Original Research Article

Effect of Vermicompost and Zn on Physico-Chemical Properties of Soil, GrowthandYieldofOkra(*Abelmoschus esculentus*L.)var. SupperGreen

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ABSTRACT

The objective of experiment was to show the effect of Vermicompost and zinc on soil health andyield attributes of okra.The design applied was 3x3 RBD having three levels of vermicompost @ 0,50 and100% ha^{-1}, three levels of Zn @ 0, 50 and 100% ha^{-1} respectively. Thesoil physicochemical characteristics like pH, Ec, bulk density, water holding capacity, organic carbon, available nitrogen, potassium, zinc was evaluated. It was observed The result obtained withthattreatment T9 (Vermicompost @ 100% + Zn @ 100%) improved the soil pH, EC, BD, PD, WHC, OC, available N,that showed vermicompost in combinationresulted in a slight in soil pH 7.28, EC 0.388 dS m^{-1} and bulk density 1.40 Mg m^{-3} and particledensity 2.64 Mg m^{-3}. In postsoil of fertilizers observations were resulted in significant increase inpore space 48.20%, water holdingcapacity 43.22 %, organic carbon 0.52 %, and available N 307.14kg ha^{-1}, P 34.14 kg ha^{-1}, K 186.58 kg ha^{-1} and Zn 0.57 mg kg^{-1}, significant increase in case ofNitrogen kg ha^{-1},Phosphoruskgha^{-1},Potassium kgha^{-1}andZincmgkg^{-1}wasfoundtobesignificant among other treatments in okra cultivation and soilquality improvement. The maximumyield regarding, gave the best results with respect to plant height 120.70 cm, number of leavesplant^{-1}49.31,numberoffruitplant^{-1}24.22,andyieldoffruits135.59qha^{-1}.Itgavehighestyield 135.59 q ha^{-1}. It was also revealed that the application of Zinc with organic manures was excellentsource for fertilizationthanfertilizers.

Keywords: Okra,Vermicompost,Zinc,Physico-chemicalpropertiesofSoil,GrowthandYieldetc.

Comment [DSS1]:

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Comment [DSS5]: How can you add only zinc in the soil what is the associated anion with zn in the form of a compound

Comment [DSS6]: What is RBD-randomized block design
Avoid using abbreviations in the abstract

Comment [DSS7]: Write down about the source of zinc added to the soil its foliar spray or incorporated in the soil, write down about the treatments before the results and the sampling time

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INTRODUCTION

Okraisapopularvegetablewhichiscultivatedinthetropicalandsub-tropicalregionoftheworld.OkrabelongstotheMalvaceaefamilyandsemipollinatedinnaturewhichplaysanimportantroleto thedemand of vegetables in the country where they are scanty in the market. The nutritional constituents ofokra include calcium, protein, oil and carbohydrates; others are Iron, Magnesium and Phosphorus. MostOkra is eaten in cooked or processed form. Young fruits may be eaten raw, the oil could be as high as inpoultryeggs andsoyabean.**Adesida*etal.*, (2019).**

Okraismostpopular inIndia,Nigeria,Sudan,Pakistan,Ghana,Egypt,Berlin,SaudiArabia,MexicoandCameron Largest area and production is in India followed by Nigeria. Total area under okra in Indiareported to be 528.37thousand hectare, production 6145.97 thousand tonnes and productive highest in2018-19. West Bengal is the leading state of area and production of okra, way has area 77.40 thousandhectare and production 913:32 thousand tonnes. Highest production is 17.40 t ha of Andhra Pradesh.Uttar Pradesh climate is good for okra that in total 22.64 thousand hectare and production is 303,05thousandtonnesin2018-19 **NationalHorticultureBoarddata,(2018-19).**

UseofVermicompost hasbeenadvocatedinintegratednutrientmanagement (INM)systeminvegetablecrops. Vermicompost helps in reducing C:N ratio,increasedhumic acid content, cation exchangecapacity and water-soluble carbohydrate. Vermicompost is a source of micro and macro nutrients andacts as a chelating agent. Vermicompost is greatly humified through the fragmentation of parent organicmaterialsbyearthwormsandcolonizationbymicro-organisms **Singh*et al.*, (2013).**

Vermicompost is a mixture of worm castings, undigested organic wastes, microbes, vitamins, enzymes,hormonesandantibiotics.Ithas lesssolublesalts, neutralpH,greaterionexchangecapacity,humic acidcontent,nitrates,calciumandmagnesium. Itimproveswaterholdingcapacityofthesoil.It containsplanthormones like auxins and gibberellins and enzymes which believed to stimulate plant growth anddiscourage plant pathogens. It also enriches the soil with useful microorganisms which add different 4enzymeslikephosphatasesandcellulasestothesoil.Itenhancesgermination,plantgrowthandthusoverallcrop yield,Itis richinNPKandretainthenutrientsfor longtime**Tensingh*et al.*,(2017)**.

Zinc mainly functions as the metal component of a series of enzymes. The most important enzymesactivate by this element are carbonic anhydrase and a number of dehydrogenases. Zinc deficiency isthoughttorestrict RNAsynthesis,whichinturninhibitsproteinsynthesis.Zincisalsoinvolvedinauxinproduction as well as flower and fruit setting. Shoots and buds of zinc deficient plants contain very lowauxin,whichcauses dwarfismandgrowthreproduction**Nusrat*et al.*, (2020)**.

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add new references

METHODOLOGY

The field experiment is to be conducted out during the Zaid season 2022 central research farmof 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 98mabove mean sea level. Representing the Agro-ecological sub region [North Alluvium plain zone (0-1%slop)]andAgro-climatic zone (Uppergangeticplainregion).

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 thelocation ranges between 46°C and seldom falls below 4°C-5°C. The relative humidity ranges between20-94%.Theaveragerainfallofthis areaisaround 1100mmannually.

Thesoilsampleswillberandomlycollectedfromonesiteintheexperimentplotpriortotillageoperation from a depth of 0-15 cm and 15-30 cm. The volume of the soil sample will be reduced byconning and quartering the composites soil sample will be air dried and passed through a 2 mm sieve byway of preparing the sample for physical anlysis, bulk density, particle density, pore space %, waterholdingcapacity%(Muthuvel*etal*.,1992)andchemicalanalysis,pH(Jackson,1958),EC(Wilcox,1950), organic carbon (Walkley and Black,1947), available nitrogen (Subbaih and Asija,1956),phosphorus(Olsen*etal*.,1954),potassium(TothandPrince,1949),andzinc(LindsayandNorvell, 1969).

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Table1.Treatment combinationofOkravar.Suppergreen

S.No.	Treatmentcombination
T_1	**AbsoluteControl,**
T_2	**(Vermicompost@0tha^{-1}andZinc@2.5kgha^{-1}),**
T_3	**(Vermicompost@0tha^{-1}andZinc@5kgha^{-1}),**
T_4	**(Vermicompost@2.5tha^{-1}andZinc@ 0kgha^{-1}),**
T_5	**(Vermicompost@2.5tha^{-1}andZinc@2.5kgha^{-1}),**
T_6	**(Vermicompost@2.5tha^{-1}andZinc@5kgha^{-1}),**
T_7	**(Vermicompost@5tha^{-1}andZinc@0kgha^{-1}),**
T_8	**(Vermicompost@5tha^{-1}andZinc@2.5kgha^{-1}),**
T_9	**(Vermicompost@5tha^{-1}andZinc@5kgha^{-1}).**

RESULTANDDISCUSSION

Soilparameters

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,andzincwiththeimprovementofsoilparameters,Table2.revealedthatapplicationofdifferentlevelsofvermicompostandZnhavefollowingroll,onsoil.IntreatmentT$_1$lowestdata observed particle density 2.61 and 2.63 Mg m^{-3}, pore space 42.34 and 40.12%, water holdingcapacity 38.35 and 36.16% and T$_9$ shows the highest particle density 2.64 and 2.66 Mg m^{-3}, pore space48.20% and 46.96%, water holding capacity 43.22% and 41.98% respectively in 0-15cm and 15-30cmdepth of soil. Also in table 2. shown bulk density with highest in T$_1$ 1.48 and 1.50 with lowest in T$_9$ 1.40and1.43respectivelyin0-15cmand15-30cmdepthofsoil.

Table 3. shown that in Treatment T$_1$ have lowest pH 7.20 and 7.21, EC 0.213 and 0.228 dS m^{-1}, organiccarbon 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 T$_9$ have highest pH 7.28 and 7.29,EC0.388and0.391dSm^{-1},organiccarbon0.52%and0.45%,nitrogen307.14and298.97kgha^{-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}respectivelyin0-15cmand15-30cmdepthofsoil.

Physical andChemical propertiesrespectively areshown whereitsclear thattheT$_9$treatmentisbetterfollowedbyT$_8$.IteventuallyshowsthatthevermicompostandZn applicationisthebeneficial effecton thesoil,thatwillmaintainthesoil.T$_1$shows thatlowesteffectonthesoilparameters.

Table2.Effectofdifferentlevelsof VermicompostandZnonphysicalpropertiesofsoil

Treatments	Bulk density(Mgm^{-3})		Particledensity (Mgm^{-3})		Porespace(%)		Water holdingcapacity(%)	
	0-15cm	15-30cm	0-15cm	15-30cm	0-15cm	15-30cm	0-15cm	15-30cm
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

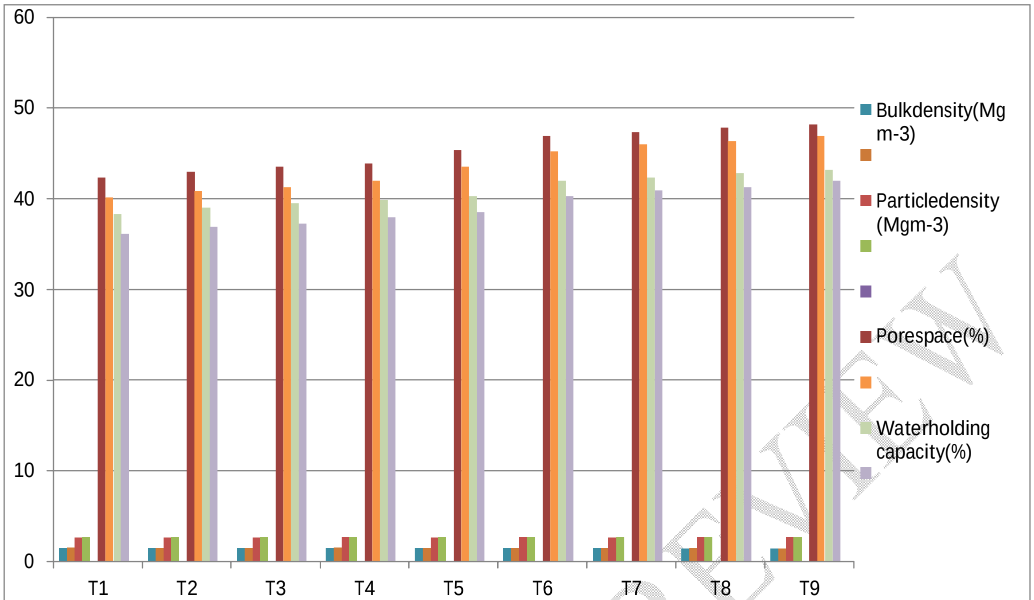

Fig.1.Effectofdifferentlevelsof VermicompostandZnonphysicalpropertiesofsoil

Table3.EffectofdifferentlevelsofVermicompostandZn onchemicalpropertiesofsoil

Treatments	pH		EC(dSm^{-1})		OrganicCarbon(%)		Nitrogen (kg ha^{-1})		Phosphorus (kg ha^{-1})		Potassium (kg ha^{-1})		Zinc(mgkg^{-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

Comment [DSS17]: please include error bars and statistical analysis in the figure and mentioned the LSD value

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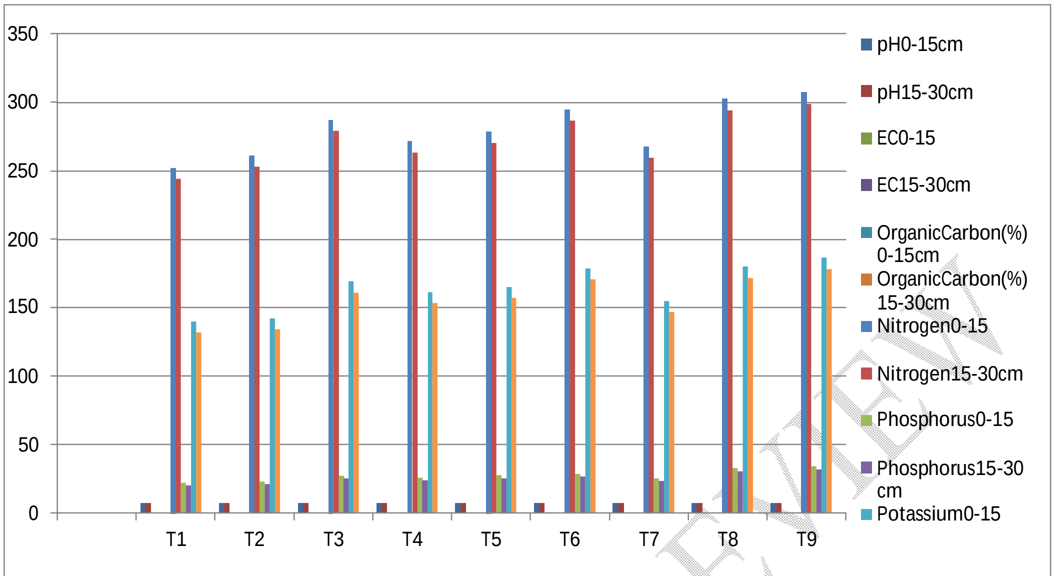

Fig.2.EffectofdifferentlevelsofVermicompostandZn onchemicalpropertiesofsoil

Sellingpriceof Okra(Yield)=1000q^{-1}

Accordingtofollowingtable3.Theeconomyofdifferenttreatmentconcerned,thetreatmentT_9 provides highest net profit of ₹ 92165.34 with cost benefit ratio 1:3.12 however, the minimum netprofitof₹ 12633.84wasrecorded inthetreatmentT_1withcost benefitratiois1:1.36.

Table4.Effectofdifferenttreatmentcombinationoncostbenefitratio(C:B)ofOkra

Treatment	Yield(qha^{-1})	Selling price (₹q^{-1})	Gross return(₹ha^{-1})	Totalcostof cultivation (₹ha^{-1})	Net Profit(₹ ha^{-1})	Cost Benefitratio(C:B)
T_1	47.56	1000	47560	34926.16	12633.84	1:1.36
T_2	52.06	1000	52060	35008.66	17051.34	1:1.48
T_3	73.71	1000	73710	35091.16	38618.84	1:2.10
T_4	61.46	1000	61460	39092.91	22367.09	1:1.57
T_5	107.34	1000	107340	39175.41	68164.55	1:2.70
T_6	115.91	1000	115910	39257.91	76652.09	1:2.90
T_7	87.53	1000	87530	43259.66	44270.34	1:2.02
T_8	118.74	1000	118740	43342.16	75397.84	1:2.73
T_9	135.59	1000	135590	43424.66	92165.34	1:3.12

CONCLUSION

On the basis of above findings, it concluded that the treatment combinations of T_9 (Vermicompost @100% + Zn @ 100 %) shows best results with respect to in comparison to other treatment combinations.It gives highest profit of ₹ 92165.34 ha^{-1} with highest benefit cost ratio is 1:3.12. So, Vermicompost andZincforprofitableproductionofOkraandgoodforsoil.

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