Original Research Article

Response of Integrated Nutrients onSoil Health and Yield Attributes of Cluster bean (*Cyamopsistetragonoloba*L.) *cv.*Neelam

ABSTRACT

An experiment was conducted during *zaid*(April- July) season 2022 to study "Response of integratednutrients on soil health and yield attributes of cluster bean (*Cyamopsistetragonoloba*L.) *cv.* Neelam" **o**n centralresearch farm department of Soil Science and Agricultural Chemistry, SHUATS, Prayagraj. The design appliedfor statistical analysis was carried out with randomized block design having two factors with three levels of@NPK 0, 50, and 100% ha^{-1}, three levels of @Vermicompost0, 50 and 100% ha^{-1}, three levels of Zinc 0, 50 and 100%ha^{-1} respectively.The best treatment was T9(100% RDF+100%ZnSO4+ Vermicompost @10 t ha^{-1}) has effect onphysical and chemical property of soil and yield of cluster bean. The observed in post harvest soiland preharvest resulted were significantly increased maximum values of percentage pore space (%)(46.533 and 44.404)at 0-15 and 15-30 cm soil depth, water holding capacity (41.103 and 40.193%) at 0-15 and 15-30 cm soil depth,organic carbon (%) (0.56 and 0.53%) at 0-15 and 15-30 cm soil depth, Nitrogen (kg ha^{-1}) (328.32 and 310.83 $kgha^{-1}$)at0-15and15-30cmsoildepth,Phosphorus ($kgha^{-1}$)(20.270and17.267$kgha^{-1}$)at0-15and15-30cmsoildepth and Potassium (kg ha^{-1}) (234.893 and 197.617 kg ha^{-1}) at 0-15 and 15-30 cm soil depth. Plant height atdifferent days 30, 60 and90 DAS was (23.03, 54.22 and 121.86 cm), No. of leaves per plant at different days 30,60 and 90 DAS was (29.11, 47.74 and 82.60) Pod length (14.11), number of cluster $plant^{-1}$ (6.47), number ofpods $cluster^{-1}$ (7.47), number of pods per plant (48.35), number of seed pods (9.76), pod weight (g) (2.35). Thecombination of T9 (100% RDF+100% $ZnSO_4$+ Vermicompost @10 t ha^{-1}) showed slight decrease in pH (7.250 and7.567)at0-15and15-30cmsoildepth,bulkdensity(Mgm^{-3})(1.172and1.462)at0-15and15-30cmsoildepth,andparticledensity(Mgm^{-3}) (2.228and2.503)at0-15and15-30cmsoildepth.Themaximumcostbenefitratio(C: B)1:2.67,maximumgrossreturn750900.00,maximumnetprofit 469604.00ha^{-1},andhighestyield25.03q $ha^{-1}$with T_9-(100%RDF+100%$ZnSO_4$+Vermicompost@10 tha^{-1})

Keyword: Soil nutrients,yieldattributes, vermicompost,NPK,Zn andClusterbean

INTRODUCTION

The agricultural soil supports the crop growth better, if the growing crops aresuppliedwithsuitablefertilizersforthegrowthofallvegetablecrops**Chavan*etal.*,(2014).**Cyamopsistetragonolobaorclusterbean(Guar)belongstothefamilyFabaceae(Leguminaceae).Itiscommerciallygrownforitsseedsasasourceofnaturalpolysaccharide (galactomannan), commercially known as guar gum. Guar gum has anumberof uses in food**Khalil., (2001).** Use of inorganic fertilizers alone though increases the production at a faster ratebut it may not sustain the productivity in long run and affects soil health. Moreover,inorganic fertilizers are costly and their imbalanced use deteriorate soil physio-chemicalenvironment. On the other hand, organic sources of nutrients are cheaper, ecofriendly,improve soil properties and can substitute nutrient requirement of crops partially. Hence,integrateduseofinorganicfertilizers,organic

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manures,andlow-costnutrientsources such asbiofertilizersisthebetteroptionforsustainableproductionandmaintenanceofsoilhealth**Parmar *et al.*, (2019).** The application of vermicompost helps to improves and conserves the fertility of soil. Vermicompost imparts a dark color of the soil and thereby help to maintain the temperature of soil. Vermicompost is one of the manures used by the farmer in growing crops because of early availability and presence of almost all the nutrients required by plants. The composition of vermicompost is 0.6-1.2% N, 0.13-0.22% P and 0.40-0.75% **(K Pawar. 2007) and Kumar et al., (2018).** For soils low in available P, the nutrient must be applied in either organic or inorganic P sources to obtain optimal crop yield. However, excessive use of applied P sources can cause eutrophication in water bodies from surface runoff of sediments carrying P or leaching of P in sandy soils (Chien et al., 2011). Vermicomposting is a process in which vermicompost is produced by earthworms and is proving to be an extremely nourishing organic fertilizer and more omnipotent growth promoter over the traditional compost. It has a protective function against the pestilential chemical fertilizers which destroy the soil richness and affect natural soil fertility adversely. Vermicompost is rich in NPK, micronutrients, crude proteins, beneficial soil microbes, and growth-promoting plant hormones and enzymes **Kumar et al., (2022).**Vermicompost can withhold nutrients for a longer period of time, while the traditional compost fails to provide the essential amount of macro and micronutrients to plants in a shorter time, the vermicompost does. Vermicompost works as a 'slow-release organic fertilizer' whereas the chemical fertilizers release their nutrients more rapidly in soil and soon get depleted. Nitrogen and phosphorus are not completely available to the roots of the plant in the first year, because nitrogen and phosphorus compost are higher in 'ammonium content' while the vermicompost contains a higher content of 'nitrates' which is an extensively available form of nitrogen to plants. Vermicompost acts as an efficient 'soil conditioner' and its prolonged application over the years lead to the up gradation of soil quality and soil fertility. Vermicompost possesses high-water holding capacity, aeration, and drainage. The soil treated with vermicompost over the years is characterized by near-neutral pH and more electrical conductivity. The high levels of beneficial microbial population in vermicompost paves a way for inhibition of plant pathogens by out-competing plant pathogens for available food resources. Vermicomposting improves the physiochemical and biological properties of the soil and also contributes to organic enrichment **Ansari et al., (2016) and Chauhan and Singh (2013).**Zn deficient soil can lead to Zn deficiency in human and livestock as well. Such nation communities, having maize as their staple food are prone to the Zn deficiency induced health challenges (Jiang et al., 2008). In order to reverse this trend, method of zinc application is a critical concern. Many researchers found soil application of Zn to be a better alternative of Zn nutrition whereas, some reported foliar application to be beneficial and more zinc fertilizer efficient. It was recently documented that zinc foliar application is a simple way for making quick correction of plant nutritional status, as reported for wheat **(Erenoglu et al., 2002) and maize (Grzebisz et al., 2008).**

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MATERIALS AND METHODS

The investigation on **"Response of integrated nutrients on soil health and yield Attributes ofclusterbean(*Cyamopsistetragonoloba*L.)cv.Neelam"** compriseofafieldexperiment which was carried out at the Soil Science Research Farm, Sam HigginbottomUniversity of Agriculture Technology, Prayagraj during*Zaid* season 2022. The experiment was laid out in a RBD design with each three levels of NPK, Vermicompost and Zincwith nine treatments, each consisting of three replicates. The total number of plots was 27. Cluster bean was sown in zaid season plots of size 2 x 2 m with row spacing 15 cm and plant to plant distance 30 cm.

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Table 1. Treatmentcombinations ofclusterbean

S.No.	TreatmentsNo.	Treatmentcombinations
1.	T1	Control
2.	T2	0%RDF+0%ZnSO4+Vermicompost @5tha^{-1}
3.	T3	0%RDF+0%ZnSO4+Vermicompost@10tha^{-1}
4.	T4	50%RDF+50%ZnSO4+Vermicompost@0 tha^{-1}
5.	T5	50%RDF+50%ZnSO4+ Vermicompost@5tha^{-1}
6.	T6	50%RDF+50%ZnSO4+Vermicompost@10tha^{-1}
7.	T7	100%RDF+100%ZnSO4+Vermicompost@0tha^{-1}
8.	T8	100%RDF+100%ZnSO4+Vermicompost@5 tha^{-1}
9.	T9	100%RDF+100%ZnSO4+Vermicompost @10 tha^{-1}

Physical and chemical analysis

The soil samples were preserved in polythene bags for analysis of physical and chemical properties.

Physical analysis

The physical analysis was done with the help of Bouyoucous Hydrometer method for textural class and copper cylinder method for bulk and particledensity. The results of analysis are under.

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Chemical analysis

The chemical analysis of post sowing was done for pH, Ec, availablenitrogen, phosphorus Potassium, organiccarbon, and zinc. The results and various methods employed are Represented under the following table.

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StatisticalAnalysis

The data recorded during the course of the investigation will subject to statisticallyanalysis by randomized block design (RBD), for drawing conclusion. The significant andnon-significant effect will judge with the help of "F" (variance ratio) table. The significantdifference between the means will be tested against the critical difference of 5% level. Fortestingthe hypothesis.

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RESULTS AND DISCUSSION

Effect of Integrated nutrients on physical properties of soil after harvest

The result of the data depleted that the minimumbulk density (mg m^{-3}) (1.172&1.462)at0-15and15-30cmsoildepthafterharvestwasfoundin100%RDF+100%ZnSO$_4$+ Vermicompost @10 t ha^{-1} and maximum bulk density (mg m^{-3})wasfound in T_1. (control) which was (1.194 and 1.580) respectively. Theresultofthedatadepletedthattheminimumparticledensity(mgm^{-3})(2.228and2.503)at0-15and15-30cmsoildepthafterharvestwasfoundin100%RDF+100%ZnSO$_4$+ Vermicompost @10 t ha^{-1}

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and maximum particledensity (mg m^{-3})was found in T_1. (control) which was (2.377 and 2.600) respectively. The result of the data depleted that the maximum pore space (%) (46.533 and44.404)at0-15and15-30cmsoildepthafterharvestwasfoundin100%RDF+100%$ZnSO_4$+ Vermicompost @10 t ha^{-1} and minimum pore space (%)was foundinT_1.(control)whichwas(45.703and42.900)respectively. The result of the data depleted that the maximumwater holding capacity (%)(44.84 and 42.82) at 0-15 and 15-30 cm soil depth after harvestwas found in 100%RDF+100%$ZnSO_4$+ Vermicompost @10 t ha^{-1} and minimum Available water holdingcapacity(%)wasfoundinT_1.(control)whichwas(41.10and40.19)respectively.

Effect of Integrated nutrients on chemical properties of soil after harvest

Theresultofthedatadepletedthattheminimump**H**(7.250&7.567)at0-15and15-30 cm soil depth after harvest was found in 100% RDF+100%$ZnSO_4$+ Vermicompost@10 t ha^{-1} and maximum pHwas found in T_1. (control) which was(7.657 & 7.810)respectively. minimumEC dSm^{-1} (0.260 & 0.257) at0-15 and 15-30 cm soil depth after harvestwas found in 100% RDF+100%ZnSO4+Vermicompost @10 t ha^{-1} and maximum EC dSm^{-1} was found in T_1. (control) which was(0.353 and 0.326) respectively. Theresultofthedatadepletedthatthemaximum**O**rganic**c**arbon(0.56and0.53)at 0-15 and 15-30 cm soil depth after harvestwas found in 100% RDF+100%$ZnSO_4$+Vermicompost @10 t ha^{-1} and minimum Organic carbon was found in T_1. (control) whichwas(0.32 and 0.30) respectively. maximum Available nitrogen (kg ha^{-1})(328.32 and 310.80) at 0-15 and 15-30 cm soil depth after harvestwas found in 100%RDF+100%$ZnSO_4$+ Vermicompost @10 t ha^{-1} and minimum Available nitrogen (kg ha^{-1})was found in T_1. (control) which was(280.53 and 271.61) respectively. The result of the data depleted that the maximum Available phosphorus (kg ha^{-1}) (33.063 and 29.867) at 0-15 and 15-30 cm soil depth after harvestwas found in 100%RDF+100%$ZnSO_4$+ Vermicompost @10 t ha^{-1} and minimum Available phosphorus (kgha-1) was found in T1. (control) which was(20.270 and 17.267) respectively. maximumAvailable potassium (kg ha^{-1})(234.893 and 197.617) at 0-15 and 15-30 cm soil depth after harvestwas found in 100%RDF+100%$ZnSO_4$+Vermicompost@10tha^{-1}andminimumAvailablepotassium(kgha-$^{-1}$) was found in T_1. (control) which was(209.330 and 177.427) respectively. Theresultofthedatadepletedthatthemaximum**A**vailable**z**inc(mgkg^{-1})(0.95and0.82)at0-15and15-30cmsoildepthafterharvestwasfoundin100%RDF+100%$ZnSO_4$+ Vermicompost @10 t ha^{-1} and minimum Available zinc (mg kg^{-1}) was found in T_1. (control) which was(0.57 and 0.41) respectively

Effect of integrated nutrients on growth parameters and yield attributes of cluster bean

It is indicated from table (4) that nutrient sources significantly improved the growth and yield attributes of cluster bean. Among the nutrient sources100%RDF+100%$ZnSO_4$+Vermicompost@10tha^{-1} gave highest values of plant height at 90DAS (121.86), no of leaves per plant at 90DAS (82.60) pod length (14.17), no of pods per cluster (7.47), pod weight
(2.35g), pod yield per plant (113.79g), pod yield per plot (10.01kg), pod yield t ha^{-1} (25.03)

Table 2: Effect of different levels of NPK, Vermicompost and zinc on bd, pd, porespace, Whc, and ph.

S. No.	Treatments No.	Treatmentcombinations	BulkDensity(mg m^{-3})		ParticleDensity(mgm^{-3})		Porespace (%)		Waterholding capacity (%)		pH	
			0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15cm	15-30cm	0-15 cm	15-30 cm
1	T1	Control	1.194	1.580	2.377	2.600	45.703	42.900	41.103	40.193	7.657	7.810
2	T2	0%RDF+0%ZnSO4+Vermicompost @5t ha^{-1}	1.186	1.551	2.369	2.574	45.907	42.980	42.183	40.550	7.553	7.767
3	T3	0%RDF+0%ZnSO4+Vermicompost @10t ha^{-1}	1.182	1.499	2.260	2.547	46.317	43.710	42.340	41.663	7.537	7.697
4	T4	50%RDF+50%ZnSO4+ Vermicompost@ 0 t ha^{-1}	1.180	1.502	2.255	2.559	46.307	43.790	41.277	41.107	7.503	7.660
5	T5	50%RDF+50%ZnSO4+ Vermicompost@5tha^{-1}	1.178	1.501	2.253	2.556	46.353	43.917	43.170	42.080	7.487	7.663
6	T6	50%RDF+50%ZnSO4+ Vermicompost@10 t ha^{-1}	1.176	1.492	2.241	2.533	46.280	44.010	43.670	42.344	7.403	7.633
7	T7	100%RDF+100%ZnSO4+ Vermicompost@0t ha^{-1}	1.177	1.498	2.240	2.554	46.356	44.021	41.550	41.383	7.400	7.657
8	T8	100%RDF+100%ZnSO4+ Vermicompost@5tha^{-1}	1.175	1.479	2.234	2.526	46.453	44.327	44.630	42.518	7.367	7.603
9	T9	100%RDF+100%ZnSO4+Vermicompost@10 t ha^{-1}	1.172	1.462	2.228	2.503	46.533	44.404	44.840	42.827	7.250	7.567
		F-Test	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
		C.D. at0.5%	**0.005**	**0.052**	**0.087**	**0.043**	**0.333**	**0.542**	**0.235**	**0.215**	**0.070**	**0.067**
		S. Ed.(+)	**0.002**	**0.024**	**0.041**	**0.020**	**0.157**	**0.256**	**0.111**	**0.102**	**0.033**	**0.032**

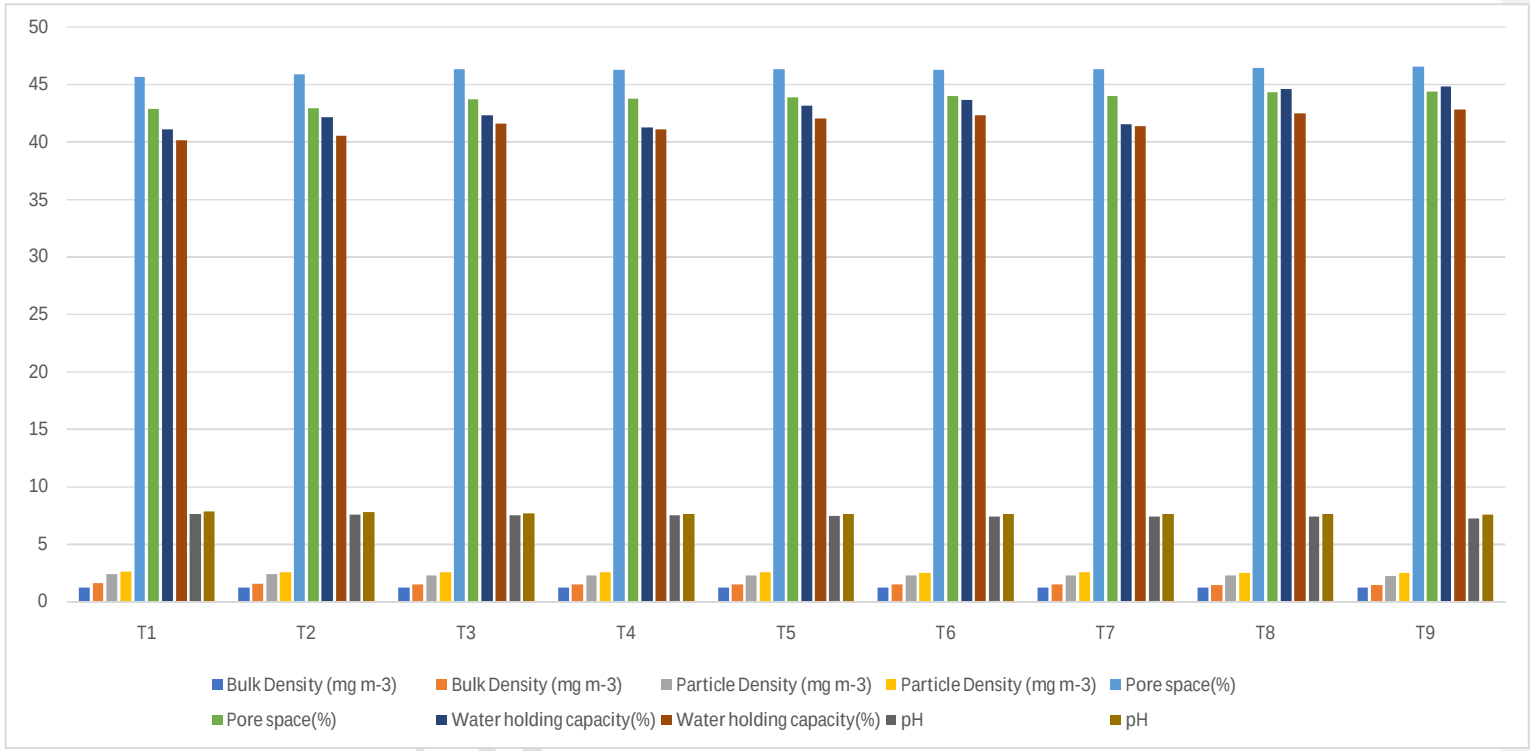

Fig 1. Effect of different levels of NPK, Vermicompost, Zinc on bd, pd. porespace, water holding capacity and ph.

Table 3: Effect of different levels of NPK, Vermicompost and zinc onEc, Oc, N, P, K and Zinc.

S. No.	Treatments No.	Treatmentcombinations	ECdsm^{-1}		Organic carbon (%)		Nitrogen (Kg ha^{-1})		Phosphorus (Kg ha^{-1})		Potassium (Kg ha^{-1})		Zinc (Mg 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	0-15 cm	15-30 cm
1	T1	Control	0.353	0.326	0.32	0.30	280.53	271.76	20.270	17.267	209.330	177.427	0.56	0.41
2	T2	0%RDF+0%ZnSO4+Vermicompost @5t ha^{-1}	0.294	0.290	0.41	0.39	284.61	273.20	23.790	17.987	212.420	179.267	0.72	0.57
3	T3	0%RDF+0%ZnSO4+Vermicompost @10t ha^{-1}	0.284	0.282	0.42	0.40	287.33	272.21	24.930	21.140	214.510	178.960	0.75	0.60
4	T4	50%RDF+50%ZnSO4+ Vermicompost@ 0 t ha^{-1}	0.280	0.279	0.43	0.42	291.42	282.77	27.443	22.693	229.853	185.023	0.61	0.58
5	T5	50%RDF+50%ZnSO4+ Vermicompost@5tha^{-1}	0.272	0.270	0.45	0.43	296.23	291.12	29.053	24.340	230.763	187.200	0.81	0.67
6	T6	50%RDF+50%ZnSO4+ Vermicompost@10 t ha^{-1}	0.267	0.263	0.47	0.41	308.75	301.49	30.027	24.540	231.657	187.570	0.86	0.75
7	T7	100%RDF+100%ZnSO4 + Vermicompost@0t ha^{-1}	0.265	0.264	0.46	0.44	313.87	304.98	30.177	25.557	232.107	194.237	0.88	0.78
8	T8	100%RDF+100%ZnSO4 + Vermicompost@5tha^{-1}	0.264	0.262	0.54	0.51	325.41	315.27	31.423	27.247	233.803	195.957	0.090	0.79
9	T9	100%RDF+100%ZnSO4 +Vermicompost@10 t ha^{-1}	0.260	0.257	0.56	0.53	328.32	310.83	33.063	29.867	234.893	197.617	0.95	0.80
		F-Test	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
		C.D. at0.5%	**0.044**	**0.038**	**0.021**	**0.010**	**0.043**	**0.274**	**0.713**	**0.526**	**0.713**	**0.526**	**0.51**	**0.057**
		S. Ed.(+)	**0.021**	**0.018**	**0.010**	**0.005**	**0.021**	**0.129**	**0.336**	**0.248**	**0.336**	**0.248**	**0.024**	**0.027**

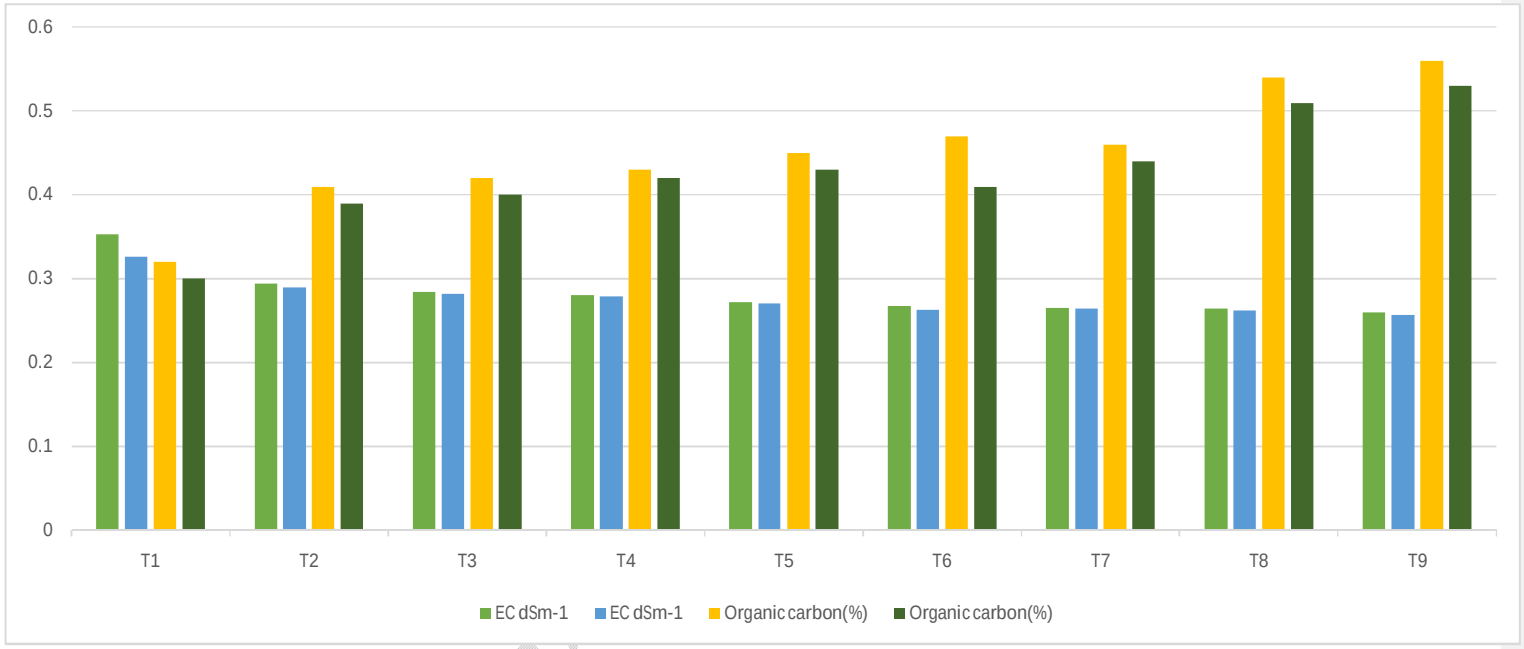

Fig 2. Effect of different levels of NPK, Vermicompost and zinc on Ec, Organiccarbon.

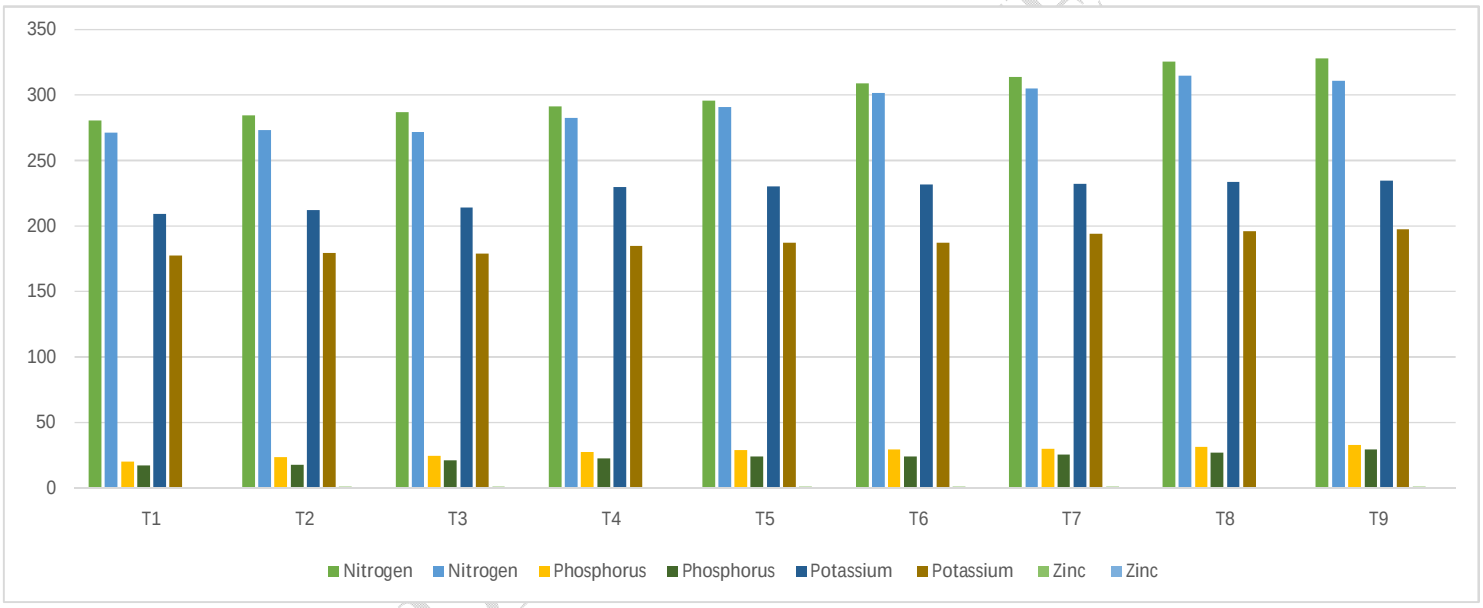

Fig 3. Effect of different levels of NPK, Vermicompost and Zinc on Nitrogen, Phosphorus, potassium, and zinc.

Table 4: Effect of different levels of NPK, Vermicompost and zinc on growth and yield attributes of cluster bean.

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			plant height			no of leaves per plant			pod length	no of pods per cluster	pod wt.	pod yield per plant	pod yield t ha-1
S. No	**Treatment no**	**Treatment combination**	**30DAS**	**60DAS**	**90DAS**	**30DAS**	**60DAS**	**90DAS**					
1	**T1**	Control	15.82	33.74	80.81	16.13	25.93	49.65	10.01	5.17	2.05	45.83	10.08
2	**T2**	0% RDF + 0%ZnSO4 + Vermicompost @5 t ha-1	19.04	47.31	97.75	21.05	31.39	68.74	12.24	6.1	2.2	71.85	15.81
3	**T3**	0% RDF +0%ZnSO4 + Vermicompost @10 t ha-1	19.25	48.83	102.28	21.93	38.61	71.82	13.01	6.18	2.24	77.73	17.11
4	**T4**	50% RDF +50%$ZnSO_4$ + Vermicompost @ 0 t ha^{-1}	18.39	41.42	90.17	17.81	33.41	62.97	11.43	5.84	2.12	64.22	14.13
5	**T5**	50% RDF +50%$ZnSO_4$ + Vermicompost @5 t ha^{-1}	19.37	50.39	106.77	23.91	40.28	72.91	12.86	6.36	2.26	84.33	18.55
6	**T6**	50% RDF +50%$ZnSO_4$ + Vermicompost @10 t ha^{-1}	20.35	51.79	115.75	25.75	42.81	75.91	13.17	6.79	2.28	93.21	20.51
7	**T7**	100% RDF +100%$ZnSO_4$ + Vermicompost @ 0 t ha^{-1}	18.81	45.86	93.42	19.02	36.19	66.06	12.04	5.64	2.17	61.89	13.62
8	**T8**	100% RDF +100%$ZnSO_4$ + Vermicompost @5 t ha^{-1}	21.41	52.61	118.21	27.26	45.51	78.85	13.73	7.34	2.32	105.31	23.17
9	**T9**	100% RDF +100%$ZnSO_4$ + Vermicompost @10 t ha^{-1}	23.03	54.22	121.86	29.11	47.74	82.61	14.11	7.47	2.35	113.79	25.03
		F-Test	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
		C.D.at 0.5%	**1.391**	**2.879**	**4.167**	**1.901**	**2.302**	**3.142**	**0.705**	**0.262**	**0.031**	**3.984**	**0.876**
		S. Ed. (+)	**0.656**	**1.358**	**1.966**	**0.897**	**1.086**	**1.482**	**0.333**	**0.124**	**0.015**	**1.879**	**0.413**

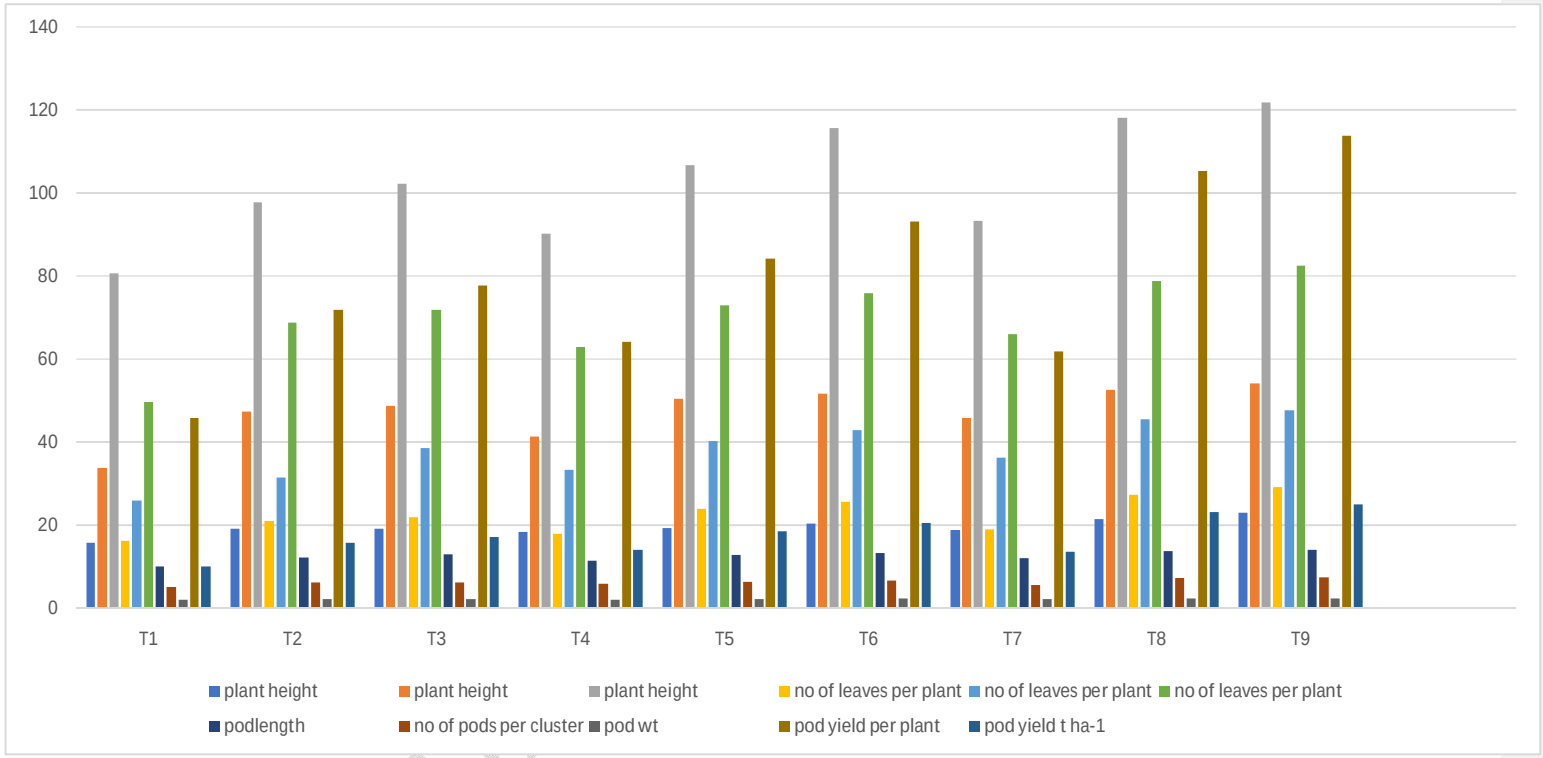

Fig 4. Effect of different levels of NPK, Vermicompost and Zinc on growth and yield attributes.

CONCLUSION

On the basis of findings, it is concluded that the treatment combination 100%RDF+100%$ZnSO_4$+ Vermicompost @10 t ha^{-1}i.e., Treatment T_9shows best result onphysio-chemical properties of soil analysis after harvest of cluster bean (*Cyamopsistetragonoloba*L.) in comparison to othertreatment combination. Since the findings are based ontheresearchdoneinoneofseasonfurtherexperimentswithmorethanoneseasonwillhelpin better to study the effect of integrated nutrienton soil health analysis of soil after crop harvest. The minimum bulk density (mg m^{-3}), particledensity(mgm^{-3}), Waterholdingcapacity,pHandECdsm^{-1}wasnotedin100%RDF+100%$ZnSO_4$+ Vermicompost @10 t ha^{-1}which was significantly superior over T_0Control.Whereas the maximum pore space (%), organic carbon,available nitrogen(kg ha^{-1}),available phosphorus (kg ha^{-1}) and available potassium (kg ha^{-1}),Zinc (mg ha^{-1}) was noted in100% RDF+100%$ZnSO_4$+ Vermicompost @10 t ha^{-1}which was significantly superior overT_0 Control.

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