Effect of Recommended dose of fertilizer, Vermicompost andZinc on Physico-Chemical Properties of Soil, GrowthandYieldof Okra (*Abelmoschusesculentus*L.)var. SupperGreen

ABSTRACT

Theexperiment'sgoalwastodemonstratehowzincandvermicompostalongwithrecommended dose of fertilizer effected the yield characteristics of okra and the health of thesoil. Three levels of vermicompost at 0, 50, and 100% ha^{-1}, N,P,K at 100 % ha^{-1} and threelevels of zinc at 0, 50, and 100% ha^{-1}, respectively, were applied in the 3x3 RBD design.Vermicompost in combination produced a small decrease in soil pH 7.00 and negligiblechangeinEC0.19dSm^{-1},decreaseinbulkdensity1.40Mgm^{-1},increaseinparticledensity 2.64Mgm^{-1},accordingtotreatmentT9(Vermicompost@100%+Zn@100%+Recommended dose of fertilizer). Following fertilizer application, observations showed asignificant increase in pore space (48.83%), water holding capacity (43.22%), organic carbon(0.52%), and available Phosphorous 24.67 kg ha^{-1}, Potassium 182.86 kg ha^{-1}, and Zn 0.53mgkg^{-1}and T7 has highest at Nitrogen content with 292.33 kg h^{-1}. Among other treatments forokra cultivation, nitrogen kg ha^{-1} phosphorus kg ha^{-1}, potassium kg ha^{-1}, and zinc mg kg-^{1}were also found to be significant. With regard to plant height of 120.70 cm,number of fruitplants-^{1} 30.33,andfruityieldof141.33qha^{-1},themaximumyieldexhibitedthebestqualities. At 141.33q ha^{-1}, it produced the highest yield. Applying zinc along with organicmanureswasalsofound to beasuperior sourceoffertilization thanusingfertilizers alone.

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

Introduction

Okra is a popular vegetable which is cultivated in the tropical and sub-tropical region of theworld. Okra belongs to the Malvaceae family and semi pollinated in nature which plays animportant role to the demand of vegetables inthe country where they are scanty inthemarket. The nutritional constituents of okra include calcium, protein, oil and carbohydrates;others are Iron, Magnesium and Phosphorus. Most 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*etal*., (2019).**

Okra is most popular in India, Nigeria, Sudan, Pakistan, Ghana, Egypt, Berlin, Saudi Arabia,Mexico and Cameron Largest area and production is in India followed by Nigeria. Total areaunder okra in India reported to be 528.37thousand hectare, production 6145.97 thousandtonnes and productive highest in 2018-19. West Bengal is the leading state of area andproduction of okra , way has area 77.40 thousand hectare and production 913:32 thousandtonnes. Highest production is 17.40 t ha of Andhra Pradesh. Uttar Pradesh climate is good forokra that in total 22.64 thousand hectare and production is 303,05 thousand tonnes in 2018-19NationalHorticultureBoard data,(2018-19).

UseofVermicomposthasbeenadvocatedinintegratednutrientmanagement(INM)systemin 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 microand macro nutrients and acts as a chelating agent. Vermicompost is greatly humified throughthe fragmentation of parent organic materials by earthworms and colonization by micro-organisms**Singh*et al*., (2013).**

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 exchangecapacity, humic acid content, nitrates, calcium and magnesium. It improves water holdingcapacity of the soil. It contains plant hormones like auxins and gibberellins and enzymeswhich believed to stimulate plant growth and discourage plant pathogens. It also enriches thesoilwithusefulmicroorganismswhichadddifferent4enzymeslikephosphatasesandcellulases to the soil. It enhances germination, plant growth and thus over all crop yield, It isrichin NPK and retain thenutrients forlongtime**Tensingh*et al*., (2017).**

Zinc mainly functions as the metal component of a series of enzymes. The most importantenzymes activate by this element are carbonic anhydrase and a number of dehydrogenases.Zinc deficiency is thought to restrict RNA synthesis, which in turn inhibits protein synthesis.Zinc is also involved in auxin production as well as flower and fruit setting. Shoots and budsofzincdeficientplantscontainverylowauxin,whichcausesdwarfismandgrowthreproduction **Nusrat*et al*., (2020).**

Material andmethod

The central research farm of the department of soil science and agricultural chemistry at theNaini Agricultural Institute, Prayagraj (Allahabad) 211 007, (U.P.), situated at 25°24'30"North latitude, 81°51'10" East longitude, and 98 meters above mean sea level, is where thefield experiment will be carried out during the Zaid season in 2023. standing in for the Agro-climaticzone(UpperGangeticPlainRegion)andtheAgro-ecologicalsubregion(NorthAlluviumPlain Zone, 0-1% Slope).

Argo The Prayagraj district's climate, which features a scorching summer and a chilly winter,isrepresentativeofthesubtropicalbeltthatrunsthroughthesoutheastoftheUnitedProvince. The location's maximum temperature is 46°C, with rare dips below 4°C or 5°C.There is a 20–94% relative humidity range. This location receives approximately 1100 mm ofrainon averageeachyear.

Prior toplowing, a single site in the trial plot willhave randomsoil samples taken fromdepths of 0–15 cm and 15–30 cm. The soil sample will be reduced in volume by being cinnedand quartered. The sample will then be air dried and put through a 2 mm sieve in order toprepare it for chemical analysis (PH: Jackson, 1958; EC: Wilcox, 1950); organic carbon:Walkley and Black, 1947; available nitrogen: Subbaih and Asija, 1956; phosphorus: Olsen etal.,1954; potassium: Toth andPrince, 1949; zinc: Lindsayand Norvell, 1967).

Table 1. List of Treatment combinations used for the study

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

[RDF=RecommendeddoseofFertilizer=N,P,K@ 100,60,50Kgha^{-1}respectively]

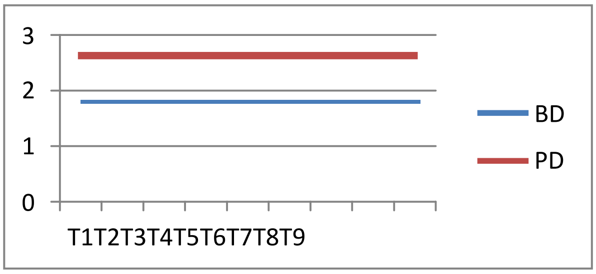
RESULTANDDISCUSSION

<u>SoilParameters</u>:

The soil parameters exhibit a notable rise in the composition of vermicompostand zinc. Table2. shows that applying varying amounts of vermicompost and zinc with RDFhas the following effects on soil: it increases pore space, water holding capacity, organiccarbon, accessible nitrogen, phosphorus, potassium, and zinc. The lowest measurements forparticle density in treatment T1 were 2.61 and 2.63 mg m^{-1}. , pore space 42.1 and 40.99%,waterholdingcapacity38.35and36.16%andT9showsthehighestparticledensity2.64and 2.66 Mg m^{-1}, pore space 48.42% and 45.89 %, water holding capacity 43.22% and 41.98%respectively in 0-15cm and 15-30cm depth of soil. Also in table2. shown bulk density withhighest in T1 1.4 and 1.49 with lowest in T9 1.40 and 1.41 respectively in 0-15cm and 15-30cmdepthofsoil.Table3.shownthatinTreatmentT1havehighestpH7.60and7.63,EC 0.28and 0.29 dS m^{-1}, organic carbon 0.37 and 0.30%, nitrogen 264 and 261.89 kg ha^{-1},phosphorus 17.96 and 13.67 kg ha^{-1}, Potassium 139.89 and 132.59 kg h^{-1}, zinc 0.38 and 0.20mg kg^{-1} and T9 have lowest pH 7.00 and 7.08, EC 0.19 and 0.20 dS m^{-1}, organic carbon0.52% and 0.45 , Phosphrous 24.67and 22.33 kg ha^{-1}, potassium 182.86 and 175.60 kg ha^{-1},zinc 0.53 and 0.32 mg kg^{-1} respectively in 0-15cm and 15-30cm depth of soil.T7 has highestnitrogen recorded with 292.33and289.00kgh^{-1} . Physical and Chemical properties respectivelyare shown where its clear that the T9 treatment is better followed by T8 and T7. It eventuallyshowsthatthe vermicompostandZnapplicationwithRDFisthe beneficialeffectonthe soil ,that willmaintain thesoil. T1 showsthat lowesteffect on thesoilparameters.

Table2: EffectofRDFanddifferent levelsofVermicomposta ndZn onphysicalprop ertiesofsoil

Treatments	Bulk density(Mg m^{-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	1.47	1.49	2.61	2.63	41.97	40.99	38.35	36.16
T_2	1.46	1.47	2.62	2.64	42.01	41.51	38.99	36.87
T_3	1.46	1.47	2.61	2.63	42.1	42.28	39.51	37.23
T_4	1.45	1.46	2.63	2.64	42.62	43.28	39.87	37.95
T_5	1.45	1.44	2.62	2.64	44.43	44.16	40.33	38.52
T_6	1.44	1.42	2.63	2.66	45.24	44.5	41.96	40.26
T_7	1.43	1.44	2.62	2.65	45.51	44.98	42.32	40.93
T_8	1.42	1.42	2.64	2.66	46.03	46.27	42.84	41.31
T_9	1.40	1.41	2.64	2.66	48.43	45.89	43.22	41.98
F-test	S	S	NS	NS	S	S	S	S
S.Em.(±)	0.01	0.01	-	-	0.64	0.58	0.87	0.76
C.D.@5%	0.02	0.02	-	-	1.36	1.23	1.87	1.62



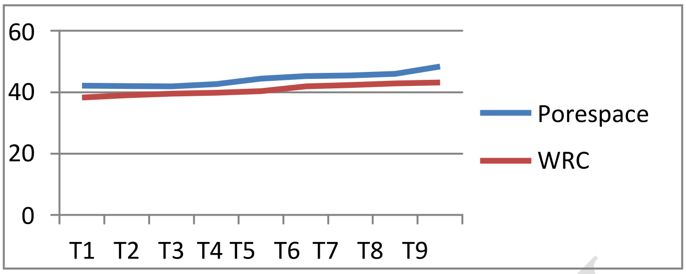


Fig 1. Treatment CombinationVSBulkDensitya

Fig 2. Treatment CombinationVSPoreSpaceAndW

Table:3EffectofRDFanddifferentlevelsofVermicompostandZnonChemicalpropertiesofsoil

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	7.60	7.63	0.28	0.29	0.37	0.30	264.00	261.89	17.96	13.67	139.89	132.59	0.38	0.20
T_2	7.53	7.60	0.27	0.28	0.39	0.33	259.33	258.33	19.25	14.74	142.26	133.56	0.44	0.23
T_3	7.30	7.40	0.25	0.26	0.44	0.40	256.67	255.67	20.36	15.33	143.22	135.22	0.45	0.25
T_4	7.30	7.40	0.22	0.23	0.45	0.38	270.00	266.67	20.67	15.67	144.92	145.44	0.46	0.26
T_5	7.20	7.30	0.23	0.24	0.47	0.40	263.67	273.67	21.25	16.33	145.90	145.96	0.47	0.27
T_6	7.10	7.17	0.23	0.24	0.48	0.41	275.00	269.67	21.33	17.33	156.62	156.63	0.48	0.28
T_7	7.01	7.08	0.22	0.23	0.49	0.40	292.33	289.00	22.33	20.67	160.88	157.63	0.48	0.30
T_8	7.02	7.00	0.21	0.22	0.50	0.43	276.67	274.67	24.33	21.33	174.59	160.89	0.50	0.30
T_9	7.00	7.08	0.19	0.20	0.52	0.45	286.33	282.67	24.67	22.33	182.86	175.60	0.53	0.32
F-test	S	S	S	S	S	S	S	S	S	S	S	S	S	S
S.Em. (±)	0.07	0.07	0.02	0.01	0.01	0.03	8.11	11.95	21.33	17.33	1.26	1.14	0.01	0.01
C.D.@5 %	0.15	0.16	0.01	0.02	0.02	0.07	17.20	25.35	22.33	20.67	2.66	2.42	0.02	0.02

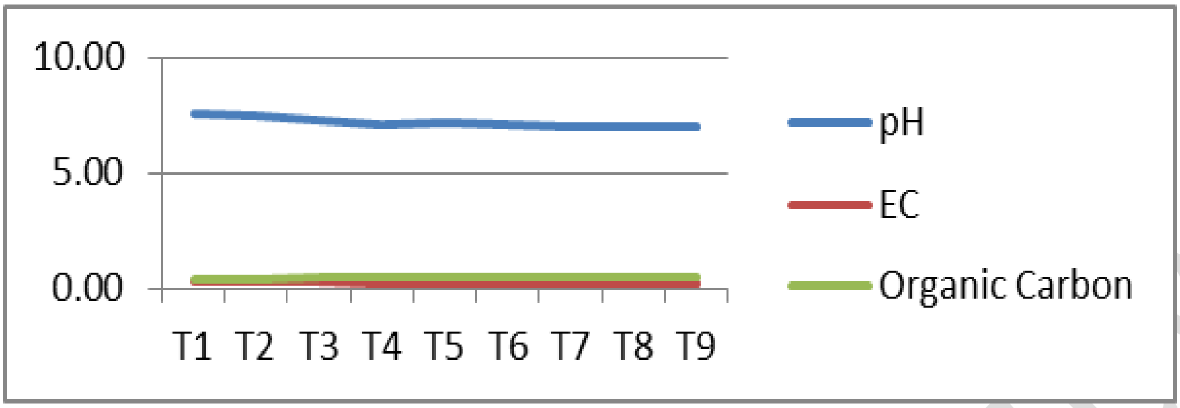


Fig 3.

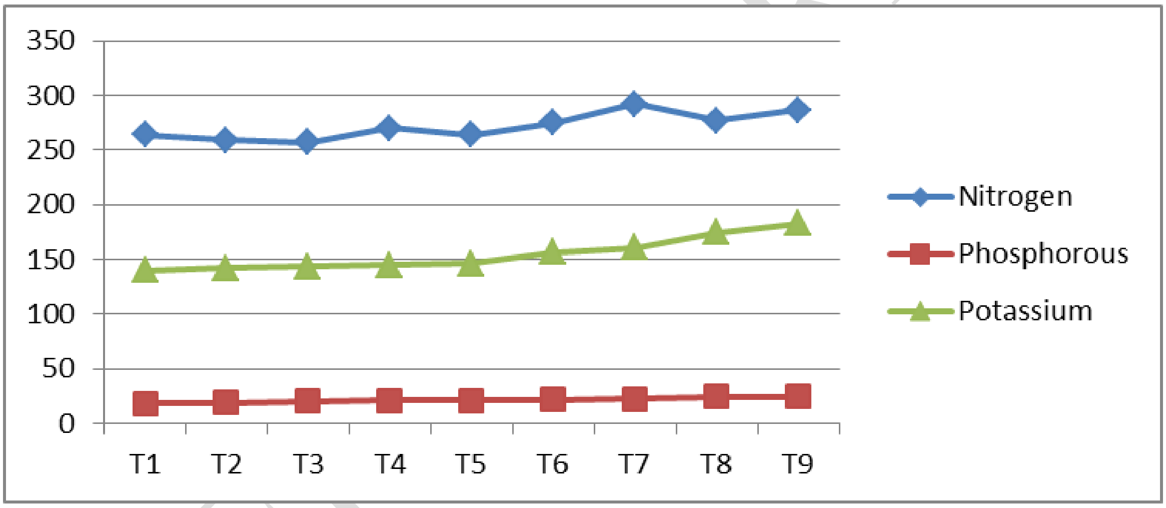


Fig 4.

TreatmentCombinationVSAmountOfNitr

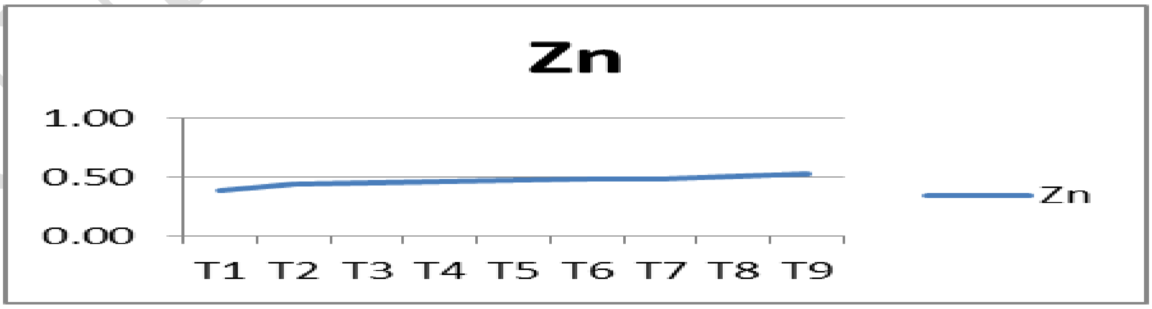


Fig 5.Treatment CombinationVSamount Zincinsoil

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

According to followingtable 3. The economy of different treatmentconcerned, the treatment T_9provides highest net profit of ₹ **97905.34**with costbenefit ratio however, the minimum net profit of ₹ **9743.84** was recorded in thetreatmentT_1withcost benefitratiois

Table4. Effect of different treatment combination on cost benefit ratio (C: B)ofOkra

Treatment	Yield (qha^{-1})	Selling price (₹ q^{-1})	Grossreturn (₹ ha^{-1})	Totalcostof cultivation (₹ ha^{-1})	NetProfit (₹ ha^{-1})	Cost Benefitratio(C:B)
T_1	44.67	1000	44670	36926.16	9743.84	1:1.20
T_2	47.33	1000	47330	36927.66	12321.34	1:128
T_3	52.33	1000	52330	36091.16	17238.84	1:1.44
T_4	55.67	1000	55670	39092.91	16577.09	1:1.42
T_5	77.00	1000	77000	39175.41	37824.59	1:1.96
T_6	85.00	1000	85000	39257.91	45723.09	1:2.1
T_7	111.67	1000	111670	43259.66	68410.34	1:2.5
T_8	133.67	1000	133670	43442.16	90327.84	1:3.0
T_9	141.33	1000	141330	43324.66	97905.34	1:3.2

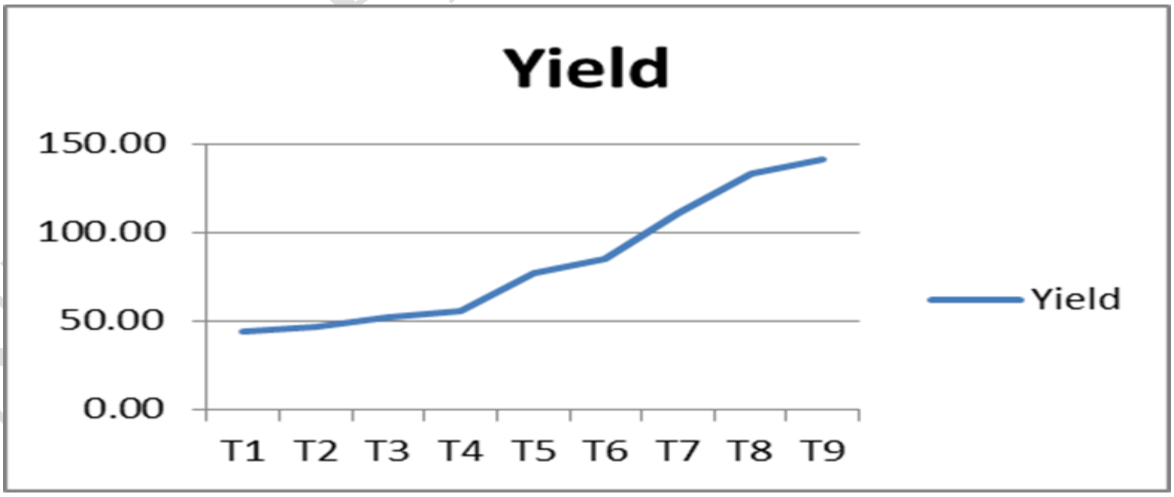


Fig 6. Treatment CombinationVSYeildofOkra

Conclusion

Based on the aforementioned data, it was determined that, when compared to alternativetreatmentcombinations,theT9therapycombination(Recommendeddoseoffertilizer +Vermicompost @ 100% + Zn @ 100%) produced the best outcomes. It yields a maximumprofit of ₹ 97905.34ha^{-1} and a maximum benefit-cost ratio of 1:3.2. Vermicompost and zincarethereforebeneficial to soil health andaprofitable crop of okra. In case of soil T7 has highest at Nitrogen content with 292.33 kg h^{-1}.We can conclude the T9 gives the best result for production of Okra and T7 is best according to soil nutrient content.

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