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IMPACT OF VERMICOMPOST AND ZINC IMPLEMENTATION ON SOIL PHYSICO-CHEMICAL PROPERTIES AFTER HARVEST OF MUNG BEAN

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Abstract– At Research Farm, Department of Soil Science and Agricultural Chemistry, SHUATS, Prayagraj a field experiment was undertaken in the kharif season 2021-2022, with 9 treatments and 3 replications, the experiment was set up in a Randomized Block Design (RBD) includes Particle density ranged from 2.09 Mg m^{-3} to 2.26 Mg m^{-3} in 0-15 cm soil depth and 2.30 Mg m^{-3} to 2.37 Mg m^{-3} in 15-30 cm soil depth, bulk density ranging from 1.193 Mg m^{-3} to 1.290 Mg m^{-3} at 0-15 cm soil depth and 1.247 Mg m^{-3} to 1.365 Mg m^{-3} in 15-30 cm soil depth, Porosity ranged from 44.71 percent to 46.18 percent in the 0-15 cm of soil, but as depth increased, porosity declined, with the depth at 15-30 cm Porosity ranged from 40.39 percent to 43.93 percent. At 0-15 cm and 15-30 cm soil depths as due to the implementation of vermicompost and zinc a considerable impact on soil pH, EC, and Organic Carbon. At 0-15 cm soil level, available nitrogen content ranged from 177.00 kg ha^{-1} to 227.17 kg ha^{-1}, while at 15-30 cm soil depth, available nitrogen content ranged from 184.60 kg ha^{-1} to 192.12 kg ha^{-1}. In the 0-15 cm and 15-30 cm soil depths founded maximum available Phosphorus and available Potassium. The available zinc concentration in soil varies from 0.360 ppm to 0.570 ppm at 0-15 cm depth and 0.290 ppm to 0.530 ppm at 15-30 cm depth.

INTRODUCTION

Greengram [*Vigna radiata* (L.)] commonly known as Mung bean and Golden gram, is one of the important kharif pulse crop. Greengram is tolerant to drought and can be successfully grown on well drained loamy to sandy loam soils in areas of erratic rainfall. Green gram requires less irrigation than many field crops to produce a good yield, and helps to maintain soil fertility. There is a great scope for increasing the production of green gram by bringing more area under cultivation and by increasing its productivity by applying organic manures (FYM/ compost/vermicompost) with balanced fertilization and maintaining soil fertility status. (Srivastava *et al*., 2017). In many parts of the country, zinc (Zn) as a plant nutrient stands third inimportance i.e., next to nitrogen and phosphorus. Availability of zinc decreases with rise in soil pH. Zn is an essential component of synthetic and natural organic complexes in plants. (Roy *et al*., 2017). Vermicompost enhances soilbiodiversity by promoting beneficial microbes, which in turn enhances plant growth directly by production of plant growth regulating substances (hormones and enzymes) and indirectly by controlling plant pathogens, nematodes and other north east hillpests, thereby enhancing plant health and minimizing the yield loss (Pathama and Sakthivel, 2012).

MATERIALS AND METHODS

Experimental site: The trail was carried out at Central Research Farm, NAI, SHUATS' Prayagraj, which is located at 25° 2423022N latitude, 81°

5121022 E longitude, and 98 meters above sea level (MSL) Prayagraj has a subtropical climate with summer and winter extremes.

Summer moong variety MH 421 is Medium - dwarf plant type, seed is attractive, shining, green and medium size and special characters are Non shattering, resistant to Yellow Mosaic Virus (Singh *et al*., 2019). Bulk density and Particle density of soil was determined and expressed in Mg m^{-3}. The pH of soil was recorded by Jackson, 1973 using digital pH meter. Electrical conductivity of the soil was determined by Wilcox, 1950 using digital conductivity meter. Organic Carbon content of the soil was estimated by Walkley and Black, 1947 wet oxidation method. Modified alkaline permanganate oxidation method was used in estimating available Nitrogen as outlined by Subbiah and Asija, 1956. Available Phosphorus in soil was determined by Olsen's extractant. Determination of available Potassium by using neutral normal ammonium acetate (pH 7.0) described by Jackson, 1958 using flame photometer. Available Zn, is determined by following Lindsay and Norvell 1978 procedure using DTPA extractant.

Experimental Design and Treatments: The present research investigation was set up in a RBD having nine treatment combination at 3 levels (0%, 50% and 100%) of Vermicompost and Zinc and 100% RDF. The recommended dose of Nitrogen (20Kg ha^{-1}) through urea, Phosphorus (40 Kg ha^{-1}) through DAP, Potassium (20Kg ha^{-1}) through MOP, Zinc (25Kg ha^{-1}) through $ZnSO_4.7H_2O$, Vermicompost (2.5 t ha^{-1}) were applied as basal as per treatment, which is replicated thrice, randomly allocated in each replication, dividing the research site into 27 plots. The data recorded during the course of the investigation will be subjected to statistical analysis by 3X3 RBD, as per the method "Analysis of Variance (ANOVA) technique" as given by (Fischer1950).

RESULTS AND DISCUSSION

Influence of Different Treatments combination on Physico-chemical properties of Soil

During the trail of field experiment, A perusal of data (Table) indicate the application of Vermicompost and Zinc was observed that Bulk density ranged from 1.193 Mg m^{-3} to 1.290 Mg m^{-3} at 0-15 cm soil depth and 1.247 Mg m^{-3} to 1.365 Mg m^{-3} at 15-30 cm soil depth. Lowest bulk density was recorded into T_9 (which was at par with T_8 and T_7) followed by T_6 (which was at par with T_5 and T_4) and T_3 (which was at par with T_1 and T_2) in both soil depth. Due to application of vermicompost increased porosity and bulk density automatically decreased. Soil particle density ranged from 2.09 Mg m^{-3} to 2.26 Mg m^{-3} in 0-15 cm soil depth and 2.30 Mg m^{-3} to 2.37 Mg m^{-3} in 15-30 cm soil depth. Vermicompost impact on particle density positively means lowest particle density observed in T_9. Porosity varied 44.71 % to 46.18 % in 0-15 cm soil depth but when depth increase porosity decreased means at 15-30 cm soil depth porosity varied 40.39 % to 43.93 %. Similar results were also reported by Abadi *et al.* (2012), Jat *et al.* (2015).

Maximum soil pH recorded6.83 and 7.14 at 0-15 cm and 15-30 cm respectively. Minimum soil pH was recorded under the treatment T_8 (which was at par with T_9 and T_7) followed by T_6 (which was at par with T_5 and T_4) and T_3 (which was at par with T_1 and T_2).Organic acid decreases the soil pH due Increasing rate of vermicompost. Electrical conductivity was influenced significantly, it is ranged from 0.127 dSm^{-1} to 0.233 dSm^{-1}. Maximum EC was recorded into T_9 and minimum in T_1. Increase rate of vermicompost soil organic carbon increases soluble salt in soil and increased in soil depth increase in electrical conductivity. Percent organic carbon maximum found in T_9 0.597 % and 0.455 % in 0-15 cm and 15-30 cm soil depths respectively (which was at par with T_8) followed by T_6 (which was at par with T_5 and T_4) and T_3 (which was at par with T_1 and T_2). When increase vermicompost rate in soil automatically build up soil organic carbon due to it contain huge amount organic carbon. Similar result recorded by Arbad *et al.*, (2011) and Abadi *et al.* (2012).

The available nitrogen content in soil ranged from 177.00 kg ha^{-1} to 227.17 kg ha^{-1} at 0-15cm soil depth and 137.00 kg ha^{-1} to 184.60 kg ha^{-1} at 15-30 cm soil depth. Vermicompost is also a nitrogen source and when its mineralization occur availability of nitrogen also increased. Available phosphorus ranged from 19.79 Kg ha^{-1} to 32.43 Kg ha^{-1} at 0-15 soil depth and 15.67 Kg ha^{-1} to 28.31 Kg ha^{-1} at 15-30 cm soil depth. Vermicompost increased soil organic carbon in soil its organic carbon increased the activity of phosphorus solubilizing microorganism into soil. Maximum available potassium in 0-15 cm and 15-30 cm soil depth, i.e 220.55 kg ha^{-1} and 198.18 kg ha^{-1} respectively (which was at par with T_8 and T_7) followed by T_6 (which was at par with T_5 and T_4) and T_3 (which was at par with T_1 and T_2) in both soil

Table: Influence of different combination of Vermicompost and Zinc on Physico-chemical property of Soil

Treatment	D_b ($Mg\ m^{-3}$)		D_p ($Mg\ m^{-3}$)		Porosity (%)		Soil pH		EC (dSm^{-1})		OC (%)		Avl N ($kg\ ha^{-1}$)		Avl P ($kg\ ha^{-1}$)		Avl K ($kg\ ha^{-1}$)		Avl Zn ($kg\ ha^{-1}$)	
	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	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 (VC 0 % + 0 % $ZnSO_4$)	1.291	1.295	2.262	2.265	44.713	44.717	6.835	6.839	0.207	0.212	0.467	0.472	177.00	137.00	19.79	15.67	193.50	171.40	0.360	0.290
T_2 (VC 0 % + 50 % $ZnSO_4$)	1.290	1.293	2.264	2.269	44.579	44.584	6.867	6.872	0.208	0.214	0.483	0.487	178.33	137.65	20.92	16.93	194.92	171.69	0.390	0.320
T_3 (VC 0 % + 100 %$ZnSO_4$)	1.287	1.291	2.265	2.271	44.412	44.419	6.852	6.856	0.210	0.216	0.487	0.492	179.00	137.98	20.99	16.05	194.41	170.68	0.410	0.347
T_4 (VC 50 % + 0 % $ZnSO_4$)	1.230	1.236	2.141	2.144	44.853	44.857	6.741	6.744	0.213	0.218	0.517	0.522	183.67	143.55	24.38	20.86	210.77	188.09	0.450	0.377
T_5 (VC 50 % + 50 % $ZnSO_4$)	1.233	1.238	2.147	2.151	44.619	44.624	6.798	6.803	0.217	0.223	0.527	0.533	187.33	145.90	25.91	22.41	209.65	186.27	0.469	0.397
T_6 (VC 50 % + 100 % $ZnSO_4$)	1.237	1.241	2.149	2.153	44.462	44.469	6.789	6.795	0.213	0.219	0.537	0.541	193.08	149.20	25.84	22.64	211.50	188.57	0.490	0.427
T_7 (VC 100 % + 0 % $ZnSO_4$)	1.183	1.187	2.098	2.104	46.081	46.087	6.696	6.701	0.220	0.224	0.583	0.588	216.37	165.23	30.83	26.83	218.00	194.96	0.510	0.413
T_8 (VC 100 % + 50 %$ZnSO_4$)	1.190	1.196	2.095	2.099	45.948	45.953	6.663	6.668	0.221	0.227	0.587	0.593	223.20	173.40	31.89	28.50	219.55	196.63	0.540	0.470
T_9 (VC 100 % +100%$ZnSO_4$)	1.193	1.199	2.094	2.097	46.184	46.189	6.674	6.680	0.233	0.237	0.597	0.601	227.17	184.60	32.43	28.31	220.55	198.18	0.570	0.530
S.Em(±)	0.005	0.003	0.014	0.016	0.383	0.262	0.041	0.042	0.005	0.006	0.004	0.003	1.61	1.96	0.37	1.66	1.32	2.50	0.000	0.007
C.D@5%	0.015	0.010	0.021	0.032	1.15	0.78	0.133	0.135	0.015	0.016	0.011	0.009	4.82	5.89	1.11	4.99	3.97	7.49	0.001	0.022
F-test	NS	NS	NS	NS	NS	NS	S	S	S	S	S	S	S	S	S	S	S	S	S	S

D_b = Bulk Density, D_p = Particle Density, NS = Non Significant, pH-potential of hydrogen, EC- Electrical Conductivity, O.C-Organic Carbon, Avl N = Available Nitrogen, Avl P = Available Phosphorus, Avl K = Available Potassium, Avl ZN = Available Zinc.
S.Em = Standard error mean, S-Significant.

depth by vermicompost and due to zinc application availability of potassium slightly increased. Available zinc content in soil ranged 0.360 mg Kg^{-1} to 0.570 mg Kg^{-1} at 0-15 cm soil depth and 0.290 mg Kg^{-1} to 0.530 mg Kg^{-1} 15-30 cm soil depth. It is due to source of zinc and vermicompost both contains appropriate quantity of zinc so availability zinc automatically increased. Similar results were recorded by Jat *et al.*, (2015).

CONCLUSION

It is concluded from the field trial that the use of Vermicompost and Zinc improves the soil Physico-chemical properties with adequate BD, PD, pore space and water holding capacity. Vermicompost increases soil Microbial Activity and hence makes Soil more porus. Soil pH is neutral to alkaline as favourable electrical conductivity for green gram growth, Soil fertility with high organic content and low to medium of macronutrients *viz.* Nitrogen. Phosphorous and Potassium and medium Zinc content in the soil. Farmers are required to maintain soil nutrient status, adopt suitable management practices and provide proper nutrition to the soil for green gram growth. Use of Vermicompost and Zinc increases yield and quality of green gram.

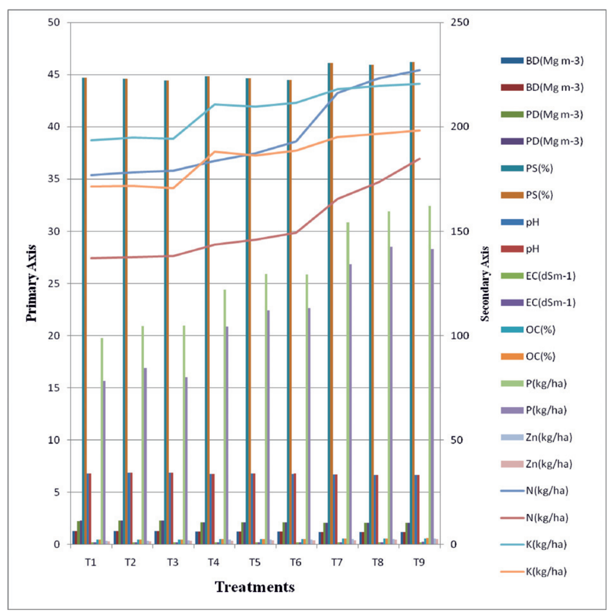

Fig.: Physico-chemical property of Soil

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