	140.25	132.08	0.39	0.18
T_2	7.22	7.23	0.231	0.246	0.39	0.33	261.08	252.91	23.11	21.20	142.59	134.43	0.45	0.24
T_3	7.23	7.24	0.356	0.371	0.44	0.40	287.11	278.94	27.35	25.44	169.32	161.15	0.41	0.21
T_4	7.21	7.22	0.327	0.342	0.45	0.38	271.65	263.48	25.98	24.07	161.74	153.57	0.46	0.26
T_5	7.23	7.24	0.318	0.333	0.47	0.40	278.57	270.4	27.64	25.73	165.33	157.16	0.48	0.27
T_6	7.24	7.25	0.364	0.379	0.48	0.41	294.85	286.50	28.74	26.83	178.87	170.70	0.43	0.21
T_7	7.26	7.27	0.287	0.300	0.49	0.40	267.75	259.58	25.48	23.57	154.88	146.80	0.44	0.23
T_8	7.27	7.28	0.373	0.388	0.50	0.43	302.43	294.26	32.66	30.75	180.12	171.95	0.51	0.30
T_9	7.28	7.29	0.388	0.391	0.52	0.45	307.14	298.97	34.14	32.23	186.58	178.41	0.57	0.35
F-test	NS	NS	S	S	S	S	S	S	S	S	S	S	S	S
S.Em. (±)	-	-	0.23	0.18	0.01	0.03	1.09	1.02	0.67	0.74	0.90	1.08	0.004	0.004
C.D.@5 %	-	-	0.41	0.71	0.02	0.07	2.32	1.98	1.42	1.23	1.90	2.18	0.461	0.253

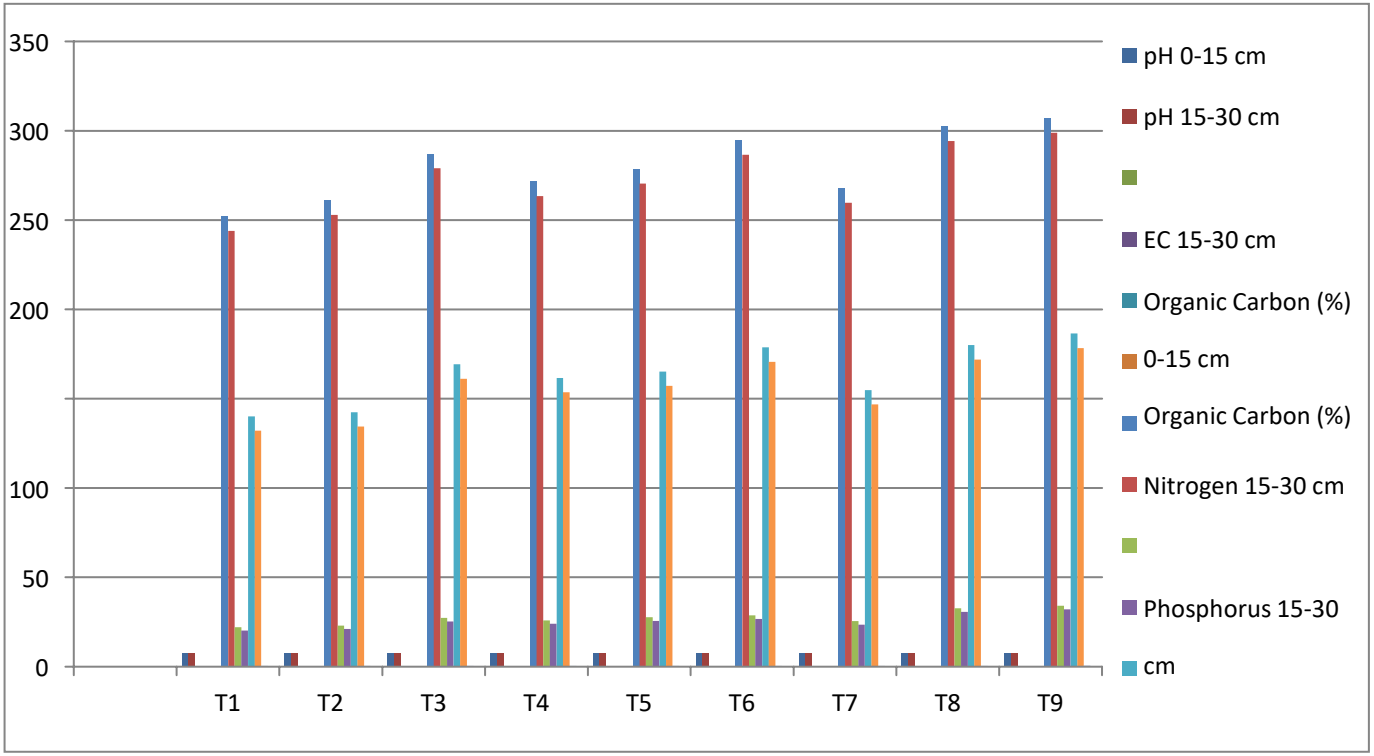

Fig. 2. Effect of different levels of Vermicompost and Zn on chemical properties of soil

Physical and Chemical properties respectively are shown where its clear that the T9 treatment is better followed by T8. It eventually shows that the vermicompost and Zn application is the beneficial effect on the soil, that will maintain the soil. T1 shows that lowest effect on the soil parameters.

4. CONCLUSION

The use of vermicompost and zinc in field can improve soil parameters and crop productivity in okra. The treatment combination T9 (Vermicompost @ 100% + Zn @ 100 %) is the best for significant increase of soil physical and chemical properties. It also help in management of soil fertility and soil resources.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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